EXECUTIVE SUMMARY

The Joint Task Force on Areas of Practice for Geologists and Civil Engineers (JTFAP) was formed in 2004 as an inter-society working group and cooperative venture among the Geo-Institute of the American Society of Civil Engineers (G-I), xxx and the American Institute of Professional Geologists (AIPG). Each of these professional organizations has a significant stake in providing support, technical guidance, and representation for professional engineers and geologists throughout the United States and internationally. While specific charters and by-laws for each of the organizations vary somewhat, they have a common interest in maintaining, promoting, and improving the ability of engineers and geologists to serve the public and society at large. The JTFAP was formed to more clearly define the technical skills and academic knowledge base for, and thus criteria for, evaluating the qualifications of individual engineers and geologists practicing within the geo-construction industry. This charter arises from a number of practice overlap concerns between engineering and geologic practice over past decades that the principal societies of both professions desire to resolve in an effort to further teamwork and mutual goals. As an example, state registration boards for each profession are routinely faced with formal complaints regarding individual practice outside of one's technical expertise, yet the criteria for judging the validity of any such complaint varies not only depending on locale, but also varies widely where presently defined.

This guideline is aimed at defining the practice skills and academic knowledge base for the following professional practices within the geo-construction industry:

- Professional Civil Engineers,
- Professional Geotechnical Engineers,
- Professional Engineering Geologists, and
- Professional Geologists.

Each professional category can be associated with a Body of Knowledge (BOK). The BOK represents the suite of practice capabilities obtained through education, training, and experience that can be used to evaluate the basic required educational qualifications and competence of individual professionals. A separate BOK has not been prepared for the profession of Geologic Engineer as this profession is considered by the JTFAP to overlap and to include the near-end capabilities of the BOKs for both geotechnical engineers and engineering geologists. Even though individuals practicing the professions being discussed herein may, and many do, practice in the fields of environmental engineering/geology, hydrogeology/geohydrology, and engineering geophysics, the BOKs do not reflect the spectrum of capabilities and qualifications required for competent practice therein. The reason for these exclusions is to retain JTFAP's focus on what technical capabilities constitute fundamental practices within the geo-construction industry, at least initially, as a basis upon which other skill criteria can be developed.

In general, professional engineers provide design products directed primarily toward the built and natural environments, and are licensed in accordance with the legal requirements of all 50 states and United States territories. Geotechnical engineering, as a subset of civil engineering, exists as a separately licensed profession only in California and Oregon. Geotechnical engineering generally involves the practice of evaluation of surface and subsurface engineering properties and characteristics in a quantitative manner that can be analyzed and modeled such that recommendations for design and construction dependent on those conditions can be provided. The BOKs for civil engineering and geotechnical engineering are presented as overall educational criteria for qualifications to practice within the areas defined in this guideline.

Professional geologists provide scientific expertise in the interpretation of earth processes and materials, along with identification of geologic structure in both the built and natural environments. Currently, 29 of the 50 states have legal requirements providing for licensure of geologists. Engineering geology, like geotechnical engineering, is a subset of the profession of geology and exists as a separately licensed profession in California, Oregon, and Washington. Engineering geology generally involves the practice of applying the science of geology to engineered and natural environments.

Because of certain gross similarities in geo-professional practice between engineering geology and geotechnical engineering, there tends to be the greatest overlap within the BOKs of individuals practicing in each profession, as well as the greatest degree of confusion and contention over the areas of expertise for successful practice within common overlap areas. This guideline presents a geo-professional practice matrix defining areas of common practice with overlaps for practitioners having the skills and expertise normally obtained by the engineers and geologists working within the geo-construction industry.

The JTFAP offers the following findings based on the BOKs and practice overlap matrix presented for the four professions evaluated:

- Teamwork between geologists and engineers raises the level of individual and joint functionality, responsibility, accountability, and reliability in providing the highest level of service to humanity.

- The practice of geotechnical engineering and engineering geology involves skills that, while in the BOK of professional engineers or geologists, are not normally obtained without specialized education and training.

- Professional engineers are generally best suited to perform analytical evaluation and design of the built and natural environments. Professional geologists are generally best suited to provide scientific evaluation of geologic processes and subsurface materials along with structural geologic and geomorphological interpretations.

- As specialists in engineering, geotechnical engineers generally possess expertise in the quantitative engineering analysis of subsurface conditions and interaction of the earth with structures.

- As specialists in geology, engineering geologists generally possess expertise in applying the knowledge of defining and specifying how earth materials, processes, and structure may affect the built and natural environments.

- In the future, other related professional practices such as environmental engineering/geology, groundwater/geohydrology/hydrogeology, engineering geophysics, and other specialized areas of expertise should be similarly explored.

- State licensing programs typically specify basic qualifications and minimal requirements for the defined practice areas.

This JTFAP guideline may be utilized for academic and continuing education programs to aid in preparing students and professionals to practice in the geo-construction industry.

TABLE OF CONTENTS

EXECUTIVE SUMMARY i
TABLE OF CONTENTS iv
1.0 INTRODUCTION 1
1.1 Missions of the Sponsoring Professional Societies 1
1.2 Task Force Composition 2
1.3 Task Force Report Content 2
1.4 Guideline Content 3
1.5 Exclusions 3
2.0 TODAY'S PRACTICE 4
2.1 Legal Requirements 4
2.1.1 Engineers 4
2.1.2 Geologists 4
2.2 Status of Overlapping Areas of Practice 5
2.3 Professional Practice Responsibilities 6
3.0 PROFESSIONAL PRACTICE DEFINITIONS AND BODIES OF KNOWLEDGE 7
3.1 Professional Practice Disciplines 7
3.2 Bodies of Knowledge (BOK) 7
3.3 Skills and Capabilities of Geologists and Engineers 7
3.3.1 Engineers 7
3.3.2 Geologists 8
4.0 AREAS OF PRACTICE 10
4.1 Areas of Professional Practice 10
4.1.1 PE – Professional Civil Engineer 10
4.1.2 PGE – Professional Geotechnical Engineer 10
4.1.3 PEG - Professional Engineering Geologist 10
4.1.4 PG – Professional Geologist 10
4.2 OVERLAPPING AREAS OF PRACTICE MATRIX. 11
5.0 TASK FORCE RECOMMENDATIONS 13
5.1 Recommended Guidelines 13
5.2 Use by the Sponsoring Societies 13
5.3 Regulatory Agencies 13
Appendix A - BODIES OF KNOWLEDGE 15
A.1 Engineering 15
A.1.1 General Science 15
A.1.2 Engineering Analysis 15
A.1.3 Engineering Design 15
A.1.4 Engineering Management 16
A.2 Geotechnical Engineering 16
A.2.1 Soil and Rock Mechanics 16
A.2.2 Drilling and Sampling for Site Characterization 16
A.2.3 Soil Mechanics Laboratory 17
A.2.4 Foundation Design 17

