United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Office of the Director
Reston, Virginia 20192

In Reply Refer To:
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APR 19 2012

Memorandum

To: Secretary

From: Kevin T. Gallagher
Associate Director, Core Science Systems
Chair, Federal Advisory Committee

Subject: Transmittal of the 2011 Annual Report to the Secretary of the Interior from the Federal Advisory Committee for the National Cooperative Geologic Mapping Program and the National Geological and Geophysical Data Preservation Program

The National Cooperative Geologic Mapping Program (NCGMP), created by an act of Congress in 1992 under the National Geologic Mapping Act (NGMA), is an exemplar of a successful Federal-State-university partnership that leverages expertise and dollars to address the geologic mapping needs of the Nation. The National Geological and Geophysical Data Preservation Program (NGGDPP), created by the Energy Policy Act of 2005, provides funding for State agencies and agencies within the Department of the Interior to inventory, archive, and preserve geological and geophysical data and samples. The Federal Advisory Committee (FAC) for these programs is required to submit an annual report to the Secretary of the Interior that evaluates the progress made toward fulfilling the Federal, State, and educational geologic mapping requirements of the NGMA and that evaluates the progress of the NGGDPP. The 2011 annual report is attached.

For the past 15 years, the FAC has brought the perspectives of Federal and State Governments, academia, and the private sector to bear on the geologic mapping that is foundational to solving high-priority national issues related to groundwater availability, natural hazards, energy and mineral resources, and education and workforce diversity in the geosciences. The Committee comprises nationally recognized experts from State geological surveys, academia, the private sector, and Federal agencies. The attached report describes ongoing progress made toward fulfilling requirements of the NGMA and the Energy Policy Act of 2005.

The FAC deems the NCGMP to be progressing well. The NCGMP is effective in creating new geologic maps that provide the Nation with the scientific information to address a broad range of issues, including reducing risks from natural hazards, aiding in land-management and land-use

decisions, assessing water, energy, and mineral resources, aiding in environmental and health concerns, and furthering our scientific knowledge about Earth processes. The program also helps train the next generation of geologic mappers through its successful education component. In fact, in an annual poll of students, an average of 95 percent of EDMAP students continue on in geoscience studies or obtain a job in a geoscience-related career. We are pleased that the FAC recognizes this program's measurable results related to accomplishing STEM-education goals.

The FAC deems the NGGDPP to be progressing well. Within resource constraints, the program provided support to State geological surveys to inventory collections of geological and geophysical data, continued development of a National Digital Catalog of information that will allow users to discover and access geoscience data easily, and curated valuable paleontological samples, energy-related cores, and geophysical data. In addition, the NGGDPP has assembled a white paper describing a collections management plan for USGS geologic and sample collections, coordinated data rescue efforts for the USGS programs, and facilitated the rescue of over 170,000 feet of valuable oil shale core from the Anvil Points Mine near Rifle, Colorado, and relocated it to the USGS's Core Research Center in Denver, Colorado. The replacement value of re-drilling this oil shale core exceeds $150 million.

This report of the FAC has not been reviewed or cleared by the Office of Management and Budget.

Attachment

Federal Advisory Committee

for the

U.S. Geological Survey

National Cooperative Geologic Mapping Program

and

National Geological and Geophysical Data Preservation Program

2011 Annual Report to the Secretary of the Interior

Executive Summary

As mandated by the National Geologic Mapping Act (NGMA) of 1992 (Public Law 102–285) and its reauthorizations of 1997, 1999, and 2009 (Public Laws 105–36, 106–148, and 111–11, respectively), the Federal Advisory Committee (FAC) for the National Cooperative Geologic Mapping Program is required to submit a report to the Secretary of the Interior that evaluates progress made toward fulfilling the Federal, State, and educational components of the NGMA as well as an evaluation of the progress of the National Geological and Geophysical Data Preservation Program as established by the NGGDPP Act of 2005 (Public Law 109–58). This document fulfills these requirements for 2011.

The FAC deems the **National Cooperative Geologic Mapping Program** (NCGMP) to be progressing well. The NCGMP is effective in creating new geologic maps that provide the Nation with the scientific information to address a broad range of issues, including (1) reducing risks from natural hazards, (2) aiding in land-management and land-use decisions, (3) assessing water, energy, and mineral resources, (4) aiding in environmental and health concerns, and (5) furthering our scientific knowledge about Earth processes. The NCGMP also helps train the next generation of geologic mappers through its successful education component.

