Executive Summary
Report of the 2017 Committee of Visitors
Division of Earth Sciences
Directorate for Geosciences
National Science Foundation
2014 – 2016 Review Period

FY2014-FY2016

Critical Zone Observatories (CZO)
EarthScope (ES)
Geobiology and Low Temperature Geochemistry (GG)
Geoinformatics (GI)
Geomorphology and Land Use Dynamics (GLD)
Geophysics (PH)
Hydrologic Sciences (HS)
Integrated Earth Systems (IES)
Paleo Perspectives in Climate Change (P2C2)
Petrology and Geochemistry (CH)
Sedimentary Geology and Paleobiology (SGP)
Studies of the Earth Deep Interior (CSEDI)
Tectonics (TE)

FY2013-FY2016

Education and Human Resources (E&HR)
GeoPrisms (GPR)
Instrumentation and Facilities (IF)
Postdoctoral Fellowships (PF)

Committee Membership

Dr. Pamela Kempton, Kansas State University, Chair; Advisory Committee for Geosciences (AC GEO) Member
Dr. Rajendra Bose, Columbia University
Dr. Virginia Burkett, USGS at Reston, VA
Dr. Jacqueline Dixon, University of South Florida
Dr. Steven Driese, Baylor University
Dr. Diana Elder, Northern Arizona University
Dr. Francisco Gomez, University of Missouri-Columbia
Dr. Michael Hamburger, Indiana University, Bloomington
Dr. Bruce Houghton, University of Hawaii
Dr. Guy Hovis, Lafayette College
Dr. Steve Ingebritsen, USGS at Menlo Park, CA
Dr. Patricia Kelley, University of North Carolina Wilmington
Dr. Carla Koretsky, Western Michigan University
Dr. Carolina Lithgow-Bertelloni, University College London
Dr. Timothy Melbourne, Central Washington University
Dr. Joshua Roering, University of Oregon
Dr. James Rustad, Department of Energy

COV Process and Committee Charge

The 2017 Committee of Visitors (COV) to the Division of Earth Sciences (EAR) met on June 19-20, 2017, at the National Science Foundation. Our charge was to review and comment on the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions. In particular, the COV examined the integrity and efficiency of processes used to solicit, review, recommend, and document proposal evaluation and actions, including the effective use of NSF's two merit review criteria, and considered the relationship between decisions and program goals. In contrast to previous COVs, our charge was directed at a Division level. This change increased the number of programs and proposals reviewed by the COV members. As a consequence, the number of participants in the COV was larger in order to cover the breadth of EAR. This Division-level perspective also reduced the time for briefings from NSF Project Officers (POs) during the in-person meeting.

The COV's observations were based on proposal jackets, a series of informational reports, open-session group discussions with EAR staff and the personal knowledge and experience of COV members, the majority of whom have participated in the NSF merit review process through proposal submissions, ad hoc reviews and/or panel reviews. Written reports on Division Management, Program Management, Portfolio Planning and an analysis of the No Deadlines Pilot project were provided to the COV in advance of the June meeting. Two webinars were also held, one on April 19th and the other on May 17th, to provide COV members with context and background information.

The COV report template focused our observations on four areas, as described below: (1) the merit review process, (2) selection of reviewers, (3) program management and (4) portfolio planning. In addition, the COV addressed the impact of a No Deadlines policy pilot, introduced recently by some EAR programs to aid with workload management (Section V below).

For the programs under review during this COV period, there were 7,121 different actions taken by program staff. These actions fall into different categories as summarized in the table below. The COV focused on 5,579 Competitive Actions, which include proposals submitted for evaluation through merit review. These include Early-concept Grants for Exploratory Research (EaGERs), Grants for Rapid Response Research (RAPIDs), Workshops, and New, Renewal and Accomplishment-Based Renewal (ABR) proposals.

Action	**2014**	**2015**	**2016**	***Total***
CGI	320	389	379	*1088*
COMP	**2038**	**2011**	**1530**	***5579***
OTHER	41	39	25	*105*
RTNR	21	84	42	*147*
SUPP	44	66	66	*176*
W/DRAW	6	16	4	*26*
Total	***2470***	***2605***	***2046***	***7121***

CGI= Awarded Continuing Grant Increment
COMP= Competitive (Includes EaGERs, RAPIDs, Workshops, ABRs)
OTHER= FWRD Funding, PI Transfer
RTNR= Return Without Review
SUPP= Supplement
W/DRAW= PI withdraws the proposal from consideration

The jackets reviewed by the COV were drawn from the full list of EAR Competitive Actions from FY2014 to FY2016 (or FY2013 to 2016 for E&HR, GPR, IF and PF) using a random number generator in Microsoft Excel. Non-lead collaborative proposals were removed from consideration because they duplicate documentation of the lead proposal, leaving a pool of 3,979 unique projects during the period. Five percent of the projects for each program were selected for consideration. They were evaluated for conflicts with the COV members and were replaced by another random selection if needed. For programs with fewer than five projects resulting from the random selection of five percent, their total count was augmented to ensureall programs had at least five actions included in the pool with both awards and declinations represented

In addition, EAR provided the COV with limited information for one competition from each program. Each competition had at least two assigned COV members, who could recommend up to 10 projects (or no more than 20% for small competitions) to augment their review. COV members were asked to select additional projects for evaluation that ranked near the "waterline" (on the border between those proposals funded and those not), had strongly divergent reviews, or had outcomes that might appear to be inconsistent with reviewer or panel ratings.

The committee was highly appreciative of the efforts of NSF staff to prepare comprehensive, well-organized and timely information in advance of the meeting, as well as open and frank feedback regarding questions that arose during the on-site COV meeting. A brief summary of our findings is given below, followed by our list of recommendations. The complete report appears in the template that follows.

Section I: Merit Review

The COV was impressed with the overall quality, consistency and integrity of the Merit Review Process managed by EAR and values the contribution EAR staff make through their knowledge, expertise and dedication. The system works well primarily due to the excellence of the people within EAR and its long history of commitment to the highest standards of scientific review.

The majority of reviewers take the merit review process seriously and offer at least some substantive comments, although there is clearly variation in the quantity of substantive feedback. The COV noted, for example, that ad hoc reviews range widely in the degree to which both merit review criteria are addressed. Most panel summaries are clearly written, including a brief description of strengths and weaknesses discussed by the panel, and the rationale for the panel consensus is usually well articulated, although with some notable exceptions and variations across programs. However, the panel summaries tend to be more focused on, and include more detail with respect to, the Intellectual Merit (IM) criterion as compared to the Broader Impacts (BI) criterion. In most cases the documentation for proposal handling and decision making is very well written and provides sufficient rationale for the award/decline decision. Our advice for maintaining and enhancing the high quality of merit review delivered by EAR is encompassed in Recommendations 1 to 7.

> ***Recommendation 1.*** *The COV views the combination of ad hoc and panel reviews to be highly effective, and recognizes it as the "gold standard" of merit review undertaken so expertly by EAR staff. While we acknowledge the value of including alternative mechanisms for merit review within their portfolio of delivery mechanisms (e.g. virtual panels, panel review only, etc.), we strongly encourage EAR to continue the use of the ad hoc peer review coupled with on-site panels as the principal merit review process.*
>
> ***Recommendation 2.*** *The COV was disappointed with the chronically low response rate of ad hoc reviews, despite tremendous effort on the part of EAR staff to solicit reviews. We encourage EAR to promote alternative reviewer management technologies that allow reviewers to accept or decline review requests quickly and to recommend alternate reviewers as one mechanism for improving the response rate. Such technologies may also enable EAR to more efficiently monitor the proportion of invitations and responses, for ad hoc and panel reviews from women, under-represented minorities, early career scientists and scientists from different institution types to broaden reviewer participation (see Recommendations 16, 17 and 18).*
>
> ***Recommendation 3.*** *The COV was pleased to learn of the initiatives already underway to improve community understanding and appreciation of the BI criterion (e.g., the pilot educational webinar training for reviewers and panel members). We encourage EAR to continue its efforts to improve community understanding and assessment of Broader Impacts. We recommend that EAR consider*

adding a checklist directly on the ad hoc reviewer and panelist review forms to encourage more thorough responses from reviewers.

Recommendation 4. *We recommend that Program Officers use their comments to signal the importance of Broader Impacts to the EAR community in feedback.*

Recommendation 5. *The COV recognizes the important role EAR staff play in maintaining portfolio balance (see Section IV). However, the rationale for funding decisions should be clearly documented in the Review Analysis, particularly in those rare cases where disparity exists between ad hoc and panel reviews or where projects are elevated or demoted significantly relative to the panel ranking.*

Recommendation 6. *The COV recommends that EAR provide a consistent summary of panel activity in the Review Analysis across all programs. This includes essential information such as the number of panelists, where they convened, who led which aspects of the review, and a generalized statement of each proposal's relative ranking in the panel's assessment.*

Recommendation 7. *Clear communication to the Principal Investigators (PIs), including strengths and weaknesses of proposals with respect to both intellectual merit and broader impacts, is essential, especially for new investigatorsand declined proposals. We recommend that EAR provide consistent feedback to PIs with respect to merit criteria across all programs in panel summaries, PO comments and context statements, including general indications of relative proposal rankings.*

Section II: Selection of Reviewers

COV members were impressed with the level of due diligence paid by EAR staff to the selection of reviewers. Reviews were solicited from individuals with appropriate expertise in almost all cases, and drew from a variety of institutional types, including Tier 1 research universities, PhD and masters-granting universities, 4-yr and 2-yr undergraduate colleges and universities and governmental agencies. POs also targeted a cross-section of researchers in terms of their career level, gender, ethnicity and expertise. Male and female reviewers were represented in proportion to the typical gender breakdown found in most earth science departments or research agencies. However, the rate of review response was surprisingly low (<50%), which often necessitates heroic efforts on the part of POs to preserve the integrity of the merit review process.