A.2.5 Shear Strength and Slope Stability ... 17
A.2.6 Lateral Earth Pressure and Retaining Structures ... 17
A.2.7 Excavations, Embankments, and Earth Dams ... 17
A.2.8 Geosynthetics ... 18
A.2.9 Soil and Rock Dynamics ... 18
A.2.10 Geo-environmental Engineering ... 18
A.2.11 Earthquake Engineering ... 18
A.3. Geology ... 18
A.3.1 Physical Geology ... 18
A.3.2 Historical Geology ... 18
A.3.3 Mineralogy and Petrology (Minerals and Rocks – Earth Materials) ... 18
A.3.4 Structural Geology ... 19
A.3.5 Stratigraphy/Sedimentology/Paleontology ... 19
A.3.6 Field Geology, Methods and Techniques ... 19
A.3.7 Geophysics/Tectonics/Geochemistry ... 19
A.3.8 Environmental Geology and Geological Hazards ... 19
A.3.9 Economic Geology ... 19
A.3.10 Hydrogeology ... 19
A.4 Engineering Geology ... 19
A.4.1 Geology Fundamentals ... 19
A.4.2 Field Geology/Mapping ... 19
A.4.3 Drilling and Sampling for Site Characterization ... 20
A.4.4 Remote Sensing for Site Characterization ... 20
A.4.5 Soil Mechanics and Soils Properties Testing to Support Engineering Design ... 20
A.4.6 Rock Mechanics and Rock Properties Testing ... 21
A.4.7 Soil and Rock Slope Stability ... 21
A.4.8 Seepage Analysis ... 22
A.4.9 Contaminant Hydrogeology/Environmental Analysis ... 22
A.4.10 Earthquake Hazards and Seismicity ... 22

1.0 INTRODUCTION

The Joint Task Force on Areas of Practice for Geologists and Civil Engineers (JTFAP) is a collaboration of the Geo-Institute (G-I) of the American Society of Civil Engineers (ASCE), the xxx, and the American Institute of Professional Geologists (AIPG).

The JTFAP was formed to address the following charter:

- Evaluate the possibility and practicality of developing a statement on the areas of practice for geologists and civil engineers;
- Define the group's contributions to the health, safety, and welfare of the public;
- Make a recommendation about the practicality of proceeding to develop a document in which areas of practice are spelled out, and
- Develop the practice area document as appropriate.

Many challenges exist in characterizing sites in the built and natural earth-material environments. The contributions of various geo-construction industry professionals are a necessity to achieve owner, designer, constructor, and regulatory objectives. In fact, these objectives can be met more effectively through a collaborative approach between geologists and engineers. Given the JTFAP charter, each of the three sponsoring societies recognizes the need for an industry consensus on the appropriate areas of practice for the various professions of geology and engineering.

1.1 Missions of the Sponsoring Professional Societies

The G-I's core purpose is to advance the geo-engineering community. G-I's core values are: *responsiveness to members' needs, ethical behavior, service to the profession and society, innovation, technical excellence, and inclusiveness.*

xxx contributes to its members' professional success and the public welfare by providing leadership, advocacy, and applied research in environmental and engineering geology.

xxx values are:

- Upholding sound principles of scientific inquiry with respect to the study and evaluation of geologic processes, their impact on humans, and the human impact on Earth;
- Encouraging and facilitating ongoing education and training as well as supporting members in their dedication to their work, and
- Building public appreciation for how environmental and engineering geology contribute to public safety and the protection of property.

AIPG focuses on the issues of professional geological practice, such as certification, ethics, licensure and registration, and advocacy.

1.2 Task Force Composition

The Task Force (JTFAP) is comprised of members of the three sponsoring societies, each of which may have as many as three sitting members of the Task Force at any given time. All JTFAP members are appointed by their sponsoring society and are certified, registered, and/or licensed in the geo-construction industry area in which they actively practice. During the course of deliberations, beginning September 2004, a total of seventeen persons have occupied the twelve appointed seats on the task force.

The twelve Task Force members represent a wide range of knowledge, skills, and experience, and practice in all of the physiographic regions of the country is represented. All appointments have been made from the ranks of practitioners and the Task Force has not had any members who were concurrently on full-time appointment as university faculty. All members were in active consulting practice while serving on the Task Force.

Additionally, each of the sponsoring societies can have, and has had, an ex-officio member of the task force. Each ex-officio member contributes as a non-voting member and coordinates with his or her sponsoring society.

1.3 Task Force Report Content

This report identifies, compares, and contrasts the capabilities of the fundamental professional engineering and geology practices and further defines the nature of appropriate areas of geo-practice for each. The typical educational background, or body of knowledge (BOK), defining the professional practices is explored. Areas of practice for the following professional engineers and geologists are carefully delineated for practice within the geo-construction industry:

- Professional Civil Engineers,
- Professional Geotechnical Engineers,
- Professional Engineering Geologists, and
- Professional Geologists.