The NCGMP is authorized for $64 million, and the Fiscal Year (FY) 2011 appropriation is $27.7 million. Despite its accomplishments, the NCGMP needs a substantial increase in funding to keep pace with the demand for new geologic maps and digital, geographic information system versions of previously published geologic maps and to more fully accomplish its mission: "To provide accurate geologic maps and three-dimensional framework models that help to sustain and improve the quality of life and economic viability of the Nation."

The FAC deems the **National Geological and Geophysical Data Preservation Program** (NGGDPP) to be progressing well. Within resource constraints, the NGGDPP has (1) provided support to State geological surveys to inventory collections of geological and geophysical data and create metadata for items in those collections, (2) continued developing the National Digital Catalog of metadata so users can easily discover and access geoscience data, (3) curated valuable paleontological samples, energy related

core, and geophysical data, (4) created a community to share data preservation best practices, (5) co-sponsored a workshop with the Association of American State Geologists (AASG) to share data preservation techniques, metadata creation strategies, and demonstrate incorporating State metadata in the National Digital Catalog, and (6) co-sponsored five Geological Society of America (GSA) topical sessions with AASG, from 2007 to 2011, on different aspects of data preservation.

The NGGDPP was authorized for $30 million per year for 5 years. The FY 2011 appropriation is $998,000. To date, the NGGDPP Financial and Technical Assistance (Grants) Program has awarded $2,515,213 to State geological surveys.

FAC Recommendations from the 2011 Annual Meeting

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Opening Statement

The FAC met for 2 days (June 22-23, 2011) at USGS headquarters, Reston, Virginia, to discuss and develop recommendations related to the following topics:

1. Developing program marketing plans,
2. Enhancing Federal-State-education collaboration,
3. Realizing a nationally consistent data model, and
4. Repercussions of proposed (FY 2012 President's Budget) elimination of all funding for the Data Preservation Program.

The FAC deems the NCGMP and NGGDPP to be progressing well. However, current and proposed levels of funding are viewed to be inadequate to ensure that both the NCGMP and NGGDPP can be sustained. The NGGDPP was slated for elimination under the President's proposed FY 2012 budget. This seems especially unfortunate in light of the Nation's critical needs for strategic energy, mineral, and water resources, and to address significant geologic hazards. [Addendum: Congress restored NGGDPP funding in the FY 2012 enacted budget.]

Summary Statement for NCGMP

The National Cooperative Geologic Mapping Program (NCGMP) is effective in providing accurate geologic maps and three-dimensional framework models that help to sustain and improve the quality of life and economic vitality of the Nation and to mitigate natural hazards. The NCGMP is the primary source of funds for the production of geologic maps in the United States. The NCGMP represents 2 decades of successful cooperation among Federal (FEDMAP), State (STATEMAP), and university (EDMAP) partners to deliver digital geologic maps to customers. Each of these three components has a

unique role, yet all work cooperatively to select and map high-priority areas for new geologic maps. Geologic mapping data from all of North America is presented via the National Geologic Map Database.

National needs require additional resources for map-based data. An independent economic study (Bhagwat and Ipe, 2000) showed that every dollar invested in geologic mapping returns at least $25 in benefits. Congressionally authorized funding for NCGMP has been:

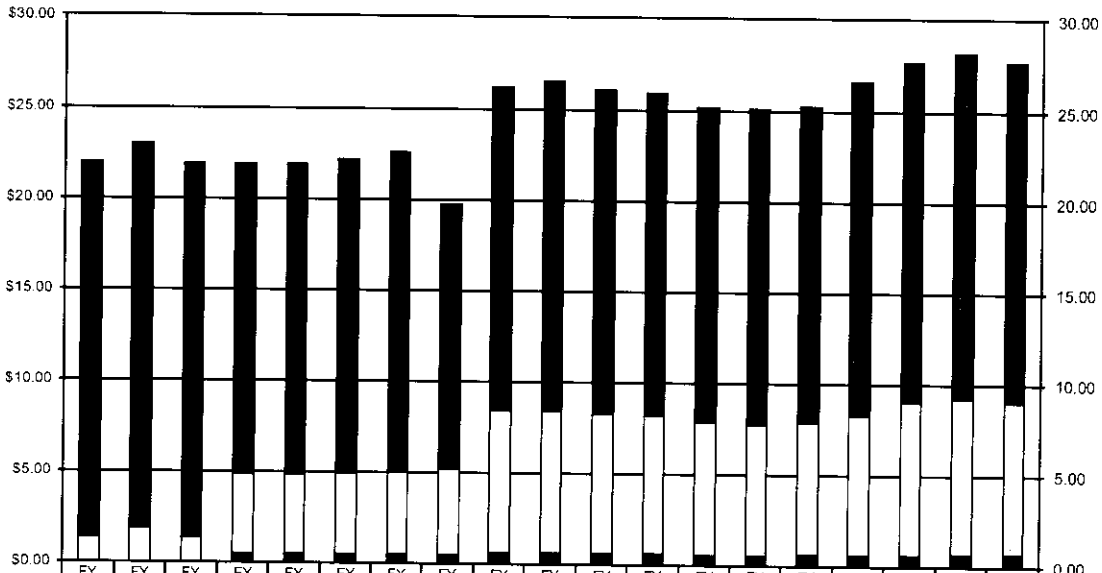
Fiscal Year	1999	2000	2001	2002	2003	2004	2005-Present
($millions)	28	30	37	43	50	57	64