Recommendation 8. *The COV was disappointed by the low response to requests for review from the earth science community, as this creates excess workload for POs and for responsive reviewers and potentially risks the quality of merit review. We encourage EAR to explore innovative means to incentivize the community to respond to requests.*

Section III: Program Management

The COV commends EAR Program Officers for their excellent program management. The merit review process is exemplary and the quality of the funded projects is outstanding. Even with persistent uncertainty in the timing and amount of funding, the programs have performed admirably and with flexibility. Program Officers have managed their complex and dynamic portfolios with efficiency and fairness, while continuing to respond to emerging scientific opportunities and community needs.

The processes and mechanisms for decision-making at the Division level were less clear to the COV, including the development of new initiatives and the distribution of funds among existing programs (see Section IV). There will be perpetual and appropriate tension between new strategic initiatives and core programs, and between long-term commitments to facilities (including field sites) and more flexible funding. We would like to see EAR articulate more clearly the mechanism(s) used for developing strategic initiatives, being clearer about where they are driven top-down in response to stated national priorities (responding to known societal needs) and where they are driven bottom-up by specific earth science communities. In addition, EAR

is encouraged to seek greater input from the earth science community in its strategic planning and decision-making.

The 2017 COV team was pleased to see that significant changes had taken place in response to previous COV recommendations. However, we also recognized persistent issues that have been raised by previous COVs that have yet to be satisfactorily resolved, hence our reiteration of several of these, including clarifying expectations for Broader Impacts (Recommendations 3 & 4); improving the ad hoc reviewing system (Recommendation 2); and continued attention to enhancing diversity (Recommendation 16).

> ***Recommendation 9.*** *The COV commends EAR staff for the excellent management of their programs, particularly through periods of resource challenges. The COV is concerned about the sustainability of this excellent work, given the workload demands relative to other NSF programs. The COV emphasizes the need for increased personnel and fiscal resources to help sustain the important contributions of EAR staff.*
>
> ***Recommendation 10.*** *The COV noted the significant increase in the proportion of EAR's budget devoted to infrastructure between FY2003 and FY2010 as EAR took over operations following NSF's investment in EarthScope facilities. The COV recommends that EAR be strategic in determining the appropriate balance of future funding for infrastructure relative to other areas of investment. Processes should be put in place for identifying major investments that may eventually need to be sunset, and the timelines for doing this to make way for new commitments, so that both EAR and the community can plan well in advance for these changes.*
>
> ***Recommendation 11.*** *We recommend that EAR develop a clearer way of articulating to the community the mechanism(s) used for developing strategic initiatives, clarifying which are driven top-down in response to stated national priorities (responding to known societal needs) and which are bottom-up, driven by specific science communities.*
>
> ***Recommendation 12.*** *We commend EAR for their responsiveness to previous COVs and recommend they continue current progress with issues such as Broader Impacts and improvements to the ad hoc review software system.*

Section IV: Portfolio Planning

In general, the range and scope of EAR-funded awards is impressive. There is a broad mix of grants focused on deep Earth and surface processes, as well as a balance of research- and education-oriented projects. Decision-making processes affecting portfolio balance within individual programs are clear. In addition to scientific merit, attention is paid to creating and sustaining balance among program subdisciplines; geographic distribution of awards; institution type, career status, gender, and ethnicity of PIs; and availability of co-funding. We find that the Program Officers do an outstanding job in balancing these criteria. Their dedication, integrity, knowledge and expertise are crucial to the success of the system and facilitate a more nuanced balancing of portfolios within individual programs than could otherwise be achieved.

It is apparent that the PIs, reviewers, panelists and program officers are cognizant of the need to increase participation of underrepresented groups and institutions, but the relatively low number of submissions from such individuals and institution types remains a cause for concern. Consistent with these proposal submission statistics, we note two observations: (1) The majority of awards continue to be made to research-intensive PhD-granting institutions, with a minority of awards made to other institution types, (2) The demographics of PIs remain mostly white and male. We urge EAR's continued attention to these issues and efforts to increase proposal submission and participation by under-represented institutions and investigators. Additionally, we suggest that new practices, including evidence-based practices such as the implicit bias training being piloted for reviewers, continue to be adopted to strengthen the review process.

The processes by which decisions are made regarding scientific priorities and funding balance at the Division level were less clear to the COV than those at the program level. A significant control regarding portfolio balance within EAR is the allocation of funding among programs, which has been essentially static throughout the review period. Nevertheless, information on how these decisions are reached (or adjusted in response to changing strategic drivers) was not clear. Similarly, reports were vague about how EAR develops initiatives in response to national priorities. How do strategic initiatives (e.g. "special programs") arise? Do they emerge in a top-down fashion through EAR/NSF actions or do they arise from the earth science community (bottom-up)? Individuals within the COV suspect from experience that it is a combination of these mechanisms, depending on discipline, but what is the balance within EAR as a whole? EAR needs to be clearer about its strategic vision at all levels, from individual programs to EAR-wide, and to become more transparent regarding how decisions to invest in strategic initiatives are made.

As part of its portfolio planning and management activities, the COV also sees a need for EAR to explore ways to more effectively disseminate discovery and innovation in a timely fashion to better communicate and promote to the various stakeholder communities the exciting science supported by EAR.

Recommendation 13. *We recommend that EAR increases transparency to stakeholder communities regarding the processes by which the priorities and balance of funding of individual programs are determined. A variety of factors, including perceived trends in science, proposal pressure, and collective opinion are presumably at work, but long-term EAR strategic planning should be driven by a transparent process at the Division level.*

Recommendation 14. *The COV recommends that EAR as a whole (in addition to individual programs) engage in long-term strategic planning based, in part, on formal mechanisms to ensure broader community input.*

Recommendation 15. *EAR is currently limited by the mechanisms available to rapidly disseminate discoveries and innovation to PIs and the broader public. The COV encourages EAR to work with partners in GEO and elsewhere within NSF to explore ways to more effectively disseminate discovery and innovation in a timely fashion.*

Recommendation 16. *The geographic distribution of awards seems to map well onto proposal pressure, state populations and research-intensive institutions. At the same time, we recognize the need to further broaden participation in fundamental research, and recommend that EAR continue their efforts to broaden outreach to states with low proposal success rates and, especially, numbers of submissions.*

Recommendation 17. *The COV recommends that EAR enhances outreach efforts to under-represented institutions to increase submissions from more diverse institution types. We anticipate that this will have the added benefit of diversifying the pipeline and participation of diverse students and early career researchers in EAR.*

Recommendation 18. *We recommend EAR continue and expand their efforts to broaden participation of under-represented groups based on demonstrated best practices. This should include establishing success metrics, rigorous assessment of ongoing activities, and implementation of new approaches.*

Section V: No Deadlines Pilot

In response to a previous COV (the 2014 Surface Earth Processes (SEP) Section) recommendation that SEP find ways to decrease workloads for NSF staff and PIs while increasing proposal success rates, SEP instituted a No Deadlines pilot in April 2015 for its four core programs (HS, GG, SGP and GLD); IF had taken a similar approach in FY 2012 with apparent success. The one year of data available (FY 2016) to this COV suggests

that the desired effects have been achieved in SEP. Proposal submissions decreased by 39% (SGP) to 55% (HS). We conclude that the intended goals of the No Deadlines pilot were met in the first year, and currently available data suggest that this change has not affected the percentage of proposals that were collaborative, the submission of proposals from different types of institutions, or the proportion of submissions and awards to female, minority, or new PIs. Data from 2011 – 2016 for IF suggest that these patterns may be sustainable over longer periods. In moving forward with the No Deadlines policy, EAR will need to continue to monitor not only workload and PI demographics, as is already being done, but also proposal quality.

> ***Recommendation 19.*** *The COV recommends that EAR move forward with the No Deadlines pilot, but should continue to monitor workload, dwell time, success rate, PI and institutional demographics, and should undertake more in-depth research into any unintended consequences, including impacts on proposal quality or participation by prospective PIs.*

Concluding Remarks

Earth science research is critical to virtually all issues facing our nation in the 21st century: public health, national security, energy and mineral resources, food security, community resilience to natural hazards, economic competitiveness, and environmental stewardship. The United States has long been recognized as the world's leader in earth science research. Its leadership has been based, in large part, on NSF-funded earth science research. More generally, the National Science Foundation has set the global standard for fundamental scientific research—based on its broad support for basic scientific research; its efforts to link research to broader impacts of societally relevant issues; its support for timely, community-driven interdisciplinary strategic research initiatives; and its gold standard for independent peer review.