Some areas of practice in the geo-construction industry are regulated under various legal jurisdictions and the Task Force makes broad recommendations that this guideline be considered by those who administer those regulations. The Task Force makes these recommendations with the expectation that these professionals will:

- apply their skills towards maintaining or increasing their technical competence within the areas of practice for which they claim expertise,

- evaluate their personal competence when offering professional services,
- work within their personal areas of expertise only, and
- conduct their business in a spirit of cooperation and teamwork, with respect for other professionals.

It is possible that some attorneys may seek to use the work product of the JTFAP in legal proceedings involving the professional qualifications and competence of individual geologists or engineers. The JTFAP wishes to make clear that its deliberations and findings were undertaken and developed solely for the use of the sponsoring societies and their individual members, agencies, organizations, and consumers involved with the geo-construction industry. They are not specifically formulated for use in legal proceedings involving the evaluation of skills, qualifications, or capabilities of individual practitioners.

1.4 Guideline Content

This guideline contains practice definitions and corresponding BOKs for each of the four professions involved. The areas of expertise of each profession are explored and defined as criteria for practice within the geo-construction industry. Since this document is dynamic and evolving, requiring extensive collaborative discussion and commentary, recommendations are provided for further development of this guideline. Finally, this guideline provides a detailed description of how it is intended to be used, and how it should not be used, to ensure its effective use in meeting the JTFAP's charter.

1.5 Exclusions

This guideline focuses on professional practice within the geo-construction industry which involves engineering, geology, and their respective specialty areas of geotechnical engineering and engineering geology. Geological engineering has been excluded because of its unique position as a dual profession straddling both science and engineering where the corresponding BOK would permit normal expertise throughout the scope of geo-professional practice. Other areas of specialty, such as geohydrology/hydrogeology, environmental engineering/geology and engineering geophysics, have not been addressed at this time. Each of these and other related geo-practice areas are relatively new specialty fields, not yet fully defined, and BOKs are not yet fully developed. These geo-practice areas should be similarly explored and evaluated as this document is expanded in the future or in subsequent documents.

2.0 TODAY'S PRACTICE

Today, both engineers and geologists practice in an aggressively competitive market. As a result, engineers and geologists are at times driven to consider offering their services in areas of expertise that may actually be better and more competently performed by the other. The contention over relevant areas of practice typically occurs due to:

- an insensitivity to, or lack of awareness of, the traditional and academic preparation backgrounds separating the two basic professions, engineering and geology. Some of this may stem from members of either profession lacking sufficient experience to judge their personal capabilities or those of their colleagues;
- the economic pressures of today's geo-construction industry;
- the desire to serve the client to the fullest degree possible, without employing the services of the "other" discipline; and
- the lack of sophistication of the client, who may not understand or value the use of both professions.

These are a few of the issues that led to the creation of the JTFAP and thus a means of providing guidance for those who are concerned with overlapping areas of practice. The JTFAP recognizes that the client and public are best served by a multidisciplinary approach to geo-construction projects.

2.1 Legal Requirements

2.1.1 Engineers

Licensure for professional engineers is regulated at the state level and typically requires proof of a Bachelor of Science degree in engineering from an institution accredited by the Accreditation Board for Engineering & Technology (ABET), a minimum number of years of experience with continuously increasing responsibility, and the passing of an examination administrated by each state.

A license to practice engineering is required in all 50 states, the District of Columbia, and United States territories including Guam, the Northern Mariana Islands, Puerto Rico, and the Virgin Islands. California provides licensure for geotechnical engineering, and Oregon is in the process of developing licensure for geotechnical engineering. Registered professional engineers are bound by professional ethics to practice only within their areas of expertise and competence.

2.1.2 Geologists

According to the Association of State Boards of Geology (ASBOG), currently 29 states provide licensure for professional geologists. Only six states (Arkansas, California, Mississippi, Missouri, Oregon, and Washington) require licensure to practice specialty skills such as engineering geology and hydrogeology. Twenty-seven states have geologist practice registration acts. Additionally, there are some lesser forms of legal control over the practice of geology in Virginia and Puerto Rico.

2.2 Status of Overlapping Areas of Practice

The JTFAP is not the only body attempting to reduce confusion and define criteria for identifying areas of practice within geology and engineering. The Task Force has sought to identify similar professional association action bodies dealing with the same menu of concerns. As well, it has sought to identify and seek relevant evidence generated by licensing boards and other groups of professional engineers and geologists outside of the professional societies.

The National Council of Examiners for Engineering and Surveying (NCEES) conducted a survey of state engineering licensing boards in 2005. The survey determined that only five states (Alabama, Arizona, Missouri, North Carolina, and Wyoming) had a formal agreement or policy, or memorandum of understanding (MOU), regarding practice overlap between engineers and geologists. Oregon was not identified in the survey but as of 2001 has an MOU to address practice overlap issues. The state licensing boards' MOUs generally provide policy and procedures to address practice overlap issues as opposed to defining specific criteria in evaluating relevant engineering and geology practice areas. The language of the MOU in Missouri is currently being either renegotiated or will be repealed by the Missouri Board of Geologist Registration because it provides latitude for professional engineers to practice geology without possessing minimal requirements that others would need to practice under the Geologist's Registration Act.

The Oregon State Board of Geologist Examiners (OSBGE) prepared a *Draft Professional Practices Guidance* document dated February 7, 2007. This document focuses on defining the professional practice of geology in Oregon and aids in determining "when one be registered, for such work," and "who can perform what work." The OSBGE has an MOU with the Oregon engineering board to jointly consider practice overlap issues. The OSBGE has further provided written guidance dated July 2007 that certified engineering geologists "can complete geotechnical investigation, analysis and design as part of their engineering geology practice, and complete geotechnical reports."

Section 50.2.1.2 of the Colorado Engineering Licensing Regulations entitled "Multi-Disciplinary Approach" indicates that "mitigation of effects from natural hazards requires a multi-disciplinary approach encompassing the fields of engineering, geology, hydrology, architecture, and land-use planning …." and "individual licensees are unlikely to possess the necessary knowledge and expertise to deal with all natural hazards in all cases."

