Appendix E - Business Uses

BU 01 - Water Supply and Quality

BU 01 Scope

Business Use #1 (BU 01) includes the fate and transport of contaminants; pollution risk mitigation; runoff and sedimentation analyses; point- or non-point source pollution modeling; management of contaminants and marine debris – point, non-point, vessel, and atmospheric pollution; spills; and trash. Many federal, state, and local agencies and non-governmental organizations are responsible for MCAs relevant to water supply and quality, with EPA taking the lead on water quality.

BU 01 Background Information

Water is our most precious natural resource. Plant, animal, and human life cannot exist without it. Humans need clean water for drinking, cooking, cleaning, and bathing, and we use it for recreation. We need water for irrigation and to grow vegetables, fruits, and animals. Industries need water for raw materials, generating electricity, heating, cooling, and for river and ocean transport of raw and finished products. Water continually recycles between solid, liquid, and gas; water circulation helps to maintain balance on the earth and within all biological organisms. Of all the water that continually recycles, only a small percentage is actually available for our use; usable water includes underground aquifers and above-ground rivers, lakes, streams, and marshes, comprising less than one percent of the total water on the planet. It is incumbent on everyone to conserve water and to act in ways to maintain the purity of our surface and sub-surface waters.

Figure E.1a. Top view: Topobathy lidar derived DEM that contains lidar voids within stormwater retention ponds in Tarpon Springs, FL. Bottom view: Orthoimage of the same area. Such retention ponds are used to manage stormwater runoff to prevent flooding and downstream erosion, and to filter pollutants to improve water quality in adjacent rivers, streams, lakes, or bays. Image courtesy of NOAA.

America's sources of safe drinking water are constantly vulnerable to contamination. Many federal, state, and local governmental agencies, as well as private sector companies, are responsible for water supply and quality, to include reductions in farm runoff and/or establishment of wetlands that filter runoff into streams that supply us with water that sustains life.

Examples of the use of digital elevation data for BU 01 include hydrodynamic modeling, which is the study of fluids in motion. Hydrodynamic modeling uses digital elevation data and hydrodynamic inputs to quantify and predict related processes such as sediment transport, scour and water quality. 3D hydrodynamic modeling is just one of the 46 mission-critical requirements for elevation data summarized in the next section. Digital elevation data that include the bottom surface of reservoirs are also needed to perform volumetric analyses of reservoirs for hydropower capacity and to identify storage capacity and sedimentation rates.

BU 01 Elevation Data Uses

Using their own words, respondents documented 81 Mission Critical Activities (MCAs) that identified BU 01 as their primary Business Use and identified the following 46 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.1a. BU 01 Elevation Data Uses

Data Use
Engineering Design and Construction
1. Engineering and design of water infrastructure
Environmental Protection
2. Environmental protection
3. Environmental restoration
4. Fate and transport of contaminants
5. Pollution risk mitigation
6. Reclamation of abandoned mines
7. Total Maximum Daily Load (TMDL) development
8. Water quality analysis
9. Water quality improvement
10. Water quality management
11. Wellhead protection
Erosion/Sediment Control
12. Erosion control
Geology
13. Sinkhole mapping, monitoring, and analysis
Habitat Analysis and Management
14. Aquatic species management
15. Ecosystem management
16. Habitat restoration
Hazard Assessment and Mitigation
17. Spills prevention, preparedness and response
Mapping/Boundary Delineation
18. Identification of geomorphologic units
19. Karst mapping
20. Mapping of sewers, manholes, pipes, and inverts
21. Soils mapping
22. Wetlands mapping
Modeling
23. 3D hydrodynamic modeling
24. Aquifer modeling
25. Environmental modeling
26. Geologic modeling of aquifers
27. Hydrologic and Hydraulic (H&H) modeling
28. Modeling of global terrestrial hydrologic cycle
29. Modeling of nitrate vulnerability

Data Use
30. Oil spill modeling
31. Surface and groundwater modeling
32. Water flow modeling
Permitting
33. Environmental permits
Planning
34. Water supply planning
35. Tribal water planning
Regulatory Reviews and Enforcement
36. Clean Water Act (CWA) monitoring and enforcement
37. Environmental impact assessments
Water Supply and Delivery
38. Development of water delivery systems
39. Drinking water purification
40. Reservoir capacity determination
41. Sedimentation studies
42. Stream assessments
43. Studies of water supply and reliability
44. Water resources management
45. Water supply analysis
46. Water supply development

BU 01 Tangible and Intangible Benefits

For the 81 MCAs that list Water Supply and Quality as their primary Business Use:

- **Table E.1b** summarizes the reported future annual dollar benefits by geography type, totaling $301.4 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.1c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.1e.
- **Table E.1d** shows (in blue) the eight federal agencies, 32 states and territories, and five non-governmental entities that submitted MCAs with BU 01 as the primary Business Use. MCAs for which BU 01 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.1d.
- **Table E.1e** documents all the MCAs that listed BU 01 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.1e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 01 Reported Future Annual Dollar Benefits

Of the 81 MCAs that listed Water Supply and Quality as their primary Business Use, 51 MCAs estimated their tangible annual benefits totally in financial terms; 11 MCAs had a combination of tangible and

"Major" intangible benefits; and 16 MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in **Table E.1b**, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 81 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.1b. BU 01 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$54,182,317	$8,119,258	$62,301,575
Inland Bathymetry	$176,255,890	$12,142,092	$188,397,982
Nearshore Bathymetry	$8,796,573	$8,085,622	$16,882,195
Offshore Bathymetry	$5,815,204	$28,070,702	$33,885,906
Totals	**$245,049,984**	**$56,417,674**	**$301,467,658**

BU 01 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.1c. BU 01 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	68	56	17	47	18
Inland Bathymetry	46	21	11	32	11
Nearshore Bathymetry	21	6	5	6	4
Offshore Bathymetry	13	13	2	11	10
Totals	**148**	**96**	**35**	**96**	**43**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 01 Reported Future Annual Dollar Benefits Maps

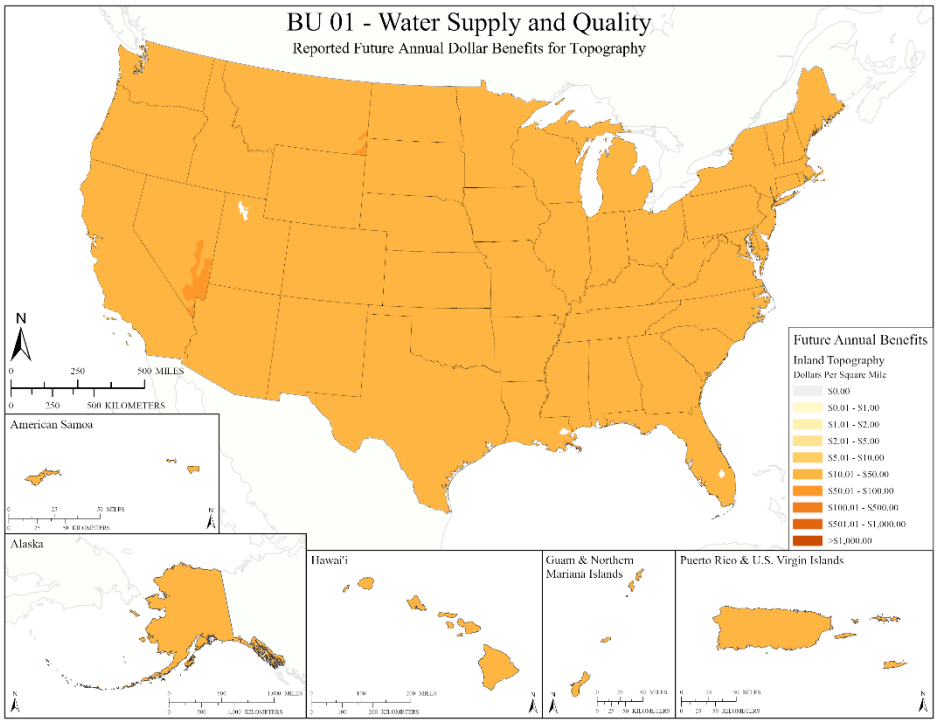

Figure E.1b. Reported Future Annual Dollar Benefits for Topography

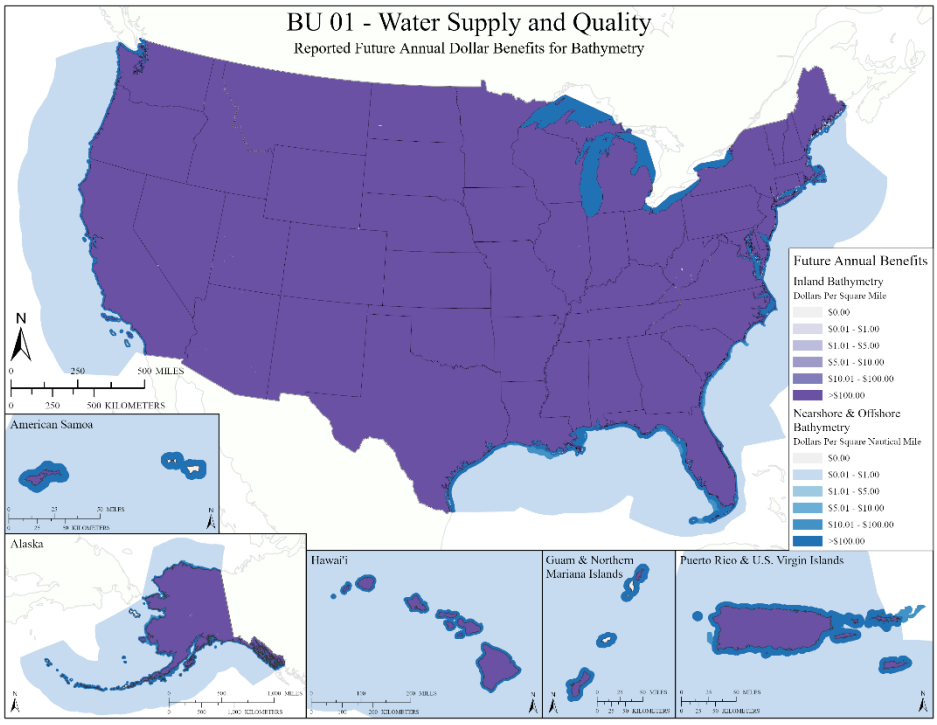

Figure E.1c. Reported Future Annual Dollar Benefits for Bathymetry

BU 01 Benefits Analysis

The total future annual benefits ($301.4 million per year) reported for BU 01 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 01 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, 12 federal agencies (ARS, BLM, CDC, EPA, IBWC, IJC, NASA, NPS, USACE, USAF, USARC, and USGS) submitted a total of 12 MCAs listing BU 01 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the 12 federal MCAs listing BU 01 as primary:
    - Inland Topography: Six provided dollar benefits and six indicated "Major" benefits.
    - Inland Bathymetry: Six provided dollar benefits and two indicated "Major" benefits.
    - Nearshore Bathymetry: Five provided dollar benefits and two indicated "Major" benefits.
    - Offshore Bathymetry: Two provided dollar benefits and one indicated "Major" benefits.
    - The dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.
    - Three federal agencies (NOAA, Smithsonian Institution, and U.S. Forest Service) submitted MCAs with BU 01 as secondary, and one federal agency (Oak Ridge National Laboratory) submitted an MCA with BU 01 as tertiary.
- State/Local/Tribal and U.S. Territory MCAs: Forty-eight (48) states and territories submitted a total of 68 MCAs that designated BU 01 as their primary Business Use. Of the 68 MCAs listing BU 01 as primary:
    - Inland Topography: 54 provided dollar benefits and nine indicated "Major" benefits.
    - Inland Bathymetry: 39 provided dollar benefits and nine indicated "Major" benefits.
    - Nearshore Bathymetry: 16 provided dollar benefits and two indicated "Major" benefits.
    - Offshore Bathymetry: Ten provided dollar benefits and two indicated "Major" benefits.
    - The dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.
- Non-governmental MCAs: One non-governmental organization (Glorieta Geoscience) submitted an MCA that designated BU 01 as primary; however, benefits for inland topography were "Moderate" and benefits for inland bathymetry were "don't know." Montana State University and Taylor Shellfish Farms submitted MCAs with BU 01 as secondary, and Ayers Associates and MSA Professional Services submitted MCAs with BU 01 as tertiary. Thus, no dollar benefits accrued to BU 01.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Table E.1b:
    - Whereas Colorado and Illinois submitted MCAs for which BU 01 was secondary, Arkansas, Indiana, Maryland, New Hampshire, New York, and Puerto Rico had no MCAs that listed BU 01 as either primary, secondary, or tertiary. Recognizing that water

quality is a major issue in all of these areas, and especially for the Chesapeake Bay, Long Island Sound, Great Lakes, and Puerto Rico, we believe the BU 01 benefits are understated.

- 244 "Major" Operational and Customer Service benefits and 174 "Major" benefits for Education and Outreach, Environmental, Public Safety, and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Dollar Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 01 for which "Major" benefits are documented, this could easily be translated into tens of millions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.
- In the section above on BU 01 Mission Critical Requirements for Elevation Data, 46 user-defined elevation data uses were listed including engineering and design of water infrastructure. Those requirements were largely documented by government agencies who contract the actual engineering studies, engineering design, and topographic survey services to private sector engineering, mapping and surveying firms or technical consultants. Of the 24,000+ private sector engineering firms and 16,000+ private sector land surveying firms in the U.S., only one small engineering firm responded to the 3D Nation questionnaire. That one engineering firm indicated millions of dollars in annual savings from the availability of accurate and authoritative elevation data in the public domain routinely used for engineering studies and engineering design services and topographic surveys mandated by local zoning and permitting regulations. NOAA and USGS had no way to contact 40,000 engineering and surveying companies to document their elevation data requirements and benefits, and it would have been impractical to do so; however, if many of the 24,000 other engineering firms and 16,000 land survey firms had similarly responded, the annual benefits of public domain elevation data would have been billions of dollars higher, spread across most of the 30 Business Uses.

BU 01 Summary Tables for Requirements and Benefits

The following tables summarize the MCAs with requirements and benefits for BU 01:

- **Table E.1d** color-codes those organizations having an MCA with BU 01 as Primary, Secondary, or Tertiary.
- **Table E.1e** summarizes the 81 MCAs with primary benefits for BU 01, rank ordered from the highest to the lowest tangible benefits.

Table E.1d. Organizations having an MCA with BU 01 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	**ARS**	BIA	**BLM**	BOEM	**CDC**	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	**IJC**	MARAD	**NASA**	NGA	*NOAA*	**NPS**	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	*SI*	TVA	**USACE**	**USAF**	**USARC**	USBR	USCB
	USCG	*USFS*	**USGS**	USMC	USN					

State/Ter	**AL**	**AK**	AR	**AZ**	**CA**	*CO*	**CT**	**DC**	**DE**	**FL**	**GA**	**HI**	**IA**	**ID**
	IL	IN	**KS**	**KY**	**LA**	**MA**	MD	**ME**	**MI**	**MO**	**MN**	**MS**	**MT**	**NC**
	ND	**NE**	NH	**NJ**	**NM**	**NV**	NY	**OH**	**OK**	**OR**	**PA**	**RI**	**SC**	**SD**
	TN	**TX**	**UT**	**VA**	**VT**	**WA**	**WI**	**WV**	**WY**	PR	**VI**	**GU**	**AS**	**CNMI**

Non-Gov	Ayers Associates	**Glorieta Geoscience, Inc.**	MSA Professional Services	*Montana State University*
	Taylor Shellfish Farms			

Table E.1e. MCA summaries for BU 01, rank ordered from the highest to the lowest tangible benefits.

Organization	EPA		Water quality. High accuracy elevation data are mission-critical for EPA to understand urban area modeling, to understand characteristics and hydrodynamics of streams and estuaries, and to make decisions on how to protect and/or restore the water we drink, and/or the environment that sustains us.				
MCA Name	MCA No.						
Water Quality	50011						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$18,208,275	$2,089,711	don't know	don't know	don't know
Inland Bathy	QL2B	4-5 yrs.	$70,615,844	$4,099,749	don't know	don't know	don't know
Nearshore B.	QL2B	4-5 yrs.	$3,763,786	$3,100,198	don't know	don't know	don't know
Offshore B.	Order 1b	2-3 yrs.	$5,505,568	$27,527,840	Moderate	Major	don't know

Organization	USACE		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60679						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$18,208,275	$2,089,711	Moderate	Major	None
Inland Bathy	QL1B	6-10 yrs.	$70,615,844	$4,099,749	Moderate	Major	None
Nearshore B.	QL1B	6-10 yrs.	$3,763,786	$3,100,198	Moderate	Moderate	None

Organization	IBWC		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60692						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$923,575	$105,996	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$3,579,543	$207,817	Moderate	Major	Moderate
Nearshore B.	QL1B	4-5 yrs.	$40,401	$33,278	Moderate	Moderate	Moderate

Organization	New Mexico		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60304						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$674,170	$180,579	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$2,916,517	$304,788	Moderate	Major	Moderate

Organization	Arizona		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60034						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$632,080	$169,305	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$2,734,434	$285,759	Moderate	Major	Moderate

Organization	Iowa		Water quality improvement. Elevation data are used for watershed modeling, H&H modeling, environmental assessments, Phase 1 investigations of contaminated sites, water quality programs, water flow modeling, and conservation. Inland bathy data is highly desirable.				
MCA Name	MCA No.						
Water Quality Improvement	22442						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	>10 yrs.	$721,708	$473,664	don't know	Moderate	Moderate
Inland Bathy	X-Sec meet needs	>10 yrs.	$1,349,773	$141,056	Moderate	Major	Moderate

Organization	Florida		Total Maximum Daily Load (TMDL) Development. This activity determines the maximum amount of a given pollutant that a surface water can absorb and still meet the water quality standards that protect human health and aquatic life.				
MCA Name	MCA No.						
Total Maximum Daily Load (TMDL) Development	32991						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$311,137	$83,339	Minor	Moderate	Minor
Inland Bathy	QL0B	Event driven	$1,346,009	$140,663	don't know	Minor	None
Nearshore B.	I don't know	Ideally, they would be more frequent to capture tidal durations	$288,609	$475,449	don't know	Moderate	don't know

Organization	North Dakota		Water appropriations - permitting of ground and surface water appropriations including geological studies of surface waters and ground waters for primarily agricultural and oil field operations. Regulatory - for all water related structures including permitting and safety regarding dams, dikes, drains, etc. Development - focused primarily on rural water delivery and development Investigations - focused on surface water modeling, flooding and dam break scenarios, emergency response. Atmospheric resources - focused on collection of meteorological information and management of weather modification operations. Elevation data are needed for flood risk identification, emergency operations, surface water modeling, H&H modeling, FEMA Base Level Engineering (BLE), and groundwater modeling. BU 08 – Agriculture and Precision Farming would be an additional Business Use.					
MCA Name	MCA No.						
Statewide Water Resource Management, Data Collection, Distribution, and Emergency Management	21599						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$2,500,000	$125,424	None	Moderate	Moderate
Inland Bathy	QL3B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Missouri		Issue of environmental permits. Every DNR permit needs to know the downstream impacts of the proposed project. A surface trace to the first down land stream is performed, then a trace down the stream network to see impacts. The DNR permits all things that would release or drain into the watershed (e.g. industrial, mining, drilling, air pollution, asbestos, wells, boreholes, hazardous waste, land reclamation, stormwater, landfills, infectious waste, etc.). OGIS provides data to other state agencies as well.				
MCA Name	MCA No.						
Environmental Permitting	1298						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$68,479	Major	don't know	don't know	don't know
Inland Topo	QL2	6-10 yrs.	$2,536,481	Major	don't know	don't know	don't know
Inland Bathy	QL3B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Oregon		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60349						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL1B	6-10 yrs.	$2,327,748	$243,259	Moderate	Major	Moderate
Nearshore B.	QL1B	4-5 yrs.	$8,886	$14,639	Moderate	Moderate	Moderate

Organization	South Dakota		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60407						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$427,573	$114,527	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$1,849,718	$193,303	Moderate	Major	Moderate

Organization	Michigan		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and atmospheric pollution; spills; Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Geologic mapping and analysis. Sinkhole and mapping, monitoring, and analysis. Identification of geomorphologic units. Karst mapping, including springs and caves. Aquifer recharge. Onshore mineral extraction. Monitoring sand as a local resource. Stockpile analysis. Environmental impact assessment and site restoration. Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance. Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts. Development of 3D visualizations of the Earth. Stormwater modeling. Includes impact assessment and monitoring and wetlands mapping. Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.						
MCA Name	MCA No.						
Michigan Environmental Quality and Natural Resources Evaluation	22460						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$322,061	$86,265	Moderate	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$1,393,263	$145,601	Moderate	Moderate	Moderate
Nearshore B.	QL0B	6-10 yrs.	$121,941	$200,885	Minor	Major	Major
Offshore B.	Order 2	6-10 yrs.	$41,617	$208,088	Minor	Major	Major

Organization	Kansas		Kansas Water Vision and Plan, which includes conducting sedimentation analyses upstream of water supply reservoirs, evaluating geomorphic changes, identifying actively eroding streambanks and targeting of state resources to address. Follow up review of impacts of past streambank stabilization projects. Calculating sediment volumes and land lost, calculating impacts of sediment on water supply quantity and nutrients on water quality in downstream public water supply reservoirs. Analysis of erosion from agriculture sites and targeting of state/federal environmental efforts. Targeting of water quality and water quantity projects. With expanding harmful algal bloom occurrences, need to identify sources of nutrients and upstream erosion.				
MCA Name	MCA No.						
Elevation Data to Support State Water Planning Initiatives	1274						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$164,433	$44,044	Moderate	Major	don't know
Inland Topo	QL2	6-10 yrs.	$63,667	$17,053	Moderate	Major	don't know
Inland Bathy	QL2B	4-5 yrs.	$1,973,558	$206,245	Moderate	Major	Minor

Organization	Washington		Oil spill prevention, spill contingency planning, and spill response. Future use of bathymetry for analysis and modeling and to inform where to place resources – spill response resources, planning, and protection of natural resources, For the Spills Prevention, Preparedness, and Response Program, bathymetry data from nearshore areas is important to understanding risk from vessels striking fixed objects or running aground. The information may also prove useful when trying to identify locations where oil that sinks or submerges may naturally collect. Additionally, improved bathymetry data can help identify local factors that influence the potential for spills in specific waterways. The Spills Prevention, Preparedness, and Response Program sees great value in a national effort to coordinate and prioritize mapping activities. A national effort should limit the duplication of efforts and ultimately result in a standardized dataset with a wide range of practical applications.					
MCA Name	MCA No.						
Oil Spill Prevention, Spill Contingency Planning, and Spill Response	22430						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$374,581	$100,333	Moderate	Major	Moderate
Inland Bathy	QL1B	2-3 yrs.	$1,620,471	$169,345	None	Moderate	Moderate
Nearshore B.	QL1B	2-3 yrs.	$50,520	$83,227	None	Minor	Moderate
Offshore B.	Order 1a	2-3 yrs.	$2,834	$14,170	None	Minor	Moderate

Organization	Montana		Water resources investigation and modeling. Elevation data are used for surface and groundwater modeling to predict development scenarios and analyze the relationship in time between aquifers and surface water. Water wells are used to estimate ground water elevations. GMS groundwater modeling software is used, also ArcHydro, HEC HMS, and HEC RAS. The bureau uses elevation data to analyze the effects of development on water resources and runoff water components. Inland bathymetry is needed to estimate reservoir volume for hydropower. Seamless nationwide topo and bathy data would be extremely useful to us as an agency.				
MCA Name	MCA No.						
Water Resources Investigation and Modeling	1207						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$620,992	$578,880	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$663,847	$463,104	Major	Major	Major

Organization	Vermont		3D hydrodynamic modeling for the purpose of understanding the 1) disposition of nutrients from land sources, 2) effects of causeways within Lake Champlain, 3) implementing better choices for effluent & water intake pipes and finally, 4) investigations on the effects of flooding within the lake. Also, modeling of pollutant movement, algal bloom dynamics, and circulation dynamics; bathymetry is critical to the models.				
MCA Name	MCA No.						
3D Hydrodynamic Modeling for Management of Major Lakes	1308						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	>10 yrs.	$2,055,340	$91,656	Major	Major	Major

Organization	Louisiana		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point - or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Environmental Management	32959						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$255,515	$68,441	None	Major	None
Inland Bathy	QL1B	6-10 yrs.	$1,105,383	$115,517	None	Major	Minor
Nearshore B.	QL1B	4-5 yrs.	$200,405	$330,144	Moderate	Moderate	Moderate
Offshore B.	Order 1a	4-5 yrs.	$326	$1,633	Minor	Major	Major

Organization	North Carolina		Environmental restoration and protection of natural resources. Topography and bathymetry are needed for the inland for modeling of water quantity and quality. The data are also needed to identify public safety/facilities that are permitted (livestock facilities) that might be inundated during storms, to model runoff, and to establish buffers for groundwater, etc. Elevation data are used for both restoration planning and protection. Another use is for prioritizing culvert to bridge retrofit to allow fish passage during low flow. A future use would be to refine the stream origin models for updating the hydrography.				
MCA Name	MCA No.						
Environmental Restoration and Protection of Natural Resources	1155						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$274,963	$73,318	Moderate	Moderate	Minor
Inland Bathy	QL2B	4-5 yrs.	$1,184,151	$123,748	Moderate	Moderate	Minor
Nearshore B.	QL1B	2-3 yrs.	$141,560	$233,204	Moderate	Minor	Moderate

Organization	CDC		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60641						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$250,000	$250,000	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$250,000	$250,000	Moderate	Major	Moderate
Nearshore B.	QL1B	4-5 yrs.	$250,000	$250,000	Moderate	Moderate	Moderate
Offshore B.	Order 1b	2-3 yrs.	$250,000	$250,000	Moderate	Major	Major

Organization	Alabama		Managing water quality in the State of Alabama. We need good elevation data to determine drainage areas. We use it to determine which stream/streams are affected by activities that we regulate. Water modeling to determine velocity, volume, watershed size, land use. Size of watershed, velocity and volume of water. Size of watershed and change in elevation dictates land use. Compare Das of similar characteristics, size, land use, etc. ID causes of quality problems. Inland Bathy for velocity, volume, in models. Nearshore bathy for outflow pipes, coastal change over time, Mobile Bay - bathy in dynamic model Oil spill response may use bathy – boom placement in shallow water, water depth is important in response. Shape and volume of water important. Air quality models use topo as well. Interbasin transfer for water supply. Sample reservoirs in summer. Red tide impacts to fish and wildlife.				
MCA Name	MCA No.						
Managing Water Quality in the State of Alabama	1412						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$286,417	$76,718	Moderate	Major	Major
Inland Bathy	QL2B	6-10 yrs.	$1,239,067	$129,487	Minor	Minor	don't know
Nearshore B.	QL2B	6-10 yrs.	$25,499	$42,007	Minor	Moderate	Minor
Offshore B.	Order 1a	4-5 yrs.	$77	$389	Minor	Major	Major

Organization	California		Our primary water management goals are related to water supply reliability, which include supply infrastructure development, conveyance, infrastructure O&M, and water quality. Elevation data are needed for planning, design and construction, operations and maintenance for projects. The data are used to identify risk, for environmental permitting, infrastructure design, regional monitoring, subsidence monitoring (requires more frequent updates), groundwater monitoring. The data are also used for H&H modeling, flood management, water supply to the state, delta specific and statewide operations models, and to monitor snowpack. For emergency response, elevation data is critical for analyzing the potential for spillway failure, flooding, etc. Elevation is more critical than imagery. The state acquires its own lidar and bathymetry, uses contractors, and uses USGS 3DEP/NOAA data.					
MCA Name	MCA No.						
Statewide Water Resources Management	22046						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	6-10 yrs.	$876,862	$234,871	don't know	don't know	don't know
Inland Bathy	Project specific, currentl y collect single beam, but high density multi beam is needed more and more	6-10 yrs.	$496,481	$51,884	don't know	don't know	don't know
Nearshore B.	QL1B	4-5 yrs.	$26,804	$44,157	Moderate	Moderate	Moderate
Offshore B.	Order 1a	4-5 yrs.	$5,753	$28,768	Minor	Major	Major

Organization	Mississippi		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60244						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$264,291	$70,791	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$1,143,345	$119,484	Moderate	Major	Moderate

Organization	Tennessee		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60423						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$233,663	$62,587	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$1,010,847	$105,637	Moderate	Major	Moderate

Organization	Virginia		Implement agricultural best management practices to improve water quality. Protect the public from dam breaks and related flooding events.				
MCA Name	MCA No.						
Natural Resource Protection	1079						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$223,897	$59,971	Major	Major	Major
Inland Bathy	I don't know	4-5 yrs.	$968,600	$101,222	Major	Major	Major

Organization	South Carolina		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60397						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$171,625	$45,970	Moderate	Major	Moderate
Inland Bathy	QL0B	6-10 yrs.	$742,465	$77,590	Moderate	Major	Moderate
Nearshore B.	QL1B	6-10 yrs.	$39,944	$65,803	Moderate	Moderate	Moderate
Offshore B.	Order 1a	4-5 yrs.	Major	$2	Minor	Major	Major

Organization	Wyoming		Water supply development and rehabilitation. Hydrologic modeling. Reservoir planning, construction, and operation. Water infrastructure mapping and assessment, rangeland, stream, and riparian assessments, development of aquifers. Inland bathy for sediment loading in reservoirs, storage capacity, dam integrity, elevations surrounding reservoirs. Elevation data are used for H&H modeling, to ensure water runs downhill, and for construction planning for water storage tanks, reservoirs, diversion structures (dams) in reservoirs, pipelines, and ditches. Planning is done at the basin-wide level as well as for individual structures.				
MCA Name	MCA No.						
Water Infrastructure Planning and Development	1422						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	>10 yrs.	$679,898	$160,000	don't know	Major	None
Inland Bathy	X-Sec meet needs	>10 yrs.	$272,612	Moderate	None	Minor	None

Organization	Oklahoma		Water Quality Monitoring and Standards. Bathymetric surveys of lakes are needed for establishing contours of the present lake level, the conservation pool, and the flood pool (1/2' contours are needed). The conservation pool is the normal shoreline. If the lake is controlled it is the maintenance level. The flood pool is what would pass over the spillway. OWRB currently performs bathymetry collections using boats with sonar/GPS. Elevation data are also needed for water quality uses – to identify and update wetlands, and to identify beneficial uses.				
MCA Name	MCA No.						
Water Quality Monitoring and Standards	21507						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$129,190	$34,604	Major	Moderate	Moderate
Inland Bathy	QL2B	6-10 yrs.	$838,330	$87,608	Major	Moderate	Minor

Organization	Oklahoma		Spill and other disaster response, air modeling, environmental remediation planning, environmental permit application review				
MCA Name	MCA No.						
Environmental Protection	21711						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$129,190	$34,604	Minor	Moderate	Minor
Inland Bathy	X-Sec meet needs	6-10 yrs.	$838,330	$87,608	Minor	Moderate	Moderate

Organization	Nevada		Secure a sustainable high quality source of water.				
MCA Name	MCA No.						
Secure a Sustainable High Quality Source of Water.	21563						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	>10 yrs.	$613,017	$164,199	None	Major	None
Inland Bathy	Coarser bathymetric data satisfies my needs	>10 yrs.	Major	Minor	None	Minor	None

Organization	Utah		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60461						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$463,469	$124,142	Moderate	Major	Moderate

Organization	Nebraska		Water quality improvement and water pollution prevention and control.				
MCA Name	MCA No.						
Water Quality Planning, Monitoring, and Project Development	21710						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$428,889	$114,879	Minor	Moderate	don't know

Organization	Wyoming		Regulate and permit activity under the Clean Water Act, Clean Air Act, NEPA, SMCRA, and Abandoned Mines. Elevation data are needed for modeling of nitrate vulnerability for groundwater (pesticide models and aquifer prioritization for regulation) and for public water supplies the data are used to model wellhead protection zones above water supplies. Air quality studies use DEMs to improve models and show ozone. Elevation data are also needed for coal mine regulation, both active and abandoned. For monitoring of active mines we match recent imagery to DEMs and we also estimate cut and fill volumes for abandoned mines. Elevation data are also needed for permitting of oil and gas fields. The Abandoned Mine Lands program closes, and reclaims to native habitat, both small mine openings, and large-scale open pit features. Additionally hazardous features such as highwalls, abandoned equipment and buildings, open mine shafts, and other dangerous features are closed, reduced, covered, or otherwise rendered safe. Where appropriate and as possible, environmental degradation is reduced and remediated. Additionally underground cement grouting of mine voids is undertaken to remediate or reduce the potential of mine subsidence that can damage or destroy buildings, roads, pipelines, and other infrastructure.						
MCA Name	MCA No.						
Environmental Permitting and Enforcement	21500						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	>10 yrs.	$500,000	Major	don't know	Major	Moderate
Inland Bathy	X-Sec meet needs	>10 yrs.	Major	Major	Moderate	Major	don't know

Organization	New Jersey		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60293						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$41,761	$11,185	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$180,662	$18,879	Moderate	Major	Moderate
Nearshore B.	QL1B	4-5 yrs.	$33,222	$54,730	Moderate	Moderate	Moderate
Offshore B.	Order 1a	4-5 yrs.	$335	$1,679	Minor	Major	Major

Organization	Vermont		Stream channel analysis and mapping. Stream bank erosion analysis. Flood resilience planning. Point or non-point source pollution modeling. Landslide hazard mapping and assessment. Runoff and sedimentation analyses. Fate and transport of contaminants. Flood resilience planning. Flood damage mitigation. Flood risk modeling and mapping of riverine and lake flooding. Stream geomorphic assessment. Future: cut cross sections without field surveys for floodplain modeling. Additional requirements for hydro enforcement of culverts beyond current USGS QL2 specification. Frequent, integrated topographic data is important for watershed management efforts inclusive of water quality, flood resilience, hazard mitigation, and the abatement of eutrophication.						
MCA Name	MCA No.						
Floodplain Restoration and Sedimentation Reduction	1180						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$53,306	$14,278	Major	Major	Major
Inland Bathy	QL2B	4-5 yrs.	$230,609	$24,099	Major	Major	Major

Organization	Texas		The Surface Water department provides scientific and engineering expertise to better inform the activities of agency programs in water planning, development, and flood mitigation. This includes coastal hydrodynamic modeling, reservoir capacity determinations, sedimentation studies, fresh water inflow requirements, and siting of weather stations. Elevation data are needed for all forms of environmental modeling including flood pool modeling for lakes, hydraulic models, sediment transport modeling, habitat identification (fish and oysters), coastal inundation assessment, and oil spill modeling.				
MCA Name	MCA No.						
Environmental Modeling	1267						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$133,612	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	2-3 yrs.	$169,140	Moderate	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Major	Minor	Moderate	Moderate	Moderate
Offshore B.	Order 1a	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Kansas		Water flow modeling for remediation efforts - both contaminated and preventative. Lidar data are needed for modeling to support stream bank stabilization, watershed boundary delineation, water quality modeling, point and non-point source pollution modeling, well contamination sampling, depth to wells (i.e. contours of groundwater surface), and H&H modeling. Site design requires survey grade elevation data.				
MCA Name	MCA No.						
Water Flow Modeling for Remediation Efforts	1130						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$228,100	$61,097	Minor	Moderate	Moderate

Organization	Kentucky		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60187						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$224,056	$60,014	Moderate	Major	Moderate

Organization	Minnesota		Geological mapping. Elevation data are needed for coordinating with neighboring Great Lakes states, groundwater protection, and creating county geologic atlases. Minnesota Geological Survey needs elevation data for geologic models, which are done in conjunction with DNR and other state and county agencies. Consultants use the geologic maps for wellhead protect, land use management, groundwater management, monitoring nitrate concentrations, and water level maintenance. Existing lidar data are used with soil maps and the water well database for drilling efforts. The maps show near surface and subsurface formations. The data are also used to identify locations of sand and gravel, clay, till, deposits, and other sediment types. Sand and gravel resources are needed by every county for construction. Rock distribution can be inferred from sediment types, especially southeastern and northeastern Minnesota. Lidar helps expose the bedrock structure. Elevation data are also used to identify bedrock vs. beaches on islands and predict the likelihood of lakewater/groundwater interaction.				
MCA Name	MCA No.						
Geological Mapping	21655						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$150,750	$60,300	Major	Major	Major
Inland Bathy	QL2B	6-10 yrs.	$15,075	Moderate	Moderate	Moderate	Moderate
Nearshore B.	QL1B	6-10 yrs.	$3,015	$3,015	Minor	Minor	Minor
Offshore B.	Order 1a	6-10 yrs.	$3,015	$15,075	Minor	Minor	Minor

Organization	Hawai'i		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60112						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$35,677	$9,556	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$154,343	$16,129	Moderate	Major	Moderate

Organization	Connecticut		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60059						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$27,567	$7,384	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$119,258	$12,462	Moderate	Major	Moderate
Nearshore B.	QL1B	4-5 yrs.	$8,291	$13,659	Moderate	Moderate	Moderate
Offshore B.	Order 1a	4-5 yrs.	$410	$2,054	Minor	Major	Major

Organization	Oklahoma		Technical Studies- Water Supply Planning, Research, Water Resource Mapping. Water Use Appropriation and Permitting. Elevation data are needed for water resources administration within the state, primarily groundwater. OWRB studies the use of water within an aquifer and determines what can be used. Bathymetry is needed for volumetric analysis of lakes and to study sedimentation over time. Technical studies are performed to support the administration of the water rights program. BU 23 – Urban and Regional Planning is an additional Business Use.				
MCA Name	MCA No.						
Water Supply Planning and Water Rights Program Administration	21479						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$143,915	$34,604	Major	Moderate	Minor

Organization	ARS		Agricultural conservation research and planning. Sustainable agriculture research. Simulating alternative agricultural design and management scenarios at local, landscape and regional scales. Watershed scale hydrologic modeling. Water quality analysis, including edge of field, enterprise and watershed scales. Nutrient and carbon stocks modeling from field to enterprise to region. Sediment erosion modeling from wind and water action at local, landscape and regional scales. Water Supply and Quality. Fate and transport of contaminants and runoff and sedimentation analyses from rotational cropping and grazing systems. Point- or non-point source pollution modeling. Assessment of rangeland health. Mapping for soil erosion potential due to grazing. Inland bathymetry as important for being able to estimate inland water storage capacity, for example in flood risk mitigation and irrigation management.				
MCA Name	MCA No.						
Agricultural Conservation Research and Planning	21718						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$108,951	Major	Major	Major	don't know
Inland Topo	QL1	6-10 yrs.	$57,980	Major	Major	Major	don't know
Inland Topo	QL0	4-5 yrs.	$100	Major	Major	Major	don't know
Inland Bathy	QL2B	6-10 yrs.	$3,618	Minor	don't know	Moderate	don't know
Nearshore B.	QL2B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	West Virginia		1. Oversee water quality and quantity issues for the state. All Clean Water Act monitoring and enforcement. 2. Regulate and monitor all mining and quarry activity in the state. 3. Regulate and monitor all oil and gas activity in the state. 4. Regulate and monitor all air quality issues for the state. 5. Regulate and monitor all Super Fund and other remediation activity for the state. The use of lidar hillshade data and DEM derived data into mobile platforms is the future of this work. The mixing of these data in Artificial Reality and Virtual Reality platforms is also very exciting. Jumping between tagged photospheres and lidar is more powerful than most people realize.				
MCA Name	MCA No.						
Environmental Protection for West Virginia	22333						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$133,896	$13,025	Minor	Moderate	Moderate

Organization	Guam		Mapping Guam Waterworks assets such as Sewer manholes, pipes and inverts. 3D elevation data will also be good for planning where new wells will go. Elevation data are needed for planning and to locate new facilities. Bathymetry is needed for locating outfalls. In addition to the three noted Business Uses, BU 22 Infrastructure and Construction Management would also be applicable.				
MCA Name	MCA No.						
Support Water and Wastewater System	21668						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$2,496	Major	Minor	Major	Moderate
Inland Bathy	QL1B	2-3 yrs.	$77,172	$8,064	don't know	don't know	don't know
Nearshore B.	QL1B	2-3 yrs.	$14,357	$23,652	don't know	don't know	don't know
Offshore B.	Order 2	4-5 yrs.	$1,069	Major	don't know	don't know	don't know

Organization	Guam		To ensure the protection of human health and the environment				
MCA Name	MCA No.						
Environmental Protection	21894						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	4-5 yrs.	$2,496	Moderate	Major	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	$77,172	$8,064	don't know	don't know	don't know

Organization	Virginia		Watershed delineation for water quality assessment, flood inundation mapping, streambank erosion evaluation, cultural resources preservation and management, 3D visualization, visual impact analysis, urban forest management				
MCA Name	MCA No.						
Geospatial Data Coordination and Stormwater Planning	1457						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$72,000	Major	Major	Moderate	don't know
Inland Bathy	QL0B	6-10 yrs.	Major	Moderate	Minor	Moderate	don't know

Organization	Minnesota		Terrain analysis using digital elevation models to serve environmental management business needs related to wildlife, fisheries, vegetation, mining, and water across the state of Minnesota. Elevation data are needed for hydro terrain analysis and routing concentrated flow across the landscape into streams and rivers.				
MCA Name	MCA No.						
Natural Resource Management for the State of Minnesota	21698						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$50,598	Major	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$18,090	Major	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Major	Major	Major
Offshore B.	Order 1a	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Air Force		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60627						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$47,020	$5,396	Moderate	Major	Moderate

Organization	Rhode Island		BU 01 Water quality issues related to management of stormwater runoff rely on high quality elevation data for delineation of small catchments draining to individual drainage outfalls. BU 07 Forest habitat management utilizes lidar derived models of canopy and shrub understory height and density.				
MCA Name	MCA No.						
Water Quality and Forest Habitat Management and Assessment	1385						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$4,291	$1,149	don't know	Moderate	don't know
Inland Bathy	QL1B	6-10 yrs.	$25,974	$2,714	Moderate	Major	Moderate
Nearshore B.	QL1B	4-5 yrs.	$5,971	$9,837	Moderate	Moderate	Moderate

Organization	Delaware		Watershed and water quality protection, storm and flooding study, science and policy translation				
MCA Name	MCA No.						
Water Resources Management	22185						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$33,744	$3,015	Moderate	Major	Moderate
Nearshore B.	QL3B	4-5 yrs.	$5,000	Moderate	Moderate	Major	Moderate

Organization	Northern Mariana Islands		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60337						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$2,024	$542	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$8,756	$914	Moderate	Major	Moderate
Nearshore B.	QL1B	4-5 yrs.	$624	$1,028	Moderate	Moderate	Moderate
Offshore B.	Order 1a	4-5 yrs.	$4,200	$21,004	Minor	Major	Major

Organization	Idaho		To ensure clean air, water, and land in the state and protect Idaho citizens from the adverse health impacts of pollution.				
MCA Name	MCA No.						
Environmental Protection	21640						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$36,180	Moderate	None	Moderate	Minor
Inland Bathy	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Major	Moderate

Organization	USGS		Water quality. Our primary mission critical activity (both Water Mission Area and the local science center) focuses on water quality, supply, and availability, both from an observational and modeling perspective. Mission critical activities pertain to terrestrial ground and surface waters, as well as coastal waters.				
MCA Name	MCA No.						
National Civilian Mapping – Water Quality	1390						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Moderate	Moderate	Moderate	Moderate
Inland Bathy	QL0B	2-3 yrs.	$30,150	Major	Major	Moderate	Major
Nearshore B.	QL2B	6-10 yrs.	Major	Major	Major	Major	don't know

Organization	Alaska		Fate and transport of contaminants. Pollution risk mitigation. DEC needs elevation data to monitor pollution including contaminant spills, solid waste sites in flood risk areas, drinking water contamination, and groundwater contamination and modeling. Elevation data are also needed to address mining concerns in rural areas – tailings, tailings pond breaches, and contaminant flow. Bathymetry is also needed to address marine spills and potential groundings.				
MCA Name	MCA No.						
Pollution Risk	1090						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$16,281	Major	Minor	Moderate	Moderate
Inland Bathy	X-Sec meet needs	6-10 yrs.	Moderate	Moderate	Minor	Moderate	Moderate
Nearshore B.	QL4B	6-10 yrs.	Moderate	Moderate	Minor	Moderate	Moderate

Organization	Wisconsin		Watershed modeling, stream bank and land erosion prediction				
MCA Name	MCA No.						
Watershed Modeling, Stream Bank and Land Erosion Prediction	1372						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$12,854	$1,809	Moderate	Major	Minor
Inland Bathy	QL3B	>10 yrs.	$1,054	$150	Minor	Minor	Minor

Organization	U.S. Virgin Islands		Elevation data are needed for downhill tracing of point source and non-point source pollution. Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60450						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$742	$198	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	$3,210	$335	Moderate	Major	Moderate
Nearshore B.	QL1B	4-5 yrs.	$3,919	$6,457	Moderate	Moderate	Moderate

Organization	District of Columbia		Stream Assessment, Habitat restoration along riparian zones, watershed modeling, working with USGS on the National Hydrographic Dataset and Watershed Boundary Dataset of DC, water quality modeling, inundation mapping, and mitigating environmental risks. Elevation data is critical to all DOEE programs including water quality, watershed protection, solar panel placement, floodplain studies, BMPs, stream restoration, and sea level rise analyses. Elevation data plus pipe inverts can be used to visualize pipe locations and reduce field inspections. It is also crucial to understanding how water flows and accumulates. BU 06 – Natural Resources Conservation is an additional Business Use.				
MCA Name	MCA No.						
Water Quantity and Water Quality for the District	1413						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$12,060	Major	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Oregon		Manage bathymetric data as part of Oregon GIS Framework				
MCA Name	MCA No.						
Oregon Lakes and Reservoirs Research and Data Provisioning	21630						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	Coarser bathymetric data satisfies my needs	Event driven	$2,000	$7,000	Moderate	don't know	don't know

Organization	Massachusetts		Water quality/quantity monitoring, analyses and management. This is a multi-fold process that requires an accurate hydrologically connected stream/drainage network for flow modeling, proper management of forestry resources to ensure water quality, management of wildlife populations to prevent source water contamination and management of critical infrastructure throughout the watersheds.				
MCA Name	MCA No.						
Water Quality/Quantity Monitoring, Analyses and Management	1102						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$8,744	Moderate	None	Moderate	Minor
Inland Bathy	QL1B	6-10 yrs.	Major	Moderate	don't know	Minor	Minor

Organization	Maine		Watershed delineation for the purpose of accurately defining the point and non-point sources, as well as fates, of pollution and contaminants to the State's surface and ground waters. Elevation data are needed to delineate watersheds to determine land use, refine NHD, as input to hydrology GIS tools to identify permanent and ephemeral streams, for lake volume measurements and to identify reservoir sedimentation, and to formulate required treatments to reduce phosphate or aquatic infestations.				
MCA Name	MCA No.						
Watershed Assessments and Management	1452						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$603	Moderate	Minor	Moderate	None
Inland Bathy	X-Sec meet needs	6-10 yrs.	$6,221	$1,206	Moderate	Moderate	None

Organization	American Samoa		In engineering design and decisions we rely heavily on elevations. We have limited survey equipment and most of our waterline, wells, and tank designs are dependent on the accuracy of elevations. We use our existing DEM file for most of this information. We also use elevations to run our hydraulic analysis. Bathymetry is desired for future projects such as siting wind farms, etc. Lidar data are needed for H&H modeling, design of water and wastewater systems, also for electric transmission and distribution, to locate wind and solar elements, and for future design work.				
MCA Name	MCA No.						
Planning and Design for Electric, Water, Wastewater, and Solid Waste Utilities	33022						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	$431	$115	Major	Major	Major
Inland Bathy	QL0B	Annually	$1,866	$195	Major	Major	Major
Nearshore B.	QL0B	Annually	$33	$55	Major	Major	Major

Organization	Rhode Island		Drinking water purification. Drinking water transmission and distribution. Pollution risk mitigation. Management of owned watershed parcels. Elevation data are needed for engineering planning for new infrastructure, to include a new wind farm at Scituate Reservoir, how/where to site new infrastructure, decision making regarding repair vs. installation of new mains, etc. Elevation data are also needed as input for water quality modeling (currently using InfoWater).				
MCA Name	MCA No.						
Drinking Water Infrastructure Siting and System Planning	1179						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL3	4-5 yrs.	$1,713	$459	None	None	Minor

Organization	Pennsylvania		Commission programs include water quality protection, water supply allocation, water conservation initiatives, watershed planning, drought management, and flood loss reduction.				
MCA Name	MCA No.						
Comprehensive Watershed Management	21585						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Minor	$1,206	None	Minor	None
Inland Bathy	Coarser bathymetric data satisfies my needs	6-10 yrs.	Moderate	Minor	None	None	None
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Oklahoma		We are developing a tribal water plan to assure sustainable water supplies of good water quality for the future.				
MCA Name	MCA No.						
Water Supply and Quality	1085						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	Moderate	Moderate	Moderate	Moderate	Moderate
Inland Bathy	QL1B	6-10 yrs.	Moderate	Major	don't know	don't know	don't know

Organization	Ohio		Emergency Response, also sediment migration, offshore disposal sites				
MCA Name	MCA No.						
Emergency Response	1157						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	don't know	Major	don't know	Major	Major
Inland Bathy	QL2B	2-3 yrs.	Major	Major	don't know	don't know	don't know
Nearshore B.	QL2B	2-3 yrs.	Moderate	don't know	don't know	don't know	don't know
Offshore B.	Order 1	2-3 yrs.	Moderate	don't know	don't know	don't know	don't know

Organization	IJC		Bi-national cooperation and data harmonization between the U.S. and Canada to protect shared waters. Elevation data are needed for the International Watersheds Initiative, which is working on integrating and standardizing hydrographic data along the 5,000-mile U.S.-Canada border. An additional Business Use for this MCA is BU 08 - Agriculture and Precision Farming.				
MCA Name	MCA No.						
Bi-National Cooperation	1244						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Virginia		Pollution and hazard risk mitigation. This includes determination of drainage areas and base flood elevations, stormwater modeling, environmental management pertaining to identification and monitoring of point source pollution into streams and waterways. Municipal mapping. Additional Business Use is BU 23 - Urban and Regional Planning.				
MCA Name	MCA No.						
Pollution, Hazard Risk Mitigation, and Municipal Mapping	1317						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Major	Moderate	Moderate

Organization	USARC		Develop and recommend national Arctic research policy. Review federal Arctic research programs and suggest improvements. Review the President's budget request and report to Congress on the adherence to the Arctic Research Plan. Facilitate cooperation among federal, state and local governments in advancing Arctic research. Cooperate with the Governor of Alaska to support Arctic Research policy. Recommend improved Arctic research logistics planning and support. Recommend improved sharing and dissemination of Arctic data/information among public and private institutions. Publish a statement of goals and objectives to guide IARPC. Provide geospatial framework for all Arctic research.				
MCA Name	MCA No.						
Provide Geospatial Framework for All Arctic Research	1383						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Major	Moderate	Moderate
Inland Bathy	QL2B	2-3 yrs.	Moderate	Major	Moderate	Moderate	Moderate
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Moderate	Moderate
Offshore B.	Order 1b	2-3 yrs.	Major	Major	Major	Moderate	Moderate

Organization	West Virginia		Seeking to optimize the benefits of GIS technology for the state into the future. Elevation data are needed for floodplain modeling and mapping, state planning, and data dissemination for other state users.				
MCA Name	MCA No.						
GIS Coordination and Data Dissemination	1396						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Moderate	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	North Dakota		Riverine and ecosystem management; water, air and land quality regulation, disaster response; health & human services. Elevation data are needed for delineation of the Watershed Boundary Dataset (as the state WBD Steward) and surface water quality modeling to include modeling nutrients and runoff. State regulatory requirements include a requirement to determine slope for Animal Feeding Operations (AFO) and Confined Animal Feeding Operations (CAFO) permits. BU 08 – Agriculture and Precision Farming would be an additional Business Use.				
MCA Name	MCA No.						
Environmental Protection	1399						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	Major	Moderate	Moderate	Major	don't know

Organization	Vermont		Alluvial Soil Management / Flooding Issues with farm infrastructure - stream banks & farmland Water Quality Soil Erosion & Nutrient Loss Prevention (on farmland). Farm field flooding identification. Soil type "frequently flooded" and field observations are used but these are not accurate enough. New Required Agriculture Practices require extra care for fields that flood frequently. Elevation data and riverine bathymetry will help with H&H modeling to identify fields that flood. FEMA maps are helpful but do not cover all needed streams, also some are quite old. VCGI did FIRM conversion but there are not many new studies. Animation of flood waters using elevation model can help with communication, outreach to farmers. The goal is to avoid manure and fertilizer runoff into streams. Also farm infrastructure siting to avoid flooded areas.				
MCA Name	MCA No.						
Up to Date Determination of Farmland Flooding	1424						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Moderate	Major	Moderate
Inland Bathy	X-Sec meet needs	2-3 yrs.	Moderate	Moderate	Minor	Minor	Minor

Organization	Pennsylvania		Water resource management				
MCA Name	MCA No.						
Water Resource Management	11473						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	No requirement for this	Major	Moderate	Moderate	Moderate	Moderate

Organization	Vermont		Water quality and ecosystem integrity, protection, and restoration.				
MCA Name	MCA No.						
Water Resource Protection	21674						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Moderate	Major	Major
Inland Bathy	QL2B	6-10 yrs.	Moderate	Moderate	Moderate	Moderate	don't know

Organization	Pennsylvania		Mine subsidence mapping, oil and gas mapping, water quality mapping, forestry mapping				
MCA Name	MCA No.						
Environmental Protection of Air, Land, and Water	21767						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Moderate	Moderate	Moderate
Inland Bathy	Coarser bathymetric data satisfies my needs	4-5 yrs.	Major	Major	Major	Moderate	Minor
Nearshore B.	I don't know	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Georgia		BU 01 Water Supply and Quality - Performing high level H&H studies to influence regionally significant projects which may address stream base flow and water quality issues. BU 15 - Flood Risk Management - Performing risk assessments for critical transportation infrastructure using high level H&H models BU 23 - Urban and Regional Planning - Creating 3d visualizations of transportation project corridors, and to pull out building footprints. Also project site development, impervious surface, slope (runoff, storm water), infrastructure planning.				
MCA Name	MCA No.						
Water Quality, Flood Risk Resiliency, and Municipal Planning	21940						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL2B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Montana		Water supply: Municipal, rural, industrial and irrigation				
MCA Name	MCA No.						
Tribal Water Municipal, Rural, Industrial, and Irrigation Mapping	21998						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	Major	Major	None	Major	don't know

Organization	BLM		Abandoned Mine Lands and Hazardous Materials Program. Elevation data are needed to inventory and identify potential sites, secure land, mitigate safety, and potentially remediate impacted lands. QL2 elevation data is the minimum requirement, some areas may require higher quality data. The AML program uses lidar to assist with the large workload in the discovery and inventory efforts for presently unknown AML features, confirm previously discovered features, initiate field characterization efforts (cultural, biological, reclamation/engineering, soil/water sampling), improving conceptual site modeling, and help prioritize hazard abatement actions. Lidar- facilitated inventory of AMLs is proven to be safer, faster, more accurate, more efficient, and more cost-effective than traditional literature review plus field-based inventory protocols, yielding results ranging from 100-300% greater than conventional methods.				
MCA Name	MCA No.						
Abandoned Mine Lands and Hazardous Materials Program	22190						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	NASA		Remote sensing and modeling of the global terrestrial hydrologic cycle. NASA's data in conjunction with lidar, sonar derived bathymetry, field collected data, etc. would improve water resources applications throughout the user community of water resources engineers. Data management, accuracy, and efficiency could all be improved.				
MCA Name	MCA No.						
Remote Sensing and Modeling of the Global Terrestrial Hydrologic Cycle	22539						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Moderate	Major	Major	Major
Inland Bathy	QL2B	4-5 yrs.	don't know	don't know	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	don't know	don't know	Major	Major	Major

Organization	NPS		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.				
MCA Name	MCA No.						
Water Supply and Quality	60701						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Moderate	Major	Moderate
Inland Bathy	QL1B	6-10 yrs.	Major	Moderate	Moderate	Major	Moderate

Organization	Glorieta Geoscience, Inc.		Soils and wetlands mapping and characterization, Stream channel analysis and mapping, Detailed site analysis to support precision farming, Geologic mapping and analysis, Identification of geomorphologic units. Glorieta Geoscience is a hydrologic consulting firm. Elevation data are needed to perform cross section analysis of the river beds of the Rio Grande and other large rivers for capacity and sedimentation, also flooding, and water release to other states/Mexico. Similar activities would apply to other users in New Mexico as well. The state, USACE, BOR, and BIA are involved in the river monitoring activities and the Interstate Stream Commission administers the stream compacts.				
MCA Name	MCA No.						
Geology/Hydrology Consulting	21612						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Event driven	Moderate	Moderate	None	Moderate	Minor
Inland Bathy	QL2B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Minnesota		Environmental Public Health, particularly around drinking water protection via identifying and mitigating risks from contaminants, and waterborne disease monitoring.				
MCA Name	MCA No.						
Environmental Public Health	32974						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Moderate	Moderate	Minor	Moderate	None
Inland Bathy	QL3B	4-5 yrs.	Minor	Minor	don't know	Minor	Minor
Nearshore B.	QL3B	4-5 yrs.	Minor	Minor	don't know	Minor	Minor

BU 02 – Riverine Ecosystem Management

BU 02 Scope

Business Use #2 (BU 02) includes stream channel analysis and mapping; stream bank erosion analysis; aquatic and terrestrial species habitat management; and environmental management. Many federal, state, and local agencies and non-governmental organizations are responsible for MCAs relevant to riverine ecosystem management.

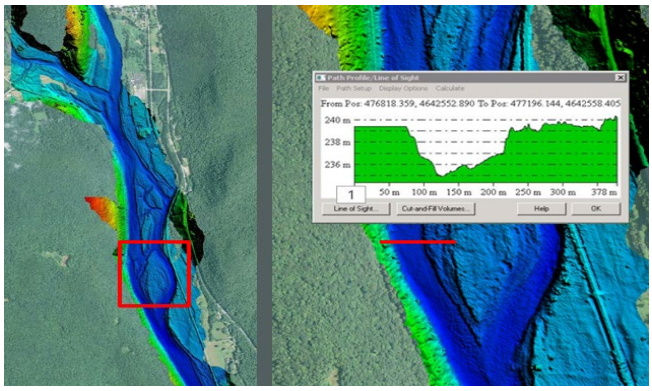

Figure E.2a. Topobathy lidar and cross section of Delaware River. Topobathy lidar enables hydrologic and hydraulic (H&H) modeling of riverine ecosystems. Image courtesy of the USGS.

BU 02 Background Information

Riverine ecosystems are flowing waters that drain the landscape and include the biotic (living) interactions amongst plants, animals, and micro-organisms as well as abiotic (nonliving) physical and chemical interactions of its many parts. Riverine ecosystems are part of larger watershed networks where small headwaters drain into mid-size streams, which progressively drain into larger river networks. Healthy streams are important because they provide water for drinking, cleaning, irrigation, fish and recreational use. Healthy rivers are an insurance policy needed for climate change. Rivers also provide economic and cultural value. Power plants and many other industries depend upon reliable water supplies from rivers and streams. Furthermore, healthy floodplains and marshes reduce flood risks.

Today, the water information framework is a collection of datasets that are managed by multiple Federal agencies and in partnership with State and local governments. Reliable and accurate high-resolution maps of the Nation's waters are critical inputs to models and decision support systems used to predict risk and enable response to water resource impacts. An up-to-date, high-resolution national hydrography framework is required to support these needs, and a standardized system for managing and discovering water-related information is essential.

USGS manages the National Hydrography Dataset (NHD), the Watershed Boundary Dataset (WBD), and the National Hydrography Dataset Plus High Resolution (NHDPlus HR). USGS is embarking on the 3D Hydrography Program (3DHP). The 3DHP and the 3D Elevation Program (3DEP) will be guided by a new initiative to build an integrated 3D National Topography Model (3DNTM). 3DEP and 3DHP will be managed as companion programs where the co-dependent components of terrain and water data will be integrated to support the production of higher-quality data and improved geospatial analysis.

The vision of the 3DNTM is to integrate USGS elevation and hydrography datasets to model the Nation's topography in 3D to support day-to-day water management needs and inform emerging U.S. climate and water policies. Thus, 3D elevation data are critical to the management and improvement of the U.S water information framework.

BU 02 Elevation Data Uses

Using their own words, respondents documented 44 Mission Critical Activities (MCAs) that identified BU 02 as their primary Business Use and identified the following 66 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.2a. BU 02 Elevation Data Uses

Data Use
Data Development and Management
1. MARIS geospatial clearinghouse
2. National Hydrography Dataset (NHD) stewardship
3. Update the National Hydrography Dataset (NHD)
4. Watershed Boundary Dataset (WBD) delineation
Emergency Management
5. Disaster response
6. Emergency management and response
Engineering Design and Construction
7. Design of water and wastewater systems
8. Engineer planning for new infrastructure
9. Waterlines, wells and tank design
Environmental Protection
10. Abandoned mine lands and hazardous materials management
11. Development of Best Management Practices (BMPs)
12. Environmental conservation
13. Environmental management
14. Environmental protection
15. Environmental public health
16. Environmental remediation planning
17. Fate and transport of contaminants
18. Locating outfalls where wastewater is discharged into streams
19. Management of contaminants and marine debris
20. Management of spills, trash
21. Offshore disposal sites
22. Pollution risk mitigation
23. Water pollution prevention and control
24. Water quality assessment and management
25. Water quality improvement
26. Wetlands and freshwater systems
Erosion/Sediment Control
27. Runoff and sedimentation analysis
28. Sediment migration/reduction
29. Stream bank erosion analysis
Floodplain Management
30. Floodplain restoration
Habitat Analysis and Management
31. Aquatic and terrestrial species habitat management
32. Assessment of biological habitats
33. Fisheries and riparian management
34. Freshwater fisheries conservation
35. Restoration of critical habitats

Data Use
36. River channel analysis in support of salmon habitat assessment
37. Stream channel species and habitat assessment and management
Infrastructure Management
38. Decision making regarding repair vs. installation of new water mains
39. Management of agricultural tax ditches, managed like a utility
40. Support for water and wastewater systems
Mapping/Boundary Delineation
41. BLM inventories
42. Change detection
43. Management of owned watershed parcels
44. Mapping waterworks assets, e.g., sewer manholes, pipes, and inverts
45. Municipal mapping and planning
46. Stream channel analysis and mapping
47. Tribal water municipal, rural, industrial, and irrigation mapping
Modeling
48. Flow studies
49. Hydrologic and hydraulic (H&H) modeling and analysis
50. Modeling of nutrients and runoff
51. Point- and non-point source pollution modeling
52. Stream/groundwater interaction analysis, modeling, and mapping
53. Surface and ground water modeling and mapping
54. Water flow modeling for remediation efforts
Natural Resources Conservation
55. Conservation engineering
Planning
56. Culvert planning
57. Drinking water infrastructure siting and system planning
58. Planning for design of water, wastewater, and solid waste utilities
59. Well planning
Regulatory Reviews and Enforcement
60. Environmental permit application review
61. Regulatory compliance
62. Slope analysis for Animal Feeding Operations (AFO) and Confined Animal Feeding Operation (CAFO) permits
Water Supply and Delivery
63. Drinking water purification
64. Drinking water transmission and distribution
65. Secure a sustainable, high quality source of water
66. Water supply and quality

BU 02 Tangible and Intangible Benefits

For the 44 MCAs that list Riverine Ecosystem Management as their primary Business Use:

- **Table E.2b** summarizes the reported future annual dollar benefits by geography type, totaling $72.90 million per year in tangible benefits if all MCA requirements are satisfied.
- **Table E.2c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.2e.
- **Table E.2d** shows (in blue) the six federal agencies, 37 states and territories, and one non-governmental entities that submitted MCAs with BU 02 as the primary Business Use. MCAs for which BU 02 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.2d.
- **Table E.2e** documents all the MCAs that listed BU 02 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.2e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 02 Reported Future Annual Dollar Benefits

Of the 44 MCAs that listed Riverine Ecosystem Management as their primary Business Use, 40 MCAs estimated their tangible annual benefits totally in financial terms; one MCA had a combination of tangible and "Major" intangible benefits; and three MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

BU 02 Reported Future Annual Dollar Benefits

The reported future annual dollar benefits are summarized in Table E.2b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 44 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.2b. BU 02 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$17,266,749	$1,489,990	$18,756,739
Inland Bathymetry	$9,645,884	$811,368	$10,457,252
Nearshore Bathymetry	$29,398,308	$13,796,850	$43,195,158
Offshore Bathymetry	$250,000	$250,000	$500,000
Totals	**$56,560,941**	**$16,348,208**	**$72,909,149**

BU 02 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.2c. BU 02 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	41	40	38	38	38
Inland Bathymetry	38	36	36	37	35
Nearshore Bathymetry	0	1	1	1	1
Offshore Bathymetry	0	0	0	0	0
Totals	**79**	**77**	**75**	**76**	**74**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 02 Reported Future Annual Dollar Benefits Maps

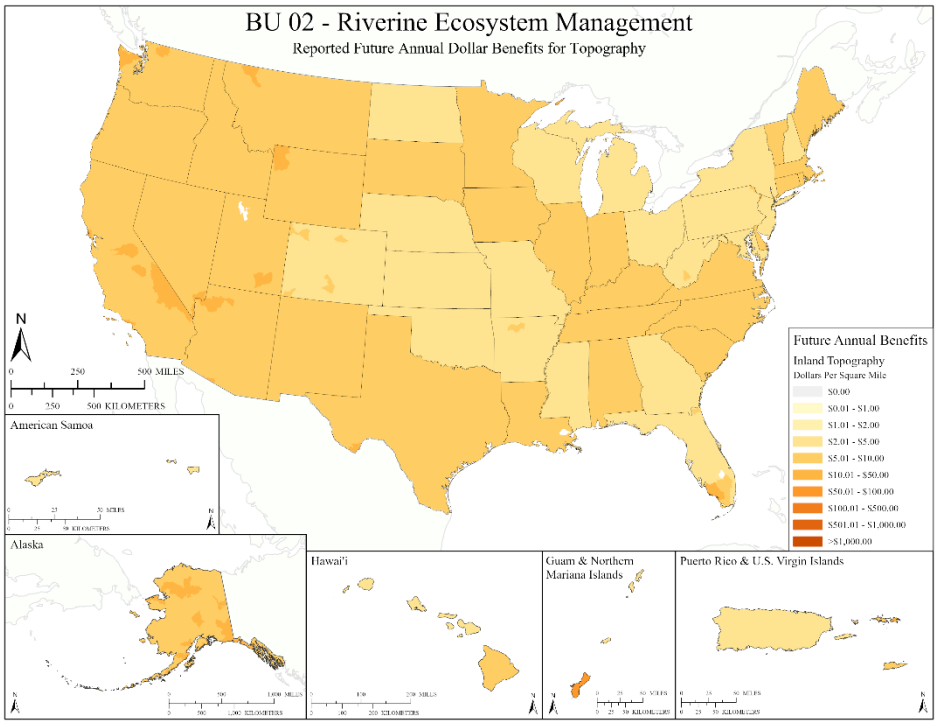

Figure E.2b. Reported Future Annual Dollar Benefits for Topography

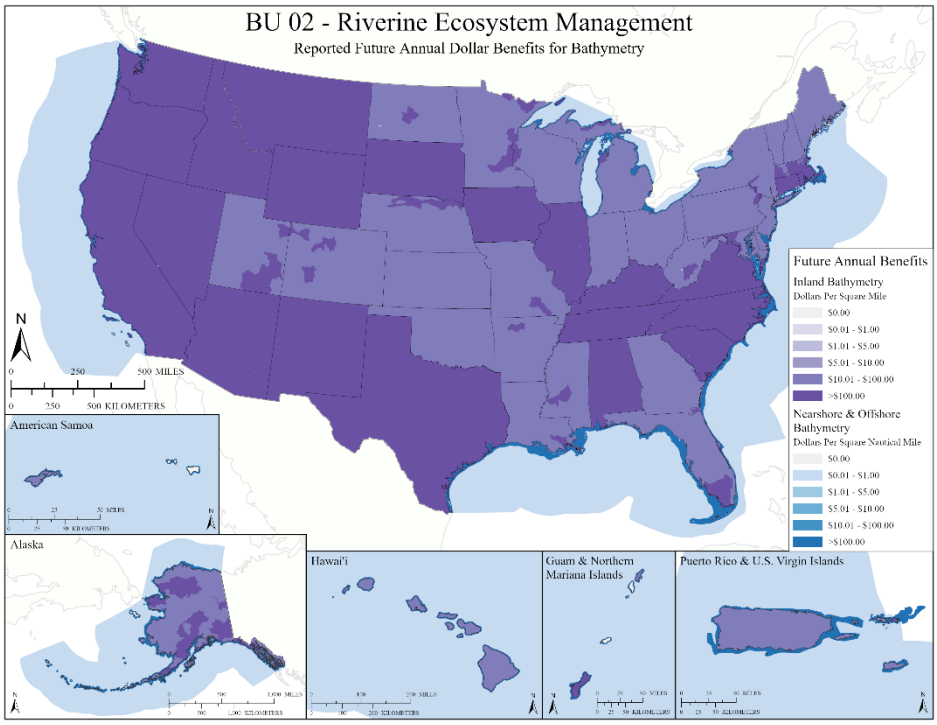

Figure E.2c. Reported Future Annual Dollar Benefits for Bathymetry

BU 02 Benefits Analysis

The total future annual benefits ($72.90 million per year) reported for BU 02 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that both the BU 02 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, six federal agencies (BLM, CDC, EPA, NPA, SI, and USACE) submitted a total of six MCAs listing BU 02 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry and offshore bathymetry. Of the six total federal MCAs listing BU 02 as primary:
    - Inland Topography: Five provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: Five provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: Four provided dollar benefits and none indicated "Major" benefits.
    - Offshore Bathymetry: One provided dollar benefits and none indicated "Major" benefits.
    - Even though the WBD, NHD, and NHDPlus products are produced from elevation data using the Elevation Derived Hydrography (EDH) process, the USGS did not submit an MCA for BU 02 as the primary Business Use. Instead USGS submitted MCA 1444 on the WBD and NHD and assigned it to BU 15 (Flood Risk Management) – meaning dollar benefits are accrued elsewhere.
    - Even though hydrologic and hydraulic (H&H) modeling of streams is central to most Flood Insurance Studies, FEMA also did not submit an MCA for BU 02 as the primary Business Use – meaning dollar benefits are accrued elsewhere.
    - The same is true for many other federal agencies that listed BU 02 as either a secondary or tertiary Business Use.
- State/Local/Tribal and U.S. Territory MCAs: Thirty-five (35) states and territories submitted a total of 37 MCAs that designated BU 02 as their primary BU. Of the 37 MCAs listing BU 02 as primary:
    - Inland Topography: 34 provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: 31 provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: 17 provided dollar benefits and one indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and none indicated "Major" benefits.
- Arkansas, Colorado, Washington D.C., Florida, Georgia, Hawaii, Kansas, Maryland, Michigan, Missouri, North Dakota, New Hampshire, New York, Ohio, Oklahoma, Pennsylvania, Wisconsin, West Virginia, and Puerto Rico did not include an MCA for BU 02 even though their major rivers include the Missouri, Ohio, Potomac, Hudson, Allegheny, Delaware, Susquehanna, Rio Grande, Platte, Colorado, St. Johns, and Red Rivers.
- Non-governmental MCAs: Only Trout Unlimited submitted an MCA with BU 02 as its primary Business Use. The Nature Conservancy and other non-governmental agencies did not identify

BU 02 as primary, although riverine ecosystem management is known to be important to many non-governmental agencies.

- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.2b and E.2c:
    - 156 "Major" Operational and Customer Service benefits and 225 "Major" benefits for Education and Outreach, Environmental, Public Safety, and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, If "Major" could be translated into a one percent savings for All of the total program budgets for BU 02 for which "Major" benefits are documented, this could easily be translated into millions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.
    - In the section above on BU 02 Elevation Data Requirements, 70 user-defined elevation data uses were listed including engineering, mapping, planning, designing, modeling, analyzing, and performing diverse technical studies for riverine ecosystem management. Those tasks are largely managed by government agencies but executed by private-sector engineering firms or subject matter experts (SMEs) contracted by the government. Of the 24,000+ private sector engineering firms in the U.S., and 16,000+ private-sector survey firms in the U.S., one small engineering firm responded to the 3D Nation questionnaire, indicating millions of dollars in annual savings from the availability of accurate and authoritative elevation data in the public domain routinely used for engineering studies and engineering design services, negating that company's need for costly field surveys to obtain topographic and bathymetric data. NOAA and USGS had no way to contact 40,000 engineering and surveying companies to document their elevation data requirements and benefits, and it would have been impractical to do so; however, if many of those 40,000 firms had similarly responded, the annual benefits of public domain elevation data would have been billions of dollars higher, spread across most of the 30 Business Uses, including BU 02.

BU 02 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 02:

- **Table E.2d** color-codes those organizations having an MCA with BU 02 as Primary, Secondary, or Tertiary.
- **Table E.2e** summarizes the 44 MCAs with primary benefits for BU 02, rank ordered from the highest to the lowest tangible benefits.

Table E.2d. Organizations having an MCA with BU 02 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	**BLM**	BOEM	**CDC**	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	*NASA*	NGA	*NOAA*	**NPS**	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	**SI**	TVA	**USACE**	USAF	USARC	*USBR*	USCB
	USCG	USFS	*USGS*	USMC	USN					

State/Ter	**AL**	**AK**	AR	**AZ**	**CA**	CO	**CT**	DC	**DE**	*FL*	GA	HI	**IA**	**ID**
	IL	**IN**	*KS*	**KY**	**LA**	**MA**	*MD*	**ME**	*MI*	*MO*	**MN**	**MS**	**MT**	**NC**
	ND	**NE**	NH	**NJ**	**NM**	**NV**	NY	*OH*	*OK*	**OR**	PA	**RI**	**SC**	**SD**
	TN	**TX**	**UT**	**VA**	**VT**	**WA**	*WI*	*WV*	**WY**	PR	**VI**	**GU**	AS	CNMI

Non-Gov	**Trout Unlimited**			

Table E.2e. MCA summaries for BU 02, rank ordered from the highest to the lowest tangible benefits.

Organization	USACE		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60680						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$5,503,923	$329,856	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$2,931,795	$137,819	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$11,414,676	$4,361,309	Moderate	Moderate	Moderate

Organization	EPA		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60720						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$5,503,923	$329,856	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$2,931,795	$137,819	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$11,414,676	$4,361,309	Moderate	Moderate	Moderate

Organization	Alaska		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60006						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$894,104	$89,307	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$475,960	$33,561	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$4,034,591	$3,083,065	Moderate	Moderate	Moderate

Organization	NPS		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60702						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$1,917,597	$114,923	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$1,020,805	$47,986	Major	Major	Major

Organization	CDC		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60642						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$250,000	$250,000	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$250,000	$250,000	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$250,000	$250,000	Moderate	Moderate	Moderate
Offshore B.	I don't know	I don't know	$250,000	$250,000	don't know	don't know	don't know

Organization	Texas		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60434						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$405,176	$40,471	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$215,688	$15,208	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$397,400	$303,676	Moderate	Moderate	Moderate

Organization	Louisiana		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60199						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$70,537	$7,045	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$37,549	$2,647	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$607,781	$464,441	Moderate	Moderate	Moderate
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	North Carolina		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60319						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$75,563	$7,547	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$300,000	$2,836	Major	Major	Major
Nearshore B.	QL0B	4-5 yrs.	$429,319	$328,067	Moderate	Moderate	Moderate
Offshore B.	I don't know	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Virginia		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60492						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$61,808	$6,173	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$32,902	$2,320	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$195,513	$149,403	Moderate	Moderate	Moderate

Organization	Washington		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60510						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$103,405	$10,328	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$55,046	$3,881	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$153,217	$117,082	Moderate	Moderate	Moderate

Organization	California		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60040						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$242,064	$24,178	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$128,858	$9,086	Major	Major	Major

Organization	Montana		Hydrography Mapping. Create and maintain a digital, spatial representation of the streams, rivers, lakes, wetlands, and other water features of Montana. Update NHD using lidar (as state NHD steward). Statewide lidar would significantly improve statewide hydro and elevation mapping.				
MCA Name	MCA No.						
Statewide Hydrography Mapping	21552						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$226,079	$22,480	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$119,808	$8,448	don't know	don't know	don't know

Organization	New Mexico		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60305						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$186,109	$18,589	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$99,072	$6,985	Major	Major	Major

Organization	Oregon		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60350						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$148,538	$14,836	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$79,072	$5,575	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$26,950	$20,594	Moderate	Moderate	Moderate

Organization	South Carolina		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60398						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$47,378	$4,732	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$25,221	$1,778	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	$121,142	$92,571	Moderate	Moderate	Moderate

Organization	Arizona		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60035						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$174,490	$17,429	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$92,886	$6,549	Major	Major	Major

Organization	Nevada		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60282						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$169,227	$16,903	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$90,085	$6,352	Major	Major	Major

Organization	Alabama		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60002						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$79,067	$7,897	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$42,090	$2,967	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$77,333	$59,095	Moderate	Moderate	Moderate
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Trout Unlimited		Freshwater fisheries conservation				
MCA Name	MCA No.						
Freshwater Fisheries Conservation	22527						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$46,798	$56,079	Moderate	Moderate	don't know
Inland Bathy	QL1B	6-10 yrs.	$63,225	$86,832	Major	Major	None

Organization	Wyoming		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60534						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$149,714	$14,954	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$79,698	$5,619	Major	Major	Major

Organization	Maine		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60205						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$49,605	$4,954	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$26,406	$1,862	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$88,345	$67,510	Moderate	Moderate	Moderate

Organization	Massachusetts		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60225						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$12,413	$1,239	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$6,607	$465	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$116,450	$88,986	Moderate	Moderate	Moderate
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Minnesota		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60605						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$129,150	$12,900	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$68,750	$4,847	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$5,436	$4,154	Moderate	Moderate	Moderate
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Idaho		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60130						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$127,912	$12,776	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$68,092	$4,801	Major	Major	Major

Organization	South Dakota		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60408						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$118,034	$11,789	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$62,833	$4,430	Major	Major	Major

Organization	Washington		River channel and analysis in support of salmon habitat assessments - e.g., the placement of engineered log jams to protect, stabilize and enhance spawning and rearing habitat of the Quinault River sockeye salmon, a historically and culturally cherished resource of the Quinault peoples.				
MCA Name	MCA No.						
River Channel Analysis in Support of Salmon Habitat Assessments	22149						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	Annually	$150,000	$6,030	Major	Major	Major

Organization	Illinois		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60137						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$86,237	$8,613	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$45,906	$3,237	Major	Major	Major

Organization	Iowa		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60168						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$86,132	$8,603	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$45,850	$3,233	Major	Major	Major

Organization	Utah		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60462						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$127,944	$12,779	Major	Major	Major

Organization	Indiana		Ensure that regulated entities comply with federal and state environmental laws and rules that help protect citizens and our environment. Elevation data are needed to derive slopes for flow direction, velocity, and gradient calculations. The data are also used to assess water quality and biological habitats, identify species habitats in different land use areas, and identify how they impact water quality and water uses. Managing agricultural use of water and runoff is another important use for elevation data related to water quality.				
MCA Name	MCA No.						
Water Quality Management	1104						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	4-5 yrs.	$7,978	$520	Major	Major	Major
Inland Topo	X-Sec meet needs	6-10 yrs.	$91,517	$5,962	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$8,291	Major	Major	Major	Major
Nearshore B.	QL0B	4-5 yrs.	$7,839	$3,015	Major	Major	Major

Organization	Tennessee		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60424						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$64,504	$6,443	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$34,337	$2,421	Major	Major	Major

Organization	Kentucky		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60188						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$61,852	$6,178	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$32,926	$2,321	Major	Major	Major

Organization	Connecticut		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60060						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$7,610	$760	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$4,051	$285	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$25,145	$19,215	Moderate	Moderate	Moderate

Organization	Rhode Island		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60370						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$1,657	$165	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$882	$62	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$18,110	$13,839	Moderate	Moderate	Moderate

Organization	Vermont		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60479						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$14,715	$1,469	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$7,833	$552	Major	Major	Major

Organization	U.S. Virgin Islands		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60451						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$204	$20	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$11,887	$9,083	Moderate	Moderate	Moderate

Organization	Nebraska		Stream/groundwater interaction analysis, modeling and mapping.				
MCA Name	MCA No.						
Surface and Ground Water Modeling and Mapping	1322						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	>10 yrs.	$3,136	$7,960	Major	Moderate	Minor
Inland Bathy	QL2B	>10 yrs.	$6,030	$2,171	Moderate	Minor	don't know

Organization	Guam		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management. Wetlands and freshwater systems.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60091						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$9,848	$983	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$5,242	$369	Major	Major	Major

Organization	Delaware		Management of Delaware Tax Ditches. Agricultural ditches that were constructed in the 1800s to create agricultural lands are managed like a utility, by watershed. Owners pay a tax for maintenance of the ditches in perpetuity. Maintenance includes mowing, weed scour, cleaning out obstructions, and periodic application of herbicide for woody debris. Topographic elevation data are needed to improve the accuracy of the tax ditch maps, to help identify ditches that need reconstruction, for cost estimating for ditch improvements, and to improve communication with owners. Currently field crews survey ditch bottoms as needed to get bottom elevations and pipe inverts. Inland Bathymetry could reduce the need for field surveys and help with management of sedimentation. Some ditches are always filled with water, others are filled only perennially. DNREC has considered use of drones to help identify the condition of ditches. Additional Business Uses are BU 06 - Natural Resources Conservation BU 15 - Flood Risk Management BU 22 - Infrastructure and Construction Management				
MCA Name	MCA No.						
Management of Delaware Tax Ditches	21923						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$9,045	Moderate	Moderate	Moderate	Moderate
Inland Bathy	QL0B	>10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	New Jersey		Environmental conservation. Includes forest management, stream channel analysis, conservation engineering, flooding/inundation analysis, and restoration of critical habitats.				
MCA Name	MCA No.						
Environmental Conservation	21502						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,206	$2,261	None	None	None
Inland Bathy	QL1B	2-3 yrs.	Minor	Minor	None	None	None
Nearshore B.	QL1B	2-3 yrs.	$1,357	Minor	None	None	None

Organization	SI		Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Riverine Ecosystem Management	60671						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$550	$33	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$293	$14	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$1,141	$436	Moderate	Moderate	Moderate
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Washington		Salmon habitat research, restoration, and protection				
MCA Name	MCA No.						
Salmon Habitat Research, Restoration, and Protection	1420						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	Major	Major	don't know	don't know	don't know
Inland Topo	QL2	6-10 yrs.	Major	Major	don't know	don't know	don't know
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	don't know

Organization	Mississippi		MARIS is a geospatial clearinghouse - assisting all other users of geospatial data in their individual mission critical activities. In-house, mission critical activities include: NHD stewards for Mississippi, oil & gas production mapping, legislative reapportionment, emergency management, change detection for natural resource management and urban planning, telecommunication mapping, compilation of local addressing and technical assistance in best management practices for addressing and a wide variety of geospatial activities. Laser leveling is used in delta areas to flatten land. Culverts dramatically change flow direction. Bi-directional flow is a problem for modeling				
MCA Name	MCA No.						
Geospatial Clearinghouse Activities	22152						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Major	Major	Major	Major
Inland Topo	QL0HD	6-10 yrs.	Major	Major	Major	Major	Major

Organization	BLM		Stream channel species and habitat assessment and management. Water quality assessment and management. Fisheries and riparian management. Linking upland conditions to stream and river condition and trend. BLM inventories rivers and streams nationally.				
MCA Name	MCA No.						
Stream and River Water Quality and Habitat Monitoring and Assessment	22183						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	Major	Moderate	Moderate	Major	Minor
Inland Bathy	QL0B	4-5 yrs.	Major	Moderate	Moderate	Major	Minor

BU 03 - Coastal Zone Management

BU 03 Scope

Business Use #3 (BU 03) includes the analysis of coastal erosion and inundation; hurricane storm surge and wind damage modeling and assessment; coastal hazard modeling and mapping; coastal hazard mitigation; tsunami modeling; coastal land use and environmental planning; coastal resiliency; oil spill modeling; and littoral zone management including dunes and beaches.

Figure E.3a. Merged topobathy lidar and imagery of Seabrook, NH and its backbay marsh, vital for marine navigation and coastal zone management. Image courtesy of JALBTCX.

BU 03 Background Information

The 66 MCAs in Table E.3e document how elevation data are mission-critical for coastal planning, analysis, decision support, 3D visualization, change detection, and environmental stewardship; for mitigation of coastal hazards (coastal erosion, inundation, tsunami and hurricane storm surge and wind damage modeling and assessment, oil spills, disaster monitoring and recovery); land use and environmental planning; habitat restoration; management of sediment, dunes, and beaches; resiliency of coastal ecosystems; coastal zone jurisdictional boundaries that are elevation-based; and managing the dynamic changes of coastal, estuarine, and wetland systems.

BU 03 is separate from BU 15, Flood Risk Management, which includes coastal flood studies that assess the effects of storm surge (water piled up against the shore during a storm) and tidal- and wind-driven wave action. BU 03 is also separate from BU 16, Sea Level Rise and Subsidence, which specifically includes modeling and mapping the effects of sea level rise or subsidence, population and economic vulnerability assessments, and coastal inundation and infrastructure assessment as the result of sea level rise and/or subsidence.

BU 03 Elevation Data Uses

Using their own words, respondents documented 66 Mission Critical Activities (MCAs) that identified BU 03 as their primary Business Use and identified the following 53 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.3a. BU 03 Elevation Data Uses

Data Use
Coastal Resource Management
1. Changing nearshore bathymetry
2. Coastal change detection
3. Coastal economy protection
4. Coastal ecosystems and land management
5. Coastal management and protection research

Data Use
6. Coastal planning, analysis, decision support, visualization
7. Coastal resource management
8. Coastal studies
9. Coastal wetland restoration modeling
10. Coastal zone management education and research
11. Coastal zone management of National Parks
12. Lake Erie coastal zone management
13. Littoral zone management, including dunes and beaches
14. Management of National Estuarine Research Reserve System (NERRS)
15. Management of state-owned aquatic lands
16. Monitoring sand as a local resource
17. StormSmart Coasts Program
Data Development and Management
18. Coastal National Elevation Database (CoNED)
Emergency Management
19. Disaster monitoring and recovery
20. Emergency management
Engineering Design and Construction
21. Coastal structure engineering and design
Environmental Protection
22. Environmental management
23. Land use and environmental protection
Erosion/Sediment Control
24. Sediment Management
Geology
25. Marine geologic assessment
Habitat Analysis and Management
26. Conservation of coral and seagrass habitats
27. Conserving and restoring Florida coastal aquatic resources
28. Habitat classification
29. Maintain sustainable populations of living resources and aquatic habitat
30. Resilience of coastal ecosystems and communities
Hazard Assessment and Mitigation
31. Analysis of coastal erosion and inundation
32. Assessment of hazards from storm inundation
33. Coastal hazard mitigation
34. Coastal hazard mitigation planning through identification of coastal erosion rates, flood hazard zones, landslide hazard zones and tsunami inundation hazard zones
35. Coastal resiliency planning and hazard mitigation
36. Tsunami inundation mapping and modeling for coastal communities
Mapping/Boundary Delineation
37. Characterization and mapping of wetlands
38. Coastal zone jurisdictional boundaries
39. Florida Coastal Mapping Program (FCMaP)
40. Lake Michigan coastal mapping
41. Mapping offshore bathymetric changes
42. Shoreland zone delineation
43. Topographic and bathymetric surveys of official state shorelines

Data Use
Modeling
44. Coastal hazard modeling and mapping
45. Hurricane storm surge and wind damage modeling and assessment
46. Inundation mapping/modeling for current and future conditions
47. Oil spill modeling
48. Storm surge modeling and assessment
49. Wetlands and species distribution modeling
Permitting
50. Structure permitting and recreation access
Planning
51. Coastal and regional planning
52. Land and water use planning
53. Spatial planning

BU 03 Tangible and Intangible Benefits

For the 66 MCAs that list Coastal Zone Management as their primary Business Use:

- **Table E.3b** summarizes the reported future annual dollar benefits by geography type, totaling $4.35 billion per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.3c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.3e.
- **Table E.3d** shows (in blue) the 12 federal agencies, 48 states and territories, and six non-governmental entities that submitted MCAs with BU 03 as the primary Business Use. MCAs for which BU 03 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.3d.
- **Table E.3e** documents all the MCAs that listed BU 03 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.3e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 03 Reported Future Annual Dollar Benefits

Of the 66 MCAs that listed Coastal Zone Management as their primary Business Use, 44 MCAs estimated their tangible annual benefits totally in financial terms; four MCAs had a combination of tangible and "Major" intangible benefits; and 14 MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.3b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 66 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.3b. BU 03 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$2,120,943,274	$16,909,693	$2,137,852,967
Inland Bathymetry	$52,477,577	$21,010,581	$73,488,158
Nearshore Bathymetry	$2,055,216,870	$54,077,964	$2,109,294,834
Offshore Bathymetry	$20,213,482	$4,734,722	$24,948,204
Totals	**$4,248,851,203**	**$96,732,960**	**$4,345,584,163**

BU 03 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.3c. BU 03 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	41	40	29	31	30
Inland Bathymetry	22	21	7	16	14
Nearshore Bathymetry	42	38	21	27	31
Offshore Bathymetry	24	13	4	5	6
Totals	**129**	**112**	**61**	**79**	**81**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 03 Reported Future Annual Dollar Benefits Maps

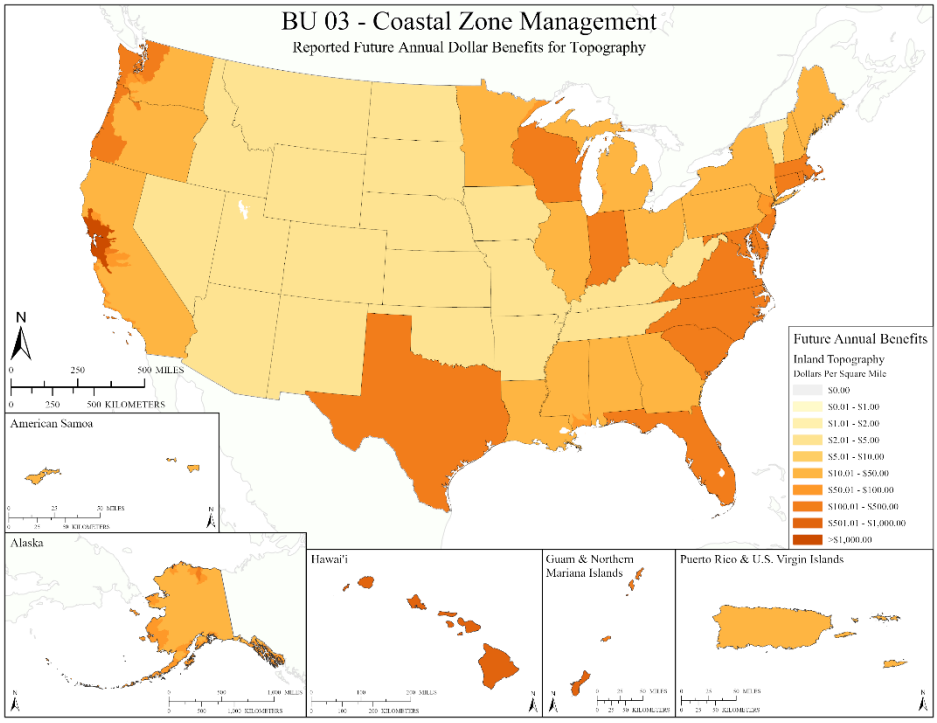

Figure E.3b. Reported Future Annual Dollar Benefits for Topography

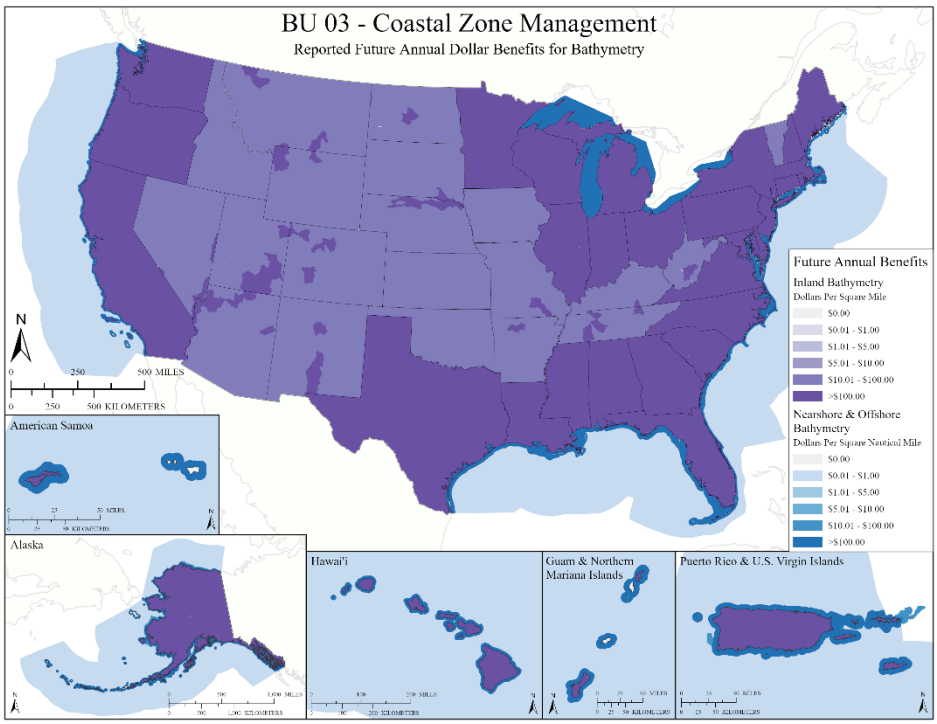

Figure E.3c. Reported Future Annual Dollar Benefits for Bathymetry

BU 03 Benefits Analysis

The total combined future annual benefits ($4.35 billion per year) reported for BU 03 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements

Regardless, we believe that the Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, eight federal agencies (CDC, CMTS, EPA, NOAA, NPS, NRC, SI, and USGS) submitted a total of 12 MCAs listing BU 03 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry.
    - Inland Topography: Eight provided dollar benefits and three indicated "Major" benefits.
    - Inland Bathymetry: Seven provided dollar benefits and four indicated "Major" benefits.
    - Nearshore Bathymetry: Nine provided dollar benefits and three indicated "Major" benefits.
    - Offshore Bathymetry: Four provided dollar benefits and five indicated "Major" benefits.
    - Two federal agencies (USACE and NRCS) submitted MCAs listing BU 03 as secondary, and two federal agencies (DISDI and NASA) listed BU 03 as tertiary, meaning dollar benefits do not accrue to BU 03. The remaining federal agencies did not submit MCAs that designated BU 03 as either primary, secondary, or tertiary, including the Bureau of Land Management (BLM), Bureau of Ocean Energy Management (BOEM), U.S. Fish and Wildlife Service (FWS), U.S. Coast Guard (USCG), U.S. Marine Corps (USMC), and U.S. Navy (USN), all of which have significant coastal zone management missions.
- State/Local/Tribal and U.S. Territory MCAs: Thirty-two (32) states and territories submitted a total of 48 MCAs that designated BU 03 as their primary BU. Of the 48 MCAs listing BU 03 as primary:
    - Inland Topography: 34 provided dollar benefits and four indicated "Major" benefits.
    - Inland Bathymetry: 25 provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: 39 provided dollar benefits and six indicated "Major" benefits.
    - Offshore Bathymetry: 22 provided dollar benefits and four indicated "Major" benefits.
    - New York and New Hampshire did not provide any MCA with BU 03 as primary but would appear to have needs for elevation data for coastal zone management.
- Non-governmental MCAs: Only one of the six non-governmental organizations with MCAs for BU 03 provided dollar benefits; the remainder listed "Major" but unspecified benefits.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.3b and E.3c:
    - 241 "Major" Operational and Customer Service benefits and 221 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 03 for which "Major" benefits are documented, this

could easily be translated into millions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

- In the section above on BU 03 Elevation Data Uses, 55 user-defined elevation data uses were listed, including engineering, mapping, planning, designing, modeling, analyzing, and performing diverse technical studies for coastal zone management. Those tasks are largely managed by government agencies but executed by private-sector engineering firms or subject matter experts (SMEs) contracted by the government. Of the 24,000+ private sector engineering firms in the U.S., and 16,000+ private-sector survey firms in the U.S., one small engineering firm responded to the 3D Nation questionnaire, indicating millions of dollars in annual savings from the availability of accurate and authoritative elevation data in the public domain routinely used for engineering studies and engineering design services, negating that company's need for costly field surveys to obtain topographic and bathymetric data. NOAA and USGS had no way to contact 40,000 engineering and surveying companies to document their elevation data requirements and benefits, and it would have been impractical to do so; however, if many of those 40,000 firms had similarly responded, the annual benefits of public domain elevation data would have been billions of dollars higher, spread across most of the 30 Business Uses, including BU 03.

BU 03 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 03:

- **Table E.3d** color-codes those organizations having an MCA with BU 03 as Primary, Secondary, or Tertiary.
- **Table E.3e** summarizes the 66 MCAs with primary benefits for BU 03, rank ordered from the highest to the lowest tangible benefits.

Table E.3d. Organizations having an MCA with BU 03 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	**CDC**	**CMTS**	DHS	**DISDI**	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	**NASA**	NGA	**NOAA**	**NPS**	**NRC**	*NRCS*	NREL
	ORNL	OSMRE	PHMSA	**SI**	TVA	*USACE*	USAF	USARC	USBR	USCB
	USCG	USFS	**USGS**	USMC	USN					

State/Ter	**AL**	**AK**	AR	AZ	**CA**	CO	**CT**	DC	**DE**	**FL**	**GA**	**HI**	IA	ID
	IL	**IN**	KS	KY	**LA**	**MA**	**MD**	**ME**	**MI**	MO	**MN**	**MS**	MT	**NC**
	ND	NE	*NH*	**NJ**	NM	NV	**NY**	**OH**	OK	**OR**	PA	**RI**	**SC**	SD
	TN	**TX**	UT	**VA**	VT	**WA**	**WI**	WV	WY	**PR**	**VI**	**GU**	**AS**	**CNMI**

Non-Gov	**American Shore and Beach Preservation Association**	*Fugro*	*Geodynamics*	**HERE Technologies**
	HydroTerra Technologies, LLC	*National Disaster Preparedness Training Center, University of Hawaii*	**Old Dominion University**	Pacific Disaster Center
	Quality Positioning Services	**The Nature Conservancy**	*University of New Hampshire Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC)*	**University of North Carolina**

Table E.3e. MCA summaries for BU 03, rank ordered from the highest to the lowest tangible benefits.

Organization	California		Coastal Zone Management, Flood Hazard Planning. The Commission needs elevation data for developing coastal flood maps for adaptation planning, sediment management, and wetland restoration. Additionally, the coastal zone jurisdictional boundaries are elevation-based, particularly Suisun Marsh and the head of tide.				
MCA Name	MCA No.						
Coastal Zone Management	1416						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	$2,002,025,618	Major	Major	Major	Major
Inland Bathy	QL0B	Annually	$2,004,009	Major	Minor	Moderate	Moderate
Nearshore B.	QL0B	Annually	$2,000,005,809	Major	Major	Moderate	Major

Organization	EPA		Coastal zone management. Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches.				
MCA Name	MCA No.						
Coastal Zone Management	50012						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$72,279,842	$7,448,562	Major	Major	don't know
Inland Bathy	QL2B	4-5 yrs.	$33,165,372	$11,504,962	Moderate	Major	don't know
Nearshore B.	QL2B	4-5 yrs.	$21,328,019	$19,778,611	Major	Major	don't know
Offshore B.	Order 1b	6-10 yrs.	$8,862,355	$1,415,022	Minor	Moderate	don't know

Organization	Texas		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches.				
MCA Name	MCA No.						
Coastal Zone Management	60435						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$13,647,596	$2,385,885	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$5,856,518	$3,433,370	Minor	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$889,876	$1,505,333	Moderate	Major	Major
Offshore B.	Order 1b	6-10 yrs.	$208,589	$41,645	Minor	Moderate	Moderate

Organization	Alaska		Resource management, coastal zone management, flooding, ecosystems, and land management. The Geospatial Council's concern is to identify data needs and get the data to the end users – including state, federal, and local entities. As a part of addressing this concern, the Council identifies state mapping strategies.				
MCA Name	MCA No.						
Coastal Zone Management	32721						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$582,808	$101,887	Moderate	Major	Major
Inland Topo	QL2	4-5 yrs.	$913,146	$159,637	Moderate	Major	Major
Nearshore B.	QL1B	Depends on variables	$6,912,192	$11,692,800	Moderate	Major	Major
Offshore B.	Order 1	Depends on variables	$2,416,365	$482,430	Moderate	Major	Major

Organization	USGS		Coastal National Elevation Database (CoNED), Topobathymetric Digital Elevation Models (TBDEMs). CoNED constructs regional integrated elevation models in the coastal zone by assimilating the land surface topography with littoral zone and continental shelf bathymetry. These TBDEMs are used widely for mapping inundation zones from riverine flood events, hurricanes, and sea-level rise and for other Earth science applications, such as sediment transport, erosion, and storm impact models. These regional TBDEMs are intended to fulfill the pressing needs of decision makers establishing policies for hazard mitigation and emergency preparedness, coastal managers tasked with coastal and marine spatial planning to support coastal zone decision support applications, and scientists investigating processes of coastal geomorphic change.				
MCA Name	MCA No.						
National Civilian Mapping - Coastal	11470						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$4,865,005	$1,475,000	Minor	Minor	don't know
Inland Bathy	QL2B	2-3 yrs.	$1,193,055	$1,080,000	Minor	Minor	don't know
Nearshore B.	QL2B	2-3 yrs.	$4,133,332	$1,900,000	Minor	Minor	don't know
Offshore B.	Order 2	4-5 yrs.	$5,516,665	$1,950,000	Minor	Minor	don't know

Organization	Hawai'i		Planning, Analysis, Decision Support, Visualization to support all Hawaii state agencies				
MCA Name	MCA No.						
Planning, Analysis, Decision Support, and Visualization to Support All Hawaii State Agencies	22113						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	2-3 yrs.	$3,296,732	$279,898	don't know	Moderate	Moderate
Inland Bathy	X-Sec meet needs	2-3 yrs.	$823,315	$325,628	don't know	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$855,600	$1,645,188	don't know	Moderate	Moderate
Offshore B.	X-Sec meet needs	2-3 yrs.	$360,075	$132,538	don't know	Moderate	Moderate

Organization	North Carolina		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches.				
MCA Name	MCA No.						
Coastal Zone Management	60320						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$2,545,207	$444,955	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$1,092,210	$640,305	Minor	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$961,351	$1,626,241	Moderate	Major	Major
Offshore B.	I don't know	4-5 yrs.	$48,642	$9,711	Minor	Moderate	Moderate

Organization	NPS		Our main interests are to understand, map, and manage the dynamic changes of coastal, estuarine, and wetland systems. Therefore, our primary interests are in coastal zone management, cultural resources preservation and management, flood risk management, water supply and quality, sea level rise and subsidence.				
MCA Name	MCA No.						
Coastal Zone Management in National Parks	1284						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Moderate	Moderate	Moderate	Minor
Inland Bathy	QL2B	4-5 yrs.	$2,244,720	Major	Moderate	Major	Major
Nearshore B.	QL2B	2-3 yrs.	$4,748,202	$8,140	Moderate	Major	Moderate

Organization	Florida		Emergency management. Plan for and respond to both natural and man-made disasters. These range from floods and hurricanes to incidents involving hazardous materials or nuclear power. Prepare and implement a statewide Comprehensive Emergency Management Plan. Conduct exercises to test state and county emergency response capabilities. Provide technical assistance to local governments as they prepare emergency plans and procedures. Conduct emergency operations training for state and local governmental agencies. Conduct post-event damage assessment surveys and advise the Governor on whether to declare an emergency and seek federal relief funds. Maintain and operate the state's Emergency Operations Center (EOC) in Tallahassee, which serves as the communications and command center for reporting emergencies and coordinating state response activities, and the State Warning Point, a state emergency communications center staffed 24 hours each day.					
MCA Name	MCA No.						
Emergency Management	21733						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$2,893,110	$505,776	Moderate	Minor	Major
Inland Bathy	X-Sec meet needs	4-5 yrs.	$620,753	$363,915	Minor	Minor	Moderate
Nearshore B.	X-Sec meet needs	2-3 yrs.	$869,571	$1,470,983	don't know	don't know	don't know
Offshore B.	X-Sec meet needs	Event driven	$67,029	$13,382	don't know	don't know	don't know

Organization	Alaska		Tsunami inundation mapping and modeling for coastal communities, development of the tsunami inundation maps				
MCA Name	MCA No.						
Tsunami Inundation Mapping and Modeling for Coastal Communities	32630						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL4	4-5 yrs.	$224,673	$38,772	don't know	don't know	don't know
Inland Bathy	QL4B	>10 yrs.	$95,171	$55,794	don't know	don't know	don't know
Nearshore B.	QL4B	>10 yrs.	$1,929,288	$3,261,582	don't know	don't know	don't know
Offshore B.	Order 3	>10 yrs.	$275,045	$54,913	don't know	don't know	don't know

Organization	Wisconsin		Geospatial coordination. As part of the Dept. of Administration, our program supports a wide range of geospatial activities in a wide range of local and state agencies in Wisconsin, mostly through grants to local governments.				
MCA Name	MCA No.						
Geospatial Coordination	1327						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$2,890,439	$505,309	don't know	don't know	don't know
Inland Bathy	QL1B	6-10 yrs.	$380,905	$223,305	don't know	don't know	don't know
Nearshore B.	QL0B	6-10 yrs.	$184,149	$311,510	don't know	don't know	don't know
Offshore B.	X-Sec meet needs	>10 yrs.	$641,666	$128,109	don't know	don't know	don't know

Organization	Virginia		Our formal mission is to support informed decision-making on resource management issues at all levels of government, including private and corporate citizens. In that capacity we have several mission critical activities, including Coastal Zone Management (e.g. coastal inundation, littoral zone management), Coastal Ecology (e.g. wetlands' present and future location and health, habitat studies), Sea level rise and flood risk management, and Outreach Education. We have an overarching mission but because we have grants that change over time (1-3 years), the focus may shift or evolve depending upon the grants. This affects the areal extent over which we work, as well as the smallest 3D features of interest.				
MCA Name	MCA No.						
Coastal Zone Management, Education, and Research	1252						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$39,002	$6,818	Major	Major	Major
Inland Topo	QL2	4-5 yrs.	$2,040,801	$356,774	Major	Major	Major
Inland Bathy	QL2B	6-10 yrs.	$893,395	$523,750	Major	Major	Major
Nearshore B.	QL1B	4-5 yrs.	$437,802	$740,594	Major	Major	Major
Offshore B.	Special Order	4-5 yrs.	$47,944	$9,564	Major	Major	Major

Organization	NOAA		Coastal hazard mitigation, resilience, disaster monitoring, and recovery. Support for coastal hazard preparedness and mitigation. Analysis of coastal erosion, inundation and water levels. Analysis of inland inundation. Sea level rise mapping. Coastal intelligence and coastal management. Habitat restoration. Establishment and maintenance of marine and land boundaries. Downscaling of numerical weather prediction models and providing weather forecasts at appropriate scales and resolutions. Understanding and prediction of weather, air quality, and climate.				
MCA Name	MCA No.						
Coastal Hazard Mitigation, Resilience, Disaster Monitoring, and Recovery	21635						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$1,700,395	$899,488	Major	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$248,138	$506,520	Major	Major	Major
Nearshore B.	QL0B	Annually	$1,616,676	$21,708	Moderate	Moderate	Major
Offshore B.	Special Order	4-5 yrs.	Major	Major	Minor	Minor	Minor

Organization	South Carolina		Coastal hazard modeling and mapping. Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Geologic mapping and analysis. Monitoring sand as a local resource. Seabed resources. Alternate energy development – solar, tidal, wind, wave, and ocean current. Flood risk modeling and mapping of riverine and coastal areas. Development of 3D visualizations to help students understand the Earth they live on.				
MCA Name	MCA No.						
Coastal Hazard Modeling and Mapping	21491						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$1,595,850	$278,988	Major	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$684,818	$401,473	Major	Major	Minor
Nearshore B.	QL1B	4-5 yrs.	$271,267	$458,881	Major	Major	None

Organization	Indiana		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches.				
MCA Name	MCA No.						
Coastal Zone Management	60149						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,865,469	$326,123	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$800,518	$469,302	Minor	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$8,653	$14,638	Moderate	Major	Major

Organization	Washington		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches.				
MCA Name	MCA No.						
Coastal Zone Management	60001						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,180,128	$206,310	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$506,422	$296,889	Minor	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$343,092	$580,381	Moderate	Major	Major
Offshore B.	Order 1b	6-10 yrs.	$177,479	$35,433	Minor	Moderate	Moderate

Organization	Alaska		Analysis of coastal erosion and inundation. Extra-tropical storm surge modeling and assessment. Coastal hazard modeling and mapping. Coastal resiliency. Flood risk modeling and mapping of coastal areas. Flood forecasts. Modeling and mapping the effects of sea level rise or subsidence. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Coastal Hazards	1187						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$1,267,135	$67,838	Major	Major	Major
Inland Bathy	QL3B	6-10 yrs.	$64,366	$34,200	Major	Major	Major
Nearshore B.	X-Sec meet needs	6-10 yrs.	$240,501	$1,002,412	Major	Major	Major

Organization	Florida		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches.				
MCA Name	MCA No.						
Coastal Zone Management	32992						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL1B	4-5 yrs.	$869,571	$1,470,983	don't know	don't know	don't know
Offshore B.	Order 1	4-5 yrs.	$67,029	$13,382	don't know	don't know	don't know

Organization	Florida		The Florida Coastal Mapping Program (FCMaP) is an initiative between federal and Florida State agencies and institutions to assess existing data, and develop a prioritization and strategy for filling gaps with high resolution data for all of Florida's coastal waters from the shore to the shelf edge. Bathymetry is needed for management of statewide interests to include shell-fish (oyster) hatcheries, packing fish and western oil interests, recreation, and game fishing among others.				
MCA Name	MCA No.						
Florida Coastal Mapping Program	50002						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	6-10 yrs.	$869,571	$1,470,983	don't know	don't know	don't know
Offshore B.	Special Order	>10 yrs.	$67,028	$13,382	don't know	don't know	don't know

Organization	Michigan		Coastal hazards mapping and management. Coastal change detection with bathymetry would allow volumetric approach instead of 1D from imagery. Bathymetry is also needed for sediment budget studies. The state's existing rules and regulations for coastal construction setbacks revolve around measuring and applying a one-dimensional (recession) shoreline change monitoring approach. Availability of 3D surfaces over time would provide the ability to move into a realm where monitoring is for 3-dimensional erosion rather than recession. Once these capabilities are realized and policy catches up, understanding of coastal change will be vastly improved and have great potential to better predict and protect threatened buildings and infrastructure.				
MCA Name	MCA No.						
Coastal Hazards Mapping and Management	1291						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$101,034	$17,658	Minor	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$828,120	$1,400,865	Minor	Moderate	Major

Organization	NOAA		The National Estuarine Research Reserve System (NERRS) is a network of 29 coastal sites designated to protect and study estuarine systems. Established through the Coastal Zone Management Act, the reserves represent a partnership program between NOAA and the coastal states. NOAA provides funding and national guidance, and each site is managed on a daily basis by a lead state agency or university with input from local partners. The NERRS was established to promote informed management of the Nation's estuaries and coastal habitats Elevation data are needed to do the following. Improve resilience of coastal ecosystems and communities to anthropogenic and natural drivers of environmental change. Monitor response of coastal ecosystems to habitat change and alteration. Develop knowledge about processes governing connectivity of habitats and communities from watershed to ocean. Monitor vulnerability of critical coastal habitats to climate and human-induced stressors. Monitor, research and manage estuarine and associated habitats. Conduct estuarine research to inform coastal management. Perform estuarine research monitoring, natural resource management, habitat mapping, inundation mapping, sea level rise mapping, coastal communities, outreach, and education. Coastal hazard mitigation, non-point source pollution modeling. Land use and environmental planning, Coastal resiliency, wetlands mapping and characterization, and mapping the effects of sea level rise or subsidence.				
MCA Name	MCA No.						
Improve Resilience of Coastal Ecosystems and Communities	22275						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	$1,283,680	$472,149	Moderate	Moderate	Moderate
Inland Bathy	QL2B	Event driven	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	4-5 yrs.	$324,974	$43,718	Major	Moderate	Minor
Organization	USGS		Coastal change hazard assessment. Frequent coastal change hazard and resource mapping, assessment, and analysis. Enhanced elevation data will save time and money and improve our products. Those savings are directed toward more or better products. A consistent need is more temporal resolution in dynamic coastal regions. Complete and consistent data saves time and reduces errors.				
MCA Name	MCA No.						
Frequent Coastal	1272						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$19,296	Major	Moderate	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL1B	2-3 yrs.	$1,251,650	$230,300	Major	Major	Major

Organization	CDC		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches.				
MCA Name	MCA No.						
Coastal Zone Management	60643						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$250,000	$250,000	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$250,000	$250,000	Moderate	Major	Major
Nearshore B.	QL1B	4-5 yrs.	$250,000	$250,000	Major	Major	Major
Offshore B.	Order 1a	6-10 yrs.	$250,000	$250,000	Minor	Moderate	Moderate

Organization	Florida		Conserving and restoring Florida coastal aquatic resources. Bathymetry is needed for GIS analysis for projects including coral mapping, oyster bar recovery, and post –disaster impacts. Also for beach renourishment projects which dovetail with seagrass and smothering issues.				
MCA Name	MCA No.						
Conserving and Restoring Florida Coastal Aquatic Resources	21554						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	2-3 yrs.	$632,751	$365,422	Major	Major	Minor
Nearshore B.	QL0B	2-3 yrs.	$235,124	$378,949	Moderate	Major	Moderate
Offshore B.	Order 1	4-5 yrs.	$79,029	$14,890	None	Moderate	Minor

Organization	Massachusetts		Coastal hazards. (https://www.mass.gov/stormsmart-coasts-program) Massachusetts Sea Level Rise and Coastal Flooding Viewer. Saltmarsh mapping.				
MCA Name	MCA No.						
Coastal Hazards Storm Smart Coasts Program	1466						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$418,110	$73,094	Major	Major	Major
Nearshore B.	QL0B	4-5 yrs.	$260,761	$441,109	Minor	Moderate	Moderate

Organization	Oregon		Coastal hazards mitigation planning through identification of coastal erosion rates and hazard zones, flood hazard zones, landslide hazard zones and tsunami inundation hazard zones.				
MCA Name	MCA No.						
Coastal Community Resiliency	21606						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$937,585	$163,909	Moderate	Major	Major
Nearshore B.	QL1B	2-3 yrs.	$30,174	$51,044	Major	Major	Major

Organization	Maryland		Maintain Sustainable Populations of Living Resources and Aquatic Habitat. Elevation data are needed for fisheries management, habitat analysis, flood assessment, shoreline stabilization, management of oyster leases and bottom habitat, recreational and commercial boating, siting for BMPs, and dredging sand to protect shorelines. An additional Business Use is BU 27 – Recreation.				
MCA Name	MCA No.						
Maintain Sustainable Populations of Living Resources and Aquatic Habitat	1388						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$510,444	$89,473	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$219,434	$128,421	Minor	Major	Major
Nearshore B.	QL1B	2-3 yrs.	$54,994	$66,923	Minor	Major	Major
Offshore B.	Order 1b	4-5 yrs.	$38,209	$11,578	Minor	Major	Major

Organization	Louisiana		Coastal Zone Management				
MCA Name	MCA No.						
Coastal Zone Management	22067						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL1B	Annually	$1,057,232	$25,628	Major	Major	Major

Organization	USGS		Analysis of coastal erosion and inundation; erosion and inundation hazard assessment and mitigation analysis. Hurricane storm surge and wave modeling and assessment. Coastal elevation and bathymetry mapping. Coastal hazard modeling, mapping and assessment. Coastal hazard mitigation analysis. Tsunami modeling. Tsunami hazard assessment. Land use. Coastal resiliency. Wind, wave, current, water-level and sediment-transport modeling. Oil spill modeling. Water quality modeling. Coastal and wetland ecosystem modeling. Analysis of coastal and wetland response to sea-level change. Assessment of coastal and marine sources and sinks of greenhouse gases. Littoral zone management including dunes and beaches. Identification and conservation of critical coastal, marine, and wetland habitats. Coastal archaeological site protection assessment. Coastal resource. Monitoring sand as a local resource. Seabed resources. Littoral sediment budget analysis. Enhanced elevation data will save time and money and improve our products. Those savings are directed toward more or better products. A consistent need is more temporal resolution in dynamic coastal regions. Complete and consistent data saves time and reduces errors.				
MCA Name	MCA No.						
Event-Driven Coastal	1296						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Event driven	Major	Major	Major	Major	don't know
Inland Bathy	QL1B is often sufficient, but higher quality data is needed for high-resolution models	Event driven	Major	Major	Moderate	Major	don't know
Nearshore B.	QL1B	Event driven	$1,079,948	don't know	don't know	don't know	don't know
Offshore B.	Special Order	Event driven	Major	Major	Moderate	Major	don't know

Organization	Maine		Seafloor Mapping; Seamless integration of LiDAR and Bathymetry, coastal hazards modeling, impervious surface ID and analysis, and storm response. The Maine seafloor mapping program needs topobathy to ½ mi offshore to connect the bathymetry to the topographic lidar. Bathymetry are needed for seafloor mapping and habitat classification as well as coastal hazards modeling.				
MCA Name	MCA No.						
Seafloor Mapping and Habitat Classification	22092						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL2B	6-10 yrs.	$785,628	Major	Major	Major	Major
Offshore B.	Order 1a	6-10 yrs.	$240,000	don't know	don't know	don't know	don't know

Organization	California		The primary function of the California Coastal Commission of the coastal zone management program is to protect, conserve, restore, and enhance environmental and human-based resources of the California coast and ocean for environmentally sustainable use by current and future generations. High resolution elevation data supports spatial analysis, data development, data visualization, and the production of maps for multiple coastal management applications within the Agency. Application areas consist of mapping geographic jurisdictional boundaries, delineation of legal boundaries and other coastal and inland boundaries, and shoreline mapping, habitat mapping and assessment, land use mapping and zoning, assessing vulnerability to sea level rise, storm surge, and coastal erosion, slope stability analysis, emergency response and enforcement, and mapping public access and recreational use areas.				
MCA Name	MCA No.						
California Coastal Management, Land Use, and Protection	21561						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$119,698	$20,926	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$51,365	$30,113	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$116,692	$197,399	Moderate	Moderate	Moderate
Offshore B.	Order 1b	6-10 yrs.	$360,318	$71,937	Minor	Moderate	Moderate

Organization	Delaware		Coastal resiliency				
MCA Name	MCA No.						
Coastal Resiliency	1451						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$79,439	$8,884	Minor	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$21,808	$12,785	Minor	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$282,675	$478,179	don't know	don't know	don't know

Organization	Delaware		Coastal Zone Management, Coastal resource and coastal economy protection, Research in coastal resource management and protection, Coastal Resiliency activities including supporting local communities, Federal Consistency				
MCA Name	MCA No.						
Coastal Zone Management	21776						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$50,821	$8,884	Major	Major	Major
Inland Bathy	QL2B	>10 yrs.	$21,808	$12,785	Minor	Moderate	Moderate
Nearshore B.	QL2B	2-3 yrs.	$282,675	$478,179	Minor	Moderate	Moderate
Offshore B.	Order 1b	6-10 yrs.	$9,899	$1,976	Minor	Moderate	Moderate

Organization	New Jersey		Coastal wetland restoration modeling. Species distribution modeling. Freshwater wetland modeling. BU 30 – Maritime and Land Boundary Management would be an additional Business Use for NJ DEP.				
MCA Name	MCA No.						
Wetland and Species Distribution Modeling	21588						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$234,334	$41,128	Minor	Moderate	Moderate
Inland Bathy	QL0B	2-3 yrs.	$100,667	$58,959	Minor	Moderate	Moderate
Nearshore B.	QL0B	Annually	$113,017	$190,904	Minor	Moderate	Moderate
Offshore B.	Order 2	Annually	$10,727	$4,703	Minor	Moderate	Moderate

Organization	Minnesota		Coastal hazard mitigation. Elevation data are needed to identify shoreline/bluff recession due to erosion and prevent new building with setbacks. The current data is from the 1980s, and DNR is working to update and modernize the data. The data were previously derived from stereo imagery. Lidar and high resolution imagery are needed for 3D modeling. NOAA bathy lidar from 2010 (29.3cm RMSE, 3m horizontal accuracy) and 2009 Park Point JALBTCX QL3 data are currently used for enforcement, but these data are no longer sufficient. Bathymetry is needed for navigation use (Safe Harbors). BU 20 - Marine and Riverine Navigation and Safety is an additional Business Use for this activity.				
MCA Name	MCA No.						
Coastal Hazard Mitigation	21691						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$59,535	$10,408	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	$255,748	$149,931	Minor	Moderate	Moderate
Nearshore B.	QL0B	6-10 yrs.	$12,172	$20,590	Major	don't know	Moderate
Offshore B.	I don't know	Event driven	$184,910	$36,918	don't know	don't know	don't know

Organization	Mississippi		Coastal Resource Management. Elevation data are needed for management of fisheries (e.g. economic aspects), habitat suitability modeling, suitability modeling for restoration and beneficial use (e.g. dredge material for rebuilding of habitats), wetland mapping and restoration, management of National Estuarine Research Reserves (NERRs), evaluation of marsh subsidence, and habitat mapping. The data are also needed for management of coastal reserves including marsh monitoring, monitoring shoreline change for habitat mapping, and determining the state boundary of tidelands for tidelands permitting (e.g. permitting for bulkheading, permitting for activities adjacent to wetlands or state owned waters, etc.).				
MCA Name	MCA No.						
Coastal Resource Management	21682						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$92,727	$16,211	don't know	Moderate	don't know
Inland Bathy	I don't know	4-5 yrs.	$39,791	$23,328	None	Moderate	Minor
Nearshore B.	QL3B	6-10 yrs.	$183,973	$311,213	don't know	Moderate	don't know
Offshore B.	I don't know	4-5 yrs.	Major	Major	don't know	Moderate	don't know
Offshore B.	I don't know	>10 yrs.	Major	Major	don't know	Moderate	don't know

Organization	New Jersey		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Land use and environmental planning. Coastal resiliency. Littoral zone management including dunes and beaches. Ocean Planning. Coastal and Ocean Federal Consistency reviews. Coastal Ecological Solution Project Development. Fisheries. Fish habitat. Wind farm siting.				
MCA Name	MCA No.						
New Jersey Coast Elevation and Bathymetry for Coastal Resiliency Planning	1455						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$154,248	$26,966	Moderate	Moderate	Moderate
Inland Bathy	QL2B	2-3 yrs.	$66,191	$38,804	Moderate	Moderate	Moderate
Nearshore B.	QL2B	2-3 yrs.	$112,808	$190,830	Moderate	Moderate	Moderate
Offshore B.	Special Order	2-3 yrs.	$72,000	$2,100	Moderate	Moderate	Moderate

Organization	Connecticut		Environmental management. Includes H&H modeling for floodplain management, regulatory work, land management, forest management, and biological and geological resource surveys. Also jurisdictional boundaries, remediation, enforcement, coastal zone management, regulatory plan reviews, etc. Elevation data are a fundamental data layer to all activities. Regulations may cite percent slope, specific elevations, tide lines, etc. Any changes or mapping improvements are relevant to environmental management areas. The shellfish industry is an important user of bathymetry. A new industry is the nearshore kelp industry. 95% of bathymetry uses fall within the 0 – 30m depth range, which is currently the least well mapped currently. Many additional Business Uses are included in this MCA.				
MCA Name	MCA No.						
Environmental Management	1449						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$256,332	$44,812	Minor	Major	Major
Inland Bathy	QL2B	4-5 yrs.	$109,998	$64,486	Minor	Major	Major
Nearshore B.	QL2B	4-5 yrs.	$56,308	$95,251	Minor	Moderate	Moderate
Offshore B.	Order 1b	6-10 yrs.	$25,735	$5,138	Minor	Moderate	Moderate

Organization	Guam		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches.				
MCA Name	MCA No.						
Coastal Zone Management	60092						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$107,990	$18,870	Major	Major	Major
Nearshore B.	QL0B	4-5 yrs.	$75,130	$127,100	Moderate	Major	Major

Organization	Massachusetts		Coastal hazard mitigation				
MCA Name	MCA No.						
Coastal Hazard Mitigation	1197						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$213,618	$4,824	Major	Major	Major
Nearshore B.	QL1B	4-5 yrs.	$103,015	$5,427	Major	Major	Major

Organization	The Nature Conservancy		Conservation of natural resources. Environmental stewardship. Restoration of critical habitats. Forest management. Fisheries management. Hydrographic mapping (stream channel analysis and mapping). Conservation engineering. Flooding/inundation analyses. Bathymetry is needed for identification of oyster reefs, sometimes less than 12". Additional Business Uses include BU 04 – Forest Resources Management, BU 02 - Riverine Ecosystem Management, BU 15 – Flood Risk Management, and BU 09 – Fisheries Management and Aquaculture.				
MCA Name	MCA No.						
Natural Resources Conservation	51204						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$72,360	$135,675	Major	Major	Major
Inland Bathy	QL0B	2-3 yrs.	Minor	Minor	None	None	None
Nearshore B.	QL0B	2-3 yrs.	$81,405	Moderate	Moderate	Major	don't know
Offshore B.	Order 1b	6-10 yrs.	Minor	None	Minor	Minor	don't know

Organization	Rhode Island		Coastal hazards mapping including shoreline change; inundation mapping/modeling for both current and future conditions; offshore bathymetric changes; land use changes. Bathymetry is needed for siting wind energy projects, monitoring sand movement in nearshore areas. Elevation data are needed for all Coastal Zone Management Program activities including planning and permitting, modeling and planning for sea level rise, monitoring erosion, and modeling storm surge. RI CRMC works with URI for SLOSH modeling and uses X-Beach for wave modeling. Inland bathymetry is needed for the coastal ponds and lagoons along the shoreline and to evaluate sea level rise impacts to inland flooding.				
MCA Name	MCA No.						
Coastal Zone Management	1311						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$55,830	$9,760	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$23,958	$14,045	Moderate	don't know	don't know
Nearshore B.	QL2B	4-5 yrs.	$40,652	$68,600	Major	Moderate	don't know
Offshore B.	Order 1b	6-10 yrs.	$22,375	$4,467	Major	Moderate	don't know

Organization	Northern Mariana Islands		Coastal erosion and inundation, characterization and mapping of wetlands, sea level modeling and mapping, conservation of coral and seagrass habitats. Elevation data are needed for model input, generalized view of habitats, identification of preferred areas, input into exposure and resilience tools, and SLOSH modeling (out to 30-50m depth contour).				
MCA Name	MCA No.						
Coastal Resource Management	1375						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$9,410	$1,645	Minor	Major	Minor
Nearshore B.	QL1B	2-3 yrs.	$2,121	$3,589	Minor	Major	Major
Offshore B.	Order 1b	2-3 yrs.	$131,546	$26,263	don't know	Moderate	don't know

Organization	Oregon		Ocean shore management for protection structure permitting and recreation access. Shore management includes permitting for structures on the beach such as armoring (rip rap, other ways to protect property). Property owners have to apply for a permit. Recreation access – the public has a right to access the entire state shoreline, lidar helps manage access and areas that require access. A swath of data both onshore and nearshore is needed. Topographic data is required, topobathy is highly desirable.				
MCA Name	MCA No.						
Ocean Shore Management for Protection Structure Permitting and Recreation Access	21670						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$23,763	$4,139	don't know	Minor	don't know
Nearshore B.	QL4B	4-5 yrs.	$30,472	$51,081	don't know	Minor	don't know

Organization	SI		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches.				
MCA Name	MCA No.						
Coastal Zone Management	60672						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$13,142	$1,354	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$6,030	$2,092	Moderate	Major	Major
Nearshore B.	QL1B	4-5 yrs.	$2,133	$1,978	Major	Major	Major
Offshore B.	Order 1a	6-10 yrs.	$32,824	$5,241	Minor	Moderate	Moderate

Organization	Georgia		The mission critical activity requiring 3D elevation data is assessment of hazards from sea level rise, storm inundation and changing nearshore shallow bathymetry. Also sand resource assessments for harvesting for beach re-nourishment.				
MCA Name	MCA No.						
Marine Geologic Assessments	1132						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$18,302	Moderate	Minor	Minor	Moderate
Nearshore B.	QL2B	4-5 yrs.	$42,538	Moderate	Moderate	Moderate	Major
Offshore B.	X-Sec meet needs	6-10 yrs.	Moderate	Moderate	don't know	don't know	don't know

Organization	New Jersey		Topographic and bathymetric surveys of the New Jersey coastline. The university has been involved in collecting new elevation data along the New Jersey coast. The collect 170 transects along the beach to 5m depth every 6 months. Single beam bathymetry is also collected as requested of NJ inlets to the ebb tidal delta. The elevation data are used for management decisions and to discover if the sand supply is recovered for other beach nourishment uses by NJ DEP and USACE. Mobile lidar is collected by the university on land for FWS beach and dune system as requested to monitor change as indicated by dredging of undeveloped shorelines. The mobile lidar augments the USGS lidar.				
MCA Name	MCA No.						
Topographic and Bathymetric Surveys of the New Jersey Coastline	1350						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	Event driven	$41,012	$7,538	None	don't know	don't know

Organization	Washington		Management of state-owned aquatic lands. Bathymetry is needed to manage eel grass, geoduck farms, aquatic habitat restoration, aquatic leases (fish and clam farms), facilities, terminals (oil and gas export terminals). Nearshore lidar at low tide is also needed in critical habitat areas.				
MCA Name	MCA No.						
Management of State-Owned Aquatic Lands	21642						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL1B	>10 yrs.	$4,342	Moderate	Moderate	Minor	Moderate
Nearshore B.	QL0B	>10 yrs.	$4,342	Moderate	Moderate	Minor	Moderate
Offshore B.	X-Sec meet needs	>10 yrs.	Minor	Minor	Minor	Minor	Minor

Organization	Alabama		BU 03 - Coastal Zone Management. Coastal hazard mitigation; coastal zones, flood plain management, building inspections, MS4.				
MCA Name	MCA No.						
Coastal Zone Management	33021						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$7,236	None	None	Moderate	Minor

Organization	Maine		Shoreland zone delineation for inland and coastal waters and wetlands. Wetlands land use restrictions are applied within the shoreland zone around all ponds, rivers, and coastal zones. The shoreland zone is defined by a horizontal distance that varies by the type of water feature. Elevation data are needed to help define the shoreland zone. The Mandatory Shoreland Zoning Act (MSZA) requires municipalities to adopt, administer, and enforce local ordinances that regulate land use activities in the shoreland zone. The shoreland zone is comprised of all land areas within 250 feet, horizontal distance, of the: a) normal high-water line of any great pond or river; b) upland edge of a coastal wetland, including all areas affected by tidal action, and c) upland edge of defined freshwater wetlands; and d) all land areas within 75 feet, of the normal high-water line of certain streams.				
MCA Name	MCA No.						
Shoreland Zone Delineation	21531						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$302	$904	Moderate	Moderate	Minor
Nearshore B.	QL3B	6-10 yrs.	$603	$603	Minor	Minor	None

Organization	U.S. Virgin Islands		Spatial planning, coastal hazard mitigation, land and water-use planning, environmental planning. Elevation data are needed for planning and management of marinas, especially on the south shore where the gradual slopes are impacted by sea level rise. Elevation data are also used for evaluation of development impacts, monitoring changes to shorelines and elevation, planning fill for roadways, creating sea level rise animations to communicate future impacts, analysis of storm surge impacts, stormwater runoff modeling, and as input to storm surge and sea level rise models from NOAA and others. Data on buoys and waves and currents are also needed, although not much is currently available. Elevation data are used in the environmental group for inland water quality monitoring. Inland bathymetry could be used for evaluating retention pond systems, mapping waterways for stormwater, and improving stormwater models. Near infra-red, 4band imagery is also highly desirable for the processing of NDVI in considering monitoring coastal vegetation species.				
MCA Name	MCA No.						
Spatial Planning, Coastal Hazard Mitigation, Land and Water-use Planning, and Environmental Planning	1394						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$1,085	Major	Major	Moderate	Moderate
Inland Bathy	QL0B	2-3 yrs.	Major	Moderate	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	Major	Major	Moderate	Moderate	Major
Offshore B.	Order 1	4-5 yrs.	Major	Major	Moderate	Moderate	Moderate

Organization	NOAA		Modeling and mapping of coastal processes and hazards. This includes the following: Creation of DEMs for the modeling and mapping of coastal processes, especially coastal inundation modeling and mitigation. Water quality modeling of cyanobacteria harmful algal blooms (cyanoHABs) and hyperspectral camera flyovers to monitor cyanoHABs. Water quality measurements for cyanoHAB detection and environmental sampling processor for toxin detection. Fisheries Management and Aquaculture - Long-term ecological observations, fundamental research on ecological processes, and data used to develop models critical to understanding ecosystem structure and function. Development of models to forecast impacts of multiple stressors e.g., invasive species, climate, and nutrients on water quality, food webs and fisheries. Observations, laboratory, and field experiments to support the development of new concepts, models, forecasting tools and applications to evaluate and forecast impacts of, and mitigation strategies for, present and future stressors. Anticipate, monitor, analyze, understand, and forecast changes in the Great Lakes and coastal ecosystems to strengthen capacity for managing water quality, fisheries, and ecosystem and human health. Fate and transport of contaminants. Oil Spill Modeling. Pollution risk mitigation. Point- or non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, and vessel spills. Land use and environmental planning. Modeling of biological and ecological systems. Management of diverse coral reef communities, marine mammals, protected fish species, and trust resources. Disaster response. Data dissemination.				
MCA Name	MCA No.						
Modeling and Mapping of Coastal Processes and Hazards	1076						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL2B	2-3 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Major
Offshore B.	Order 1b	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Virginia		Conservation of natural resources				
MCA Name	MCA No.						
Conservation of Natural Resources	1204						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Moderate	Major	Major	Minor
Nearshore B.	QL2B	4-5 yrs.	Moderate	Moderate	Moderate	Moderate	None
Offshore B.	Order 1b	6-10 yrs.	Minor	None	Minor	Minor	don't know

Organization	Old Dominion University		We engage in research activities and educate students in the following areas: Analysis of coastal erosion and inundation, Sea level rise modeling and mapping, Hurricane storm surge modeling and assessment, Coastal hazard modeling and mapping, Coastal resiliency, Subsidence monitoring and mapping. Tide-coordinated lidar acquisitions and improved digital bathymetry (resolution and currency.) or of great value to Old Dominion University. Research and applications are seeing ever more use of topobathymetry for fine-scale hydrologic modeling (e.g., storm surges, sea level rise, and coastal erosion/sedimentation.).				
MCA Name	MCA No.						
Academic Research	1225						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	Major	Major	Major	Moderate	Moderate
Inland Bathy	QL2B	4-5 yrs.	Major	Major	Moderate	None	None
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Moderate	None	None

Organization	Michigan		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches. Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Coastal and Regional Planning	21514						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	Moderate	Major	Moderate	Moderate	Moderate
Inland Bathy	QL4B	4-5 yrs.	Moderate	Major	Minor	Moderate	Moderate
Nearshore B.	QL4B	6-10 yrs.	Moderate	Moderate	Minor	Minor	Minor

Organization	American Samoa		Coastal hazard mitigation, Inundation mapping, Land use mapping. Elevation data are needed for the review of development and building permits, to determine a proposed structure's proximity to shore, to identify flood or landslide prone areas, to monitor beach erosion, and determine the environmental impacts of new development.				
MCA Name	MCA No.						
Coastal Hazard Mitigation, Inundation Mapping, and Land Use Mapping	21567						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Moderate	Major	Major
Nearshore B.	QL0B	6-10 yrs.	Major	Major	Moderate	Moderate	Moderate

Organization	New Jersey		Coastal resiliency planning and hazard mitigation. Lidar is needed for estimation of damage and mitigation strategies; bathymetry is needed for back bay regions. BU 23 - Urban and Regional Planning is an additional Business Use for this MCA.				
MCA Name	MCA No.						
Coastal Resiliency Planning and Hazard Mitigation	21729						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Moderate	Major	Moderate	Moderate	Moderate
Nearshore B.	QL1B	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Illinois		Coastal hazard mitigation; coastal process research. Elevation data are needed for analysis of littoral habitat, nearshore habitat impacts, sedimentation, carbon sequestration in coastal wetlands, wetlands protection, and physical modeling of coastal areas. Nearshore geology is also needed for sedimentation. Multi-beam, single beam, and topobathy, and imagery are all collected to support these activities. Data collection is funded through the Great Lakes Restoration Initiative				
MCA Name	MCA No.						
Lake Michigan Coastal Mapping	22116						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	Annually	Major	Moderate	Major	Moderate	Moderate
Offshore B.	Special Order	Annually	Major	Major	Moderate	Moderate	Major

Organization	Ohio		Coastal Zone Management including Coastal Hazard Mitigation, Protection and Management of State Lake Erie Public Trust Lands, Coastal Resilience and Adaptation Planning, Beneficial Use and Management of Dredge Material, and Sustainable Economic Development. Natural Resources Conservation including the Protection, Enhancement, and Restoration of Coastal Wetland and Nearshore Habitats, Fisheries, Wildlife, and Waterfowl.				
MCA Name	MCA No.						
Lake Erie Coastal Zone Management	22117						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	4-5 yrs.	Moderate	Moderate	Minor	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	Major	Major	Minor	Major	Major
Offshore B.	Order 1a	6-10 yrs.	Moderate	Moderate	Minor	Moderate	Minor

Organization	American Shore and Beach Preservation Association		Advocacy for federal coastal research and infrastructure investment				
MCA Name	MCA No.						
Protection and Preservation of Our Nation's Coasts	22319						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	don't know	Major	Major	don't know	don't know
Nearshore B.	QL1B	Annually	don't know	Major	Major	don't know	don't know

Organization	CMTS		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches				
MCA Name	MCA No.						
Coastal Zone Management	22378						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	2-3 yrs.	don't know	don't know	don't know	don't know	don't know
Inland Bathy	X-Sec meet needs	Event driven	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Moderate	Moderate	Major
Offshore B.	Special Order	6-10 yrs.	Major	Major	Major	Moderate	Major

Organization	Puerto Rico		Coastal Research and Planning (shoreline changes, coastal erosion, recommendation in coastal zoning). Coastal Zone Management. Flood Risk Management. Sea Level Rise and Subsidence.				
MCA Name	MCA No.						
Coastal Research and Planning	22550						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	Major	don't know	don't know	don't know	don't know
Inland Bathy	QL1B	2-3 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL1B	2-3 yrs.	Major	don't know	don't know	don't know	don't know
Offshore B.	Order 1	2-3 yrs.	Major	don't know	don't know	don't know	don't know

Organization	University of North Carolina		Coastal Zone Management				
MCA Name	MCA No.						
Coastal Zone Management	51001						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Moderate	Major	Major
Nearshore B.	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Offshore B.	Order 1a	6-10 yrs.	Major	Moderate	Minor	Moderate	Moderate

Organization	NRC		Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Land use and environmental planning. Coastal resiliency. Oil spill modeling. Littoral zone management including dunes and beaches.				
MCA Name	MCA No.						
Coastal Zone Management	60668						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Moderate	Major	Major
Nearshore B.	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Offshore B.	Order 1a	6-10 yrs.	Major	Moderate	Minor	Moderate	Moderate

Organization	HERE Technologies		Damage modeling and assessment in built-up areas.				
MCA Name	MCA No.						
Damage Modeling and Assessment in Built-up Areas	60721						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Major	Major	Major

Organization	HydroTerra Technologies, LLC		Land and hydrographic surveying in support of coastal restoration projects, shoreline protection projects and dredging projects				
MCA Name	MCA No.						
Land Survey and Hydrographic Solutions	22013						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	Annually	don't know	don't know	don't know	don't know	don't know
Inland Bathy	X-Sec meet needs	Annually	don't know	don't know	don't know	don't know	don't know
Nearshore B.	X-Sec meet needs	Annually	don't know	don't know	don't know	don't know	don't know

BU 04 - Forest Resources Management

BU 04 Scope

Business Use #4 (BU 04) includes forest health assessment; determination of standing inventory of forest resources; prescribed burn planning; analysis of carbon stocks for trade; and harvest systems planning. Working in partnership with others, the U.S. Forest Service (USFS), within the U.S. Department of Agriculture (USDA), is an obvious champion for this Business Use, but other federal, state and local agencies have related responsibilities for management of forest resources, as do commercial timber companies. Figure E.4a shows an example of a lidar point cloud and transect used to determine forest metrics.