Appropriated funding has been substantially below the authorized levels as the following table shows.

NCGMP actual funding 1993 – 2011

Data updated November 2011

(Dollars in Millions)



	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
FEDMAP	20.64	21.17	20.54	17.06	17.06	17.28	17.56	14.56	17.75	18.13	17.80	17.73	17.31	17.42	17.35	18.39	18.70	18.92	18.70
STATEMAP	1.34	1.84	1.34	4.38	4.38	4.44	4.54	4.76	7.84	7.83	7.67	7.59	7.29	7.13	7.32	7.66	8.41	8.57	8.36
EDMAP	0.00	0.00	0.00	0.44	0.44	0.44	0.45	0.48	0.59	0.59	0.58	0.58	0.56	0.56	0.57	0.58	0.61	0.67	0.65
TOTAL	21.98	23.01	21.88	21.88	21.88	22.16	22.55	19.78	26.18	26.55	26.05	25.90	25.16	25.11	25.24	26.63	27.72	28.16	27.71

FEDMAP Accomplishments — In FY 2011, USGS researchers in the Federal component of the program contributed to furthering geologic mapping and science with approximately 100 peer-reviewed geologic maps, digital products, professional papers, and journal articles. Trends are increasing in the release of the latest in digital three- and four-dimensional models, analyses, and visualizations, for example the "Three-Dimensional Geologic Model of the Southeastern Espanola Basin, Santa Fe County, New Mexico" (USGS Scientific Investigations Report 2011-2025, http://pubs.usgs.gov/sir/2011/5025/).

Of particular note, the newly released and eagerly anticipated "Geologic Map of Big Bend National Park, Texas" (USGS Scientific Investigations Map 3142, http://pubs.usgs.gov/sim/3142/) will aid park managers and researchers in natural resource and ecosystem management and monitoring and in educational and recreational uses. The map was funded and prepared in collaboration with the National Park Service.

FY 2011 project areas for the FEDMAP component include a focus on providing framework geologic mapping for climate change studies along the Platte River particularly in Nebraska. Work is coordinated with regional partners and stakeholders. New work also was initiated in the Northern Great Basin, Nevada, which is rich in mineral and geothermal energy resources. The study is coordinated with the Nevada Bureau of Mines and Geology. Because the Federal Government administers over 90 percent of the lands in the area, the results are needed by the Bureau of Land Management and the National Park Service, which oversee two dozen Wilderness and Wilderness Study Areas and one National Park.

STATEMAP Accomplishments — For FY 2011, 45 State geological survey proposals were funded for a total of $6.9 million; the total request was about $9.8 million. The total amount of Federal funds that have been distributed to State geological surveys since 1993 is more than $95 million. Item of interest: The most cited societal impact that STATEMAP proposals address concerns water related issues—primarily water quality and water availability for public use.

EDMAP Accomplishments — For FY 2011, 45 EDMAP proposals were funded at 40 Universities that included 85 students for a total of about $566,000. The total amount of Federal funds awarded through the EDMAP program since 1996 is $7,416,325. Items of interest: The 2011 EDMAP student survey indicated that 100 percent of EDMAP students were very satisfied with their EDMAP mapping experience and that it was beneficial in gaining employment or furthering their education. Of the students polled, 83 percent indicated that the EDMAP experience had helped them to gain employment, continue their education, or in their day-to-day job functions. Additionally, all but two persons polled pursued studies after participating in the EDMAP program.