The JTFAP has considered and incorporated concepts presented in the *Fields of Expertise* document published by the California Board of Registration for Professional Engineers and Land Surveyors in 1988 (updated 1997). This document was prepared for use by both California's engineering and geology boards "to clarify and differentiate between the responsibilities and duties of registered civil engineers and geologists, for reviewing the 'gray' areas where civil engineering and geology overlap," and for use "when a dispute or complaint is filed." The California *Fields of Expertise* practice matrix identifies activities limited to individual practice of the licensed geologist and civil engineer and those common to both. It is noted that the 1988 version identified the practice areas as "Certified Engineering Geologist" and "Civil Engineer Competent to Practice Geotechnical Engineering," whereas the updated 1997 document differentiates between "Registered Geologist" and "Registered

Civil Engineer." It is understood that the *Fields of Expertise* document has been repealed and is not currently used by the California registration boards.

The Joint European Working Group made up of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE), the International Society for Rock Mechanics (ISRM), and the International Association for Engineering Geology and the Environment (IAEG) published *Professional Tasks, Responsibilities and Co-operation in Ground Engineering* in 2004. The purpose of this working group was to address growing concerns over the "particular contribution and responsibilities of Engineering Geologists and Geotechnical Engineers in the solution of problems in ground engineering." The working group presented a model for the integrated approach to solving ground engineering problems including a transition from scientific aspects (engineering geology and geomechanics) to the engineering design aspects of ground engineering. The working group concluded that the identified tasks "are highly interdependent," that "no strict boundaries are identifiable between any of the aspects," that "no strict rules are justifiable in defining those tasks to be carried out by Engineering Geologists and Geotechnical Engineers," and that each "task should be carried out by the person with the relevant competence."

2.3 Professional Practice Responsibilities

State-regulated consulting firms made up of professional engineers and/or professional geologists normally have the legal right to offer professionally competent services in either or both fields as long as one or more of the corporate officers are appropriately licensed and the firm accepts the responsibility of providing the required supervision over the technical services it offers to its clients. To this end, it is incumbent upon the owners of the firm to assign geo-professionals from their staff only within their areas of expertise.

State-regulated professional individuals have the legal responsibility to undertake assignments for which they possess the qualifications and experience sufficient to the task in which they are about to engage. This self-discipline is required whether self-employed or as an employee of a firm engaged in practice within the geo-construction industry.

3.0 PROFESSIONAL PRACTICE DEFINITIONS AND BODIES OF KNOWLEDGE

JTFAP began its work with no preconceived agenda, but did proceed with the expectation that members would deliberate in a cooperative manner, fulfill their charge through investigation, and produce tangible findings as a result of their deliberations.

3.1 Professional Practice Disciplines

The term "professional" is used herein to define practitioners who are compensated for their services. The JTFAP recognized and considered the following categories of professionals who practice in the geo-construction industry with respect to defining areas of practice:

- Professional Civil Engineer,
- Professional Geotechnical Engineer,
- Professional Engineering Geologist¸and
- Professional Geologist.

3.2 Bodies of Knowledge (BOK)

The JTFAP has embraced the concept of BOK statements. A BOK describes the sum of knowledge which is obtainable within a profession. It is the overall knowledge base that can be developed as a result of education, training, background, and experience of a practitioner within the particular discipline. Appendix A presents the BOKs for each of the four professional disciplines considered.

The BOKs are not meant to reflect the course curricula or requirements for graduation at any specific accredited university. Likewise, the JTFAP does not expect that any one geo-practitioner commands complete knowledge of every item contained within any BOK. Individual geo-professionals develop areas of personal expertise based on interests and capabilities, and on the demands of their individual practice. The JTFAP further recognizes the strong influence that regional geologic conditions have on the nature of geo-professional practice in geographic areas of the world. Therefore, the BOKs are presented as one component of a suite of capabilities that can be used to evaluate the qualifications and competence of professionals for any particular task.

3.3 Skills and Capabilities of Geologists and Engineers

The JTFAP spent considerable time and effort in developing a mutually acceptable concept of the skills, capabilities, and responsibilities of engineers and geologists required for professional practice within the geo-construction industry. Although individual geo-industry professionals may possess overlapping skills, capabilities, and competence based on their personal knowledge and experience, the JTFAP believes that the geo-industry professions are distinct.

3.3.1 Engineers

Civil Engineering

Civil engineers provide design products directed primarily toward the construction of engineered works or the implementation of measures designed to provide direct means of sustenance, habitation, or infrastructure support for society. These work products involve computations, development of design drawings, and specifications for the construction of engineered works based on various measurements and assumptions. The engineering curriculum of accredited universities includes defined instruction in the design process. The professional engineer attains the ability and authorization to practice engineering based on formal education, training, experience, and examination.

Geotechnical Engineering

Geotechnical engineering is a specialty branch of civil engineering that deals with earth materials and is primarily concerned with defining, understanding, and utilizing through design the engineering characteristics and properties of these earth materials. Both *in situ* and laboratory tests of earth media are conducted for the purposes of determining engineering properties as required for the design of engineered works. These properties include basic, intrinsic material properties as well as other properties that are developed by placing materials under test conditions which represent the conditions under which the materials will be placed as a result of engineered construction. In addition, engineers design considering soil-structure interaction, particularly as applied to foundations, underground structures, and earth retaining structures. Engineered design, for these purposes, takes on a three-dimensional character and builds upon the descriptions of earth materials and structures provided through practitioners within the geo-construction industry.

The geotechnical engineer uses the results of field and laboratory investigations and the understanding of project requirements to determine the geo-engineering characteristics of the project setting. Consideration is given to the earth's responses to the loads and stresses applied by the proposed facility, as well as to the facility's response to the potential loads and stresses applied to bodies of earth materials.