The COV recognizes that the Earth Sciences Division faces a number of critical challenges that could affect its future. Most pressing is the persistence of flat or declining budgets, which severely limit the potential for supporting excellent research, the career path for young scientists, and proposals from under-represented groups. This situation poses a grave danger for the future of technological and scientific advancement in the United States The NSF has long been one of the foremost agencies in supporting the best science in the world; with diminishing federal support for NSF programs, we are in danger of falling behind other countries and discouraging and disengaging the next generation of scientists.

Although the following statement is outside the limited scope of the COV charge, members of the COV wish to express their strong and clear support for the continuity, integrity and growth of the U.S. earth science effort. We feel that American leadership in global earth science depends on continued support and independence of National Science Foundation's Earth Science Division.

CORE QUESTIONS and REPORT TEMPLATE
for
FY 2017 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to NSF Staff: This document includes the FY 2017 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2017. Specific guidance for NSF staff describing the COV review process is described in the "COV Reviews" section of NSF's Administrative Policies and Procedures which can be obtained at https://inside.nsf.gov/tools/toolsdocuments/Inside%20NSF%20Documents/COV%20Policy%20and%20Procedures%20070915.pdf [1].

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. COV reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations; and (2) program-level technical and managerial matters pertaining to proposal decisions.

The program(s) under review may include several sub-activities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs – a portfolio of activities integrated as a whole – or to provide answers specific to the sub-activities of the program, with the latter requiring more time but providing more detailed information.

The Division or Directorate may add questions relevant to the activities under review. Copies of the report template and the charge to the COV should be provided to OIA prior to forwarding to the COV. In order to provide COV members adequate time to read and consider the COV materials, including proposal jackets, COV members should be given access to the materials in the eJacket COV module approximately four weeks before the scheduled face-to-face meeting of the COV members. Before providing access to jackets, the Conflict of Interest and Confidentiality briefing for COV members should be conducted by webinar, during which, NSF staff should also summarize the scope of the program(s) under review and answer COV questions about the template.

Suggested sources of information for COVs to consider are provided for each item. As indicated, a resource for NSF staff preparing data for COVs is the Enterprise Information System (EIS) –Web COV module, which can be accessed by NSF staff only at http://budg-eis-01/eisportal/default.aspx. In addition, NSF staff preparing for the COV should consider other sources of information, as appropriate for the programs under review.

For programs using section IV (addressing portfolio balance), the program should provide the COV with a statement of the program's portfolio goals and ask specific questions about the program under review. Some suggestions regarding portfolio dimensions are given on the template. These suggestions will not be appropriate for all programs.

Guidance to the COV: The COV report should provide a balanced assessment of NSF's performance in the integrity and efficiency of the ***processes*** related to proposal review. Discussions leading to answers of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. ***COV reports should not contain confidential material or specific information about declined proposals.*** The reports generated by COVs are made available to the public.

We encourage COV members to provide comments to NSF on how to improve in all areas, as well as suggestions for the COV process, format, and questions. For past COV reports, please see http://www.nsf.gov/od/oia/activities/cov/.

[1] This document has three parts: (1) Policy, (2) Procedures, and (3) Roles & Responsibilities.

FY 2017 REPORT TEMPLATE FOR NSF COMMITTEES OF VISITORS (COVs)

The table below should be completed by program staff.

Date of COV: June 19-20, 2017
Program/Cluster/Section: All Division of Earth Sciences Programs
Division: Division of Earth Sciences (EAR)
Directorate: Directorate for Geosciences (GEO)
Number of actions reviewed: 406 proposals **Awards: 145 proposals** **Declinations: 261 proposals** **Other: 0**
Total number of actions within Program/Cluster/Division during period under review: 7,121 total actions, including 5,579 competitive actions (see table on page 1). The 5,579 competitive actions included: **Awards: 1,409** **Declinations: 4,170**
Manner in which reviewed actions were selected: The full list of 5,579 EAR Competitive Actions from FY2014 to FY2016, or FY2013 to 2016 for programs with a longer review, was downloaded from the NSF Enterprise Information System. Non-lead collaborative proposals that were part of a project were removed from consideration because they duplicated documentation of the lead proposal, leaving a pool of 3,979 unique projects during the period. Five percent of the projects for each program were selected using a random number generator in Microsoft Excel. They were evaluated for conflicts with the COV members and replaced by another random selection, as needed. For programs where there were less than 5 projects, the total count was augmented, so that all programs had at least 5 actions included in the pool, and an adequate representation of both awards and declinations. The total number of projects from this random selection was 214 projects. In addition, EAR provided the COV with limited and non-identifying information for one competition from each program. COV members who were not conflicted with a particular program or the competition were able to recommend up to 10 projects (no more than 20% for small competitions) to augment their review with proposals that ranked at the "waterline," had strongly divergent reviews, or had outcomes that might appear inconsistent with the reviewer or panel ratings. NSF checked recommended projects to ensure that there were no conflicts of interest with the COV reviewers, and included those proposals in the COV module. There were an additional 72 actions added, for a total of 286 projects (406 proposals) available to the COV.

COV Membership

	Name	Affiliation
COV Chair:	Pamela Kempton	Kansas State University
COV Members:	Rajendra Bose	Columbia University
	Virginia Burkett	United States Geological Survey (USGS)
	Jaqueline Dixon	University of South Florida
	Steven Driese	Baylor University
	Diana Elder	Northern Arizona University
	Francisco Gomez	University of Missouri-Columbia
	Michael Hamburger	Indiana University
	Bruce Houghton	University of Hawaii
	Guy Hovis	Lafayette College
	Steve Ingebritsen	United States Geological Survey (USGS)
	Patricia Kelley	University of North Carolina Wilmington
	Carla Koretsky	Western Michigan University
	Carolina Lithgow-Bertelloni	University College London
	Tim Melbourne	Central Washington University
	Joshua Roering	University of Oregon
	James Rustad	Department of Energy

MERIT REVIEW CRITERIA

An understanding of NSF's merit review criteria is important in order to answer some of the questions on the template. Reproduced below is the information provided to proposers in the Grant Proposal Guide about the merit review criteria and the principles associated with them. Also included is a description of some examples of broader impacts, provided by the National Science Board

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.

- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These broader impacts may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.

- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities. These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. Both criteria are to be given full consideration during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (GPG Chapter II.C.2.d.(i) contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including GPG Chapter II.C.2.d.(i), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit**: The Intellectual Merit criterion encompasses the potential to advance knowledge; and

- **Broader Impacts**: The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to:
   a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
   b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

3. Examples of Broader Impacts

The National Science Board described some examples of broader impacts of research, beyond the intrinsic importance of advancing knowledge.[2] "These outcomes include (but are not limited to) increased participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education at all levels; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a globally competitive STEM workforce; increased partnerships between academia, industry, and others; increased national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education. These examples of societally relevant outcomes should not be considered either comprehensive or prescriptive. Investigators may include appropriate outcomes not covered by these examples."

[2] NSB-MR-11-22

INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, returns without review, and withdrawals) that were *completed within the past four fiscal years.* Provide comments for *each* program being reviewed and for those questions that are relevant to the program(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Are the review methods (for example, panel, ad hoc, site visits) appropriate? Comments: The COV was impressed with the overall quality, consistency and integrity of the Merit Review Process managed by EAR and values the contributions EAR staff make through their knowledge, expertise and dedication. The system works well primarily due to the excellence and dedication of the staff within EAR. The merit review process employs a combination of ad hoc reviews and panel reviews for single-PI disciplinary, collaborative/multi-institutional, Faculty Early Career Development Program (CAREER) and postdoctoral fellowship proposals. RAPID, EaGER and workshop proposal decisions are typically made by program officers (singly or together) without ad hoc or panel review. CZOs were awarded based on a combination of ad hoc review, panel review, review by multiple program officers and reverse site visits (i.e. where the principal investigator makes a presentation to the review panel) for continuing awards. The COV views the combination of ad hoc and panel reviews as highly effective and recognizes it as the gold standard of merit review. The two types of review provide distinct and complementary information to program officers. Ad hoc reviewers typically provide valuable, discipline-specific advice and/or penetrating technical commentary. Panelists provide in-depth discussion and synthesis of proposal merits within the context of each program. In our view, it is important to maintain the independence of the panel and ad hoc reviews to provide maximum input into decisions.	Yes

For RAPID, EaGER and workshop proposals, which are smaller in cost and scope than most other proposals, the use of program officer review only was viewed as reasonable, although it was suggested that proposals receiving more than $100K receive a higher level of scrutiny (e.g., via the addition of ad hoc reviews, or inclusion of several POs in decision-making) than smaller proposals. Reverse site review for CZO proposals was considered to be appropriate given the broad scope and high level of funding.

In at least two programs, proposals ranked as "not competitive" based only on ad hoc reviews were not always discussed by panelists. Given the large number of submitted proposals, the decision not to spend valuable panel time discussing proposals with low ad hoc rankings was considered to be reasonable. However, we caution that when few ad hoc reviews are received, lack of panel review might be problematic and should be avoided if possible.