Summary Statement for NGGDPP

The NGGDPP was authorized in Section 351 of the Energy Policy Act of 2005 (Public Law 109-58, Sec. 351). Objectives of the program as outlined in the Act are to:

1. Archive geologic, geophysical, and engineering data, maps, well logs, and samples,
2. Provide a national catalog of such archival material, and
3. Provide technical and financial assistance related to the archival material.

The NGGDPP offers the opportunity to inventory, archive, and preserve geologic and geophysical data collected by many organizations over the past 150 years. Section 351 of the Energy Policy Act directs the Secretary of the Interior, through the Director of the USGS, "to carry out a National Geological and Geophysical Data Preservation Program" comprising "State agencies that elect to be part of the system and agencies within the Department of the Interior that maintain geological and geophysical data and samples." Section 351 also states that "the Secretary may not designate a State agency as a component of the data archive system unless that agency is the agency that acts as the geological survey in the State."

NGGDPP Accomplishments —

- Update the publicly accessible version of the National Digital Catalog (NDC). The Catalog is the fundamental digital infrastructure that makes useful information for items in geological and geophysical collections available to the public.
- Awarded $618,391 in financial assistance in FY 2011 to 22 States to support data preservation activities.
- Continued participation on the Interagency Working Group on Scientific Collections and the Interior Museum Property Committee.
- Continued development of a National Paleontology Database.

Sharing Best Practices for Data Preservation — In FY 2011, the NGGDPP developed an interactive and collaborative knowledge management web site that provides State geological surveys, the USGS, and other research institutions with geological and geophysical data information to make

prudent, well-informed decisions based on best practices in data handling. The site also provides a forum for the exchange of best practices among all parties. Targeted categories in collections management include curating physical samples and paper and digital records; updating digital records to current and widely available formats; and creating metadata, catalogs, and inventories.

This Best Practices web site is a myUSGS-wiki site that is a guide for individuals, institutions, and repositories interested in preservation of geologic materials and geoscience data. It provides resources and case studies in effective specimen and data management and identifies key issues and standards for repositories to consider.

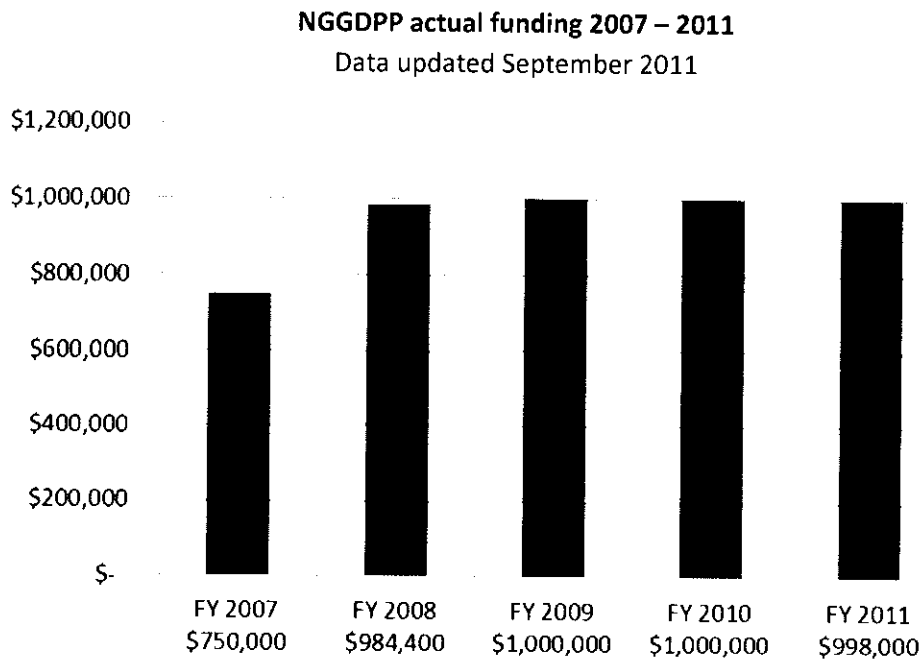
The web site is designed to function as a collaborative community resource with additions and suggestions incorporated as techniques in preservation change and improve. Visits to repositories and participation in professional meetings facilitate community involvement in collecting and developing state-of-the-art techniques for sample and data preservation. This web site is a dynamic tool and its content (quality, value, quantity, etc.) depends on the number of entities using and contributing to it.