The geotechnical engineer uses his education, training, and experience to understand these earth properties. This understanding is combined with the client's requirements for the proposed facility to design a structure which is consistent with site conditions and is safe, compliant with building codes, and cost effective.

3.3.2 Geologists

Geologists

Geologists define, delimit, describe, or otherwise provide characterization of earth processes and materials, including fluids and minerals.

The science of geology is an observationally-based science employing not only the myriad of geologic principles but mathematics, chemistry, physics, and biology as tools to characterize the geologic condition. The background, training, and experience necessary to conduct this general scope of work are quite different from that required of engineers to perform a design role. The realm of physical and chemical variations in the earth materials is complex and often only slight variations can affect engineering design, thus the geologist must have the level of precision that is required to support the engineering design task demands.

In their primary role within the geo-construction industry, the main work product of geologists is that of site characterization as it relates to geologic processes and conditions. These characterizations can provide three-dimensional physical and chemical descriptions of both surface and subsurface locations of earth materials, some of which may be necessary for engineered works. The practice involves inspection of the visible surface of the earth along with subsurface exploration and imagery. The role of the geologist typically includes taking samples and making measurements of earth materials and performing visual and/or laboratory analyses relating to their geologic character.

Engineering Geology

Engineering Geology is a specialty branch of geology which is involved with the geo-construction industry. Engineering Geology deals with the application of the geologic sciences to engineering practice for the purpose of assuring that the geologic factors affecting the location, design, construction, operation, and maintenance of engineering works are recognized and adequately provided for. Engineering geologists investigate and provide recommendations on the character of earth materials for engineering analyses and design.

Engineering Geology is the discipline which applies geologic data, techniques, and principles to the study of naturally-occurring rock and soil materials, surface and subsurface fluids, and to the interaction of geologic processes so that those factors affecting the planning, design, construction, operation, and maintenance of engineering structures (fixed works) are adequately recognized, interpreted, and presented for use in engineering and related practice. The Engineering Geologist utilizes specialized geologic training and experience to provide quantitative geologic information and recommendations.

4.0 AREAS OF PRACTICE

Engineering and geology are distinct professions with different educational and licensure requirements. Within the geo-construction industry, there are similarities in knowledge and experience for those practicing as geo-professionals. The main purpose of the JTFAP has been to study, identify, and define the normal areas of practice for professionals involved in the geo-construction industry, to indicate where professional expertise may be similar, and to contrast differences. The JTFAP has also endeavored to judge the capabilities of the individual professions and to recommend an appropriate way to differentiate between them. To this end, the Task Force has developed the following descriptions of professional practice.

4.1 Areas of Professional Practice

The geo-professional practice within the disciplines of civil engineering and geology contain considerable overlap. Individual practitioners should be placed in responsible charge of only those specific practice areas in which they are competent to perform and/or manage. The decision as to whether a practitioner is able to perform a particular task should be made on an individual basis and should reflect the practitioner's education, training, and professional experience. The term "responsible charge" used herein is defined as an engineer or geologist who conducts or directs the collection of field and laboratory data, evaluation, interpretation, analysis, modeling, and formulating conclusions and recommendations for the planning, design, and construction of the "built" and natural environments.

The disciplines of civil engineering and geology and their specialized practices are defined as follows:

4.1.1 PE – Professional Civil Engineer

A licensed civil engineer with relevant education, training, and experience in the application of engineering principles, engaged in the investigation, evaluation, planning, design, and specification of constructed improvements or processes.

4.1.2 PGE – Professional Geotechnical Engineer

A licensed civil engineer with relevant education, training, and experience in the application of soil and rock mechanics, engaged within the geo-profession in the investigation and engineering evaluation and analysis of the interaction between earth and man-made materials in the performance of civil engineering works.

4.1.3 PEG - Professional Engineering Geologist

A geologist with relevant education, training, and experience in the identification of earth materials, including fluids, geologic processes, and geologic hazards, who applies geologic principles within the geo-profession for the design and construction of civil engineering works.

4.1.4 PG – Professional Geologist

.

A geologist with relevant education, training, and experience in the study of the earth who is engaged in the investigation and evaluation of earth materials and fluids, geologic processes which include natural and physical forces, and chemical characteristics and processes.

4.2 OVERLAPPING AREAS OF PRACTICE MATRIX.

The following matrix has been prepared to summarize the various overlapping areas of professional practice that are often controversial. The matrix has been compiled so as to indicate a global perspective in regard to practice within the various core-practice areas. It is important to note that more overlap than indicated may exist when the area of practice is confined within a small geographical area having a defined “geologic province.” JTFAP also emphasizes and strongly recommends a teamwork approach in the many instances where the expertise and skills, and thus the mutual involvement of geotechnical engineers and engineering geologists, is required. Nonetheless, this document should only be utilized as guidance for determining individual competence for professional practice, as applicable to the geo-construction industry. As discussed earlier, environmental engineering/geology and hydrogeology/geohydrology, as well as other specialty skills, have been specifically excluded from this document. In developing this guidance document, the JTFAP has not attempted to establish individual technical practice standards or specifications.

