Testimony before the U.S. Senate
Committee on Energy and Natural Resources

Hearing to conduct Oversight of the U.S. Geological Survey

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Submitted by:
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Testimony on behalf of:
The State of Alaska

I. Introduction

Chairwoman Murkowski, Ranking Member Cantwell, and honorable members of the Senate Committee on Energy and Natural Resources – My name is Ed Fogels and I am Deputy Commissioner of the Alaska Department of Natural Resources (AK DNR). On behalf of Governor Bill Walker, thank you for this opportunity to testify in strong support of Alaska mapping and the critical role the U.S. Geological Survey (USGS) plays in this effort. I have personally been active in the mapping initiative since 2006.

Before testifying, I want to recognize USGS Director Suzette Kimball. The State of Alaska would like to thank Director Kimball for the recent efforts on behalf of the USGS to map the state of Alaska. We have certainly made progress to date and the State applauds this progress — but, as is abundantly clear, there is much yet to be done. I also want to recognize Mr. Kevin Gallagher, Associate Director of USGS in charge of Core Sciences, and thank him for his work in this area.

II. Background on Alaska and its Mapping Needs

Alaska is one fifth the size of the entire United States, is the only state with lands north of the Arctic Circle, and is the least geographically and geologically understood of all the states. It has twice the land area of Texas and covers 32 ecoregions, from temperate rainforest to tundra. Its easternmost point to its westernmost is roughly the same distance as Savanah, Georgia, is from Santa Barbara, California. From Barrow to Juneau is the equivalent distance of New York to Orlando (See Figure 1). The federal government is the largest landowner in Alaska with 60% of lands, or roughly 222 million acres under federal management, which makes cooperation and joint funding for mapping efforts critical.

Alaska is also under-explored and very incompletely mapped. The USGS is Alaska's primary partner in improving our knowledge base of our vast state, whether it be mapping our topography, our geology, our geologic hazards, or out energy and mineral resources.

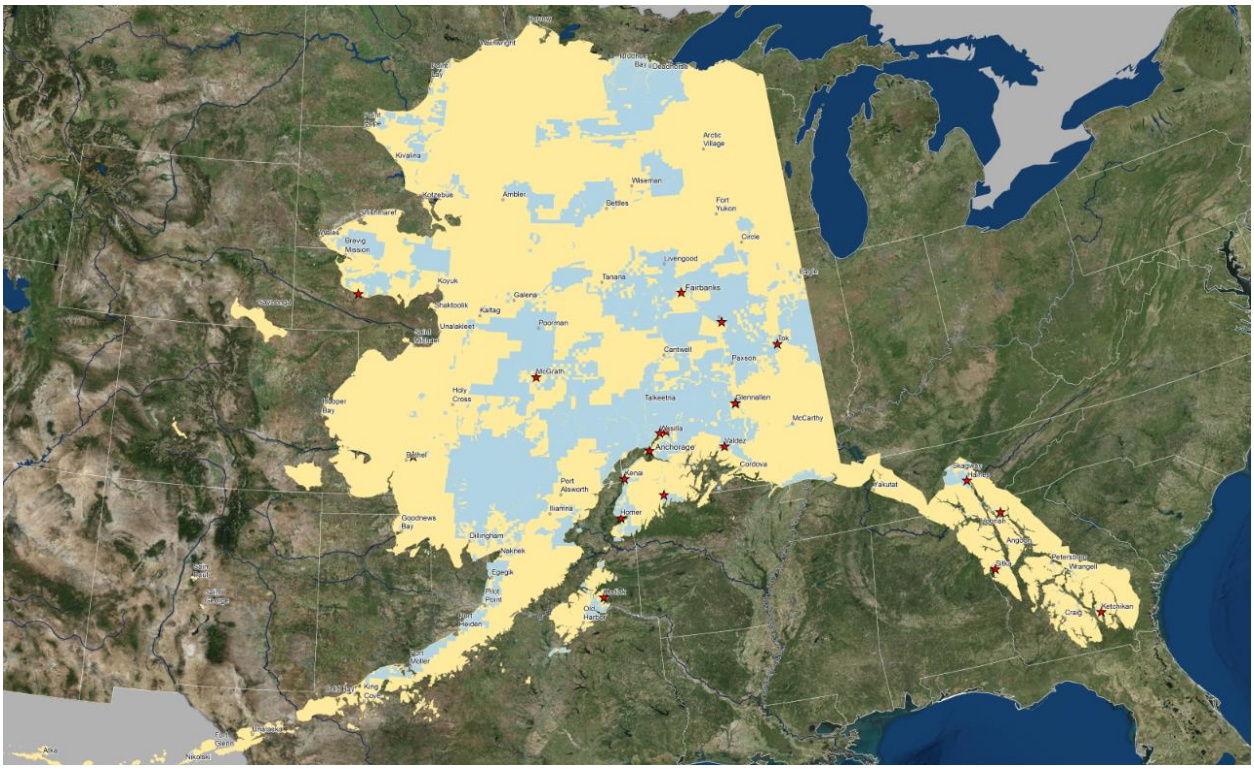


Figure 1.

Alaska's topographical maps, which a myriad of disciplines rely on for public and private business, are in excess of a half-century old and compiled from antiquated surveys dating from 1948 to 1955. They are notoriously inaccurate and have never met National Map Accuracy Standards. In fact, the current effort to modernize Alaska's maps has found evidence of mountains horizontally displaced by over one quarter mile with ridgelines that are off by 1,000 meters or more vertically on these maps. Regarding scale, Alaska's maps are 1:63,000 in scale while a typical map for the remainder of the United States is 1:24,000 or better. These facts alone show how dramatically Alaska lags behind the nation in mapping and how the numerous public interests involved with understanding Alaska have been underserved.

Alaska was the last state in the United States to procure a modern statewide digital base map of uniform resolution and accuracy providing contiguous statewide coverage. *In many respects, the planet Mars is more accurately mapped and more extensively mapped than Alaska*.

These shortcomings have impacts to Alaska and the Nation as a whole. The map of Alaska is widely regarded as being incapable of supporting modern electronic information management practices and analyses, which are mission critical in the digital era across many different applications. Accurate geospatial data is essential to economic and infrastructure development as well as responsible resource development – cornerstones of Alaska's economy. It is also essential to the responsible management and preservation of Alaska's public lands, wildlife habitat and water resources – some of the most pristine in the Nation. Finally, accurate geospatial data is foundational to the preservation of human life and public safety, search and rescue, as well as the advancement of scientific discovery, physical science and the understanding of climate change, its impacts and adaptation. As the last frontier, Alaska's needs in all of these areas are significant.

