EXECUTIVE SUMMARY

The nation is at an environmental crossroads where the confluence of global environmental change and new scientific capabilities create both an imperative and an opportunity. There is a pressing need for investment in research and education that can contribute to changing the trajectory of current trends away from warming, stress, conflict, and vulnerability, and toward resilience, well-being, stewardship, and prosperity. We are currently facing an unprecedented range of challenges from drought in California, urban growth in the southwest, desertification in Asia, a rapidly changing Arctic, impacts of sea level rise and storms on coastal communities, and outbreaks of infectious disease worldwide. Policy makers, managers, and local communities all want to know: What is our current trajectory and what choices do we have to influence the outcome? Science can help us anticipate and shape our future, not merely adapt.

The notion that environmental protection and economic prosperity are conflicting goals is now outdated. In fact, consideration of the environment is coupled to development and contributes to making a nation strong and prosperous. The AC-ERE recommends that the National Science Foundation revitalize its investments in environmental research and education with the aim of supporting science that can be used to design resilient landscapes, productive managed and natural ecosystems, sustainable urban spaces, and a healthy planet. The goal of this report is to articulate a 10-year vision in which environmental research and education contributes to long-term societal well-being and economic prosperity.

Although environmental change is accelerating, environmental research and education is reaching new heights with tools and approaches for engaging diverse researchers, stakeholders, citizens, and students of all ages. The AC-ERE envisions a strategy for the next ten years that builds on these opportunities. We recommend that NSF focus on understanding the role of humans as drivers of environmental change, the effect of these changes on environmental and human well-being, and opportunities for changing socio-environmental trajectories to achieve desired outcomes in order to prepare the nation for a secure, prosperous, and thriving century.

This report articulates a strategic framework based on three important areas of investment and programming, for which NSF is uniquely capable.

1. Understanding the Challenges is aimed at identifying needs and possibilities for fundamental research and education based on new questions and developments. This focal point challenges NSF to take a strong position that the integration of social sciences, natural sciences, and engineering continues to be a critical characteristic of environmental research and education. We must improve our understanding of how the components of complex socio-environmental systems interact if we are to move from responding to change, to anticipating change, averting harm, and creating opportunity. It highlights improving fundamental understanding of interactions of multiple components of socio-environmental systems, such as between food, water and energy. This section highlights the importance of observing systems and the emerging big data paradigm as well as the need for improvements in the scientific capacity to forecast future states of the environment.

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2. Designing the Future and Changing the Forecast

is aimed at leveraging an improved scientific understanding and forecasting capability to redesign future trajectories using state-of-the-art science, engineering, and technical knowledge. This is a new area of emphasis that moves science from its current focus on observation and projection to the design of resilient and adaptive systems that reduce our risk and vulnerability to changes and extreme events. The participation and input of a diverse range of end-users through partnerships with scientists, practitioners, and managers will facilitate not only the design and construction of resilient systems but also their utility, feasibility, and social acceptance. This section emphasizes the importance of engaging new kinds of education and training that support science to inform the design of resilient systems.

3. Enabling and Securing the Future

includes building scientific infrastructure and observing systems; devising strategies for utilization of massive datasets; providing scientific support for cross-disciplinary, problem-based research and decision-making; developing communication tools for translating knowledge into action; and capitalizing on the diverse human capacity to solve environmental problems. NSF must make building the nation’s diverse scientific capacity to secure the future a priority of equal weight to advancing discovery to enable and design the future. This section calls for programs that build stronger interdisciplinary partnerships and that connect the scientific community to society and industry. The skill set required for this endeavor is an unprecedented combination of multi-scalar, systems-thinking skills, innovative and collaborative research and design capacity, the ability to co-create and share scientific knowledge with the public, and engagement with individuals and institutions that implement solutions. Beyond building the capacity of the scientific workforce, this section emphasizes the development of a scientifically-informed public by supporting and advancing scientific literacy and increasing diversity in STEM.

This Vision for the next decade can be realized through NSF initiatives that:

Endure by ensuring an over-arching portfolio for coordination of NSF’s investments in environmental research and education, and maintaining an internal structure for its management and coordination.

• Establish stable, consistent, and long-lasting cross-directorate, Foundation-wide support that builds on core and emerging programs to catalyze and support cross-disciplinary research and education teams.

Design by facilitating a “science of integration” that fosters ingenuity in the design of resilient systems.

• Focus on causes of, impacts from, and responses to a rapidly changing national and global environment.
• Strengthen relationships among the natural science, engineering, and social science directorates and programs to advance science for environmental design.
• Identify and create new opportunities that help society change the environmental trajectory in beneficial ways.

Leverage by capitalizing on new developments in sensors and human observing networks, large observatories, and “big data” to advance data-informed design.

Diversify by accelerating diversity in research and education through systems science motivated by societal issues as well as multiple pathways for educating people from diverse populations at all levels of formal and informal education.

Engage by exciting, involving, and educating diverse individuals from multiple generations and fields to develop the skills necessary to anticipate and cope with socio-environmental change.

Enlist by connecting stakeholders, decision-makers, educators, community engagement professionals, and businesses with researchers through broader impacts networks and nodes in order to more effectively accomplish broader impact objectives.
NSF’s mission is “to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense....” This report notes that NSF is poised to address some of the most pressing scientific and engineering challenges of our time, and can capitalize on the experience of more than half a century of establishing scientific research and education networks, promoting the development of new scientific disciplines, and building infrastructure to support scientific research and education. The report provides a strategic vision that encourages NSF to continue to provide leadership in environmental research and education while charting new programs and investments in this important area. As the pace of environmental change accelerates, investment in science and engineering must keep pace to better understand the components of complex socio-environmental systems and their interactions, to design adaptive systems which increase our resilience to the coming changes and extreme events, and to build the nation’s scientific capacity to secure a thriving and prosperous future.

This report outlines a framework for re-envisioning NSF’s ERE programs with an emphasis on sustaining past successes and continuing to support strong investments in interdisciplinary environmental science, engineering, education, and human resources. The report promotes the notion of improving environmental forecasting coupled with scientifically-informed design of sustainable and resilient environmental systems. As we highlight, investments in research and education can be directed to activities that anticipate and shape, not merely adapt to future states and conditions in the environment and economy. This requires programs that improve our understanding of environmental changes coupled to translation of this knowledge into new ideas and designs for the type of environment in which we want to live. Society is continually designing and redesigning the built and natural environment, and science and engineering can be marshaled to improve these designs and enable and secure a thriving century. At the same time, NSF must continue and expand investment in an interdisciplinary and diverse ERE workforce. We note the increasing need to facilitate broadening impact, since by definition environmental research begins with strong connections to societal needs.

This is the challenge, opportunity, and imperative for our time.