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September 23, 2015

Dr. Suzette Kimball, Director
U.S. Geological Survey
12201 Sunrise Valley Drive, Mail Stop 100
Reston, VA 20192

Dear Director Kimball,

After discussions of the Scientific Earthquake Studies Advisory Committee (SESAC) meeting September 1, 2 at Southern Methodist University, we felt that there was an urgent and imperative need to supplement our report of July 28, 2015. I have attached a special letter to you and the Congress from SESAC.

With warm regards,

A handwritten signature in black ink that reads "Ralph J. Archuleta".

Ralph J. Archuleta, Chair of SESAC
Research Professor and Emeritus

cc: Members, Scientific Earthquake Studies Advisory Committee
David Applegate, Associate Director, Natural Hazards
William Leith, Program Coordinator, Earthquake Hazards Program

**Special Letter to Director of the US Geological Survey and the Congress from the
FACA Scientific Earthquake Studies Advisory Committee (SESAC)**

September 23, 2015

The Scientific Earthquake Studies Advisory Committee (SESAC) is increasingly concerned that the USGS Earthquake Hazards Program (EHP) has fallen behind in its ability to properly monitor earthquake activity and advise the nation on the assessment of and response to earthquake hazards. This situation results not from deficiencies in leadership, ability or commitment within the EHP, but from chronic underfunding of the program. In spite of significant advances in increased awareness of earthquake hazards across the nation and in observational technology, the scope and core support for the program has not changed significantly since it was established in 1977. The impact of stagnant funding has been compounded over the past decade by disturbing changes in our assessment of earthquake hazards in parts of the US and exciting—but as yet unfulfilled—opportunities for enhanced observations and response:

- There has been a fundamental change in the assessment of the earthquake hazard in the Pacific Northwest since the Earthquake Hazards Program was established. It is now recognized that this region is capable of a significant subduction zone earthquake and tsunami, similar to recent devastating megathrust events in Sumatra, Japan and Chile.
- Unprecedented increases in seismicity in regions of hydrocarbon production in Oklahoma, Texas, Kansas and elsewhere have prompted concerns about seismic hazard in regions of the U.S. previously considered to be essentially aseismic. While the detailed mechanism responsible for this new class of human-influenced seismicity deserves additional investigation, it is clearly related to recent changes in drilling technology and disposal of fluid wastes.
- The August 2011, magnitude 5.8, Mineral VA earthquake, which caused significant damage in Washington DC, was a reminder of the potential for significant damage from moderate earthquakes in relatively stable parts of the central and eastern US.
- Modern observational systems that provide rapid, automatic identification and quantification of earthquake occurrence have allowed other nations, such as Japan and Mexico, to develop Earthquake Early Warning systems; however, the infrastructure necessary to implement a similar system in the western US is well beyond the resources currently available to the USGS.

SESAC is sending this letter, supplementing its annual report of July 2015, to emphasize that these recent developments in earthquake science and technology present valuable opportunities for the USGS Earthquake Hazards Program to benefit society. Over the past two years our committee has systematically reviewed all aspects of the current USGS Earthquake Hazards Program. We are impressed with the quality, efficiency, and value of their activities in impacting the short-term and long-term risk reduction within the entire US. The Earthquake Hazards Program is continually forced, however, to bypass opportunities that could initiate quantum changes in the understanding of earthquakes and in mitigating seismic risk. This letter summarizes opportunities that could be realized with adequate support.