III. Progress to Date

Despite the shortcomings in Alaska's maps, the USGS and the State have made a great deal of progress on these issues recently. In 2006, the State of Alaska appropriated $2 million dollars in capital funds to address these needs. These funds were appropriated as seed money for the planning and creation of an accurate base map of Alaska consisting of satellite imagery and elevation data, and the Statewide Digital Mapping Initiative (SDMI) was established. The SDMI executed a broadly supported stakeholder survey and conducted two public workshops producing two enlightening white papers regarding satellite imagery and elevation data. Broad stakeholder consensus on a path forward was achieved in 2009 and data collection commenced in 2010 under a State and Federal cost sharing collaborations. To date the State of Alaska has appropriated $19.5 million dollars (including $13.5 million alone for interferometric synthetic aperture radar or IfSAR data) and our federal partners have contributed $35.1 million in good faith efforts to collaborate and jointly benefit from acquiring accurate map data. (See Table 1).

Governmental Unit (000)	2005	2010	2011	2012	2013	2014	2015	2016 *TBD*	TOTAL (000)
BLM	$2,755	$ 216	$ 20	$1,000	$ 141	$ 50	$2,062	$ 50	$ 6,474
FWS				550			250		800
NGA		2,400							2,400
NPS		100	150	182	30		450		912
USDA/NRCS		100	232	100	630	450	200	300	2,012
USDA/USFS				354	50	447	233	250	1,334
USGS	2,755	1,016	870	3,066	3,701	2,581	3,526	3,700	21.215
Federal Total	5,509	3,832	1,272	4,253	4,552	3,628	6,151	4,300	35,147
State of Alaska		1,875		5,050	2,550	2,800		1,300	13,575
TOTAL	**$5,509**	**$5,707**	**$1,271**	**$9,302**	**$7,103**	**$6,428**	**$6,151**	**$5,600**	**$48,722**
FUNDING NEEDED TO COMPLETE IFSAR (Elevation):									***$19,700***

Table 1.

Using a federal grant, the SDMI authored two intergovernmental and stakeholder-driven plans: *the Geospatial Strategic Plan & the Geospatial Business Plan*. These plans served to identify and document the most responsible and efficient path forward for these mapping efforts. They address data acquisitions, data stewardship, and intergovernmental governance/oversight, and were finalized in 2011 and 2012 respectively.

The above efforts paved the way to the 2012 Alaska/Federal Mapping Roundtable here in Washington DC[1], which was robustly attended by 29 high-level agency and administration officials. The resulting unanimous conclusion was that every federal agency has a stake in mapping Alaska and would be a direct beneficiary of the mapping efforts, and that there was no time to waste. The roundtable gave rise to the Alaska Mapping Executive Committee (AMEC),[2] chaired by the Department of Interior and having 29 active members representing 19 federal

[1] http://agc.dnr.alaska.gov/?content=federal_coordination

[2] http://nationalmap.gov/alaska/ak_excomm.html

agencies/departments and the State of Alaska. The USGS has been instrumental in this effort, and the State is very appreciative for all of their work in the area.

In 2014, the SDMI graduated to become the Alaska Geospatial Council (AGC)[3] as prescribed in the Alaska Geospatial Strategic Plan and endorsed by Governor Sean Parnell and subsequently Governor Bill Walker. As a council, the AGC enjoys executive representation from interests including state, federal, and local government as well as tribal and university stakeholders. Additionally, several technical working groups comprised of an all-voluntary intergovernmental cadre of subject matter experts are now established and functional. The AGC is now addressing all mapping and geospatial concerns within Alaska whereas the SDMI addressed only imagery and elevation.

The USGS has been an integral partner in this effort, establishing the Alaska Mapping Initiative[4] in 2012 and providing the largest portion of funding for elevation data to date. As of 2015, elevation acquisitions for Alaska exceeded 63% and, in 2016, expectations are they will exceed 70%. This accomplishment is largely achieved through end-of-year unbudgeted funding, which has been coordinated by AMEC. The incoming elevation data is being used to produce modernized USGS topographic maps of Alaska. The data is also being used to dramatically update hydrological features such as surface water. The Federal Aviation Administration (FAA) is also eagerly awaiting the completed dataset to revise and modernize Alaska's aeronautical maps.

Elevation data is the most critical and expensive part of a map to acquire, but is useful for a very long time once acquired. The USGS manages the 3D Elevation Program (3DEP) in response to the increasing need for high-quality elevation data. In Alaska, the data collected is moderate resolution IfSAR while the remainder of the United States will utilize high resolution Light Detection And Ranging (LiDAR). In preparation for 3DEP, the USGS contracted with Dewberry Consulting (2011) to perform the National Enhanced Elevation Assessment (NEEA). A total of 602 mission-critical activities were identified that need significantly more accurate data than are currently available. The results of the assessment indicate enhanced elevation data have the potential to generate $13 billion in new benefits annually.[5]

IV. The Seven Framework Layers of Data

The National States Geographic Information Council has defined seven framework layers that form a foundation for a robust geospatial framework. These are elevation, imagery, hydrography, transportation, geodetic control, parcel boundaries and administrative boundaries. These layers provide information necessary to identify and predict spatial trends and patterns used to plan strategically for improved public health and safety, responsible and sustainable economic development and protection of the environment, and are considered essential to business in the rest of the US. However, accurate, detailed geospatial information is lacking for much of Alaska, inhibiting responsible development and resource conservation, delaying or preventing adequate

[3] http://agc.dnr.alaska.gov/

[4] http://nationalmap.gov/alaska/index.html

[5] http://pubs.usgs.gov/fs/2012/3088/pdf/fs2012-3088.pdf

response to natural disasters and emergencies, and preventing effective measurement and monitoring of ecological processes. For Alaska, these foundational datasets need to be fully acquired and receive the maintenance, updates and stewardship required to ensure their continued relevance over time.