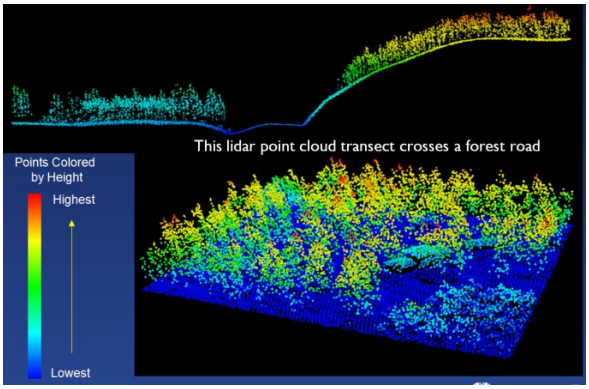

Figure E.4a. Lidar point clouds are used to produce a Digital Surface Model (DSM) of the forest canopy, understory, and the bare-earth Digital Terrain Model (DTM). Shown here, a normalized DSM (nDSM) is a height-above-ground model produced by subtracting the DTM from the DSM, as though the trees grew on flat terrain at zero elevation. At the top, the transect maps the actual steep terrain beneath the trees. Such lidar products are vital for forest and timber metrics and forest health assessment. Image courtesy of the USFS.

BU 04 Background Information

The mission of the USFS is to "sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations." This mission includes forest inventories (inventory metrics include hardwood/conifer discrimination, canopy height, mean diameter, volume, biomass, basal area, canopy density) and forest assessments (including forest health) of USFS lands as well as forested areas in non-USFS lands. Figure E.4a. illustrates the use of a Digital Surface Model (DSM) and a Digital Terrain Model (DTM) to estimate forest and timber metrics and assess forest health. Other agencies and commercial timber companies assess forest resources in different ways for different purposes, e.g., Bureau of Indian Affairs (BIA) for timber harvests on Indian lands, National Park Service (NPS) for monitoring changes in forests in national parks, U.S. Fish and Wildlife Service (FWS) for analyzing changes in wildlife habitat, or the Bureau of Land Management (BLM) for wildfire management.

Similarly, the commercial timber industry has major interests in sustainable forestry for the timber, paper and forest products industry in the U.S. According to the USGS FS-1035, U.S. Forest Resource Facts and Historical Trends, approximately 33 percent of the land area in the U.S. is forested, including reserved forests (not harvested for timber), timberland, private forests, and urban forests. According to the American Forest and Paper Association, the U.S. forest products industry employs about one million workers and accounts for approximately six percent of the total U.S. manufacturing gross domestic product (GDP), placing it roughly on par with the automotive and plastics industries. The forest products industry is among the top ten manufacturing sector employers and generates more than $200 billion a year in sales and about $54 billion in annual payroll. It is in our national interest to maintain healthy and sustainable forests.

Forest ecosystems are the largest terrestrial carbon sink on earth and their management has been recognized as a relatively cost-effective strategy for offsetting greenhouse gas emissions.

BU 04 Elevation Data Uses

Using their own words, respondents documented 50 Mission Critical Activities (MCAs) that identified BU 04 as their primary Business Use and identified the following 54 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.4a. BU 04 Elevation Data Uses

Data Use
Climate Change Analysis
1. Analysis of carbon stocks for trade
Engineering Design and Construction
2. Assessment of slope stability, road placement, and siting of bridges and culverts
Environmental Protection
3. Environmental analysis and decision making
Forestry
4. Biomass estimation
5. Forest health assessment
6. Forest inventory analysis
7. Forestry best management practices (BMPs)
8. Harvest systems planning
9. Management and health of state trust forest resources
10. Management of timber sales and health
11. Protect and manage forest resources
12. Research of forest activities, ponds, and lakes
13. Silvicultural planning
14. Sustainable commercial use of forest resources
15. Sustainable forest resource management/ecosystem management
16. Timber harvests and reforestation
Habitat Analysis and Management
17. Characterization of forest resources (biomass, species, habitat suitability)
18. Conservation of critical habitats
19. Management of forested recreation areas and wildlife habitat
20. Monitoring forest/grasslands and habitat health
21. Wildlife habitat restoration and aquatic conservation
Hazard Assessment and Mitigation
22. Post fire analysis to determine landslide-prone areas
Mapping/Boundary Delineation
23. Characterization of forest vegetation structure (height, size, density)
24. Determination of standing inventory of forest resources
25. Equitable taxation between and among all counties in the state
26. Forest area mapping
27. Forest structure metrics
28. Land cover mapping
29. Land cover typing and land cover change analysis
30. Line-of-sight analyses

Data Use
31. Map risks of invasive species
32. Soils mapping
33. Standing inventory for planning and implementation of forest restoration treatments
34. Topographic Position Index (TPI) analyses
35. Tree canopy analysis
36. Understory data estimate; ground bulk density
37. Vegetation change detection
38. Wildland/urban interface building identification
Modeling
39. Fire behavior modeling to support wildfire suppression activities
40. Modeling of standing volume and basal area
41. Wildfire modeling and management
Natural Resources Conservation
42. Conservation and management of natural resources
43. Urban/wildland interface
44. Planning
45. Focused field reconnaissance; reduced field visits
46. Urban ecology planning
Recreation
47. Tourism: trail and vista site planning
Wildfire Management
48. Determination of forest fuel and fire susceptibility
49. Fire documentation and enforcement
50. Fire fuel loading
51. Prescribed burn planning
52. Situational awareness and safety of fire fighters
53. Wildfire fighting/response
54. Wildfire prevention and suppression

BU 04 Tangible and Intangible Benefits

For the 50 MCAs that list Forest Resources Management as their primary Business Use:

- **Table E.4b** summarizes the reported future annual dollar benefits by geography type, totaling $35.92 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.4c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.4e.
- **Table E.4d** shows (in blue) the three federal agencies, 38 states and territories, and two non-governmental entities that submitted MCAs with BU 04 as the primary Business Use. MCAs for which BU 04 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.4d.
- **Table E.4e** documents all the MCAs that listed BU 04 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.4e documents the MCA name and

number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 04 Reported Future Annual Dollar Benefits

Of the 50 MCAs that listed Forest Resources Management as their primary Business Use, 37 MCAs estimated their tangible annual benefits totally in financial terms; four MCAs had a combination of tangible and "Major" intangible benefits; and six MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.4b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 50 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.4b. BU 04 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$19,177,505	$16,693,776	$35,871,281
Inland Bathymetry	$50,000	$0	$50,000
Nearshore Bathymetry	$0	$0	$0
Offshore Bathymetry	$0	$0	$0
Totals	**$19,227,505**	**$16,693,776**	**$35,921,281**

BU 04 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.4c. BU 04 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	47	44	37	43	41
Inland Bathymetry	15	14	12	14	14
Nearshore Bathymetry	8	8	7	8	1
Offshore Bathymetry	0	0	0	0	0
Totals	**70**	**66**	**56**	**65**	**56**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 04 Reported Future Annual Dollar Benefits Maps

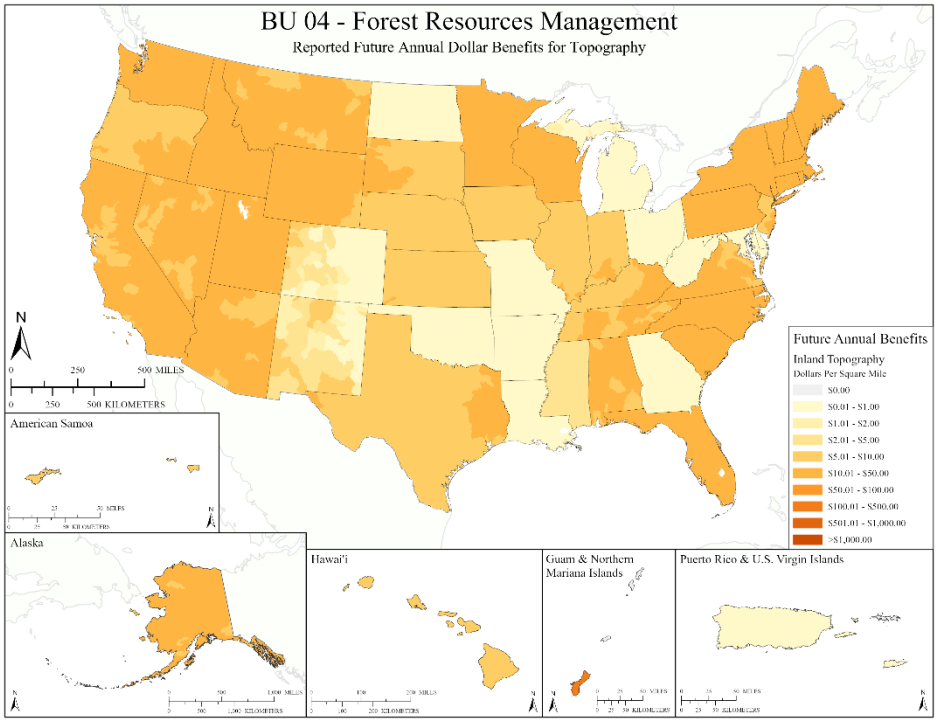

Figure E.4b. Reported Future Annual Dollar Benefits for Topography

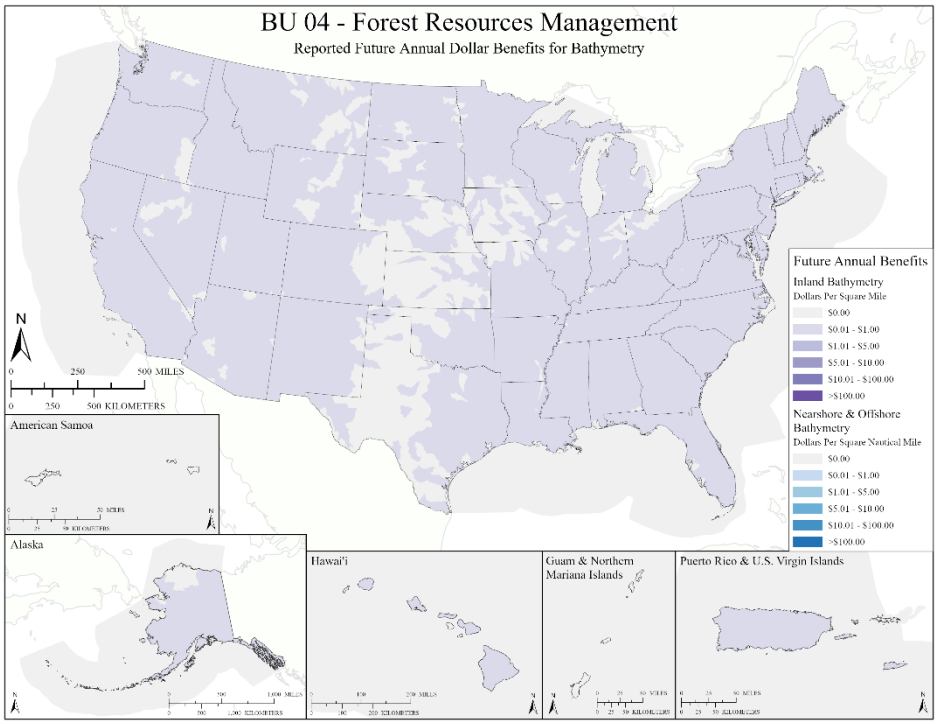

Figure E.4c. Reported Future Annual Dollar Benefits for Bathymetry

BU 04 Benefits Analysis

The total combined future annual benefits ($35.92 million per year) reported for BU 04 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that a national elevation program could deliver data that would meet all user requirements.

Regardless, we believe the BU 04 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, three federal agencies (BLM, NASA, and USFS) submitted a total of five MCAs listing BU 04 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the five total federal MCAs listing BU 04 as primary:
    - Inland Topography: Three provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: One provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: No MCA referenced nearshore bathymetry for BU 04.
    - Offshore Bathymetry: No MCA referenced offshore bathymetry for BU 04.
    - The federal dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.
    - Two federal agencies (NPS and USGS) submitted MCAs with BU 04 as secondary, and two federal agencies (BIA and USMC) submitted MCAs with BU 04 as tertiary, meaning dollar benefits accrued to other Business Uses.
- State/Local/Tribal and U.S. Territory MCAs: Thirty-eight (38) states and territories submitted a total of 43 MCAs that designated BU 04 as their primary BU. Of the 43 MCAs listing BU 04 as primary:
    - Inland Topography: 37 provided dollar benefits and four indicated "Major" benefits.
    - Inland Bathymetry: None listed dollar benefits and 12 indicated "Major" benefits.
    - Nearshore Bathymetry: None listed dollar benefits and eight indicated "Major" benefits.
    - Offshore Bathymetry: No MCAs for BU 04 pertained to offshore bathymetry.
    - The state dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.
- Non-governmental MCAs: Two non-governmental organizations (Leading Edge Geomatics and Appalachian Mountain Club) submitted MCAs that designated BU 04 as primary; one provided dollar benefits for inland topography and "Major" benefits for inland bathymetry and the other indicated benefits were "Major" for inland topography.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.4b and E.4c:
    - 136 "Major" Operational and Customer Service benefits and 177 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 04 for which "Major" benefits are documented, this

could easily be translated into millions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

- No commercial timber companies, either large or small, participated in the survey. The top ten timber companies in the U.S. include Weyerhaeuser; Georgia-Pacific LLC; West Fraser Timber Co. Ltd., Sierra Pacific Industries; Interfor Corporation; Hampton Affiliates, Inc.; Canfor; Idaho Forest Group, LLC; RSG Forest Products, Inc.; and PotlatchDeltic. Because these companies did not participate, benefits to them from public domain elevation data were not included.

BU 04 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 04:

- **Table E.4d** color-codes those organizations having an MCA with BU 04 as Primary, Secondary, or Tertiary.
- **Table E.4e** summarizes the 50 MCAs with primary benefits for BU 04, rank ordered from the highest to the lowest tangible benefits.

Table E.4d. Organizations having an MCA with BU 04 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	**BLM**	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	**NASA**	NGA	NOAA	*NPS*	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	USAF	USARC	USBR	USCB
	USCG	**USFS**	*USGS*	USMC	USN					

State/Ter	**AL**	**AK**	AR	**AZ**	**CA**	CO	**CT**	DC	DE	**FL**	GA	**HI**	**IA**	**ID**
	IL	**IN**	**KS**	**KY**	*LA*	MA	*MD*	**ME**	*MI*	MO	**MN**	**MS**	**MT**	**NC**
	ND	**NE**	NH	**NJ**	**NM**	**NV**	NY	OH	OK	**OR**	**PA**	**RI**	**SC**	**SD**
	TN	**TX**	**UT**	**VA**	**VT**	**WA**	**WI**	**WV**	**WY**	PR	VI	**GU**	**AS**	*CNMI*

Non-Gov	**Appalachian Mountain Club**	*HERE Technologies*	**Leading Edge Geomatics**	

Table E.4e. MCA summaries for BU 04, rank ordered from the highest to the lowest tangible benefits.

Organization	Alaska		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60007						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$2,309,579	$3,348,010	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Major	Major	don't know

Organization	BLM		Timber harvest and reforestation, Wildfire fighting, Wildlife habitat restoration, and Aquatic conservation. Inland bathy data is needed for forestry activities in Oregon. Elevation data is used for forest structure metrics. Having good quality elevation data reduces field visits.				
MCA Name	MCA No.						
Forestry Management	21707						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$4,120,500	Major	Major	Major	Major
Inland Bathy	QL2B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Maine		Characterization of the forest resource (biomass, species, habitat suitability). Change detection in aboveground vegetation (forest losses due to natural or manmade disturbances). Mapping of the digital terrain for soils, stream identification or depth to water table.				
MCA Name	MCA No.						
Characterization of the Forest and Water Resource	22115						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,318,090	$1,715,075	Major	Major	Minor

Organization	Texas		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60436						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$1,046,620	$1,517,201	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Minnesota		To conserve and manage the state's natural resources and to provide for sustainable commercial uses of those natural resources. Elevation data are used to estimate aboveground biomass, for land cover typing and land cover change analysis, to model standing volume and basal area, for site indexes of forest resources, to map risks of invasive species, for habitat mapping, and fire activities. Understory data are needed to estimate ground bulk density, fire fuel loading, and proximity to property. For ecosystem and wildlife management, data on wetlands, submerged aquatics, and aquatic invasive species are needed. BU 17 - Wildfire Management, Planning, and Response is an additional Business Use for this activity.				
MCA Name	MCA No.						
Natural Resources and Forest Resources Management	11471						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,750,000	$483,609	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Major	Major	don't know

Organization	California		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60041						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$625,281	$906,419	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Montana		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60254						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$581,364	$842,756	Major	Major	Major

Organization	Arizona		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60036						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$450,729	$653,386	Major	Major	Major

Organization	Wyoming		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60535						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$386,731	$560,613	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Washington		Management and health of state trust forest resources. DNR manages all forested lands (both for timber sales and health). DEM and DSM are needed to calculate stand height and volume, DEMs are needed for assessment of slope stability, road placement, and siting of bridges and culverts. May be able to identify species (future goal). Timber sales on state owned lands fund school construction. BU 26 – Education K12 and Beyond, Basic Research would be an additional Business Use.				
MCA Name	MCA No.						
Management and Health of State Trust Forest Resources	21695						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	6-10 yrs.	$501,595	$387,207	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Major	Major	don't know

Organization	Utah		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60463						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$330,495	$479,091	Major	Major	Major

Organization	Idaho		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60131						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$330,414	$478,974	Major	Major	Major

Organization	Kansas		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60183						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$325,311	$471,577	Major	Major	Major

Organization	Nebraska		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60270						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$305,836	$443,346	Major	Major	Major

Organization	South Dakota		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60409						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$304,897	$441,985	Major	Major	Major

Organization	Oregon		All aspects of forestry and the supporting activities. Forest resources management; Timber harvests; Wildfire management; Homeland security, law enforcement, disaster response, and emergency management; Recreation; and Telecommunications (used for siting radio repeater sites across the state for self and other agencies. Topo is used for line of sight and coverage analysis). For forestry, Topographic Position Index (TPI) analysis is run on DEMs. This is a neighborhood analysis used to see the relationship of a cell to its neighbors; negative indicates a valley, positive is a ridge, neutral is flat. TPI is used to identify stream channels, valleys, draws, etc. It is used for fire documentation and enforcement of Oregon Forest Practice Act. The regulations are based on proximity to streams. High quality lidar data is critical for all aspects of our mission.				
MCA Name	MCA No.						
Statewide Wildfire Management and Forest Management	1360						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	6-10 yrs.	$506,878	$69,104	Minor	Moderate	Moderate

Organization	Illinois		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60138						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$222,761	$322,919	Major	Major	Major

Organization	Iowa		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60170						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$222,489	$322,525	Major	Major	Major

Organization	Florida		The Florida Forest Service (FFS) consists of more than 1,250 dedicated employees with the mission to protect and manage the forest resources of Florida, ensuring that they are available for future generations. Wildfire prevention and suppression are key components in our efforts to protect homeowners from the threat of damage in a natural, fire-dependent environment. We are dedicated to training individuals to meet these goals. In addition to managing over one million acres of state forests for multiple public uses including timber, recreation and wildlife habitat, we also provide services to landowners throughout the state with technical information and grant programs. The Florida Forest Service's forestry programs are implemented by its Field Operations staff within 15 field units across the state. Field personnel and equipment provide a more responsive and comprehensive approach to land management and wildfire control statewide. The Florida Forest Service is currently investing in a helicopter to collect site-specific lidar. Statewide collections would be beneficial for temporal analysis.					
MCA Name	MCA No.						
Forest Resources Management	1355						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$221,869	$321,626	Moderate	Major	don't know
Nearshore B.	QL3B	4-5 yrs.	Major	Major	Moderate	Major	don't know

Organization	Florida		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60080						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$221,869	$321,626	Major	Major	Major

Organization	Wisconsin		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60525						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$221,664	$321,329	Major	Major	Major

Organization	Nevada		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60283						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$218,568	$316,840	Major	Major	Major

Organization	North Carolina		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60321						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$250,000	$282,950	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL0B	4-5 yrs.	Major	Major	Major	Major	don't know

Organization	Alabama		Forest area mapping, forest health assessment, forest inventory analysis, prescribed burn, silvicultural planning, canopy analysis, determination of forest fuel and fire susceptibility, fire behavior modeling to support wildfire suppression activities, urban wildland interface, wildfire response. Elevation data are needed for urban forestry planning to include canopy analysis, understand drainage patterns to manage forest resources, calculating forest biomass, and identifying prescribed burning areas. Elevation data are also needed as input into wildfire models to include calculating slope, estimating fuel loads, and predicting fire risk and fire spread. Any tornado debris residue contributes to fire hazards. There is a small amount of timber harvesting on state lands, mostly harvesting is done on privately owned lands.				
MCA Name	MCA No.						
Forest Resources Management	1417						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$204,241	$296,072	Major	Major	Major

Organization	USFS		Characterization of forest vegetative structure in terms of height, size and density, standing inventory for planning and implementation of forest restoration treatments. Wildfire management. An additional Business Use would be BU 01- Water Supply and Quality.				
MCA Name	MCA No.						
Forest Management and Restoration	50007						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$450,000	Major	Moderate	Moderate	Moderate
Inland Bathy	QL2B	4-5 yrs.	$50,000	don't know	Moderate	Moderate	Moderate

Organization	Leading Edge Geomatics		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60729						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$500,000	Major	Major	Major	Major
Inland Bathy	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Major

Organization	South Carolina		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60399						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$250,000	$177,410	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL1B	4-5 yrs.	Major	Major	Major	Major	don't know

Organization	Tennessee		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60425						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$166,622	$241,539	Major	Major	Major

Organization	Kentucky		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60189						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$159,772	$231,609	Major	Major	Major

Organization	Virginia		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60493						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$159,658	$231,444	Major	Major	Major

Organization	Indiana		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	22143						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$143,061	$207,383	None	Moderate	None

Organization	New Mexico		Characterization of forest vegetative structure in terms of height, size and density, standing inventory for planning and implementation of forest restoration treatments. Wildfire management.				
MCA Name	MCA No.						
Forest Management and Restoration	1456						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Depends on variables	$63,438	$91,961	Minor	Moderate	Moderate

Organization	Mississippi		Forest Resources Management. Elevation data improves situational awareness and the safety of our fire fighters. It is critical to proper implementation and monitoring of our Forestry Best Management Practices. Topography data is invaluable in forest management. Time saved in planning and through focused field reconnaissance is a major benefit to our agency.				
MCA Name	MCA No.						
Forest Resources Management	1411						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$94,068	Moderate	Minor	Major	Moderate

Organization	Vermont		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60480						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$38,012	$55,103	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major

Organization	New Jersey		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60294						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$29,779	$43,168	Major	Major	Major

Organization	USFS		Regional Land Management and Natural Resource Conservation activities. Natural Resource Assessments. Additional Business Uses for this MCA are BU 07 – Wildlife and Habitat Management and BU 17 – Wildfire Management.				
MCA Name	MCA No.						
Land Management and Natural Resource Conservation	1066						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$70,178	$1,000	Moderate	Major	Major

Organization	Guam		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60093						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$25,441	$36,879	Major	Major	Major

Organization	Hawai'i		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60113						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$25,441	$36,879	Major	Major	Major

Organization	Connecticut		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60061						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$19,657	$28,496	Major	Major	Major

Organization	Rhode Island		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60371						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$4,281	$6,206	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major

Organization	American Samoa		Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.				
MCA Name	MCA No.						
Forest Resources Management	60026						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$317	$460	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Major	Major	don't know

Organization	Nevada		Monitoring forest-grasslands and habitat health. An additional Business Use for this activity is BU 07 - Wildlife and Habitat Management.				
MCA Name	MCA No.						
Forest Structure Mapping and Habitat Modeling	21785						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	>10 yrs.	Major	Major	Minor	Minor	Minor

Organization	NASA		Assess Interactions of Global Biogeochemical Cycles and Ecosystems with Global Environmental Change NASA's technology investments, data collection and dissemination, scientific research and applications related to elevation data extend across many Earth science disciplines. The primary information is topography of the land surface, the height and 3D structure of vegetation and the height of snow, ice and water, including those of ice sheets, ice caps and glaciers. The anthropogenic and natural change in these attributes is often a fundamental component of NASA's objectives. The uses of these data are diverse, with these as prominent, but not complete, examples. Topography: Characterization and modeling of tectonics/deposition/erosion/climate coupled processes. Earthquake, volcano, landslide and coastal hazard assessment, response, mitigation and modeling. Planetary analog studies. Biosphere: Biomass inventory, dynamics and monitoring. Habitat quality and its response to disturbance. Land use and land cover. Biodiversity and forest services management. Wild-fire fuel, slope stability and storm/tsunami surge resistance. Hydrosphere: Lake and reservoir heights. Snow depth and melt timing impact on water resources. Stream and river routing. Flooding and inundation modeling. Wetland monitoring and management. Cryosphere: Ice sheet, ice cap and glacier elevation change and sea level impact. Sea ice cover and thickness change and effect on ocean circulation. Constraints for modeling ice flow and dynamics. Although not an operational organization, a part of NASA's mandate is to transfer technologic, observational, analytic and modeling capabilities it develops to national and international organizations whose responsibilities benefit from incorporation of these capabilities. BU 06 – Natural Resources Conservation, BU 16 – Sea Level Rise and Subsidence, BU 07 – Wildlife and Habitat Management, BU 24 – Health and Human Services, and BU 26 – Education K12 and Beyond, Basic Research are additional Business Uses.Response to Question 5a. Given the broad scope of NASA scientific and applications objectives, identification of one or a few business uses that require elevation data is not applicable. Of the 30 Business Uses these are the ones that do not directly pertain to NASA objectives: 11, 12, 13, 19, 20, 21, 22, 25, 27, 28, 29, 30				
MCA Name	MCA No.						
Assess Interactions of Global Biogeochemical Cycles and Ecosystems with Global Environmental ChangeScientific Research and Data Collection to Understand Changes in the Earth's Surface	22036						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	don't know	don't know	Major	Major	Major

Organization	West Virginia		All of the following are the WVDOF's mission critical activities: Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning. Conservation of critical habitats. Stream channel analysis and mapping for riparian buffers. Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post-fire analysis to determine landslide-prone areas. Urban ecology planning. Tourism. Trail and vista site planning.				
MCA Name	MCA No.						
Forest Resources Management	22081						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	Major	Major	Major	Major	Major

Organization	Pennsylvania		Sustainable Forest Resource Management / Ecosystem Management				
MCA Name	MCA No.						
Forest and Ecosystem Management	22182						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	Major	Major	Minor	Major	Minor

Organization	Minnesota		Environmental Analysis and Decision Making. The University is research oriented; its needs are project based and may vary. Projects could be anywhere. Needs for smaller islands would be project dependent. The data are needed for land cover mapping, tree canopy analysis, H&H analysis, and water clarity evaluations.				
MCA Name	MCA No.						
Environmental Analysis and Decision Making	22184						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	Major	Major	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL1B	Event driven	Major	Major	Major	Major	don't know

Organization	Appalachian Mountain Club		1. Forest health assessment. Determination of standing inventory of forest resources. Analysis of carbon stocks for trade. Harvest systems planning. 2. Alpine mapping, Modeling of biological and ecological systems including carbon stocks, Assessing ecological/conservation components for land protection including viewshed analysis. 3. Recreation planning and development; facilities; maps and guides; trail planning. 4. Analysis of wind energy potential and turbine placement including viewshed analysis.				
MCA Name	MCA No.						
Protection, Enjoyment, and Understanding the Mountains, Forests, Waters, and Trails of America's Northeast and Mid-Atlantic Regions	22350						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Moderate	Major	None
Inland Topo	QL2	4-5 yrs.	Major	Major	Moderate	Major	None

Organization	USFS		Natural resource management.				
MCA Name	MCA No.						
Geospatial Science for Natural Resource Management	32759						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	Major	Major	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Major
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Florida		Equitable taxation between and among all 67 counties of the state.				
MCA Name	MCA No.						
Property Assessment and Taxation	21748						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	2-3 yrs.	Moderate	Moderate	don't know	don't know	don't know

Organization	Idaho		Almost all of the ones listed below. Research is taking place in many of these. The College of Natural Resources needs elevation data for forest activities, and the College of Science needs bathymetry for ponds and lakes.				
MCA Name	MCA No.						
Higher Education Research and Teaching Activities	22407						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	don't know	don't know	don't know	don't know	don't know
Inland Bathy	I don't know	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

BU 05 - Rangeland Management

BU 05 Scope

Business Use #5 (BU 05) includes assessment of rangeland health and mapping for soil erosion potential due to grazing. The Bureau of Land Management (BLM) and the National Resources Conservation Service (NRCS) serve as champions for this Business Use on Federal and private lands respectively.

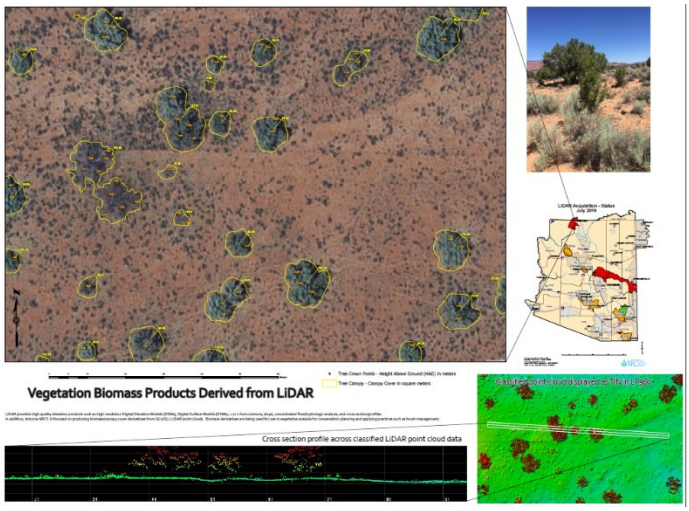

Figure E.5a. Example of how NRCS uses lidar elevation data for quantification of vegetation types in rangeland. The number of acres of shrub and tree vegetation types can be estimated by spatial analysis map algebra functions. Image courtesy of the NRCS.

BU 05 Background Information

Rangelands are vast natural landscapes in the form of grasslands, shrublands, woodlands, and deserts. Types of rangelands include tallgrass and shortgrass prairies, desert grasslands and shrublands, woodlands, savannas, chaparrals, steppes, and tundra. Rangelands are not: barren desert, farmland, closed canopy forests, or land covered by solid rock and/or glaciers. Rangelands are important for America's livestock and wildlife habitat.

The Federal Land Policy Management Act (FLPMA) of 1976 recognized BLM's role in managing the public lands under principles of multiple use and sustained yield; this includes rangeland management. Livestock grazing, an important use of public lands, is central to the livelihood and culture of many communities. A significant portion of the cattle and sheep produced in the West graze on public lands managed by BLM.

NRCS assists private landowners with rangeland management and considers lidar as an essential tool. Lidar data provides an efficient method to map and monitor the various forms of rangelands, vegetation, and hydrographic features that nourish them; to assess changes in topography; to map erosional features such as gully cross-sections; and to assess changing morphology resulting from a shift from grassland to shrubland vegetation, for example. Figure E.5a shows one such example where the DTM (bare-earth) surface is subtracted from the DSM (top reflective surface) to quantify and convert acres to percent for different vegetation types per Planning Land Unit (PLU). This can be used with other terrain derivatives and soil information for brush management planning and improved estimation of potential stocking rates.

BU 05 Elevation Data Uses

Using their own words, respondents documented 17 Mission Critical Activities (MCAs) that identified BU 05 as their primary Business Use and identified the following 15 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.5a. BU 05 Elevation Data Uses

Data Use
Habitat Analysis and Management
1. Combat invasive species
2. Identification of prairie dog colonies
3. Identification of sage brush
4. Sage grouse planning
5. Vegetation management for sage grouse habitat, other wildlife, and feral horses
Mapping/Boundary Delineation
6. Assessment of slope, aspect and land cover (in office) to reduce field work
7. Identification of vegetation structure, heights of shrubs, etc.
8. Land cover mapping and modeling
9. Mapping for soil erosion potential due to grazing
10. Public lands research
Natural Resources Conservation
11. Assessment of rangeland/arid lands health
12. Assessment of urban/wildland interfaces
13. Vegetation management for cattle grazing
Permitting
14. Permittee allotment; identification of grass types for allotment
Planning
15. Bioregional/regional planning

BU 05 Tangible and Intangible Benefits

For the 17 MCAs that list Rangeland Management as their primary Business Use:

- **Table E.5b** summarizes the reported future annual dollar benefits by geography type, totaling $976,008 per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.5c** summarizes the major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.5e.
- **Table E.5d** shows (in blue) the one federal agency and the 16 states that submitted MCAs with BU 05 as the primary Business Use. MCAs for which BU 05 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.5d.
- **Table E.5e** documents all the MCAs that listed BU 05 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.5e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 05 Reported Future Annual Dollar Benefits

Of the 17 MCAs that listed Rangeland Management as their primary Business Use, two MCAs estimated their tangible annual benefits totally in financial terms, and 15 MCAs listed “Major” intangible benefits only. Others had “Moderate” or “Minor” intangible benefits.

The Reported future annual dollar benefits are summarized in Table E.5b, using the highest value when an MCA specified a range of annual benefits.. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 17 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.5b. BU 05 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$495,853	$480,155	$976,008
Inland Bathymetry	$0	$0	$0
Nearshore Bathymetry	$0	$0	$0
Offshore Bathymetry	$0	$0	$0
Totals	**$495,853**	**$480,155**	**$976,008**

BU 05 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.5c. BU 05 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	17	17	1	17	1
Inland Bathymetry	1	1	1	1	1
Nearshore Bathymetry	0	0	0	0	0
Offshore Bathymetry	0	0	0	0	0
Totals	**18**	**18**	**2**	**18**	**2**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 05 Reported Future Annual Dollar Benefits Maps

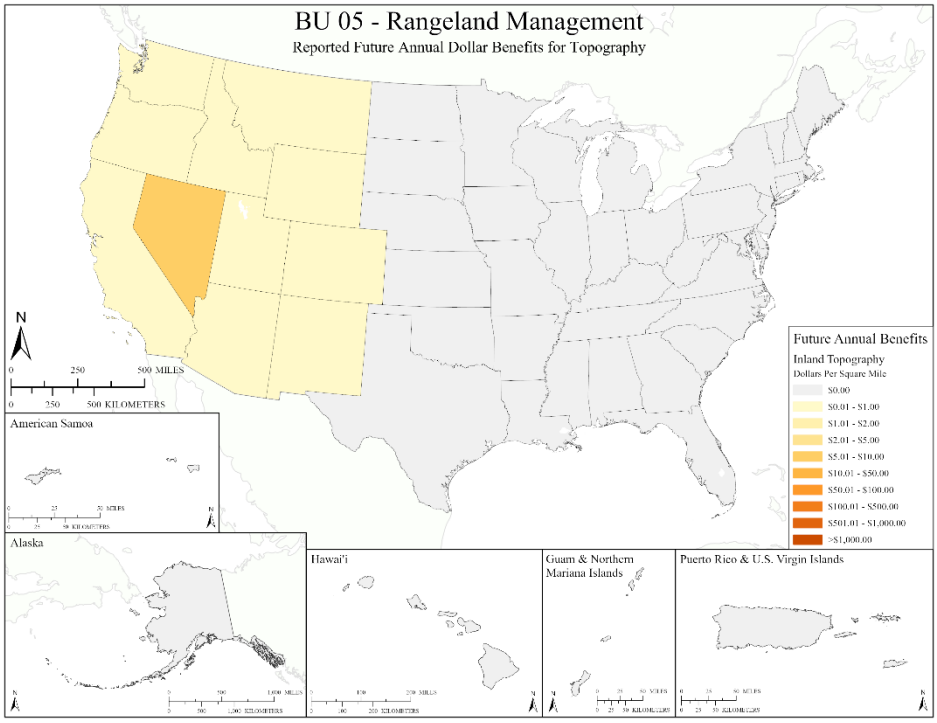

Figure E.5b. Reported Future Annual Dollar Benefits for Topography

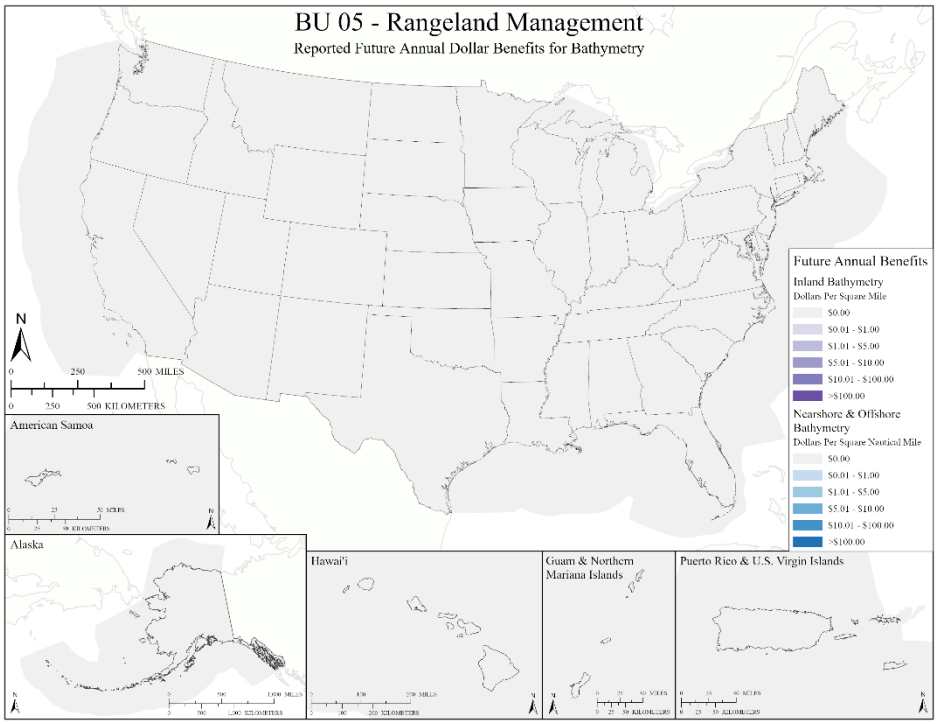

Figure E.5c. Reported Future Annual Dollar Benefits for Bathymetry

BU 05 Benefits Analysis

The total combined future annual benefits ($976,008 per year) reported for BU 05 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that a national elevation program could deliver data that would meet all user requirements.

Regardless, we believe the BU 05 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs:
    - Inland Topography: Only BLM submitted an MCA listing BU 05 as primary, accounting for benefits on federal lands; but NRCS submitted an MCA listing BU 05 as tertiary, therefore not accruing any benefits to rangeland management on private lands.
    - Inland Bathymetry: No federal MCA listing BU 05 as primary included any requirements for or benefits from inland bathymetry.
    - Nearshore and Offshore Bathymetry: No federal MCA listing BU 05 as primary included any requirements for or benefits from nearshore or offshore bathymetry.
- State/Local/Tribal and U.S. Territory MCAs:
    - Inland Topography: 15 states submitted 16 MCAs listing BU 05 as primary; of these, two MCA's estimated dollar benefits and 14 states indicated "Major" benefits.
    - Inland Bathymetry: Only one state (Utah) included an MCA listing BU 05 as primary; that MCA indicated "Major" benefits from inland bathymetry for rangeland management.
    - Nearshore and Offshore Bathymetry: No State MCA listing BU 05 as primary included any requirements for or benefits from nearshore or offshore bathymetry.
- Non-governmental MCAs: No non-governmental organization submitted an MCA listing BU 05 as primary, secondary, or tertiary.
- Increased Combined Benefits: There are several factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.5b and E.5c:
    - 36 "Major" Operational and Customer Service benefits and 22 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for which "Major" benefits are documented, this could easily be translated into significant additional dollars in annual savings. But we have no way of knowing if a one percent savings is appropriate or not.
    - Rangeland management benefits to private landowners were not considered because NRCS's MCA listed BU 05 as tertiary.

BU 05 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 05:

- **Table E.5d** color-codes those organizations having an MCA with BU 05 as Primary, Secondary, or Tertiary

- **Table E.5e** summarizes the 17 MCAs with primary benefits for BU 05, rank ordered from the highest to the lowest tangible benefits

Table E.5d. Organizations having an MCA with BU 05 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	**BLM**	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	NOAA	NPS	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	USAF	USARC	USBR	USCB
	USCG	USFS	USGS	USMC	USN					

State/Ter	AL	**AK**	AR	**AZ**	**CA**	CO	CT	DC	DE	FL	GA	HI	**IA**	*ID*
	IL	**IN**	KS	KY	LA	MA	MD	ME	MI	MO	**MN**	MS	**MT**	NC
	ND	**NE**	NH	NJ	**NM**	**NV**	NY	OH	OK	OR	PA	**RI**	SC	**SD**
	TN	**TX**	**UT**	VA	VT	*WA*	WI	WV	**WY**	PR	VI	GU	AS	CNMI

Table E.5e. MCA summaries for BU 05 rank ordered from the highest to the lowest tangible benefits

Organization	Nevada		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60284						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	$218,568	$316,840	Minor	Major	don't know

Organization	Utah		The MCA of Utah State University varies widely between researchers and departments. However, the key MCAs are land cover mapping and modeling with a primary focus of assessing long-term rangeland/arid lands health in the western US. Further, the University would also be keen to identify other MCAs such as river/channel system monitoring and recovery, wildlife/habitat management with the goal of supporting local management agencies, bioregional/regional planning including urban/wildland interfaces.				
MCA Name	MCA No.						
Land Cover Mapping and Modeling	1159						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$277,285	$163,315	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Wyoming		Rangeland health assessments. 95% of rangeland is on public lands. Forest Service permits can be on public lands as well. Permittees' allotments may cross state boundary. Permittees provide data with their applications in the eastern part of state where there are little public lands. The use of elevation data for this activity is aspirational. Elevation data should be able to help identify grass types for allotment, help combat invasives, and allow the department to focus on projects with a greater chance of success. Having aspect, slope, and land cover data would result in less field work. The data could help with sage grouse plans, identification of prairie dog colonies, and sage brush. Having both bare earth and tops of vegetation should lead to fewer or faster field visits. Shrub height and shape, and grass height would be needed. Imagery is currently used and will also be needed.				
MCA Name	MCA No.						
Rangeland Health Assessments	1114						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	BLM		Vegetation management on rangelands for cattle grazing, sage-grouse habitat, other wildlife, and feral horses. QL1 point density is needed to be able to identify vegetation structure, heights of shrubs, etc. Point density is more important than vertical accuracy.				
MCA Name	MCA No.						
Rangeland Management	1301						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	Major	Major	Moderate	Major	Moderate

Organization	Alaska		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60008						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	Arizona		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60037						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	California		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60042						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	Indiana		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60150						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	Iowa		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60171						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	Montana		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60255						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	Nebraska		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60271						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	New Mexico		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60306						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	Rhode Island		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60372						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	South Dakota		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60410						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	Texas		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60437						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	Utah		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60464						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Major	don't know

Organization	Minnesota		Assessment of rangeland health. Mapping for soil erosion potential due to grazing.				
MCA Name	MCA No.						
Rangeland Management	60606						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	Major	Major	Minor	Major	don't know
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

BU 06 - Natural Resources Conservation

BU 06 Scope

Business Use #6 (BU 06) includes conservation engineering; soils and wetlands mapping and characterization; modeling of biological and ecological systems; erosion control; rainfall penetration studies; impervious surfaces; and assessment of blue carbon stocks. Working in partnership with state and local natural resources or environmental agencies (governmental and non-governmental), the Natural Resources Conservation Service (NRCS), within the U.S. Department of Agriculture (USDA), is the federal champion for this Business Use. Its mission is to develop and deliver high quality products and services that enable people to be good stewards of the nation's soil, water, and related natural related resources on non-federal lands.

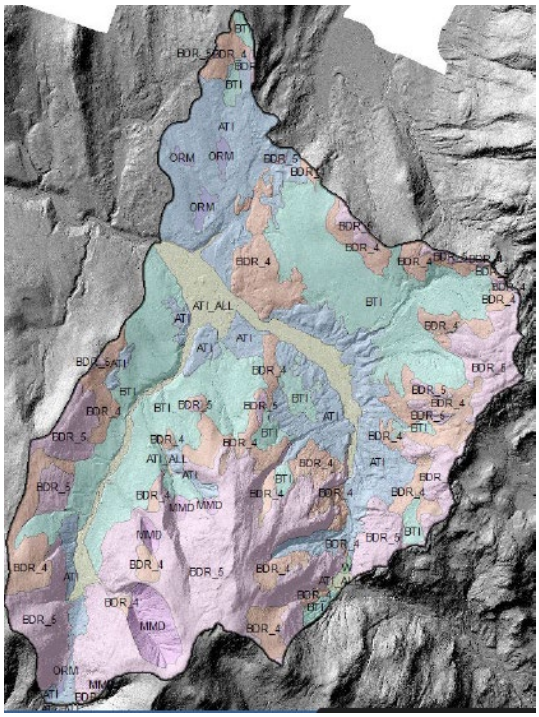

Figure E.6a. NRCS soil scientists use high-resolution lidar data and derivatives (slope, aspect, curvature, soil wetness index) and Arc Soil Inference Engine (ArcSIE) to stratify each type of parent material into appropriate soil classes. Image courtesy of the NRCS.

BU 06 Background Information

The founding motto of the NRCS, originally the Soil Conservation Service (SCS), is "If we take care of the land, it will take care of us." DEM derivatives (slope, aspect, and curvature) are the three principal parameters in NRCS's soil survey computer models. Furthermore, DEMs and DEM derivatives are mission-critical for conservation of soil, wetlands, and other natural resources for many other federal and state agencies.

Approximately 70 percent of the land in the U.S. is privately owned, making stewardship by private landowners critical to the health of our nation's environment. NRCS works with private landowners through conservation planning and assistance designed to benefit the soil, water, air, plants, and animals that result in productive lands and healthy ecosystems. Other federal, state, and local agencies have similar but different environmental stewardship responsibilities for federal, state, local, tribal, and privately-owned lands, and they all benefit from lidar and other elevation datasets used as a tool for landscape/landform/ soil parent material visualization and stratification, and as a source of terrain derivatives for soil predictive models, as shown in Figure E.6a.

BU 06 Elevation Data Uses

Using their own words, respondents documented 65 Mission Critical Activities (MCAs) that identified BU 06 as their primary Business Use and identified the following 85 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.6a. BU 06 Elevation Data Uses

Data Use
Climate Change Analysis
1. Analysis of coastal hazards and climate change
2. Assess blue carbon stocks

Data Use
3. Climate monitoring and modeling
Data Development and Management
4. Develop policies, practices and standards; promote geospatial data sharing
5. GIS for natural resources
6. Infrastructure architecture to support mission critical remote sensing tasks service-wide
7. Manage statewide GIS projects grants and resources
8. Provide GIS support for forestry and agricultural programs
9. Support all state Natural Resources Districts and local requirements
10. Support biologists, range scientists, archeologists, agronomists, and water resources engineers
11. Support BLM field offices and activities
Economic Development
12. Tribal economic development, in a culturally appropriate and sustainable way
Education
13. Snow science, ecology, biology, geology and environmental science
14. Terrain analysis in snow science, geological hazards, suitable habitat, migration pathways
Environmental Protection
15. Abandoned Mine Lands (AML) reclamation
16. Environmental assessments, consulting, management, quality
17. Investigation of contaminated sites, solid waste, water quality programs
18. Preserve or enhance air, land, and water quality
19. Protect and improve water quality from contaminants, excess nutrients and sediment
20. Research blue-green algae blooms and protect water quality
21. Restore and protect surface and groundwater resources through pollution prevention/mitigation
22. Review of environmentally sensitive areas
23. State environmental management to include coastal, instream flow, geologic mapping of deposits
Erosion/Sediment Control
24. Erosion control
25. Reservoir calculations and sedimentation analyses
26. Water quality and erosion control
Groundwater Management
27. Manage aquifer recharge sites
Habitat Analysis and Management
28. Assess aquatic and terrestrial habitat
29. Forest and fisheries management
30. Living resources – to protect, restore and enhance habitats to ensure healthy and sustainable natural communities of plants and animals
31. Protect and conserve wetlands and riparian habitats to maintain beneficial functions
32. Restoration of aquatic habits such as rivers, wetlands and watersheds
33. State park management operations including public safety, natural resources, cultural resources, invasive species, habitat conservation, roads and trails, wildland fire management, and education
Hazard Assessment and Mitigation
34. Emergency management and hazard mitigation

Data Use
35. Hazard mitigation, e.g., spills, floods, fires, landslides
Mapping/Boundary Delineation
36. Calculate lake volumes
37. Hydrographic mapping and stream channel analysis
38. Impervious surface mapping
39. Land cover mapping and feature extraction
40. Mapping and characterization of soils, wetlands, and erodible lands
41. Mapping to support deep ocean exploration and research
42. Nez Perce Tribe homeland asset management; maintenance of hunting and fishing rights
43. Support the National Land Cover Database (NLCD) and LANDFIRE program
44. Topographic mapping – U.S. Topo mapping
45. Vegetation/habitat mapping
46. Visualization and morphology extraction
47. Water resources mapping/surveying
Modeling
48. Modeling of biological and ecological systems
49. Modeling of critical habitats
50. Monitoring and modeling of coastal erosion and inundation
51. Rainfall penetration studies
52. Snow surveys, monitoring, modeling, forecasting
53. Species distribution modeling
54. TMDL modeling and non-point source pollution
55. Water flow modeling
Natural Resources Conservation
56. Administer farm and conservation programs
57. Agricultural Conservation Planning Framework (ACPF) tools to identify critical source areas
58. Conservation and recreation
59. Conservation engineering
60. Conservation Reserve Program (CRP) activities
61. Conservation to protect soils, water, wetlands, grazing lands, forests and other natural resources
62. Design of conservation practices
63. Holistic management of land and water resources to support the state's economy/environment
64. Land services, fisheries, forestry and water resources
65. Manage BIA trust assets, including natural resources
66. Manage natural resources for Tribes including fishing rights and water rights
67. Precision conservation: land cover mapping, stream mapping, riparian assessment, BMP siting
68. Protect and improve living resources, soil function and hydrology
69. Protect, conserve, and manage state natural resources
70. Site inventories of natural resources
71. Support sustained, productive, working farms and ranches that optimize natural resource benefits, enhance water quality, and protect sensitive environmental features
72. Terrain analysis for conservation
73. Use DEMs to target and prioritize agriculture and urban conservation practices

Data Use
74. Watershed planning using the Agricultural Conservation Planning Framework (ACPF) and the Prioritize, Target, Measure (PTM) application
Planning
75. Irrigation system planning and development
76. Land use – to improve and sustain collaborative regional approaches to responsible land use planning and open space protection
77. Planning and design of agricultural systems that benefit natural resource conservation
78. Planning for resource conservation to include water quality/quantity, energy conservation, erosion control; impacts from slope and surface drainage networks on agronomic and structural practices
79. Siting of dam locations
80. Support engineers and field office staff for planning
Regulatory Reviews and Enforcement
81. Enforce state environmental laws
82. Environmental/social impact assessment and permitting
83. National Environmental Policy Act (NEPA) compliance
Wildlife Management
84. Protect shellfish harvesting and beach health
85. Track endangered, threatened, and candidate fungi, animals, birds, and plants

BU 06 Tangible and Intangible Benefits

For the 65 MCAs that list Natural Resources Conservation as their primary Business Use:

- **Table E.6b** summarizes the reported future annual dollar benefits by geography type, totaling $720.8 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.6c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.6e.
- **Table E.6d** shows (in blue) the nine federal agencies, 41 states and territories, and seven non-governmental entities that submitted MCAs with BU 06 as the primary Business Use. MCAs for which BU 06 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.6d.
- **Table E.6e** documents all the MCAs that listed BU 06 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.6e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 06 Reported Future Annual Dollar Benefits

Of the 65 MCAs that listed Natural Resources Conservation as their primary Business Use, 46 MCAs estimated their tangible annual benefits totally in financial terms; eight MCAs had a combination of tangible and "Major" intangible benefits; and eight MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.6b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 65 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.6b. BU 06 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$202,539,020	$491,375,136	$693,914,156
Inland Bathymetry	$25,674,430	$1,100,686	$26,775,116
Nearshore Bathymetry	$164,748	$43,641	$208,389
Offshore Bathymetry	$0	$0	$0
Totals	**$228,378,198**	**$492,519,463**	**$720,897,661**

BU 06 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.6c. BU 06 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	58	56	42	52	44
Inland Bathymetry	33	31	26	30	25
Nearshore Bathymetry	22	21	3	21	2
Offshore Bathymetry	14	11	0	12	11
Totals	**127**	**119**	**71**	**115**	**82**

The types of benefits included under the category of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 06 Reported Future Annual Dollar Benefits Maps

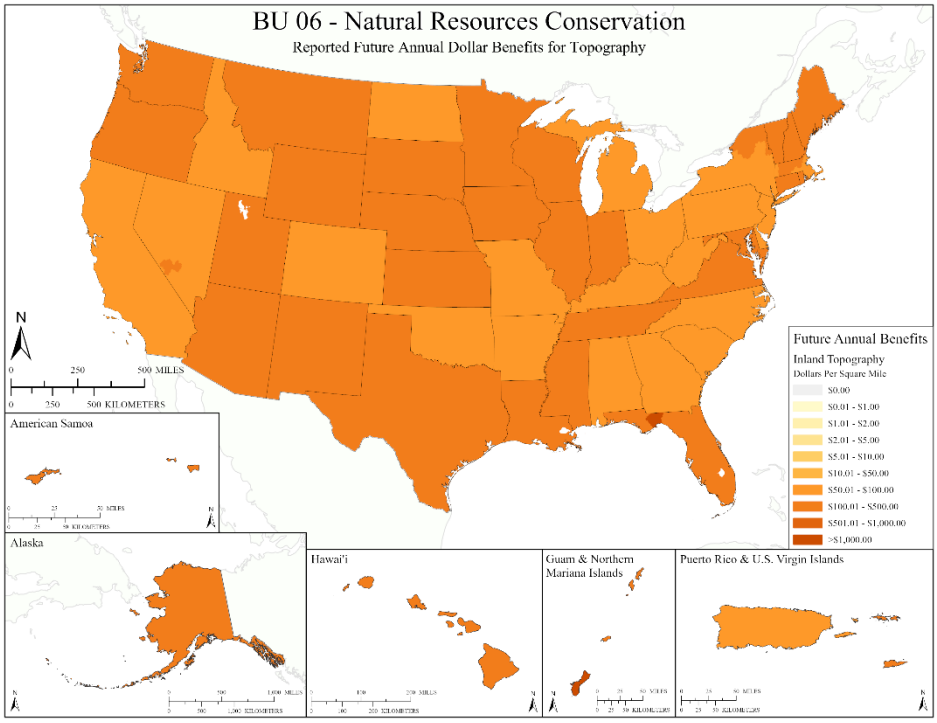

Figure E.6b. Reported Future Annual Dollar Benefits for Topography

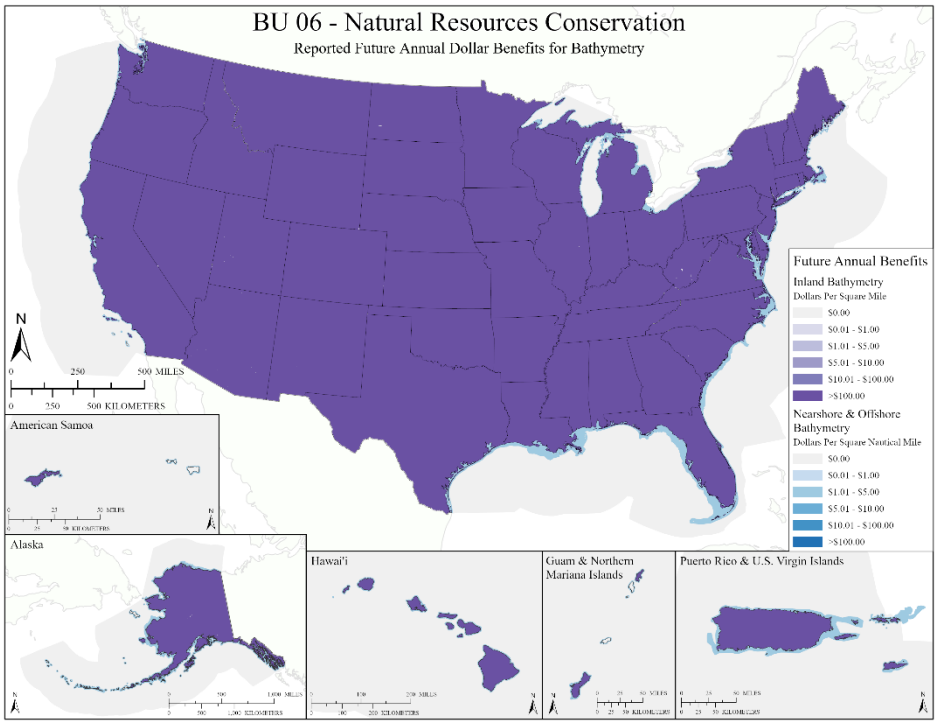

Figure E.6c. Reported Future Annual Dollar Benefits for Bathymetry

BU 06 Benefits Analysis

The total combined future annual benefits ($720.8 million per year) reported for BU 06 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 06 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, nine federal agencies (BIA, BLM, FSA, NOAA, NPS, NRCS, SI, USAF, and USGS) submitted a total of 12 MCAs listing BU 06 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the 12 total federal MCAs listing BU 06 as primary:
    - Inland Topography: Seven provided dollar benefits and three indicated "Major" benefits.
    - Inland Bathymetry: Three provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: Three provided dollar benefits and one indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and three indicated "Major" benefits.
    - The dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.
    - Three federal agencies (ARS, FWS, and USFS) submitted MCAs with BU 06 as secondary, and one federal agency (EPA) submitted an MCA with BU 06 as tertiary; their financial benefits therefore do not accrue to BU 06.
    - Many other federal organizations that manage land areas (e.g., DISDI, USACE, USMC, and USN) would seem to have a need to manage natural resources on their lands; but they did not submit an MCA listing BU 06 as either primary, secondary, or tertiary.
- State/Local/Tribal and U.S. Territory MCAs:
    - Inland Topography: 44 provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: 27 provided dollar benefits and three indicated "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits but 17 indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits but 10 indicated "Major" benefits.
    - The State dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.
- Non-governmental MCAs: Seven non-governmental organizations submitted MCAs listing BU 06 as primary, including MCAs from AECOM, Chesapeake Conservancy, Hobu, Leading Edge Geomatics, Montana State University, Sappos Environmental Inc, and University of Vermont.
    - Inland Topography: Three provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: One provided dollar benefits and two indicated "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits and one indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and one indicated "Major" benefits.

- Dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.

- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.6b and E.6c:
  - 246 "Major" Operational and Customer Service benefits and 268 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 06 for which "Major" benefits are documented, this could easily be translated into tens of millions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.
  - There are thousands of engineering firms and consultants in the U.S. that are contracted by federal, state, and local governments to perform studies and to develop plans for natural resources conservation. Their costs of doing business are significantly lower when they can user accurate and authoritative public domain elevation data without having to perform field surveys and assessments. Because none of these firms participated in this study, their benefits are unknown.

BU 06 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 06:

- Table E.6d color-codes those organizations having an MCA with BU 06 as Primary, Secondary, or Tertiary
- Table E.6e summarizes the 65 MCAs with primary benefits for BU 06, rank ordered from the highest to the lowest tangible benefits

Table E.6d. Organizations having an MCA with BU 06 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	*ARS*	**BIA**	**BLM**	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	**FSA**	*FWS*
	IBWC	IJC	MARAD	NASA	NGA	**NOAA**	**NPS**	NRC	**NRCS**	NREL
	ORNL	OSMRE	PHMSA	**SI**	TVA	USACE	**USAF**	USARC	USBR	USCB
	USCG	*USFS*	**USGS**	USMC	USN					

State/Ter	AL	**AK**	AR	**AZ**	**CA**	CO	**CT**	DC	**DE**	**FL**	GA	**HI**	**IA**	**ID**
	IL	**IN**	**KS**	KY	**LA**	**MA**	**MD**	**ME**	*MI*	*MO*	**MN**	**MS**	**MT**	**NC**
	ND	**NE**	**NH**	**NJ**	**NM**	**NV**	NY	*OH*	*OK*	**OR**	PA	**RI**	**SC**	**SD**
	TN	**TX**	**UT**	**VA**	**VT**	**WA**	**WI**	WV	**WY**	PR	**VI**	**GU**	**AS**	**CNMI**

Non-Gov	**AECOM**	*Appalachian Mountain Club*	**Chesapeake Conservancy**	**Hobu**
	Leading Edge Geomatics	**Montana State University**	**Sapphos Environmental, Inc.**	*The Nature Conservancy*
	University of Vermont			

Table E.6e. MCA summaries for BU 06, rank ordered from the highest to the lowest tangible benefits.