Grants Program Priorities and Accomplishments FY 2007 to FY 2011 — In FY 2007, the program priority was collections-level inventories for State geological surveys. In FY 2008 and FY 2009, the program priorities were to continue support for collections-level inventories and to support creation of metadata (descriptive information) for individual items in collections for the NDC. Two additional program priorities were added for FY 2010 and FY 2011: (1) digital infrastructure and (2) special needs awards to rescue data. All grants provided by the program have gone to State geological surveys.

> **In FY 2007**, 35 State geological surveys and 8 USGS Science Centers received approximately $5,000 each to inventory collections.
>
> **In FY 2008**, 34 States requested more than $1 million in funding; $541,000 was awarded to 28 States. State geological survey requests ranged from $5,524 to $60,000, averaging $31,405. Awards ranged from $5,000 to $47,651, averaging $19,347.
>
> **In FY 2009**, 30 States requested more than $795,000; $549,875.97 was awarded to 29 States. For the first time, Arkansas and California participated. State geological survey requests ranged from $10,866 to $60,000, averaging $26,504. Awards ranged from $2,000 to $49,074, averaging $18,742.
>
> **In FY 2010,** 30 States requested nearly $1.1 million in funding; $637,766 was awarded to 24 States. Requests ranged from $9,286 to $138,292, averaging $36,402. Awards ranged from $11,710 to $48,312, averaging $26,574.
>
> **In FY 2011,** 28 States requested about $946,000 in funding; $618,391 was awarded to 22 States. Requests ranged from $5,000 to $139,742, averaging $65,208. Awards ranged from $5,000 to $45,592, averaging $28,109.

Five-year Plan — the USGS selected a working group to draft a five-year plan to help set NGGDPP priorities. Several meetings were held including a face-to-face meeting during the 2010 GSA Annual Meeting held in Denver, Colorado.

Reauthorization of the National Geological and Geophysical Data Preservation Program Act of 2005 — The Act is up for reauthorization. Since the NGGDP Program was unfunded in the President's FY 2012 budget, the program holds this effort in abeyance until further direction is given by Congress.



Data Model for Geologic Maps

Over the past several decades, Federal and State geologic mapping agencies have developed data models for digital geologic maps that meet specific agency and user needs. These models are as numerous as the number of agencies involved in digital geologic mapping. The FAC recognizes that converging on a common data model for digital geologic maps is a critical long-term goal for NCGMP and recognizes that the program has made substantial progress with development of the draft data model standard. The FAC also recognizes that moving to a single data model would be a difficult undertaking.

FAC Recommendations for a Data Model:

1. The FAC shall formally request that AASG survey the States and that the NCGMP survey Federal participants, including other Federal agencies, regarding aspects of the common data model design. Among the topics the survey should investigate are the following:

   a) Who has adopted all or part of the draft data model? If partly adopted, which aspects were found useful, and which were not?
   b) Who has tested the model on one or more maps?
   c) Degree of commonality with agency system(s) in current use.
   d) Would the data model meet your needs?
   e) Estimated technical, staffing, and financial effort that would be required to move to a full implementation of the data model for production of all new maps (i.e., not previously published maps).
   f) The relative benefits of developing translation software vs. adoption of a common data model.
   g) Could this common data model be a subset or a full implementation of a common data model (perhaps with some modifications)?
   h) What incentives might encourage States to move to the common data model?

2. The FAC should request that AASG, FEDMAP, and other Federal agencies' project chiefs rigorously test the model.
3. The FAC recommends that the NCGMP consider incentives, based on results of the survey, to encourage Surveys (States and Federal) to move to a common data model. Follow up with mid-year teleconference.
4. Surveys, State and Federal, should fully document the schema of their current data models for digital geologic maps. The precise meaning of "fully document" should be determined jointly.
5. The program should investigate the effort needed to translate from data models in current use to a common data model.
6. In the near-term, the FAC highly recommends that States and FEDMAP project chiefs adopt common fieldnames (i.e., from the draft data model) for key database fields. This would be a tangible step toward a greater level of interoperability of data from all agencies, providing quick benefit to users.
7. The FAC requests that the AASG organize a session for the 2012 Annual Meeting to discuss the common data model and the survey results.