Modernized geospatial information acquired to date in Alaska supports the development of updated USGS topographic maps at a scale of 1:25,000, improving from previous 1:63,360 scale maps produced in the 1950's. These new digital maps are an essential tool for many, such as first responders such as wildland firefighters. Their situational awareness is enhanced with detailed, accurate and current elevation, imagery, hydrography and infrastructure understandings. Operational safety is improved for these responders through conducting indivisibility, view shed and line of sight analysis for the placement of communications repeaters to improve overall communication. Slope and aspect analysis are used for determining and mitigating the associated risk of wildfire for Hot Shot crews. Understanding slope and topographic effects allows prediction and mitigation of wildfire behavior and progression. Slope and aspect are also important for predetermination of helicopter landing and wildland fire personnel safe zones, and have an impact in assessing burned areas for recovery and potential stabilization needs. The best tools for situational awareness and spatial understanding are good, accurate, and updated geospatial layers available for use in Geographic Information System (GIS) and the derivative mapping products in a mobile, field-ready format for both operations and planning.

Elevation

Elevation is the most foundational spatial dataset. Other layers, such as imagery, are draped over elevation to provide three-dimensional models of the earth's surface. Elsewhere in the United States, elevation is being acquired at 1-meter or better resolution, often repeatedly to show changes over time. In Alaska many areas are only mapped to 60-meter resolution elevation data. This results in enormous errors and inaccuracies, which has proven fatal to pilots relying on accurate information to safely navigate in low visibility conditions. IfSAR technology is now being used to collect improved elevation data in Alaska at a 5-meter resolution.

Alaska's IfSAR elevation dataset is now approximately 63% complete (Anticipated to be over 70% after this summer field season), a testament to the highly effective collaborative efforts between the state of Alaska and partnering Federal agencies, especially USGS. This dataset allows for detailed 3-dimensional modeling of mountain ranges, drainage basins, and even glaciers. For IfSAR data, radar pulses are used to measure surface (tree tops) and bare earth elevations. Another product of IfSAR are images of the radar returns called orthorectified radar images, or ORIs, which are used for mapping soils and geology. The State is making this elevation data publically available for download or as a web service through the Division of Geological & Geophysical Surveys web site.

Imagery

Imagery is the second most basic dataset after elevation. From imagery, additional information such as hydrography, infrastructure including roads, structures, railways, pipelines and trails can be derived. For other states in the U.S., the National Agriculture Imagery Program provides high-resolution imagery every one to three years. In 2010 a joint state-federal imagery

project was launched in Alaska which resulted in 2.5-meter resolution imagery being available statewide in 2015, with the exception of 14,000 km^2 in the Aleutian Islands where nearly perpetual cloud cover prevented acquisition of cloud free images. Prior to this effort, 30-meter resolution digital images were the best available for many areas of the state. Details such as buildings, trails and other infrastructure such as drilling pads are now discernible, and coastlines, vegetation, and other natural features can be clearly and accurately mapped. A program for imagery refresh is needed for Alaska which provides up-to-date imagery throughout the state on a three to five year cycle.

Hydrography

The National Hydrography Dataset (NHD) is the standard national surface water mapping dataset. It is a comprehensive set of digital, geographic information systems (GIS) surface water data including common features such as lakes, streams, ice fields, coastlines, stream gages, dams and flow networks. The NHD is critical for meeting both short and long-term science, regulatory, cartographic, natural resource management and planning requirements. However, like other data sets, the NHD in Alaska needs to be updated.

While consistently mapped at 1:24,000 scale or better in the contiguous U.S., the NHD in Alaska was taken from 1950s-era USGS Historical Topographic Maps at a broad scale of 1:63,360. These historic data need extensive updates and improvements to meet modern mapping standards and applications. The dataset contains many errors including streams outside their channels, misrepresentations of flowlines, irregular stream density, disconnected streams and broken hydrologic networks, omission of existing streams and waterbodies, poor lake and waterbody perimeter mapping, and lack of stream/lake connectivity.

Updated hydrography is an essential dataset necessary to identify, monitor, and conserve key aquatic resources. It supports research and management; guides community, infrastructure, and industrial development; and aides in design and permitting for many other resource management decisions. Successful completion of hydrography updates requires coordination between local, state, federal and NGO partners, which is accomplished through the Alaska Hydrography Technical Working Group (AHTWG). In recent years, efforts by AHTWG and partners have updated the NHD to modern mapping standards in approximately 11% of Alaska with additional partial updates across more than 28% of the state. Although much work remains to complete hydrography updates statewide, many partners are making great strides in improving this important dataset. An estimated $10 million is needed to complete the NHD update for Alaska.

Geodetic Control

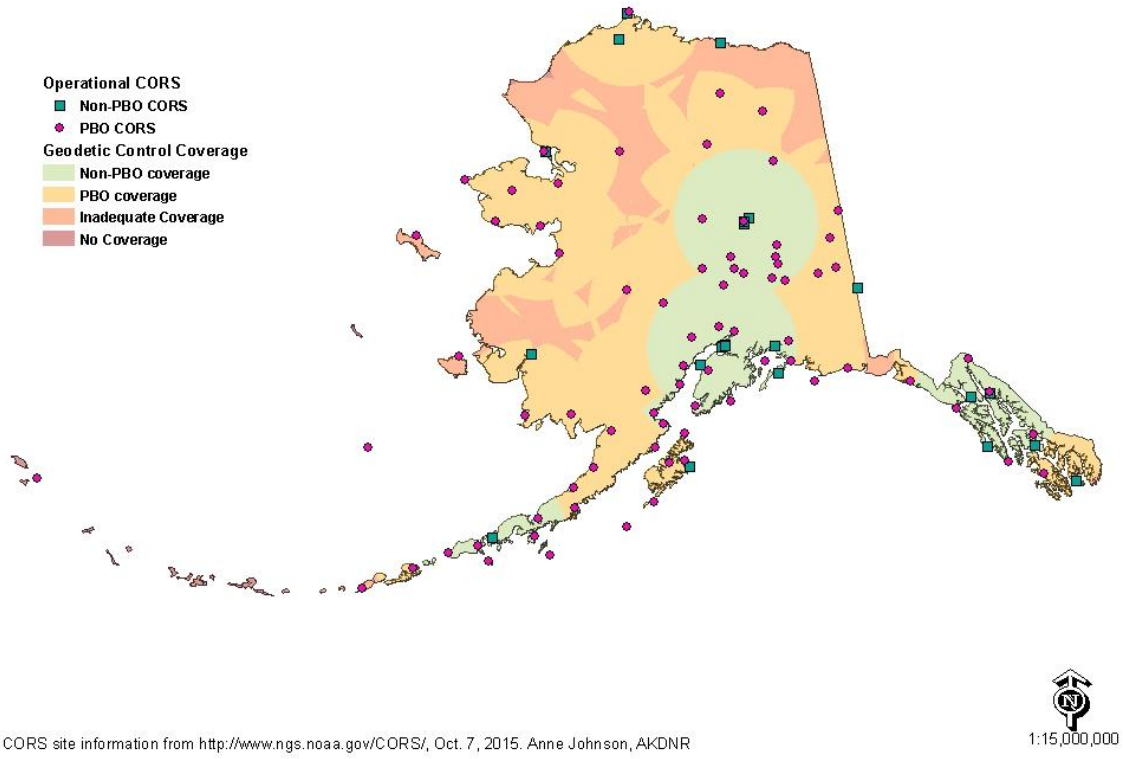
Geodetic control allows accurate horizontal and vertical positioning of overlaying datasets, including elevation. Geodetic control provides the framework for all positioning and mapping activities in Alaska, including the accurate horizontal and vertical positioning of geospatial datasets. The foundational elements of geodetic control are latitude, longitude, elevation, and their changes over time. Geodetic positions may be accessed via passive control (benchmarks) or via active GNSS/GPS-based control (in the form of Continuously Operating Reference Stations, or CORS) combined with an accurate model of the earth's gravity potential (provided by the GRAV-D project). Sound geodetic control contributes to informed decision-making and impacts a wide range of