Organization	NOAA		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60660						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$95,222,907	$133,955,686	Major	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$15,161,190	$569,947	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	$82,791	$21,931	Moderate	Major	Moderate

Organization	Alaska		Forest management, fisheries management, hydrographic mapping (stream channel analysis and mapping), conservation engineering, flooding/inundation analyses				
MCA Name	MCA No.						
Natural Resources Conservation	32660						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$22,911,703	$84,138,763	Major	Major	Major
Inland Bathy	QL2B	6-10 yrs.	$3,105,423	$139,798	don't know	don't know	don't know

Organization	Texas		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60438						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$10,382,782	$38,128,742	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$1,407,269	$63,351	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate

Organization	Montana		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60256						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$5,767,304	$21,179,302	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$781,693	$35,190	Major	Major	Major

Organization	New Mexico		Developing vegetation/habitat maps and species distribution models. Elevation and vegetation data are used to model critical habitats; tree canopy is an important component. The goal is to track endangered, threatened, and candidate fungi, animals, birds, and plants.				
MCA Name	MCA No.						
Eco-Habitat Mapping and Modeling	22448						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$1,947	$7,148	Moderate	Major	None
Inland Topo	QL1HD	4-5 yrs.	$4,767,168	$17,506,499	Moderate	Major	None

Organization	Arizona		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60038						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$4,471,372	$16,420,243	Major	Major	Major

Organization	Wyoming		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60536						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$3,836,493	$14,088,774	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$519,993	$23,408	Major	Major	Major

Organization	Oregon		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60351						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$3,806,356	$13,978,100	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$515,908	$23,225	Major	Major	Major

Organization	Minnesota		Restore and protect surface and groundwater resources through pollution prevention and mitigation efforts. Utilize technology to help prioritize ag and urban conservation practices that are targeted in the best places on the landscape for water quality purposes. Practices must be have a measurable outcome that meets water quality goals. Hydro-conditioned DEMs are needed as input to tools for watershed planning using the Agricultural Conservation Planning Framework (ACPF) tools and the Prioritize, Target, Measure (PTM) app. Statewide DEMs are needed for work on the daily erosion project. Terrain analysis is done in conjunction with local conservation offices. BU 27 – Recreation is an additional Business Use for this activity.					
MCA Name	MCA No.						
Restore and Protect Surface and Groundwater Resources	21542						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$3,309,520	$12,153,567	Major	Major	don't know
Inland Bathy	X-Sec meet needs	6-10 yrs.	$448,568	$20,193	Major	Major	don't know
Nearshore B.	X-Sec meet needs	6-10 yrs.	don't know	don't know	don't know	don't know	don't know
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	Utah		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60465						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$3,278,607	$12,040,046	Major	Major	Major

Organization	Kansas		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60184						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$3,227,181	$11,851,192	Major	Major	Major

Organization	South Dakota		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60411						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$3,024,676	$11,107,536	Major	Major	Major

Organization	Washington		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60511						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$2,649,809	$9,730,907	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$359,151	$16,168	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	Illinois		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60139						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$2,209,859	$8,115,278	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$299,521	$13,483	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	Iowa		Geographic Information Systems for Natural Resources. Elevation data are used for floodplain mapping, watershed modeling, H&H modeling, land cover development, environmental assessments, Phase 1 investigations of contaminated sites, solid waste, water quality programs, water flow modeling, floodplain permitting programs, conservation and recreation, and law enforcement within parks and wildlife areas (e.g. line of sight, boating, etc.). Inland bathy data is highly desirable, depending on the data quality that could be acquired (higher quality is more important).				
MCA Name	MCA No.						
Geographic Information Systems for Natural Resources	1247						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$2,207,161	$8,105,368	Moderate	Major	Major
Inland Bathy	X-Sec meet needs	6-10 yrs.	$299,155	$13,467	Moderate	Moderate	Major

Organization	Florida		The Department protects, conserves and manages Florida's natural resources and enforces the State's environmental laws. The department shall act as the lead agency of the 1712 executive branch for the development and review of policies, practices, and standards related to geospatial data. The department shall coordinate and promote geospatial data sharing throughout the state government and serve as the primary point of contact for statewide geographic information systems projects, grants, and resources. Lidar will support the Governor's initiative to research blue-green algae blooms and protect water quality for Floridians, and support ongoing modeling and protection measures.				
MCA Name	MCA No.						
Protection, Conservation and Management of Florida's Natural Resources and Enforcement of Environmental Laws	1232						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$2,201,012	$8,082,789	Moderate	Major	Major
Inland Bathy	QL2B	4-5 yrs.	$298,322	$13,429	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Major	Major	Major
Offshore B.	X-Sec meet needs	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Wisconsin		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60526						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$2,198,981	$8,075,329	Major	Major	Major

Organization	Mississippi		Environmental Quality. Elevation data are needed for NFIP floodplain mapping, dam safety, H&H modeling, dam breach routing, evaluation of storage volumes, monitoring water quality, TMDL modeling, non-point source pollution, geological mapping including alluvial soils and subsurface geology, and management of erosion issues. BU 01 – Water Supply and Quality could be added as another Business Use. Bathymetry is needed for navigable waters to identify areas suitable for casino placement.				
MCA Name	MCA No.						
Environmental Quality	21481						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$379,154	$1,392,370	Minor	Major	Major
Inland Topo	QL2	6-10 yrs.	$1,490,455	$5,473,405	Minor	Major	Major
Inland Bathy	X-Sec meet needs	Event driven	$253,404	$11,407	don't know	don't know	don't know

Organization	Louisiana		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60200						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$1,807,533	$6,637,814	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$244,990	$11,028	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	Tennessee		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60426						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$1,652,947	$6,070,128	Major	Major	Major

Organization	Virginia		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60494						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$1,583,863	$5,816,430	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$214,674	$9,664	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	Nebraska		My agency does not have a specific mission critical activity. I would help agencies with their mission critical activities. Support all state, Natural Resources Districts, local agency data requirements with geospatial data coordination. Inland bathymetry is needed for reservoir calculations and sedimentation analysis.				
MCA Name	MCA No.						
Geospatial Data Coordination	21900						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,516,994	$5,570,863	Major	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$205,611	$9,256	Major	Major	Major

Organization	Nebraska		Natural resources management. Elevation data and color infrared imagery are collected by the district and used for siting new dam locations and managing aquifer recharge sites (monthly). Bathymetry is needed to calculate lake volumes (monthly) and for retiming of water capture back to river. 1 meter DEMs are needed for small areas. Elevation data are also needed for new agricultural irrigation development: We use elevation data as a tool to help identify areas of land that have historically or the potential for new irrigation development. We have rules and regulations that specify the use of lidar data to determine if proposed new irrigation development will be allowed. BU 27 – Recreation would be an additional Business Use.				
MCA Name	MCA No.						
Natural Resources Management	22236						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,516,994	$5,570,863	Major	Major	Major
Inland Bathy	QL1B	Event driven	$205,611	$9,256	Major	Major	Major

Organization	Indiana		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60151						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$1,419,207	$5,211,761	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$192,357	$8,659	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate

Organization	New Hampshire		State environmental management to include coastal, instream flow, geologic mapping of deposits, and flood hazards.				
MCA Name	MCA No.						
State Environmental Management	1264						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$2,205,525	$4,000,000	Major	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$143,877	Major	don't know	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Major	Major	Moderate	Moderate	Moderate

Organization	Maine		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60206						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$1,271,164	$4,668,105	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$172,292	$7,756	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	NRCS		Natural Resource Conservation: Implement conservation to protect soils, water, wetlands, grazing lands, forests, and other related natural resources on non-federal land. This includes site inventory and analysis which involves mapping of stream channels, soils, wetlands, and highly erodible lands, among other characteristics related to the soil, as well as modeling of biological and ecological systems for the purposes of designing conservation practices. It also includes planning and design of agricultural systems that benefit natural resource conservation and address individual issues to include water quality and quantity, energy conservation, and erosion control and impacts from slope and surface drainage networks on agronomic and structural practices. The goal is to support sustained, productive, working farms and ranches that optimize natural resource benefits, enhance and sustain the quality and quantity of water resources, and protect sensitive environmental features. Technical Assistance: Provide technical GIS assistance to users as well as GIS datasets that aid farmers and NRCS field staff. Lidar and updated imagery are large pieces of that pie. Lidar data is used by soil scientists, wetland specialists, engineers, and field office staff for planning and by various state office staff including biologists, range scientists, program support staff, archeologists, agronomists, and water resources engineers. NRCS also supports many other activities that impact the health of our natural resources to include assessment of blue carbon stocks, aquatic and terrestrial species habitat management; environmental management; forest health assessment; prescribed burning; assessment of rangeland health; climate monitoring and modeling; and snow survey, monitoring, modeling, and forecasting. Additional Business Uses for NRCS programs include BU 01 - Water Supply and Quality, BU 02 - Riverine Ecosystem Management, BU 04 - Forest Resources Management, BU 07 - Wildlife and Habitat Management, BU 10 - Geologic Assessment and Hazard Mitigation, BU 14 - Cultural Resources Preservation and Management, and BU 15 – Flood Risk Management.					
MCA Name	MCA No.						
Natural Resources Conservation Planning, Design, Engineering, and Technical Assistance	22128						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$5,044,475	$1,020,517	Moderate	Major	Moderate
Inland Bathy	QL2B	6-10 yrs.	Major	None	None	None	None

Organization	Montana State University		The Elevation data is a mission critical data set to many of the laboratory assignments in the undergraduate and graduate spatial sciences classes where the following topics are addressed: rangeland ecology and management, snow science, ecology, biology, geology, environmental science. It is also a valuable tool for graduate research, specifically so for terrain analysis in snow science (natural and human induced avalanches), geologic hazards, rangeland ecology and biology, suitable habitat, migration pathways, precision farming, water quality and supply, and soils to name a few.				
MCA Name	MCA No.						
Undergraduate and Graduate Spatial Sciences Education and Research	21662						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	$372,654	$3,268,863	Major	Major	None
Inland Bathy	QL2B	4-5 yrs.	Major	Major	Major	Major	don't know

Organization	Florida		Topographic mapping and analysis to support city and county departments				
MCA Name	MCA No.						
Topographic Mapping and Analysis to Support City and County Departments	21596						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$3,042,210	Major	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	Moderate	Minor	don't know	don't know	don't know

Organization	NPS		Infrastructure architecture to support mission critical remote sensing tasks service-wide; Monitoring of modeling of coastal erosion and inundation; water resources mapping/surveying, coastal hazard and climate change, facilities management, etc.; Preservation and Protection of Natural and Cultural Resources				
MCA Name	MCA No.						
Natural and Cultural Resources Protection in National Parks	1161						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$293,048	$1,857,722	Moderate	Moderate	Moderate
Inland Bathy	QL1B	6-10 yrs.	$114,972	$50,049	Moderate	Major	Minor
Nearshore B.	QL1B	2-3 yrs.	$81,949	$21,708	Minor	Major	Moderate
Offshore B.	Order 1	4-5 yrs.	Major	Major	Moderate	Major	Moderate

Organization	Maryland		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60214						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$387,814	$1,424,172	Major	Major	Major
Inland Bathy	Better than options	6-10 yrs.	$52,563	$2,366	Major	Major	Major
Nearshore B.	More accurate than options provided	6-10 yrs.	Major	Major	Moderate	Major	Moderate

Organization	Vermont		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60481						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$377,094	$1,384,806	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$51,110	$2,300	Major	Major	Major

Organization	Hawai'i		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60114						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$252,383	$926,829	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$34,207	$1,539	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate

Organization	North Carolina		Natural resource conservation. Elevation data are needed for review of environmentally sensitive areas as they pertain to federal and state-funded transportation projects.				
MCA Name	MCA No.						
Natural Resource Conservation	22261						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$400,000	$700,000	Minor	Moderate	Moderate

Organization	Connecticut		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60062						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$195,012	$716,144	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$26,431	$1,189	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	South Carolina		Holistic management of land and water resources to support the state's economy and environment. Wildlife conservation, geological and hydrological management, law enforcement and marine resources. Fisheries management, flood mapping, and geology are included. BU 09 - Fisheries Management and Aquaculture and BU 20 - Marine and Riverine Navigation and Safety are additional Business Uses.				
MCA Name	MCA No.						
Management of Land and Water Resources	21485						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$47,526	$7,984	Major	Major	Major
Inland Topo	QL2	6-10 yrs.	$369,174	$62,016	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$95,100	$23,771	Moderate	Moderate	Moderate
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate
Offshore B.	X-Sec meet needs	I don't know, my work is not offshore	don't know	don't know	don't know	don't know	Major

Organization	Air Force		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60628						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$245,902	$345,926	Major	Major	Major

Organization	Leading Edge Geomatics		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces.				
MCA Name	MCA No.						
Natural Resources Conservation	60730						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$150,000	Major	Major	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$400,000	Major	Major	Major	Major

Organization	Guam		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60094						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$82,150	$301,700	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	Idaho		The Nez Perce Tribe is a leader in our area working with raster and imagery data. We work with five counties in Idaho and three counties in Oregon and Washington. We maintain hunting and fishing rights within the Columbia basin, so our range is broad. Elevation data aid services provided by the following departments: Land Services, Fisheries, Forestry and Water Resource. We all contribute to emergency management and hazard mitigation. Our Water Resources department is certified to assess and assist in hazardous spills in our rivers and streams. Elevation data are needed for the following: Hazard mitigation for floods, fires, and landslides. Forest resource protection. Riverine fisheries management. Flood modeling for planning. Wildlife mitigation and monitoring of habitat. Utility resource management. Agriculture and rangeland management. Cultural protection and restoration. Note: This is several departments. BUs: 01, 02, 04, 05, 06, 07, 08, 09, 10, 14, 15, 17, 18, 23, 26, 28				
MCA Name	MCA No.						
Nez Perce Tribe Homeland Asset Management	21639						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$210,408	$31,150	Moderate	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$52,683	$20,000	Major	Major	Major

Organization	NPS		Forest canopy modeling, hydrologic modeling				
MCA Name	MCA No.						
Forest Inventory and Monitoring	1328						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$231,072	don't know	don't know	don't know	don't know

Organization	Rhode Island		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks. Rhode Island maps impervious surfaces on an 8-10 year cycle.				
MCA Name	MCA No.						
Natural Resources Conservation	60373						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$42,474	$155,978	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$5,756	$259	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Major	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	USGS		Provision of nationwide 1:24,000-scale U.S. topographic maps freely available for download in geospatial PDF; multi-scale topographic base mapping in multiple formats, including web services.				
MCA Name	MCA No.						
National Civilian Mapping - U.S. Topo	1223						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$195,000	Major	Major	Major	Major
Inland Bathy	QL2B	4-5 yrs.	Moderate	Moderate	Moderate	Moderate	Moderate
Nearshore B.	QL2B	4-5 yrs.	Moderate	Minor	Minor	Minor	Minor
Offshore B.	Order 1b	4-5 yrs.	Minor	Minor	Minor	Minor	Minor

Organization	Nevada		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60285						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$125,000	$20,000	Major	Major	Major

Organization	Massachusetts		Restoration of aquatic habitats such as Rivers, Wetlands and Watersheds.				
MCA Name	MCA No.						
Ecological Restoration	22368						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$107,236	Moderate	Moderate	Major	Minor
Inland Bathy	QL0B	2-3 yrs.	Major	Moderate	Minor	Major	don't know
Nearshore B.	QL0B	2-3 yrs.	Moderate	Minor	Minor	Major	Moderate

Organization	Northern Mariana Islands		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60338						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$7,159	$26,291	Major	Major	Major

Organization	U.S. Virgin Islands		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60452						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$5,249	$19,276	Major	Major	Major

Organization	SI		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces. Assessment of blue carbon stocks.				
MCA Name	MCA No.						
Natural Resources Conservation	60673						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$9,522	$13,396	Major	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$1,516	$57	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	$8	$2	Moderate	Major	Moderate
Offshore B.	Order 2	4-5 yrs.	Major	Moderate	Moderate	Major	Moderate

Organization	Delaware		Protect and improve water quality from contaminants, excess nutrients and sediment. Protect shellfish harvesting and beach health. Protect and conserve wetlands and riparian habitat so that natural functions provided by these habitats remain beneficial (e.g. flood attenuation, water quality, etc.).				
MCA Name	MCA No.						
Watershed Assessment and Management	21747						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$9,899	$1,976	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$10,480	$471	Major	Major	Major
Nearshore B.	QL1B	Annually	don't know	don't know	don't know	don't know	don't know

Organization	American Samoa		Provide GIS support for Forestry and Agriculture programs				
MCA Name	MCA No.						
Research, Extension, and Educational Programs and Services	33074						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$3,053	$11,211	Major	Major	Major

Organization	New Jersey		1. Land Use- To improve and sustain collaborative regional approaches to responsible land use planning and open space protection in the watershed that protect and improve water quality, water supply, living resources, soil function and hydrology. 2. Living Resources- To protect, restore and enhance habitats in the Barnegat Bay and its watershed to ensure healthy and sustainable natural communities of plants and animals now and in the future. 3. Water Quality- To protect and improve water quality throughout Barnegat Bay and its watershed by addressing the causes of water quality degradation to achieve swimmable, fishable and drinkable water, and to support aquatic life. 4. Water Supply- To ensure adequate water supplies and flow in the Barnegat Bay Watershed for ecological and human communities now and in the future.				
MCA Name	MCA No.						
Collaborative Approach to Research, Educate, and Restore the Barnegat Bay	21620						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	4-5 yrs.	$6,120	Major	Moderate	Major	None
Inland Bathy	X-Sec meet needs	4-5 yrs.	Moderate	Major	Moderate	Major	None
Nearshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Major	Minor

Organization	Minnesota		Water quality and erosion control. Elevation data are needed as input into Agricultural Conservation Planning Framework (ACPF) tools, for terrain analysis, to develop 3-power index, and to identify critical source areas for surface water, highly erosive features, etc,				
MCA Name	MCA No.						
Water Quality and Erosion Control	1237						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$3,256	$2,171	Major	Moderate	don't know

Organization	California		Park Operations, including and not limited to: -Public Safety (police, medical, fire, towing) -Natural Resources (conservation, invasive species, wildland fire management) -Cultural Resources (archaeology, history, museums) -Interpretation and Education (publications, mapping, exhibits) -Facilities Management (physical plant). The Road and Trails Program needs elevation data to assess the condition of trails and dirt roads, set priorities for repair, address “volunteer” trails, and for general land management. The shoreline is where most significant revenue exists; elevation data are needed for sea level rise planning to project costs and cost avoidance from sea level rise. Underwater bathymetry is needed to support FWS and others to interpret and deliver recreation in the submarine environment, and for habitat conservation as well. The Boating and Waterways group also has planning and design engineering need for elevation data and for management of invasives (along with other agencies). Fire risk assessments require elevation data for inland resources. Bathymetry are also used to identify archaeological resources at shorelines that may be exposed as water levels change.				
MCA Name	MCA No.						
California State Park Management and Operations	22314						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$2,894	Major	Major	Major	Major
Inland Bathy	QL2B	6-10 yrs.	$603	Moderate	don't know	don't know	don't know
Nearshore B.	QL2B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	University of Vermont		Land cover mapping and feature extraction				
MCA Name	MCA No.						
Land Cover Mapping and Feature Extraction	21797						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$2,563	Major	Major	Major	Moderate
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	6-10 yrs.	Major	Major	Major	Major	Major

Organization	NOAA		Mapping to support deep ocean exploration and research. BU 10 Geological Assessment and Hazard Mitigation is an additional Business Use.				
MCA Name	MCA No.						
Deep Ocean Exploration and Research	1072						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL2B	>10 yrs.	Major	Moderate	Moderate	Moderate	Moderate
Offshore B.	Order 2	>10 yrs.	Major	Moderate	Moderate	Moderate	Moderate

Organization	BIA		Trust Asset management of natural resources. BIA performs activities related to its management of lands but also provides data to tribes for their use in all aspects of government – akin to whatever any other local government would use the data for. Elevation data are needed by BIA for flood risk assessment, dam safety, forestry, fire management, natural resources, assessment of impacts to Indian lands, and general GIS activities including modeling for appraisals of lands for land buyback. Tribal uses would also include management of historical and cultural resources as well as infrastructure and construction management. Bathymetry are needed for fishing rights, Tribal water rights, and identification of submerged artifacts.				
MCA Name	MCA No.						
Trust Asset Management	21524						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	don't know	Major	don't know	don't know	don't know
Inland Bathy	QL1B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL1B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	FSA		Administer Farm and Conservation Programs. GIS is used extensively to support farm, conservation, and disaster programs. FSA utilizes a multitude of GIS base data. Specific to elevation data, FSA uses FEMA DFIRM data which is dependent on elevation data to support Conservation Reserve Program (CRP) activities. The 1 percent chance annual flood (100-year) zone is required for certain CRP practices. The easy availability of the data is very beneficial.				
MCA Name	MCA No.						
Administer Farm and Conservation Programs	21669						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	don't know	don't know	don't know

Organization	USGS		The Land Resources Mission Area addresses many of the BU/MCAs listed in FAQ #1 and data is used to support the National Land Cover Database (NLCD) and LANDFIRE Program.				
MCA Name	MCA No.						
National Civilian Mapping - Land Resources	22051						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	Major	Major	Minor	Minor	don't know

Organization	Indiana		Abandoned Mine lLands (AML) reclamation.				
MCA Name	MCA No.						
Abandoned Mine Lands Reclamation	22177						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Major	Major	Moderate

Organization	Wisconsin		Natural resource management that preserves or enhances air, land and water quality and tribal economic development, in a culturally appropriate and sustainable way.				
MCA Name	MCA No.						
Natural Resource Management	22449						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	Major	Major	Moderate	Major	Moderate
Inland Bathy	I don't know	6-10 yrs.	Major	Major	don't know	Major	don't know
Nearshore B.	I don't know	6-10 yrs.	Major	Major	Major	Major	Moderate
Offshore B.	I don't know	6-10 yrs.	Major	Major	Moderate	Major	Major

Organization	Chesapeake Conservancy		Precision Conservation: land cover mapping, stream mapping, riparian assessment, BMP siting				
MCA Name	MCA No.						
Conservation of the Chesapeake Bay Watershed	32563						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Moderate	Major	None

Organization	AECOM		We deliver solutions for our clients who may have a variety of mission critical activities/primary business uses. AECOM Environment focuses heavily on the National Environmental Policy Act (NEPA) process. Environmental impact statements require spatial analysis for the majority of the business cases below.				
MCA Name	MCA No.						
Environmental/Social Impact Assessment and Permitting	32684						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	I don't know	It varies, it's client and project specific	Moderate	Moderate	don't know	Moderate	Moderate
Inland Bathy	I don't know	>10 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	6-10 yrs.	don't know	don't know	don't know	don't know	don't know
Offshore B.	X-Sec meet needs	6-10 yrs.	Major	Moderate	don't know	Moderate	Moderate

Organization	BLM		Aerial remote sensing and mapping to support BLM activities in field offices. Includes UAS collection of project specific areas at QL0 or higher.				
MCA Name	MCA No.						
Aerial Remote Sensing and Mapping	1342						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Hobu		Lidar visualization and morphology extraction.				
MCA Name	MCA No.						
Lidar Visualization and Morphology Extraction	21949						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Sapphos Environmental, Inc.		Environmental consulting services. Elevation data are used for a variety of purposes including riverine, coastal zone, and wildlife management; renewable energy and oil and gas resources; cultural resources preservation; and urban and regional planning.				
MCA Name	MCA No.						
Environmental Consulting	22346						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

BU 07 - Wildlife and Habitat Management

BU 07 Scope

Business Use #7 (BU 07) includes conservation planning for wildlife refuges and marine sanctuaries; conservation of critical habitats; management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources. Working in partnership with others, the U.S. Fish and Wildlife Service (FWS), within the Department of Interior, is an obvious champion for this Business Use, but other federal, state, and local agencies have responsibilities related to wildlife habitat.

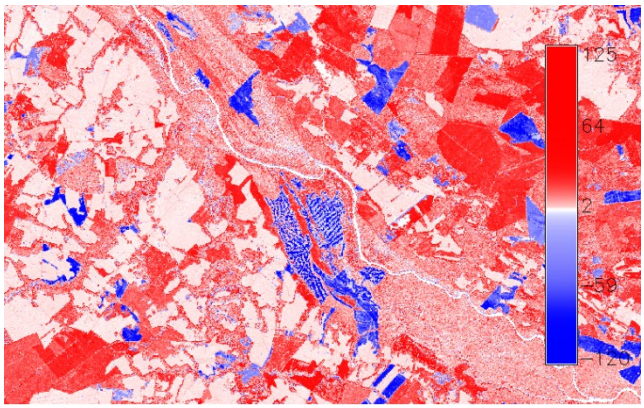

Figure E.7a. Lidar-derived differences in Loblolly pine canopy heights of ±120 feet over a 6-year period in Craven County, NC. New growth (red) and timber harvest (blue) map additions and deletions to wildlife habitat for animals and birds. Image courtesy of the FWS.

BU 07 Background Information

The mission of the FWS is working with others, to conserve, protect, and enhance fish, wildlife, plants, and their habitats for continuing benefit of the American people.

Figure E.7a shows how the FWS used lidar datasets from different years to map the rapid gain (bright red) and loss (bright blue) of Loblolly pine forest habitat in Craven County, NC. Loblolly pines are the most important commercial timber in the southeastern U.S.; they are planted in mine reclamation areas; they stabilize soil and reduce erosion; they are a possible alternative source for energy; and they provide excellent wildlife habitat for many animals and birds.

BU 07 Elevation Data Uses

Using their own words, respondents documented 58 Mission Critical Activities (MCAs) that identified BU 07 as their primary Business Use and identified the following 88 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.7a. BU 07 Elevation Data Uses

Data Use
Emergency Management
1. Search and rescue using bathymetry
Erosion/Sediment Control
2. Dam evaluation on state-owned lakes for pumps and lifts to see the health of the structure and identify if sedimentation against the dam is a problem that needs to be mitigated
3. Volume calculations of lakes and reservoirs for sedimentation and rotenone calculations
Fisheries and Aquaculture
4. Conservation and management of fisheries
5. Engineering for water rights, instream flow, irrigation, boat dock/ramp engineering, fish hatchery planning
6. Fisheries research

Data Use
Habitat Analysis and Management
7. Analyze vegetation structure on a landscape basis for basal area calculations and to improve the accuracy of vegetation structure metrics; annual habitat work planning activities
8. Conservation and restoration of critical habitats
9. Data analysis on the meso-habitat scale
10. Estimate water depths that waterfowl and other shore birds prefer in impoundments
11. Evaluate physiognomic structure requirements of avian species
12. Evaluation of created riparian and aquatic habitat for 20 species in USBR states
13. Evaluation of riparian vegetation, including individual trees and branches
14. Fish habitat management
15. Habitat and land cover assessment
16. Habitat assessment and management for marine and terrestrial animals
17. Habitat delineation; park recreation and fisheries management
18. Habitat mapping and assessment to answer scientific questions shaped by the environment
19. Habitat planning and management
20. Identification, designation and management of marine and Great Lakes areas of special national significance as national marine sanctuaries
21. Identify habitat types (coral, sea seeps, vegetation type, shipwrecks, archaeological features) for area determination and site management
22. Identify watersheds, assess water quality, and manage upstream habitats
23. Long-term coral reef monitoring; understand watersheds that drain to coral reefs
24. Maintain, manage, restore and enhance habitats on the state's Wildlife Management Area system
25. Manage natural resources during transmission line siting; identify wetlands under power corridors and for other habitat management activities
26. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources
27. Management of fish, wildlife, and habitats
28. Mapping of imperiled species' habitat and associated ecosystems
29. Measuring dynamic landscape metrics for wildlife habitat
30. Monitoring for and treatment of invasive species
31. Plant protection and quarantine activities for research visualization and habitat identification
32. Prescribed burning on Wildlife Management Areas (WMAs) for habitat management
33. Protect, conserve, and manage state fish and wildlife and their habitats
34. Stewardship over land and water to keep habitat healthy and viable
35. Waterfowl habitat and pool management
36. Wildlife and habitat management of sage grouse, other wildlife; and fish species
37. Dam inundation zone risk management
Mapping/Boundary Delineation
38. Bathymetry for mapping of lease areas
39. Determination of forest types at specific elevations and species within those elevations
40. Forest uses including determination of loss of tree types and replanting
41. Maintain lake and pond maps for the public
42. Map and maintain updates for land cover and wetland riparian thematic layers at state level

Data Use
43. Mapping vegetation canopy and understory for sage grouse management, sage brush ecosystems management and improved ecosystem mapping
44. Perform fine grained landscape scale analysis of vegetative and topographic data
Modeling
45. Anadromous fish habitat modeling using slope and elevation
46. Base mapping, engineering design and hydrologic modeling for conservation areas
47. Model wetlands that exist or can be restored
48. Modeling of large, temporally consistent regions to save money on individual collection projects
49. Modeling of waterbodies for lowering or draining
50. Vegetation mapping; hydrological modeling; volumetric mapping of impoundments
Natural Resources Conservation
51. Conservation engineering
52. Conservation of all state flora and fauna, both terrestrial and in waters
53. Coral reef conservation
54. Ensure sustainability and harvestable surplus of fish and wildlife resources
55. Evaluate areas upstream of dams that would flood and kill timber
56. Manage and protect natural resources and historical and cultural heritage
57. Monitoring the condition on key ecosystem health indicators on National Parks; change detection
58. Natural resources management to monitor change over time of sea grass, algae, coral, fish, invertebrates, pollution and sediment from land, construction-induced change, land use changes
59. Provide rigorous, objective, and timely information and guidance for the management and conservation of biological systems
Permitting
60. Management and permitting of reservoirs and docks
61. Oil and gas permitting; well emergency response
Planning
62. Enable activities that would not be done in the field from a cost perspective
63. Long-term comprehensive conservation planning
64. Planning for prescribed burning operations
Recreation
65. Channelization for boating
66. Determination of lake depth for boating and fishing; identification of submerged objects
67. Develop park facilities to provide recreation for public lands and waters
68. Development of recreation opportunities for consumptive and non-consumptive uses of wildlife
69. Enabling and promoting the safe enjoyment of the state's outdoors
70. Planning for campgrounds and roadway development in state parks
71. Provide sustainable outdoor recreational opportunities through responsible management of state parks, fisheries and wildlife
72. Recreational facilities planning management; unit boundary management
Stakeholder Engagement
73. Development of communications and outreach materials

Data Use
Wildlife Management
74. Bathymetry for identification of oyster reefs, sometimes less than 12”
75. Big game population management
76. Conservation and management of diverse game and nongame (endangered, threatened, and special concern) wildlife species and their associated habitats
77. Conservation and preservation of various species of fish and wildlife
78. Conservation planning for state wildlife species and habitats
79. Conservation planning for wildlife management areas, refuges, conservation areas, private lands, and marine sanctuaries
80. Develop hunting and fishing regulations to maintain a viable, healthy population of game and fish
81. Evaluate land and canopy changes that affect migratory birds
82. Management and monitoring of wildlife and fish populations; occupancy and species distribution modeling and monitoring fluctuation of populations
83. Management of coral reef communities and associated ecosystems
84. Marine and terrestrial protection
85. Private lands management for healthier fish and wildlife populations
86. Promote and protect wildlife and wildlife-related recreation throughout the state
87. Restoration of endangered species
88. Wildlife services to protect humans and agriculture from conflicts with wildlife (airplane strikes, livestock predation, etc.)

BU 07 Tangible and Intangible Benefits

For the 58 MCAs that list Wildlife and Habitat Management as their primary Business Use:

- **Table E.7b** summarizes the reported future annual dollar benefits by geography type, totaling $43.18 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.7c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.7e.
- **Table E.7d** shows (in blue) the ten federal agencies and 46 states and territories that submitted MCAs with BU 07 (Wildlife and Habitat Management) as the primary Business Use. MCAs for which BU 07 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.7d.
- **Table E.7e** documents all the MCAs that listed BU 07 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.7e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 07 Reported Future Annual Dollar Benefits

Of the 58 MCAs that listed Wildlife and Habitat Management as their primary Business Use, 42 MCAs estimated their tangible annual benefits totally in financial terms; six MCAs had a combination of tangible and “Major” intangible benefits; and five MCAs listed “Major” intangible benefits only. Others had “Moderate” or “Minor” intangible benefits.

The reported future annual dollar benefits are summarized in Table E.7b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 58 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.7b. BU 07 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$11,844,193	$4,364,386	$16,208,579
Inland Bathymetry	$14,761,208	$7,109,006	$21,870,214
Nearshore Bathymetry	$542,154	$7,884	$550,038
Offshore Bathymetry	$4,395,562	$155,579	$4,551,141
Totals	**$31,543,117**	**$11,636,855**	**$43,179,972**

BU 07 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.7c. BU 07 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	42	36	5	34	4
Inland Bathymetry	32	30	4	9	5
Nearshore Bathymetry	29	7	1	24	3
Offshore Bathymetry	22	21	1	21	20
Totals	**125**	**94**	**11**	**88**	**32**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 07 Reported Future Annual Dollar Benefits Maps

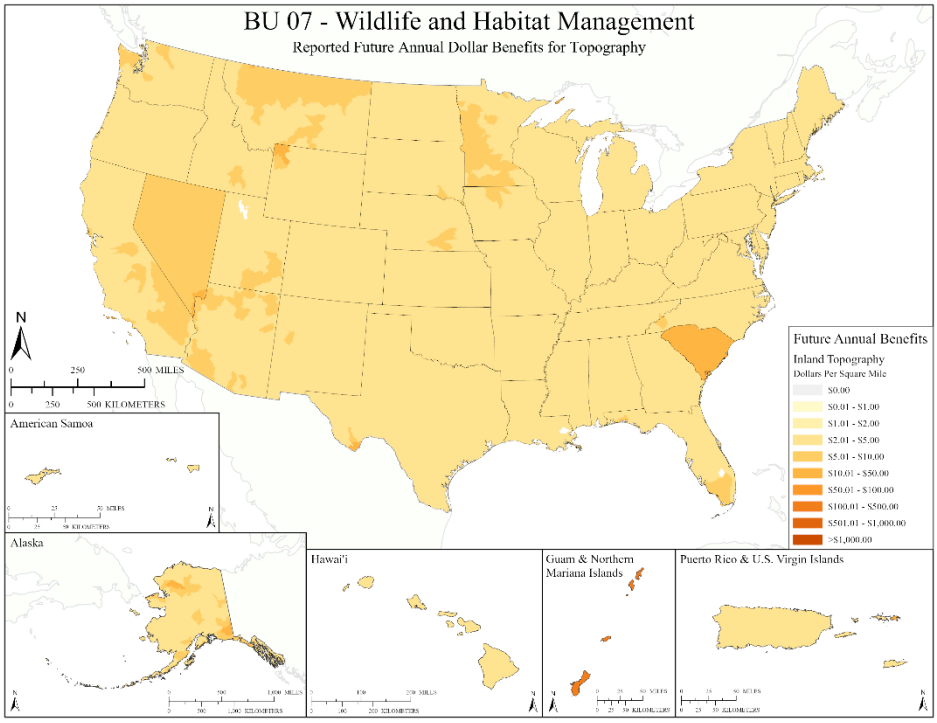

Figure E.7b. Reported Future Annual Dollar Benefits for Topography

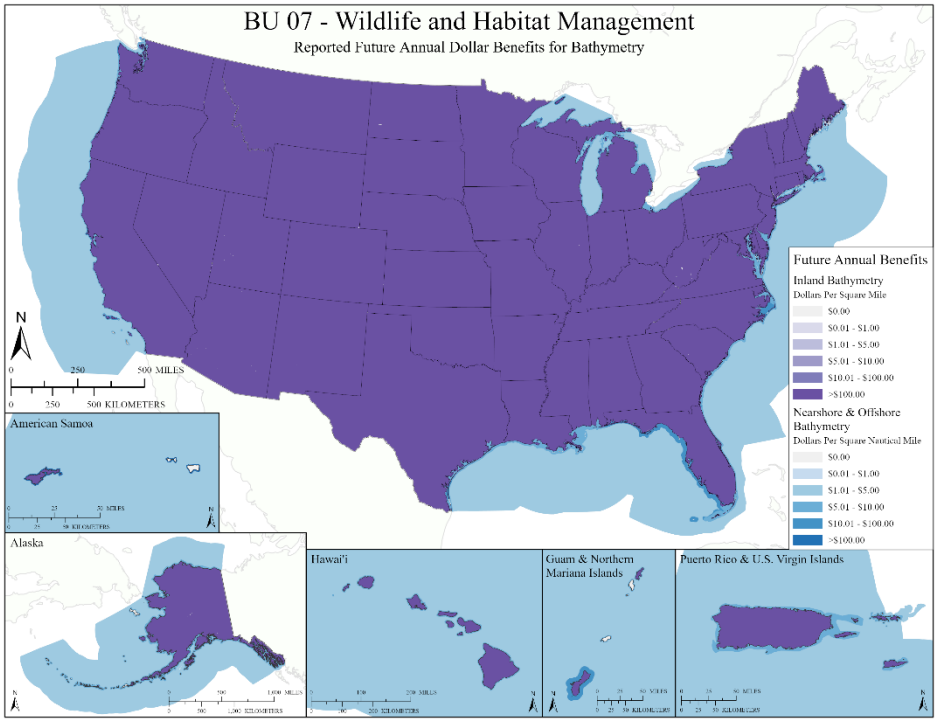

Figure E.7c. Reported Future Annual Dollar Benefits for Bathymetry

BU 07 Benefits Analysis

The total combined reported future annual benefits ($43.18 million per year) could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 07 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, ten federal agencies (APHIS, BLM, FWS, NOAA, NPS, SI, TVA, USAF, USBR, and USGS) submitted a total of 12 MCAs listing BU 07 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the 12 total federal MCAs listing BU 07 as primary:
    - Inland Topography: Seven provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: Four provided dollar benefits and two indicated "Major" benefits.
    - Nearshore Bathymetry: Four provided dollar benefits and one indicated "Major" benefits.
    - Offshore Bathymetry: Two provided dollar benefits and one indicated "Major" benefits.
    - The federal dollar benefits are understated because we have no way to translate "Major benefits into dollar benefits.
    - The USFS submitted an MCA that designated BU 07 as tertiary, meaning benefits did not accrue to BU 07.
    - USACE is one of America's leading federal providers of outdoor recreation -- managing more than 400 lake and river projects in 43 states. USACE managed recreation areas include over 41,000 miles of shoreline, nearly 3,600 miles of trails, nearly 92,000 campsites and over 3,700 boat ramps; USACE is a strong advocate for wildlife and habitat management at these facilities, but USACE MCAs did not include BU 07 as either primary, secondary, or tertiary.
    - DISDI, NRCS, USMC, and USN are all known to be strong supporters of wildlife and habitat management, but they did not include BU 07 as either primary, secondary, or tertiary on any of their MCAs.
- State/Local/Tribal and U.S. Territory MCAs: Forty-four (44) states and territories submitted a total of 46 MCAs that designated BU 07 as their primary BU. Of the 46 MCAs listing BU 07 as primary:
    - Inland Topography: 40 provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: 33 provided dollar benefits and three indicated "Major" benefits.
    - Nearshore Bathymetry: 24 provided dollar benefits and three indicated "Major" benefits.
    - Offshore Bathymetry: 18 provided dollar benefits and two indicated "Major" benefits.
    - Four other states provided MCAs with BU 07 as secondary or tertiary, meaning dollar benefits did not accrue to BU 07.
    - The State dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.

- Non-governmental MCAs: Trout Unlimited documented an MCA with BU 07 as secondary, and The Nature Conservancy documented an MCA with BU 07 as tertiary, meaning their benefits did not accrue to BU 07.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.7b and E.7c:
    - 219 "Major" Operational and Customer Service benefits and 131 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 07 for which "Major" benefits are documented, this could easily be translated into tens of millions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.
    - AECOM submitted an MCA with BU 07 as secondary; Geodynamics and Montana State University submitted MCAs with BU 07 as tertiary, meaning benefits did not accrue to BU 07. Many other private companies specialize in wildlife habitat management, but they did not participate in this study to assess their requirements for and benefits from elevation data.

BU 07 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 07:

- Table E.7d color-codes those organizations having an MCA with BU 07 as Primary, Secondary, or Tertiary.
- Table E.7e summarizes the 58 MCAs with primary benefits for BU 07, rank ordered from the highest to the lowest tangible benefits.

Table E.7d. Organizations having an MCA with BU 07 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	**APHIS**	ARS	BIA	**BLM**	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	**FWS**
	IBWC	IJC	MARAD	NASA	NGA	**NOAA**	**NPS**	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	**SI**	**TVA**	USACE	**USAF**	USARC	**USBR**	USCB
	USCG	USFS	**USGS**	USMC	USN					

State/Ter	**AL**	**AK**	**AR**	**AZ**	**CA**	CO	**CT**	DC	DE	**FL**	GA	**HI**	**IA**	**ID**
	IL	**IN**	KS	KY	**LA**	**MA**	**MD**	**ME**	*MI*	**MO**	**MN**	**MS**	**MT**	**NC**
	ND	**NE**	*NH*	**NJ**	**NM**	**NV**	NY	**OH**	**OK**	**OR**	**PA**	**RI**	**SC**	**SD**
	TN	**TX**	**UT**	**VA**	**VT**	**WA**	*WI*	**WV**	**WY**	PR	**VI**	**GU**	**AS**	**CNMI**

Non-Gov	*AECOM*	Geodynamics	Montana State University	The Nature Conservancy
	Trout Unlimited			

Table E.7e. MCA summaries for BU 07, rank ordered from the highest to the lowest tangible benefits.

Organization	NOAA		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60661						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$4,409,595	$895,653	Moderate	Major	Moderate
Inland Bathy	QL1B	4-5 yrs.	$5,528,695	$2,496,568	Moderate	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$182,256	$1,670	Moderate	Major	Moderate
Offshore B.	Order 1a	4-5 yrs.	$4,343,009	$151,315	Moderate	Major	Major

Organization	USGS		Habitat mapping and assessment to answer scientific questions shaped by the environments of the United States and our products provide rigorous, objective, and timely information and guidance for the management and conservation of biological systems				
MCA Name	MCA No.						
Habitat	1167						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$4,409,595	$895,653	Major	Major	None
Inland Bathy	QL2B	4-5 yrs.	$5,528,695	$2,496,568	Moderate	Major	Major
Nearshore B.	QL2B	4-5 yrs.	$182,256	$1,670	Moderate	Major	None

Organization	South Carolina		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60400						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$416,700	$700,000	Moderate	Major	Moderate
Inland Bathy	QL0B	6-10 yrs.	$95,100	$23,771	Moderate	Moderate	Moderate
Nearshore B.	QL1B	6-10 yrs.	$1,199	$70	Moderate	Major	Moderate
Offshore B.	Special Order	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	Texas		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60439						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$63,056	$182,124	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$505,342	$305,450	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$3,934	$232	Moderate	Major	Moderate
Offshore B.	Special Order	4-5 yrs.	$2,627	$183	Moderate	Major	Major

Organization	NPS		Monitoring the condition on key ecosystem health indicators on National Parks. Elevation data, and bathymetry in particular are needed for sea level rise analysis, flood extent modeling, and change detection at coastal structures.				
MCA Name	MCA No.						
Ecosystem Monitoring in National Parks	22381						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$916,954	Moderate	don't know	don't know	don't know
Nearshore B.	QL1B	6-10 yrs.	$36,783	Moderate	Moderate	don't know	don't know

Organization	FWS		Conservation planning for national wildlife refuges, including long-term (e.g., Comprehensive Conservation Plans - 15 years) and short-term (e.g., annual habitat work plans) planning activities. Includes vegetation mapping, hydrological modeling, volumetric mapping of impoundments, and development of communication and outreach materials.				
MCA Name	MCA No.						
Conservation Planning for National Wildlife Refuges	1186						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$49,941	$24,461	Minor	Moderate	Moderate
Inland Topo	QL2	4-5 yrs.	$300,111	$146,992	Minor	Moderate	Moderate
Inland Topo	QL5	4-5 yrs.	$117,778	$57,687	Minor	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$167,585	$27,135	Minor	don't know	Minor
Nearshore B.	QL0B	4-5 yrs.	Moderate	Moderate	Minor	Minor	Minor

Organization	California		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60043						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$37,671	$108,806	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$301,906	$182,484	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$804	$47	Moderate	Major	Moderate
Offshore B.	Special Order	4-5 yrs.	$4,538	$316	Moderate	Major	Major

Organization	Montana		Map and maintain updates for land cover and wetland/ riparian thematic layers at state level.				
MCA Name	MCA No.						
Management of Information on Biological Community Types	21754						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$35,026	$101,164	don't know	don't know	don't know
Inland Bathy	QL1B	4-5 yrs.	$280,701	$169,668	don't know	don't know	don't know

Organization	New Mexico		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60307						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$28,963	$83,654	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$232,118	$140,302	Moderate	Moderate	Moderate

Organization	Nevada		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60286						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$237,399	$203,641	Moderate	Major	Moderate

Organization	Wyoming		Conservation planning for wildlife species and their habitats in Wyoming. Development of recreation opportunities for consumptive and nonconsumptive uses of wildlife. Monitoring for and treatment of invasive species. Engineering department uses elevation data for water rights, instream flow, irrigation projects, boat dock/ramp engineering, fish hatchery planning. Future uses would include mapping vegetation canopy and understory for sage grouse management, sage brush ecosystem management, improved ecosystem mapping.				
MCA Name	MCA No.						
Wildlife and Habitat Management	1275						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$23,299	$67,295	Major	Major	Moderate
Inland Bathy	QL3B	4-5 yrs.	$186,726	$112,865	Minor	Moderate	Moderate

Organization	Oregon		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60352						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$23,116	$66,767	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$185,259	$111,979	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$266	$15	Moderate	Major	Moderate

Organization	Minnesota		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60607						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$20,099	$58,052	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$161,078	$97,362	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$53	$3	Moderate	Major	Moderate
Offshore B.	Special Order	4-5 yrs.	$2,329	$162	Moderate	Major	Major

Organization	Nebraska		Through planning and management practices, provide stewardship over land and water to keep habitat healthy and viable. Also through various hunting and fishing regulations, maintain a viable healthy population of game and fish species for the future generations to enjoy. In addition park facilities are also developed to provide further recreation for public lands and waters in the state of Nebraska. Bathymetry is needed for volume calculations of lakes and reservoirs for sedimentation and rotenone calculations. Topography is needed for buildings, vegetation, and parks.				
MCA Name	MCA No.						
Stewardship and Management of the State's Fish, Wildlife, Park, and Outdoor Recreation Resources	22383						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$5,444	$15,723	don't know	don't know	Moderate
Inland Topo	QL2	Annually	$12,982	$37,496	don't know	don't know	Moderate
Inland Bathy	QL1B	2-3 yrs.	$147,667	$89,256	don't know	don't know	Moderate

Organization	Oklahoma		Conservation of critical habitats.				
MCA Name	MCA No.						
Habitat Biodiversity Conservation	21600						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	$16,650	$48,091	Major	Major	Minor
Inland Bathy	QL1B	Annually	$133,441	$80,657	Major	Major	None

Organization	Washington		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60512						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$16,092	$46,480	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$128,969	$77,954	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$1,516	$89	Moderate	Major	Moderate
Offshore B.	Special Order	4-5 yrs.	$2,235	$155	Moderate	Major	Major

Organization	USBR		Evaluation of created riparian and aquatic habitat for 20 species across the U.S. Bureau of Reclamation states. These activities are especially important in the Pacific Northwest and the Upper Colorado River Basin. Elevation data are needed for evaluation of riparian vegetation. We are typically interested in individual trees and branches of those trees. This allows us to evaluate physiognomic structure requirements of avian species. For evaluation of marsh/wetland vegetation, we are interested in even higher resolution due to the types of vegetation present and the way that marsh birds use these habitat types.				
MCA Name	MCA No.						
Wildlife and Habitat Management	1084						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$250,000	Moderate	Minor	Moderate	None
Inland Bathy	QL1B	2-3 yrs.	Minor	Minor	Minor	Minor	None

Organization	Florida		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources. Elevation data provide opportunities for modeling large, temporally consistent regions and save money on individual collection projects.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60081						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$13,367	$38,607	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$107,125	$64,751	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$12,519	$740	Moderate	Major	Moderate
Offshore B.	Special Order	4-5 yrs.	$3,377	$235	Moderate	Major	Major

Organization	South Dakota		Provide sustainable outdoor recreational opportunities through responsible management of our state's parks, fisheries and wildlife. Bathymetry is needed for fisheries research (random samples need to be taken at different depths), for use by the public for recreation (lake depth for boating and fishing, identification of underwater submerged objects for boating), and for habitat management. Topography is needed for planning for campgrounds and roadway development.				
MCA Name	MCA No.						
Recreational Use by the Public and Project Planning	21604						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$151	$437	don't know	don't know	don't know
Inland Bathy	QL2B	6-10 yrs.	$147,214	$88,982	don't know	don't know	don't know

Organization	Arizona		Conservation Engineering, Dam Inundation Zone Risk Management, Critical Habitat Conservation, Conservation Planning, Fisheries Management, Cultural Resources Protection, In-flight Hazard Risk Management, Recreational Facilities Planning Management, Unit Boundary Management				
MCA Name	MCA No.						
Wildlife, Habitat, and Public Safety	21929						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$31,175	$156,000	Moderate	Moderate	Minor
Inland Bathy	QL4B	4-5 yrs.	$21,030	$20,000	Moderate	Moderate	Moderate

Organization	Iowa		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60172						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$13,404	$38,715	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$107,425	$64,932	Moderate	Moderate	Moderate

Organization	Alabama		Conservation of critical habitats. The department is responsible for the conservation of all flora and fauna both terrestrial and in state waters. Elevation data are needed to identify watersheds, assess water quality, and manage upstream uses re: habitats. The data are also needed for species conservation. The marine resources group may also want offshore bathymetry, although they often collect their own as needed. Bathymetry for lease areas would useful. Inland bathymetry is needed for public lakes.				
MCA Name	MCA No.						
Conservation of Critical Habitats	1136						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$12,305	$35,540	don't know	don't know	don't know
Inland Bathy	QL2B	6-10 yrs.	$98,614	$59,606	don't know	don't know	don't know
Nearshore B.	QL2B	2-3 yrs.	$765	$45	don't know	don't know	don't know

Organization	North Carolina		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources. Elevation data are needed for forestry uses including determination of loss of tree types and replanting.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60322						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$11,759	$33,965	Moderate	Major	Moderate
Inland Bathy	QL0B	4-5 yrs.	$94,243	$56,964	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$4,250	$251	Moderate	Major	Moderate
Offshore B.	I don't know	4-5 yrs.	$612	$42	Moderate	Major	Major

Organization	Louisiana		Conservation planning for wildlife management areas, refuges and conservation areas as well as private lands. Conservation and management of fisheries. Prescribed burning on Wildlife Management Areas (WMAs) for habitat management. Elevation data are used for flood modeling of WMAs. The forestry section uses elevation data for planning for prescribed burning operations. For fisheries, lidar is used to model waterbodies when levels are lowered or drained (i.e. drawdowns).				
MCA Name	MCA No.						
Habitat Modeling and Monitoring	22089						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Annually	$10,977	$31,705	Moderate	Moderate	Major
Inland Bathy	QL0B	Annually	$87,974	$53,175	Moderate	Moderate	Moderate
Nearshore B.	QL0B	Annually	$6,016	$355	Moderate	Moderate	Moderate
Offshore B.	Special Order	4-5 yrs.	$257	$17	Moderate	Major	Major

Organization	Pennsylvania		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60360						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$10,790	$31,166	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$86,479	$52,271	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$72	$4	Moderate	Major	Moderate
Offshore B.	Special Order	4-5 yrs.	$639	$44	Moderate	Major	Major

Organization	Tennessee		Protect, conserve, and manage the fish and wildlife of the state and their habitats. Elevation data are needed for habitat and land cover assessment, determination of forest types at specific elevations and species within those elevations; bathymetry is needed for inland waters for fish species management.				
MCA Name	MCA No.						
Protect, Conserve, and Manage the Fish and Wildlife of the State and Their Habitats	21496						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$10,038	$28,994	None	don't know	None
Inland Bathy	X-Sec meet needs	Event driven	$80,450	$48,628	don't know	don't know	don't know

Organization	Virginia		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60495						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$9,619	$27,782	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$77,088	$46,595	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$1,935	$114	Moderate	Major	Moderate
Offshore B.	Special Order	4-5 yrs.	$600	$41	Moderate	Major	Major

Organization	Northern Mariana Islands		Management and monitoring of wildlife and fish populations. Elevation data are needed for occupancy and species distribution modeling, monitoring fluctuation of populations, and habitat mapping for wildlife and fisheries (mostly fin fish).				
MCA Name	MCA No.						
Management and Monitoring of Wildlife and Fish Populations	21565						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$142,386	$5,728	Major	Major	None
Inland Bathy	QL2B	4-5 yrs.	$8,427	$3,015	Major	Major	don't know
Nearshore B.	QL2B	4-5 yrs.	Major	Moderate	Moderate	Moderate	Major

Organization	Indiana		Wildlife Section				
MCA Name	MCA No.						
Wildlife and Habitat Management	50001						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$8,619	$24,894	Minor	Major	None
Inland Bathy	QL2B	4-5 yrs.	$69,074	$41,751	Minor	Major	None
Nearshore B.	QL0B	4-5 yrs.	$38	$2	Moderate	Major	Moderate

Organization	Maine		Big game population management; protection and management of fish, non-game wildlife, and habitats; restoration of endangered species; enabling and promoting the safe enjoyment of Maine's outdoors.				
MCA Name	MCA No.						
Fisheries and Wildlife Management	21980						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$7,720	$22,297	don't know	Major	don't know
Inland Bathy	QL2B	6-10 yrs.	$61,869	$37,396	don't know	Major	don't know
Nearshore B.	QL0B	>10 yrs.	$874	$51	don't know	don't know	don't know
Offshore B.	Special Order	4-5 yrs.	$2,037	$141	Moderate	Major	Major

Organization	Mississippi		Mapping of imperiled species' habitat and associated ecosystems				
MCA Name	MCA No.						
Habitat and Ecosystem Mapping	22122						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$47,798	Major	Minor	Major	don't know
Nearshore B.	QL1B	Annually	$50,652	Major	Minor	Major	don't know

Organization	Massachusetts		Fisheries inventory and analysis. Location-based products and services such as maps and guides. Bathymetry is needed to analyze data on the meso-habitat scale and also turn around high quality lake and pond maps to the public. While acquiring comprehensive inland bathymetry can be very time-consuming, the benefits to our Fisheries program would be enormous; we would be able to analyze our data on the meso-habitat scale and also turn around high quality lake and pond maps to the public.				
MCA Name	MCA No.						
Wildlife and Habitat Management	21498						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL3B	2-3 yrs.	$57,285	$27,135	don't know	don't know	Moderate
Nearshore B.	QL0B	2-3 yrs.	Moderate	Moderate	Moderate	Moderate	Moderate

Organization	Utah		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60466						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$19,911	$57,509	Moderate	Major	Moderate

Organization	Idaho		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60132						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$19,906	$57,495	Moderate	Major	Moderate

Organization	Alaska		Ensure sustainability and harvestable surplus of fish and wildlife resources. Elevation data are needed for habitat assessment and management for mammals, both marine and terrestrial. Anadromous fish habitats are modeled using slope and elevation. Commercial fisheries abound.				
MCA Name	MCA No.						
Habitat Management	21489						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$241	$4,522	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$4,221	$5,427	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$25,024	$2,412	Moderate	Moderate	Moderate
Offshore B.	Special Order	4-5 yrs.	$20,804	$2,412	Minor	Minor	Moderate

Organization	Arkansas		Conservation and preservation of various species of fish and wildlife. Inland bathymetry is needed for channelization for boating. Also to evaluate dams on state-owned lakes for pumps and lifts, to see the health of the structure, and identify if sedimentation against the dam is a problem that needs to be mitigated. The commission also evaluates areas upstream of dams that would flood timber – too much water kills timber, areas are only flooded during duck hunting season, and the dam is used to drain the timbered areas after the season is over. Bathymetry data are also needed for fish habitat management.				
MCA Name	MCA No.						
Conservation and Preservation of Fish and Wildlife	1462						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$51,568	Major	Minor	Moderate	Moderate
Inland Bathy	I don't know	4-5 yrs.	Major	Major	Minor	Moderate	Major

Organization	Vermont		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60482						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$2,290	$6,614	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$18,353	$11,093	Moderate	Moderate	Moderate

Organization	Mississippi		Conservation planning for wildlife management. Conservation of critical habitats. Management of diverse habitats. Private lands management recommendations for healthier fish and wildlife populations. Search and rescue efforts need precise bathymetry data very quickly. Search and rescue teams encompass numerous agencies responsible for emergency operations. Bathymetry is also needed for management of freshwater fisheries.				
MCA Name	MCA No.						
Conservation Planning for Wildlife Management	22087						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$10,854	Moderate	Minor	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	$25,658	Major	Moderate	Moderate	Moderate

Organization	Hawai'i		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60115						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,532	$4,427	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$12,283	$7,424	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$431	$25	Moderate	Major	Moderate
Offshore B.	Special Order	4-5 yrs.	$3,853	$268	Moderate	Major	Major

Organization	American Samoa		Conservation and management of coral reef communities and associated ecosystems. Elevation data are needed for natural resources management to monitor change over time of sea grass, algae, coral, fish, invertebrates, pollution and sediment from land, construction induced change, land use changes, sedimentation, etc.				
MCA Name	MCA No.						
Conservation and Management of Coral Reef Communities and Associated Ecosystems	21509						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	don't know	don't know	don't know	don't know	don't know
Inland Bathy	QL2B	Annually	Major	Major	Major	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$24,120	Major	Major	Major	Major
Offshore B.	Order 1	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Connecticut		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60063						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,184	$3,420	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$9,491	$5,737	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$248	$14	Moderate	Major	Moderate
Offshore B.	Special Order	4-5 yrs.	$324	$22	Moderate	Major	Major

Organization	Air Force		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60629						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$11,387	$2,312	Moderate	Major	Moderate

Organization	Florida		Coral Reef Conservation				
MCA Name	MCA No.						
Coral Reef Conservation	21547						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL2B	Annually	$4,824	Major	Moderate	Major	don't know
Offshore B.	Order 1	Annually	$4,824	Major	Moderate	Major	don't know

Organization	Maryland		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60215						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$2,355	$6,802	Moderate	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$173	$10	Moderate	Major	Moderate

Organization	Guam		Long-term Coral Reef Monitoring: We are responsible for conducting regular ecological data collection at permanent sites located around Guam, as well as for carrying out rapid response surveys during coral bleaching events, crown of thorns sea star outbreaks, and vessel groundings. There are gaps in the currently available nearshore bathymetry that need to be filled. While inland topo is not included as a data requirement, it is nice to have because the land affects the reef system. Topo helps to understand the watersheds that drain to the reefs. The currently available topo is adequate for this need.				
MCA Name	MCA No.						
Long-term Coral Reef Monitoring	22391						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,532	$4,427	Moderate	Major	Moderate
Nearshore B.	QL2B	>10 yrs.	$431	$25	don't know	don't know	don't know
Offshore B.	Order 1	>10 yrs.	$2,059	$143	don't know	don't know	don't know

Organization	Rhode Island		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60374						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$257	$745	Moderate	Major	Moderate
Inland Bathy	QL2B	4-5 yrs.	$2,067	$1,249	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$179	$10	Moderate	Major	Moderate
Offshore B.	Special Order	4-5 yrs.	$281	$19	Moderate	Major	Major

Organization	New Jersey		Maintain, manage, restore, and enhance the habitats, on New Jersey's Wildlife Management Area system in order to promote and protect wildlife and wildlife-related recreation throughout the state. Conservation and management of diverse game and nongame (endangered, threatened, and special concern) wildlife species and their associated habitats.				
MCA Name	MCA No.						
Land Management for Wildlife	1219						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$125	$361	Moderate	Moderate	Moderate
Inland Bathy	QL4B	4-5 yrs.	$1,003	$606	None	None	None
Nearshore B.	QL4B	4-5 yrs.	$460	$27	None	None	None
Offshore B.	Special Order	4-5 yrs.	$265	$18	Moderate	Major	Major

Organization	SI		Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Management of diverse migratory bird habitats, coral reef and coral communities, marine mammals, protected fish species, and trust resources.				
MCA Name	MCA No.						
Wildlife and Habitat Management	60674						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$441	$90	Moderate	Major	Moderate
Inland Bathy	QL1B	4-5 yrs.	$553	$250	Moderate	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$18	$1	Moderate	Major	Moderate
Offshore B.	Order 1a	4-5 yrs.	$434	$15	Moderate	Major	Major

Organization	U.S. Virgin Islands		Marine and terrestrial protection.				
MCA Name	MCA No.						
Marine and Terrestrial Protection	21679						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$31	$92	Moderate	Moderate	Moderate
Nearshore B.	X-Sec meet needs	6-10 yrs.	$58	$3	Moderate	Major	Moderate
Offshore B.	Special Order	6-10 yrs.	$458	$31	Moderate	Major	Major

Organization	West Virginia		Conservation planning for state wildlife management areas, rivers, streams, and impoundments (lakes). Conservation of critical habitats. Management of game and fish species, diverse migratory bird and rare species habitats, protected fish species, and trust resources.				
MCA Name	MCA No.						
Conservation Planning for State Wildlife and Habitat Areas	1118						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Moderate	Major	Minor
Inland Bathy	QL2B	6-10 yrs.	Major	Major	Major	Moderate	don't know

Organization	FWS		Using biological, chemical and physical features of the water and landscape over space and time to measure habitats geospatially over the entire planet. Elevation data are needed to evaluate land and canopy changes that affect migratory birds which do not respect political boundaries. Elevation data are also used to model wetlands that exist or can be restored. Canopy height can be used to see the existence of invasive and other species. Additionally, elevation data can be used to estimate water depths the water fowl and other shore birds prefer in impoundments. Elevation data are also needed to analyze vegetation structure (canopy height and relative vegetation density) on a landscape basis, for basal area calculation, and to improve the accuracy of vegetation structure metrics. Elevation data enable activities that just would not be done in the field from a cost perspective. The power of widespread elevation data collection is the ability to perform fine grained landscape scale analysis of vegetative and topographic data. Additional Business Uses include BU 01 - Water Supply and Quality; BU 02 – Riverine Ecosystem Management: BU 08 – Agriculture and Precision Farming; BU 15 - Flood Risk Management; BU 17 - Wildfire Management, Planning, and Response; BU 16 - Sea Level Rise and Subsidence; and BU 18 - Homeland Security, Law Enforcement, Disaster Response, and Emergency Management. These are all Business Uses that elevation data can and will be used for in USFWS nationwide.					
MCA Name	MCA No.						
Measuring Dynamic Landscape Metrics for Wildlife Habitat	1124						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs. for lidar baseline.	Major	Major	Major	Major	Major
Inland Topo	QL2	4-5 yrs. for lidar baseline.	Major	Major	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Moderate	Major	Major
Nearshore B.	QL1B	4-5 yrs.	Major	Major	Moderate	Major	Major
Offshore B.	Order 2	6-10 yrs.	Major	Major	Major	Major	Major

Organization	TVA		Environment - We are committed to protecting the Tennessee Valley's natural resources, as well as its historical and cultural heritage. This includes management of natural resources during transmission line siting, etc. Elevation data are needed to help identify wetlands under power corridors and for other habitat management activities. Inland bathymetry is needed for reservoirs and their connecting rivers (but not for small farm dams). Bathymetry is also needed for permitting for docks, underwater weed control, and to check for underwater artifacts before issuing a dock permit. Additional Business Uses for this MCA include BU 01 – Water Supply and Water Quality, BU 02 – Riverine Ecosystem Management, BU 06 – Natural Resources Conservation, and BU 30 – Maritime and Land Boundary Management.					
MCA Name	MCA No.						
Environment	1213						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	Major	Major	Moderate	Major	Major
Inland Topo	QL2	2-3 yrs.	Major	Major	Moderate	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Minor	Moderate	Moderate

Organization	Ohio		Oil and Gas Permitting, well emergency response, Geologic Hazard mapping, watershed modeling, mine hazard mitigation, timber harvesting/health, coastal erosion, flood modeling, dam safety, geologic formation mapping, habitat delineation, park recreation, fisheries management.				
MCA Name	MCA No.						
Natural Resources Support	1241						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Moderate	Moderate	Major
Inland Bathy	X-Sec meet needs	4-5 yrs.	Major	Major	Moderate	Moderate	Major
Nearshore B.	QL0B	4-5 yrs.	Major	Major	Minor	Moderate	Moderate
Offshore B.	Order 1a	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	Florida		Restoration of critical habitats. Bathymetry is needed for identification of oyster reefs, sometimes less than 12”.				
MCA Name	MCA No.						
The Nature Conservancy Oyster Reef Restoration	21511						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	6-10 yrs.	Major	don't know	Moderate	Major	don't know

Organization	NOAA		Identification, designation, and management of marine and Great Lakes areas of special national significance as national marine sanctuaries. Manage natural, cultural, historical resources within sites. Identify habitat types (coral, sea seeps, vegetation type, shipwrecks, archaeological features – for determination of area and in management of sites.				
MCA Name	MCA No.						
Identification, Designation, and Management of National Marine Sanctuaries	1068						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL2B	2-3 yrs.	Moderate	Moderate	Moderate	Moderate	Moderate
Offshore B.	Order 1a	2-3 yrs.	Moderate	Moderate	Moderate	Moderate	Minor

Organization	Missouri		1. Waterfowl Habitat and Pool Management 2. Contours are used in base maps for Conservation areas Missouri Department of Conservation (MDC) manages. 3. Engineering Design Plans 4. Hydrologic Modeling MDC uses canopy cover, vegetation types (NLCD), HUC12s, lidar (QL2 0.5m accuracy), and contours to help with navigation to areas, cartography, H&H modeling, wetlands and waterfowl management, pumping water in/out of pools, and vegetation planting. Having a central repository for state data is highly important. Design and development of infrastructure uses aerials and lidar to assign elevations to points. Better elevation data improves decision making. Statewide DEMs are used for many purposes. More accurate than QL2 (survey grade) may be needed for specific projects. MDC's mission includes getting more citizens to discover nature.				
MCA Name	MCA No.						
Fish, Forest, and Wildlife Management; Infrastructure Asset Management; and Recreation	1226						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Moderate	Moderate	None	Minor	Minor
Inland Bathy	I don't know	>10 yrs.	Moderate	Minor	Minor	Minor	Minor

Organization	APHIS		In APHIS Wildlife Services we protect humans and agriculture from conflicts with wildlife. Some activities can include wildlife rabies vaccinations, protecting airports and air travel from wildlife strikes, protecting threatened and endangered species from invasive species, and protecting livestock from predation. Elevation data support Wildlife Services activities, primarily through research and visualization. Elevation data are generally not used for day to day activities. Elevation data are also used for Plant Protection and Quarantine activities for research, visualization, and habitat identification.				
MCA Name	MCA No.						
Wildlife Services and Plant Protection	1117						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Minor	don't know	None	None	None

Organization	BLM		Wildlife and Habitat Management; includes sage grouse and other wildlife. Inland bathy would be nice for managing fish species.				
MCA Name	MCA No.						
Wildlife and Habitat Management	21992						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	don't know	don't know	don't know	don't know	don't know
Inland Bathy	X-Sec meet needs	Annually	don't know	don't know	don't know	don't know	don't know

BU 08 - Agriculture and Precision Farming

BU 08 Scope

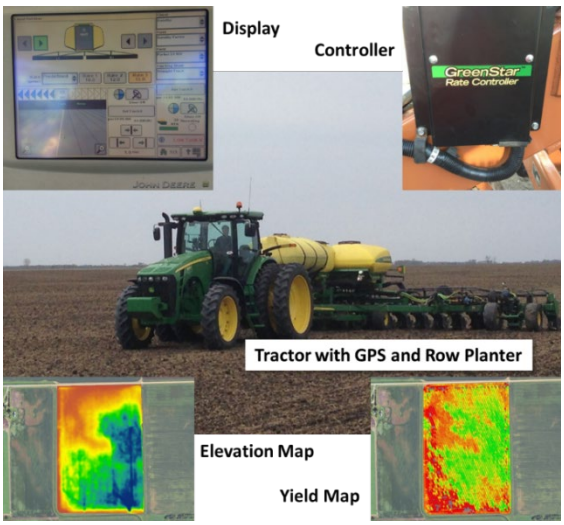

Figure E.8a. For precision farming, lidar optimizes crop productivity by enabling farmers to vary their application of seed, fertilizer and water per square meter, based partly on lidar mapping of terrain variations that impact soil wetness. Image courtesy of the J.R. Simplot Company.

Business Use #8 (BU 08) includes farm pond design; irrigation system design; detailed site analysis to support precision farming; analysis of farm sedimentation and runoff; calibration of fertilizer application, fertilizer management, and irrigation planning; and optimized terraforming. Although the U.S. Department of Agriculture (USDA) promotes technologies that reduce agricultural costs, increase agricultural productivity and efficiency, and/or reduce environmental impacts, the implementation of "Precision Ag," as it is popularly referenced, is largely left to the private sector where the farmers themselves make business decisions without government direction. Precision Ag is championed by organizations such as the Precision Ag Institute, the Fertilizer Institute, and various types of Precision Ag businesses including Precision Ag consultants and manufacturers of Precision Ag technologies (e.g. GPS-enabled electronic controllers for application of seed, fertilizer, lime, and pesticides; yield monitoring systems; and irrigation systems). Many state universities also have Precision Ag Centers with Precision Ag research goals to "get the right product – at the right rate – in the right place – at the right time."

BU 08 Background Information

Figure E.8a demonstrates site-specific Precision Ag farming methods where the tractor is equipped with a GPS receiver that enables site-specific application of seed, fertilizer, lime, pesticides, and water. Precision Ag also includes knowledge of soil type, soil wetness, drainage, and topographic variations within farm fields that can affect crop yield. Without such site-specific methods, the uniform treatment of wheat, corn, soybean, and cotton fields, for example, wastes costly fertilizers, pesticides, and herbicides with potentially excessive farm run-off. Farm fields can contain wide spatial variations in soil types, slopes, depressions, soil wetness, nutrient availability, and other important factors; not taking these variations into account can result in a loss of productivity. An important effect of Precision Ag is the high environmental benefit from using chemical treatments only where and when they are necessary. The promotion of environmental stewardship is a key component of Precision Ag. Whereas nitrogen fertilizer is one of the biggest agricultural expenses, it's also a major contributor to water pollution and climate change.