EAR program officers strive to receive at least three ad hoc reviews in addition to panel review for the majority of proposals. The mean number of reviews received across EAR was: 4.65 (2014), 4.8 (2015) and 4.71 (2016), which indicates that most proposals do receive at least three reviews. However in some cases, two or fewer ad hoc reviews were received, so additional reviews were instead submitted by panelists. This was viewed by the COV as potentially problematic, because in such cases the panel review has no independent check from ad hoc reviewers, potentially resulting in review by individuals lacking sufficient expertise on the topic of the proposal.

Nearly all members of the COV found the ad hoc review response rate to be disappointingly low and problematic. Some members of the COV also noted that inviting more reviews does not necessarily ensure an increase in the number of reviews received. In one instance 13 reviews were requested, yielding only three ad hoc reviews. We encourage EAR to promote alternative reviewer management technologies that allow reviewers to accept or decline review requests quickly and recommend alternate reviewers as one mechanism for improving the response rate. Such technologies may also enable EAR to monitor the proportion of invitations and responses (for ad hoc and panel reviews) from women, under-represented minorities, early career scientists and scientists from different institution types to broaden participation (see Section II). We note that previous COVs have made similar recommendations to address reviewer response rates, but the problem persists. The COV strongly encourages EAR to make progress in this area.

COV members observed that on-site panel meetings are far more effective in promoting discussions and facilitating panel consensus than virtual panels. We also note that the on-site panel process is particularly critical for interdisciplinary programs, given the inherent challenge of achieving consensus among multiple scientists with different disciplinary expertise. We encourage the continued use of on-site panels. Our view is based on the experience of COV members who have served as program officers for other programs and on numerous panels that have been conducted virtually, including panels for other federal agencies. We do, however, support the continued use of distance participation in on-site panels for those panelists who are unable to travel due to personal issues.

We also suggest that attention be paid to the proportion of invitations and accepted requests for ad hoc and panel review from women, underrepresented minorities, early

career scientists and scientists from different institution types to ensure that the full breadth of community knowledge is being included in the merit review process. We did not have statistical data to address this question. Overall, the COV commends the Division staff for their efforts to ensure excellence in the merit review process. ***Recommendation 1.*** *The COV views the combination of ad hoc and panel reviews to be highly effective, and recognizes it as the "gold standard" of merit review undertaken so expertly by EAR staff. While we acknowledge the value of including alternative mechanisms for merit review within their portfolio of delivery mechanisms (e.g. virtual panels, panel review only, etc.), we strongly encourage EAR to continue the use of the ad hoc peer review coupled with on-site panels as the principal merit review process.* ***Recommendation 2.*** *The COV was disappointed with the chronically low response rate of ad hoc reviews, despite tremendous effort on the part of EAR staff to solicit reviews. We encourage EAR to promote alternative reviewer management technologies that allow reviewers to accept or decline review requests quickly and to recommend alternate reviewers as one mechanism for improving the response rate. Such technologies may also enable EAR to more efficiently monitor the proportion of invitations and responses for ad hoc and panel reviews from women, under-represented minorities, early career scientists and scientists from different institution types to broaden reviewer participation (see Recommendations 16, 17 and 18)*	
2. Are both merit review criteria addressed a) In individual reviews? Ad hoc reviews range widely in quality and in the degree to which both merit review criteria are addressed. Nearly all individual reviewers included at least some comment on both merit criteria. However, many COV members noted that much more attention was typically given to the IM criteria than to the BI criteria. Also, where appropriate, individual reviewers did not consistently address solicitation-specific criteria. b) In panel summaries? Nearly all panel summaries address both merit review criteria. However, panel summaries were typically much more focused on and more detailed with respect to the IM criteria, with less attention given to the BI criteria. Proposal strengths and weaknesses, for example, were primarily articulated for IM criteria. For some programs COV members found that panel summaries were often able to fill in gaps from ad hoc reviews due to the impressive disciplinary breadth of the panelists, and that this formed a critical contribution to those programs' merit review process. c) In Program Officer review analyses? For most of the programs assessed by the COV, program officer review analyses addressed both merit review criteria. However, not all program officer review analyses directly, clearly and separately addressed the two merit review criteria.	IM – Yes BI – not always IM – Yes BI – not always Mostly Yes

Recommendation 3. *The COV was pleased to learn of the initiatives already underway to improve community understanding and appreciation of the BI criterion (e.g., the pilot educational webinar training for reviewers and panel members). We encourage EAR to continue its efforts to improve community understanding and assessment of Broader Impacts. We recommend that EAR consider adding a checklist directly on the ad hoc reviewer and panelist review forms to encourage more thorough responses from reviewers.* ***Recommendation 4.*** *We recommend that Program Officers use their PO Comments to signal the importance of Broader Impacts to the EAR community in feedback.*	
3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals? Comments: Although there is clearly variation in the quantity of substantive feedback, the majority of reviewers take the merit review process seriously and offer at least some substantive comments. Some reviewers offer exceptionally thoughtful and thorough reviews. Other reviews are perfunctory, brief or offer somewhat broad or vague criticisms. In rare cases, reviewers mostly provide an endorsement of the PI(s) rather than carefully assessing the specific proposal. POs watch carefully for such reviews, and as documented in review analyses, give them much less weight than more substantive evaluations. Nearly all COV members reported that there were far more instances of detailed and substantive comments provided with respect to IM as compared to broader impact merit review criteria. In many instances, reviewers provide insubstantial, vague or incomplete comments with respect to the BI criterion. Also, for special programs, ad hoc reviewers did not always address additional review criteria separately, although assessments of these criteria were sometimes embedded within comments for IM and BI. For interdisciplinary proposals and programs, reviewers often commented on their lack of ability to assess specific components of the project, which is probably difficult to avoid in assessments of highly interdisciplinary work. Because of this, the reviewer pools were sometimes unrepresentative for interdisciplinary projects and, when present, the specific disciplinary input provided by reviewers was subject to small sample sizes. This sometimes led to disparate panel and ad hoc reviewer opinions. These divergent views can be healthy from the standpoint of evoking scientific debate, but it does raise potentially troubling issues for big-budget, multi-PI projects if proposals do not receive significant feedback on one of the major components of the project. In these cases, the panel consensus (or rating) appears to hold sway, which is likely appropriate given that the panels assembled appeared to be intellectually diverse and quite strong overall. Overall, sufficient information is typically present in ad hoc reviews to provide informed advice to the panel members and program officer for an award/decline decision to be made with confidence with respect to the proposal merits.	Yes

4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)? Comments: In most cases, panel summaries were consistently and clearly written, including a brief description of strengths and weaknesses discussed by the panel. The rationale for the panel consensus was usually well articulated (although with some exceptions) and gave the PI a clear view of why the proposal was deemed competitive, not competitive or highly competitive. A few areas of inconsistency with potential for improvement were identified: • The panel summary recommendation and scores were not always clear in the documentation provided to PIs, particularly in cases where the panel input diverged from the ad hoc reviews. Where proposals were discussed by two different panels from separate EAR programs, summaries from some programs were consistently more substantive than those from another. • Some panel summaries did not explicitly state how the BI criterion figured into the panel recommendation. • Some panel summaries were too brief, and could have provided a better synthesis of reviews (e.g., explaining how outlier reviews were considered by the panel). Clearer guidance to PIs for improvement that would facilitate future submissions would be helpful, especially for new PIs. • Some panel summaries did not include a summary statement, making it difficult to determine the final outcome of the panel discussion. *Recommendation 7 below relates to our feedback on this question.*	Mostly Yes
5. Does the documentation in the jacket provide the rationale for the award/decline decision? [Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.] Comments: In most cases the documentation in the jackets is very well written and provides sufficient rationale for the award/decline decision. Typically included are a summary of the proposed research, ad hoc reviews, panel review, program comments and an award/decline recommendation by the PO. Program Officer review analyses are typically thorough and explain the rationale for award/decline decisions based on merit review criteria, ad hoc and panel consideration of merit review criteria and, to a lesser extent, programmatic perspectives. The case for or against funding is usually presented in clear, functional language that explains how a decision has been reached, often on very pragmatic grounds or utilizing wider considerations than IM or BI alone, such as portfolio balance. A few areas for improvement were noted.	Yes

• In a few cases, the summary provided to the PI was less informative than the Review Analysis, and the context statement was of limited value. • Information on relative ranking of proposals was not always provided. • Several cases were noted where the PO's decision diverged from the panel and/or ad hoc review. In most cases, but not all, the review analysis clearly explained the PO decision. ***Recommendation 5.*** *The COV recognizes the important role EAR staff play in maintaining portfolio balance (see Section IV). However, the rationale for funding decisions should be clearly documented in the Review Analysis, particularly in those rare cases where disparity exists between ad hoc and panel reviews or where projects are elevated or demoted significantly relative to the panel ranking.* ***Recommendation 6.*** *The COV recommends that EAR provide a consistent summary of panel activity in the Review Analysis across all programs. This includes essential information such as the number of panelists, where they convened, who led which aspects of the review, and a generalized statement of each proposal's relative ranking in the panel's assessment.*	
6. Does the documentation to the PI provide the rationale for the award/decline decision? [Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.] Comments: Documentation of the award/decline decision provided to the PI ranges from excellent to adequate. Typically, such documentation includes the ad hoc and panel reviews plus comments by the Program Officer. In addition to providing the rationale for award/decline decisions, this feedback typically includes specific advice for PIs to use in either revision for resubmission or execution of the proposed activities. The context statements are important but of inconsistent quality across the various programs (see *Recommendation 5*). Presumably due to the very high workload, PO comments were typically brief, and did not always clearly and separately address the two merit review criteria. The COV appreciates the dilemma the heavy workload creates for POs in trying to provide sufficient rationale for the funding decision. However, we discourage POs from using boilerplate text, which is not very helpful to PIs. Providing additional recommendations, or pointing out the most significant one or two weaknesses from the PO's perspective would be beneficial to the applicant in case the proposal is revised and resubmitted. ***Recommendation 7.*** *Clear communication to the PIs, including strengths and weaknesses of proposals with respect to both IM and BI, is essential, especially for new investigators and declined proposals. We recommend that EAR provide consistent feedback to PIs with respect to merit criteria across all programs in panel summaries,*	Mostly Yes

PO comments and context statements, including general indications of relative proposal rankings.	
7. Additional comments on the quality and effectiveness of the program's use of merit review process: The COV commends EAR and its staff on the quality and effectiveness of the merit review process, which overall is exemplary. Issues such as low response rate from reviewers, or the return of reviews that are perfunctory or vague, are outside the control of program officers. Yet even with these challenges, the POs do an excellent job of selecting highly qualified panelists and combining the ad hoc mail reviews with panel review. Award/decline decisions are made with great care, based on the agency's mission and goals and POs have been outstanding stewards of NSF funds.	