important activities including mapping and charting, navigation, flood risk determination, transportation, land use and ecosystem management.

NOAA's National Geodetic Survey (NGS) launched the GRAV-D project (Gravity for the Redefinition of the American Vertical Datum) to correct problems in positioning across the nation, and most especially in Alaska. In Alaska, elevations can be incorrect on average 2 meters or 6.5 feet, and probably worse than that in mountainous regions. The GRAV-D project enables NGS to correct the elevations within the state by creating a new vertical reference surface, called a vertical datum. This new datum will be released in 2022. GRAV-D has performed an airborne gravity survey over nearly 60% of mainland Alaska since 2008, and surveys are about to commence now in Juneau and then later in western Alaska, out of Nome.

We expect Alaska to reap the benefits of more accurate heights in a variety of ways. More accurate elevations allow us to better measure and monitor coastal erosion, it provides the correct surface with which to refer IfSAR, LiDAR and photogrammetry products (instead of to GPS heights which do not relate to sea level). Better heights allow improved prediction of possible inundation from storm surges or tsunamis, which are a real risk along the western coast. Better heights along with better horizontal positions and digital elevation models from the Statewide Digital Mapping Initiative, will improve aviation safety.

The density of CORS used as control for GPS in Alaska is 1 for every 6,000 square miles of land, making Alaska 46th in the nation with regards to the density of our active geodetic control network. In addition, overlapping coverage from CORS in adjoining states is not available in Alaska as it is for other states. More than half of Alaska's CORS are run by the Plate Boundary Observatory Program, a part of the UNAVCO Earthscope project established through a 2013 National Science Foundation award. Funding to support these plate boundary observatory stations will run out in two years. Only 70% of the state currently has adequate CORS coverage, broadly defined here for the purpose of illustration as being within 250 km of three active CORS stations. If no funding is provided to maintain the UNAVCO CORS, adequate geodetic control coverage will not be available for 75% of the state's area. Alaska's Geospatial Framework Data Status is available at http://arcg.is/1Ua2N40.



V. Improved U.S. Topographical Maps

Prior to the start of the "U.S. Topo" map program in Alaska, statewide USGS topographic maps were 15-minute 1:63,360-scale printed maps produced nearly 50 years ago. Starting in 2013, the USGS National Geospatial Program began creating US Topo maps in Alaska, providing a new map series for the state. The new 7.5-minute digital maps are created at 1:25,000 map scale, and show greatly increased topographic detail when compared to the older maps. The term "US Topo" refers specifically to quadrangle topographic maps published in 2009 and later, reflecting the 2009 start of the National US Topo project. Up-to-date digital map data for US Topo maps is fed from The National Map, and includes data that is refreshed such as imagery, transportation, geographic names, topographic contours, boundaries, hydrography, and structures, plus additional layers such as the Public Land Survey System (PLSS) and United States National Grid (USNG).

When completed, over 11,000 US Topo maps will be created to cover all of Alaska at a 1:25,000 map scale. Maps can only be created where satellite imagery and highly detailed elevation data exist. The USGS is coordinating with the State of Alaska and multiple Federal agencies to acquire required data through partnerships such as the Alaska Statewide Digital Mapping Initiative and the Alaska Mapping Executive Committee. This multi-year mapping initiative vastly improves the base topographic maps for the state, and the underlying digital map data benefits high priority applications in safety, planning, research and resource management.

VI. Geologic and Geophysical Surveys

Alaska is the nation's largest producer of silver and zinc, and second largest producer of lead and gold. Alaska is blessed with vast mineral potential. Based on USGS estimates, if Alaska was a country, it would be in the top 10 for:

- Coal (17% of the world's coal; 2nd most in the world)
- Copper (3% of the world's copper; 5th most in the world)
- Lead (3% of the world's lead; 8th most in the world)
- Gold: (7% of the world's gold; 5th most in the world)
- Zinc: (4% of the world's zinc; 6th most in the world)
- Silver (1% of the world's silver; 9th most in the world)

In addition, Alaska has more than 70 known occurrences of rare earth elements (REEs) and multiple occurrences of other strategic and critical minerals. For example, Alaska has two exciting projects that this Committee should be aware of. The Graphite-1 deposit is the largest graphite deposit in the US, and is currently in the pre-permitting phase. There has not been any graphite mined in the US since 1991. The Bokan Mountain project is also in the pre-permitting phase, and, contains significant amounts of heavy rare earth elements. We expect that continued exploration will lead to additional discoveries, and welcome federal initiatives to stimulate this exploration.

Industry experts routinely rank Alaska in the top three jurisdictions globally in terms of pure mineral potential. The state is known for its world-class mines such as Red Dog, Greens Creek and Pogo, as well as many huge undeveloped mineral deposits. The state is underexplored, and explorers recognize the great potential present in a region that is underexplored and is so richly endowed in mineral resources. However, Alaska does not rate so highly in the same surveys in terms of the quality and quantity of geologic data available on the states mineral resources. Alaska routinely ranks in the middle tiers in terms of geologic, geophysical and geochemical data availability. This reflects the size of the state, and the scale of efforts to date.