From the National Enhanced Elevation Assessment (NEEA), we learned that lidar data have tremendous financial benefits for Precision Ag, potentially hundreds of millions of dollars annually. Lidar identifies areas that need surface ditching, tile drainage, or grass waterways, for example, to reduce saturated soils and crop damage. DEM derivative products are also valuable for Precision Ag: slope data are used to minimize soil erosion; aspect data are used to identify areas of solar heating where soils are more wet or dry; and landscape position (curvature) data are used to identify areas of high/low soil moisture content. But private sector Precision Ag firms did not participate in this 3D Nation study, meaning benefits are seriously undercounted.

BU 08 Elevation Data Uses

Using their own words, respondents documented 33 Mission Critical Activities (MCAs) that identified BU 08 as their primary Business Use and identified the following 28 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.7a. BU 08 Elevation Data Uses

Data Use
Engineering Design and Construction
1. Engineering and construction of farm dams and reservoirs
2. Farm pond design
3. Irrigation system design and planning
Environmental Protection
4. EPA 9 key element watershed protection planning: (1) causes/source of pollution identified, (2) expected load reductions for solutions identified, (3) nonpoint source management measures identified, (4) technical and financial assistance, (5) education and outreach, (6) implementation schedule, (7) milestones identified, (8) load reduction evaluation criteria, (9) monitoring.
5. Non-point source pollution
Erosion/Sediment Control
6. Analysis of farm sedimentation and runoff
7. Sediment removal from ponds
Farming/Agriculture
8. Delineate and identify crops and other areas involved with FSA programs
9. Detailed site analysis to support precision farming
10. Digital terrain analysis to allow farmers to manage their fields on a finer scale than previously possible
11. Economic analysis of ag/residential development
12. Farm management from large sugarcane and pineapple operations to small, diversified crops supporting farm-to-table.
13. Fertilizer management
14. Incentivize beneficial farm practices
15. Optimized terraforming
16. Protection of agricultural productivity
17. Pump, drain, and well placement for irrigation infrastructure
Hazard Assessment and Mitigation
18. Farm dam safety
19. Farm flood preparedness to plan staging areas
20. Flood preparedness for protecting farm assets
Mapping/Boundary delineation
21. Map accurate drainage systems at large scale to help farmers manage drainage and flooding and deal with soil erosion issues
Modeling
22. Dam breach modeling
23. Hydrologic and hydraulic (H&H) modeling to regulate and analyze stream flow and runoff for irrigation

Data Use
Natural Resources Conservation Modeling
24. Conservation Best Management Practice (BMP) planning and design
25. Conservation engineering
Research
26. Agroforestry research; identify pockets of past agroforest systems to help future agroforests
Water Supply and Delivery
27. Analysis of water years for irrigation and how to better regulate water for users
28. Engineering of water distribution to farmers

BU 08 Tangible and Intangible Benefits

For the 33 MCAs that list Agriculture and Precision Farming as their primary Business Use:

- **Table E.8b** summarizes the reported future annual dollar benefits by geography type, totaling $8.75 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.8c** summarizes the major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.8e.
- **Table E.8d** shows (in blue) the one federal agency and 32 states and territories that submitted MCAs with BU 08 as the primary Business Use. MCAs for which BU 08 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.8d.
- **Table E.8e** documents all the MCAs that listed BU 08 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.8e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 08 Reported Future Annual Dollar Benefits

Of the 33 MCAs that listed Agriculture and Precision Farming as their primary Business Use, 28 MCAs estimated their tangible annual benefits totally in financial terms; and four MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.8b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because some of the 33 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.8b. BU 08 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$2,538,720	$2,320,270	$4,858,990
Inland Bathymetry	$2,675,726	$1,210,731	$3,886,457
Nearshore Bathymetry	$0	$0	$0
Offshore Bathymetry	$0	$0	$0
Totals	**$5,214,446**	**$3,531,001**	**$8,745,447**

BU 08 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.8c. BU 08 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	29	27	26	27	3
Inland Bathymetry	14	14	0	14	14
Nearshore Bathymetry	0	0	0	0	0
Offshore Bathymetry	0	0	0	0	0
Totals	**43**	**41**	**26**	**41**	**17**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 08 Reported Future Annual Dollar Benefits Maps

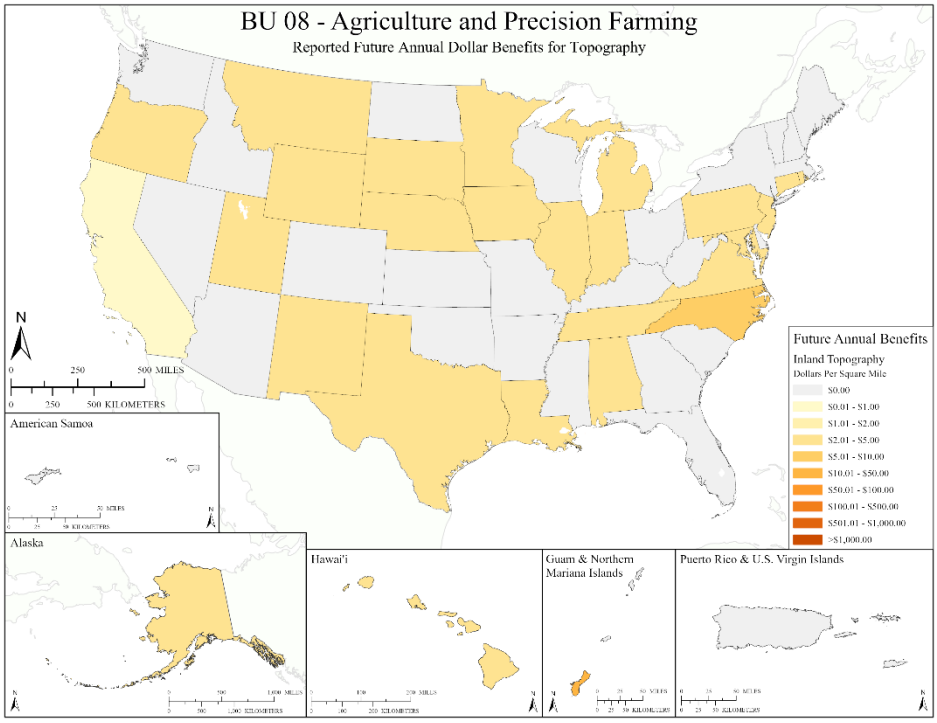

Figure E.8b. Reported Future Annual Dollar Benefits for Topography

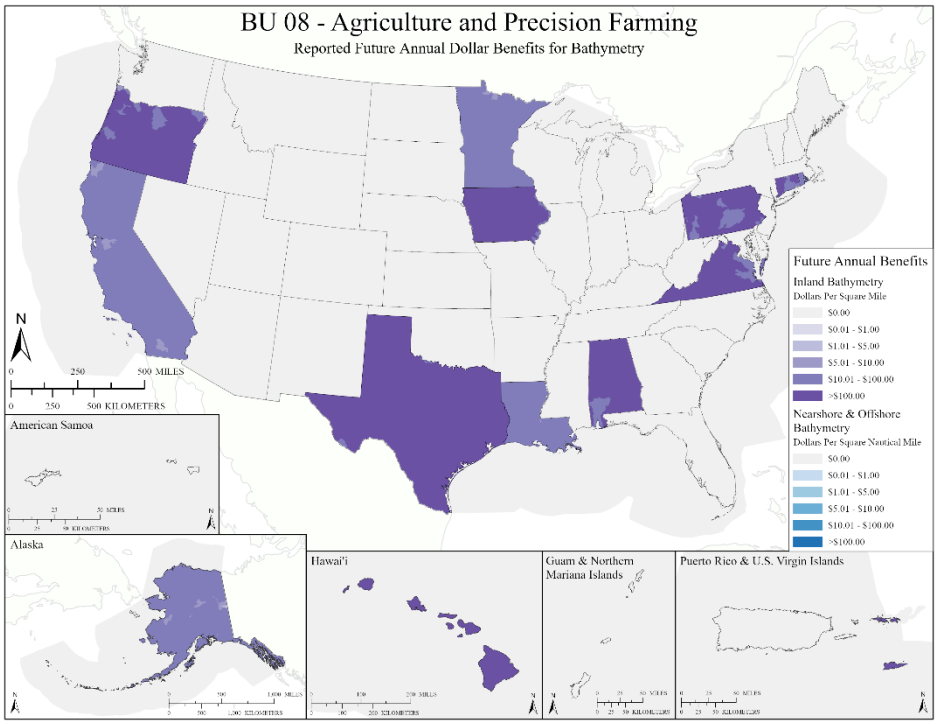

Figure E.8c. Reported Future Annual Dollar Benefits for Bathymetry

BU 08 Benefits Analysis

The total combined reported future annual benefits ($8.75 million per year) could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe the BU 08 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Only one federal Agency (Farm Service Agency – FSA) submitted an MCA listing BU 08 as primary, and it listed "Moderate" benefits only for inland topography. NRCS submitted an MCA with BU 08 as secondary, and the ARS submitted an MCA with BU 08 as tertiary, meaning financial benefits do not accrue to BU 08.
- State/Local/Tribal and U.S. Territory MCAs: 32 states and territories submitted 32 MCAs that designated BU 08 as their primary BU. Of the 32 MCAs listing BU 08 as primary:
    - Inland Topography: 27 provided dollar benefits and four indicated "Major" benefits.
    - Inland Bathymetry: 13 provided dollar benefits and one indicated "Major" benefits.
    - Nearshore and Offshore Bathymetry: No MCAs listing BU 08 as primary included any benefits for nearshore or offshore bathymetry.
    - Two states (DE and FL) submitted an MCA listing BU 08 as secondary, and states (ID, KS, and OK) and American Samoa submitted an MCA listing BU 08 as tertiary, meaning no dollar benefits accrued to BU 08.
    - Many agricultural states (AR, CO, GA, KY, MA, MO, MS, ND, and SC) did not submit an MCA including BU 08 as either primary, secondary or tertiary.
- Non-governmental MCAs: Only one non-governmental entity (Glorieta Geoscience) submitted an MCA with BU 08 as secondary. For the NEEA study in 2012, private sector Precision Ag firms were major contributors to the major cost benefits accrued to Agriculture and Precision Farming, but they did not participate in the 3D Nation study, so their input is lacking.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.8b and E.8c:
    - 84 "Major" Operational and Customer Service benefits and 84 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 08 for which "Major" benefits are documented, this could easily be translated into hundreds of thousands of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.
    - The lack of input from private sector Precision Ag companies was the primary reason why benefits are seriously understated for BU 08.

BU 08 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 08:

- **Table E.8d** color-codes those organizations having an MCA with BU 08 as Primary, Secondary, or Tertiary.
- **Table E.8e** summarizes the 33 MCAs with primary benefits for BU 08, rank ordered from the highest to the lowest tangible benefits.

Table E.8d. Organizations having an MCA with BU 08 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	**FSA**	FWS
	IBWC	IJC	MARAD	NASA	NGA	NOAA	NPS	NRC	*NRCS*	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	USAF	USARC	USBR	USCB
	USCG	USFS	USGS	USMC	USN					

State/Ter	**AL**	**AK**	AR	AZ	**CA**	CO	**CT**	DC	*DE*	*FL*	GA	**HI**	**IA**	ID
	IL	**IN**	KS	KY	**LA**	MA	**MD**	**ME**	**MI**	MO	**MN**	MS	**MT**	**NC**
	ND	**NE**	NH	**NJ**	**NM**	NV	NY	**OH**	OK	**OR**	**PA**	**RI**	SC	**SD**
	TN	**TX**	**UT**	**VA**	VT	**WA**	**WI**	WV	**WY**	PR	**VI**	**GU**	AS	CNMI

Non-Gov	*Glorieta Geoscience, Inc.*			

Table E.8e. MCA summaries for BU 08, rank ordered from the highest to the lowest tangible benefits.

Organization	Alaska		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60009						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$676,309	$536,154	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	$1,184,901	$536,154	Moderate	Major	Major

Organization	Texas		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60440						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$306,480	$242,966	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	$536,955	$242,966	Moderate	Major	Major

Organization	Oregon		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60353						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$112,356	$89,072	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	$196,849	$89,072	Moderate	Major	Major

Organization	Minnesota		Agriculture and Precision Farming. We use LIDAR for digital terrain analysis to allow farmers to manage their fields on a finer scale than was previously possible. Flood Risk Management. Flood preparedness is important for our agency response, allowing us to plan staging areas outside the flood risk zone and protecting assets.				
MCA Name	MCA No.						
Agriculture and Precision Farming	32950						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$97,690	$77,445	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	$171,155	$77,445	Moderate	Major	Major

Organization	North Carolina		Emergency Response (hurricane, flooding), Farm pond design. Timber harvesting. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Precision Ag -- RYE, Calibration of fertilizer application, fertilizer management, and irrigation planning. There is a need to see streams in the DEMs for pond design. Sediment removal from ponds is the concern.				
MCA Name	MCA No.						
Emergency Response, Farm Pond Design, Forest Management, and Precision Agriculture	22119						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$60,298	$360,000	don't know	don't know	Minor

Organization	Montana		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60257						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$170,239	$134,960	Major	Major	Minor

Organization	Iowa		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60173						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$65,151	$51,649	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	$114,145	$51,649	Moderate	Major	Major

Organization	Alabama		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60003						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$59,807	$47,413	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	$104,783	$47,413	Moderate	Major	Major
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	New Mexico		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60308						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$140,775	$111,601	Major	Major	Minor

Organization	Louisiana		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60201						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$53,354	$42,297	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	$93,478	$42,297	Moderate	Major	Major
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Pennsylvania		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60361						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$52,448	$41,578	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	$91,889	$41,578	Moderate	Major	Major

Organization	Wyoming		Modeling stream flow for such cases of dam breakages, analysis of water years for irrigation and how to regulate water for users better. Elevation data are needed for H&H modeling, and to regulate and analyze stream flow and runoff for irrigation. The data are also needed for dam safety – dam breach modeling.				
MCA Name	MCA No.						
Stream Analysis	22091						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$113,246	$89,777	None	Moderate	Moderate

Organization	Virginia		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60496						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$46,752	$37,063	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	$81,911	$37,063	Moderate	Major	Major

Organization	California		Protection of agricultural productivity and incentivizing beneficial practices				
MCA Name	MCA No.						
Protection of Agricultural Productivity and Incentivizing Beneficial Practices	21647						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$42,113	$33,386	Moderate	Moderate	Minor
Inland Bathy	QL4B	Event driven	$73,782	$33,386	don't know	don't know	don't know

Organization	Utah		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60467						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$96,778	$76,722	Major	Major	Minor

Organization	Nebraska		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60272						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$89,557	$70,998	Major	Major	Minor

Organization	South Dakota		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60412						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$89,282	$70,780	Major	Major	Minor

Organization	Michigan		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60233						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$67,250	$53,313	Major	Major	Minor

Organization	Illinois		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60140						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$65,230	$51,712	Major	Major	Minor

Organization	Tennessee		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60427						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$48,791	$38,680	Major	Major	Minor

Organization	Indiana		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60152						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$41,892	$33,210	Major	Major	Minor

Organization	Hawai'i		Irrigation system design; system is gravity fed so terrain data very important. Detailed site analysis to support precision farming. Farming moving from large sugarcane and pineapple operations to smaller (to two+ acre operations) and more diversified crops supporting farm-to-table. 1,000+ farms per island served. Analysis of farm sedimentation and runoff. Engineering and construction of dams, reservoirs, and distribution to farmers. Pump, drain, and well placement – all irrigation system-related infrastructure. Disaster response; knowledge of headwaters to reservoirs to ditches to irrigated fields. Flood risk analysis resulting from acts of terrorism and natural hazards.				
MCA Name	MCA No.						
Agriculture Management	21649						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$13,326	$6,030	Moderate	Major	Major
Inland Bathy	QL4B	4-5 yrs.	$13,326	$6,030	Moderate	Major	Major

Organization	Connecticut		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60064						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$5,756	$4,563	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	$10,085	$4,563	Moderate	Major	Major

Organization	Maryland		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60216						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$11,447	$9,075	Major	Major	Minor

Organization	New Jersey		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60295						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$8,720	$6,913	Major	Major	Minor

Organization	Rhode Island		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60375						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$1,253	$993	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	$2,196	$993	Moderate	Major	Major

Organization	Guam		Elevation data are needed for agroforestry research. Elevation data in conjunction with multi-spectral imagery can be used to identify pockets of past agroforest systems and perhaps help site future agroforests. Farm pond design. Irrigation system design. Detailed site analysis. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60095						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$2,420	$1,920	Major	Major	Minor

Organization	U.S. Virgin Islands		Inland bathymetry is needed for small retention ponds. Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60453						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL4B	4-5 yrs.	$271	$122	Moderate	Major	Major

Organization	Wisconsin		Conservation Best Management Practice planning and design, EPA 9-Key Element Watershed Planning, Provide and serve elevation data to our residents, Support ongoing federal agency modeling efforts within our region, flood inundation modeling, basemap representations, economic/residential development				
MCA Name	MCA No.						
Outagamie County Conservation Planning and Design	1445						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Major	Major	Major

Organization	Ohio		Runoff, and sedimentation analyses, Non-point source pollution, precision agriculture, conservation engineering, Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management,				
MCA Name	MCA No.						
Agricultural Conservation	22225						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	Major	Moderate	Minor	Moderate	Minor

Organization	Maine		Agriculture and Precision Farming. With LiDAR, accurate drainage systems at large-scale can be mapped to help farmers manage drainage and flooding and deal with soil erosion issues.				
MCA Name	MCA No.						
Agriculture and Precision Farming	50003						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Major	Major	don't know

Organization	Washington		Farm pond design. Irrigation system design. Detailed site analysis to support precision farming. Analysis of farm sedimentation and runoff. Calibration of fertilizer application, fertilizer management, and irrigation planning. Optimized terraforming.				
MCA Name	MCA No.						
Agriculture and Precision Farming	60513						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Major	Major	Minor
Inland Bathy	QL4B	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	FSA		Delineate and identify crops and other areas involved with agency programs.				
MCA Name	MCA No.						
NAIP Imagery for Agricultural Programs	1193						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL5	2-3 yrs.	Moderate	Moderate	don't know	Moderate	Moderate
Inland Topo	QL3	2-3 yrs.	Moderate	Moderate	don't know	Moderate	Moderate

BU 09 - Fisheries Management and Aquaculture

BU 09 Scope

Business Use #9 (BU 09) includes management of fisheries and sustainable aquaculture. NOAA is the primary federal champion for fisheries and aquaculture management.

BU 09 Background Information

NOAA Fisheries is responsible for managing marine fisheries within the U.S. exclusive economic zone, the 4.4-million-square-mile zone that extends from three to 200 nautical miles off the coast of the U.S. Individual states are responsible for fishery management from their coastline out to three miles. NOAA manages fisheries to sustain, protect, and increase domestic seafood supply; maintain and enhance recreational and subsistence fishing opportunities; protect ecosystem health and sustainability; and create jobs, support related economic and social benefits, and sustain community resilience. NOAA works closely with eight regional fishery management councils responsible for the fisheries in their region; council members represent commercial and recreational fishing as well as environmental, academic, and government interests.

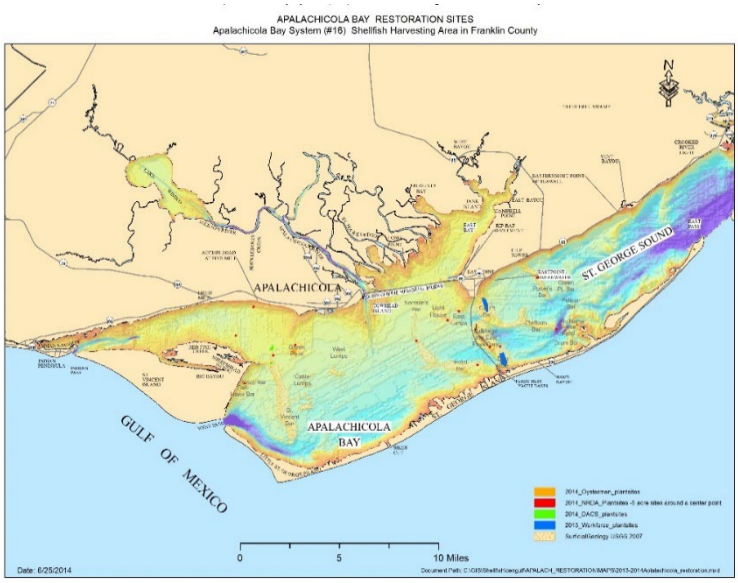

Figure E.9a. Topobathymetric lidar is used to map water depths for oyster beds and other aquaculture features in Apalachicola Bay. Image courtesy of the Florida Department of Agriculture and Consumer Services, Division of Aquaculture.

NOAA is also responsible for management of aquaculture -- the breeding, rearing, and harvesting of fish, shellfish, plants, algae, and other organisms in all types of water environments. Aquaculture is a method used to produce food and other commercial products, restore habitat and replenish wild stocks, and rebuild populations of threatened and endangered species. There are two main types of aquaculture – marine and freshwater.

- NOAA efforts primarily focus on marine aquaculture, which refers to farming species that live in the ocean, to include oysters, clams, mussels, shrimp, seaweeds, and fish such as salmon and black sea bass. There are many ways to farm marine shellfish, including "seeding" small shellfish on the seafloor or by growing them in sinking or floating cages. Marine fish farming is typically done in net pens in the water or in tanks on land.
- U.S. freshwater aquaculture produces species such as catfish and trout. Freshwater aquaculture primarily takes place in ponds or other manmade systems.

Aquaculture also includes the restoration of coral and oyster reefs impacted by climate change. Both coral reefs and oyster reefs are essential to healthy coasts and vibrant economies. Healthy coral reefs absorb 97 percent of a wave's energy, which buffers shorelines from currents, waves, and storms, helping to prevent loss of life and property damage; coastlines protected by coral reefs are also more stable in terms of erosion than those without. Similarly, oyster reefs are the ecosystem engineers of bays and estuaries; they provide important services to people and nature by: (1) cleaning water (a single oyster can filter as much as 50 gallons per day) by extracting organic and inorganic particles; (2) providing food and habitat for a diversity of plants and animals; and (3) serving as natural coastal buffers from boat wakes,

sea-level rise, and storms. NOAA estimates that over 85 percent of oyster reefs are gone, making it the most threatened marine habitat in the world. This has spawned a need for oyster restoration projects (see example at Figure E.9a) in order to revitalize the depleted natural resource of the oyster population. The first step in oyster reef restoration is to determine the locations for potential reefs for which water depths and tidal ranges are among factors to be considered.

BU 09 Elevation Data Uses

Using their own words, respondents documented 43 Mission Critical Activities (MCAs) that identified BU 09 as their primary Business Use and identified the following 37 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.9a. BU 09 Elevation Data Uses

Data Use
Environmental Protection
1. Maintaining and improving local water quality by identifying installed farm potential to contribute to plastic pollution, minimizing those risks, and addressing any occurrences
Fisheries and Aquaculture
2. Design improved spatial fishery management measures including closure and gear restrictions for better conservation of fishery stocks
3. Fishery stock assessments and fisheries management
4. Identification of areas suitable for development of offshore aquaculture
5. Improve understanding of seafloor features for confidence in fisheries management
6. Management of Lake Erie fisheries resources for benefit of residents and tourists
7. Shellfish production for recreational and commercial uses
8. Sustainable aquaculture of native species of the state
9. Sustainable aquaculture using best management practices
Habitat Analysis and Management
10. Analysis of winter flounder spawning habitats, beach fill, dredging, eelgrass and offshore wind
11. Benthic habitat rugosity assessment for coastal barriers and resilience
12. Exploration, description, and modeling of marine fisheries habitats in support of sustainable fisheries
13. Fish habitat identification, management, and improvement
14. Habitat restoration following dam removal
15. Information on existing habitat features and conditions that support species recovery under a Habitat Conservation Plan
16. Manage, protect, and enhance state marine fishery resources and habitat
Mapping/Boundary Delineation
17. Bottom contour mapping
18. Coastal zone soil survey mapping for fisheries management and aquaculture
19. GIS support for infrastructure management, vegetation inventory, and assessment
20. Lake volume determination for aquaculture and fishing support
21. Mapping of geomorphic, biologic and physical changes during and after dam removal
22. Mapping of marine habitats for use in Fisheries Science
23. Submerged aquatic vegetation mapping
24. Volumetric analysis of interior lakes

Data Use
Modeling
25. Mapping, modeling, and engineering for regulatory understanding and permitting for aquaculture
26. Modeling and monitoring habitat extent and quality; manage impacts to and productivity of these habitats
Natural Resources Conservation
27. Fish and wildlife conservation and protection
28. Manage coastal ecosystems
29. Management and enhancement of shellfish population for environmental benefits
30. Marine fisheries conservation
Permitting
31. Marine aquaculture permitting and development
Recreation
32. Provide sustainable fishing, hunting and other wildlife-related recreational and commercial experiences
33. Water information to anglers
Water Supply and Delivery
34. Evaluate current water supply capacities
35. Water supply, planning and studies to coordinate and assure adequate and reliable supplies of clean water are available when needed
Wildlife Management
36. Elevation changes for healthy river and salmon populations
37. Protection and management of aquatic resources of freshwater streams and public lakes

BU 09 Tangible and Intangible Benefits

For the 43 MCAs that list Fisheries Management and Aquaculture as their primary Business Use:

- **Table E.9b** summarizes the reported future annual dollar benefits by geography type, totaling $38.96 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.9c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.9e.
- **Table E.9d** shows (in blue) the four federal agencies, 34 states and territories, and three non-governmental entities that submitted MCAs with BU 09 as the primary Business Use. MCAs for which BU 09 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.9d.
- **Table E.9e** documents all the MCAs that listed BU 09 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.9e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 09 Reported Future Annual Dollar Benefits

Of the 43 MCAs that listed Fisheries Management and Aquaculture as their primary Business Use, 35 MCAs estimated their tangible annual benefits totally in financial terms; three MCAs had a combination

of tangible and "Major" intangible benefits; and four MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.9b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 43 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.9b. BU 09 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$3,520,000	$5,162,331	$8,682,331
Inland Bathymetry	$6,866,622	$3,109,039	$9,975,661
Nearshore Bathymetry	$18,282,936	$1,785,929	$20,068,865
Offshore Bathymetry	$180,918	$54,275	$235,193
Totals	**$28,850,476**	**$10,111,574**	**$38,962,050**

BU 09 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.9c. BU 09 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	22	21	1	4	1
Inland Bathymetry	29	29	26	28	1
Nearshore Bathymetry	31	27	1	27	1
Offshore Bathymetry	5	4	1	5	1
Totals	**87**	**81**	**29**	**64**	**4**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 09 Reported Future Annual Dollar Benefits Maps

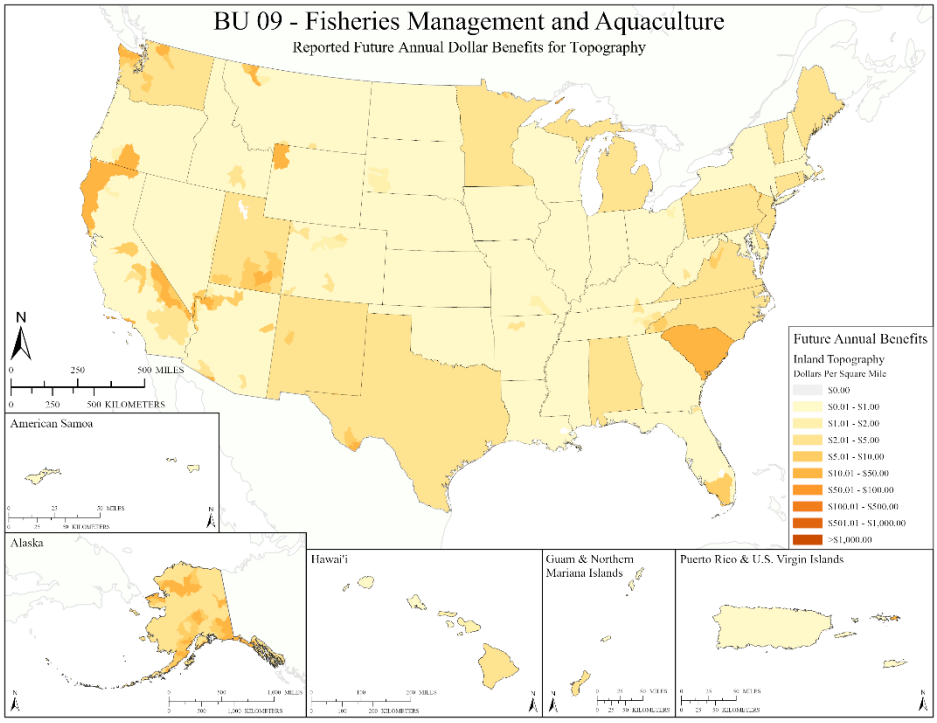

Figure E.9b. Reported Future Annual Dollar Benefits for Topography

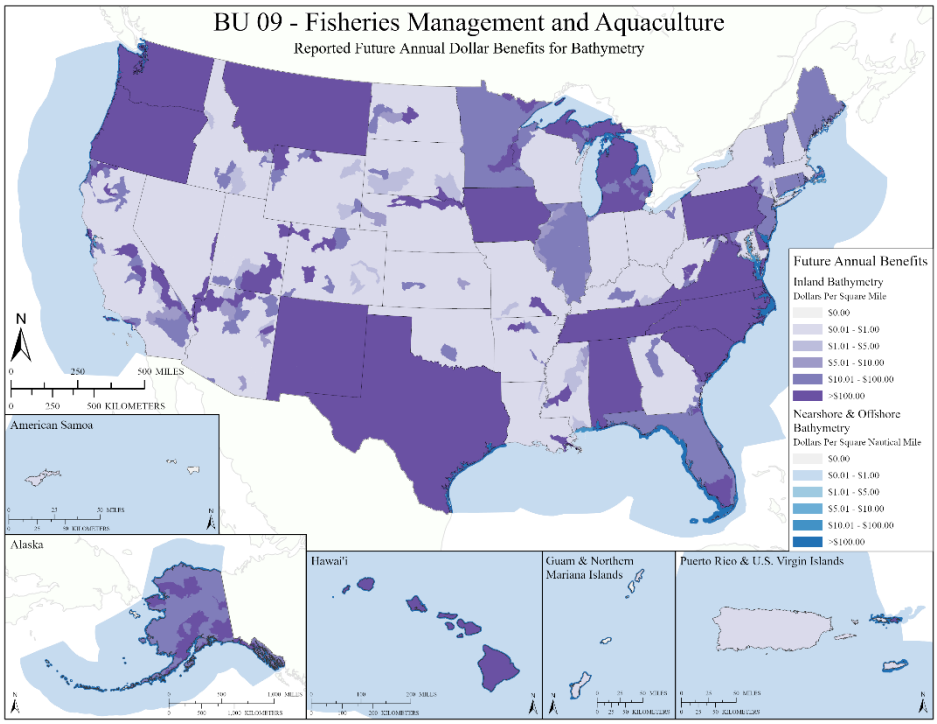

Figure E.9c. Reported Future Annual Dollar Benefits for Bathymetry

BU 09 Benefits Analysis

The total combined future annual benefits ($38.96 million per year) reported for BU 09 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe the BU 09 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in this study, four federal agencies (NOAA, NPS, NRCS, and SI) submitted four MCAs listing BU 09 as their primary business use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the four total federal MCAs listing BU 09 as primary:
    - Inland Topography: Two provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: Two provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: Three provided dollar benefits and one indicated "Major" benefits.
    - Offshore Bathymetry: Two provided dollar benefits and none indicated "Major" benefits.
    - The dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.
    - Two federal agencies (BLM and USGS) submitted MCAs with BU 09 as secondary, and one federal agency (FWS) submitted an MCA with BU 09 as tertiary – meaning that no benefits accrued to BU 09.
- State/Local/Tribal and U.S. Territory MCAs: Thirty-four (34) states and territories submitted a total of 36 MCAs listing B09 as their primary BU. Of the 36 State MCAs listing BU 09 as primary:
    - Inland Topography: 20 provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: 25 provided dollar benefits and two indicated "Major" benefits.
    - Nearshore Bathymetry: 24 provided dollar benefits and two indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits but two indicated "Major" benefits.
- The Louisiana State University's AgCenter indicates that Louisiana is a state leader in aquaculture (shrimp, oysters, soft-shall blue crabs, crawfish, catfish, and tilapia, for example); and Louisiana's aquaculture industry includes more than 2,000 diverse operations throughout the state with potential for significant increases; yet Louisiana submitted an MCA that listed BU 09 as tertiary. Similarly, Mississippi submitted an MCA that listed BU 09 as secondary, even though aquaculture in an important commodity for the state (farm raised catfish), and Mississippi's aquaculture is ranked first in the U.S. with over $230 million in annual sales. Thus, no benefits accrued to BU 09 from either Louisiana or Mississippi – two of the top aquaculture states in the U.S.
- Non-governmental MCAs: Three non-governmental entities (Cooke Aquaculture, New England Fishery Management Council, and Taylor Shellfish Farms) submitted a total of three MCAs listing BU 09 as their primary BU.
    - Inland Topography and Inland Bathymetry: No non-governmental MCAs included requirements for either inland topography or inland bathymetry.

- Nearshore Bathymetry: One MCA provided dollar benefits and two indicated "Major" benefits.
- Offshore Bathymetry: No MCA provided dollar benefits and two indicated "Major" benefits.

- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.9b and E.9c:
  - 168 "Major" Operational and Customer Service benefits and 97 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 09 for which "Major" benefits are documented, this could easily be translated into hundreds of thousands of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.
  - There are over 4,000 fish and seafood aquaculture businesses in the U.S.; only a small percentage of aquaculture firms participated in the survey for the 3D Nation Study, and they mostly indicated "Major" benefits rather than dollar benefits.

BU 09 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 09:

- **Table E.9d** color-codes those organizations having an MCA with BU 09 as Primary, Secondary, or Tertiary.
- **Table E.9e** summarizes the 43 MCAs with primary benefits for BU 09, rank ordered from the highest to the lowest tangible benefits.

Table E.9d. Organizations having an MCA with BU 09 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	*BLM*	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	**NOAA**	**NPS**	NRC	**NRCS**	NREL
	ORNL	OSMRE	PHMSA	**SI**	TVA	USACE	USAF	USARC	USBR	USCB
	USCG	USFS	*USGS*	USMC	USN					

State/Ter	**AL**	**AK**	*AR*	*AZ*	**CA**	CO	**CT**	DC	**DE**	**FL**	GA	**HI**	**IA**	*ID*
	IL	*IN*	KS	KY	LA	**MA**	**MD**	**ME**	**MI**	MO	**MN**	*MS*	**MT**	**NC**
	ND	*NE*	NH	**NJ**	**NM**	NV	NY	**OH**	OK	**OR**	**PA**	**RI**	**SC**	SD
	TN	**TX**	**UT**	**VA**	**VT**	**WA**	**WI**	WV	WY	PR	**VI**	**GU**	**AS**	**CNMI**

Non-Gov	**Cooke Aquaculture**	**New England Fishery Management Council**	**Taylor Shellfish Farms**	

Table E.9e. MCA summaries for BU 09, rank ordered from the highest to the lowest tangible benefits.

Organization	NPS		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60703						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,280,630	$1,390,816	Moderate	Major	Moderate
Inland Bathy	QL2B	6-10 yrs.	$2,506,776	$1,140,933	Major	Major	Moderate
Nearshore B.	QL1B	4-5 yrs.	$5,971,069	$875,873	Moderate	Major	Minor

Organization	Alaska		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60010						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$597,110	$1,296,971	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$1,168,810	$531,972	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$6,336,771	$465,386	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Texas		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60441						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$270,589	$587,742	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$529,663	$241,071	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$624,160	$45,839	Moderate	Major	Minor

Organization	Florida		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60082						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	6-10 yrs.	$112,281	$51,103	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$1,986,254	$145,874	Moderate	Major	Minor

Organization	California		Elevation data are needed for construction and restoration design on the Trinity River and Klamath River. USACE will collect bathymetry and USGS will collect lidar prior to the 2021 dam removals on the Klamath River (four dams in sequence will be removed). The bathymetry will be multi-beam for the Klamath River. 2D hydraulic modeling will be performed of baseline conditions and geomorphic, biologic, and physical changes during and after dam removal. The goal is to understand the impacts of dam removal over the long term, better understand the river response to the dam removals. Subsequent 3DEP data will be important to seeing the river response and to inform future projects and scientific studies. Long term topo and bathy collections out into the future will be desired to evaluate changes over time. A healthy river and salmon population is the end goal. BU 02 – Riverine Ecosystem Management is a Business Use.					
MCA Name	MCA No.						
Riverine Ecosystem Management	21933						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$280,226	$351,683	Major	Major	Moderate
Inland Bathy	QL2B	2-3 yrs.	$585,628	$270,852	Major	Major	Moderate
Nearshore B.	QL2B	2-3 yrs.	$127,839	$9,045	don't know	don't know	don't know
Offshore B.	Order 1	2-3 yrs.	None	None	None	None	don't know

Organization	North Carolina		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60323						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$50,463	$109,610	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$98,779	$44,958	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$674,293	$49,521	Moderate	Major	Minor
Offshore B.	I don't know	4-5 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Michigan		GIS support for infrastructure management, vegetation inventory and assessment, and forest fire management. Elevation data are needed for wetland determination, land cover mapping, and contours serve many GIS uses.				
MCA Name	MCA No.						
GIS Support for Infrastructure Management, Vegetation Inventory and Assessment, and Forest Fire Management	1465						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$59,374	$128,967	don't know	don't know	don't know
Inland Bathy	QL2B	>10 yrs.	$116,223	$52,897	Major	Major	Moderate
Nearshore B.	QL2B	>10 yrs.	$580,845	$42,658	don't know	don't know	don't know
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	South Carolina		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60401						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$416,700	$70,000	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$95,100	$23,771	Major	Major	Moderate
Nearshore B.	QL1B	6-10 yrs.	$190,267	$13,973	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	New Mexico		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60309						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$124,289	$269,967	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$243,290	$110,731	Major	Major	Moderate

Organization	Washington		Washington Department of Fish and Wildlife (WDFW) has a wide range of mission critical activities. We: Conserve and protect native fish and wildlife. Provide sustainable fishing, hunting, and other wildlife-related recreational and commercial experiences. Promote a healthy economy, protect community character, maintain an overall high quality of life, and deliver high-quality customer service. WDFW has a broad mission that covers the state's lands, rivers and waterbodies, and nearshore and offshore areas plus the areas outside the state that are have an influence on animals and their habitats.				
MCA Name	MCA No.						
Fish and Wildlife Conservation and Protection	21551						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$69,057	$149,998	don't know	Moderate	Moderate
Inland Bathy	QL1B	6-10 yrs.	$135,176	$61,524	don't know	Major	don't know
Nearshore B.	QL0B	Depends on variables	$240,645	$17,673	Major	Major	don't know
Offshore B.	Special Order	Depends on variables.	Major	Major	Major	Major	Major

Organization	Virginia		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60497						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$41,277	$89,658	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$80,798	$36,774	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$307,075	$22,552	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Minnesota		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60608						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$86,250	$187,343	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$168,830	$76,841	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$8,538	$627	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Alabama		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60004						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$52,803	$114,694	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$103,360	$47,043	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$121,460	$8,920	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Delaware		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60076						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$2,015	$4,377	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$3,944	$1,795	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$396,537	$29,122	Moderate	Major	Minor

Organization	Montana		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60258						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	6-10 yrs.	$294,211	$133,907	Major	Major	Moderate

Organization	Maine		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60207						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$33,128	$71,957	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$64,846	$29,514	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$138,756	$10,190	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Oregon		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60354						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	6-10 yrs.	$194,176	$88,377	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$42,329	$3,108	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Pennsylvania		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60362						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$46,306	$100,580	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$90,641	$41,254	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$11,540	$847	Moderate	Major	Minor

Organization	Utah		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60468						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$85,444	$185,593	Moderate	Moderate	Moderate

Organization	NOAA		Fisheries management and aquaculture. Fish habitat assessment in rivers, estuaries and the ocean. Mapping of marine habitats for use in Fisheries Science. Exploration, description, and modeling of marine fisheries habitats in support of sustainable fisheries, fishery stock assessments and fisheries management.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	21566						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	Annually	Major	Major	Moderate	Major	Moderate
Offshore B.	Special Order	>10 yrs.	$180,900	$54,270	Moderate	Major	None

Organization	Iowa		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60174						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	6-10 yrs.	$112,595	$51,246	Major	Major	Moderate

Organization	New Jersey		Manage, protect and enhance state marine fishery resource and habitat.				
MCA Name	MCA No.						
Marine Fisheries Conservation	21734						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	Depends on variables	$118,298	$8,688	don't know	don't know	Minor
Offshore B.	Special Order	Event driven	don't know	Minor	don't know	don't know	Minor

Organization	Tennessee		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60428						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	6-10 yrs.	$84,322	$38,378	Major	Major	Moderate

Organization	Taylor Shellfish Farms		Sustainable aquaculture using best management practices. Maintaining and improving local water quality by identifying installed farm potential to contribute to plastic pollution, minimizing those risks, and addressing any occurrences. Bathymetric data also provide information regarding existing habitat features and conditions that supports species recovery under a Habitat Conservation Plan,				
MCA Name	MCA No.						
Sustainable Aquaculture	32774						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	4-5 yrs.	$102,412	Minor	Moderate	Moderate	None

Organization	Hawai'i		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60116						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	6-10 yrs.	$12,875	$5,859	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$68,390	$5,022	Moderate	Major	Minor

Organization	Guam		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60096						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$214	$465	Moderate	Moderate	Moderate
Nearshore B.	QL0B	6-10 yrs.	$68,390	$5,022	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Connecticut		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60065						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$5,082	$11,039	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$9,948	$4,527	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$39,494	$2,900	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Vermont		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60483						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$9,827	$21,346	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$19,236	$8,755	Major	Major	Moderate

Organization	New Jersey		Freshwater Fisheries Management - protection and management of the aquatic resources in the State's 26,000 miles of freshwater streams and over 400 public lakes.				
MCA Name	MCA No.						
Freshwater Fisheries Management	21701						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Event driven	$7,742	$16,722	None	Moderate	None
Inland Bathy	QL0B	Event driven	$15,070	$6,859	Moderate	Moderate	Moderate

Organization	New Jersey		Management and enhancement of shellfish population for environmental benefits as well as shellfish production for recreational and commercial users. This is to include sustainable aquaculture of native species of the state.				
MCA Name	MCA No.						
Shellfisheries Management	21721						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL1B	2-3 yrs.	$39,950	$2,934	Moderate	Moderate	Minor

Organization	Rhode Island		Management of fisheries. Sustainable aquaculture. Shellfish. Submerged aquatic vegetation mapping.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60376						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$1,106	$2,404	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$2,166	$986	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	$28,444	$2,088	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Maryland		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60217						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	6-10 yrs.	$27,600	$2,027	Moderate	Major	Minor

Organization	Illinois		Volumetric analysis of interior lakes. The OWR Water Supply and Planning is involved in studies and coordination to assure that adequate and reliable supplies of clean water are available where needed. Part of this involves evaluating current water supply capacities. Therefore, volumes of water supply lakes are evaluated using bathymetry. OWR also supports other parts of IDNR that need lake volume data for aquaculture and fishing support. The same bathymetry analysis is used for some non-water-supply lakes to satisfy these needs. Bottom contour maps are also produced from the bathymetry data.				
MCA Name	MCA No.						
Volumetric Analysis of Interior Lakes	21666						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	>10 yrs.	$17,159	$6,784	None	None	None

Organization	U.S. Virgin Islands		Bathymetry is needed for possible benthic habitat rugosity assessment for coastal barrier and resilience. Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60454						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	6-10 yrs.	$18,670	$1,371	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Massachusetts		Identification and delineation of marine fish habitats for the purpose of modeling and monitoring habitat extent and quality to more effectively manage impacts to and productivity of those habitats. Elevation data are needed to manage coastal ecosystems along that entire coast with a focus on Massachusetts. We have projects related to beach fill, winter flounder spawning habitats and dredging, eelgrass, and offshore wind.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	21750						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	6-10 yrs.	Major	$14,472	Moderate	Major	Minor
Offshore B.	Order 1	6-10 yrs.	don't know	don't know	Moderate	Major	Minor

Organization	NRCS		Fisheries Management and Aquaculture and Coastal Zone Management. The Soil Science Division (SSD) produces and maintains Coastal Zone Soil Survey maps containing high resolution (<= 1:12,000 mapping scale) soil spatial and tabular data. SSD also provides data interfaces containing interpretation reports that process said data into plain language interpretations targeted at coastal managers including aquaculture producers and coastal zone managers. An additional Business Use for this MCA is BU 08 – Agriculture and Precision Farming.				
MCA Name	MCA No.						
Coastal Zone Soil Survey Mapping	11474						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Moderate	Major	don't know
Inland Bathy	QL3B	>10 yrs.	Major	Major	Moderate	Major	don't know
Nearshore B.	QL3B	4-5 yrs.	$10,824	Major	Moderate	Major	don't know

Organization	SI		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60675						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$368	$399	Moderate	Major	Moderate
Inland Bathy	QL2B	6-10 yrs.	$720	$328	Major	Major	Moderate
Nearshore B.	QL1B	4-5 yrs.	$598	$88	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	$18	$5	Moderate	Major	Minor

Organization	Northern Mariana Islands		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60339						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	6-10 yrs.	$1,488	$109	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Wisconsin		Bathymetry data for fish habitat identification, management, and improvement. Interest from our staff and from customers regarding depth data/maps and using sonar for submerged vegetation. Bathymetry for fisheries would help to more effectively manage fish habitat and ecology (on specific projects such as pesticide application, tree removal, habitat rehab, etc.) as well as provide more information for anglers about our waters.				
MCA Name	MCA No.						
Fisheries Management	21497						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	X-Sec meet needs	>10 yrs.	Major	Major	Major	Major	Minor

Organization	Cooke Aquaculture		Marine aquaculture permitting and development. Our interest is in developing the growth of U.S. aquaculture. The U.S. is a net importer of seafood products and is losing a huge opportunity to increase domestic seafood production and the creation of thousands of jobs by relying on importing seafood for domestic consumption. It is possible that having this information readily available to the public could spark more understanding of the coastal environment and that there are unique areas that could be suitable for the development of offshore aquaculture. Private industry could use these maps to identify potential areas and the mapping would help with modeling, engineering, regulatory understanding and the permitting work to accomplish a project.				
MCA Name	MCA No.						
Marine Aquaculture Permitting and Development	32761						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL4B	4-5 yrs.	Major	Moderate	Moderate	Moderate	Moderate
Offshore B.	Order 1	4-5 yrs.	Major	Moderate	Moderate	Moderate	Moderate

Organization	New England Fishery Management Council		Management of fisheries. Sustainable aquaculture. Bathymetric data can be used to design improved spatial fishery management measures, and these closures and gear restrictions in combination with many other measures lead to better conservation of fishery stocks. Also, a clearer understanding of seafloor features leads to more confidence in the management process.				
MCA Name	MCA No.						
Fishery Management	51002						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL1B	4-5 yrs.	Major	Major	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Major	Major	Moderate	Major	Minor

Organization	American Samoa		Management of fisheries. Sustainable aquaculture.				
MCA Name	MCA No.						
Fisheries Management and Aquaculture	60027						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	Major	Major	Major	Major	Moderate
Nearshore B.	QL0B	6-10 yrs.	Major	Major	Moderate	Major	Minor
Offshore B.	Special Order	6-10 yrs.	Minor	Minor	Moderate	Moderate	Minor

Organization	Ohio		Managing Lake Erie's fisheries resources for the benefit of all Ohio's residents and tourists.				
MCA Name	MCA No.						
Lake Erie Fisheries Management	32882						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL1B	>10 yrs.	Minor	Minor	Minor	None	None
Offshore B.	Order 2	>10 yrs.	Minor	Minor	Minor	None	None

BU 10 - Geologic Assessment and Hazard Mitigation

BU 10 Scope

Business Use #10 (BU 10) includes geologic mapping and analysis; sinkhole and steephead mapping, monitoring, and analysis; identification of geomorphologic units; landslide hazard mapping and assessment; karst mapping, including springs and caves; and aquifer recharge. USGS is the primary federal champion for this Business Use.

BU 10 Background Information

High-resolution lidar is now the technology of choice for mapping geology and morphology. In explaining how geologic maps are produced, largely from knowledge of slopes and outcrops, a brochure from the Pennsylvania Geologic Survey states: "Lidar data provides a wealth of information not discernible on photography of even in the field." The same is true for seismic fault detection. The discovery of over a dozen new faults in western Washington through the use of lidar (see Figure E.10a) identified surface ruptures from past earthquakes previously hidden from view by thick vegetation. Lidar is also widely used for mapping of landslide hazards nationwide. Lidar maps alluvial fans as well as sheet flows, channel flows, and debris flows. Lidar profiles are routinely used to map concave and convex morphology. Both lidar and IfSAR are used for mapping of active volcanoes in the U.S.

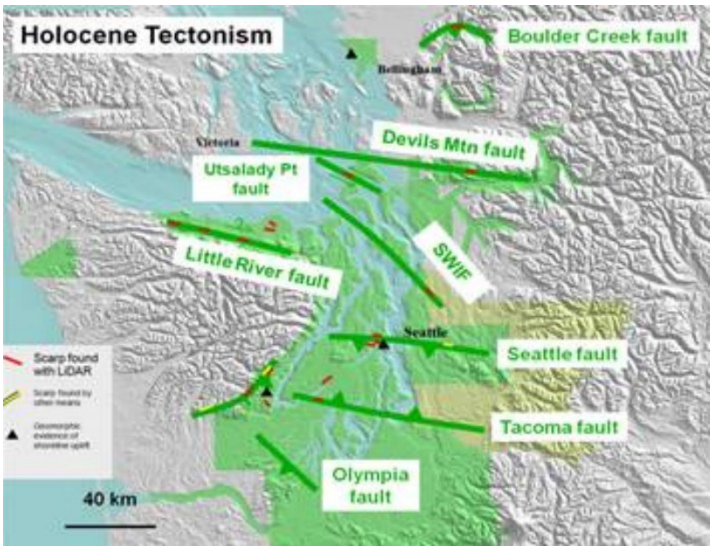

Figure E.10a. Lidar has revolutionized geologic science worldwide, by mapping geologic formations and seismic faults not detected from imagery or field surveys, including these faults near Seattle, WA. Lidar has also detected previously unknown earthquake faults near a $12 billion nuclear waste treatment plant and a $735 million suspension bridge under construction across the Tacoma Narrows, both in Washington. Image courtesy of USGS.

BU 10 Elevation Data Uses

Using their own words, respondents documented 61 Mission Critical Activities (MCAs) that identified BU 10 as their primary Business Use and identified the following 87 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.10a.. BU 10 Elevation Data Uses

Data Use
Climate Change Analysis
1. Hydrocarbon resources
Environmental Protection
2. Abandoned Mine Lands identification and clean up
3. Superfund monitoring
Erosion/Sediment Control
4. Erosion control
Geology

Data Use
5. Analyze geological and natural resources including bedrock geologic mapping, surficial geologic mapping, coal, oil and gas, building stone, ground and surface water
6. Coastal geomorphology and resource mapping and studies
7. Construct geologic histories and establish geologic frameworks
8. Delineation of geologic hazard areas, river terraces, ancient river courses, bedrock
9. Geomorphic interpretation and measurement for landslide mapping
10. Identification of tectonic geomorphologic features
11. Provide geological data to industry, governmental agencies, and the public about geology and mineral resources
12. Research and report on mineral and energy resources, engineering geology, environmental geology, hydrogeology
13. Utilization of geological resources for social and economic benefits
Groundwater Management
14. Assessment of groundwater availability, quantity and quality
15. Comprehensive aquifer management planning
16. Define and describe aquifer bearing formations and structures that partition groundwater resources
17. Groundwater resources studies
18. Manage overall demand for water within aquifers; increase recharge to the aquifer
Habitat Analysis and Management
19. Submerged habitats for mineral resources, waste disposal, cable and pipeline routes, and renewable energy resources
Hazard Assessment and Mitigation
20. Abandoned Mine Lands reclamation and mine safety; mine subsidence insurance
21. Earthquake hazard assessment and mitigation
22. Geologic hazard and active geologic process technical assistance
23. Geologic hazards analysis and mapping (landslide, earthquake, flooding, erosion, active faulting)
24. Geologic mapping, resource assessment, and hazard mitigation
25. Identification of nearshore and inland geohazards, slope failure, potential sink holes
26. Increase preparedness and resilience of built infrastructure, bridges, highways, and slopes to recover from expected earthquakes and ensuing tsunami
27. Landslide risk identification and mitigation
28. Modeling of debris flow hazards downstream of burn areas
29. Perform and evaluate probabilistic seismic hazard analyses for siting of new nuclear facilities and risk informed regulation of existing facilities
30. Post-fire analysis to determine landslide-prone areas
31. Seismic hazard mapping and analysis (liquefaction, earthquake-induced landslides)
32. Tsunami risk identification, mapping, preparedness, and mitigation
33. Volcano hazard assessment and mitigation
Infrastructure Management
34. Permafrost research for highway maintenance
Mapping/Boundary Delineation
35. Abandoned Mine Lands (AML) inventory

Data Use
36. Bedrock and surficial geologic mapping
37. Characterize water resources, geology, environmental protection, and energy and mineral resources
38. Coastal mapping of geological features and seafloor feature extraction
39. Develop site descriptions, perform change detection and site characterization for active mines
40. Fault mapping
41. Find fissures
42. Fluvial process mapping and analysis
43. Geologic mapping and classification of seabed geologic substrates for use by managers of ocean development
44. Geologic mapping of formations and structures that represent geologic history
45. Geologic resources mapping and studies
46. Geological research and mapping for oil and gas
47. Glacial deposit mapping, coastal erosion, karst mapping (including springs and caves), surface mapping, educational outreach
48. Identification of active alluvial surfaces and faults
49. Identification of geomorphologic units
50. Identify fault locations and estimate age by offset
51. Landslide and rockfall mapping, monitoring and analysis
52. Locate faults and site seismometers
53. Locate geological formations, plan field work, locate landslides, debris flows
54. Locate historic mine sites
55. Location and identification of sinkhole lakes and swallets
56. Map areas of accretion/retreat, nearshore substrate change, and sediment movement
57. Mapping geology and industrial minerals
58. Mapping of geologic and glacial features, eskers, drumlins, ice walled lake plains and deltas
59. Mapping of geologic resources and geologic hazards
60. Mapping of glacial materials and glacial processes that formed the surface
61. Mapping of mineral resources and geologic hazards
62. Mapping of subsurface resources
63. Mapping the distribution of consolidated and unconsolidated geological materials
64. Mapping the impacts of removing resources
65. Mineral resource identification, and groundwater resource mapping and modeling
66. Seafloor mapping and mapping of marine geohazards
67. Tsunami inundation zone mapping
68. Update the Mineral Information Layer for Oregon (MILO) to show occurrences, prospects and mine locations
Mining
69. Geologic resource mining and extraction
70. Identify likelihood of existence of rare earth minerals based on landforms
71. Mining and oil and gas resource consulting on land and offshore
72. Onshore or offshore mineral extraction
73. Resource development (mining, oil, gas, coal, gravel)
Modeling

Data Use
74. Baseline coastal resource mapping, modeling, assessment and analysis
75. Enhanced ground terrain modeling
76. Geologic mapping, modeling, and analysis
77. Liquefaction zone modeling
78. Surface and sub-surface hydrology
79. Tsunami modeling
Permitting
80. Mine permitting and compliance operations
Planning
81. Infrastructure siting
82. Off-coast marine planning and decision making
Regulatory Reviews and Enforcement
83. Oil and Gas Board regulatory requirements for oil and gas extraction
Research
84. Basic and applied research in geology and geologic mapping
85. Geospatial research, education, and disaster response and recovery
86. Scientific research on landscape evolution
Sea Level Rise/Subsidence
87. Subsidence monitoring

BU 10 Tangible and Intangible Benefits

For the 61 MCAs that list Geologic Assessment and Hazard Mitigation as their primary Business Use:

- **Table E.10b** summarizes the reported future annual dollar benefits by geography type, totaling $873.4 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.10c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.10e.
- **Table E.10d** shows (in blue) the five federal agencies and 41 states and territories that submitted MCAs with BU 10 (Geologic Assessment and Hazard Mitigation) as the primary Business Use. MCAs for which BU 10 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.10d.
- **Table E.10e** documents all the MCAs that listed BU 10 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.10e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 10 Reported Future Annual Dollar Benefits

Of the 61 MCAs that listed Geologic Assessment and Hazard Mitigation as their primary Business Use, 42 MCAs estimated their tangible annual benefits totally in financial terms; 11 MCAs had a combination of tangible and "Major" intangible benefits; and seven MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.10b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 61 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.10b. BU 10 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$831,371,335	$10,801,309	$842,172,644
Inland Bathymetry	$2,908,117	$2,407,822	$5,315,939
Nearshore Bathymetry	$2,029,515	$2,679,490	$4,709,005
Offshore Bathymetry	$20,960,155	$265,678	$21,225,833
Totals	**$857,269,122**	**$16,154,299**	**$873,423,421**

BU 10 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.10c. BU 10 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	56	51	28	31	51
Inland Bathymetry	20	17	6	6	18
Nearshore Bathymetry	22	19	11	6	17
Offshore Bathymetry	15	11	9	4	11
Totals	**113**	**98**	**54**	**47**	**97**

- The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 10 Reported Future Annual Dollar Benefits Maps

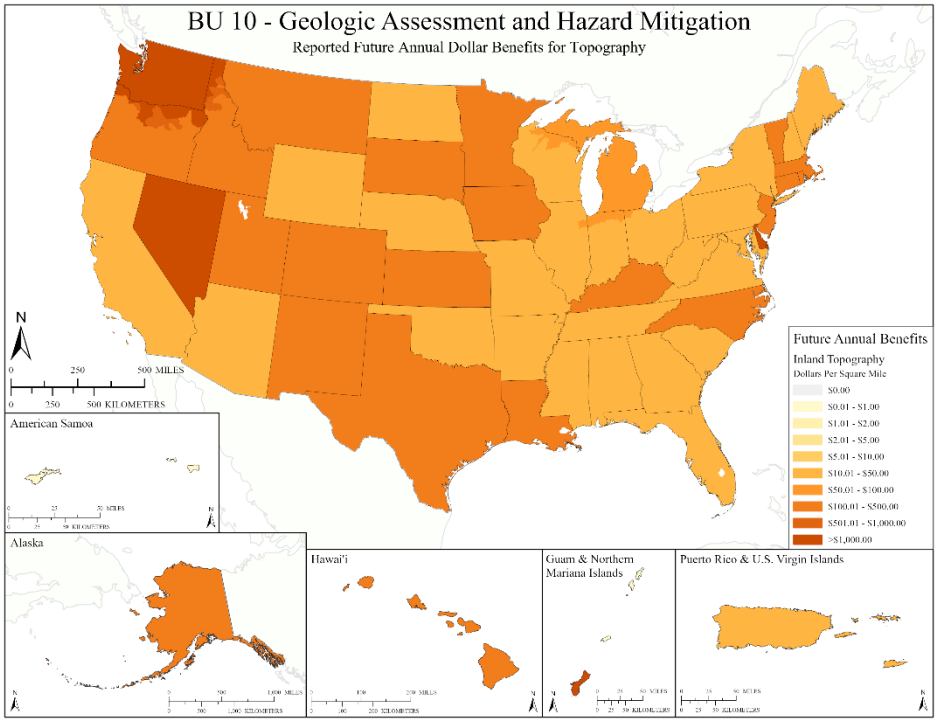

Figure E.10b. Reported Future Annual Dollar Benefits for Topography

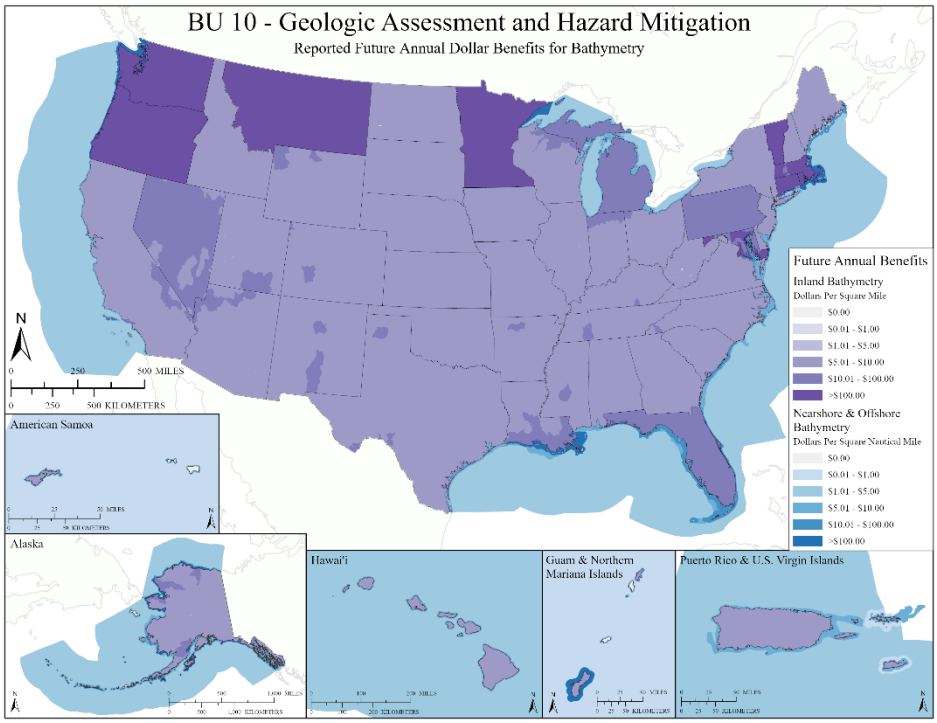

Figure E.10c. Reported Future Annual Dollar Benefits for Bathymetry

BU 10 Benefits Analysis

The total combined future annual benefits ($873.4 million per year) reported for BU 10 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe the BU 10 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, only five federal agencies (CDC, NASA, NPS, NRC and USGS) submitted a total of nine MCAs listing BU 10 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry and offshore bathymetry. Of the nine total federal MCAs listing BU 10 as primary:
    - Inland Topography: Six provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: Three provided dollar benefits two indicated "Major" benefits.
    - Nearshore Bathymetry: Four provided dollar benefits and three indicated "Major" benefits.
    - Offshore Bathymetry: Four provided dollar benefits and none indicated "Major" benefits.
    - One federal agency (BLM) submitted an MCA with BU 10 as secondary, and three federal agencies (DMS, OSMRE and TVA) submitted MCA's with BU 10 as tertiary, meaning no benefits accrued to BU 10.
- State/Local/Tribal and U.S. Territory MCAs: Forty-one (41) states and territories submitted a total of 51 MCAs that designated BU 10 as their primary BU. Of the 51 MCAs listing BU 10 as primary:
    - Inland Topography: 42 provided dollar benefits and eight indicated "Major" benefits.
    - Inland Bathymetry: 18 provided dollar benefits and four indicated "Major" benefits.
    - Nearshore Bathymetry: 17 provided dollar benefits and five indicated "Major" benefits.
    - Offshore Bathymetry: Eight provided dollar benefits and five indicated "Major" benefits.
- Non-governmental MCAs: No non-governmental entities submitted an MCA listing BU 10 as primary; but three (GSI Service Group, Pacific Disaster Center, and TerraSond) submitted MCAs listing BU 10 as secondary, and three (Glorieta Geoscience, Lampl Herbert Consultants, and Oregon State University) submitted MCAs listing BU 10 as tertiary. No dollar benefits accrue from MCAs listing BU 10 as secondary or tertiary.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.10b and E.10c:
    - 211 "Major" Operational and Customer Service benefits and 198 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 10 for which "Major" benefits are documented, this

could easily be translated into millions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

- No input was received from the Society for Mining, Metallurgy & Exploration Inc., the American Geological Institute, the Geological Society of America, or other national organization representing geologists; and many states with known geological programs did not submit MCAs listing BU 10 as primary, secondary or tertiary – meaning many geologists were underrepresented in this study.

BU 10 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 10:

- **Table E.10d** color-codes those organizations having an MCA with BU 10 as Primary, Secondary, or Tertiary.
- **Table E.10e** summarizes the 61 MCAs with primary benefits for BU 10, rank ordered from the highest to the lowest tangible benefits.

Table E.10d. Organizations having an MCA with BU 10 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	*BLM*	BOEM	**CDC**	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	**NASA**	NGA	NOAA	**NPS**	**NRC**	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	USAF	USARC	USBR	USCB
	USCG	USFS	**USGS**	USMC	USN					

State/Ter	**AL**	**AK**	**AR**	**AZ**	**CA**	**CO**	**CT**	DC	**DE**	**FL**	GA	**HI**	**IA**	**ID**
	IL	*IN*	**KS**	**KY**	**LA**	**MA**	**MD**	**ME**	**MI**	MO	**MN**	*MS*	**MT**	**NC**
	ND	NE	NH	**NJ**	**NM**	**NV**	*NY*	**OH**	**OK**	**OR**	**PA**	**RI**	**SC**	**SD**
	TN	**TX**	**UT**	**VA**	**VT**	**WA**	WI	**WV**	**WY**	PR	VI	**GU**	AS	CNMI

Non-Gov	*GSI Service Group, Inc.*	Glorieta Geoscience, Inc.	Lampl Herbert Consultants, Inc.	National Disaster Preparedness Training Center, University of Hawaii
	Oregon State University	*Pacific Disaster Center*	*TerraSond*	

Table E.10e. MCA summaries for BU 10, rank ordered from the highest to the lowest tangible benefits.