TABLE 1. OVERLAPPING AREAS OF PRACTICE MATRIX

AREA OF PRACTICE	PE	PGE	PEG	PG
Site Characterization:				
Subsurface Literature/Map Review		X	X	X
Aerial Photography Review	X	X	X	X
Surface Hydrology and Drainage Conditions	X	X	X	X
Geologic Interpretation – Aerial Photography			X	X
Geologic Mapping			X	X
Geophysical Surveys		X	X	X
General Subsurface Exploration		X	X	X
Landslide Subsurface Exploration		X	X	
Subsurface Exploration for Portions of Projects Involving Earth/Structure Interaction		X		
In-Situ Testing for Engineering Parameters		X	X	
Laboratory Testing – Engineering Classifications		X	X	X
Laboratory Testing – Engineering Analytical Parameters		X	X	
Field Classification of Soil		X	X	X
Field Classification of Rock			X	X
Interpretation of Geologic Structure and Processes			X	X
Landslide Hazards Recognition and Mapping			X	X
Fault Capability and Rupture Assessment			X	X
Analysis and Design:				
Surface Water Hydrology	X	X	X	X
Seepage Analysis		X	X	X
Groundwater Modeling		X	X	X

AREA OF PRACTICE	**PE**	**PGE**	**PEG**	**PG**
Dewatering - System Design Criteria		X	X	
Dewatering - Material/Equipment Design	X	X		
Erosion and/or Scour Evaluation for Structures		X	X	
Ground Motion Analysis		X	X	X
Liquefaction Analysis		X	X	
Ground Deformation Analysis		X		
Expansive/Collapsible Soil Analysis/Mitigation		X		
Suitability Evaluation of Earth Construction Materials		X	X	
Excavatability Assessment		X	X	
Man-made Fill Disposition Assessment		X		
Slope Stability Analysis		X	X	
Slope Stabilization Design – Earth/Structure Interaction		X		
Slope Stabilization Design – Earth Masses Only		X	X	
Soil or Rock Bearing Capacity Determination		X		
Instrumentation Selection – Earth/Structure Interaction		X		
Instrumentation Selection – Earth/Groundwater Analysis		X	X	X
Design of Structural Elements	X			
Construction Observation and Documentation:				
Engineered Fill Placement		X	X	
Geologic Conditions			X	X
Groundwater Control		X	X	X
Excavations		X	X	
Grouting		X	X	
Ground Improvement/Stabilization		X		
Ground Vibration		X	X	X
Geo-Synthetics	X	X		
Manufactured Construction Materials	X	X		

The JTFAP makes a strong distinction between the engineer’s focus on design-level activities and the geologist’s focus on field observational and testing data used to specify and describe geologic conditions essential for engineering design. In other words, the matrix recognizes the need for the gathering of scientific field evidence vital to specifying conditions for consideration and inclusion in engineered design. This field evidence is necessary to meet the owner’s goals and objective for performance of the completed engineered works.

5.0 TASK FORCE RECOMMENDATIONS

The JTFAP offers the following recommendations to any jurisdiction, client, organization, or individual who is interested in selecting engineers or geologists for practice within the geo-profession in regards to applied geoscience data or design requirements. Generally, this document is not intended as a policy restricting the practice of fellow professionals. It has been prepared for the intended use as a guideline for readers to reach a clearer understanding of geo-professional practice areas based on education and experience. The matrix may also serve as a tool for education within universities and the practicing community to better equip professional engineers and geologists in these fields of practice. Further, as collective practices continue to evolve, this guidance document will need to be updated regularly to reflect recent changes and improvements. The following sections provide recommendations for:

- advancing the collective geo-professional practice,
- use by the sponsoring societies (ASCE, AIPG, and xxx), and
- use by regulatory agencies.

5.1 Recommended Guidelines

Professionals are responsible for limiting their practices to only their areas of professional competence. Professionals within the geo-construction industry are normally those who practice within the fields of engineering geology and geotechnical engineering. Collectively, these professionals should accept and embrace the skills, capabilities, education, experience, training, and competence of other professionals and recognize their specialized expertise. Because there is so much overlap within the engineering and geology disciplines, the JTFAP strongly encourages fellow professionals to work together as a team, rather than as adversaries, to bring the best value to their clients, their professions, and society.

The overlapping areas of practice presented in this document are recommended for use by professionals when evaluating their own capabilities and those of their organizations in providing services within the geo-construction industry. Professionals are further encouraged to advocate use of the Overlapping Areas of Practice Matrix in the assignment and acceptance of work tasks within their practice environment.

5.2 Use by the Sponsoring Societies

The JTFAP hopes that its findings and recommendations will be of use in educating members of the sponsoring societies, and the geo-construction industry at large, about the common areas of practice and the overlaps which exist in geo-professional practice. In addition, this guidance document is intended for use by students and/or educators in better preparing students for future careers in applied engineering and geology.

5.3 Regulatory Agencies

This document defining common areas of practice and the recommendations of the JTFAP are intended to be made available to engineering and geology licensing boards. Its use is particularly encouraged where registration boards are engaged in resolving qualification concerns or charges involving their licensees. These recommendations should be considered for evaluation of professional competence in the formulation of new or updated registration laws.

Appendix A - BODIES OF KNOWLEDGE

A.1 Engineering

A Civil Engineer who practices as a Registered/Licensed Professional must, as a starting point, possess the educational requirements associated with graduation from an academic civil engineering program as accredited by ABET. This needs to be followed by the number of years and quality of experience required to successfully obtain a license in the state where practice is being performed.

Typically, the educational course work for a civil engineer in general practice will include no more than 9 semester hours of study in the arena of soil/rock mechanics and/or geotechnical engineering design/construction principles related to structures or environmental concerns.

The following comprises the general Body of Knowledge (BOK) for Civil Engineering:

A.1.1 General Science

a. Calculus
b. Differential equations
c. Chemistry
d. Physics

A.1.2 Engineering Analysis

a. Engineering graphics and CAD
b. Mechanics of materials
c. Circuits
d. Dynamics
e. Statistics
f. Soil mechanics
g. Fluid mechanics
h. Thermodynamics
i. Hydrology
j. Plane and topographic surveying
k. Structure analysis

A.1.3 Engineering Design

a. Engineering graphics and CAD
b. Hydraulic flow design
c. Transportation systems
d. Steel design
e. Seismic behavior of structures
f. Bridge design
g. Prestressed concrete design
h. Timber design
i. Reinforced masonry design
j. Foundation engineering
k. Environmental engineering
l. Hydraulics (closed conduit and open channel)

m. Water quality processes
n. Pollution control
o. Earthquake engineering

A.1.4 Engineering Management

a. Construction management
b. Ethics
c. Engineering economics

A.2 Geotechnical Engineering

Registered/Licensed Professional Civil Engineers practicing in the specialty area known as Geotechnical Engineering possess the Civil Engineering BOK except that academic study should include no less than a total of 24 semester hours in the arena of soil/rock mechanics and/or geotechnical engineering design/construction principles. Post-academic experience must be gained extensively in geotechnical engineering design/construction activities.