II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

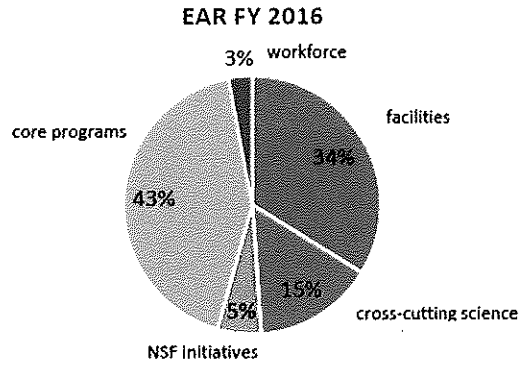
SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: For each proposal, program officers use a systematic and comprehensive process that draws on many resources to identify ad hoc reviewers with appropriate expertise and/or qualifications. The Division drew input from a variety of institutional types, including Tier 1 research universities, PhD and masters-granting universities, 4-yr and 2-yr undergraduate colleges and universities and governmental agencies. In selecting reviewers, POs target a cross-section of researchers in terms of career level, gender, ethnicity and expertise. Male and female reviewers were represented in proportion to the typical gender breakdown found in most earth science departments or research agencies. However, the rate of review response was surprisingly low (<50%), which often necessitated heroic efforts on the part of POs to preserve the integrity of the merit review process. Few review requests (estimated <10%) were sent to researchers at international institutions and the return rate for these tended to be lower than for US reviewers. Reviews were solicited from reviewers with appropriate expertise in almost all cases, although reviews for cross-cutting programs (such as IES or CZO) often included caveats as to the reviewer's professional experience or comfort level with portions of the proposal. Familiarity with the merit review process was generally strong, although a few reviewers admitted to not understanding all elements of the proposals that they were reviewing. For several proposals examined by the COV, fewer than three ad hoc reviews were received, so panelists were enlisted to generate reviews. In rare situations, the expertise of these panelist reviewers was not closely aligned with the proposal content, although the integrity and quality of the review process did not appear to be diminished. *Recommendation 2 above relates to our feedback on this question.*	Yes
2. Did the program recognize and resolve conflicts of interest when appropriate? Comments: Prior to participation in an ad hoc review or panel, reviewers and panelists are appropriately informed about NSF Conflict of Interest (COI) policy. For most proposals,	Yes

no conflicts were noted, but when COIs emerged appropriate resolution was effected. Importantly, efforts to avoid COIs do not appear to impart a burden on reviewers and panelists nor compromise the comprehensive nature of the review process. In a few cases, the program (POs, Panels) identified reviewers who had a COI due to institutional affiliation, undetected overlaps in submitted proposals, or relationships to institution where they had earned degrees. In these cases, those reviews were discounted to eliminate potential COI concerns. Likewise, panelists recused themselves from panel discussion and decision-making when COIs were present by stepping out of the room, or by leaving virtual panels. In summary, EAR staff are very sensitive to COIs and effectively operate to minimize potential issues.	
3. Additional comments on review selection: For cross-cutting programs, attention to reviewer selection and response rate is critical in order to assure appropriate input for projects that span diverse disciplines. In many programs, the rate of review response was less than 50%, which is concerning and creates challenges for POs. The NSF may wish to explore whether an incentive process could improve these statistics. For example, many journals and professional societies now publicize (and gratefully acknowledge) "outstanding" or "excellent" peer-reviewers. One approach could be sending the reviewer's home institution an NSF notification indicating that the faculty member/employee has participated in NSF peer-review, either as an ad hoc reviewer or a panelist. More generally, the electronic review system available to POs for tracking reviewers and responses should be updated, perhaps akin to current journal systems. Under such a system the PO could be immediately notified regarding the status of review invitations. Such a system could improve the efficiency and success of the review process. If reviewer return rates continue to deteriorate, NSF may want to consider implementing a return-rate tracking system by which potential reviewers could be informed of their relative participation in the NSF ad hoc peer-review process relative to their peers. ***Recommendation 8.*** *The COV was disappointed by the low response to requests for review from the earth science community, as this creates excess workload for POs and for responsive reviewers and potentially risks the quality of merit review. We encourage EAR to explore innovative means to incentivize the community to respond to requests.*	

III. Questions concerning the management of the program under review. Please comment on the following:

MANAGEMENT OF THE PROGRAM UNDER REVIEW	**APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE**
1. Management of the program. Comments: The COV is impressed with the ability of the EAR Division to successfully manage a complex and dynamic array of research programs with efficiency and fairness. The merit review process is exemplary and the quality of the funded projects is outstanding (see *Recommendation 1*). EAR as a whole has a clear framework in place for guiding program officers (POs) in managing solicitations, merit review, budget and portfolio, and post-award actions. Award criteria other than merit review have been used appropriately, including participation of new/early career PIs, current funding levels of PIs, numbers of PIs from underrepresented groups, balance among subdisciplines, potential for co-funding and risk/return potential. The communication with investigators is very responsive and flexible to adjust to changing conditions, when needed. Given persistent uncertainty in the timing and amount of funding, programs have performed admirably and with flexibility, and the COV commends EAR staff for the excellent management of their programs. The change to "no deadlines" has been thoughtfully rolled out by SEP and should continue to be carefully assessed. Early indications suggest that this change will result in long-term positive impacts with respect to PO and reviewer workload as well as increased funding success rates (see Section V of this report for more complete discussion on this point). However, the COV is concerned about the sustainability of this excellent work, given the apparent workload demands relative to other Divisions in GEO. NSF-provided data for EAR as a whole (Figure 1) suggest a low-overhead organization that attempts to balance investment in core programs, facilities, cross-cutting science and new initiatives. As such, the COV emphasizes the need for increased personnel and fiscal resources to help sustain the important contributions of EAR staff.	Appropriate

Figure 1 – Allocation of EAR resources in FY 2016.



Indications are that the Division will continue to face a number of critical management challenges. Most pressing are flat or potentially declining budgets, which severely limit the potential for supporting excellent research and PIs. This situation poses a grave danger for the future of technological and scientific advancement in the U.S. The NSF has long been one of the foremost agencies in supporting the best science in the world; with diminishing federal support for NSF programs, we are in danger of falling behind other countries and discouraging and disengaging the next generation of scientists.

EAR programs are already very competitive, and many excellent projects cannot be funded. In an anticipated level-to-declining budget environment, it may be impossible to maintain support of core programs while also launching new initiatives. NSF management will be challenged to prioritize. Indeed, difficult decisions are already being made with respect to the amount of funding directed toward special programs as compared to infrastructure and core disciplinary programs (see response to Question 2 below). The current balance of funding seems appropriate; however, the COV noted the significant increase in the proportion of EAR's budget devoted to infrastructure between FY2003 and FY2010. The COV recommends that EAR be strategic in determining the appropriate balance of future funding for infrastructure relative to other areas of investment. Processes should be put in place for identifying major investments that will eventually need to be sunset, and the timelines for doing this, so that both EAR and the community can plan well in advance for these changes. Continued funding to support CAREER, graduate fellows and postdoctoral fellows is also critical to ensure a pipeline of outstanding early career scientists.