Organization	Nevada		Conduct research and publish reports on mineral and energy resources, engineering geology, environmental geology, hydrogeology, and geologic mapping.				
MCA Name	MCA No.						
Geologic Research in Nevada	1190						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Event driven	$200,241,884	$4,522	Major	Major	Major
Inland Bathy	QL2B	Event driven	$1,809	$3,618	Moderate	Moderate	Moderate

Organization	Alaska		Mapping of geologic resources and geologic hazards within the State of Alaska. Elevation data are important to resource development activities (e.g. mining, oil, gas, coal, gravel, etc.), commercial and industrial activities, community development, transportation, geologic hazards analysis (e.g. landslide, earthquake, flooding, erosion, active faulting), and permafrost research for highway maintenance. Elevation data are also needed for mapping the impacts of removing resources, moving infrastructure, long term planning, and tsunami modeling.				
MCA Name	MCA No.						
Mapping of Geologic Resources and Geologic Hazards	1092						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$123,306,248	$2,164,641	don't know	don't know	don't know
Inland Bathy	X-Sec meet needs	6-10 yrs.	$12,020	$13,208	don't know	don't know	don't know
Nearshore B.	QL2B	6-10 yrs.	$658,786	$1,059,961	don't know	don't know	don't know

Organization	Washington		Geological mapping and geologic hazard identification. Tsunami modeling, fault mapping, coastal erosion and flooding. Ecology group collects data, DNR would use data. Shoreline change is tracked annually for local planning using bathymetry and topographic data. The data are needed to map the beach profile and identify areas of accretion/retreat, nearshore substrate change, and sediment movement. BU 26 – Education K12 and Beyond, Basic Research would be an additional Business Use.				
MCA Name	MCA No.						
Geological Mapping and Geologic Hazard Identification	21543						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$110,759,290	$890,450	Major	Major	Major
Inland Bathy	QL2B	>10 yrs.	$94,385	$103,714	Major	Major	Major
Nearshore B.	QL2B	>10 yrs.	$59,098	$95,046	Major	Major	Major
Offshore B.	Special Order	>10 yrs.	$3,385,941	Major	Major	Major	Major

Organization	USGS		The US Geological Survey's Earthquake Hazard Program Mission Critical Activity is earthquake hazard assessment and mitigation.				
MCA Name	MCA No.						
Earthquake	1240						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Event driven	$33,181,083	Major	Moderate	None	Major
Inland Topo	QL2	Event driven	$67,484,433	Major	Moderate	None	Major
Inland Bathy	QL2B	Event driven	Major	Major	Moderate	None	Major
Nearshore B.	QL2B	Event driven	Major	Major	Moderate	Minor	Major
Offshore B.	Order 1b	Event driven	$10,028,944	Major	Minor	None	Major

Organization	Texas		We acquire topographic and bathymetric lidar data for several mission-critical earth science applications, including geologic hazards assessment, geologic mapping, beach and dune monitoring, subsidence monitoring, and storm impact and recovery. Federal data sets give us a good first-pass look at areas we'd like to survey and study in more detail; this works well given the large size of the state, the level of regional coverage, and our much smaller specific study areas.				
MCA Name	MCA No.						
Geologic Mapping, Hazards, and Coastal Monitoring	22390						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$55,878,076	$980,939	Moderate	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Moderate	Minor	Major	Moderate

Organization	Montana		Geological mapping and analysis. Elevation data are used to identify locations of faults and estimate age by offset. Canopy cover hinders current collection of faults from imagery, lidar that penetrates to bare earth is more useful. Faults should be continuous under lakes and through wetlands, hence inland bathy is needed. The data are used to locate geologic formations, plan field work, and locate landslides, debris flows, block slides, etc. Approximately 90% of the state's groundwater use is for irrigation for agriculture. Elevation data are also needed for Abandoned Mine Lands identification and clean up monitoring, Superfund monitoring, and pre- and post-oil and gas development (Bakken shale development impacts to water quality and well water levels). There are 45,000 oil and gas wells in Montana. For this critical mission area, topographic lidar is critical and inland bathymetric data are useful.				
MCA Name	MCA No.						
Geological Mapping and Analysis	1210						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$31,050,395	$555,594	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$411,204	$453,544	Major	Major	Major

Organization	New Mexico		Geologic mapping and analysis. Geologic mapping of formations and structures that represent the geologic history of the state. Geologic mapping helps us better define and describe aquifer bearing formations and structures that may partition groundwater resources. Mapping of geologic hazards such as sinkhole mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Mapping and Analysis	1438						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$25,666,436	$450,574	Moderate	Moderate	Major

Organization	Minnesota		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60609						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$17,811,181	$312,675	Major	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$235,767	$259,070	Moderate	Moderate	Major
Nearshore B.	QL1B	4-5 yrs.	$4,191	$6,744	Major	Moderate	Major
Offshore B.	Special Order	4-5 yrs.	$3,528,044	Major	Major	Moderate	Major

Organization	Utah		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60469						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$17,644,815	$309,754	Major	Major	Major

Organization	Idaho		Geologic mapping and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Earthquake and fault hazard mapping. Identification of tectonic geomorphologic features. Analysis of mineral resources. Analysis of oil and gas resources. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Mapping and Analysis	21557						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$17,640,510	$309,679	Major	Major	Major
Inland Bathy	QL2B	>10 yrs.	Minor	don't know	don't know	don't know	don't know

Organization	Kansas		Geologic mapping and analysis. Scientific research on landscape evolution, identification of geomorphic processes and units, geologic hazards, and the distribution and availability of geologic natural resources. Aquifer recharge and behavior. Assessment of groundwater availability, quality and quantity. Mapping geologic hazards, base mapping, supporting state map activities, and field collection. Drone collection of elevation data is being done for some stream bank stabilization projects.				
MCA Name	MCA No.						
Geologic Mapping and Analysis	21712						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$17,368,048	$304,896	don't know	don't know	Major

Organization	South Dakota		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60413						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$16,278,211	$285,764	Major	Major	Major

Organization	Oregon		Oregon Department of Geology and Mineral Industries operates the Oregon Lidar Consortium. The Oregon Lidar Consortium mission critical activity is to acquire, organize and distribute high resolution lidar and other remotely sensed imagery for the state. Geologic assessment and hazard mitigation, Geologic resource mining and extraction. Geologic mapping and resource identification. Bare earth and imagery together yield more accurate maps of bedrock and surficial geology. Elevation data are used to identify faults, tighten up GIS layers to follow contacts between formations, for geohazard mapping (e.g. landslide, liquefaction, floodplain delineation, channel migration zone mapping, etc.) Lidar are used to update the Mineral Information Layer (MILO) to show occurrences, prospects, and mine locations. The data are also used to locate historic mine sites, develop site descriptions, perform change detection and site characterization for active mines.				
MCA Name	MCA No.						
Geohazard Mitigation and Geologic Resource Identification and Mapping	1184						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$7,410,648	$154,347	Moderate	Major	Major
Inland Topo	QL2	6-10 yrs.	$3,083,648	$64,225	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$1,569,296	$1,108,442	Minor	Moderate	Major
Nearshore B.	QL2B	6-10 yrs.	$112,663	$100,000	Major	Moderate	Major

Organization	Iowa		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60175						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$11,878,503	$208,527	Major	Major	Major

Organization	Louisiana		As a major university department (LSU), Louisiana Geological Survey is engaged in a wide range of high level geospatial research, education, and disaster response and recovery. Our MCA is geospatial mapping, analysis, and cartography. Many BUs are included from the list in Question 5a. If I could list more than 3 Primary BUs I would. Research takes place across the U.S. and globally; various spatial resolutions are needed. The topo and bathy requirements vary by research project.				
MCA Name	MCA No.						
Geospatial Mapping, Analysis, and Cartography	22446						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$9,727,787	$170,771	Major	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$27,719	$30,459	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	$468,662	$754,060	Major	Major	Major
Offshore B.	Order 3	6-10 yrs.	Major	Major	Major	Major	Major

Organization	North Carolina		Geologic mapping and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves.				
MCA Name	MCA No.						
Geologic Mapping and Analysis	1373						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$10,420,976	$182,940	Moderate	Moderate	Major

Organization	Oregon		Increasing Oregon's level of preparedness and improving the resilience of Oregon's built infrastructure, bridges, highways, and slopes so that we make the state more resilient and ready to recover for the expected 9.0 Cascadia earthquake and ensuing tsunami.				
MCA Name	MCA No.						
State Infrastructure Resiliency	1246						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$10,242,526	$179,808	Major	Major	Major
Nearshore B.	QL4B	4-5 yrs.	$10,390	$16,718	Major	Major	Major
Offshore B.	Order 1	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Colorado		Geologic hazard mapping, geologic mapping, mineral resource identification and ground-water resource mapping and modeling. Extensive use of elevation data for geologic mapping program to delineate geologic hazard areas, river terraces, ancient river courses, bedrock (roughness,). Also used for mineral resources, including – Abandoned Mine Lands (AML) inventory. The Division of Reclamation Mining & Safety acquires lidar. Data are used to locate faults and site seismometers – bare earth is a critical layer. Inland bathy would be handy for flood mapping and reservoir bottoms.				
MCA Name	MCA No.						
Geologic Hazard Mapping, Geologic Mapping, Mineral Resource Identification and Groundwater Resource Mapping and Modeling	21873						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$10,222,311	$21,708	Minor	Minor	Major
Inland Bathy	QL1B	6-10 yrs.	Major	Major	Moderate	Moderate	Major

Organization	Kentucky		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60190						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$8,530,104	$149,745	Major	Major	Major

Organization	Washington		Tsunami risk identification, mapping, preparedness, and mitigation. Landslide risk identification, and mitigation. Hazard mitigation planning. We need better elevation data to improve the quality of our hazard and risk assessments, land use codes, evacuation maps, mitigation action identification, and the effectiveness of this data in convincing local partners of the risk and the importance of personal preparedness and mitigation.				
MCA Name	MCA No.						
Tsunami, Landslide, and Other Hazard Risk Management	1173						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	>10 yrs.	$7,130,374	$125,174	Major	Moderate	Major
Inland Bathy	QL1B	>10 yrs.	$94,385	$103,714	Major	None	Major
Nearshore B.	QL2B	>10 yrs.	$59,073	$95,046	Major	Major	Major

Organization	Delaware		The DGS's mission critical activities are to characterize water resources, geology, environmental protection, and energy and mineral resources (to include sand resources) to economic development, land-use planning, emergency management, public health, and recreation.				
MCA Name	MCA No.						
Geologic Mapping	21879						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$5,020,000	$3,015	Minor	Moderate	Moderate
Inland Bathy	QL2B	6-10 yrs.	Moderate	Moderate	Minor	Minor	Minor
Nearshore B.	QL2B	2-3 yrs.	Minor	Moderate	Minor	Minor	Minor
Offshore B.	Order 1	2-3 yrs.	Minor	Moderate	Minor	Minor	Minor

Organization	Massachusetts		Geologic Mapping Natural Hazard Identification and Mitigation Sand Resource Assessment Water Resources. Availability of QL2 Lidar has revolutionized geologic mapping by providing detailed terrain information in the office and with widespread detail that would be prohibitively time-intensive and expensive to acquire via field work. There are well documented ROIs on availability of complete geologic mapping, whether on land or under water.				
MCA Name	MCA No.						
Geologic Mapping	22125						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$1,711,893	$30,052	Moderate	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$22,660	$24,900	Moderate	Moderate	Major
Nearshore B.	QL0B	2-3 yrs.	$89,795	$144,477	Minor	Moderate	Major
Offshore B.	Order 1b	4-5 yrs.	$2,061,927	Moderate	None	None	None

Organization	Michigan		The mission of the Michigan Geological Survey is to facilitate basic and applied geological research to promote the best use of Michigan's geological resources for their social and economic benefits while protecting associated resource values and the environment. The safety, health, welfare, social and economic benefits of completing these functions will enhance the education and employment opportunities for Michigan residents while preserving the environment. Less than 10% of Michigan has been mapped to provide critical subsurface and surface information associated with the natural resources of the State. LiDAR and other indirect methods are critical to expediting the assessment of critical geographic areas in a timely manner. Elevation data are critical to identification of nearshore and inland geohazards, slope failure, potential sink holes, and releases from accidents. Recent 1-meter DEMs have shown unique geologic/glacial features, eskers, drumlins, ice walled lake plains, and deltas not seen in earlier DEMs. Elevation and geologic data are also needed in areas of proposed highway widening or increased load weights, which would require more road base. This is for releases as well as groundwater flows through an area – i.e. Tunnel Valleys.				
MCA Name	MCA No.						
Geologic Mapping and Geohazards Assessment	1163						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,224,602	$2,164,068	Major	Major	Major
Inland Bathy	QL2B	4-5 yrs.	$16,000	don't know	Moderate	Moderate	Moderate
Nearshore B.	X-Sec meet needs	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Vermont		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60484						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$2,029,447	$35,626	Major	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$26,863	$29,519	Moderate	Moderate	Major

Organization	CDC		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60644						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$250,000	$250,000	Major	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$250,000	$250,000	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$250,000	$250,000	Moderate	Moderate	Major
Offshore B.	Special Order	6-10 yrs.	$250,000	$250,000	Major	Moderate	Major

Organization	New Jersey		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60296						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,589,895	$27,910	Major	Major	Major

Organization	Hawai'i		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60117						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,358,277	$23,844	Major	Major	Major

Organization	California		Seismic hazard mapping and analysis (liquefaction, earthquake-induced landslides); Fault mapping; Tsunami inundation zone mapping. Legislatively mandated and regulatory products are provided by state survey agency. Regulatory zones require investigation. Planning products are used differently than project specific products. Regulatory maps are used by planners, building code officials, etc. to identify where detailed site specific studies are needed. Building is not allowed on an active fault. Seismic hazard maps are developed using geologic maps – lidar allows more accurate identification of young alluvium subject to liquefaction and settlement. More accurate mapping is possible. Liquefaction zone modeling requires more accurate elevations in flat areas in order to obtain more accurate groundwater elevations, which are often tied to surface elevations through depth-to-groundwater records. Bathymetric data for offshore areas in California are needed for tsunami modeling both offshore and onshore. With higher detail, the predictive models become more useful. It is also very helpful to capture recent grading activity for landslide hazard zone mapping.					
MCA Name	MCA No.						
Seismic Hazard Analysis and Mapping	1282						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$963,362	$172,458	Moderate	Minor	Major
Nearshore B.	QL3B	4-5 yrs.	Major	Major	Moderate	Minor	Major
Offshore B.	Special Order	4-5 yrs.	Major	Major	Moderate	Minor	Major

Organization	Connecticut		Geologic Mapping, Resource Evaluation, Hazards Mitigation, Infrastructure Siting. Mining and oil and gas resource consulting on land and offshore (not regulatory).				
MCA Name	MCA No.						
Geologic Mapping	22418						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$517,294	$9,081	Moderate	Major	Moderate
Inland Bathy	QL3B	6-10 yrs.	$6,847	$7,524	Moderate	Major	Minor
Nearshore B.	QL3B	4-5 yrs.	$9,090	$14,625	Moderate	Moderate	Moderate
Offshore B.	Special Order	6-10 yrs.	$481,462	Moderate	don't know	Moderate	Minor

Organization	Guam		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60097						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$442,150	$23,844	Major	Major	Major
Nearshore B.	QL1B	4-5 yrs.	$33,576	$54,024	Major	Moderate	Major
Offshore B.	Special Order	4-5 yrs.	$466,142	Major	Major	Moderate	Major

Organization	California		Landslide mapping and hazard assessment; Post-fire analysis to determine landslide-prone areas; Watershed assessment for protected water supplies; Stream channel analysis and mapping; Erosion control. QL1 hillshades and contours are needed for geomorphic interpretation and measurement for landslide mapping. Elevation data are needed for post-fire analysis for rapid assessment after fires and risk of flooding. The data are used to model debris flow hazards downstream of burn areas, impacts of debris flow runoff, and watershed assessment/erosion. Additionally, forest management, timber harvest, landslide assessments, and erosion hazard mapping are all improved with lidar. Elevation data are used for comprehensive identification of landslide and erosion potential for consideration. In timber harvest planning operations, elevation data are used to minimize landslides that generate sediment that would impair riverine ecosystems. Inland bathy is a new use case to identify watershed sediment generated by erosion and landslides in and near burn areas. Also for mapping migration of sediment downstream. Bare earth elevation data that is hydro-enforced for water flow (preferably through low-order streams and culverts), and a consistent quality of the data across the state, are both important.					
MCA Name	MCA No.						
Landslide Identification and Hazard Mapping	1211						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$753,941	$148,941	Moderate	Major	Major
Inland Bathy	QL2B	4-5 yrs.	Moderate	Moderate	Minor	Minor	Moderate

Organization	Illinois		Geologic mapping and analysis. At the ISGS, about 200 scientists and technical support staff conduct basic and applied research in geology, compile geologic maps, and gather and manage the state's geological data to provide information to industry, governmental agencies and the public about the geology and mineral resources of Illinois. Lidar acquisition for statewide needs.				
MCA Name	MCA No.						
Lidar Acquisition for Statewide Needs	21638						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2+	6-10 yrs.	$750,000	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Rhode Island		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge. Rhode Island monitors and analyzes geomorphology along its coastline.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60377						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$228,588	$4,012	Major	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$3,025	$3,324	Moderate	Moderate	Major
Nearshore B.	QL1B	4-5 yrs.	$13,964	$22,468	Major	Moderate	Major
Offshore B.	Special Order	4-5 yrs.	$426,879	Major	Major	Moderate	Major

Organization	Connecticut		Geologic Mapping and Analysis; Cultural Resources Preservation and Conservation				
MCA Name	MCA No.						
Geologic Mapping and Analysis and Cultural Resources Preservation and Conservation	1415						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$517,467	$9,134	Major	None	None
Inland Bathy	QL2B	2-3 yrs.	$6,847	$7,524	don't know	don't know	don't know
Nearshore B.	QL1B	2-3 yrs.	$9,090	$14,625	don't know	don't know	don't know

Organization	USGS		Baseline coastal resource mapping, modeling, assessment, and analysis. Investigating processes related to coastal and marine environments and societal implications related to natural hazards, resource sustainability, and environmental change.				
MCA Name	MCA No.						
Baseline Coastal	1367						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$36,180	don't know	don't know	don't know	don't know
Inland Bathy	QL3B	4-5 yrs.	$31,658	don't know	don't know	don't know	don't know
Nearshore B.	QL3B	4-5 yrs.	$151,658	$48,542	don't know	don't know	don't know
Offshore B.	Order 1b	6-10 yrs.	$213,732	$15,678	don't know	don't know	don't know

Organization	California		Geologic mapping (regional mapping and coastal sediment mapping). Maps of surficial and bedrock geology landslides are used as framework data for other derivative products (e.g. landslide susceptibility mapping, seismic hazard regulatory maps, coastal sediment mapping and coastal sediment management plans). River and lake bottom data are used for sediment management plans.				
MCA Name	MCA No.						
Regional Geologic Mapping	1287						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$260,034	$47,034	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Major	don't know	Major
Offshore B.	Special Order	4-5 yrs.	Major	Major	Major	don't know	Major

Organization	Arizona		Bedrock and surficial geologic mapping, geologic hazards mapping and assessments. Lidar data are used for geomorphic mapping, to identify active alluvial surfaces, identify faults, and for post-fire analysis to understand flood and debris flows, find fissures, and for landslide mapping.				
MCA Name	MCA No.						
Geologic Mapping and Geologic Hazards	22064						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$39,482	Major	Moderate	Minor	Major
Inland Topo	QL1	2-3 yrs.	$110,518	Major	Moderate	Minor	Major

Organization	NPS		Geologic hazard and active geologic process technical assistance. Geologic mapping and analysis. Landslide and rockfall mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and risk assessment. Fluvial process mapping, and analysis.				
MCA Name	MCA No.						
Geologic Mapping and Analysis	22224						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$79,899	$18,090	Moderate	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$32,412	Major	Major	Moderate	Moderate
Nearshore B.	QL1B	2-3 yrs.	$2,110	Moderate	Moderate	Moderate	Moderate

Organization	Maine		Geologic mapping, resource assessment, and hazard mitigation. Geologic mapping involves identifying and mapping the distribution of consolidated and unconsolidated geological materials. This is the first step in resource assessment, such as for aggregate and water resources. Hazard mitigation involves identifying landslide-prone geological materials and the characteristics that contribute to landslide failures. The department currently captures nearshore bathymetry using a jet-ski outfitted with high end GPS and a fathometer to identify sand resources within the beach systems; it can get closer to shore than boats.				
MCA Name	MCA No.						
Geologic Mapping, Resource Assessment, and Hazard Mitigation	1205						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$22,236	Major	Major	Moderate	None
Nearshore B.	Comparable to quality of jetski mounted fathometer	2-3 yrs.	$36,281	$603	Major	Moderate	Major
Offshore B.	Order 1b	6-10 yrs.	$54,221	Moderate	Moderate	Moderate	Moderate

Organization	USGS		Geologic mapping, modeling, and analysis. Constructing geologic histories, establishing geologic frameworks, and assessing geologic hazards through analysis and modeling of geologic data, including geologic maps.				
MCA Name	MCA No.						
National Civilian Mapping - Geology	21544						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Event driven	$110,874	$1,930	Major	don't know	don't know

Organization	USGS		Geologic mapping and geophysical monitoring of volcanoes, researching eruptive processes and deposits, delineating and determining volcano hazards and risk, and responding to restless or erupting volcanoes				
MCA Name	MCA No.						
Volcano Baseline	1243						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$100,000	Major	Minor	Minor	Major
Inland Bathy	QL2B	6-10 yrs.	Major	Major	Minor	Minor	Major
Nearshore B.	QL2B	6-10 yrs.	Major	Moderate	Minor	Minor	Moderate

Organization	USGS		Seafloor mapping; mapping of marine geohazards; and geologic mapping and classification of seabed geologic substrates for use by fishery ecologists, planners, managers of ocean development, and the public. The submerged margins of the U.S. comprise half the land area of the Nation. They provide a range of essential services, including: biological habitats for fisheries; mineral, aggregate, and hydrocarbon resources; waste disposal; cable and pipeline routes; and renewable energy resources. An understanding of the geology of the sea floor and the processes that shape it is necessary for the safe, productive, and sustainable use of America's submerged lands. However, much of the U.S. continental margin has not been mapped at the resolution required for marine planning and decision making. High-resolution bathymetric and backscatter surveys and interpretations of small areas in the last ten years have illustrated its spatial and temporal complexity, and a methodology has been developed for mapping these poorly-known lands in an efficient manner.					
MCA Name	MCA No.						
Seafloor Mapping	1073						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL1B	6-10 yrs.	$34,250	Major	Major	Major	Major
Offshore B.	Special Order	>10 yrs.	$61,506	Major	Major	Major	Major

Organization	Alabama		Geologic Assessment and Hazard Mitigation. Geologic resources mapping and studies. Groundwater resources studies. Coastal geomorphology and resources mapping and studies. Wetlands mapping and characterization. Modeling of biological and ecological systems. Rainfall penetration studies, impervious surfaces. Elevation data are needed for surface water modeling as well as modeling of natural resources and ecosystems. The focus is on natural resources related to mineral resources and geologic hazards. The Geologic Survey includes many divisions that focus on separate activities. The Oil and Gas Board is responsible for regulatory requirements of oil and gas extraction. The Geologic Survey does research and mapping for oil and gas. The Geologic Survey is also responsible for the sand inventory for beach re-nourishment and post dredging placement. Additional relevant Business Uses are BU 02 – Riverine Ecosystem Management, BU 06 – Natural Resources Conservation, and BU 11 – Geologic Resource Mining and Extraction.					
MCA Name	MCA No.						
Geologic and Ecologic Assessments and Hazards/Disaster Management	1310						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$73,879	Major	Minor	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Moderate	Moderate	Minor	Minor	don't know

Organization	Maryland		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Mapping and Analysis	1198						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	>10 yrs.	$70,300	$3,015	Moderate	Moderate	Moderate

Organization	Florida		Coastal mapping of geological features and seafloor feature extraction. We also have an interest in inland bathymetry in an effort to locate and identify sinkhole lakes and swallets.				
MCA Name	MCA No.						
Mapping of Geological Features and Seafloor Feature Extraction	33010						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	Major	Moderate	Minor	Moderate	Moderate
Inland Bathy	QL1B	6-10 yrs.	$31,658	$9,045	Minor	Moderate	Moderate
Nearshore B.	QL1B	6-10 yrs.	$21,105	Minor	Minor	Minor	Minor
Offshore B.	Order 1a	6-10 yrs.	Moderate	Minor	Minor	Minor	Minor

Organization	Idaho		Comprehensive Aquifer Management Plans (specifically as pertains to the Eastern Snake Plain Aquifer. The objectives of Aquifer Management Plans are to: * Increase predictability for water users by managing for a reliable supply * Create alternatives to administrative water use curtailment * Manage overall demand for water within the aquifer * Increase recharge to the aquifer * Reduce withdrawals from the aquifer				
MCA Name	MCA No.						
Recharge Projects Located Within the Eastern Snake Plain Aquifer Groundwater Model Area	1305						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$56,030	Major	Major	Major	Major

Organization	Pennsylvania		Fulfill our legislatively assigned mission of topographic mapping for Pennsylvania				
MCA Name	MCA No.						
Geologic Mapping	1447						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$19,296	$2,261	Moderate	Major	Major
Inland Bathy	QL1B	Event driven	$12,260	Moderate	Minor	None	Minor
Nearshore B.	QL0B	4-5 yrs.	don't know	Major	Moderate	Moderate	Minor
Offshore B.	Special Order	6-10 yrs.	Major	Moderate	Moderate	None	None

Organization	Maryland		Coastal Sediment Studies. Elevation data are needed for habitat assessment based on depth and sediment type, sand resources assessment, sediment classification for grain size, monitor for bottom of reservoir sedimentation, transport of sediments in inland waters, beach nourishment, pipeline assessments, CO2 sequestration, and wind platform siting.				
MCA Name	MCA No.						
Sediment Studies	22160						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	4-5 yrs.	$21,105	Moderate	Moderate	Moderate	Major
Nearshore B.	I do not need any of the QLs listed. We need vertical accuracies of 1-2cm through out the beach profile and down to -18 feet.	4-5 yrs.	$3,015	don't know	don't know	don't know	don't know
Offshore B.	I do not need any of the QLs listed. We need vertical accuracies of 1-2 cm through out the beach profile and down to -18 feet.	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Wyoming		Geologic hazard mapping, modeling and interpretation including, but not limited to landslides, Quaternary-aged faulting, subsidence, active eolian (windblown – unvegetated sand dunes, etc.) features, and other geologic hazards. Enhanced ground terrain models improve ability to map geologic hazards and locate previously unrecognized events (landslides, etc.). Future ability to identify likelihood of existence of rare earth minerals based on landforms.				
MCA Name	MCA No.						
Geologic Hazard and Resource Mapping	1238						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	4-5 yrs.	$22,099	Major	Major	Moderate	Major
Inland Bathy	X-Sec meet needs	>10 yrs.	None	None	None	None	None

Organization	Virginia		Geologic hazards				
MCA Name	MCA No.						
Geologic Hazards	1316						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$21,578	Major	Moderate	None	Major

Organization	USGS		Volcano hazard assessment and mitigation (including geologic mapping, hazard modeling, volcano monitoring, hazard mitigation)				
MCA Name	MCA No.						
Volcano Event Driven	22307						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Event driven	$19,598	Major	Moderate	Minor	Major

Organization	Connecticut		Hazard Mitigation Planning				
MCA Name	MCA No.						
Hazard Mitigation Planning	21523						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$14,929	$262	Moderate	Major	Major
Inland Bathy	X-Sec meet needs	4-5 yrs.	$198	$217	Minor	Minor	Minor
Nearshore B.	QL1B	4-5 yrs.	$1,210	$1,946	Minor	Moderate	Minor

Organization	South Carolina		Geologic mapping and analysis. Onshore or offshore mineral extraction. Modeling and mapping the effects of sea level rise or subsidence. Evaluation of sand and mineral resources. Coastal hazards mitigation. BU 03 – Coastal Zone Management is also a Business Use.				
MCA Name	MCA No.						
Geologic Mapping and Analysis	21484						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Moderate	Moderate	Moderate
Inland Topo	QL2	4-5 yrs.	Major	Major	Moderate	Moderate	Moderate
Inland Bathy	QL2B	Event driven	Major	Major	Moderate	Major	Major
Nearshore B.	QL3B	2-3 yrs.	$1,508	$603	Moderate	Moderate	Moderate
Offshore B.	I don't know	4-5 yrs.	$1,357	Moderate	Moderate	Moderate	don't know

Organization	West Virginia		Analyze geological and natural resources of our state including bedrock geologic mapping, surficial geologic mapping, coal, oil, and gas, building stone, ground water, surface water, earth-science education, and anything else related to geology in West Virginia				
MCA Name	MCA No.						
Geological Mapping and Analysis	1256						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Arkansas		Geology				
MCA Name	MCA No.						
Geology	1260						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	As frequently as possible	Major	Major	Moderate	None	None

Organization	Ohio		Bedrock mapping, glacial deposit mapping, coastal erosion, karst mapping, hydrologic modeling, subsurface mapping, educational outreach				
MCA Name	MCA No.						
Geologic Mapping	1448						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Moderate	Moderate
Nearshore B.	QL0B	6-10 yrs.	Major	Major	Moderate	Minor	Moderate

Organization	Oklahoma		OGS research focuses primarily on mapping geology, geohazards (mass movement, landslides and soil, etc.) and industrial minerals; seismology; surface and sub-surface hydrology; and hydrocarbon resources. Additionally, OGS is involved in various outreach activities, such as K-12 education, field training, and organizing workshops.				
MCA Name	MCA No.						
Geohazards and Landslides	21541						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Major	Moderate	Moderate

Organization	Illinois		Geologic Mapping. Elevation of the earth's surface is needed to create geologic maps. The surface will indicate the glacial materials and glacial processes that formed the surface.				
MCA Name	MCA No.						
Geologic Mapping	21727						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	4-5 yrs.	Major	Moderate	Moderate	Moderate	Moderate
Inland Bathy	QL0B	2-3 yrs.	Moderate	don't know	don't know	don't know	don't know
Nearshore B.	QL0B	Annually	don't know	don't know	don't know	don't know	don't know
Offshore B.	Order 1	Annually	don't know	don't know	don't know	don't know	don't know

Organization	Pennsylvania		Geospatial technologies including elevation data are used to support DEP's mine permitting and compliance operations (active mining regulation) as well as abandoned mine lands reclamation, mine safety, and other programs such as Mine Subsidence Insurance. Topographic mapping of abandoned mine areas.				
MCA Name	MCA No.						
Mine Permitting, Compliance, and Reclamation	22432						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	don't know	Major	don't know
Inland Bathy	QL1B	Event driven	Major	Major	don't know	Major	Major
Nearshore B.	I don't know	Event driven	don't know	don't know	don't know	don't know	don't know

Organization	NASA		Geologic mapping and analysis. Sinkhole and steephead mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Aquifer recharge.				
MCA Name	MCA No.						
Geologic Assessment and Hazard Mitigation	60659						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Moderate	Moderate	Major

Organization	NRC		Perform and evaluate probabilistic seismic hazard analyses as they relate to siting of new facilities and risk informed regulation of existing facilities. These include commercial reactors for generating electric power; research and test reactors used for research, testing, and training; nuclear materials used in medical, industrial, and academic settings; facilities that produce nuclear fuel; transportation, storage, and disposal of nuclear materials and waste; and decommissioning of nuclear facilities from service. Because these facilities could be sited anywhere within the U.S., elevation data could be needed anywhere, including on smaller islands if nuclear medicine facilities are located there. However, the need for the smallest and/or unpopulated islands is unlikely.				
MCA Name	MCA No.						
Evaluate Geologic Hazards at Proposed and Existing Nuclear Facilities	21636						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	>10 yrs.	Moderate	Moderate	None	Minor	Moderate

BU 11 - Geologic Resource Mining and Extraction

BU 11 Scope

Business Use #11 (BU 11) includes onshore or offshore mineral extraction; monitoring sand as a local resource; seabed resources; open mine volume computations; stockpile analysis; and environmental impact assessment and site restoration.

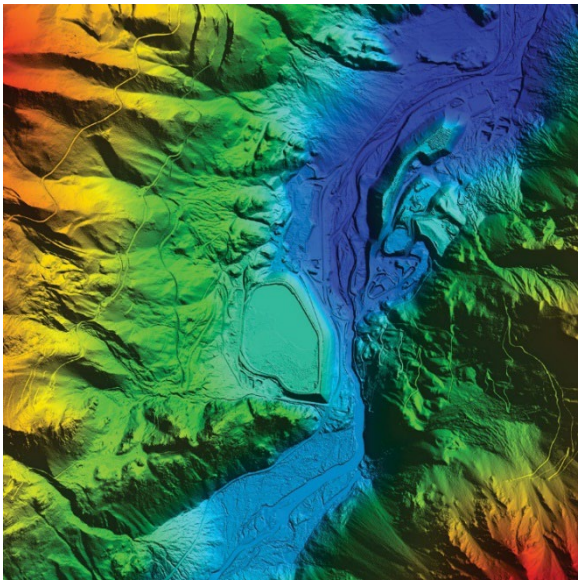

Figure E.11a. Lidar can assist in the mining of critical minerals at sites such as this one in Montana's Stillwater Complex where platinum and palladium are mined. Image courtesy of USGS.

BU 11 Background Information

Mineral resources are critical components of the Nation's economy. The top commodities traditionally mined in the U.S. include coal, crushed rock, cement, sand, gravel, copper, gold, and iron ore. However, the U.S. is currently 100 percent dependent on foreign nations for dozens of different mineral commodities, including several that are critical for national security. Critical minerals are rare earth elements used in many industrial processes and products that underpin modern life. They are used in computers, computer monitors, smart phones, batteries, LED lights, digital cameras and camera lenses, automobile catalytic converters, and petroleum refining to name a few of the products and processes that rely on them.

Sources for these minerals could be developed in the U.S., but private sector exploration is hampered by the lack of modern geological and geophysical data. USGS' Earth Mapping Resources Initiative (Earth MRI) effort (USGS Fact Sheet 2019-3007) is intended to improve our knowledge of the geologic framework in the U.S. and to identify areas that have the potential to contain undiscovered critical mineral resources. The May/June 2019 issue of *LiDAR Magazine* includes an article entitled: "Lidar Enlightens the Search for Critical Minerals," explaining how the use of lidar to search for important minerals can turn decades of work into a few years.

BU 11 Elevation Data Uses

Using their own words, respondents documented 25 Mission Critical Activities (MCAs) that identified BU 11 as their primary Business Use and identified the following 35 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.11a. BU 11 Elevation Data Uses

Data Use
Coastal Resource Management
1. Monitoring sand as a local resource
2. Sand resource management in shallow waters less than 150 feet deep
Environmental Protection
3. Abandoned mine safety reclamation
4. Assure that mining activity does not affect natural water resources, i.e., producing pollutants that will result in acid mine drainage or too many sediments
5. Environmental impact assessment and site restoration

Data Use
6. Evaluate runoff and land management capabilities
7. Ground water and stream/river legacy mining remediation
8. Identify, inventory, safeguard, and reclaim abandoned mines that present a public safety hazard or environmental detriment
9. Reclamation and restoration of post-mining activity
10. Remediation of abandoned coal mines and active reclamation of mines
Erosion/Sediment Control
11. Slope stability and erosion control
Habitat Analysis and Management
12. Assure that reclaimed mines provide suitable habitats for wildlife natively found in the region
Hazard Assessment and Mitigation
13. Tailings impoundment risk analysis.
Mapping/Boundary Delineation
14. Map submerged geologic features
Mining
15. Design and control of mining impacted waters
16. Ensure access to offshore outer continental shelf mineral resources
17. Identify the quantity of gravel available for extraction
18. Monitor stockpiles of topsoil to assure that there will be enough material to reclaim the site post-mining
19. Onshore or offshore mineral extraction
20. Open mine volume computations
21. Stockpile analysis
Natural Resources Conservation
22. Conservation engineering
23. Natural resource management of state lands and water
Permitting
24. Mine licensing
25. Mine permitting and mine environmental remediation
Planning
26. Identify field surveying needs
27. Identify pre-existing conditions and reconnaissance before site visits
Regulatory Reviews and Enforcement
28. Evaluation of uses such as mining or gravel extraction to determine impacts and make regulatory decisions to determine if the activity is warranted
29. Identify/verify/quantify restoration of mining disturbed lands to approximate original contour (current and abandoned mines)
30. Inspect and enforce reclamation and permit rules on all hard rock or minerals mines (excluding aggregate, coal and potash mines)
31. Mineral production verification program
32. Monitor resources relative to surrounding areas during extraction
33. Monitor surface coal mines as the open pit progresses and it is being reclaimed on the back end.
34. Regulate inspect and enforce reclamation and permit rules on coal mines

Data Use
35. Review of surface mining and mineral extraction activities

BU 11 Tangible and Intangible Benefits

For the 25 MCAs that list Geologic Resource Mining and Extraction as their primary Business Use:

- **Table E.11b** summarizes the reported future annual dollar benefits by geography type, totaling $26.12 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.11c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.11e.
- **Table E.11d** shows (in blue) the four federal agencies and 21 states and territories that submitted MCAs with BU 11 (Geologic Resource Mining and Extraction) as the primary Business Use. MCAs for which BU 11 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.11d.
- **Table E.11e** documents all the MCAs that listed BU 11 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.11e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 11 Reported Future Annual Dollar Benefits

Of the 25 MCAs that listed Geologic Resource Mining and Extraction as their primary Business Use, 18 MCAs estimated their tangible annual benefits totally in financial terms; and six MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.11b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 25 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.11b. BU 11 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$20,711,120	$5,388,653	$26,099,773
Inland Bathymetry	$7,236	$18,580	$25,816
Nearshore Bathymetry	$0	$0	$0
Offshore Bathymetry	$0	$0	$0
Totals	**$20,718,356**	**$5,407,233**	**$26,125,589**

BU 11 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.11c. BU 11 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	21	17	1	16	18
Inland Bathymetry	2	2	1	2	2
Nearshore Bathymetry	1	0	0	0	0
Offshore Bathymetry	2	0	0	0	0
Totals	**26**	**19**	**2**	**18**	**20**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 11 Reported Future Annual Dollar Benefits Maps

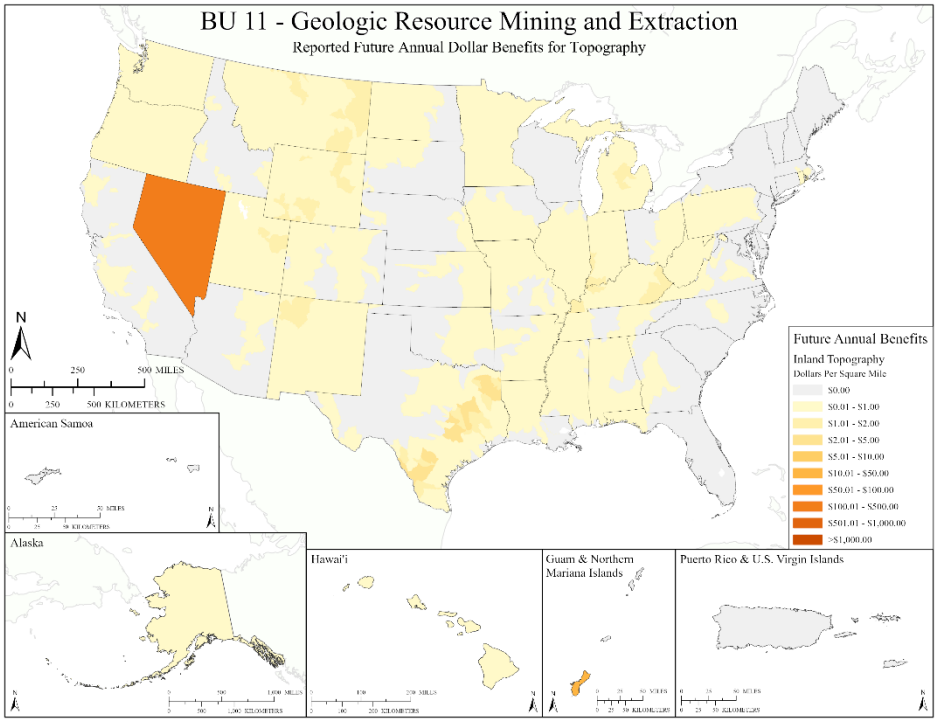

Figure E.11b. Reported Future Annual Dollar Benefits for Topography

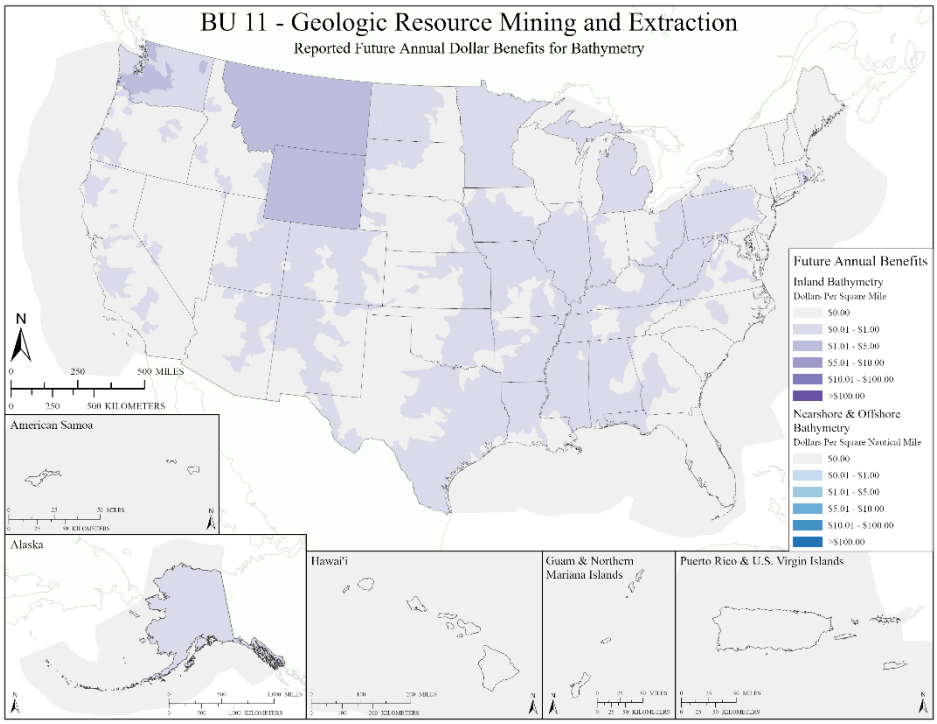

Figure E.11c. Reported Future Annual Dollar Benefits for Bathymetry

BU 11 Benefits Analysis

The total combined future annual benefits ($26.12 million per year) reported for BU 11 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe the BU 11 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, four federal agencies (BLM, BOEM, NOAA and OSMRE) submitted a total of four MCAs listing BU 11 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry and offshore bathymetry. Of the four total federal MCAs listing BU 11 as primary:
    - Inland Topography: One provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: One provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits and one indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and two indicated "Major" benefits.
    - USACE did not submit any MCA that listed BU 11 as primary, secondary or tertiary even though USACE's dredging and beach nourishment programs focus on the beneficial uses of materials dredged from navigable rivers.
- State/Local/Tribal and U.S. Territory MCAs: Twenty (20) states and territories submitted a total of 20 MCAs that designated BU 11 as their primary BU. Of the 20 MCAs listing BU 11 as primary:
    - Inland Topography: 16 provided dollar benefits and three indicated "Major" benefits.
    - Inland Bathymetry: Seven provided dollar benefits and none indicated "Major" benefits.
    - Nearshore and Offshore Bathymetry: No state MCAs were submitted that listed BU 11 as primary.
    - Although nine states submitted MCAs listing BU 11 as secondary, and two states submitted MCAs listing BU 11 as tertiary, those benefits do not accrue to BU 11.
- Non-governmental MCAs: One non-governmental organization (Lampl Herbert Consultants) submitted an MCA that listed BU 11 as secondary.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.11b and E.11c:
    - 45 "Major" Operational and Customer Service benefits and 40 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 11 for which "Major" benefits are documented, this could easily be translated into millions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 11 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 11:

- **Table E.11d** color-codes those organizations having an MCA with BU 11 as Primary, Secondary, or Tertiary.
- **Table E.11e** summarizes the 25 MCAs with primary benefits for BU 11, rank ordered from the highest to the lowest tangible benefits.

Table E.11d. Organizations having an MCA with BU 11 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	**BLM**	**BOEM**	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	**NOAA**	NPS	NRC	NRCS	NREL
	ORNL	**OSMRE**	PHMSA	SI	TVA	USACE	USAF	USARC	USBR	USCB
	USCG	USFS	USGS	USMC	USN					

State/Ter	**AL**	**AK**	**AR**	*AZ*	**CA**	CO	CT	DC	DE	FL	GA	**HI**	IA	*ID*
	IL	**IN**	*KS*	**KY**	LA	*MA*	MD	ME	**MI**	MO	**MN**	MS	**MT**	NC
	ND	NE	NH	NJ	**NM**	**NV**	NY	**OH**	OK	**OR**	*PA*	**RI**	*SC*	SD
	TN	**TX**	**UT**	*VA*	VT	**WA**	WI	*WV*	**WY**	PR	VI	**GU**	*AS*	CNMI

Non-Gov	*Lampl Herbert Consultants, Inc.*			

Table E.11e. MCA summaries for BU 11, rank ordered from the highest to the lowest tangible benefits.

Organization	Nevada		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration. Nevada mines $5 billion in gold annually.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60287						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$20,000,000	$5,000,000	Minor	Major	Major

Organization	OSMRE		Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration. Identify/verify/quantify restoration of mining disturbed lands to approximate original contour (current and abandoned mines). Design and control of mining impacted waters. Assure that mining activity does not affect natural water resources, i.e. producing pollutants that will result in acid mine drainage or too many sediments. Assure that reclaimed mines provide suitable habitats for wildlife naively found in that region. Monitor surface coal mines as the open pit progresses and it is being reclaimed on the back end (contemporaneous reclamation), as well as monitor stock piles of top soil to assure that there will be enough material to reclaim the site post mining. Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Conservation of critical habitats. Geologic mapping and analysis. Environmental impact assessment and site restoration. Additional Business Uses include BU 01 – Water Supply and Quality, BU 06 – Natural Resources Conservation, and BU 07 – Wildlife and Habitat Management.						
MCA Name	MCA No.						
Regulation and Reclamation of Surface Coal Mining Activities	1389						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$285,020	$150,750	Moderate	Moderate	Major
Inland Bathy	QL2B	2-3 yrs.	$7,236	Major	Major	Major	Major

Organization	Alaska		Natural Resource Management of State Lands and Water. Specifically evaluation of uses such as mining or gravel extraction to determine impacts and to make regulatory decisions to determine if the activity is warranted, to monitor resources relative to surrounding areas during extraction, and to identify needed restoration/reclamation after extraction, if needed. Elevation data are also needed to identify the quantity of gravel available for extraction.				
MCA Name	MCA No.						
Natural Resource Management of State Lands and Water	21756						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$142,689	$94,652	Moderate	Moderate	don't know
Inland Bathy	QL1B	4-5 yrs.	don't know	$9,759	don't know	don't know	don't know
Nearshore B.	QL3B	Event driven	Moderate	Moderate	don't know	Moderate	don't know
Offshore B.	Order 1b	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Texas		Regulation of surface coal mining in the state of Texas.				
MCA Name	MCA No.						
Regulation of Surface Coal Mining in the State of Texas	22126						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Event driven	$68,934	$2,894	None	Minor	Minor

Organization	Montana		DEQ's Critical Mission Activity reaches across a number of different programs, which include Air, Water, Land and Energy. Various programs include, but are not limited to: -Mine Licensing -Oil/hazardous spill response -Abandoned Mine safety reclamation (subsidence) -Tailings impoundment risk analysis -Ground Water issues -Stream/river Legacy mining remediation				
MCA Name	MCA No.						
Environmental Protection	33032						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$36,110	$23,825	Minor	Major	Moderate
Inland Bathy	QL0B	4-5 yrs.	don't know	$2,456	don't know	don't know	don't know

Organization	New Mexico		Reclamation of post-mining activity; identify, inventory, safeguard and reclaim (pre-1977) abandoned mines that present a public safety hazard or environmental detriment; regulate, inspect and enforce reclamation and permit rules on all coal mines not on Native American reservations; regulate, inspect and enforce reclamation and permit rules on all hard rock or minerals mines (excluding aggregate, coal and potash mines).				
MCA Name	MCA No.						
Permitting and Monitoring of Mining, Oil, and Gas Activities	1227						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$29,701	$19,702	Major	Major	Major

Organization	Wyoming		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60537						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$23,892	$15,849	Minor	Major	Major
Inland Bathy	QL0B	4-5 yrs.	Moderate	$1,634	None	Minor	Minor

Organization	Oregon		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60355						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$23,705	$15,724	Minor	Major	Major

Organization	Minnesota		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60610						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$20,610	$13,672	Minor	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Moderate	$1,409	None	Minor	Minor
Nearshore B.	QL1B	I don't know	Moderate	Moderate	don't know	Moderate	don't know
Offshore B.	Order 1b	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Utah		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60470						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$20,418	$13,544	Minor	Major	Major

Organization	Washington		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration. Topography is used for regulating and within the industry.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60514						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$16,502	$10,946	Minor	Major	Major
Inland Bathy	QL0B	4-5 yrs.	Moderate	$1,128	None	Minor	Minor

Organization	Michigan		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60234						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$14,188	$9,411	Minor	Major	Major
Inland Bathy	QL0B	4-5 yrs.	Moderate	$970	None	Minor	Minor
Nearshore B.	QL3B	I don't know	Moderate	Moderate	don't know	Moderate	don't know
Offshore B.	Order 1b	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Kentucky		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60191						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$9,870	$6,547	Minor	Major	Major

Organization	Indiana		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60153						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$8,838	$5,863	Minor	Major	Major

Organization	North Dakota		Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration. Slope stability and erosion control. Elevation data are used to identify surveying needs, identify pre-existing conditions and reconnaissance before site visits, see runoff, and evaluate land management capabilities. Lidar data may be merged with field survey data to fill out an Area of Interest. The data are used for remediation of abandoned coal mines as well as active reclamation of mines. BU 10 – Geologic Assessment and Hazard Mitigation, BU 12 – Renewable Energy Resources, and BU 13 – Oil and Gas Resources would be additional Business Uses.				
MCA Name	MCA No.						
Mine Land Reclamation	1439						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$7,236	$3,015	None	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	Moderate	$1,206	None	Minor	Minor

Organization	Guam		Elevation data are needed to update fault maps, identify how much limestone extraction is occurring, and identify new quarries. Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60098						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$1,571	$1,042	Minor	Major	Major

Organization	Hawai'i		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60118						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$1,571	$1,042	Minor	Major	Major
Offshore B.	Order 1b	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Rhode Island		The University of Rhode Island maps submerged geologic bottom type using multi-beam instruments. Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60378						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$264	$175	Minor	Major	Major
Inland Bathy	QL0B	4-5 yrs.	Moderate	$18	None	Minor	Minor
Nearshore B.	QL3B	I don't know	Moderate	Moderate	don't know	Moderate	don't know
Offshore B.	Order 1b	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	BLM		Mineral production verification program. Elevation data are needed for review of surface mining and mineral extraction activities. Includes BLM's minerals responsibilities underneath non-BLM lands. Primarily located in Colorado, but extends elsewhere as well. Includes all or portions of the following: BU 02 BU 04, BU 05, BU 06, BU 09, BU 11, BU 12, BU 13, BU 14, BU 17, and BU 27.				
MCA Name	MCA No.						
Mineral Production Verification	1331						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Quarterly	Major	Minor	None	None	None

Organization	Arkansas		Geologic Resource Mining and Extraction				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	1435						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	Major	Moderate	Moderate	Moderate	don't know

Organization	Ohio		Mine permitting and mine environmental remediation.				
MCA Name	MCA No.						
Mine Permitting and Mine Environmental Remediation	1441						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	Major	Major	Minor	Major	Major

Organization	BOEM		Ensure access to offshore outer continental shelf mineral resources Bathymetry is needed for sand resource management in shallow waters less than 150 feet deep. USACE also has similar needs for bathymetry for sand resource management. Pre- and post-dredging bathymetry are needed for management of mineral resources.				
MCA Name	MCA No.						
Offshore Marine Minerals Resource Management	33020						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL4B	4-5 yrs.	Major	don't know	don't know	don't know	don't know
Offshore B.	Order 1b	4-5 yrs.	Major	don't know	don't know	don't know	don't know

Organization	California		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60044						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	Major	Major	Minor	Major	Major

Organization	NOAA		Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Open mine volume computations. Stockpile analysis. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Geologic Resource Mining and Extraction	60662						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	Major	Moderate	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Moderate	Major	Major
Nearshore B.	QL4B	4-5 yrs.	Moderate	Moderate	don't know	Moderate	don't know
Offshore B.	Order 1b	4-5 yrs.	Major	don't know	don't know	don't know	don't know

Organization	Alabama		Open mine volume computations, stockpile analysis, environmental impact assessment, and site restoration				
MCA Name	MCA No.						
Regulation of Surface Coal Mining in the State of Alabama	21831						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

BU 12 - Renewable Energy Resources

BU 12 Scope

Business Use #12 (BU 12) includes alternate energy development – solar, tidal, wind, wave, and ocean current; assessment of rooftops for solar energy potential; analysis of wind energy potential and turbine placement; low head power potential for hydropower.

The Department of Energy (DOE) promotes renewable energy technologies and practices that reduce the use of fossil fuels. However, the implementation of renewable energy programs is largely left to the private sector.

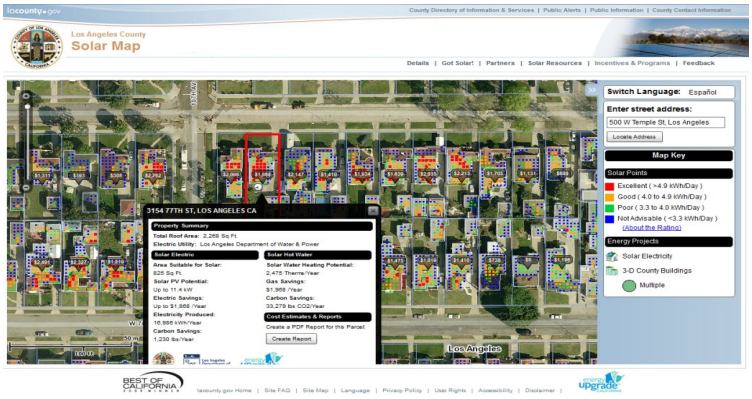

Figure E.12a. Example of a Los Angeles County Solar Map, available on-line, for which homeowners can easily print a report for their home/property explaining its potential for solar energy and/or solar water heating, and potential cost savings and carbon savings as well as estimated installation costs. Image courtesy of Los Angeles County.

BU 12 Background Information

Elevation data are used for siting of industrial wind farms and solar farms; and lidar data are vital for individual homeowners considering the efficiency of their own home and property for solar panels. Modern cities and metropolitan areas provide lidar-based solar maps for individuals considering the installation of solar panels.

For the Los Angeles County Solar Map, Figure E.12a shows an example home selected at random. Individuals can zoom in and see exactly which parts of their roof are good for solar -- then print the results in a report. The LA County Solar Map is based upon the most accurate large-scale solar model in the world, with solar radiation calculated every five feet. Measurements taken from lidar include shading from trees, roof features (chimneys, other stories), roof pitch and aspect, nearby buildings and mountains. For each home/building, the web-based report provides the total roof area; area suitable for solar; solar photo-voltaic (PV) potential, electric savings and carbon savings per year; solar water heating potential; gas savings and carbon savings per year; cost estimates and other information to encourage installation of solar panels.

BU 12 Elevation Data Uses

Using their own words, respondents documented 44 Mission Critical Activities (MCAs) that identified BU 12 as their primary Business Use and identified the following 24 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.12a. BU 12 Elevation Data Uses

Data Use
Climate Change Analysis
1. Carbon sequestration
2. Develop a high-resolution nationwide biomass estimation tool
3. Emissions inventory of facilities that output carbon such as refineries, waste, etc.
4. Estimate biomass for forests for cap and trade and estimating carbon

Data Use
Planning
5. Analysis of wind energy potential and turbine placement
6. Bathymetry for wind and hydrokinetic potential
7. Electricity grid assessment
8. Estimate photovoltaic output
9. Geothermal exploration using topography for planning
10. Lidar data for wind and solar siting
11. Low head power potential for hydropower
12. Planning, engineering review, technical review, and environmental review of offshore renewable energy projects (wind, marine hydrokinetic)
13. Power potential for hydropower
14. Renewable energy resource assessment and siting
15. Study of offshore windfarm potential and issues
16. Topographic data for siting wind energy (ridge lines are better than valleys) and to help lay out solar panels (slope and aspect are important)
Renewable Energy
17. Alternate energy development – solar, tidal, wind, wave, and ocean current
18. Assessment of rooftops for solar energy potential
19. Calculate rebates and renewable credits based on rooftop potential vs. actuals.
20. Development of major solar installations and promoting residential development
21. EnergyForward – to provide safe, reliable and clean energy while helping to transform the way energy is produced, delivered and used
22. Geothermal development
23. Inform policy-making regarding renewable targets
Stakeholder Engagement
24. Help customers find ways to understand, manage and reduce energy use

BU 12 Tangible and Intangible Benefits

For the 44 MCAs that list Renewable Energy Resources as their primary Business Use:

- **Table E.12b** summarizes the reported future annual dollar benefits by geography type, totaling $11.54 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.12c** summarizes over a hundred major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.12e.
- **Table E.12d** shows (in blue) the seven federal agencies, 36 states and territories, and one non-governmental entities that submitted MCAs with BU 12 as the primary Business Use. MCAs for which BU 12 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.12d.
- **Table E.12e** documents all the MCAs that listed BU 12 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.12e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 12 Reported Future Annual Dollar Benefits

Of the 44 MCAs that listed Renewable Energy Resources as their primary Business Use, one MCA estimated their tangible annual benefits totally in financial terms; one MCA had a combination of tangible and "Major" intangible benefits; and 42 MCAs listed "Major" intangible benefits only. Others had

The reported future annual dollar benefits are summarized in Table E.12b, using the highest value when an MCA specified a range of annual benefits Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 44 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.12b. BU 12 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$5,000,000	$1,000,000	$6,000,000
Inland Bathymetry	$503,015	$0	$503,015
Nearshore Bathymetry	$1,015,075	$0	$1,015,075
Offshore Bathymetry	$4,030,150	$0	$4,030,150
Totals	**$10,548,240**	**$1,000,000**	**$11,548,240**

BU 12 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.12c. BU 12 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	41	40	0	1	0
Inland Bathymetry	2	1	0	1	1
Nearshore Bathymetry	5	5	0	1	1
Offshore Bathymetry	5	5	0	1	1
Totals	**53**	**51**	**0**	**4**	**3**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 12 Reported Future Annual Dollar Benefits Maps

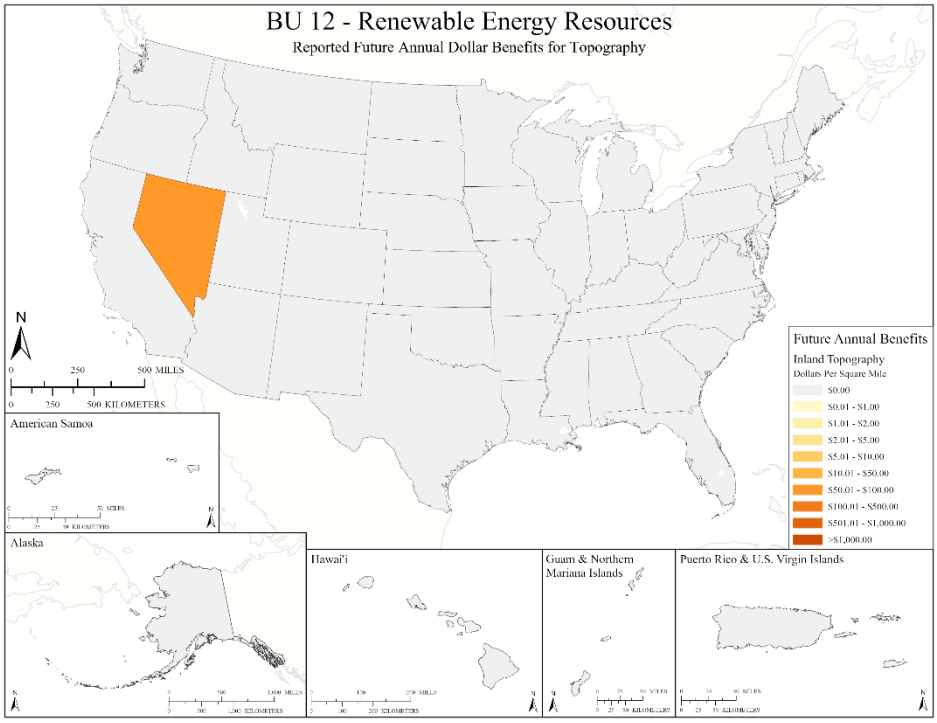

Figure E.12b. Reported Future Annual Dollar Benefits for Topography

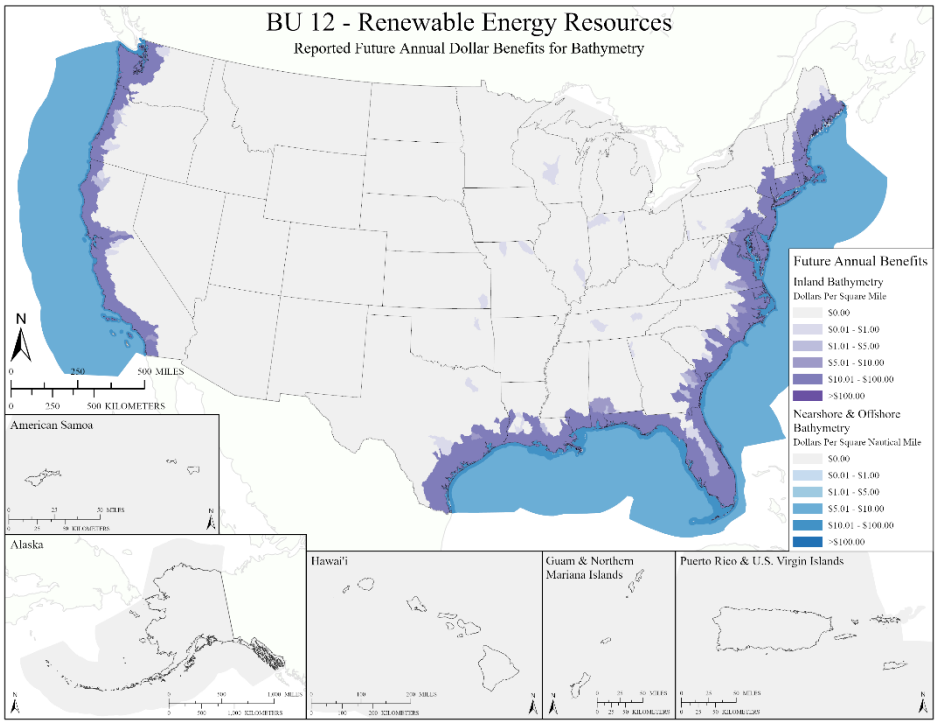

Figure E.12c. Reported Future Annual Dollar Benefits for Bathymetry

BU 12 Benefits Analysis

The total combined future annual benefits ($11.54 million per year) reported for BU 12 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe the BU 12 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, seven federal agencies (BOEM, CMTS, FERC, NOAA, NREL, USAF, and USGS) submitted a total of seven MCAs listing BU 12 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the seven total federal MCAs listing BU 12 as primary:
    - Inland Topography: None provided dollar benefits and five indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits and four indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and three indicated "Major" benefits.
    - The federal dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.
    - Within the U.S. Department of Energy (DOE), the National Renewable Energy Laboratory submitted an MCA with BU 12 as primary.
    - Many other federal agencies with major renewable energy programs did not submit MCAs with BU 12 as either primary, secondary or tertiary. These include: (a) the Oak Ridge National Laboratory (ORNL) with major research programs in renewable energy; (b) the Tennessee Valley Authority (TVA) which advertises a major commitment to renewable energy; (c) the U.S. Army Corps of Engineers (USACE) which operates major hydropower facilities in the U.S., (d) the Bureau of Land Management (BLM) which manages vast stretches of public lands that have the potential to make significant contributions to the nation's renewable energy portfolio, and (e) the Natural Resources Conservation Service (NRCS) that has major programs and grants to help farmers produce electricity from wind or solar power on their farms and grasslands.
- State/Local/Tribal and U.S. Territory MCAs: Thirty-six (36) states and territories submitted a total of 36 MCAs that designated BU 12 as their primary BU. Of the 36 MCAs listing BU 12 as primary:
    - Inland Topography: One provided dollar benefits and 35 indicated "Major" benefits.
    - Inland Bathymetry, Nearshore Bathymetry, and Offshore Bathymetry: None provided dollar benefits, and none indicated "Major" benefits.
    - One state provided an MCA with BU 12 as secondary and three states provided MCAs with BU 12 as tertiary.
    - We have no way to translate "Major" benefits into dollar benefits, and benefits from secondary or tertiary Business Uses do not accrue to BU 12.

- Non-governmental MCAs: The Atlantic Shores Offshore Wind submitted an MCA with BU 12 as primary, providing dollar benefits for inland bathymetry, nearshore bathymetry, and offshore bathymetry. Sapphos Environmental Inc. provided an MCA with BU 12 as secondary, and TerraSond submitted an MCA with BU 12 as tertiary; these do not accrue benefits to BU 12.
- Increased Combined Benefits: There are several additional significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.12b and E.12c:
    - 104 "Major" Operational and Customer Service benefits and seven "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 12 for which "Major" benefits are documented, this could easily be translated into hundreds of thousands of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 12 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 12:

- **Table E.12d** color-codes those organizations having an MCA with BU 12 as Primary, Secondary, or Tertiary
- **Table E.12e** summarizes the 44 MCAs with primary benefits for BU 12, rank ordered from the highest to the lowest tangible benefits

Table E.12d. Organizations having an MCA with BU 12 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	**BOEM**	CDC	**CMTS**	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	**FERC**	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	**NOAA**	NPS	NRC	NRCS	**NREL**
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	**USAF**	USARC	USBR	USCB
	USCG	USFS	**USGS**	USMC	USN					

State/Ter	AL	**AK**	AR	AZ	**CA**	CO	**CT**	DC	**DE**	FL	GA	**HI**	**IA**	**ID**
	IL	**IN**	**KS**	KY	**LA**	**MA**	MD	**ME**	**MI**	MO	**MN**	MS	**MT**	**NC**
	ND	**NE**	NH	**NJ**	**NM**	**NV**	NY	**OH**	OK	**OR**	**PA**	**RI**	SC	**SD**
	TN	**TX**	**UT**	VA	**VT**	**WA**	**WI**	WV	**WY**	PR	**VI**	*GU*	**AS**	CNMI

Non-Gov	**Atlantic Shores Offshore Wind**	*Sapphos Environmental, Inc.*	TerraSond	

Table E.12e. MCA summaries for BU 12, rank ordered from the highest to the lowest tangible benefits.

Organization	Nevada		Nevada is experiencing significant geothermal developments annually. Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60288						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$5,000,000	$1,000,000	Minor	Minor	None

Organization	Atlantic Shores Offshore Wind		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60733						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	2-3 yrs.	$503,015	Major	Moderate	Major	Major
Nearshore B.	QL4B	2-3 yrs.	$1,015,075	Major	Minor	Moderate	Moderate
Offshore B.	Special Order	2-3 yrs.	$4,030,150	Major	Minor	Moderate	Moderate

Organization	Minnesota		EnergyForward is how we're doing our part to provide safe, reliable and clean energy while helping to transform the way energy is produced, delivered and used. We're strengthening the electric grid that delivers energy to homes, businesses and industry. We're generating more power from renewable sources like the wind, water and sun. And we're helping customers find ways to understand, manage and reduce their energy use. Minnesota Power supports state efforts and manages the utility corridors. Currently Minnesota Power flies yearly lidar, but with better data, flights could be reduced to only every 3-5 years, thus saving money. The data are also used for wind and solar siting.				
MCA Name	MCA No.						
Project Planning and Infrastructure Maintenance Including Vegetation Management	1086						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	Major	Moderate	Moderate	Minor	don't know

Organization	California		Carbon sequestration: Develop a high resolution nationwide biomass estimation tool. Forest/veg structure data (heights, diameters, species, age) and canopy outlines. One project requires nationwide lidar, two require statewide lidar. Other projects are in development including the California working lands inventory, the biomass estimation tool (nationwide) which has NASA funding, and the Garcia project in Mendocino County. Lidar are input into the tool to estimate biomass for forests for cap and trade and estimating carbon. Carbon accounting will be a future requirement for fire; the biomass calculator would support this effort. Elevation data are also used for emissions inventory of facilities that output carbon such as refineries, waste, etc. – the facilities are geocoded, building footprints are used for spatial analysis along with building height and parcel data.				
MCA Name	MCA No.						
U.S. Forest Biomass Estimation and Carbon Monitoring	21562						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	don't know	Major	don't know

Organization	BOEM		Planning, engineering review, technical review, and environmental review of offshore renewable energy projects (wind, marine hydrokinetic). Developers provide the site specific data for individual project areas, BOEM uses NOAA and others' data for planning purposes only.				
MCA Name	MCA No.						
Offshore Renewable Energy Projects	21912						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL3B	2-3 yrs.	Major	Major	Moderate	Major	Major
Offshore B.	Special Order	2-3 yrs.	Major	Major	Moderate	Major	Major

Organization	Montana		Renewable Energy - Wind				
MCA Name	MCA No.						
Tribal Renewable Energy Mapping	22070						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	>10 yrs.	Major	Major	None	None	None

Organization	NREL		Renewable energy resource assessment and siting; electricity grid assessment. Elevation data are needed as input to models for resource assessments, for economic and technical potential analysis needed to assess the costs and issues around renewable energy vs. conventional energy for a given area, and for national energy portfolio assessments. Topographic data are needed for siting wind energy (ridgelines are better than valleys), and to help lay out solar panels (slope and aspect are important factors). NREL also uses lidar from the DHS HSIP data layer for identification of rooftop potential for solar. Bathymetry is needed for wind and hydrokinetic potential. For wind, depth information is important for identifying anchor technologies. In addition to using elevation data for analysis, NREL also includes topography as an information layer in its web apps. NREL products are used by industry, researchers, planners, developers, and government. Federal and local governments use NREL data to inform policy-making regarding renewable targets. Utilities use NREL data to estimate photovoltaic output, and to calculate rebates and renewable credits based on rooftop potential vs. actuals.				
MCA Name	MCA No.						
Renewable Energy Resource Analysis and Development Issues	22500						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL4	2-3 yrs.	Major	Major	Moderate	Moderate	Minor
Inland Topo	QL5	2-3 yrs.	Major	Major	Moderate	Moderate	Minor
Nearshore B.	QL4B	2-3 yrs.	Moderate	Minor	None	None	None
Offshore B.	Order 1	2-3 yrs.	Moderate	Minor	None	None	None

Organization	Alaska		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60011						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	American Samoa		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60028						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	California		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60045						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Connecticut		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60066						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Delaware		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60077						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Hawai'i		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60119						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Idaho		Idaho Power. Alternate energy development – solar and wind. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60133						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Illinois		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60141						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Indiana		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60154						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Iowa		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60176						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Kansas		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60185						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Louisiana		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60202						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Maine		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60208						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Massachusetts		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60226						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Michigan		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60235						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Nebraska		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60273						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	New Jersey		New Jersey has extensively studied offshore windfarm potential and issues. Solar is another major focus for the state, both in development of major installations and in promoting residential development. Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60297						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	New Mexico		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60310						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	North Carolina		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60324						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	QL0B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL0B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Ohio		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60343						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Oregon		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60356						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Pennsylvania		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60363						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Rhode Island		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60379						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	South Dakota		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60414						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Tennessee		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60429						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Texas		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60442						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	U.S. Virgin Islands		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60455						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Utah		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60471						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Vermont		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60485						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Washington		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower. Geothermal Exploration. Topography is used for planning for geothermal.				
MCA Name	MCA No.						
Renewable Energy Resources	60515						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Wisconsin		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60527						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None

Organization	Wyoming		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60538						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Minor	Minor	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Air Force		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60630						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Moderate	Moderate	None

Organization	FERC		Alternate energy development – hydroelectric, tidal, wave, and ocean current. Analysis of energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources - Hydropower	60652						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Moderate	Moderate	Moderate
Inland Bathy	QL2B	2-3 yrs.	Major	Moderate	Moderate	Moderate	Moderate

Organization	NOAA		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60663						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Moderate	Moderate	None
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL4B	2-3 yrs.	Major	Major	Minor	Moderate	Moderate
Offshore B.	Special Order	2-3 yrs.	Major	Major	Minor	Moderate	Moderate

Organization	USGS		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60682						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Moderate	Moderate	None
Nearshore B.	QL4B	2-3 yrs.	Major	Major	Minor	Moderate	Moderate
Offshore B.	Special Order	2-3 yrs.	Major	Major	Minor	Moderate	Moderate

Organization	CMTS		Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.				
MCA Name	MCA No.						
Renewable Energy Resources	60696						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL4B	2-3 yrs.	Major	Major	Minor	Moderate	Moderate
Offshore B.	Special Order	2-3 yrs.	Major	Major	Minor	Moderate	Moderate

BU 13 - Oil and Gas Resources

BU 13 Scope

Business Use #13 (BU 13) includes oil and gas exploration and production; pipeline and route selection; facility siting to mitigate geologic hazards; construction planning; environmental impact assessment and mitigation; and regulatory compliance.