Federal-State-Education Collaboration

Many State geological surveys are under financial stress — some have been cut by half or more, others are currently slated for virtual elimination. Federal geological survey and land management agency budgets, although robust in the recent past, are also likely to shrink in future years as the United States wrestles with soaring deficits. Consequently, finding greater efficiencies in mapping and resource management will become ever more important. In order to meet program objectives, the FAC recommends that those dollars be stretched through increased collaboration as follows:

1. One or more USGS mapping managers or other appropriate representatives attend at least one State Mapping Advisory Committee meeting per year.
2. Make rules for FEDMAP and STATEMAP consistent in terms of requirements ("place-based" advisory panel input, project deadlines, derivative mapping rules, etc.). This will make it easier to match Federal and State projects in the long run.
3. Give special consideration during both Federal and State project reviews for projects that are Federal-State integrated and that bring FEDMAP and STATEMAP funding (plus State matching dollars) to bear on a single joint project.
4. Hold annual meetings of regional (or sub-regional: e.g., Geological Society of America sections) Federal and State mappers and administrators and use that meeting to discuss long-term strategies, plans, and possible interactions. This requires genuine integrity and faith on both sides to openly discuss ideas. It also provides a real opportunity to discuss who has what, who wants to do what, and who can most efficiently and inexpensively do which part of future projects.
5. Encourage both Federal and State agencies to work vigorously toward increasing support for mapping programs based on the demonstrated fiscal benefits of such programs. Demonstrating efficient use of funds through real Federal-State partnerships should be part of an effective campaign to increase funding.
6. Develop guidelines for collaborative publications.

FAC Advocacy Plan

The FAC recommends that both programs develop a well-balanced "advocacy source document" and work to provide a concise message (i.e., Data 22, Maps for Life, The Geologic Mapping Project, The Geo-

Data Project, Old Data for New Resources, and New Data for the Next Millennia) to supporters as a means to increase program visibility. The document should highlight accomplishments, strengths, sustainability goals, and accountability. The FAC recommends that the advocacy paper or plan be submitted as part of the five-year strategic plan as a means to leverage present and future assets for the purpose of growing the NCGMP and NGGDPP programs to meet growing needs. FY 2011 funding amounted to $28.2 million and FY 2012 is proposed to be $25.8 million in the President's Budget, although Congress authorized $64 million, which indicates a significant opportunity for improved marketing of the program's assets. The advocacy document will address the following:

1. In 2001, only 20 percent of the Nation had been mapped geologically to the scale required to make land-use, water-use, and living-resource-use decisions. At this time, less than 1 percent of these maps were available in three dimensional (3D) format for geographic information systems (GIS) and
2. In 2011, 51 percent of the Nation had been mapped by USGS / State Surveys, which equates to 2 percent area mapped per year.

This source document shall develop short, catchy informal names (see above) for the programs that will better communicate its message than "NCGMP" and "NGGDPP" as well as identify with key advocates (see below). This paper will provide strategies for engaging geologic organizations such as GSA, American Institute of Professional Geologists, American Geosciences Institute, and the USGS Coalition. This paper will provide details on how STATEMAP and FEDMAP projects can develop public outreach as a part of their projects, including talking with local government staffs, public talks on their projects, and discussing geology in the local schools.

Promoting the NCGMP and NGDPP Programs — Strategies to Improve Resources

1. How to better inform Congress, USGS, OMB, and DOI about the value of the programs and their products:
    - **a.** Inform advocates to support the programs,
    - **b.** Source document for internal use, and
    - **c.** Focus on integrated nature of mapping data; values are in surface plus subsurface, new plus old data.
2. Strategies to Improve Resources:
    - **a.** Tri-fold brochure using geology photos as background for success stories using carrot approach to identify categories for societal benefits, costs reduced, lives saved, etc.,
    - **b.** Show program accomplishments, potential job creation, new energy discoveries, etc. from preserved data and new mapping, and
    - **c.** Cost-savings examples from using preserved data. Cost savings examples from using geologic maps (e.g., Kentucky example).
3. Information needs to be concise and written in plain language for effective communication:
    - **a.** Pie chart of program accomplishments, cost savings,
    - **b.** Bulleted list of what program does, and
    - **c.** Visibility of collection issues is increasing.
4. Develop education and outreach plan targeted toward "Key Advocates":
    - **a.** Senior management at USGS and DOI, Federal lawmakers, and the general public,
    - **b.** Key stakeholder list needs to be maintained and kept current with the present and future staff at the various Gov't and Public agencies, and
    - **c.** Need "User Stories" for Hill visits, budget documents, fact sheets, web.
5. Examples of Advocates for the programs and their products:

a. Association of American State Geologists,
b. State Mapping Advisory Committees,
c. American Geosciences Institute,
d. Universities,
e. American Institute of Professional Geologists,
f. American Association of Petroleum Geologists,
g. Geological Society of America,
h. American Geophysical Union,
i. USGS Coalition,
j. General public—e.g., National Park users, friends of National Parks, and
k. Other Federal agencies.