Alaska is a young state, having entered the union on January 3, 1959. Alaska is also the largest state in the union, equal in area to about one fifth of the contiguous states. Alaska's geological survey has a staff of 39 dedicated geoscientists compared to a combined staff of 2,000 in the contiguous states. Based on area alone, Alaska's geological survey should have a staff of roughly 400, or ten times its current staff. In today's budget climate it seems unlikely that our geological survey will grow to have a staff of 400, but this illustrates that the various tasks will take a considerable length of time to accomplish with current staffing and funding levels. This inevitably leads to slow progress being made on the many fronts calling for additional information.

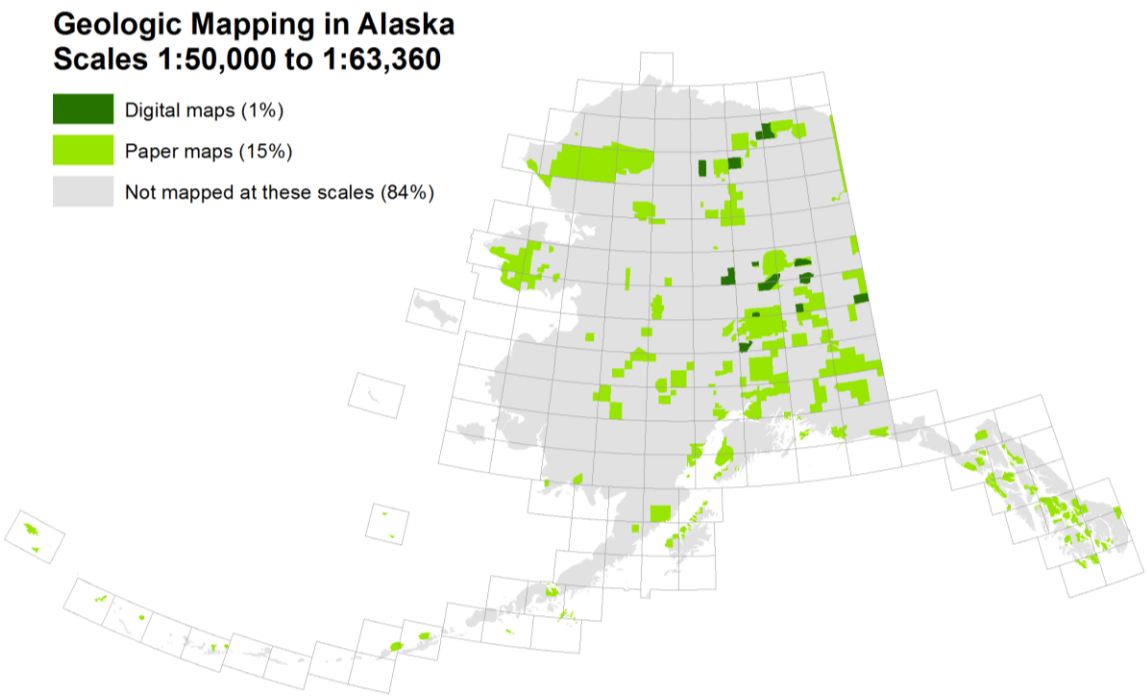
There are three key areas of basic information that, if improved, would greatly enhance the Alaska's attractiveness to mineral exploration companies. This involves completing geologic mapping, airborne geophysical, and modern geochemical surveys in areas that are both prospective for and open to mineral development. In addition, Alaskan communities urgently need additional geologic hazard mapping efforts to adequately prepare Alaskan for the many existing hazards and the changes that will results from a warming climate, shrinking sea ice and permafrost degradation.

Geologic Mapping

Geologic mapping is a foundational informational layer, upon which many additional layers of information are built. These secondary layers include soil, landslide, mineral occurrence, geochemistry, landslide, fault location and groundwater maps. Quality geologic maps are necessary before these additional layers can be constructed, and for any activity that involves working in or on the earth.

The National Cooperative Geologic Mapping Program (STATEMAP) is an excellent example of the cooperative funding and leveraging of state and federal dollars to conduct geologic mapping. This national program has been a cornerstone of cooperation between State Geologic Surveys and the USGS and has been supported by Alaska. Since inception in 1992, this program has produced approximately 4,000 geologic maps across the nation, and mapped over 500,000 square miles. STATEMAP leverages federal funding by requiring states to match federal grant dollars 1:1. This year $5.5 million, or roughly 20% of this programs funding was made available to the states. However, this year, as in most years, the states left a roughly equal amount of funding on the table. The State supports expanded funding to the authorized level for the STATEMAP portion of this program, to further the production of geologic maps and to fully leverage the available state funding.

Statewide geologic mapping at a scale suitable for mineral or energy exploration activities has been completed over 17% of the state. While not sounding very substantial, this is equal in area to the state of Arizona, but the remaining area to be mapped is roughly equal to the combined area of California, Oregon, Washington and Idaho. Unfortunately, at the current rate of geologic mapping, this will take over 400 years (and possibly over 1000 years) to complete. Completing a geologic map of Alaska is not an insurmountable task, as the remaining area is roughly equal to the combined area mapped under the STATEMAP portion of the National Cooperative Geological Mapping Program over the last 23 years. The State of Alaska has a long-standing productive relationship with various program areas within the USGS, and staff from both organizations readily participate in ongoing joint mapping activities. We hope these relationships continue to strengthen going forward. Geologists in Alaska were thrilled by the 2016 USGS publication of a statewide digital geology map, and the State supports continued mapping to ultimately complete a more detailed geology map of the state.