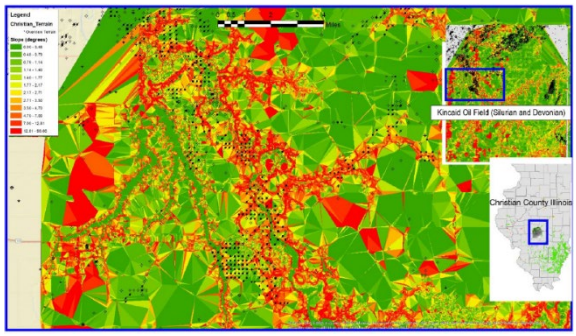

Figure E.13a. This picture is from a 2017 LiDAR Magazine article: "Using LiDAR as an Oil and Natural Gas Exploration Tool" by Chuck Knox. It compares Illinois oil fields slopes with oil from different geologic periods. Image courtesy of Knox Geological LLC.

The Department of Energy (DOE) performs research and development of future fossil energy technologies. The Federal Energy Regulatory Commission (FERC) regulates the interstate transmission of natural gas and oil via development of safe, reliable and efficient energy infrastructure that serves the public interest; and the Pipeline and Hazardous Materials Safety Administration (PHMSA) regulates and ensures the safe and secure movement of hazardous materials to industry and consumers by all modes of transportation, including pipelines. However, the responsible acquisition and safe delivery of oil and gas to generate electricity, heat our homes, and power our transportation systems, is largely left to the private sector to comply with federal and state regulations.

BU 13 Background Information

Lidar data are used by the oil and gas industry for: (1) seismic programs and exploration, (2) locating well sites, facilities and pipelines based on slope data, (3) selection of well locations and pipeline routes, (4) location and classification of buildings and other objects within special protection zones, (5) identification of land cover and timber removal calculations to minimize tree cutting, (6) asset inventories, (7) encroachment control, (8) construction planning, and (9) fast checking of critical heights of ground coverage when combined with existing sub-surface data.

Lidar is used to pre-select suitable locations in the office, which is quicker, safer, and more cost-effective than sending survey crews to the field to search for suitable well locations and pipeline routes. The challenges of selecting safe pipeline routes are recognized from pipelines transporting oil to our refineries crossing mountain ranges spanning thousands of miles; these pipelines are buried beneath rivers which can become contaminated by accidental pipeline spills, threatening the health and economy of major communities.

BU 13 Elevation Data Uses

Using their own words, respondents documented 23 Mission Critical Activities (MCAs) that identified BU 13 as their primary Business Use and identified the following 38 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.13a. BU 13 Elevation Data Uses

Data Use
Emergency Management
1. Emergency management and disaster recovery

Data Use
2. Emergency response and risk assessment for gas and liquid pipelines
3. Post storm damage assessment
Engineering Design and Construction
4. Energy development services to include civil engineering design, surveying services, permitting and environmental assessment
Environmental Protection
5. Dissolved mineral resource exploration
6. Encourage and assist safe well construction practices that do not harm state, federal, or private lands, environments or property
7. Environmental impact assessment, mitigation, and site restoration
8. Monitor land changes and address concerns while allowing for responsible exploration and production practices to continue where safe and beneficial
9. Reclamation work to restore land to pre-disturbance state
Hazard Assessment and Mitigation
10. Accurate shorelines and depths for inland waterways and bodies for pipeline safety in waterways
11. Flooding issues that impact oil and gas sites (tie down tanks in floodplains)
12. Impact assessments from oil spills
13. Oil spill prevention and response
Mapping/Boundary Delineation
14. High/low watermarks to help map new coastal ecosystems
15. Pipeline land records – land status plats, mineral estate plats, historical index, and serial register of land actions
Modeling
16. Analysis of river scouring from inland bathymetry
17. Authoritative elevation data for modeling and analysis
18. Bathymetry for undersea pipeline spill modeling
Oil and Gas
19. Bathymetry to identify debris, submerged structures, oil and gas resources, dredge management
20. Delivery of gas through state pipelines
21. Improve pipeline mileage calculations
22. Offshore oil/gas seismic surveys, oil/gas well data, high resolution survey data
23. Oil and gas exploration and production
24. Overseeing the drilling of wells for oil, gas and geothermal
25. Protect small producers from larger neighboring wells.
Permitting
26. Evaluation of sites required for permitting
27. Issuing of certificates for gas/oil interstate pipelines
28. Oil and gas leasing and permitting
Planning
29. Construction planning
30. Facility siting to ensure public safety and longer-term drilling plans
31. Facility siting to mitigate geologic hazards
32. Identify floodplains for siting new oil and gas sites in vulnerable areas

Data Use
33. Oil and gas location development; seismic survey planning
34. Pipeline and route selection
35. State land and asset management
Regulatory Reviews and Enforcement
36. Oil and gas regulatory management
37. Oil, gas and geothermal exploration and production monitoring
38. Regulatory compliance

BU 13 Tangible and Intangible Benefits

For the 23 MCAs that list Oil and Gas Resources as their primary Business Use:

- **Table E.13b** summarizes the reported future annual dollar benefits by geography type, totaling $20.39 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.13c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.13e.
- **Table E.13d** shows (in blue) the seven federal agencies, 15 states and territories, and one non-governmental entity that submitted MCAs with BU 13 as the primary Business Use. MCAs for which BU 13 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.13d.
- **Table E.13e** documents all the MCAs that listed BU 13 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.13e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 13 Reported Future Annual Dollar Benefits

Of the 23 MCAs that listed Oil and Gas Resources as their primary Business Use, one MCA estimated tangible annual benefits totally in financial terms; 14 MCAs had a combination of tangible and "Major" intangible benefits; and five MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.13b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 23 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.13b. BU 13 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$6,045,560	$100,000	$6,145,560
Inland Bathymetry	$0	$0	$0
Nearshore Bathymetry	$14,247,702	$0	$14,247,702
Offshore Bathymetry	$0	$0	$0
Totals	**$20,293,262**	**$100,000**	**$20,393,262**

BU 13 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.13c. BU 13 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	19	13	2	18	19
Inland Bathymetry	1	0	0	0	0
Nearshore Bathymetry	9	5	9	9	10
Offshore Bathymetry	4	4	4	4	4
Totals	**33**	**22**	**15**	**31**	**33**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 13 Reported Future Annual Dollar Benefits Maps

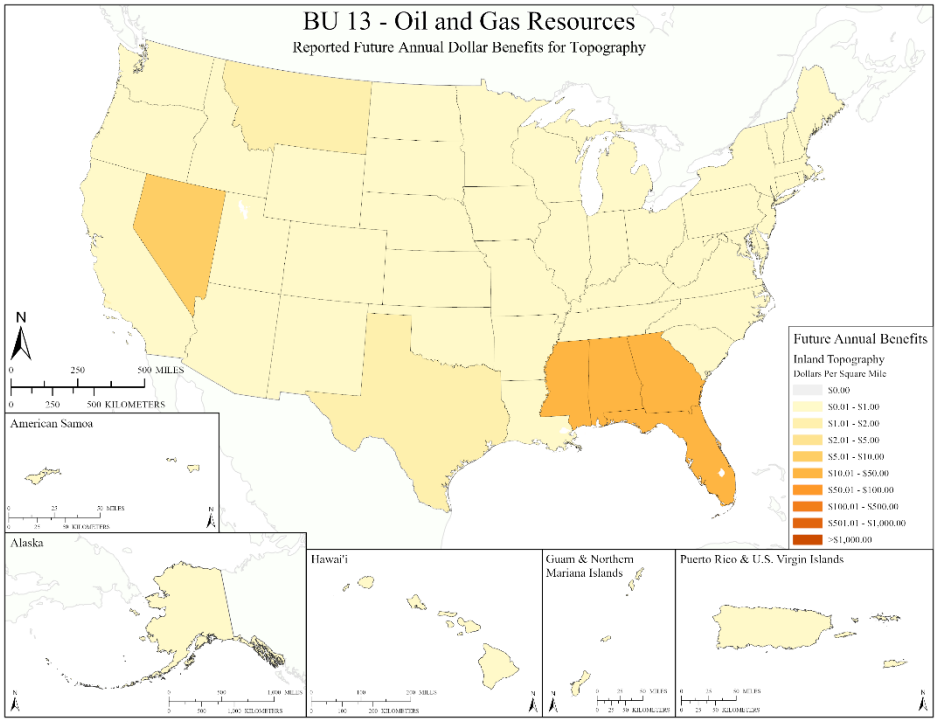

Figure E.13b. Reported Future Annual Dollar Benefits for Topography

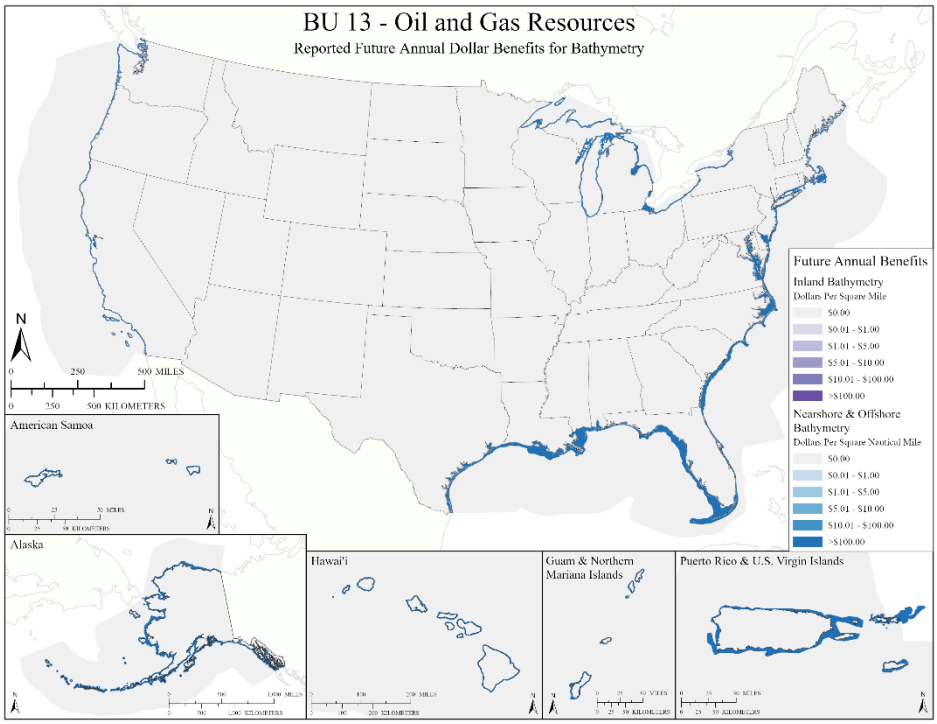

Figure E.13c. Reported Future Annual Dollar Benefits for Bathymetry

BU 13 Benefits Analysis

The total combined future benefits ($20.39 million per year) reported for BU 13 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 13 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, seven federal agencies (BOEM, FBI, FERC, NOAA, PHMSA, USAF, and USGS) submitted a total of seven MCAs listing BU 13 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry and offshore bathymetry. Of the seven total federal MCAs listing BU 13 as primary:
    - Inland Topography: Two provided dollar benefits and three indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: One provided dollar benefits and three indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and four indicated "Major" benefits.
    - The federal dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.
    - The BLM submitted an MCA with BU 13 as tertiary, but no benefits accrued to BU 13.
- State/Local/Tribal and U.S. Territory MCAs: Fourteen (14) states and territories submitted a total of 14 MCAs that designated BU 13 as their primary BU. Of the 14 MCAs listing BU 13 as primary:
    - Inland Topography: Eleven provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits or "Major" benefits.
    - Nearshore Bathymetry: Five provided dollar benefits and none indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits or "Major" benefits.
    - The state dollar benefits are understated because major oil and gas producing states, including North Dakota, Louisiana, and Oklahoma did not submit MCAs with BU 13 as primary, even though they are among the top four states for oil or gas production in the U.S.
- Non-governmental MCAs: Lampl Herbert Consultants submitted a well documented MCA including dollar benefits for BU 13. Maxar Technologies submitted an MCA with BU 13 as secondary, and Fugro and TCarta Marine submitted MCAs with BU 13 as tertiary, meaning that dollar benefits do not accrue to BU 13. There are hundreds, perhaps thousands, of private sector oil and gas consulting firms in the U.S. that did not participate in the survey; if they had participated in a way similar to Lampl Herbert, the annual dollar benefits could be billions of dollars higher.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.13b and E.13c:

- 55 “Major” Operational and Customer Service benefits and 79 “Major” benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate “Major” benefits into dollar savings. For example, if “Major” could be translated into a one percent savings for all of the total program budgets for BU 13 for which “Major” benefits are documented, this could easily be translated into millions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 13 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 13:

- **Table E.13d** color-codes those organizations having an MCA with BU 13 as Primary, Secondary, or Tertiary.
- **Table E.13e** summarizes the 23 MCAs with primary benefits for BU 13, rank ordered from the highest to the lowest tangible benefits.

Table E.13d. Organizations having an MCA with BU 13 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	**BOEM**	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	**FBI**	FCC	FEMA	**FERC**	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	**NOAA**	NPS	NRC	NRCS	NREL
	ORNL	OSMRE	**PHMSA**	SI	TVA	USACE	**USAF**	USARC	USBR	USCB
	USCG	USFS	**USGS**	USMC	USN					

State/Ter	**AL**	**AK**	AR	AZ	**CA**	**CO**	*CT*	DC	DE	FL	GA	HI	IA	ID
	IL	IN	KS	KY	*LA*	MA	MD	ME	*MI*	MO	**MN**	MS	**MT**	NC
	ND	NE	NH	NJ	**NM**	**NV**	NY	**OH**	*OK*	OR	*PA*	**RI**	SC	**SD**
	TN	**TX**	**UT**	VA	VT	*WA*	WI	**WV**	**WY**	PR	VI	GU	AS	CNMI

Non-Gov	Fugro	**Lampl Herbert Consultants, Inc.**	*Maxar Technologies*	TCarta Marine

Table E.13e. MCA summaries for BU 13, rank ordered from the highest to the lowest tangible benefits.

Organization	USGS		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60683						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	$1,578,291	Moderate	Minor	Major	Major
Inland Bathy	QL2B	2-3 yrs.	Minor	Minor	None	Minor	Minor
Nearshore B.	QL2B	2-3 yrs.	$9,259,028	Major	Major	Major	Major
Offshore B.	Order 1a	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Lampl Herbert Consultants, Inc.		Mine area delineation, wetlands, oil and gas location development, seismic survey planning. Elevation data are beneficial for conducting infills and updates.				
MCA Name	MCA No.						
Development and Management of Natural Resources	51000						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$3,000,000	Major	Major	Major	Major
Nearshore B.	QL0B	6-10 yrs.	$1,250,000	Major	Major	Major	Major

Organization	Alaska		Per Regulation: 11 AAC 53.020. Land records Land records trace the history of all land status from acquisition to disposal and consist of the following: (1) land status plats, which graphically portray all actions affecting state land and land in other ownership as required; these plats are for illustrative purposes only; the actual written documents remain the official record; there are two types of land status plats (A) land estate plats, which portray land actions and transactions on the surface of a township; and (B) mineral estate plats, which portray subsurface actions and transactions within a township; these plats may also show state tideland data; (2) the historical index, which is a narrative summary of and an index to state land actions and transactions that affect the title to, disposition of, or use status of state land or state tentatively approved land within a township; and (3) the serial register, which is a numerical index of land actions assigned division serial numbers.				
MCA Name	MCA No.						
Land Records	1209						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	$256,391	Major	don't know	don't know	don't know
Inland Bathy	QL2B	2-3 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	2-3 yrs.	$3,272,663	don't know	don't know	don't know	don't know
Offshore B.	Order 1a	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Nevada		Oil, Gas and Geothermal exploration and production monitoring and Dissolved Mineral Resource exploration. The Division of Minerals is responsible for overseeing the drilling of wells for Oil, Gas and Geothermal production or exploration. As the nation's 2nd largest, but most widespread, geothermal producer in a time when alternatives energy sources are increasingly in demand, the Division seeks to encourage and assist in safe well construction practices that do not harm state, federal or private lands, environments or property. In a few basins that have both domestic geothermal wells and industrial, we have seen concern that the larger wells are affecting the smaller producers or neighboring lands via subsidence of basins where production wells are located or bulging where injection wells are present. In the case of Dissolved Mineral Resources, such as lithium brines, exploration for new resources has been increasing in recent years, and basin could also potentially be affected by over-pumping. Nevada is a mining rich state and contributes greatly to national resource commodities needs. We wish to monitor land changes and address concerns while allowing for responsible exploration and production practices to continue where safe and beneficial to the state and nation.						
MCA Name	MCA No.						
Monitoring Basin Elevation Changes Associated With Oil, Gas, Geothermal, and Dissolved Mineral Resource Exploration	1442						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$500,149	$100,000	Minor	Major	Major

Organization	Texas		State land and asset management; oil and gas leasing; coastal resources management; permitting; emergency management and disaster recovery; oil spill prevention and response, recreation and tourism enhancement; veterans' benefits; state history preservation, outreach, and education. In coastal areas, elevation data are needed for post storm damage assessment of dunes, coastal structures, and houses as well as habitat monitoring. Bathymetry data are needed to identify debris, submerged structures, sub surface sand sources for beach renourishment, oil and gas resources, and mining activities on state lands. Bathymetry data are also needed for Dredge Management Placement Areas (DMPAs). When channels and berths are dredged, materials are placed on Permanent School Fund (PSF) lands, and fees are collected for material placed based on volume (only approved materials). The State would also like to be able to calculate post-storm volume loss using bathymetry. Currently bathymetry is collected manually with rods and boat transects. Elevation data are also needed for mine operator audits during operations (open pit mining of hard minerals) to include volume calculations on Permanent School Fund lands. The State has flown lidar and imagery for several mines for volumetric change.					
MCA Name	MCA No.						
Coastal Resource Management	21661						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$216,612	Major	Major	Major	Major
Inland Bathy	QL2B	2-3 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	2-3 yrs.	$322,653	don't know	Major	Major	Major

Organization	Montana		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60259						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$193,614	Major	Minor	Major	Major
Inland Bathy	QL2B	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	California		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60046						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$69,413	Major	Minor	Major	Major
Inland Bathy	QL2B	2-3 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	2-3 yrs.	$65,939	don't know	Major	Major	Major
Offshore B.	Order 1a	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Alabama		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60005						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$22,673	Major	Minor	Major	Major
Inland Bathy	QL2B	2-3 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	2-3 yrs.	$62,729	don't know	Major	Major	Major
Offshore B.	Order 1a	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	New Mexico		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60311						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$53,368	Major	Minor	Major	Major

Organization	Wyoming		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60539						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$42,931	Major	Minor	Major	Major
Inland Bathy	QL2B	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Minnesota		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60611						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$37,034	Major	Minor	Major	Major

Organization	Utah		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60472						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$36,688	Major	Minor	Major	Major

Organization	South Dakota		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60415						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$33,847	Major	Minor	Major	Major

Organization	Rhode Island		Rhode Island has gas pipelines and gas is delivered through its shipping port. The state has performed impact assessments from oil spills. Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60380						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$475	Major	Minor	Major	Major
Inland Bathy	QL2B	2-3 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	2-3 yrs.	$14,690	don't know	Major	Major	Major
Offshore B.	Order 1a	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Air Force		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60631						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	$4,075	Moderate	Minor	Major	Major

Organization	Ohio		Oil and gas regulatory management				
MCA Name	MCA No.						
Oil and Gas Regulatory Management	1300						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Annually	Major	Major	None	Major	Major

Organization	BOEM		Oil and Gas Resources Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance. Renewable Energy Resources Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Geologic Resource Mining and Extraction Onshore or offshore mineral extraction. Monitoring sand as a local resource. Seabed resources. Environmental impact assessment and site restoration. Offshore oil/gas operators are required to submit seismic surveys, oil/gas well data, high resolution survey data and other pertinent data. BOEM makes these data publicly available after a requisite waiting period (60 days to 25 years).				
MCA Name	MCA No.						
Oil and Gas Resources	1459						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL3B	2-3 yrs.	Major	Major	Major	Major	Major
Offshore B.	Order 1a	2-3 yrs.	Major	Major	Major	Major	Major

Organization	FERC		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance. FERC issues certificates for gas/oil interstate pipelines. Most are inland, but may be nearshore or offshore				
MCA Name	MCA No.						
Oil and Gas Resources	60653						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Moderate	Moderate	Major	Major
Inland Bathy	QL2B	2-3 yrs.	Major	Moderate	Moderate	Moderate	Moderate

Organization	NOAA		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60664						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Moderate	Minor	Major	Major
Inland Bathy	QL2B	2-3 yrs.	Minor	Minor	None	Minor	Minor
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Major
Offshore B.	Order 1a	2-3 yrs.	Major	Major	Major	Major	Major

Organization	FBI		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance.				
MCA Name	MCA No.						
Oil and Gas Resources	60709						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	Major	Moderate	Minor	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Minor	Minor	None	Minor	Minor
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Major	Major	Major
Offshore B.	Order 1	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Colorado		Environmental impact assessment and mitigation. Regulatory compliance. Facility siting to ensure public safety and longer term drilling plans - especially in areas of urbanization and mixed-use development. Flooding issues that impact oil and gas sites. Operators must tie down tanks in floodplains, etc. Elevation data help ID floodplains and for siting new oil & gas sites in vulnerable areas. Evaluation of sites required for permitting. Reclamation work helps to restore land to pre-disturbance state.				
MCA Name	MCA No.						
Environmental and Regulatory Site Assessments for Oil and Gas Activities	22163						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Moderate	Moderate	Minor	Minor	Moderate

Organization	West Virginia		Energy development services to include civil engineering design, surveying services, permitting and environmental assessment. Our project types include oil and gas, wind power, coal, telecommunications, construction, transportation, public utilities and private surveys. BU 13 - Oil and Gas Resources				
MCA Name	MCA No.						
Civil Engineering and Field Services	22403						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	Minor	Moderate	None	None	None

Organization	PHMSA		Emergency response and risk assessment for gas and liquid pipelines. Elevation data could be used to improve pipeline mileage calculations. PHMSA's stakeholders could benefit from bathymetry for undersea pipeline spill modeling. The hazardous materials group would also have similar requirements for elevation data. PHMSA's 500 stakeholders would also be interested in elevation data for modeling and analysis. An authoritative shoreline dataset would also be very helpful to PHMSA and its stakeholders. Having accurate shorelines for inland waterways and bodies, and (slightly less so) depths, would be helpful for us to analyzing pipeline safety and risk in waterways, and having high/low watermarks along coastlines and tidal headways in estuaries would help map new coastal Eco USAs. We also have an interest in analyzing river scouring, for which inland bathymetry may be helpful.					
MCA Name	MCA No.						
Emergency Response and Risk Assessment for Gas and Liquid Pipelines	22506						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	>10 yrs.	Minor	Minor	None	Minor	Minor
Inland Bathy	X-Sec meet needs	>10 yrs.	Minor	Minor	None	Minor	Minor

BU 14 - Cultural Resources Preservation and Management

BU 14 Scope

Business Use #14 (BU 14) includes discovery and analysis of underwater archaeological and historical cultural sites; site protection and preservation planning; and discovery and analysis of Native American and other historical cultural sites and subsistence activities.

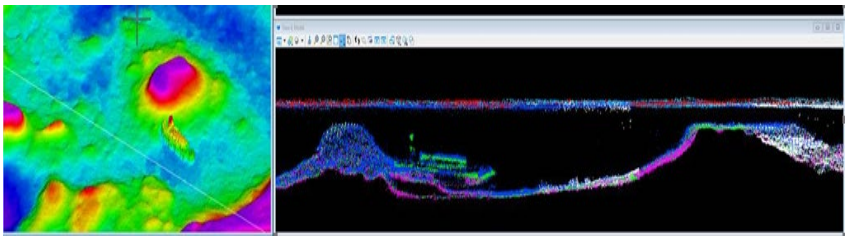

Figure E.14a. Topobathymetric lidar detected a sunken ship off the coast of Puerto Rico, previously unknown. Image courtesy of Dewberry Engineers. Similarly, topographic lidar discovered a Mayan "megalopolis" below a Guatemalan jungle, widely reported by the international press.

The National Park Service (NPS) is an obvious champion for this Business Use, but other federal, state, and local agencies have related responsibilities for Cultural Resources Preservation and Management.

BU 14 Background Information

Research by archeologists in forested areas has found that: (1) topographic lidar can be effectively used, as a pre-field method, to detect cultural features such as mounds and pits in a forested environment; (2) although ephemeral surface features can be detected, effectiveness increases with degree of slope, depth or elevation of feature, and spatial area covered by the feature; and (3) incorporation of lidar into the GIS environment produces effective navigational tools for use in field work and for the recordation of collected digital spatial data. As shown at Figure E.14a, topobathymetric lidar is also excellent in identification of underwater historical artifacts.

BU 14 Elevation Data Uses

Using their own words, respondents documented 47 Mission Critical Activities (MCAs) that identified BU 14 as their primary Business Use and identified the following 31 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.14a. BU 14 Elevation Data Uses

Data Use
Cultural Resources Management
1. Conduct or cause to conduct underwater archaeological field or laboratory investigations at prehistoric and historic sites
2. Cultural and historical resource management including onshore archaeology and offshore maritime archaeology
3. Discovery and analysis of Native American and other historical cultural sites and subsistence activities
4. Discovery and analysis of underwater archaeological and historical cultural sites
5. Elevation data are used by archaeologists for review of projects done by others and for conducting in-house projects
6. Elevation data support location and protection of Native American Midden (shell) mounds which are located on Florida's coastline and are impacted by hurricanes and sea level rise
7. Management and protection of cultural resources with regards to public and private development planning

Data Use
8. Management of cultural habitat and cultural resources, historical landscaping, discovery of historic roads and trails, and identification of changed paths of waterways and viewshed analyses
9. Protection and preservation of cultural and natural resources
10. Protecting cultural heritage sites
11. Support state historical property group
Mapping/Boundary Delineation
12. Addressing and assignment of tax parcel numbers
13. Elevation data are needed to inventory, identify, document, map, and preserve sites
14. Elevation data are used in BIM, GIS, and CADD to map historical facilities
15. Geospatial support for tribal departments, including cultural resource mapping
16. Identification and inventory of historical sites, to include those from WWII in the Marianas
17. Identification of cultural resources through research, survey, and analysis
18. Identification of historical shorelines and cultural sites
19. Identify archaeological resources – cellar holes, foundations, cemeteries, etc.
20. Locating and cataloging structures and Native developments
21. Mapping of shipwrecks and other submerged objects, including those that were once on land as shorelines have changed
22. Stone wall mapping for historical property records
23. Survey and inventory of terrestrial and underwater archaeological, cultural, and historical resources
Modeling
24. Bare earth modeling to detect historic features
25. Future predictive modeling based on elevation and presumed historic elevations, resulting in identification of potential historic sites
Permitting
26. Elevation data are needed for permit reviews, research on natural resources
Planning
27. BLM has tribal responsibilities where BLM has trust holdings
28. BLM manages the land under USBR reservoirs, including boat ramps or cultural resources under the water
29. Develop visualizations to help Smithsonian museum staff understand how we are using built space
30. Site protection and preservation planning
Regulatory Reviews and Enforcement
31. FERC regulatory reviews including details for historic/cultural sites

BU 14 Tangible and Intangible Benefits

For the 47 MCAs that list Cultural Resources Preservation and Management as their primary Business Use:

- **Table E.14b** summarizes the reported future annual dollar benefits by geography type, totaling $4.12 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.14c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.14e.
- **Table E.14d** shows (in blue) the eight federal agencies, 38 states and territories, and one non-governmental entities that submitted MCAs with BU 14 as the primary Business Use. MCAs for which BU 14 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.14d.
- **Table E.14e** documents all the MCAs that listed BU 14 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.14e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 14 Reported Future Annual Dollar Benefits

Of the 47 MCAs that listed Cultural Resources Preservation and Management as their primary Business Use, 38 MCAs estimated their tangible annual benefits totally in financial terms; two MCAs had a combination of tangible and "Major" intangible benefits; and five MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.14b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 47 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.14b. BU 14 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$1,535,817	$568,978	$2,104,795
Inland Bathymetry	$1,227,428	$0	$1,227,428
Nearshore Bathymetry	$575,243	$0	$575,243
Offshore Bathymetry	$207,332	$0	$207,332
Totals	**$3,545,820**	**$568,978**	**$4,114,798**

BU 14 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.14c. BU 14 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	8	5	0	1	3
Inland Bathymetry	2	21	1	0	0
Nearshore Bathymetry	20	4	0	1	1
Offshore Bathymetry	13	2	0	1	1
Totals	**43**	**32**	**1**	**3**	**5**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 14 Reported Future Annual Dollar Benefits Maps

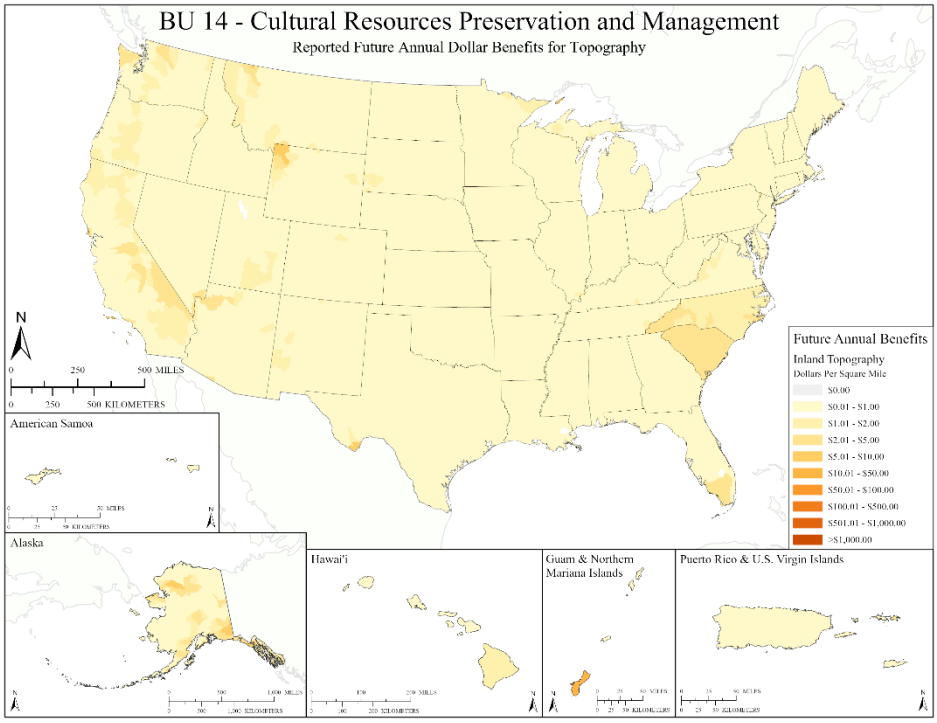

Figure E.14b. Reported Future Annual Dollar Benefits for Topography

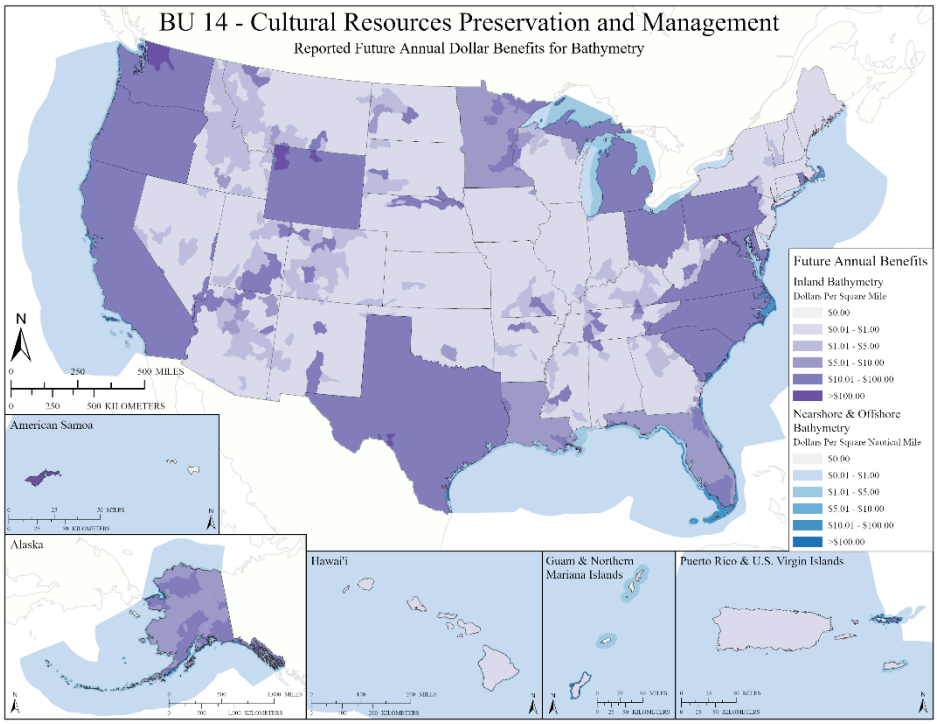

Figure E.14c. Reported Future Annual Dollar Benefits for Bathymetry

BU 14 Benefits Analysis

The total combined future annual benefits ($4.12 million per year) reported for BU 14 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 14 Reported Future Annual Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, seven federal agencies (BLM, FBI, FERC, NPS, SI, USAF, and USFS) submitted a total of eight MCAs listing BU 14 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the eight total federal MCAs listing BU 14 as primary:
    - Inland Topography: Four provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: Three provided dollar benefits and two indicated "Major" benefits.
    - Nearshore Bathymetry: Two provided dollar benefits and none indicated "Major" benefits.
    - Offshore Bathymetry: One provided dollar benefits and none indicated "Major" benefits.
    - Three federal agencies (NOAA, TVA, USGS) submitted MCAs with BU 14 as secondary, meaning dollar benefits do not accrue to BU 14.
- State/Local/Tribal and U.S. Territory MCAs: Thirty-six (36) states and territories submitted a total of 38 MCAs that designated BU 14 as their primary BU. Of the 38 MCAs listing BU 14 as primary:
    - Inland Topography: 35 provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: 19 provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: 20 provided dollar benefits and two indicated "Major" benefits.
    - Offshore Bathymetry: 12 provided dollar benefits and one indicated "Major" benefits.
- Non-governmental MCAs: One non-governmental organization (Search) provided one MCA listing BU 14 as primary and indicated "Major" benefits for inland topography, nearshore bathymetry, and offshore bathymetry. One other non-governmental organization (National Tribal Geographic Information Support Center) submitted an MCA listing BU 14 as secondary, meaning no benefits accrue to BU 14.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.14b and E.14c:
    - 75 "Major" Operational and Customer Service benefits and nine "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 14 for which "Major" benefits are documented, this could easily be translated into hundreds of thousands of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 14 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 14:

- **Table E.14d** color-codes those organizations having an MCA with BU 14 as Primary, Secondary, or Tertiary.
- **Table E.14e** summarizes the 47 MCAs with primary benefits for BU 14, rank ordered from the highest to the lowest tangible benefits.

Table E.14d. Organizations having an MCA with BU 14 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	**BLM**	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	**FBI**	FCC	FEMA	**FERC**	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	*NOAA*	**NPS**	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	**SI**	*TVA*	USACE	**USAF**	USARC	USBR	USCB
	USCG	**USFS**	*USGS*	USMC	USN					

State/Ter	AL	**AK**	AR	AZ	**CA**	CO	**CT**	DC	DE	**FL**	GA	**HI**	**IA**	ID
	IL	**IN**	**KS**	KY	**LA**	MA	**MD**	ME	**MI**	MO	**MN**	**MS**	**MT**	**NC**
	ND	**NE**	**NH**	**NJ**	**NM**	**NV**	NY	**OH**	OK	**OR**	**PA**	**RI**	**SC**	**SD**
	TN	**TX**	UT	**VA**	VT	**WA**	**WI**	WV	**WY**	PR	**VI**	**GU**	**AS**	**CNMI**

Non-Gov	*National Tribal Geographic Information Support Center*	**SEARCH**		

Table E.14e. MCA summaries for BU 14, rank ordered from the highest to the lowest tangible benefits.

Organization	NPS		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60704						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$584,951	$100,385	Moderate	Moderate	Minor
Inland Bathy	QL0B	6-10 yrs.	$401,938	Major	Moderate	Moderate	Minor
Nearshore B.	QL0B	4-5 yrs.	$325,908	Moderate	Minor	Moderate	Minor

Organization	Alaska		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60012						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$107,068	$93,611	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$256,755	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$115,445	Moderate	Minor	Moderate	Minor
Offshore B.	Order 1a	6-10 yrs.	$83,461	Moderate	Minor	Moderate	Minor

Organization	USFS		Protecting cultural heritage sites				
MCA Name	MCA No.						
Protecting Cultural Heritage Sites	50008						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$360,000	Major	Moderate	Moderate	don't know
Inland Bathy	QL2B	>10 yrs.	$40,000	Major	Moderate	Moderate	don't know

Organization	Texas		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60443						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$48,519	$42,421	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$116,352	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$11,371	Moderate	Minor	Moderate	Minor

Organization	California		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60047						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$28,987	$25,343	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$69,512	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$2,326	Moderate	Minor	Moderate	Minor
Offshore B.	Order 1a	6-10 yrs.	$11,173	Moderate	Minor	Moderate	Minor

Organization	Michigan		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60236						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$10,646	$9,308	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$25,531	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$10,582	Moderate	Minor	Moderate	Minor
Offshore B.	Order 1a	6-10 yrs.	$80,820	Moderate	Minor	Moderate	Minor

Organization	South Carolina		Conduct or cause to conduct underwater archaeological field/or laboratory investigations at prehistoric and historic sites in the best interest of the State.				
MCA Name	MCA No.						
Underwater Archaeological Investigations	22156						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$60,000	$30,000	Moderate	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$20,000	don't know	Moderate	Minor	Minor
Nearshore B.	QL1B	4-5 yrs.	$20,000	don't know	Minor	Moderate	Minor
Offshore B.	Order 1a	6-10 yrs.	don't know	don't know	Minor	Moderate	Minor

Organization	North Carolina		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities. Lidar is being used to find historic sites.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60325						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$60,000	$30,000	Minor	Minor	Minor
Inland Bathy	QL0B	4-5 yrs.	$21,699	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$12,284	Moderate	Minor	Moderate	Minor
Offshore B.	I don't know	4-5 yrs.	$1,508	Moderate	Minor	Moderate	Minor

Organization	Florida		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities. Elevation data support location and protection of Native American Midden mounds which are located on Florida's coastline and are impacted by hurricanes and sea level rise.				
MCA Name	MCA No.						
Discovery, Analysis, and Preservation of Cultural and Historical Resources	1235						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	>10 yrs.	$10,285	$8,992	Moderate	Minor	None
Inland Bathy	QL0B	>10 yrs.	$24,665	don't know	don't know	don't know	don't know
Nearshore B.	QL0B	2-3 yrs.	$36,186	don't know	don't know	don't know	don't know
Offshore B.	Order 1	2-3 yrs.	$8,314	don't know	don't know	don't know	don't know

Organization	Oregon		Statewide cultural resource protection and preservation. Elevation data are used by archaeologists for review of projects done by others and for conducting in-house projects.				
MCA Name	MCA No.						
Statewide Cultural Resource Protection and Preservation	21672						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$17,787	$15,551	Minor	None	None
Inland Bathy	QL0B	6-10 yrs.	$42,655	Major	Moderate	Minor	Minor
Nearshore B.	QL3B	6-10 yrs.	$771	don't know	don't know	don't know	don't know
Offshore B.	Order 1a	6-10 yrs.	$2,529	Moderate	Minor	Moderate	Minor

Organization	Wyoming		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60540						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$17,928	$15,675	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$42,992	Major	Moderate	Minor	Minor

Organization	Minnesota		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60612						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$15,465	$13,521	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$37,087	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$155	Moderate	Minor	Moderate	Minor

Organization	Washington		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60516						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$12,382	$10,826	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$29,694	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$4,384	Moderate	Minor	Moderate	Minor
Offshore B.	Order 1a	6-10 yrs.	$5,503	Moderate	Minor	Moderate	Minor

Organization	Louisiana		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60203						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$8,446	$7,385	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$20,255	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$17,391	Moderate	Minor	Moderate	Minor
Offshore B.	Order 1a	6-10 yrs.	$634	Moderate	Minor	Moderate	Minor

Organization	Montana		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60260						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$26,951	$23,563	Minor	Minor	Minor

Organization	New Mexico		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60312						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$22,286	$19,485	Minor	Minor	Minor

Organization	Ohio		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60344						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$7,562	$6,611	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$18,134	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$2,563	Moderate	Minor	Moderate	Minor
Offshore B.	Order 1a	6-10 yrs.	$6,343	Moderate	Minor	Moderate	Minor

Organization	Nevada		Client service and support in using geospatial data. Elevation data are needed for bare earth modeling; contours are used to derive hydrology networks. Bare earth data are needed to detect historic features.				
MCA Name	MCA No.						
Client Service and Support	22232						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$20,575	$18,090	None	Moderate	Moderate
Inland Bathy	QL3B	4-5 yrs.	Minor	Minor	None	None	None

Organization	Virginia		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60498						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$7,401	$6,471	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$17,749	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$5,594	Moderate	Minor	Moderate	Minor

Organization	Pennsylvania		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60364						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$8,303	$7,259	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$19,911	Major	Moderate	Minor	Minor

Organization	Kansas		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60186						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$15,080	$13,185	Minor	Minor	Minor

Organization	Nebraska		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60274						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$14,178	$12,396	Minor	Minor	Minor

Organization	South Dakota		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60416						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$14,134	$12,358	Minor	Minor	Minor

Organization	Illinois		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60142						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$10,326	$9,028	Minor	Minor	Minor

Organization	Iowa		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60177						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$10,314	$9,017	Minor	Minor	Minor

Organization	Wisconsin		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60528						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$10,276	$8,984	Minor	Minor	Minor

Organization	Mississippi		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60245						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$8,736	$7,638	Minor	Minor	Minor

Organization	Washington		Addressing, Assignment of Tax Parcel Numbers, Geospatial support for Tribal departments including - Water Resource Monitoring, Coastal and Geohazard Mapping, Cultural Resource Mapping, Land Record Management.				
MCA Name	MCA No.						
Swinomish Indian Tribal Community Land and Water Resources Management	1432						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	Major	Major	Moderate	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$15,000	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Minor	Moderate	Moderate

Organization	Maryland		Cultural resources management and preservation. Identification of cultural resources through research, survey and analysis. Protection and preservation of resources through outreach and education as well as planning (including hazard mitigation). Elevation data are needed for permit reviews, research on natural resources, Management of cultural habitat and cultural resources, historical landscaping, discovery of historic roads and trails, identification of changed paths of waterways, and viewshed analysis.				
MCA Name	MCA No.						
Cultural Resources Management and Preservation	21633						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	Moderate	Moderate	Minor	None	None
Inland Bathy	QL0B	4-5 yrs.	$6,874	Minor	don't know	None	None
Nearshore B.	QL0B	4-5 yrs.	$6,874	Minor	Minor	Moderate	None
Offshore B.	Order 1a	4-5 yrs.	$1,206	Minor	Minor	Moderate	None

Organization	Indiana		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60155						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$6,632	$5,798	Minor	Minor	Minor

Organization	Air Force		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60632						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$4,335	$744	Moderate	Moderate	Minor

Organization	Northern Mariana Islands		Survey and inventory of terrestrial and underwater archaeological, cultural, and historical resources. Management and protection of resources with regards to public and private development and planning. Elevation data are needed for identification and inventory of historic sites, to include those from WWII. Future predictive modelling is based on elevation and presumed historic elevations, resulting in identification of potential historic sites.				
MCA Name	MCA No.						
Management of Historic Resources	1374						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$33	$29	None	None	None
Nearshore B.	QL2B	>10 yrs.	$27	Major	None	None	None
Offshore B.	Order 1a	>10 yrs.	$4,079	Major	None	None	None

Organization	Guam		Preservation of cultural and natural resources. Elevation data are needed for future siting of wind energy projects. Bathymetry is needed for fisheries management.				
MCA Name	MCA No.						
Preservation of Cultural and Natural Resources	1382						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$1,179	$1,031	Moderate	Moderate	Major
Inland Bathy	QL2B	>10 yrs.	Major	Major	Major	Moderate	Moderate
Nearshore B.	QL1B	4-5 yrs.	$1,245	Major	Moderate	Major	Major
Offshore B.	I don't know	6-10 yrs.	Major	Major	Moderate	Major	Major

Organization	Guam		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60099						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,179	$1,031	Minor	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$1,245	Moderate	Minor	Moderate	Minor

Organization	New Jersey		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities. New Jersey has an active historical property group. Lidar point clouds would be beneficial in locating and cataloging structures and Native developments.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60298						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,380	$1,207	Minor	Minor	Minor

Organization	Hawai'i		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60120						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,179	$1,031	Minor	Minor	Minor

Organization	Rhode Island		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60381						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$198	$173	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$475	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$518	Moderate	Minor	Moderate	Minor
Offshore B.	Order 1a	6-10 yrs.	$693	Moderate	Minor	Moderate	Minor

Organization	Connecticut		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities. Stone wall mapping for property records.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60067						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$911	$796	Minor	Minor	Minor

Organization	SI		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60688						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$167	$2	Moderate	Moderate	Minor
Inland Bathy	QL0B	6-10 yrs.	$115	Major	Moderate	Moderate	Minor
Nearshore B.	QL0B	4-5 yrs.	$32	Moderate	Minor	Moderate	Minor
Offshore B.	Order 1a	6-10 yrs.	$1,069	Moderate	Minor	Moderate	Minor

Organization	U.S. Virgin Islands		Identification of historical shorelines and cultural sites. Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60456						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$24	$21	Minor	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$340	Moderate	Minor	Moderate	Minor

Organization	American Samoa		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60029						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$14	$12	Minor	Minor	Minor
Inland Bathy	QL0B	6-10 yrs.	$35	Major	Moderate	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$2	Moderate	Minor	Moderate	Minor

Organization	SI		Develop visualizations to help museum staff understand how we are using built space. Elevation data are used in BIM, GIS, and CADD to map facilities.				
MCA Name	MCA No.						
Facilities Operations and Support	1153						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	Major	Moderate	Moderate	Moderate	Moderate

Organization	New Hampshire		Discovery and analysis of archaeological and historical sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities. Identify archeological resources – cellar holes, foundations, cemeteries, etc. Currently using lidar, not yet using bathymetry. DEMs at 1-meter post spacing are not adequate for needs, but with 2.5-foot post spacing, relevant objects can be identified. Shipwrecks and other submerged objects would be of interest, including those that were once on land as shorelines have changed.				
MCA Name	MCA No.						
Discovery and Analysis of Archaeological and Historical Sites	11476						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Moderate	Minor	don't know	don't know
Nearshore B.	QL0B	2-3 yrs.	Major	Moderate	Minor	don't know	don't know

Organization	SEARCH		Cultural and historical resource management including onshore archaeology and offshore maritime archaeology				
MCA Name	MCA No.						
Cultural Resources Management	22205						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	Major	Major	Minor	Minor	Minor
Inland Bathy	QL0B	Event driven	Minor	Moderate	Minor	Minor	None
Nearshore B.	QL0B	Annually	Moderate	Major	Minor	Minor	Minor
Offshore B.	Order 1a	Annually	Major	Minor	Minor	Minor	Minor

Organization	FERC		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities. FERC regulatory reviews include details for historic/cultural sites.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60654						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Moderate	Moderate	Moderate	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	Moderate	Major	Moderate	Moderate	Moderate

Organization	FBI		Discovery and analysis of underwater archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	60710						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Moderate	Moderate	Moderate	Moderate	Minor
Inland Bathy	QL0B	2-3 yrs.	Moderate	Major	Moderate	Moderate	Minor
Nearshore B.	QL1B	2-3 yrs.	Moderate	Moderate	Minor	Moderate	Minor
Offshore B.	Order 1	2-3 yrs.	Moderate	Moderate	Minor	Moderate	Minor

Organization	BLM		Cultural Resources Preservation and Management. BLM manages the land under USBR reservoirs, including boat ramps or cultural resources under the water. USBR manages the water only. Elevation data are needed to inventory, identify, document, map, and preserve sites. BLM has Tribal responsibilities where BLM has trust holdings.				
MCA Name	MCA No.						
Cultural Resources Preservation and Management	22134						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Event driven	Moderate	Moderate	Moderate	Moderate	Moderate
Inland Bathy	QL0B	Event driven	Minor	Minor	Moderate	Moderate	Moderate

BU 15 - Flood Risk Management

BU 15 Scope

Business Use #15 (BU 15) includes flood risk modeling and mapping of riverine and coastal areas; dam/dike/levee safety analysis; emergency management; and flood forecasts.

Although the Federal Emergency Management Agency (FEMA) is a champion for this Business Use, other federal, state, and local agencies are also responsible for relevant flood risk management MCAs.

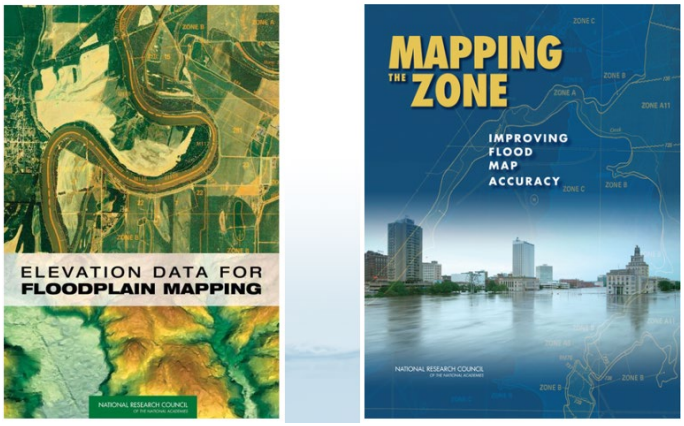

Figure E.15a. National Research Council studies consistently show that accurate topographic data from lidar are the most important factor in determining water surface elevations, base flood elevations, the extent of flooding, and the accuracy of flood maps. Courtesy NRC. FEMA now uses the USGS Lidar Base Specifications for lidar used for all Flood Insurance Studies.

BU 15 Background Information

The National Flood Insurance Program (NFIP) was established to reduce future flood damage through hazard identification and mapping, effective community floodplain management, and insurance protection for property owners. FEMA's Risk MAP (Mapping, Assessment, and Planning) approach integrates risk assessment, mitigation planning, risk communication, and actionable mitigation. It emphasizes updating the flood hazard data and maps of the nation's coastal areas; a reevaluation of the level of protection provided by levees; and watershed-based updates to reflect changes since current Flood Insurance Rate Maps (FIRMs) were produced. FIRMs are utilized 20-30 million times a year by communities issuing permits for building in high risk flood zones and mitigation planning; lenders in their enforcement of the insurance purchase requirement; federal agencies under EO 11988 (Floodplain Management); developers who build in and near the high risk areas; emergency responders and those making decisions on where and how to recover and rebuild after disasters; and individuals who rely on insurance offered by the NFIP as a financial backstop to their most valuable investment, their homes. Whether lenders, who enforce flood insurance purchase requirements based on FIRMs that delineate Special Flood Hazard Areas (SFHAs) requiring flood insurance, or home owners who may be required to purchase flood insurance for their homes, the success of the NFIP is based on using the most accurate elevation data for performing hydrologic and hydraulic (H&H) modeling and analysis and for SFHA delineation.

Two studies by the National Research Council (NRC), depicted in Figure E.15a, emphasized the high value of lidar data for the NFIP. The first NRC study, in 2007, entitled "Elevation Data for Floodplain Mapping," documented the fact that existing elevation data were inadequate and that *Elevation for the* Nation (now known as the USGS 3D Elevation Program or 3DEP), based on lidar with 2-foot contour accuracy or better, is needed for accurate mapping of floodplains and coastal areas. The second NRC study, in 2009, entitled "Mapping the Zone: Improving Flood Map Accuracy," documented 19 benefits of improved map accuracy – benefits that reduce loss of life, property and business, and reduce issues pertaining to the purchase of flood insurance by improved public confidence in the accuracy and legitimacy of FIRMs. The first finding from NRC's 2009 study states: "Topographic data are the most important factor in determining water surface elevations, base flood elevations, and the extent of flooding and, thus, the accuracy of flood maps in riverine areas;" and the first recommendation from NRC's 2007

study states: "*Elevation for the Nation* should employ lidar as the primary technology for digital elevation data acquisition."

BU 15 Elevation Data Uses

Using their own words, respondents documented 102 Mission Critical Activities (MCAs) that identified BU 15 as their primary Business Use and identified the following 104 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.15a. BU 15 Elevation Data Uses

Data Use
Climate Change Analysis
1. Climate change impact mitigation program
2. Community resilience and climate adaptation for imminently threatened Alaska Native villages
3. Evaluate sea level rise impacts and climate change predictions
Data Development and Management
4. Authoritative Living Atlas as reference tool for decision makers
5. Data discovery and distribution supporting state agencies, local governments and private firms within the state
6. GIS clearinghouse for floodplain mapping activities
7. National Hydrography Dataset (NHD) and Watershed Boundary Dataset (WBD) framework development; provide a geospatial hydrography framework for the Nation
8. NHD/WBD state stewardship
Emergency Management
9. Assist Office of Emergency Management and USACE, providing detailed elevation data for use in inundation mapping in flooding events and for pre-planning future events
10. Community coordination and emergency preparedness planning
11. County emergency management
12. Disaster recovery
13. Emergency management and flood inundation safety analyses
14. Emergency management and public works support, including Emergency Operations Center
15. Emergency planning and response/hazard mitigation
16. Homeowner notification in the event of a dam break
17. Mobile lidar solutions post disaster
18. Real-time inundation mapping
19. Real-time response to emergency management due to flooding from storms
Engineering Design and Construction
20. Engineering, architecture, planning, environmental, survey and mapping, and construction management services
21. Floodplain mapping; hydrologic forecasting, engineering design and analysis
Floodplain Management
22. 3D flood visualizations using depth grids and building footprints
23. Analysis of tidal and stream gage data and topographic/environmental conditions
24. FEMA floodplain coordination/mitigation
25. Flood inundation and risk mapping

Data Use
26. Flood inundation mapping, flood risk mitigation, emergency management, and updating of flood insurance maps
27. Flood mapping and disaster mitigation planning
28. Flood mapping and infrastructure planning
29. Floodplain management and stormwater analysis
30. Floodplain mapping to educate the public, build confidence in the NFIP, protect people and their property through regulation of floodplain development, and make better informed decisions
31. Floodplain mapping, flood mitigation, stream network digitization
32. Floodplain mapping, geodetic control, flood warning, coastal hazard mitigation, emergency management, risk management
33. Inland bathymetry provides the ability to manage flows and levels in a way that balances and improves flood control, water supply, water quality, and natural systems
34. Mapping floodplain environments for the health and welfare of citizens, habitat management, erosion, and environmental management
35. Offshore bathymetry for development of new coastal flood mapping projects
36. Prepare flood studies and coordinate with federal and local emergency management officials
37. River flood inundation mapping based on event frequency and gage state levels; web-based interactive maps show the inundation associated with selected river gage state levels
38. Storm water management
Hazard Assessment and Mitigation
39. Alaska community coastal protection project
40. Coastal and riverine mitigation guidance to state residents, local officials, and developers
41. Coastal hazard mitigation and flood risk management; improve flood management
42. Dam breach analysis and inundation mapping
43. Dam safety analysis and emergency operations
44. Design and mitigate flood event risk and impacts of areas of high topographic relief and impervious surface on stormwater and run-off
45. Disaster based situational awareness and risk assessment (e.g., dam modeling, coastal flooding, tsunami inundation, etc.)
46. Emergency Action Plans (EAPs) for high and significant hazard dams.
47. Ensure public safety through safe dams and properly permitted and constructed water wells
48. Evaluate external flood hazard and risk at proposed and existing nuclear facilities; external flood hazard and risk analysis; storm surge modeling
49. Flood risk analysis, dam/dike/levee safety analysis, emergency management
50. Flood risk assessment, analysis, mapping, and mitigation
51. Flood risk management and infrastructure improvement
52. Flood risk reduction
53. Hazard, natural resources, infrastructure and critical resource management
54. Interpretation of precipitation and development of flood forecasts
55. Local flood hazard mitigation plans
56. Mapping to show the extent of flood waters for selected river gage levels; map catalog of inundation profiles

Data Use
57. Mitigating the impacts of riverine and coastal flooding and storm surge by managing the development of flood insurance rate maps and flood risk products/tool
58. National water resource analysis and forecasting for high, low and normal flows/levels from small streams to large rivers, including the coastal tidal boundary
59. Natural hazard mitigation
60. Provide flood hazard risk information for use in wise development and flood hazard mitigation
61. Risk Mapping, Assessment and Planning (Risk MAP) program
62. Vulnerability analyses, flood risk analyses, and identification of effects on infrastructure, critical facilities, transportation routes, etc.
Modeling
63. Base Level Engineering (BLE) analysis
64. Coastal hazard mitigation, inundation modeling, flood studies, watershed studies
65. Dam break modeling and inundation mapping
66. Elevation data are needed for modeling of storm surge and sea level rise and for planning flood control structures
67. Elevation data factor into models for movement of water, H&H model input, specific flood forecasts at gage stations, national water modeling
68. Floodplain management, H&H modeling, and water use planning
69. Floodplain mapping and floodwater flow modeling, including H&H modeling, planning and existing conditions analysis
70. H&H modeling, elevation studies, viewshed analyses, site suitability assessments
71. H&H modeling, water flow analysis, and flood risk management, assisting local and state entities in identifying areas of flood risk, mitigating those risks, and recovering from flood events
72. Hazard mitigation – dam safety, floodplain management, H&H modeling, dam breach and inundation modeling, flood studies, and NFIP floodplain administration
73. Hazard mitigation planning including HAZUS
74. HAZUS Level 2 flood risk analysis and loss estimates
75. Hydro-enforced data for 2D flood inundation modeling
76. Hydrologic modeling, H&H modeling, flood mitigation, design of stormwater retention facilities, wetlands attenuation, etc.
77. Inland bathymetry to build 2D hydraulic models to help update existing and new Flood Insurance Study areas.
78. Modeling of water systems including flooding, effects of levees, dam breaks, floodplains
79. National flood and water modeling, as well as flood risk and inundation mapping
80. NFIP flood mapping activities, H&H analysis, dam repair or new dam construction, levees, and dam breach modeling
81. Storm surge modeling
82. Stream channel analysis and mapping including stream bank erosion, flood risk modeling and mapping
83. Support flood risk modeling and mapping of riverine, bayou, and low-lying areas
84. Support Risk MAP by developing an accurate flood risk model through the DFIRM data products
85. Support TVA for H&H studies, engineering and environmental studies
Permitting

Data Use
86. Issue permits for construction to assure compliance with flood regulations; evaluation of apparent violations and criteria for issuing permits
87. Permitting for construction in a floodway
88. Review/permitting of proposed floodplain development
Planning
89. Alaska village inter-agency planning
90. Community decision making
91. Effective management and planning for tribal governments
92. Elevation data improves products and work efficiency and promotes better decisions
93. Minimum Flow & Levels (MFL) projects for rivers, major lakes and springs benefit significantly from high resolution lidar bathymetry
94. Publicly available elevation data allows water management districts to request and expect more from permit applicants, supporting better planning and decision making across government agencies
Regulatory Reviews and Enforcement
95. Administering flood damage prevention ordinances for compliance with NFIP requirements and conveying flood risk information to constituents
96. Coordinate NFIP actions for the District of Columbia
97. Enforcement and permitting of construction in floodways; enforcement actions for violations of floodway rules
98. Floodplain management and Community Assistance Visits (CAV) programs
99. Identify potential buy-out areas that repeatedly flood
100. NFIP; elevation data support overall operations including flood insurance rating, floodplain management, LOMAs, etc.
101. Support local jurisdictions participating in the NFIP
Research
102. Surface hydrology research
103. University research programs for environmental modeling
Sea Level Rise/Subsidence
104. Continuous integrated surface model for the State supports evaluation of sea level rise impacts

BU 15 Tangible and Intangible Benefits

For the 102 MCAs that list Flood Risk Management as their primary Business Use:

- **Table E.15b** summarizes the reported future annual dollar benefits by geography type, totaling $1.66 billion per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.15c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.15e.
- **Table E.15d** shows (in blue) the 14 federal agencies, 53 states and territories, and seven non-governmental entities that submitted MCAs with BU 15 as the primary Business Use. MCAs for which BU 15 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.15d.

- **Table E.15e** documents all the MCAs that listed BU 15 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.15e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 15 Reported Future Annual Dollar Benefits

Of the 102 MCAs that listed Flood Risk Management as their primary Business Use, 53 MCAs estimated their tangible annual benefits totally in financial terms; 16 MCAs had a combination of tangible and "Major" intangible benefits; and 27 MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.15b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 102 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.15b. BU 15 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$1,303,801,849	$164,963,381	$1,468,765,230
Inland Bathymetry	$91,287,068	$57,053,867	$148,340,935
Nearshore Bathymetry	$26,022,044	$16,434,749	$42,456,793
Offshore Bathymetry	$250,000	$400,750	$650,750
Totals	**$1,421,360,961**	**$238,852,747**	**$1,660,213,708**

BU 15 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.15c. BU 15 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	92	87	51	21	79
Inland Bathymetry	55	52	11	10	47
Nearshore Bathymetry	33	30	25	5	28
Offshore Bathymetry	17	18	10	9	16
Totals	**197**	**187**	**97**	**45**	**170**

The types of benefits included in the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but

organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 15 Reported Future Annual Dollar Benefits Maps

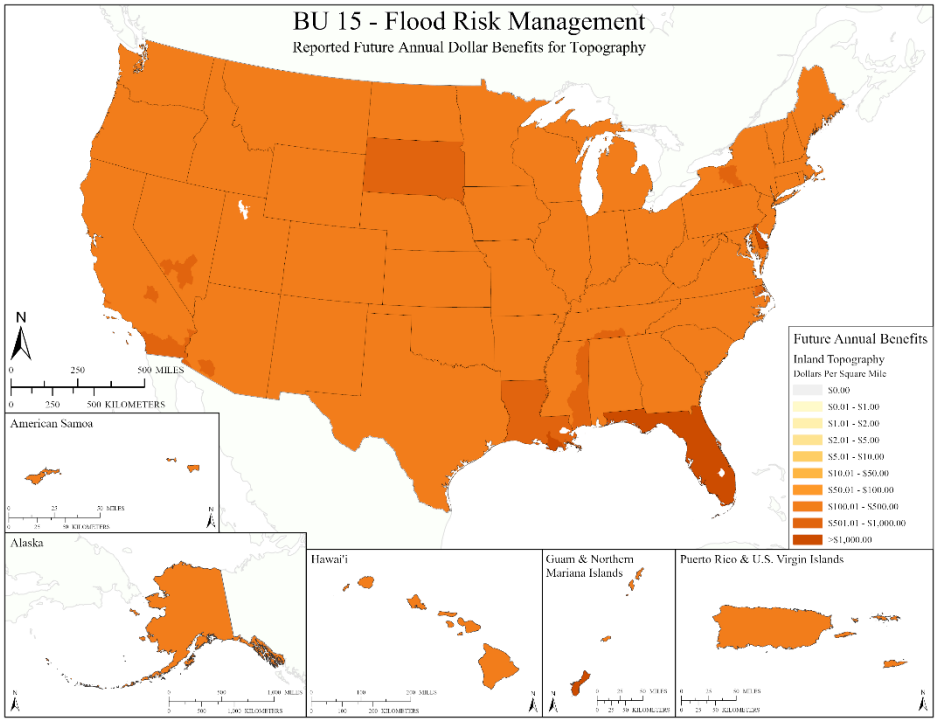

Figure E.15b. Reported Future Annual Dollar Benefits for Topography

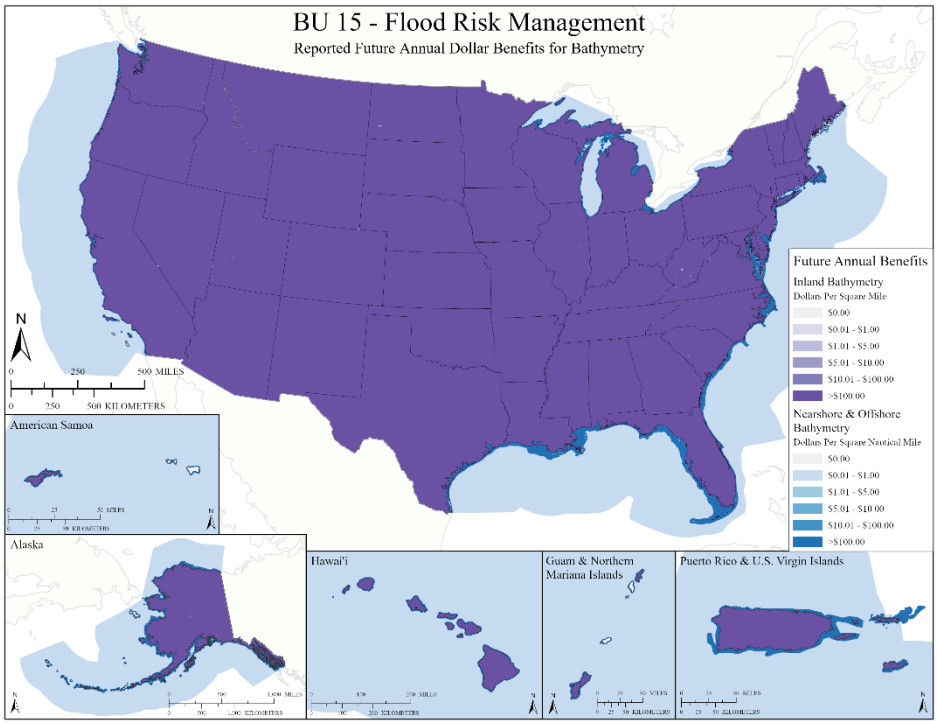

Figure E.15c. Reported Future Annual Dollar Benefits for Bathymetry

BU 15 Benefits Analysis

The total combined future annual benefits ($1.66 billion per year) reported for BU 15 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 15 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, 14 federal agencies (CDC, CMTS, DISDI, FAA, FBI, FEMA, FERC, FSA, IBWC, NOAA, NRC, USACE, USAF, and USGS) submitted a total of 15 MCAs listing BU 15 as their primary Business Uses, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the 15 total federal MCAs listing BU 15 as primary:
    - Inland Topography: Eight provided dollar benefits and six indicated "Major" benefits.
    - Inland Bathymetry: Seven provided dollar benefits and six indicated "Major" benefits.
    - Nearshore Bathymetry: Four provided dollar benefits and five indicated "Major" benefits.
    - Offshore Bathymetry: Two provided dollar benefits and three indicated "Major" benefits.
    - Five federal agencies (BIA, DHS, IJC, NASA, USBR) submitted MCAs listing BU 15 as secondary, and two federal agencies (EPA, TVA) submitted MCAs listing BU 15 as tertiary, meaning no benefits accrue to BU 15; and 24 federal agencies submitted no MCAs for BU 15 as primary, secondary, or tertiary.
- State/Local/Tribal and U.S. Territory MCAs:
    - Inland Topography: 59 provided dollar benefits and 16 indicated "Major" benefits.
    - Inland Bathymetry: 38 provided dollar benefits and 11 indicated "Major" benefits.
    - Nearshore Bathymetry: 21 provided dollar benefits and 5 indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and 11 indicated "Major" benefits.
    - Pennsylvania and Puerto Rico submitted an MCA listing BU 15 as secondary, and Michigan submitted an MCA listing BU 15 as tertiary, meaning dollar benefits to not accrue to BU 15.
- Non-governmental MCAs: Seven non-governmental organizations submitted MCAs listing BU 15 as primary, including MCAs from the Pacific Disaster Center, the National Disaster Preparedness Training Center (University of Hawaii), Wilson & Company, Fugro, Esri, National Tribal Geographic Information Support Center, and HERE Technologies:
    - Inland Topography: One provided dollar benefits and six indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits and four indicated "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits and three indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and two indicated "Major" benefits.
    - Ayers Associates submitted an MCA listing BU 15 as secondary.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.15b and E.15c:

- 384 “Major” Operational and Customer Service benefits and 312 “Major” benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate “Major” benefits into dollar savings. For example, if “Major” could be translated into a one percent savings for all of the total program budgets for BU 15 for which “Major” benefits are documented, this could easily be translated into tens of millions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 15 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 15:

- **Table E.15d** color-codes those organizations having an MCA with BU 15 as Primary, Secondary, or Tertiary.
- **Table E.15e** summarizes the 102 MCAs with primary benefits for BU 15, rank ordered from the highest to the lowest tangible benefits.