Recommendation 9. *The COV commends EAR staff for the excellent management of their programs, particularly through periods of resource challenges. The COV is concerned about the sustainability of this excellent work, given the workload demands relative to other NSF programs. The COV emphasizes the need for increased personnel and fiscal resources to help sustain the important contributions of EAR staff.*

Recommendation 10. *The COV noted the significant increase in the proportion of EAR's budget devoted to infrastructure between FY2003 and FY2010 as EAR took over operations following NSF's investment in EarthScope facilities. The COV recommends that EAR be strategic in determining the appropriate balance of future funding for infrastructure relative to other areas of investment. Processes should be put in place for identifying major investments that may eventually need to be sunset, and the*

timelines for doing this to make way for new commitments, so that both EAR and the community can plan well in advance for these changes.	
2. Responsiveness of the program to emerging research and education opportunities. Comments: Programs within EAR respond effectively to emerging scientific opportunities and community needs, as represented in the proposals received. POs are aware of and reactive to new research trends in the field, which is important because timely new initiatives are essential to the furtherance of science. For example, EAR has participated in or initiated the following programs: *Earthscope*, to perform geophysical imaging at unprecedented scale and resolution; *CZO*, to explore the connection between shallow subsurface processes and the biosphere; *Frontiers in Earth Systems Dynamics*, to promote high-risk interdisciplinary science that transcends program boundaries; *Hazards SEES* and *PREEVENTS* to understand, model and forecast natural hazards and extreme events; and *Earth-Life Transitions* and *Earthcube*, to organize and make accessible the avalanche of relevant "big data." EAR programs continue to fund a significant number of EaGER, RAPID and workshop awards and topical reviews. POs must continue to identify and support such activities. EAR has also developed synergistic international partnerships via memoranda with the United Kingdom, Israel, and Taiwan during the review period, and we encourage continuation and expansion of international scientific partnerships. The COV recognizes that there are no filters or letters-of-intent used to screen proposals in most of the core EAR programs and, as such, the programs can only make their selections for support from those opportunities (proposals) that are presented to them by PIs, i.e., of necessity, core programs are largely responsive and ad hoc. This is particularly true for educational opportunities. The processes and mechanisms for decision-making at the Division level were less clear to COV members, including the development of new initiatives (see Section IV). There will be perpetual and appropriate tension between new strategic initiatives and core programs, and between long-term commitment to facilities (including field sites) and more flexible funding. In the recent past the latter issue is exemplified by the long (and ultimately useful) debates over the Deep Underground Science and Engineering Laboratory (*DUSEL)*, proposed Consortium of Universities for the Advancement of Hydrological Sciences, Inc. (*CUAHSI)* field sites, and the *CZO* network. The COV would like to see EAR articulate more clearly the mechanism(s) used for developing strategic initiatives, being clearer about which are driven top-down in response to stated national priorities (responding to known societal needs) and which are driven bottom-up by specific science communities. In addition, EAR is encouraged to seek greater input from the user community in its strategic planning and decision-making. See Section IV for further discussion of this recommendation. ***Recommendation 11.*** *We recommend that EAR develop a clearer way of articulating to the community the mechanism(s) used for developing strategic initiatives, clarifying which are driven top-down in response to stated national priorities (responding to*	Appropriate

known societal needs) and which are bottom-up, driven by specific science communities.	
3. Program planning and prioritization process (internal and external) that guided the development of the portfolio. Comments: EAR seeks advice and guidance from diverse sources, internal and external; this COV is one example. The materials made available to the COV include links to about 20 external advisory reports. Such reports include: • *New Research Opportunities in the Earth Sciences*, National Research Council 2012 (EAR commissioned) • *Dynamic Earth: GEO Imperatives and Frontiers 2015-2020*, 2014 (AC GEO Report) • *It's about Time: Opportunities and Challenges for U.S. Geochronology*, 2015 (EAR funded) • *Future Geophysical Facilities Required to Address Grand Challenges in the Earth Sciences*, 2015 (EAR funded) • *Status of the Geoscience Workforce*, AGI 2014 and 2016 • *ERUPT: Volcanic Eruptions, and Their Repose, Unrest, Precursors, and Timing*, NAS 2017 (EAR funded) Important planning elements include workshop reports describing and advocating for scientific investment in particular topical areas. Inclusion of rotational managers in the NSF ranks greatly enhances communication and understanding among NSF, its academic constituency and other federal agencies, and provides continuous fresh perspectives to EAR management. However, the processes by which decisions are made on priorities and balance at the Division level were less clear to the COV (see Section IV). Internally, the Science Leadership Committee (SLC) is responsible for organizing division science retreats, in alternate years, to identify innovative and/or exciting emerging science directions and the best methods by which EAR can encourage that science. Some important changes, such as the decision to allow laboratory technicians to be funded via IF, have resulted from these internal planning and prioritization processes. However, the advisory structure for the SLC is unclear, and the COV suggests that EAR consider more formal mechanisms for including community advice to this group (e.g., see Section IV, *Recommendation 14*). At the program level, EAR program officers are encouraged to consider a range of factors when developing their portfolio, including new or early career PI status, co-funding, geographic distribution, institutional type, under-represented group or gender balance, and current PI funding level. The COV wonders, however, whether programs could show more clearly the linkages between special solicitations and core discipline Request for Proposals (RFP)s in discussions of portfolio planning. As currently presented, all the special programs are listed separately from the core	Appropriate

programs, but each also contributes to and is supported by one or more of the core programs. Overall, we commend EAR staff for their flexibility, nimbleness, professionalism and hard work. The funding culture at NSF is envied by researchers in other countries.	
4. Responsiveness of program to previous COV comments and recommendations. Comments: Note: We were charged with evaluating 16 programs. In drafting an answer to this question, we relied mainly on the 2014 EAR/SEP (Surface Earth Processes) and EAR/DEP COV (Deep Earth Processes) reports and responses and also, to a lesser extent, on the 2013 Education and Diversity and IF COV reports and responses. The 2017 COV team was impressed with the level of detail in previous COV comments, and by the seriousness and commitment with which NSF responded to those recommendations. Significant changes have taken place in response to previous COV recommendations. However, we also recognized persistent issues that have been raised by previous COVs and have yet to be satisfactorily resolved. Several of these merit continued attention. *Clarify expectations for Broader Impacts.* This issue is oft-cited and important, and progress has been slow. In the NSF description of Merit Review Criteria, Intellectual Merit and Broader Impacts are given co-equal status. Yet, proposals with indications of strong IM and mediocre BI may be funded, while the converse is not true. Furthermore, (1) nearly all proposals devote >90% of their allotted space to IM and (2) reviewers seldom address the actual listed criteria for BI evaluation. Broader-impact outcomes also tend to be less well-documented than technical outcomes (refereed publications, databases and open-source models). Expectations for the BI element should be clarified and communicated throughout the community. Highlighting positive BI outcomes might prompt a virtuous cycle, by which better understanding leads to improved BI representation in proposals and improved BI evaluation by reviewers. (See *Recommendations 3 and 12.*) *Improve the ad hoc reviewing system* such that reviewers can quickly accept/reject reviews and recommend alternate reviewers. This was a specific recommendation of the 2014 EAR/SEP COV that has not yet been implemented, although such systems are currently in place for many, if not most, peer-reviewed journals. The reviewer acceptance rate remains low despite the workload-reducing effect of the no-deadline policy. Such a response rate effectively burdens the subset of the community who do tend to accept review requests, and the COV expressed concerns whether this may bias outcomes in any way. To address this issue it may be helpful for EAR to investigate whether there are any correlations between review-acceptance rates and gender, career stage or PI funding success rates. (See *Recommendations 2 and 8.*) *Continued attention to diversity.* This is a community-wide issue and while NSF can nurture scientists from under-represented groups, it cannot create them. This progress depends on K-12 and university educators, employers and the broader	Appropriate

scientific community and public. We believe that EAR Program Officers have been sincere in their efforts to diversify and broaden participation. We note for instance that in the *Update to the Response to the 2013 Committee of Visitors Report: Geosciences Education and Diversity (GEO E&D) Programs* dated October 12, 2016, the Directorate for Geosciences responded to the 2013 GEO E&D COV in part by establishing the Geoscience Opportunities for Leadership in Diversity (GOLD) program, which aligns with and supports the goals of NSF's INCLUDES program to promote broader participation across STEM, and by beginning coordinated discussions with HBCU faculty about how best to be intellectually engaged in geoscience education and research. GEO continues to collaborate with EHR's Tribal College Undergraduate Program (TCUP) through the Pathways to Geoscience (PAGE) track of TCUP. Further, in the *2016 UPDATED RESPONSE TO SPECIFIC COMMENTS IN THE COV REPORT: May 29-31, 2013*, the IF program indicated that an NSF-wide analysis of minority success rates was underway, in response to the recommendation that "Funding of proposals from minority PIs may be an issue for further investigation." We support these directions and encourage EAR to continue to participate in these efforts, but note that they have not yet resulted in any substantial change in participation rates. (See *Recommendation 18.*) ***Recommendation 12.*** *We commend EAR for their responsiveness to previous COVs and recommend they continue current progress with issues such as Broader Impacts and improvements to the ad hoc review software system.*	