The educational requirements for a typical Geotechnical Engineer need to be obtained in an accredited civil engineering department. For the purposes of the definitions regarding BOKs of engineers, it is assumed that the educational information about earth materials is normally presented in a mechanical sense without great emphasis on the scientific factors regarding origin, structure, processes, stratigraphy, chemical make-up, or geomorphology that would be encountered in a geology department. A typical Geotechnical Engineer will, however, have gained a working, but not scientific, knowledge of the geologic processes that affect the formation and behavior of earth materials during the educational process and/or period of time when practical experience that becomes a part of this BOK is being accumulated.

The following comprises a summary of what is considered in the arena of soil/rock mechanics and/or geotechnical engineering design/construction principles:

A.2.1 Soil and Rock Mechanics

a. Composition and engineering classification of soils
b. Engineering classification of rocks
c. Engineering properties of soils and rocks
d. Volumetric relationships
e. Soil and rock permeability
f. Movement of pore water
g. Stress distribution in soil/effective/total stresses
h. Soils shear strength
i. Soil compressibility, consolidation, and settlement
j. Engineering properties of rock

A.2.2 Drilling and Sampling for Site Characterization

See A.4.3 BOK for Engineering Geology

A.2.3 Soil Mechanics Laboratory

a. Visual identification of soils
b. Water content
c. Atterberg limits
d. Hydrometer analysis
e. Mechanical sieve analysis
f. Proctor density relationships
g. Hydraulic conductivity
h. Unconfined compression
i. Consolidation
j. Triaxial

A.2.4 Foundation Design

a. Bearing capacity/settlement of shallow foundations
b. Bearing capacity/settlement of deep foundations
c. Lateral load capacity of deep foundations
d. Selection of deep foundation type
e. Installation of deep foundations
f. Axial/lateral load testing of driven piles and drilled shafts

A.2.5 Shear Strength and Slope Stability

a. Strength and shear properties of saturated and unsaturated soils
b. Effects of drainage
c. Stress paths
d. Analysis of natural and manmade soil slopes
e. Failure and yield criteria

A.2.6 Lateral Earth Pressure and Retaining Structures

a. Pressure theories
b. Soil structure interaction
c. Tunneling methods
d. Temporary tunnel linings
e. Conventional earth retaining structures
f. Anchored walls
g. Soil nails
h. Sheet pile walls
i. Braced excavations
j. Slurry walls
k. Cellular cofferdams
l. Ground freezing
m. MSE walls

A.2.7 Excavations, Embankments, and Earth Dams

a. Excavations
b. Earth fills
c. Fill compaction
d. Foundation soil improvement

e. Water flow in soil (flow nets)
f. Seepage and dewatering
g. Filters and granular drains
h. Radial flow and wick drains

A.2.8 Geosynthetics

a. Geosynthetic properties
b. Design with geotextiles, geogrids, geonets, geomembranes, geocomposites for separation, reinforcement, drainage, filtration, and containment

A.2.9 Soil and Rock Dynamics

a. Dynamic soil property evaluation and measurement
b. Design of foundations under dynamic loading conditions

A.2.10 Geo-environmental Engineering

a. Site investigation, characterization, and monitoring
b. Contaminate sources
c. Contaminate transport
d. Remediation and stabilization of contaminated soils and groundwater
e. Barriers
f. Landfill caps, liners, stability, and leachate

A.2.11 Earthquake Engineering

a. Influence of soil and groundwater conditions on ground response
b. Seismic hazard identification
c. Liquefaction potential

A.3. Geology

Professional geologists are educated and trained to understand the origin, history, composition, physical properties, and structure of the earth, the processes that shape it, and the global distribution of earth materials and associated natural resources. As such, a professional geologist must possess, at the very least, the BOK that is gained through the successful completion of an education program offered at universities and institutes of higher learning. In addition, those geologists who practice in fields that directly affect public safety are expected to meet the requirements specified by existing State Boards of Professional Registration and/or applicable professional regional regulatory bodies and to become licensed.

The following items are critical to the Body of Knowledge comprising Geology:

A.3.1 Physical Geology

A.3.2 Historical Geology

A.3.3 Mineralogy and Petrology (Minerals and Rocks – Earth Materials)

A.3.4 Structural Geology

A.3.5 Stratigraphy/Sedimentology/Paleontology

A.3.6 Field Geology, Methods and Techniques

A.3.7 Geophysics/Tectonics/Geochemistry

A.3.8 Environmental Geology and Geological Hazards

A.3.9 Economic Geology

A.3.10 Hydrogeology

A.4 Engineering Geology

Engineering Geology is the interdisciplinary field of study in which geology is applied to engineering. Engineering geology involves the application of geologic data, techniques, and principles to the study of naturally-occurring rock and soil materials or subsurface fluids. The practice of engineering geology provides that geologic factors affecting the planning, design, construction, operation, and maintenance of engineering structures and the development of natural resources are recognized, adequately interpreted, and presented for use in engineering practice.

Registered/Licensed Professional Geologists practicing in the specialty area of Engineering Geology must possess the BOK for Geology except that academic study should include no less than 24 hours of applied geology course work. In addition, extensive experience must be obtained in the arena of engineering geology, environmental geology, and hydrogeology as described below.

The academic BOK for a typical Engineering Geologist is obtained in an accredited geology department and the information about earth materials is normally presented in a fashion where it ties directly with application to the fields of civil and environmental engineering. Practicing professional engineering geologists should have specific formal classroom training in engineering geology to supplement the basic undergraduate curriculum in the science of geology. Course work includes soil mechanics, rock mechanics, engineering geology principles, hydrogeology, and slope stability. An Engineering Geologist will typically gain a working knowledge of the engineering principles and geologic information that affect the design of structures built on naturally occurring earth materials. This is a critical period of time when he/she is gaining practical experience which becomes a part of this body of knowledge.