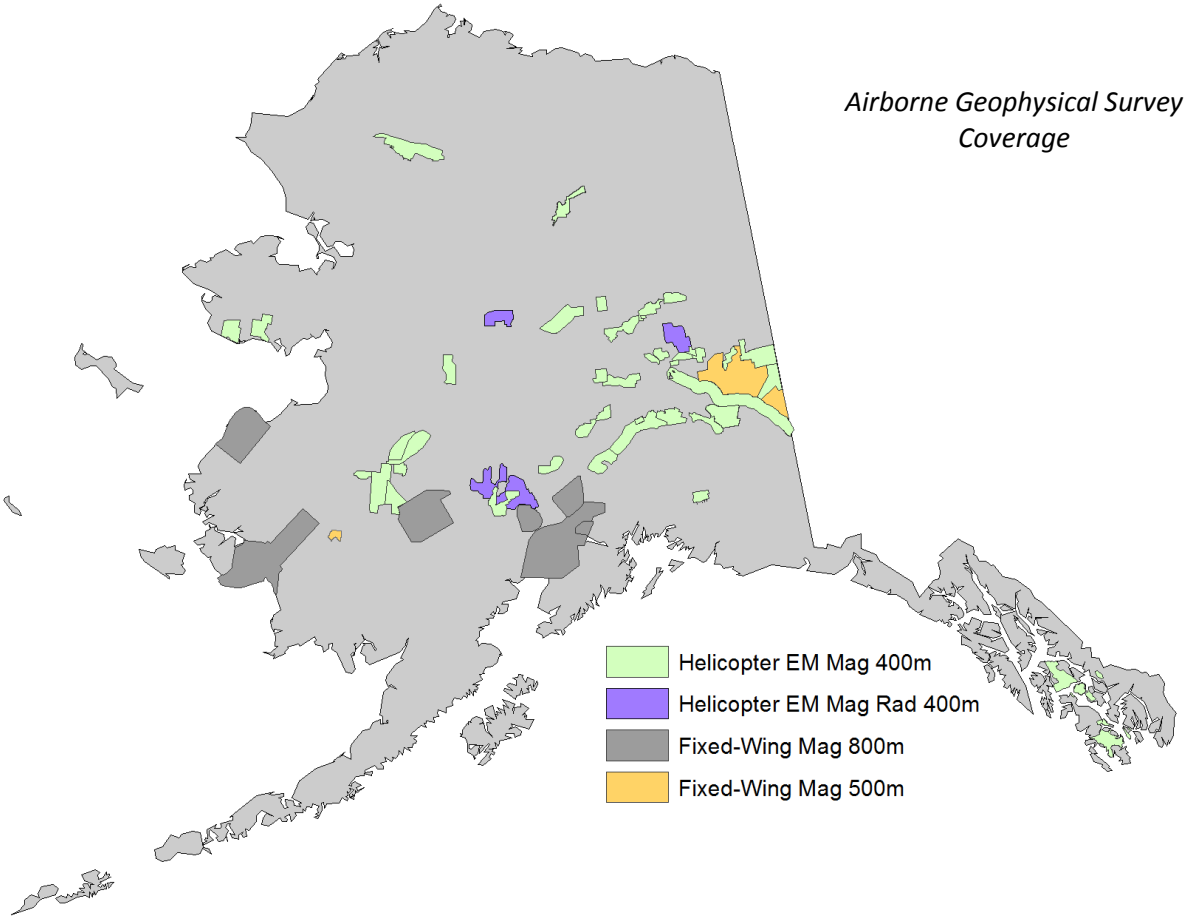


In light of a major recent oil discovery on Alaska's North Slope, geologic mapping and additional geologic data is required to allow the USGS to update the resource estimates for technically recoverable undiscovered conventional oil resources on Alaska's North Slope. In addition, tight sand plays associated with this recent discovery may also contain significant oil resources and should be included in resource estimates. The state supports funding the proposed three year collaborative State-USGS program at the requested $1.6 million per year.

Another key federal program that helps to archive samples and other forms of legacy geologic and geophysical data is the National Geological and Geophysical Data Preservation Program. A tremendous amount of valuable new information was acquired at a very low cost in Alaska by sampling archived materials from both the State and USGS collections. It is imperative that this cost-effective program is maintained and sufficiently funded to protect at-risk geologic data and samples.

Airborne Geophysical Surveys

Airborne geophysical surveys collect data on the magnetic, electromagnetic and radiometric properties of the various rock units on the earth's surface. These surveys are of great use in support of geologic mapping, and resource development, as they can help map the rock units beneath soil layers. Data is usually collected by either helicopter or fixed-wing aircraft at low altitudes, with variable additions of electromagnetic and radiometric surveys. Airborne geophysical surveys have been completed over only about 4% of the state. These have been principally funded by the State of Alaska, the Bureau of Land Management and the USGS, with support from industry and Alaska



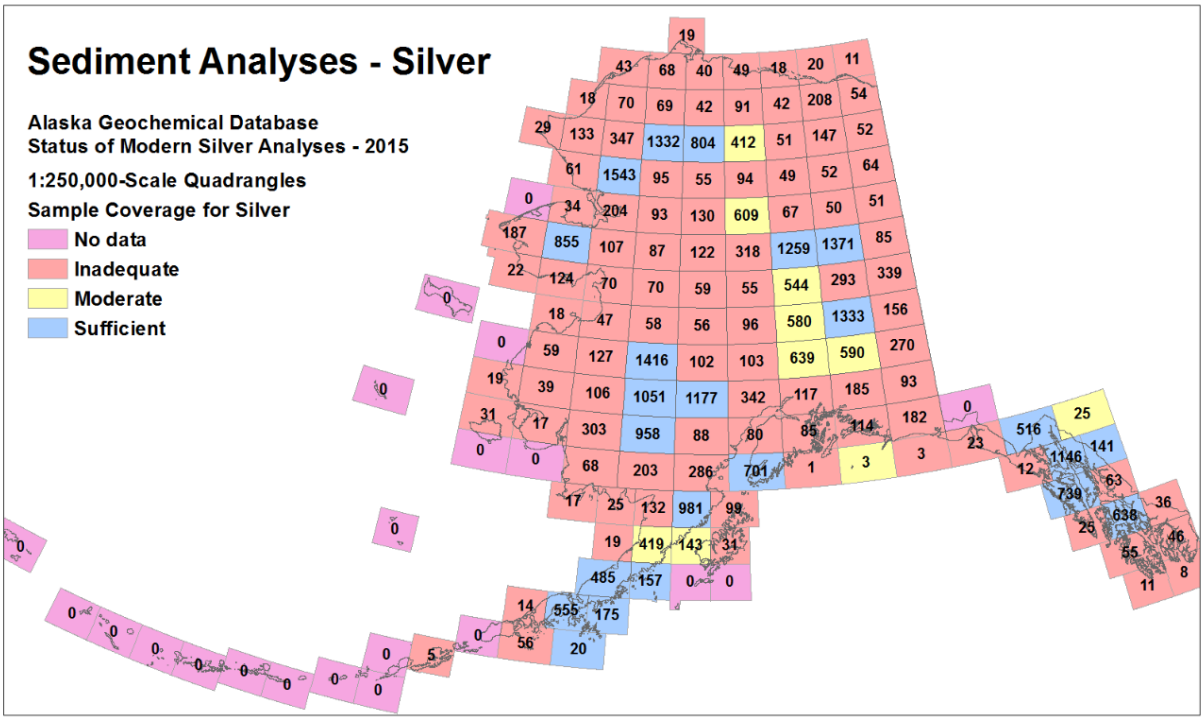
Native Claims Settlement Act (ANCSA) corporations.