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity? Comments: The range and scope of EAR-funded awards is impressive. There is a broad mix of grants covering the full range of EAR's disciplinary activities, as well as a balance of research- and education-oriented projects. Decision-making processes affecting portfolio balance within individual programs are clear and include balance among program subdisciplines, consideration of geographic distribution of institutions, institution type, early career PIs, gender balance of PIs, participation by under-represented groups, and availability of co-funding. We find that the Program Officers do an excellent job in this regard. Their dedication and integrity, in addition to knowledge and expertise, are crucial to the success of the Division and the PIs it supports, and make possible a nuanced balancing of portfolios within individual programs that would not be possible without their expertise. Some POs are also very responsive to the community and proactive about encouraging development of strategic workshops and documents to move the scientific community forward. However, it was unclear to COV members as to how (inter)-disciplinary areas that are funded across several programs are coordinated and facilitated. The processes by which decisions are made regarding strategic priorities and balance of funding at the Division level were also less clear to the COV than those at program level. A significant control on portfolio balance within EAR as a whole is the allocation of funding between programs, but information on how these decisions are reached, or funding adjusted in response to changing strategic drivers, was not clear. Similarly, reports were not specific about how EAR engages in development of and investment in strategic initiatives in response to national priorities. How do strategic initiatives (e.g. "special programs" and "big ideas") arise? Do they emerge in a top-down fashion through EAR/NSF actions, or do they arise from the earth science community (bottom-up)? Individuals within the COV suspect from experience that it is a combination of these mechanisms, depending on discipline, but what is the balance within EAR as a whole? EAR needs to be clearer about its strategic vision at all levels, from individual programs to EAR-wide planning, and to become more transparent in terms of how decisions on investing in strategic initiatives are made.	Mostly Appropriate

The COV also sees a need for EAR to explore ways to more effectively disseminate discovery and innovation in a timely fashion to better communicate and promote the exciting science supported to the various stakeholder communities. ***Recommendation 13.*** *We recommend that EAR increases transparency to stakeholder communities regarding the processes by which the priorities and balance of funding of individual programs are determined. A variety of factors, including perceived trends in science, proposal pressure, and collective opinion are presumably at work, but long-term EAR strategic planning should be driven by a transparent process at the Division level.* ***Recommendation 14.*** *The COV recommends that EAR as a whole (in addition to individual programs) engage in long-term strategic planning based, in part, on formal mechanisms to ensure broader community input.* ***Recommendation 15.*** *EAR is currently limited by the mechanisms available to rapidly disseminate discoveries and innovation to PIs and the broader public. The COV encourages EAR to work with partners in GEO and elsewhere within NSF to explore ways to more effectively disseminate discovery and innovation in a timely fashion.*	
2. Are awards appropriate in size and duration for the scope of the projects? Comments: In general, we find the duration of awards to be appropriate and commensurate with the research proposed and the costs of doing research in the geosciences. Award duration is variable across programs, e.g. CAREER grants are 5 years, workshops and exploratory grants usually <1 year, with most other awards averaging ~3 years. Award duration appears to have decreased from ca. 3.3 years in 2011 to 2.5 years in 2016, although this apparent decrease may reflect the inclusion of no-cost extensions to awards in data provided for earlier years. The Division appears to have an acceptable balance between small-scale and large-scale funding initiatives, continuing to find support for small, exploratory projects, as well as larger capital-intensive initiatives: award sizes range from $7,000 (or less) to $14M, with a median value of $200,000. The data provided to the COV suggest that median award size has increased from $150,000 in 2008 to $200,000 in 2016, with a big jump between 2008 and 2009 (i.e. increasing from ~$150,000 to ca. $185,000) due to the stimulus package. However, we note that while the increase in award size since 2009 may have kept up with inflation, it is the view of COV members that it likely has not kept pace with the cost of conducting scientific research. We commend individual programs for seeking novel ways to increase funding by partnering with other NSF units (e.g., Directorate for Computer and Information Science and Engineering (CISE)/Division of Advanced Cyberinfrastrucuture Cyberinfrastructure Framework for 21st Century Science and Engineering Venture Fund for Software Reuse; CISE Datanet) and programs (e.g., Established Program to	Appropriate

Stimulate Competitive Research (EPSCoR), Office of International Science and Engineering, Office of Integrative Activities) (see response to Question 5 below).	
3. Does the program portfolio include awards for projects that are innovative or potentially transformative? Comments: The answer is unequivocally yes for the vast majority of EAR programs. Although tight budgets can discourage the funding of high risk, potentially transformative science, ad hoc reviewers and panel members are advised that this is a key part of the review criteria, and innovation appears to be given significant value in the review and ranking process. For individual programs, COV members noted that panels commonly awarded a proposal a higher ranking than ad hoc peer reviewers if they found it to have the potential to be transformative. The use of RAPID and EaGER awards offers opportunities for innovative and opportunistic research projects, funded using streamlined decision-making processes where this is necessary and warranted. The COV noted that some programs make greater use of RAPIDs than others, although this appears to be primarily driven by an inherent need to respond to natural or time-limited events in some disciplines; the COV deems this as wholly appropriate. Although it is difficult to judge the impact of such awards, the COV is pleased to see that EAR reserves a place for them in the funding landscape. The range of workshops supported during the COV review period is not only impressive in the rich variety of scientific, education and other topics covered, but essential for fostering new collaborative relationships within the scientific community.	Appropriate
4. Does the program portfolio include inter- and multi-disciplinary projects? Comments: The answer is unequivocally yes. There are a number of interdisciplinary initiatives, particularly among the special programs/solicitations, that are designed to encourage multi-disciplinary, multi-institutional and inter-disciplinary projects. A clear indication of the importance NSF affixes to this is the range of co-funding to and from other EAR Divisions and NSF Directorates. Most awards in these categories include PIs with complementary expertise in different sub-disciplines of EAR. We note from the report that initiatives involving partnerships between EAR and other Divisions within GEO (e.g., Divisions of Atmospheric and Geospace Sciences, Ocean Sciences and Polar Programs) are less common, although there have certainly been some in the past. Less common still is cross-funding with other Directorates within NSF such as the Biological Sciences, Engineering, Mathematical and Physical Sciences, and Social, Behavioral, and Economic Sciences, etc.	Appropriate
5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators? Comments:	Appropriate

Based on information provided to the COV, it is clear that the geographic distribution of awards is not even across all states, but it does reflect proposal pressures (states with the highest submission rates, population, proportion of research-intensive institutions, etc.). Most awards are concentrated in seven states, commensurate with the greater population and/or density of research-intensive universities in these states. The COV commends EAR for its strong participation in the EPSCoR Program, which enhances the geographic distribution of EAR awards. The COV was informed that last year EAR submitted about 75% of the total EPSCoR requests from GEO, with 68% of the EPSCoR requests in FY17 being successful. We understand that awards must be governed by the quality of each proposal according to the two principal review criteria, rather than by a specific desire to gain geographical balance. Nonetheless, there may be room to expand present efforts to increase the geographic distribution of proposal submissions. In particular, we would suggest that EAR staff continue their outreach efforts with webinars and other tools in states with lower rates of proposal submission. ***Recommendation 16.*** *The geographic distribution of awards seems to map well onto proposal pressure, state populations and research-intensive institutions. At the same time, we recognize the need to further broaden participation in fundamental research, and recommend that EAR continue their efforts to broaden outreach to states with low proposal success rates and, especially, numbers of submissions.*	
6. Does the program portfolio have an appropriate balance of awards to different types of institutions? Comments: The majority of awards during the review period were made to research-intensive, PhD-granting institutions, with few awards made to other institution types, reflecting the larger number of proposals originating from research-intensive institutions. We speculate that the distribution of submissions and awards may also reflect the distribution of research laboratories, graduate education programs, and the relative size of geoscience departments. Nonetheless, in 2016, only 36% of awards were made to institutions that are not among the "Top 100 Research Intensive PhD Institutions." EAR should encourage research-intensive institutions to explore increased collaboration, on both research and educational initiatives, with more teaching-oriented institutions, particularly those serving large under-represented communities. Perhaps a research collaboration program similar to the Research Experiences for Undergraduates (REU) program could be developed to provide incentives for intercollegiate collaboration between institutions with differing missions. Research for Undergraduate Institutions awards are effective means to integrate excellent research and education. The committee would like to see more submissions from, and awards to, smaller institutions, while understanding that ultimately it is the quality of the proposal that must determine whether or not it is awarded funding, rather than the institution type.	Mostly Appropriate

Recommendation 17. *The COV recommends that EAR enhances outreach efforts to under-represented institutions to increase submissions from more diverse institution types. We anticipate that this will have the added benefit of diversifying the pipeline and participation of diverse students and early career researchers in EAR.*	
7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators? NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within seven years of receiving his or her last degree at the time of the award. Comments: Yes, there appears to be a reasonable balance of awards to early-career investigators in EAR programs. In 2016, early-career investigators accounted for approximately 25% of the submissions and about 18% of the awards. The COV was not provided with information on how many early-career investigators resubmit after a decline, or how many attempts are needed before an early-career investigator is funded for the first time, but this could be helpful information for EAR to compile for future COVs, if possible. As funding becomes tighter, additional efforts, and perhaps earmarking, may be needed to ensure appropriate representation of early-career awardees. It was not clear what strategies EAR has in place to encourage proposal submission by early-career investigators. For future COVs it could be useful to see career-stage data program-by-program to assess trends in early-career and mid-career representation among awarded PIs.	Appropriate
8. Does the program portfolio include projects that integrate research and education? Comments: Yes, based on the data provided by EAR, proposals integrating research and education are well represented. It would be useful to see the data broken down program-by-program. According to the Portfolio Report provided to the COV, the REU program has a 30% success rate. It would be useful to learn how many of the awards that integrate educational activities are conducting requisite assessment. Educational activities fall under the BI criterion, which is not well developed in many proposals. One COV review team noted that nearly all proposals devote >90% of the project description to IM, that reviewers do not appear to be entirely comfortable with reviewing the BI criterion, and that BI outcomes are often not well-documented. The COV suggests that NSF continue to provide PIs with guidance regarding more effective integration of research and education and	Mostly Appropriate