This list of opportunities and needs is followed by a brief discussion of each:

1. An article by Kathryn Schulz in the *New Yorker*¹ vividly describes the potential for a catastrophic earthquake, perhaps reaching magnitude 9.0 or higher, in the Pacific Northwest—Washington, Oregon, and northern California. The earthquake could, plausibly, cause more than 13,000 deaths and hundreds of billions of dollars in damage with serious economic consequences affecting the US for many years thereafter.
2. If an earthquake similar to the historic 1755 Cape Ann, Massachusetts, earthquake that was felt from Washington DC to Montreal with damage from New Haven, Connecticut, to Portland, Maine, including Providence and Boston, were to reoccur in the Eastern and Central US, the economic and human losses would be severe given the population density of this region, the large area affected by shaking in the Northeast, the older and more vulnerable construction, and the general lack of preparedness.
3. Recent dramatic increases in the rate of earthquakes occurring in the Eastern and Central U.S., associated with injection of waste fluids have alerted both residents and scientists that earthquake hazard lurks in places—including urban areas such as Oklahoma City, OK and Dallas, TX—where few expected it. Scientific understanding of induced earthquakes can reduce uncertainty about how large such earthquakes might become and may lead to injection procedures that mitigate the hazard during the disposal of the waste fluids.
4. Southern California is overdue for a major earthquake with a magnitude greater than any felt there in the past 150 years. While major metropolitan areas, such as the city of Los Angeles, are taking steps to prepare², the shaking will be strongly influenced by the local geological conditions as well as the evolution of the earthquake rupture. Similarly the San Francisco Bay area is primed for a repeat of a major earthquake on the Hayward Fault that cuts through communities whose aggregate population exceeds one million.
5. Where seismic networks are adequate Earthquake Early Warning technology can provide a *ShakeAlert* for strong shaking expected at a certain time. The *ShakeAlert* can trigger automated safety responses and, in some cases, alert millions of people before they experience the shaking. Applications that will satisfy the public demand require more extensive seismic networks and robust computer systems designed for 100% reliability under the extreme conditions that will occur during a severe earthquake.
6. The USGS National Seismic Hazard Maps (NSHM) are basis for seismic design that inform \$1 trillion dollars of construction annually. There are continual requests for improvement or additions to the NSHM, which are updated on a six-year cycle. By taking advantage of space geodesy, the densification of seismic networks, and state-of-the-art computer simulations, the USGS could reduce the uncertainty in its estimates of seismic hazard. Given this more accurate information, the design and construction would become more economical across the nation.
7. The demand for regional earthquake scenarios to estimate losses far exceeds the Earthquake Hazards Program's capability to generate them. Communities throughout the US use such scenarios for preparation and planning. Their ability

¹ Kathryn Schulz, "The Really Big One", *The New Yorker*, July 20, 2015.

² Resilience by Design, Dec. 8, 2014, <http://www.lamayor.org/earthquake> (accessed 9/13/2015)

to respond before and after an earthquake depends on a reasonable estimate where the losses will be greatest.

Recent earthquake occurrences along with increases in knowledge in the fields of earthquake science and engineering have made us realize that we, the members of SESAC, would be irresponsible in our mandated reporting to Congress if we did not point out that 1) the number and importance of these critical issues are greater than at any time in our collective memory; 2) it is possible for the USGS to undertake substantial new thrusts that will mitigate the hazard and risk to our great nation, 3) the scope of the work that should be done far exceeds the budget of the USGS Earthquake Hazards Program.

At this stage, SESAC does not have sufficient information to be specific about the levels of capital investment and increased annual support that would be required to return the Earthquake Hazard Program to a healthy and beneficial level. We are convinced, however, that minor, incremental changes in funding will not suffice. Substantial increases in capital and operational support will be required to sustain a program responsive to current and emerging needs.

We strongly encourage the USGS to undertake a major assessment of the cost of a revitalized Earthquake Hazard Program that is comprehensive in its goal of ensuring a safer and more resilient nation. Because of the cumulative impact of decades of underfunding and the need to quickly assess the impact of significant recent changes in earthquake science and observations, it is essential that this study be undertaken without delay, and we hope you will consider this urgency in your 2017 budget planning.

With regards,

A handwritten signature in black ink, appearing to read "Ralph J. Archuleta". The signature is fluid and cursive, with a long horizontal stroke at the end.

Ralph J. Archuleta
Chair, Scientific Earthquake Studies Advisory Committee (SESAC)