All of these data are made available through the State of Alaska Division of Geological & Geophysical Surveys web site. It is widely recognized that these surveys provide incredibly valuable information in support of geologic mapping and mineral resource discovery. State and federally funded airborne geophysical surveys in combination with geologic mapping have assisted in numerous mineral discoveries in Alaska, and will continue in the future. Completing an airborne fixed-wing geophysical survey over areas of high mineral potential would quite possibly pay huge dividends in terms of mineral discoveries and improved geologic understanding.

The State's geological survey has a close collaborative relationship with the USGS and anticipates flying an airborne magnetic survey for the USGS in Eastern Alaska near the Canadian border in 2016. Continuing to collect data over areas of high mineral potential, is a priority for the state and we look forward to continuing collaborations with the USGS. To complete moderately detailed, fixed-wing airborne magnetic surveys over mineral-rich portions of the state is achievable in a reasonable time-frame (20 years) with expenditures of roughly $1.5 million per year. The State supports continued funding for these programs within the USGS.

Hyperspectral surveys collect data on light reflecting from vegetation or soil surfaces. These data provide information on minerals present in the soil and exposed rock, as well as vegetation types. This data helps geologic mapping and mineral development, and has numerous applications in the areas of agriculture, forestry and ecology. These surveys have barely begun in Alaska, with far less than 1% surveyed, yet they would offer many benefits to help geologic mapping, mineral exploration, as well as forestry, land cover and ecological applications from determination of mineral content, vegetation type and changing patterns of vegetation with a changing climate. The University of Alaska has equipment and personnel in place to conduct such surveys in cooperation with the USGS, and the state geological survey. Due to the multiple benefits from such surveys the State strongly supports a statewide data collection, and construction of a web-based portal for data distribution.

Geochemical Surveys



The third area of critical need for mineral exploration is sufficient regional modern stream sediment and soil geochemical information. Data such as these provide direct chemical evidence to explorers of their target elements being present in a particular area. The information is also of great use for environmental and land use planning.

Sufficient, modern stream sediment analyses are only available in 15% of the state at a regional scale of 1:250,000 and about 1% of the state is covered at a detailed scale of 1:63,360. In many areas the samples from the original collections remain in sample archives and only funding for modern analyses and data compilation is required. It is estimated that to complete analyses on existing samples to bring the entire state to an adequate regional data density and would costs $3.4 million.

Soil geochemical maps of the continuous states were recently produced by the USGS. These are extremely useful products. An Alaska set would be similarly beneficial, and form a portion of a geochemical atlas for the state along with upgraded stream sediment analyses. The State supports funding for collection and analyses of soils for the generation of a series of soil geochemistry maps for Alaska.

Geologic Hazards

Alaska has all of the kinds of geologic hazards present in the rest of the nation, with additional hazards from 52 active volcanoes. Alaska is the most seismically active state with a subduction zone over 2,000 miles long that has spawned 3 of the 10 largest earthquakes ever recorded, and contains geologic hazards associated with permafrost and sea-ice.

Much of the central, northern and western parts of the state have landforms, ground and surface water patters and ecological systems controlled by the distribution of permafrost, and in

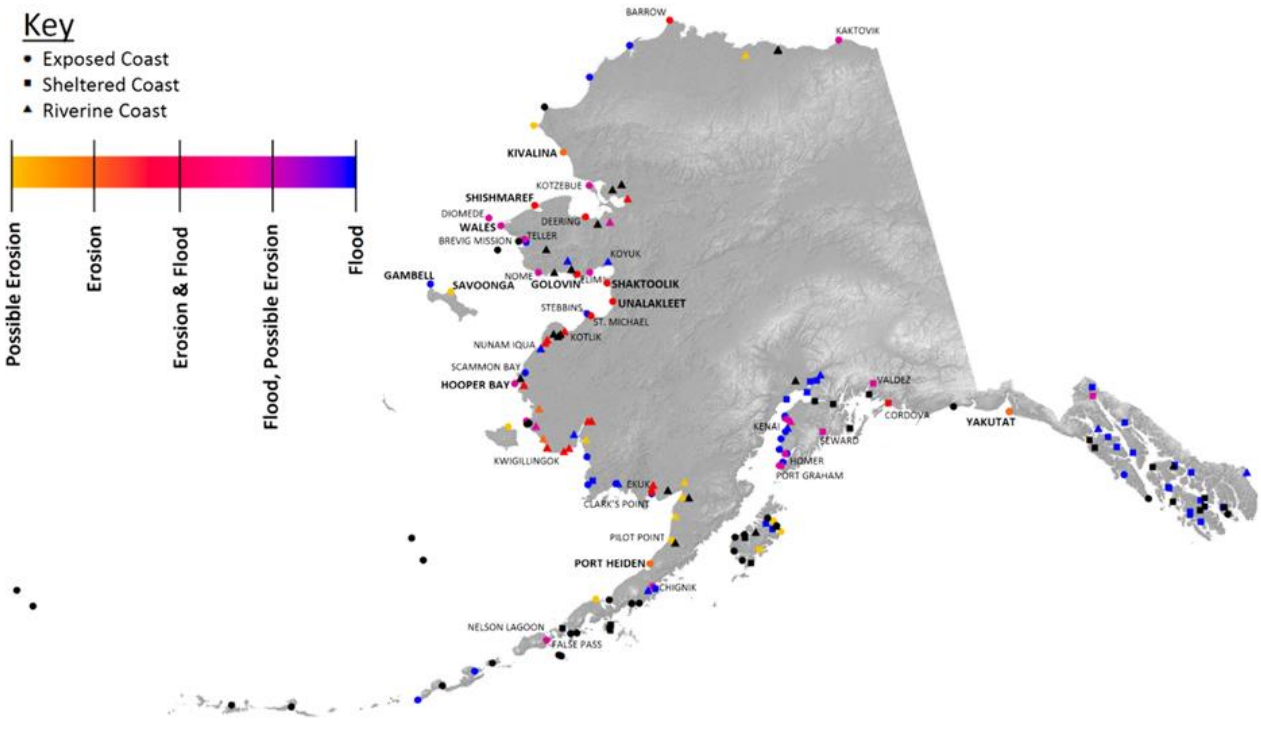
many cases the land is only stable because it is frozen. Thaw out the permafrost and all aspects of the system influenced by the presence of permafrost change to reflect this new environment. Surface and groundwater patterns change, lakes either drain, or reform elsewhere, hydrologic patterns change causing vegetation and ecological changes that affect bird and mammal populations. All of these affect the human population. Understanding changes to the permafrost is crucial to understand potential impacts of climate change on all aspects of life in Alaska.