explore methods to more effectively communicate expectations for BI to the EAR community. (See Section I, Question 2, *Recommendations 3 and 4.*)	
9. Does the program portfolio have appropriate participation of underrepresented groups[3]? Comments: The demographics in the field remain mostly white and male, although it is apparent that the PIs, reviewers, panels and program officers are paying particular attention to the need to increase the participation of underrepresented groups. The number of awards to PIs from underrepresented groups is appropriate relative to the submissions, but the number of submissions is a cause for concern. It would be useful to see demographic data broken down by program, as some programs may be making greater gains in this regard than other programs. There does not appear to be guidance for PIs regarding effective methods for increasing broader participation or a concerted effort by EAR to disseminate best practices for increasing the number of PIs from underrepresented groups. Such guidance would be useful because proposers often appear to offer only "lip service" to broadening participation. It appears that we continue to do the same thing and hope for different results. Some ideas include providing training regarding issues of bias, stereotype threat, imposter syndrome, etc. and how to counter such problems via workshops at major conferences, young investigator conferences and through modules that could be made available to PIs. Efforts to broaden participation need to begin early in the pipeline. For example, the Earth Science Women's Network (ESWN) was introduced as a model that might be used to help build a more diverse community. Gains were noted in the proportion of women awardees and PIs from underrepresented groups. The COV commends EAR for piloting implicit bias training for all panelists. We recommend offering this to all PIs as well. ***Recommendation 18.*** *We recommend EAR continue and expand their efforts to broaden participation of under-represented groups based on demonstrated best practices. This should include establishing success metrics, rigorous assessment of ongoing activities, and implementation of new approaches.*	Not Appropriate
10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports. Comments:	Appropriate

[3] NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

EAR supports societally relevant research aimed at better understanding critical issues including water, soil and energy resources, biogeochemical cycles, natural hazards, sustainable development and climate change

The GI program is an example of an effort that directly supports earlier Office of Science and Technology Policy initiatives, including the 2012 Big Data Research and Development Initiative. EAR research continues to constitute a high proportion of high-profile (*Nature*, *Science* publications) NSF-funded research. The external report *It's About Time: Opportunities & Challenges for U.S. Geochronology* defined priorities that are consistent with funding by IF of an award entitled *EarthCube Domain End-user Workshop: Bringing Geochronology into the EarthCube Framework* and by GI of an award entitled *Collaborative Research: GeoChronR - Open-source Tools for the Analysis, Visualization and Integration of Time-uncertain Geoscientific Data*. One particularly relevant external report is *Understanding Earth's Deep Past*, in which "the National Research Council reports that rocks and sediments that are millions of years old hold clues to how the Earth's future climate would respond in an environment with high levels of atmospheric greenhouse gases" (from report summary at https://www.nap.edu/catalog/13111/understanding-earths-deep-past-lessons-for-our-climate-future).

Mechanisms exist within EAR for development of program-level initiatives, but the COV was less convinced that there is consistent investment in developing a strategic vision across EAR as a whole. EAR should be clearer on its strategic vision at both the program level and EAR-wide, and should share with the community its process by which strategic initiatives are developed and promoted. The COV notes, for example, the Dynamic GEO Vision Report (2015-2020), where three GEO imperatives in research were identified: (a) maintain a strong emphasis on core research, (b) encourage collaborative efforts to improve understanding of and resilience to hazards and extreme natural events, and (c) establish a collaborative effort to understand the water cycle. In addition to GEO imperatives in Community Resources & Infrastructure, Data & Cyberinfrastructure, and Education & Diversity specified in this report, research frontiers were identified for the Dynamic Earth, including: (i) Earth system processes at the land/ocean interface, (ii) high-latitude ocean-atmosphere-ice ecosystem interactions and processes, (iii) urban geosystem science, and (iv) early Earth.

EAR should be more proactive to identify both the internal and external inputs that impact the development of an EAR-wide strategic vision that is best for the earth science community (see *Recommendations 11, 13 and 14*).

11. Additional comments on the quality of the projects or the balance of the portfolio:

EAR supports a diverse array of high-quality projects. Success rates are low (~20% for EAR as a whole) and many excellent projects simply cannot be supported. This problem hampers our efforts to continue developing a talented, diverse and productive scientific and technological workforce. Low success rates drive young career scientists away from basic scientific research and discourage innovation and

the ability to focus on basic science among mid or later career researchers. Increased investment in basic research is critical; with current funding availability many competitive proposals cannot be funded.	

V. Feedback on No Deadlines Pilot

No Deadlines Pilot	
The 2014 Surface Earth Processes Section COV recommended that SEP find ways to decrease workloads for NSF staff and PIs and increase proposal success rates. After assessing alternatives, SEP instituted a No Deadlines pilot in April 2015 for its four core programs (Hydrological Sciences, Low Temperature Geochemistry and Geobiology, Sedimentary Geology and Paleobiology, and Geomorphology and Land Use Dynamics). Instrumentation and Facilities had taken a similar approach in FY 2012 with apparent success. The SEP pilot required significant changes in program management, with panel schedules determining cutoff dates for receipt of proposals and commencement of the review process. PIs were permitted to withdraw and revise proposals submitted long before the cutoff. This approach to management appears to be appropriate and is working well for SEP. The one year of data available (FY 2016) shows that the desired effects have been achieved in SEP. Proposal submissions decreased by 39% (SGP) to 55% (HS). Consequently all programs increased their funding rates, though SGP POs used the money released by the lower proposal pressure to reduce the program mortgage (future-year commitments) from 55% to 30% instead of increasing success rates significantly. For all programs, "dwell" time from submission to PI notification was reduced by >20%, although SGP already had consistently met NSF goals for dwell time since 2012. Fewer proposals also meant decreased workload for panels and the reviewer community, although rate of return of reviews remained disappointingly low (and in fact decreased from 57% to 47% for HS and from 35% to 33% for SGP; IF showed no trends in return rate from 2007 to 2016). However, the number of reviews received per proposal did increase in three of four core programs in SEP, perhaps because POs had time to select more reviewers for each proposal. In SGP only 1.71 ad hoc reviews were received per proposal in FY 2016; based on ejackets examined, it appears that fewer ad hoc reviews were requested (4 to 8 requests, average 4.66) than in FY 2014 and 2015, when 6 to 22 reviews were requested for each proposal. Three SGP panelists also provided individual reviews for each project in FY 2016 to make up for the shortage of ad hoc reviews. The practice of relying so heavily on individual reviews by panelists concerns us because it effectively undermines the dual ad hoc/panel review system that has worked so well in EAR, although we understand PO concerns about the low review return rate. (See *Recommendation 1.*) We conclude that the intended goals of the No Deadlines pilot were met in the first year. Data indicate that the No Deadlines pilot did not affect the percent of proposals that were collaborative, the types of institutions submitting, or the proportion of submissions and awards to female, minority, or new PIs. Data from 2011 – 2016 for IF suggest that these patterns may be long term. Accordingly, EAR has decided, based on the existing workload data, to institute no deadlines for all disciplinary programs.	

In moving forward with the no-deadlines policy, EAR will need to continue to monitor not only workload and PI demographics, as is already done, but also proposal quality. Will the removal of deadlines allow PIs to hone their proposals to a greater degree before submission? With fewer proposals, is there a chance that inferior proposals will be funded? Although we did not identify any change in proposal quality after deadlines were removed based on reviewed ejackets or ad hoc reviewer scores for the past three years, a more formal and continued effort is needed to determine any effects on quality (e.g., monitor ad hoc and panel scores or survey panelists who served both before and after deadlines were removed). In terms of workload, the reviewer community still appears to be fatigued, and we are disappointed that the rate of return of reviews was not positively affected by the move to no deadlines in SEP or longer-term in IF. The COV is also concerned about whether the effects on PO workload will be sustained, despite the encouraging data from IF. To answer that question, it would be helpful to know the cause of the reduction in proposal pressure. Do researchers need deadlines as motivation to submit proposals? If so, will panel cutoff dates, if consistent from year to year, effectively turn into deadlines as they become known within the community? EAR may wish to assess, perhaps by surveys or focus groups, how this policy change affected proposal development from the viewpoint of prospective PIs. Without understanding the PI perspective, the long-term effects of no deadlines are difficult to project. ***Recommendation 19.*** *The COV recommends that EAR move forward with the No Deadlines pilot, but should continue to monitor workload, dwell time, success rate, PI and institutional demographics, and should undertake more in-depth research into any unintended consequences, including impacts on proposal quality or participation by prospective PIs.*	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

4. Please provide comments on any other issues the COV feels are relevant.

5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

The Committee of Visitors is part of a Federal advisory committee. The function of Federal advisory committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this

material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.

SIGNATURE BLOCK:

For the 2017 Division of Earth Sciences Committee of Visitors
Dr. Pamela Kempton, Kansas State University, Chair, AC/GEO Member

material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.

SIGNATURE BLOCK:

For the 2017 Division of Earth Sciences Committee of Visitors
Dr. Pamela Kempton, Kansas State University, Chair, AC/GEO Member