A.4.1 Geology Fundamentals

See A.3 BOK for Geology

A.4.2 Field Geology/Mapping

See A.3 BOK for Geology

A.4.3 Drilling and Sampling for Site Characterization

a. Knowledge of advantages and disadvantages of drilling, sampling, trenching, and testing methods to evaluate engineering properties of earth materials
b. Understanding of the appropriate drilling tools required in performing site characterization of soil and rock
c. Knowledge of what types and sizes of samples are required to perform specific laboratory testing to determine physical, chemical, and engineering properties of earth materials
d. Knowledge of environmental and safety regulations pertaining to exploration and sampling of contaminated soil and groundwater
e. Knowledge of safety hazards associated with subsurface exploration
f. Knowledge of federal, state, and local regulations to safeguard personnel engaged in excavations, trenches, and earthwork
g. Knowledge of regulatory requirements for permitting, construction, and abandonment of exploratory borings and wells
h. Measurement of the physical properties of earth materials with geophysical tests

A.4.4 Remote Sensing for Site Characterization

a. Knowledge of techniques to interpret aerial photographs
b. Knowledge of methods to interpret remote sensing data
c. Spectral geology
d. Infrared remote sensing
e. Mapping with airborne digital radar
f. Aeromagnetic surveying
g. Aeroradiometric surveying
h. Hyperspectral imaging
i. LIDAR
j. Microwave imaging
k. Multispectral imaging
l. Panchromatic imaging
m. Radar imaging
n. Thermal imaging
o. Visible light imaging
p. Application of aerial photographs and remote sensing to site characterization
q. Remote sensing techniques to the assessment of dam safety

A.4.5 Soil Mechanics and Soils Properties Testing to Support Engineering Design

a. Composition and classification of soils
b. Knowledge of soil classifications systems, in particular the Unified Soil Classification System (USCS)
c. Engineering properties of soils
d. Identification of earth materials used in construction
e. Procedures for identification and mitigation of the effects of expansive soils
f. Volumetric relationships
g. Soil permeability
h. Movement of pore water
i. Stresses in soil/effective stress
j. Excavations
k. Earth fills

l. Fill compaction
m. Soils shear strength and bearing capacity
n. Soil compressibility, consolidation, and settlement
o. Visual identification of soils
p. Water content
q. Atterberg limits
r. Hydrometer analysis
s. Mechanical sieve analysis
t. Proctor density
u. Hydraulic conductivity
v. Unconfined compression
w. Consolidation

A.4.6 Rock Mechanics and Rock Properties Testing

a. Engineering classification of intact rocks
b. Mass rock properties and strength
c. Strength of rock: compressive strength, tensile strength, and shear strength.
d. Characterization and influence of rock discontinuities
e. Knowledge of stereonet analysis of discontinuities
f. Rock mass classification systems including Q, RSR, and RMR
g. Strength criteria: tensile, compression, and shear
h. Rigid analysis
i. Elastic analysis
j. Bearing capacity
k. Rock blasting design
l. Tunneling in rock, rock bolts, and TBM production evaluation
m. Mining in rock and roof support
n. Instrumentation including extensometers and inclinometers
o. Knowledge of rock tests to assess performance and durability of slope protection stone, riprap, and aggregate materials

A.4.7 Soil and Rock Slope Stability

a. Safety and stability of both natural and manmade rock slopes, including highway cuts, mines, quarries, and building excavations
b. Types of slope failure such as falls, topples, movement by slip, lateral spread, and complex slope failures
c. Shear strength of soil and rock slopes
d. Basic stability theory
e. Effects of drainage
f. Kinematic slope stability analysis
g. Software methods of analysis -- i.e., for rock slide potential such as Colorado Rockfall Simulation Program (CRSP) and ROCKPACK III
h. 2-D force and moment equilibrium rock mass analysis
i. Rockfall modeling
j. Rockfall hazard rating systems
k. Slope remediation strategies

A.4.8 Seepage Analysis

a. Hydrogeologic properties of earth materials
b. Hydrogeologic testing for measurement of aquifer characteristics
c. Measurement of hydraulic conductivity
d. Ability to specify observation wells
e. Construction of flownets and groundwater contour maps
f. Evaluation of the flow of water through earthen dams and control with filters and drains
g. Knowledge of methods to control groundwater levels, flow, and seepage
h. Influence of groundwater on slope stability to include natural recharge
i. Importance of drainage and need for dewatering systems
j. Uplift pressure cells and instrumentation for gravity dams

A.4.9 Contaminant Hydrogeology/Environmental Analysis

a. Identification of sources of contamination
b. Collection of groundwater samples for geochemical analysis
c. Hydrogeology and contaminant transport
d. Site investigation, characterization, and monitoring
e. Knowledge of environmental and safety regulations pertaining to the exploration and sampling of contaminated groundwater.
f. Remediation and stabilization of contaminated soils and groundwater
g. Barriers
h. Landfill caps, liners, stability, and leachate

A.4.10 Earthquake Hazards and Seismicity

a. Earthquake mechanics and ground motions
b. Knowledge of relative age determination of soil deposits and geomorphic features
c. Ability to log soils in paleoseismic trenches and to identify past rupture events and magnitude of displacements
d. Influence of soil and groundwater conditions on ground response
e. Seismic hazard analysis
f. Knowledge of effects of faults on site development
g. Knowledge of different regional fault systems and tectonic frameworks
h. Knowledge of methods to assess regional seismicity and tectonics
i. Ability to evaluate the effect of site conditions on seismic ground motion and site response
j. Knowledge of procedures to determine seismic source zones and estimate ground motion parameters
k. Knowledge of methods of deterministic and probabilistic seismic hazard analysis
l. Seismic slope stability
m. Liquefaction