The USGS Alaska Climate Science Center works closely with many organizations researching these issues, and Alaska strongly supports expanding funding for the Climate Science Center research. Alaska supports expanding these research efforts so we can be ahead of these changes and adapt to them proactively.

The level of completion of geologic hazard mapping in Alaska is, for the majority of hazards, far behind that of geologic mapping. Some key areas in need of addition mapping are coastal erosion, coastal flooding, avalanche and landslide susceptibility mapping. All of these have regional or statewide significance and the lack of basic information claims lives with unfortunate frequency.

The USGS has mapped coastlines along Alaska's northern shore and a portion of its western shore. The State of Alaska's Division of Geological and Geophysical Surveys has also mapped shoreline positions along sections of coast and near communities. In order to conduct shoreline position change, additional iterations need mapping along much of the north and west coast. This will allow estimates of erosion rates around communities, with the benefit of determining which communities are stable, and which will need relocation, and provide estimates of when. The cost to complete this program is estimated at $0.75 million.

Shrinking sea ice, and ice that either forms later, or breaks up earlier, leaves coastal communities vulnerable to fall and spring storms, with associated erosion, sea ice inundation, and flooding. Most of Alaskan coastal communities do not have sufficient information on tides, water level, community elevation data and wave run up to accurately predict what will happen during any particular storm. The State of Alaska is working collaboratively with the USGS Climate Science



Center, the Land Conservation Cooperatives, the National Oceanic and Atmospheric Administration (NOAA), the Alaska Ocean Observing System and the University of Alaska to conduct the research necessary to generate upgraded storm surge models and community inundation maps. Much additional work remains before we can predict with reasonable accuracy the effects of a storm at the community level, and the State of Alaska strongly supports increased funding for these activities.

Landslides claimed the lives of three Alaskans last year. The warming climate and changing precipitation patterns indicate this may unfortunately become a more common event. As permafrost melts, slopes will become unstable. Alaska does not have either a statewide, or community level series of maps depicting areas with known landslides, or areas at risk for future landslide. This is a crucial dataset that would save lives by improving community planning through landslide avoidance. Completion of a first-pass landslide mapping assessment for communities and infrastructure corridors is estimated to cost $5 million. The recently introduced legislation entitled a National Landslide Loss Reduction Act would greatly help with these efforts. Alaska strongly supports passage and full funding of this vital piece of legislation.

Changing precipitation patters, and climate change models suggest avalanches patterns will change across the state. Alaska has no statewide avalanche susceptibility maps, and annually avalanches claim lives, and threaten homes and communities. A statewide assessment could be quickly conducted using the new IFSAR data being collected, and would provide communities and transportation planners with a rapid first look at areas susceptible to avalanches. This would be a huge first-step in saving lives and provide groundwork for more rigorous analyses of higher-risk areas, and is estimated to cost $0.5 million.

Potentially destructive earthquakes occur in Alaska on average every two months (greater than magnitude 6), the most recent being the 2015 Iniskin (magnitude 7.1) that ruptured gas lines, burned several homes and damaged roads. Alaska is the most seismically active state, with all of the earthquakes greater than magnitude 8 in the last 300 years, and 71% of the earthquakes greater than magnitude 7 in the United States. Yet Alaska's earthquake monitoring system lags those in the rest of the nation. The Alaska monitoring network falls far short of the Advanced National Seismic Standards (ANSS). Under the USArray portion of the National Science Foundation's Earthscope project, 261 seismic stations will be deployed in Alaska through 2018. Currently there are no plans to adopt a portion of the USArray into Alaska's seismic monitoring network. There is a limited window of opportunity to develop and implement a strategy to retain a subset of these stations before they are removed in 2018/2019. If integrated into the Alaska seismic monitoring network, these could form the backbone for an earthquake early warning system, and bring Alaska far closer to meeting ANSS. The USGS has formulated a working group to define the cost-benefit of such an adoption and the State is highly supportive of this effort, and steps that lead to improved seismic monitoring, and development of an earthquake early warning system. Initial estimates are that adoption of 80 of these stations would cost $2.5 to $3 million a year to maintain.

Along with earthquake monitoring, the State of Alaska Division of Geological & Geophysical Surveys, in collaboration with the USGS, NOAA and the University of Alaska, Fairbanks has a well-established and ongoing tsunami inundation mapping program that is sequentially mapping a prioritized list of coastal communities. To date thirteen communities have been mapped, leaving 10 communities in process, and as many as another 27 to be evaluated. This is a high-value impactful

program of great value to Alaska communities. Additional local detailed topographic and bathymetric information would help these analyses. Completion of each community tsunami evaluation costs roughly $250,000.

VII. Conclusion

The above cost-sharing table (Table 1) illustrates past performance for the funding and acquisition of the IfSAR elevation dataset, which is foundational to all map layers related to topographic mapping. Other framework datasets are also needed. This table clearly demonstrates USGS as a leader in funding and speaks to current USGS commitment to an accurate map of Alaska.

The State of Alaska greatly appreciates the leadership role of DOI and especially USGS in the AMEC. We will continue to work diligently with AMEC to leverage our diminishing state funding with funding from our other federal partners. We believe that other federal agencies will have a definite benefit from a more accurate map: the Federal Aviation Administration is a primary beneficiary and user of elevation data, which will improve aviation safety. The Federal Emergency Management Agency and the U.S. Army Corps of Engineers both have an interest in better mapping to address coastal and inland flooding and erosion.

The State of Alaska is currently in a severe budgetary crisis and it is unlikely Alaska will be able to contribute additional funding beyond 2016's contribution but having said that I believe Alaska has demonstrated a good faith effort to advance our shared mapping initiative. Federal agencies need to proactively program their budgets to meet this mapping need. This need will not be met simply because the elevation data has been finalized. Geodetic control, orthoimagery, transportation, hydrography, cadastral and administrative boundaries are all fundamental framework layers. Soils mapping and vegetation also needs to be addressed as does geology, hazards and etc. In short the State of Alaska is deeply appreciative of the on-going efforts to modernize the Alaska map. The State welcomes AMEC's and USGS' efforts to incentivize a more proactive budgeting process across all affected departments and beneficiaries.

Thank you very much for the opportunity to provide my testimony here today. The USGS has been an excellent partner for the State of Alaska in our efforts to better map and understand the natural resources of our great state.