Program Success Stories

1. Bullet list of success stories for source document:
   a. Health and welfare, STATEMAP, cost savings of distributed system,
   b. Cataloging national resources, quantify value of remote access and efficiencies,
   c. Carbon sequestration and hydro fracturing investigations based on existing data; ultimate in recycling,
   d. National Security,
   e. Alternative energy resources,
   f. Energy corridors environmental impact,
   g. Baseline data for green energy development,
   h. Preserved data identifying fresh water sources,
   i. State of Kentucky study: value of geologic mapping program is 25 times the cost, and
   j. Federal-State-education coordination.
2. Bullet list of success stories for trifold brochure—model after NCGMP "A decade of success":
   a. Mitigating hazards and saving lives,
   b. Discovering and protecting water resources,
   c. Searching for mineral resources,
   d. Land-use decisions,
   e. Stewardship of public lands, and
   f. Saving money by using old data for new applications.

FAC Recommendations for Advocacy Plan

1. Engage a marketing intern (USGS) to produce/refine the marketing plan – within 6 months of the date of this report.
2. Collect existing data (FAC/USGS) toward preparing value estimates for Version 1.0 – within 6 months.
3. Prepare a Version 1.0 source document (USGS) with talking points for internal use – within 1 year.
4. Prepare a trifold brochure (e.g., NPS – MS Publisher/AIPG) for outreach purposes and to educate advocates – within 1 year.
5. Conduct an economic analysis (USGS) to outline cost/benefits of mapping and use of old data. One example each of new mapping value and use of old data value—possibly an economics student. Validation from USGS economist for Version 2.0 – within 18 months.
6. Prepare a Version 2.0 source document (USGS) with talking points for internal use – within 2 years.

Participants of the 2011 Annual Meeting

Federal Advisory Committee Members in attendance:

- Peter Lyttle, USGS National Cooperative Geologic Mapping Program (NCGMP) Program Coordinator
- Robert Marvinney, Association of American State Geologists (AASG) representative, Maine State Geologist
- Peter Scholle, AASG representative, New Mexico State Geologist
- Elizabeth Schermer, academic representative, Professor, Western Washington University
- Mark Rogers, private-sector representative, Geologist, Kleinfelder
- William Siok, private-sector representative, Executive Director, American Institute of Professional Geologists
- Susan Gregersen, ex officio member, U.S. Department of Energy, Office of Oil and Natural Gas, Senior Policy Analyst
- Bruce Heise, ex officio member, Geologist, National Park Service
- Randall Ross, ex officio member, Environmental Protection Agency, National Risk Management Research Laboratory

Presenters

- Betty Adrian, NGGDPP Program Coordinator
- Frances Pierce, NGGDPP Grants Program Manager
- Linda Jacobsen, NCGMP Associate Program Coordinator
- Robert Marvinney, NGMDB Associate Program Coordinator
- Dave Soller, NGMDB Project Chief
- Douglas Howard, NCGMP Associate Program Coordinators

References:

Bhagwat, Subhash B., and Ipe, Viju C., 2000, Economic benefits of detailed geologic map to Kentucky, Illinois State Geological Survey Special Report 3, 39 p.

Pantea, M.P., Hudson, M.R., Grauch, V.J.S., and Minor, S.A., 2011, Three-dimensional geologic model of the southeastern Española Basin, Santa Fe County, New Mexico: U.S. Geological Survey Scientific Investigations Report 2011–5025, 17 p.

Turner, K.J., Berry, M.E., Page, W.R., Lehman, T.M., Bohannon, R.G., Scott, R.B., Miggins, D.P., Budahn, J.R., Cooper, R.W., Drenth, B.J., Anderson, E.D., and Williams, V.S., 2011, Geologic map of Big Bend National Park, Texas: U.S. Geological Survey Scientific Investigations Map 3142, scale 1:75,000, pamphlet 84 p.

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