Table E.15d. Organizations having an MCA with BU 15 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	*BIA*	BLM	BOEM	**CDC**	**CMTS**	*DHS*	**DISDI**	DTRA
	EPA	**FAA**	**FBI**	FCC	**FEMA**	**FERC**	FHWA	FRA	**FSA**	FWS
	IBWC	*IJC*	MARAD	*NASA*	NGA	**NOAA**	NPS	**NRC**	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	**USACE**	**USAF**	USARC	*USBR*	USCB
	USCG	USFS	**USGS**	USMC	USN					

State/Ter	**AL**	**AK**	**AR**	**AZ**	**CA**	**CO**	**CT**	**DC**	**DE**	**FL**	**GA**	**HI**	**IA**	**ID**
	IL	**IN**	**KS**	**KY**	**LA**	**MA**	**MD**	**ME**	MI	**MO**	**MN**	**MS**	**MT**	**NC**
	ND	**NE**	**NH**	**NJ**	**NM**	**NV**	**NY**	**OH**	**OK**	**OR**	*PA*	**RI**	**SC**	**SD**
	TN	**TX**	**UT**	**VA**	**VT**	**WA**	**WI**	**WV**	**WY**	*PR*	**VI**	**GU**	**AS**	**CNMI**

Non-Gov	*Ayers Associates*	**Esri**	**Fugro**	**HERE Technologies**
	National Disaster Preparedness Training Center, University of Hawaii	**National Tribal Geographic Information Support Center**	**Pacific Disaster Center**	**Wilson & Company**

Table E.15e. MCA summaries for BU 15, rank ordered from the highest to the lowest tangible benefits.

Organization	USACE		Flood Risk Management, Emergency Management, Navigation, Riverine Ecosystem, Coastal Zone Management				
MCA Name	MCA No.						
Flood Risk and Emergency Management	21590						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$443,176,220	$36,707,139	None	Major	Major
Inland Bathy	QL2B	2-3 yrs.	$28,396,705	$15,811,263	None	Minor	Moderate
Nearshore B.	X-Sec meet needs	2-3 yrs.	$13,060,385	$6,577,438	None	Minor	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Moderate	$150,750	None	Minor	don't know

Organization	NOAA		NWS provides weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy. National water resource analysis and forecasting for high, low, and normal flows/levels, from small streams to large rivers, and including the coastal tidal boundary. Atmospheric forecasts do not require high resolution elevation data, but factors into models, water models are controlled by elevation for movement of water, H&H model input, specific flood forecasts at gage stations, national water model expanding to 2.7 million locations, highly dependent on hi res inland topo and inland bathy, into coastal zone but freshwater only.				
MCA Name	MCA No.						
National Water Resource Analysis and Forecasting	21517						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$443,043,267	$36,696,127	None	None	Major
Inland Bathy	X-Sec meet needs	4-5 yrs.	$28,388,186	$15,806,520	None	None	Major

Organization	Alaska		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60013						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$82,016,806	$14,350,373	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$5,697,455	$6,396,781	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$7,637,097	$5,660,175	Major	Moderate	Major
Offshore B.	Special Order	2-3 yrs.	Major	Major	Major	Major	Major

Organization	FEMA		National Flood Insurance Program. Elevation data support overall operations including insurance rating, floodplain management, LOMAs, etc.				
MCA Name	MCA No.						
National Flood Insurance Program	22354						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$36,909,250	$22,612,500	Moderate	None	Moderate
Inland Bathy	X-Sec meet needs	6-10 yrs.	$4,070,250	Minor	Minor	None	Minor
Nearshore B.	QL1B	>10 yrs.	$361,800	Minor	Minor	None	Minor
Offshore B.	Order 1a	>10 yrs.	Minor	None	None	None	None
Offshore B.	Order 3	>10 yrs.	Minor	None	None	None	None

Organization	Florida		Managing and protecting the water resources of Florida by balancing and improving flood control, water supply, water quality and natural systems. Elevation data are needed for modeling sea level rise, planning flood control structures, and storm surge modeling (use NOAA models). Having elevation data improves products, improves work efficiency, and ultimately promotes better decisions. Plus having the data readily available in emergency situations such as flooding and hurricanes is invaluable. Also, Minimum Flow & Levels (MFL) projects would benefit significantly from high resolution lidar bathymetry data and DEM surfaces. MFL is conducted on the most significant rivers and major lakes and springs. Some of the springs are less than 0.1 acre and are over 30 feet deep. These springs play a major role in our studies and applications for water quantity, quality, and flow modeling and measuring. In addition, the lidar bathymetry data would play a significant role in improving the FEMA modeling for determining and improving accuracy for the FEMA flood hazard areas related to the rivers and lakes. A continuous integrated surface model for Florida would support evaluation of sea level rise impacts to Florida and local drainage district water management system operations including impacts to water supply, water quality, and natural systems. Inland bathymetry, particularly for Lakes Okeechobee, Lake Istokpoga, the restored Kissimmee River, and the Kissimmee Chain of Lakes is important to the ability to manage flows and levels in a way that balances and improves flood control, water supply, water quality, and natural systems. Wetland topography, best captured under low water / drought conditions, is important for estimating storage and evaluating hydrologic requirements for wetland sustainability and resiliency. The water management districts and FDEP have responsibility to manage/regulate runoff quantity and quality. To do so, topobathymetric data are needed to model, predict, and visualize as-is and to-be landscapes. Public availability of these data will allow the districts to request and expect more from permit applicants and support better planning and decision making across all governmental agencies.					
MCA Name	MCA No.						
Managing and Protecting Water Resources for Flood Control, Water Supply, Water Quality and Natural Systems	22151						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$40,991,305	$9,891,357	Major	Major	Major
Inland Bathy	QL2B	4-5 yrs.	$4,462,066	$2,746,484	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	$653,622	$1,064,687	Major	Major	Major
Offshore B.	Order 1	4-5 yrs.	Major	Major	Major	Major	Major

Organization	California		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60048						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$22,204,718	$3,885,130	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$1,542,493	$1,731,824	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$153,877	$114,045	Major	Moderate	Major

Organization	Louisiana		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Modeling and Management	1101						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$15,000,000	$5,000,000	don't know	don't know	don't know
Inland Bathy	QL1B	4-5 yrs.	$5,000,000	$2,000,000	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$1,150,473	$852,664	Major	Moderate	Major
Offshore B.	Special Order	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Montana		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60261						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$20,645,166	$3,612,257	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$1,434,156	$1,610,189	Moderate	Moderate	Major

Organization	IBWC		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60693						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$22,479,160	$1,861,890	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$1,439,439	$801,478	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$140,194	$70,604	Major	Moderate	Major

Organization	South Dakota		As a state we are concerned with the mapping of flood plain environments for the health and welfare of our citizens, habitat management, erosion and environmental management. We manage the database for this data and provide access for emergency management personnel and citizens. Elevation data are needed for H&H modeling, water flow analysis, and flood risk management - assisting local and state entities in identifying areas of flood risk, mitigating those risks, and recovering from flood events.				
MCA Name	MCA No.						
Flood Risk Management	21658						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$15,525,326	$4,027,135	Major	Major	Major
Inland Bathy	QL2B	4-5 yrs.	$6,030	$1,000,000	Major	Major	Major

Organization	Nevada		Flood risk modeling and mapping of rivers, drainages, and alluvial fans.				
MCA Name	MCA No.						
Flood Risk Modeling and Mapping of Rivers, Drainages, and Alluvial Fans	32800						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$15,523,402	$2,716,109	Moderate	Minor	Major
Inland Bathy	QL1B	4-5 yrs.	$1,078,363	$1,210,725	Moderate	Minor	Major

Organization	Wyoming		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60541						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$13,733,459	$2,402,925	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$954,021	$1,071,121	Moderate	Moderate	Major

Organization	Minnesota		Stream channel analysis and mapping including stream bank erosion. Aquatic and terrestrial species habitat management. Analysis of Lake Superior coastal erosion and coastal hazard modeling. Forest health assessment including forest fuel supply and fire susceptibility. Wetland mapping and characterization. Modeling biological and ecological units. Planning and management of Wildlife Management Areas and Scientific and Natural Areas. Management of fisheries. Geologic mapping including water quality, landslide, springs, karst, aquifer recharge, groundwater and surface water pumping, geomorphologic metrics. Flood risk modeling and mapping. Dam safety analysis and emergency operations. Stream and wetland restorations. Planning, development and operation of parks, campgrounds, hiking and skiing trails, OHV and horse trails, and supporting infrastructure such as bridges, roads, etc.				
MCA Name	MCA No.						
Support of Water Resource Management	21506						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$11,842,814	$2,072,122	Major	Moderate	Moderate
Inland Bathy	QL2B	>10 yrs.	$822,683	$923,663	Major	Major	Minor
Nearshore B.	X-Sec meet needs	>10 yrs.	$10,290	$7,626	Major	Moderate	Major
Offshore B.	Special Order	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Idaho		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60134						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$11,733,536	$2,053,001	Major	Moderate	Major

Organization	Washington		Flood Risk Reduction				
MCA Name	MCA No.						
Flood Risk Reduction	22404						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$9,485,497	$1,659,665	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	$658,928	$739,807	don't know	don't know	don't know
Nearshore B.	QL2B	4-5 yrs.	$290,026	$214,950	don't know	don't know	don't know
Offshore B.	Special Order	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Oklahoma		Hazard Mitigation – Dam Safety, Floodplain Management. H&H modeling, dam breach and inundation modeling, flood studies, and NFIP floodplain administration.				
MCA Name	MCA No.						
Hazard Mitigation – Dam Safety and Floodplain Management	21480						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$9,798,136	$1,714,362	Moderate	Moderate	Major
Inland Bathy	QL3B	4-5 yrs.	$680,656	$764,189	Moderate	Moderate	Major

Organization	Alabama		Flood risk management, modeling, mitigation, and mapping. Elevation data are needed for FEMA floodplain management activities and H&H modeling. Water use planning could also use the data. Utilities likely gather their own data.				
MCA Name	MCA No.						
Alabama Flood Risk Management	1410						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$10,697,236	$1,000,000	None	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$300,000	Moderate	None	None	None
Nearshore B.	QL2B	6-10 yrs.	$400,000	Moderate	Minor	Minor	Moderate

Organization	Wisconsin		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60529						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$7,871,671	$1,377,296	Major	Moderate	Major

Organization	Mississippi		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60246						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$6,692,622	$1,170,999	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$464,915	$521,981	Moderate	Moderate	Major

Organization	Virginia		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60499						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$5,669,741	$992,027	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$393,859	$442,203	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$370,087	$274,287	Major	Moderate	Major

Organization	Tennessee		My agency supports other agencies with their GIS needs through coordination efforts and pooling funding to develop statewide GIS datasets. As part of our mission, we work with FEMA to support their Risk MAP efforts and elevation data plays a critical role in developing an accurate flood risk model through the DFIRM data products. BU 27 – Recreation is an additional Business Use.				
MCA Name	MCA No.						
Statewide GIS Coordination	1407						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$5,917,041	$1,035,296	Moderate	Major	don't know
Inland Bathy	QL1B	4-5 yrs.	$411,038	$461,491	Moderate	Moderate	Major

Organization	Kentucky		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60192						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$5,673,775	$992,733	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$394,139	$442,517	Moderate	Moderate	Major

Organization	South Carolina		South Carolina Emergency Management Division (SCEMD) models and maps potential flood risk from the effects of rainfall, riverine and coastal areas, storm surge, sea level rise, and dam failures. Life safety, population dynamics, resource movements, and infrastructure protection are important aspects to emergency management.				
MCA Name	MCA No.						
Flood Response	1164						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$4,346,055	$760,423	Major	Moderate	Major
Inland Bathy	QL0B	6-10 yrs.	$301,907	$338,964	Major	Moderate	Major
Nearshore B.	QL1B	4-5 yrs.	$229,311	$169,952	Major	Moderate	Major
Offshore B.	Special Order	2-3 yrs.	Major	Major	Major	Major	Major

Organization	North Carolina		Floodplain mapping, geodetic control, flood warning, coastal hazard mitigation, emergency management, risk management, and development of geoid models				
MCA Name	MCA No.						
Multi Hazard Identification and Mitigation	1098						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$3,440,700	$602,002	Moderate	Moderate	Major
Inland Bathy	QL0B	2-3 yrs.	$239,009	$268,346	Moderate	Moderate	Major
Nearshore B.	QL0B	2-3 yrs.	$406,330	$301,148	Moderate	Minor	Major
Offshore B.	Special Order	2-3 yrs.	Major	Major	Major	don't know	Major

Organization	North Carolina		North Carolina Agricultural and Technical (NCAT) State University offers interdisciplinary work in a broad selection of colleges and departments. There are ongoing research activities almost on all Business Uses mentioned in the table in: College of Agriculture and Environmental Sciences, College of Engineering, College of Health and Human Sciences, and College of Science and Technology.				
MCA Name	MCA No.						
Environmental Modeling	1348						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Annually	$3,440,629	$602,002	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$239,009	$268,346	Major	Major	Major
Nearshore B.	QL0B	4-5 yrs.	$406,330	$301,148	Major	Major	Major

Organization	Iowa		Floodplain mapping; hydrologic forecasting; engineering design and analysis				
MCA Name	MCA No.						
Floodplain Mapping; Hydrologic Forecasting; and Engineering Design and Analysis	1286						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$3,950,999	$691,182	Major	Moderate	Major
Inland Bathy	QL0B	>10 yrs.	$274,416	$308,099	Moderate	Moderate	Major

Organization	Iowa		Provide flood hazard risk information to the people of Iowa for use in wise development and flood hazard mitigation. Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Review/permitting of proposed floodplain development. Flood forecasts. 2D hydraulic modeling.				
MCA Name	MCA No.						
Iowa Flood Risk Management	21771						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$3,950,636	$691,237	Moderate	Moderate	Major
Inland Bathy	I don't know	6-10 yrs.	$274,438	$308,124	don't know	don't know	don't know

Organization	DISDI		DISDI is at the very top level of DoD and does not directly perform operational missions. However, it supports planning, homeland defense, and oversight of the DoD Components (Army, Navy, Air Force, Marine Corps, Washington Headquarters Service, Defense Logistics Agency, etc.). Regarding 3D elevation data, our primary mission critical activity interests right now are Coastal Hazard Mitigation, and Flood Risk Management. Elevation data are needed to improve flood management and inundation, evaluate sea level rise impacts, and for climate change predictions. There is considerably less need for inland bathymetry, but NHD data get considerable use. DISDI also promulgates standards development and provides processing of data provided by the DoD branches.				
MCA Name	MCA No.						
DoD Planning, Homeland Defense, and Oversight	21692						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$4,256,323	$352,540	don't know	don't know	don't know
Inland Bathy	QL1B	4-5 yrs.	$272,551	$151,756	don't know	don't know	don't know
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Major	Moderate	Major

Organization	Delaware		Real-time response to emergency management due to flooding from storms (including both riverine/stream and coastal flooding), through interpretation of precipitation and flood forecasts, analysis of tidal and stream gage data, and topographic/environmental conditions. Elevation data are needed for vulnerability analyses; flood risk analyses; and identification of effects on infrastructure, critical facilities, transportation routes, etc.				
MCA Name	MCA No.						
Real-time Response to Emergency Management Due to Flooding	22145						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$5,020,000	Moderate	None	Moderate	Moderate
Nearshore B.	QL2B	6-10 yrs.	Major	Moderate	Minor	Minor	Major

Organization	Arizona		Flood risk management and infrastructure improvement. Emergency management, flood inundation safety analyses. Floodplain mapping and floodwater flow modeling, including H&H modeling, planning, and existing conditions analysis. Wastewater conveyance mapping and modeling. Road design and construction. Elevation data are used for visualization and planning for projects (note: construction still requires field work). Elevation data are needed for NFIP flood mapping program activities, H&H analysis, dam repair or new dam construction, levees, and dam breach modeling. Elevation data are also needed for emergency management activities such as sniper analysis, to help manage urban events, identify shelter in place locations, for 3D analysis, line of sight analysis, and evacuation plans. Also for tree canopy information. Additional Business Uses applicable to this activity include BU 23- Urban and Regional Planning, BU 18 – Homeland Security, and BU 26 – Education K-12 and Beyond.					
MCA Name	MCA No.						
Flood Risk Management and Infrastructure Improvement	32958						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$59,286	$1,967	Major	Major	Major
Inland Topo	QL1	4-5 yrs.	$3,022,880	$100,302	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$348,099	$158,149	Moderate	Moderate	Moderate

Organization	Louisiana		Flood risk management, especially levee systems and flood control structures, construction, operation, maintenance and management.				
MCA Name	MCA No.						
Flood Risk Management	22055						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$1,076,120	$1,105,826	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$1,079,859	$125,122	Major	Major	Major

Organization	Utah		Although there are several Mission Critical Activities within the Utah Division of Emergency Management, the program that I am responsible for includes flood risk modeling and inundation mapping of riverine and lake areas used for floodplain management purposes (BU 15). We are in inland state, but to date, have one coastal area identified around the Great Salt Lake due to high wind fetch)				
MCA Name	MCA No.						
Flood Risk Modeling and Mapping	1172						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$3,100,000	Major	don't know	don't know	don't know
Inland Bathy	X-Sec meet needs	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	CDC		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60645						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$250,000	$250,000	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$250,000	$250,000	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$250,000	$250,000	Major	Moderate	Major
Offshore B.	Order 1a	2-3 yrs.	$250,000	$250,000	Moderate	Moderate	Major

Organization	Massachusetts		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60227						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,138,661	$199,230	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$79,099	$88,808	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$220,429	$163,369	Major	Moderate	Major

Organization	Vermont		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60486						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,349,881	$236,187	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$93,772	$105,282	Moderate	Moderate	Major

Organization	Hawai'i		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60121						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$903,454	$158,076	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$62,760	$70,463	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$82,424	$61,088	Major	Moderate	Major

Organization	Air Force		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60633						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	3-5 yrs.	$1,144,455	$94,792	Major	Moderate	Major

Organization	New York		Flood Inundation Mapping, flood risk mitigation and emergency management and updating our flood insurance maps.				
MCA Name	MCA No.						
Tompkins County GIS and Soil and Water Conservation Support	21564						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$1,007,888	$113,073	None	Moderate	Major
Inland Bathy	QL2B	6-10 yrs.	$73,416	$43,416	None	Moderate	Major

Organization	Guam		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60100						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$903,454	$158,076	Major	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$82,424	$61,088	Major	Moderate	Major

Organization	Connecticut		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60068						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$698,083	$122,142	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$48,493	$54,446	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$47,598	$35,277	Major	Moderate	Major

Organization	Georgia		Contribute to mitigating the impacts of riverine and coastal flooding and storm surge by managing the development of flood insurance rate maps and flood risk products/tools, in addition to supporting local jurisdictions participating in the National Flood Insurance Program (NFIP) in administering their flood damage prevention ordinances for compliance with the requirements of the NFIP and conveying flood risk information to their constituents.				
MCA Name	MCA No.						
Flood Risk Management	1392						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$914,025	Major	Minor	Moderate	Major
Nearshore B.	X-Sec meet needs	6-10 yrs.	Major	Major	Moderate	Moderate	don't know

Organization	USGS		National flood and water modeling, as well as flood risk and inundation mapping				
MCA Name	MCA No.						
Flood Modeling	21587						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$6,206	Moderate	Minor	Moderate	Minor
Inland Bathy	QL3B	4-5 yrs.	$741,650	Moderate	Minor	Moderate	Minor

Organization	Maryland		Coastal hazard modeling and mapping, Riverine hazard modeling and mapping, Sea level change modeling and asset management, Hazard mitigation planning, Storm surge modeling.				
MCA Name	MCA No.						
Hazard Modeling and Mapping	21576						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$462,876	$80,967	Moderate	None	Major
Inland Bathy	QL2B	2-3 yrs.	Moderate	Moderate	don't know	don't know	Moderate
Nearshore B.	QL2B	2-3 yrs.	$11,088	$8,218	Minor	don't know	Minor
Offshore B.	Order 3	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Maryland		FEMA Floodplain Coordination/Mitigation; Wetland regulation; Submerged Aquatic Vegetation (SAV); Water Quality; Ground water/Drinking water; NHD/WBD State Steward; Oil Control; Voluntary Clean-up Program (VCP)/Land Restoration; Mining				
MCA Name	MCA No.						
Statewide Environmental Management	1397						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$462,752	$80,967	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL1B	2-3 yrs.	$11,088	$8,218	Major	Major	Major
Offshore B.	Special Order	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Maryland		Coastal Hazard Mitigation, Inundation Modeling, Flood Studies, Watershed Studies				
MCA Name	MCA No.						
Statewide Emergency Management	22422						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$462,752	$80,967	don't know	don't know	don't know
Inland Bathy	QL1B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL1B	Event driven	$11,088	$8,218	don't know	don't know	don't know

Organization	Maine		Flood Risk Assessment, Analysis, and Mitigation. Elevation data are needed for hazard mitigation planning, use within Hazus, sea level rise mapping, and municipal GIS services for flood risk analysis and mapping.				
MCA Name	MCA No.						
Flood Risk Assessment, Analysis, and Mitigation	1279						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$289,440	$260,496	don't know	don't know	Major

Organization	New York		Hydrologic Modeling. H& H modeling, flood mitigation, design of stormwater retention, wetlands attenuation, etc.				
MCA Name	MCA No.						
Hydrologic Modeling	1224						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$397,940	Major	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Kansas		Flood inundation and risk mapping, surface hydrology research (wetland mapping & assessment, lake/pond catchment and shoreline evaluations, erosion studies, etc.). Elevation data is the basis for the flood inundation library used for rapid flood mapping, and is needed for wetland mapping and assessment, calculating the waterbody shoreline grade for water quality and sedimentation analyses, and suitability analyses for wetland community establishment or restoration. Bathymetry is needed for erosion studies, mobilization and transport, reservoir sedimentation, and stream morphometry analyses. In addition to surface water-related uses for 3D data, we also heavily utilize vegetation structure and volume information typically determined by differencing DSM data from DTM data. There is great value provided by hydro-enforced data to 2D flood inundation modeling. Hopefully this aspect of data preparation will soon receive the attention it deserves and become a regular part of an enhanced, bare-earth lidar data preparation process.				
MCA Name	MCA No.						
Flood Mapping and Surface Hydrology Research	21702						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$168,090	Major	Major	Major	Major
Inland Bathy	QL4B	6-10 yrs.	$129,296	Major	Major	Major	Major

Organization	New Jersey		Provide coastal and riverine mitigation guidance to NJ residents, local officials and developers. H&H modeling, contract modeling out, FEMA flood studies and non-regulatory products,				
MCA Name	MCA No.						
Provide Coastal and Riverine Mitigation Guidance to NJ Residents, Local Officials and Developers	1453						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	4-5 yrs.	$55,292	$30,753	Moderate	Major	Major
Inland Bathy	X-Sec meet needs	4-5 yrs.	$1,990	Moderate	Moderate	don't know	Minor
Nearshore B.	X-Sec meet needs	6-10 yrs.	$10	$203,814	Major	Moderate	Moderate

Organization	Rhode Island		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60382						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$152,044	$26,603	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$10,562	$11,858	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$34,280	$25,406	Major	Moderate	Major
Offshore B.	Special Order	2-3 yrs.	Major	Major	Major	Major	Major

Organization	North Dakota		Design of transportation systems, water systems and other civil engineering activities. Modeling of water systems including flooding, effects of levees, dam breaks, floodplains. BU 26 – Education K12 and Beyond, Basic Research would be an additional Business Use.				
MCA Name	MCA No.						
Transportation and Water Resources Engineering	22207						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$137,034	$97,362	Major	Moderate	don't know

Organization	Ohio		Flood mapping, infrastructure planning and design for utility and campground expansion, dredging, dam safety				
MCA Name	MCA No.						
Flood Reduction and Conservation	1230						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$111,908	$22,914	None	Moderate	Major
Inland Bathy	QL1B	6-10 yrs.	$57,723	$13,266	Minor	Major	Major

Organization	Indiana		Flood mapping and disaster mitigation planning. The Polis Center is a FEMA CTP for floodplain mapping the state and performs additional work for DNR. The Polis Center also does work for Indiana Homeland Security for mitigation planning, and for Indiana DOT. Elevation data are needed for H&H modeling, floodplain mapping, flood hazard analysis, to identify vulnerable infrastructure for DOT, and to develop and interpret climate data.				
MCA Name	MCA No.						
Environmental and Disaster Informatics	1359						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$134,733	$8,683	Major	don't know	don't know
Nearshore B.	QL2B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	New Mexico		Flood risk modeling and mapping of riverine areas. Elevation data can be used to model flood hazards. We expect to receive BLE data this Fall derived from a 2016 LiDAR acquisition. In addition we hope to get contours, building footprints, and other secondary products. Improved floodplain maps and data will, I hope, make the NFIP fit for purpose in Taos County. It will help us to educate the public, build confidence in the NFIP, protect people and their property through regulation of floodplain development, and make better informed decisions. The secondary products such as building footprints will help us with our land use planning and property appraisal and assessment. 3D data is invaluable to the work of local government and the implementation of federal government programs at the local level.				
MCA Name	MCA No.						
Flood Risk Modeling and Mapping of Riverine Areas	1089						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$15,618	$121,447	Major	Minor	Major
Inland Bathy	X-Sec meet needs	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Missouri		Flood risk modeling and mapping of riverine areas. We would also use bathymetry of reservoirs for analysis of drinking water supplies. For Inland Topo, the 100-year floodplain plus 200 feet horizontally should ideally be collected more frequently and at a higher quality level. Upland areas where there is more relief and steeper slopes and smaller features are less important hydraulically could be collected at a lower frequency and lower quality level. On the other hand, urban areas should be collected more frequently, as features change more frequently, and flatter areas at a county scale should be collected at a higher quality level and at a posting density that can support a higher resolution raster. For example, the notoriously flat Bootheel and some northern Missouri counties should be collected at a higher quality level. As for inland bathy of reservoirs, once every five or ten years would be sufficient. As for quality level, it's generally not necessary do discern features for drinking water yield analyses, but only to calculate the volume-elevation curve for the reservoir and detect any storage losses due to sedimentation.				
MCA Name	MCA No.						
Flood Risk Modeling and Mapping of Riverine Areas	1332						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	varies.	Major	Moderate	don't know	Moderate	Moderate
Inland Bathy	QL0B	6-10 yrs.	$100,000	Moderate	None	Minor	don't know

Organization	Texas		Modeling and prediction of riverine flood hazards. Elevation data are needed for H&H modeling, elevation studies, viewshed analyses, and vegetation analysis (mass of vegetation) for wildfire calculations. For land development, elevation data are needed for site suitability assessments (developers get the data). Impervious surface determinations are planned as a future use of elevation data, also electric line surveys.				
MCA Name	MCA No.						
Modeling and Prediction of Riverine Flood Hazards	21982						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$100,000	Major	Minor	Minor	Moderate
Inland Bathy	QL2B	6-10 yrs.	Major	Major	don't know	don't know	Minor

Organization	North Carolina		Flood management				
MCA Name	MCA No.						
Flood Risk Management and Mitigation	1139						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	>10 yrs.	$50,226	$8,788	Moderate	Moderate	Moderate
Inland Bathy	X-Sec meet needs	>10 yrs.	$3,489	$3,917	None	None	None

Organization	New Mexico		Flood risk modeling and mapping of drainage and lake areas. Dam/dike/levee safety analysis. Base Level Engineering (BLE) analysis. Landslide threat analysis. Wildfire threat analysis. Community coordination and emergency preparedness planning. EDAC is the state clearinghouse for spatial data and the state CTP for FEMA. Elevation data are needed for a myriad of uses to include addressing flooding, wildfire, landslides, post-disaster activities, and sinkholes, among others.				
MCA Name	MCA No.						
Flood Risk Modeling, Mapping, and Mitigation	1364						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	Major	$57,888	Major	Major	Major
Inland Bathy	QL2B	6-10 yrs.	Major	Major	Minor	Moderate	Moderate

Organization	Missouri		Flood Plain Management and Stormwater Analysis. Elevation data is utilized to design and mitigate flood event risks and the impacts of areas of high topographic relief and impervious surface on stormwater and run-off.				
MCA Name	MCA No.						
Flood Plain Management and Stormwater Analysis	21657						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$46,653	Major	Major	Major	Major

Organization	Colorado		One of the missions of the Colorado Division of Water Resources is to ensure public safety through safe dams and properly permitted and constructed water wells. Elevation data are needed for Emergency Action Plans (EAPs) for high and significant hazard dams – these require inundation mapping via H&H modeling for dam break scenarios. 2013 lidar is currently being used. Program includes homeowner notification in the event of a break. Monitor well elevations are needed for collecting ground water elevations for water supply.				
MCA Name	MCA No.						
Emergency Action Plan Development for Dam Safety	1174						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$17,859	Moderate	None	Minor	Moderate
Inland Topo	QL2	6-10 yrs.	$27,366	Moderate	None	Minor	Moderate
Inland Bathy	QL4B	>10 yrs.	Minor	don't know	don't know	don't know	don't know

Organization	Northern Mariana Islands		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60340						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$25,628	$4,484	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	$1,780	$1,998	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$1,793	$1,329	Major	Moderate	Major
Offshore B.	Special Order	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Ohio		Dam break modeling and inundation mapping.				
MCA Name	MCA No.						
Dam Break Modeling and Inundation Mapping	1297						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$22,281	Major	Minor	None	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Moderate	don't know	don't know	Moderate
Nearshore B.	QL4B	>10 yrs.	don't know	don't know	don't know	None	don't know

Organization	U.S. Virgin Islands		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60457						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$18,790	$3,287	Major	Moderate	Major

Organization	Oklahoma		Emergency Planning and Response / Hazard Mitigation for the City of Ardmore, OK. Need survey data at 6" – 1' vertical accuracy, any data of worse accuracy can only be used for reference. One-foot contours are needed for most activities. City activities that depend on elevation data include: flood risk modeling and mapping of stream centerlines and floodplains, flood risk analysis, dam/dike/levee safety analysis, emergency management, flood forecasts, potential buy out areas that repeatedly flood, and local Flood Hazard Mitigation Plans. The city works in conjunction with FEMA and the Oklahoma Office of Emergency Management on local hazard mitigation plans. Elevation data are also needed for determination of natural fuel and fire susceptibility, fire behavior modeling to support wildfire suppression activities, wild land/urban interface building identification, infrastructure protection, search and rescue, line-of-sight analysis in urban areas, disaster response, determining what travel routes and infrastructure may be impacted by heavy icing on existing tree canopy, and determining low lying areas where hazardous materials would flow / travel in the event of a spill. Ardmore works on hazard mitigation plans, disaster response and recovery, security planning and site / infrastructure hardening with all fire, law, and EMS agencies.				
MCA Name	MCA No.						
Emergency Planning and Response / Hazard Mitigation	22065						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	6-10 yrs.	$16,284	$2,849	Moderate	Moderate	Major
Inland Bathy	QL1B	6-10 yrs.	$1,131	$1,270	Moderate	Moderate	Major

Organization	Pacific Disaster Center		Disaster based situational awareness, and risk assessment. (e.g. dam modeling, coastal flooding, tsunami inundation, etc.)				
MCA Name	MCA No.						
Disaster Based Situational Awareness and Risk Assessment	21513						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Event driven	$4,824	$5,427	Major	None	Major
Nearshore B.	QL3B	Event driven	don't know	don't know	don't know	don't know	don't know
Offshore B.	Order 2	Event driven	don't know	don't know	don't know	don't know	don't know

Organization	Oregon		Dam safety analysis, flood risk modeling and mapping for dam safety (not FIRMs). Identify structures at risk and save lives. Elevation data are used for H&H modeling. Hydroelectric dam licensing is covered by another group.				
MCA Name	MCA No.						
Dam Safety Analysis, Flood Risk Modeling, and Mapping	1306						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	As long as data is an accurate representation of the site, it is acceptable.	Major	Major	None	None	Major
Inland Bathy	QL0B	Only if the bathymetry has changed.	$7,236	Major	None	None	Major

Organization	Nebraska		Dam Breach Analysis and Inundation Mapping, Floodplain Mapping, Flood Mitigation, Stream Network Digitization				
MCA Name	MCA No.						
Flood Risk Management	21772						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$4,824	Major	Minor	Minor	Major

Organization	American Samoa		Coastal hazard, landslide and rockfall mitigation, and flooding hazard.				
MCA Name	MCA No.						
Coastal and Flooding Hazard and Landslide and Rockfall Mitigation	33077						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	4-5 yrs.	$4,342	Major	Minor	Minor	Major

Organization	Rhode Island		Coastal and riverine flood inundation mapping.				
MCA Name	MCA No.						
Coastal and Riverine Flood Inundation Mapping	1251						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$1,809	Moderate	Moderate	Minor	Moderate
Nearshore B.	I don't know	Event driven	Minor	Minor	Minor	don't know	Minor

Organization	Illinois		Enforcement and permitting of construction in floodways. OWR Regulatory programs conducts enforcement actions for violations of Floodway rules. They also issue permits for construction to assure compliance with the flood regulations. Elevation data is crucial in evaluation of apparent violations and the criteria for issuing permits.				
MCA Name	MCA No.						
Enforcement and Permitting of Construction in Flood Zones and Floodways	22265						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	>10 yrs.	$603	don't know	don't know	don't know	don't know
Inland Bathy	QL0B	>10 yrs.	Major	don't know	don't know	don't know	don't know

Organization	Wisconsin		Storm Water Management				
MCA Name	MCA No.						
City of Oshkosh Storm Water Management	1106						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Moderate	Moderate	Moderate

Organization	Illinois		River flood inundation mapping based on event frequency and gage stage levels. The great concern during any flooding event is how high the flood waters will get and what will be inundated. The National Weather Service provides a great forecasting service predicting the stage level of river gages. That tells how high the water level will be at a gage. OWR provides web based interactive maps that show the inundation associated with selected river gage stage levels. When a stage level is selected the map shows the extent of the flood waters and is colored to indicate the depth of the inundation. These maps are useful in quickly indicating what the disaster managers will have to deal with. They can see if it will still be possible for emergency vehicles to drive through certain areas, if the flood levels might be managed with sandbags and how bad the damage will be for critical facilities and other structures. The web maps are also useful for future planning and in sorting out claims and issues from past events. In order to build these interactive web maps, a catalog of inundation profiles must be constructed. Elevation data and bathymetry are used in modeling the surrounding river levels relative to the gage levels. These models may be done by OWR but are more commonly done by the US Army Corps of Engineers and the Illinois State Water Survey. Bare earth elevation data is then used by OWR to construct water extent and depth profiles from the model data.						
MCA Name	MCA No.							
River Flood Inundation Mapping Based on Event Frequency and Gage Stage Levels	1127							
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety	
Inland Topo	QL2	2-3 yrs.	Major	Major	Moderate	Moderate	Major	
Inland Bathy	QL1B	4-5 yrs.	Moderate	Moderate	None	None	Minor	

Organization	District of Columbia		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts. A 2013 bathymetric survey of the Anacostia River was done for the Anacostia River Sa sediment remediation project. Bathymetry is needed for managing contaminated sediment and maintaining the federal navigation channel. USACE also conducts bathymetric surveys of the Anacostia River – lower Anacostia (2018), Upper Anacostia (2010)				
MCA Name	MCA No.						
Flood Risk and Sediment Management	1152						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Event driven	Major	Major	Moderate	Minor	Major
Inland Bathy	X-Sec meet needs	Event driven	Major	Major	Major	Minor	Major
Nearshore B.	X-Sec meet needs	Event driven	Major	Major	Moderate	None	Moderate

Organization	West Virginia		MISSION CRITICAL ACTIVITY: Multi-hazard risk assessments BU 15: ** Flood Risk Management ** Flood risk mapping activities using best available topographic data to generate floodplain boundaries and flood depth grids, Hazus Level 2 flood risk analysis and loss estimates, 3D flood visualizations using depth grids and building footprints, floodplain manager NFIP functions, ground elevation determinations. Elevation data critical for WV Flood Tool (www.mapwv.gov/flood) web application. BU 10: ** Geologic Landslide Assessment and Hazard Mitigation ** Landslide hazard mapping and assessment. BU 18: ** Dam/Levee Flood Inundation Maps and Warning Systems ** Best available elevation data is critical for orthorectification of imagery. FEMA flood mapping is a primary driver for elevation data for the state. Slope models are needed for predictive landslide modeling and to identify previously undetected landslides. Addresses, elevation, and imagery are the three critical datasets for the state. Elevation data are also needed for 3D flood models, rooftop identification, and to support floodplain managers, flood determinations, advisory BFEs, etc.					
MCA Name	MCA No.						
Flood Risk Management and Geologic Assessment	1289						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Event driven	Major	Major	Major	Minor	Major

Organization	National Disaster Preparedness Training Center, University of Hawaii		Natural Hazard Mitigation				
MCA Name	MCA No.						
Natural Hazard Mitigation	1356						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Major	Minor	Moderate
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Moderate	Minor	Major
Nearshore B.	QL0B	4-5 yrs.	Major	Moderate	Moderate	None	Minor

Organization	Colorado		Data discovery and distribution supporting state agencies, local government, and private firms within the state. A Colorado BAA is under consideration.				
MCA Name	MCA No.						
Data Discovery and Distribution	1414						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	Moderate	Major	Major	Moderate	Major

Organization	USGS		National Hydrography Dataset and Watershed Boundary Dataset framework development. Providing a geospatial hydrography framework for the Nation.				
MCA Name	MCA No.						
National Civilian Mapping - Hydrography	1444						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Major	None	None
Inland Bathy	QL2B	6-10 yrs.	Major	Major	Major	None	None

Organization	Wilson & Company		Current existing topographic conditions relating to civil engineering. Engineering, architecture, planning, environmental, survey & mapping, and construction management services.				
MCA Name	MCA No.						
Engineering and Geospatial Services	21487						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Moderate	Moderate	Major
Inland Bathy	QL2B	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	NRC		External Flood Hazard and Risk Analysis. Licensees' data are used if provided, confirmed with publicly available data as necessary. Applicants typically use public data as well, except for actual site development. Storm surge (wind driven) modeling (AdCIRC) extends far offshore.				
MCA Name	MCA No.						
Evaluate External Flood Hazard and Risk at Proposed and Existing Nuclear Facilities	21490						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	None	Moderate	Major
Inland Bathy	QL2B	4-5 yrs.	Major	Major	None	Moderate	Major
Nearshore B.	QL1B	4-5 yrs.	Major	Major	None	Moderate	Major
Offshore B.	Order 2	Event driven	Major	Major	None	Moderate	Major

Organization	Indiana		Floodplain Mapping, Modeling and Management. Our agency is both the State Coordinating Agency for the NFIP and a Cooperating Technical Partner with FEMA for Floodplain Mapping. In addition, we have permitting responsibilities statewide for construction in a floodway. Elevation data are needed for H&H modeling, to support the Lake Michigan coastal zone program, and for coastal science for Lake Michigan. The DNR's Oil and Gas division would also use elevation data. Elevation data would also be valuable to the State Parks division for use in designing and enhancing park property. DNR currently has access to nearshore and offshore bathymetry that was developed for the new coastal flood mapping project. Inland bathymetry used to build 2D hydraulic models to help update existing and new Flood Insurance Study areas.				
MCA Name	MCA No.						
Floodplain Mapping, Modeling and Management	21579						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Moderate	Major	Major
Inland Bathy	QL2B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	District of Columbia		The National Flood Insurance Program Coordinating Agency in the District of Columbia				
MCA Name	MCA No.						
Flood Risk Assessment for the District	21598						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	Major	Major	Major	Major	don't know
Inland Topo	QL2	Annually	Major	Major	Major	Major	don't know
Inland Bathy	QL2B	Annually	Major	Major	Major	Major	don't know
Nearshore B.	QL2B	Annually	Major	Major	Major	Major	don't know

Organization	Illinois		Hydrologic and Hydraulic modeling of rivers for Floodplain Management. OWR Engineering Studies uses elevation and bathymetric data for models to support mitigation plan development. Flood Mitigation Planning uses the model results and elevation data when developing mitigation plans to obtain optimal solutions for investment.				
MCA Name	MCA No.						
Hydrologic and Hydraulic Modeling for Floodplain Management	21641						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	None	None	don't know
Inland Topo	QL2	4-5 yrs.	Major	Major	None	None	don't know
Inland Bathy	QL0B	4-5 yrs.	Major	Major	None	None	Major

Organization	Montana		We have been in need to assist other agencies (Office of Emergency Management, Army Corps of Engineers, etc.) with providing detailed elevation data for use in inundation mapping in flooding events and for pre-planning future events.				
MCA Name	MCA No.						
Geospatial Data Management and Flood Risk Management	21656						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Moderate	Major	Major

Organization	New Hampshire		GIS Clearinghouse, also floodplain mapping activities.				
MCA Name	MCA No.						
New Hampshire GIS Clearinghouse	21703						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	Major	Major	Major	Major	None
Inland Bathy	QL2B	6-10 yrs.	Major	Major	Moderate	Moderate	None
Nearshore B.	QL2B	6-10 yrs.	Major	Major	Major	Moderate	None

Organization	Fugro		Land and marine-based airborne / terrestrial surveying and remote monitoring services to help clients manage hazards, natural resources, infrastructure, and other critical resources more efficiently.				
MCA Name	MCA No.						
Hazard, Natural Resources, Infrastructure, and Critical Resource Management	21802						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Moderate	Major	Major
Inland Bathy	QL2B	Depends on variables	Major	Major	Moderate	Moderate	Major
Nearshore B.	QL2B	Depends on variables	Major	Major	Moderate	Moderate	Major
Offshore B.	Order 2	Event driven	Major	Major	Moderate	Moderate	Major

Organization	Tennessee		Coordinate geospatial data creation, updates, and data storage and availability for the Shelby County government and other local governmental agencies. Create and maintain data sharing agreements between the various governmental agencies within Shelby county and the surrounding counties. Host a data sharing portal to allow collaboration of geospatial information between the partnering agencies and host websites serving the general public. A county consortium of 13 agencies along with USGS, funded a $39,000 collect. The data were flown in March 2017, being QC'd now, QL2+, 4 ppsm, refresh in 4-5 years planned. Once received, the plan is to publish the data on the web site for use with planimetrics; local engineers also want contours, (clip and ship from web site). The data will also be used to support TVA for hydrology, engineering and environmental studies, and bridges. Topography will go to consortium agencies and will support their H&H studies.					
MCA Name	MCA No.						
Geospatial Support to County and Local Government Agencies	21951						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Moderate	Minor	Moderate

Organization	Esri		The Living Atlas is comprised of content that includes XYZ from authoritative sources and is used as reference material for context of other data. Our tools can be used to combine Living Atlas elevation with other sources, such as DEPARE from navigational charts or topographic maps. Additional tools provide analytical results to decision makers across government, commercial, academic, and non-profit clients around the world. All BUs below are impacted by our tools and require authoritative data. Seeing changes to land use/land cover helps users understand impacts to all Business Uses; change detection helps users understand all issues.				
MCA Name	MCA No.						
The Living Atlas	22048						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	Annually	Major	Major	Moderate	Moderate	Moderate
Nearshore B.	QL0B	Annually	Major	Major	Moderate	Moderate	Moderate
Offshore B.	Order 2	6-10 yrs.	Major	Major	Moderate	Moderate	Moderate

Organization	Florida		Volusia County Emergency Management and Public Works Support. As a central office we deal with most of your example Mission Critical Activities. Our group mans the EOC during events, maps wildfires and supports every department within the county.				
MCA Name	MCA No.						
Volusia County Emergency Management and Public Works Support	22270						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Major	Major	Major
Inland Bathy	X-Sec meet needs	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Florida		Emergency Management; providing for the safety of Manatee County residents in times of disaster.				
MCA Name	MCA No.						
Manatee County Emergency Management	22334						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Minor	Moderate	Major
Nearshore B.	QL1B	4-5 yrs.	Major	Major	Major	Major	Major

Organization	National Tribal Geographic Information Support Center		Effective management and planning for Tribal Governments				
MCA Name	MCA No.						
GIS Support for Tribal Organizations	22416						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Major	Moderate	Moderate	Moderate
Inland Topo	QL2	6-10 yrs.	Major	Major	Moderate	Moderate	Moderate

Organization	Arkansas		BU 15 – Flood Risk Modeling, Mapping, and Mitigation ANRC has generated statewide DEMs from QL2 lidar data to support flood risk modeling and mapping of riverine, bayou, and low-lying areas. The data is also being used to assess dam and levee safety. Emergency management. In the future, the DEM may be incorporated into real-time inundation mapping. Elevation data are needed for H&H modeling; bathymetry is needed for flood pool modeling.				
MCA Name	MCA No.						
Flood Risk Modeling, Mapping, and Mitigation	22537						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Major	Moderate	Major

Organization	FERC		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts. FERC requires applicants and dam owners to prepare flood studies and coordinate with Federal and local emergency management officials				
MCA Name	MCA No.						
Flood Risk Management	60655						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Moderate	Moderate	Major

Organization	FAA		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60689						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Major	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Major	Moderate	Major
Offshore B.	Order 1a	2-3 yrs.	Major	Major	Moderate	Moderate	Major

Organization	Kansas		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60695						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Major	Moderate	Major

Organization	CMTS		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60697						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Major	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Major	Moderate	Major
Offshore B.	Order 1a	2-3 yrs.	Major	Major	Moderate	Moderate	Major

Organization	FBI		Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.				
MCA Name	MCA No.						
Flood Risk Management	60711						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Major	Major	Moderate	Major
Inland Bathy	QL0B	2-3 yrs.	Major	Major	Moderate	Moderate	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Major	Moderate	Major
Offshore B.	Order 1	2-3 yrs.	Major	Major	Moderate	Moderate	Major

Organization	HERE Technologies		Mobile LiDAR solutions post disaster.				
MCA Name	MCA No.						
Mobile LiDAR Solutions Post Disaster	60722						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Major	Moderate	Major

Organization	FSA		Disaster recovery				
MCA Name	MCA No.						
Disaster Recovery	1313						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	>10 yrs.	Moderate	Moderate	don't know	don't know	don't know

Organization	Alaska	
MCA Name	MCA No.	
Community Resilience and Climate Adaptation and Imminently Threatened Alaska Native Villages	21550	1. Floodplain Management Program. Monitor community compliance by conducting Community Assistance Visits (CAV). Provide information to communities to reduce public and private sector losses and damage from flooding and erosion; provide coordination and technical assistance to National Flood Insurance Program (NFIP) communities; Provide assistance and coordination of ordinance updates in anticipation of map adoptions. Assist communities who want to enter the NFIP and assist building local floodplain management expertise and capability. 2. Community Resilience and Climate Adaptation Programs. The Division of Community and Regional Affairs (DCRA's) Community Resilience and Climate Adaptation Programs provide Alaskan communities with technical assistance, tools, training and funding to become healthier, stronger and more resilient to natural hazards and to adapt to the impacts of climate change. A. Community Decision-Making Continuum. Understanding risk is fundamental to making informed local decisions to respond and adapt to that risk. Communities can increase understanding of risk, leading to the decision-making process of planning, and ultimately, the implementation of actions to increase community resilience. DCRA's efforts to assist communities in each stage of this process are described below. B. Alaska Climate Change Impact Mitigation Program (ACCIMP). The Alaska Climate Change Impact Mitigation Program was established by Alaska's Twenty-Fifth Legislature to provide technical assistance and funding to communities imminently threatened by climate-related natural hazards such as erosion, flooding, storm surge, and thawing permafrost. The intent of the program has been to assist impacted communities develop a planned approach to shoreline protection, building relocation and/or eventual relocation of the village. The program is implemented through two measures: Hazard Impact Assessments and Community Adaptation Planning Grants. C. Alaska Community Coastal Protection Project (ACCPP). The Alaska Community Coastal Protection Project focuses on three of the most imminently threatened villages in Western Alaska: the communities of Kivalina, Shaktoolik and Shishmaref. The project is based on the premise that careful planning, agency collaboration and strong community leadership are essential to successfully addressing the needs of imperiled communities. Through this effort, comprehensive Strategic Management Plans were prepared for each community. These plans take a comprehensive approach to increasing community resilience to climate impacts and natural hazards by strengthening local capacity, assessing and guiding community and infrastructure development, and supporting environmental protection and human safety. During the planning process, Village Inter-Agency Planning Groups were organized for each community. D. Alaska Risk Mapping, Assessment and Planning (Risk MAP) Program. Risk MAP is a comprehensive, multi-year process in which FEMA and the State of Alaska work with a local government to identify and gather data on the natural hazards risks affecting the community, assess and analyze those risks, identify actions to reduce risk, and identify resources to implement those actions. The goal of Risk MAP is to increase community resilience by providing quality data and risk assessment tools to local governments, thereby enhancing local understanding of risk to natural hazards, and informing community decisions to take action to reduce risk. A new initiative of Risk MAP in Alaska focuses on imminently-threatened Alaska Native Villages. E. Village Inter-Agency Planning Groups. The focus of each inter-agency planning group is to reduce duplication and increase engagement between imminently-threatened communities, agencies and organizations to develop solutions to increase resilience in each community. The focus of the Newtok Planning Group has been on the village of Newtok's relocation to Mertarvik on Nelson Island. The inter-agency planning groups for Kivalina, Shaktoolik and Shishmaref have been focused on implementing the imminent a critical action items identified by each community in its Strategic Management Plan.

	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Moderate	Minor	Minor	Minor	Minor
Nearshore B.	QL3B	4-5 yrs.	Moderate	Moderate	don't know	don't know	don't know

Organization	Ohio		As the State of Ohio GIS Coordinating body, office supports/assists other agencies in meeting their Mission Critical Activities.				
MCA Name	MCA No.						
State of Ohio GIS Support	21568						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Event driven	Moderate	Moderate	Moderate	Moderate	Moderate

Organization	Illinois		Flood risk assessment and mapping				
MCA Name	MCA No.						
Flood Risk Assessment and Mapping	21597						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Minor	Moderate	Minor	Minor	Minor
Inland Bathy	QL1B	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Illinois		Flood inundation mapping.				
MCA Name	MCA No.						
Flood Inundation Mapping	22352						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	don't know	don't know	don't know	don't know	don't know
Inland Topo	QL2	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

BU 16 - Sea Level Rise and Subsidence

BU 16 Scope

Business Use #16 (BU 16) includes modeling and mapping the effects of sea level rise (SLR) or subsidence; population and economic vulnerability assessments; and coastal inundation and infrastructure assessment.

The U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers (USACE), and Environmental Protection Agency (EPA) are well represented in this Business Use. USACE, NOAA, and USGS are all sponsors of the Joint Airborne LiDAR Bathymetry Technical Center of Expertise (JALBTCX) which systematically acquires topographic/ bathymetric lidar of coastal areas of the U.S.

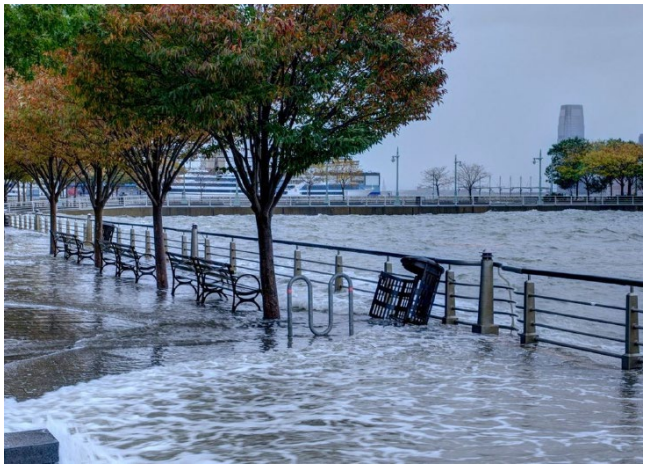

Figure E.16a. What used to be periodic nuisance flooding has become a daily event during high tides in some cities. Lidar will provide the basis for flood walls and other measures costing billions of dollars to protect key cities impacted by sea level rise and/or subsidence. Image courtesy of NOAA.

BU 16 Background Information

Because of climate change, SLR rates are increasing worldwide well above the norm for prior centuries. Projected SLR rates vary for the U.S., especially when combined with subsidence. The maximum rate of predicted SLR is two meters for this century, but the actual rate is more likely to be around 80 centimeters to one meter for the 21st century. Regardless of the rate, SLR has caused major concerns for coastal states and communities planning for an unstoppable sea threat. Federal and state agencies are working closely together to mitigate this threat, and lidar is a major part of this effort.

Based on insurance industry projections, Florida is threatened the most by SLR with over 10 percent of homes in high-risk flood zones. Louisiana, New Jersey, and Delaware have between 7.6 and 10 percent of homes in high-risk flood zones. South Carolina has between 5.1 and 7.5 percent of homes in high-risk flood zones. New York, Massachusetts, Connecticut, Maryland, Virginia, and North Carolina have between 2.6 and 5 percent of homes in high-risk flood zones. The remaining coastal states have less than 2.5 percent of homes at high risk.

New York City, Philadelphia, Houston, Baltimore, and Miami were ranked as the top five cities with the largest high social vulnerability populations within the future FEMA 100-year floodplain – and thus face a difficult double jeopardy over time. In Miami, sea levels are rising about six inches every 15 years.

Subsidence involves the collapse of the land or the slow subsidence typically caused by extraction of subsurface water, oil or gas, where extracted fluids previously helped to hold the ground up. Mine subsidence can be defined as the movement of the ground surface as a result of readjustments of the overburden due to collapse or failure of underground mine workings. Surface subsidence often takes the form of sinkholes or troughs. Some sinkholes or troughs are caused by leaking sewer pipes or water mains. Florida has thousands of natural limestone sinkholes caused by water erosion that provides a route for surface water to disappear underground. These limestone sinkholes provide a primary pathway for rainwater to replenish subsurface groundwater; they are an important part of the aquifer system that supplies 95 percent of Florida's drinking water; and if left unprotected, polluted surface water can drain into sinkholes and easily contaminate the aquifers vital for use by humans and animals and the agricultural industry. Subsidence impacts over 17,000 square miles in the U.S. The major subsidence

areas in the U.S. include the California Central Valley, the Houston-Galveston area in Texas, virtually all of Louisiana, and areas along the east coast from Florida to Virginia.

BU 16 Elevation Data Uses

Using their own words, respondents documented 38 Mission Critical Activities (MCAs) that identified BU 16 as their primary Business Use and identified the following 34 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.16a. BU 16 Elevation Data Uses

Data Use
Climate Change Analysis
1. Development of science-based climate resilience policy and adaptation plans
Coastal Resource Management
2. Elevation data are needed to analyze coastal wetlands, marshes, and sub-aquatic vegetation that affect the fish and shellfish industries
3. Shoreline monitoring/predicting
Erosion/Sediment Control
4. Sediment analysis
Geology
5. Coastal geomorphologic change measurement
Groundwater Management
6. Determine impacts on groundwater, extent of potential flooding into communities, and effects on tidal saltmarshes
7. Inland bathymetry is needed for Cape Cod's kettle ponds that are windows into the Cape's groundwater resources
8. Understand groundwater resources from inland bathymetry
Hazard Assessment and Mitigation
9. Coastal hazard mitigation
10. Coastal inundation and infrastructure assessment
11. Elevation data are needed for spatially explicit vulnerability maps and estimates of populations
12. Population and economic vulnerability assessments
13. See potential inundation areas, potential hazards to infrastructure, and potential impact to cultural resources
Mapping/Boundary Delineation
14. Land Use/Land Cover mapping
15. Map ice sheets and glaciers and their interactions with SLR
16. Mapping and 3D rendering of built environment in urban areas
Modeling
17. Coastal analyses
18. Coastal zone modeling to include salt marsh migration and wildlife habitat models
19. Storm water network modeling
Navigational Safety
20. Harbor dredging and dredging for the Chesapeake Bay, Ocean City, Salisbury, etc.
Planning
21. Coastal resilience planning

Data Use
22. Land use and environmental planning
23. Provide strategic planning, technical assistance and climate adaptation coordination to coastal parks of the National Park Service
24. Virtual City creation
Sea Level Rise/Subsidence
25. Determine future SLR scenarios for the state
26. Elevation data are needed for infrastructure and economic activities affected by SLR and steps taken to mitigate these vulnerabilities
27. Elevation data are needed for the Florida Forever land acquisition program that targets lands for acquisition impacted by SLR and subsidence
28. Environmental Impact Assessments (EIAs) depend upon accurate elevation data for vulnerability mapping and estimates of SLR threats to human populations, infrastructure, and the natural environment. Credible EIAs cannot be performed without accurate elevation data.
29. Identify, model, and map the effects of future SLR scenarios and local land subsidence
30. Impacts to communities from subsidence
31. Potential SLR damage to major coastal infrastructure
32. SLR planning
33. SLR analysis/climate/resiliency has recently become a major focus of the NJ DEP with the forming of the Climate and Flood Resilience Program and the governor's Executive Order establishing a statewide Climate Change Resilience Strategy for NJ
34. Vulnerability of facilities/assets/roads to sea level change

BU 16 Tangible and Intangible Benefits

For the 38 MCAs that list Sea Level Rise and Subsidence as their primary Business Use:

- **Table E.16b** summarizes the reported future annual dollar benefits by geography type, totaling $320.1 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.16c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.16e.
- **Table E.16d** shows (in blue) the ten federal agencies and 27 states and territories that submitted MCAs with BU 16 as the primary Business Use. MCAs for which BU 16 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.16d.
- **Table E.16e** documents all the MCAs that listed BU 16 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.16e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 16 Reported Future Annual Dollar Benefits

Of the 38 MCAs that listed Sea Level Rise and Subsidence as their primary Business Use, two MCAs estimated their tangible annual benefits totally in financial terms; 28 MCAs had a combination of tangible and "Major" intangible benefits; and five MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.16b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA

receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 38 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.16b. BU 16 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$318,353,315	$255,155	$318,608,470
Inland Bathymetry	$332,144	$255,240	$587,384
Nearshore Bathymetry	$250,000	$250,000	$500,000
Offshore Bathymetry	$250,000	$250,000	$500,000
Totals	**$319,185,459**	**$1,010,395**	**$320,195,854**

BU 16 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.16c. BU 16 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	35	34	2	2	4
Inland Bathymetry	24	24	22	22	23
Nearshore Bathymetry	32	31	29	30	2
Offshore Bathymetry	15	14	14	14	1
Totals	**106**	**103**	**67**	**68**	**30**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 16 Reported Future Annual Dollar Benefits Maps

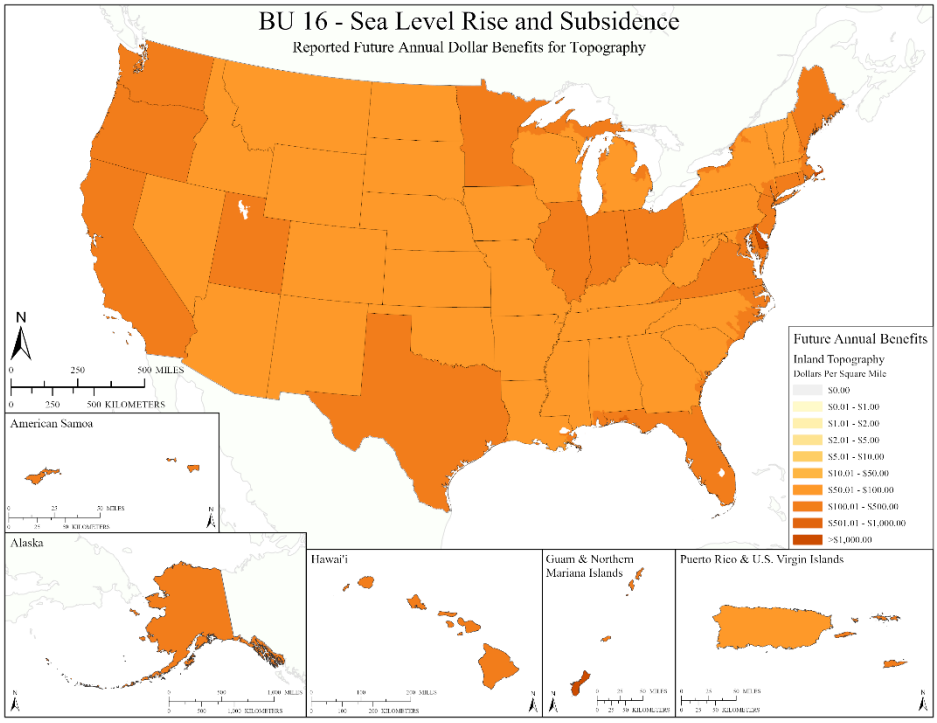

Figure E.16b. Reported Future Annual Dollar Benefits for Topography

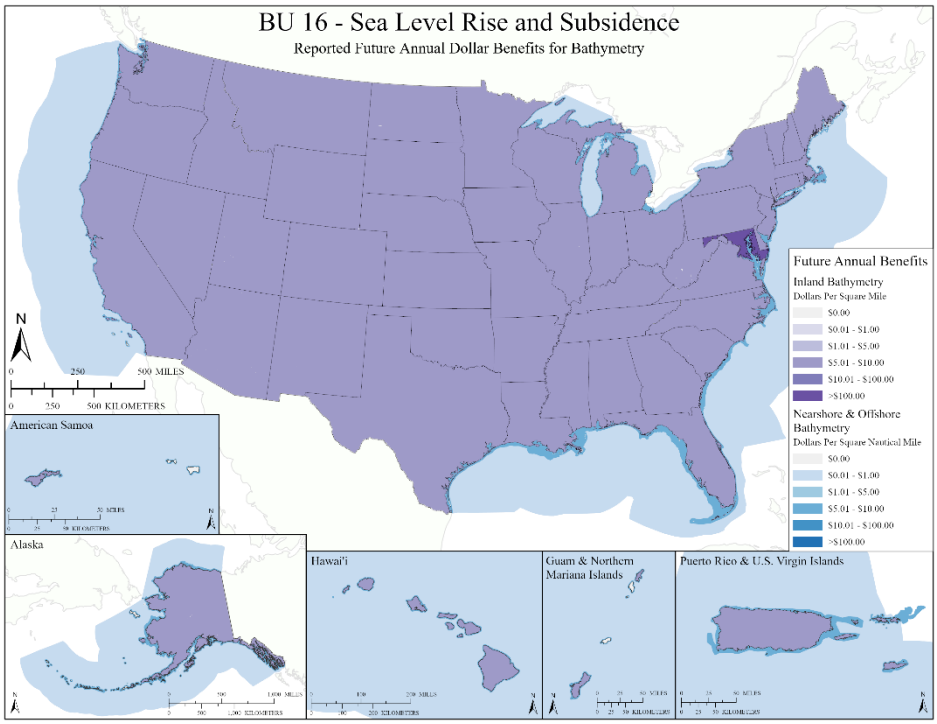

Figure E.16c. Reported Future Annual Dollar Benefits for Bathymetry

BU 16 Benefits Analysis

The total combined future annual benefits ($320.1 million per year) reported for BU 16 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 16 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, ten federal agencies (CDC, CMTS, EPA, FAA, NASA, NOAA, NPS, NRC, SI, and USAF) submitted ten MCAs listing BU 16 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the ten federal MCAs listing BU 16 as primary:
    - Inland Topography: Five provided dollar benefits and four indicted "Major" benefits.
    - Inland Bathymetry: One provided dollar benefits and four indicated "Major" benefits.
    - Nearshore Bathymetry: One provided dollar benefits and seven indicated "Major" benefits.
    - Offshore Bathymetry: One provided dollar benefits and four indicated "Major" benefits
    - DISDI and USGS submitted MCAs with BU 16 as secondary, and MARAD submitted an MCA with BU 17 as tertiary, meaning no benefits accrued to BU 16.
    - Most of the federal benefits were identified as "Major," and we have no way to translate "Major" benefits into dollar benefits.
    - FEMA, USACE, USMC, and USN did not submit MCAs with BU 16 as either primary, secondary or tertiary; but each of these federal agencies will be severely impacted by SLR and/or subsidence. For example, the world's largest naval base (Naval Station Norfolk) is subsiding significantly, compounding the already-serious impacts of SLR.
- State/Local/Tribal and U.S. Territory MCAs: Twenty-seven (27) states and territories submitted a total of 28 MCAs listing BU 16 as primary:
    - Inland Topography: 26 provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: One provided dollar benefits and 18 indicated "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits and 24 indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and ten indicated "Major" benefits.
    - South Carolina submitted an MCA with BU 16 as secondary, even though South Carolina is high on the list of states vulnerable to SLR. Similarly, Louisiana and Mississippi submitted MCAs with BU 16 as tertiary, even though both states are highly vulnerable to SLR and subsidence. No benefits accrued for MCAs listing BU 16 as secondary or tertiary.
    - Again, most MCAs identified "Major" benefits that cannot be translated into dollar benefits, thus undercounting the financial benefits to BU 16.
- Non-governmental MCAs: There were no MCAs submitted by non-governmental agencies listing BU 16 as primary, secondary, or tertiary.

- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.16b and E.16c:
    - 209 "Major" Operational and Customer Service benefits and 165 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 16 for which "Major" benefits are documented, this could easily be translated into significant additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 16 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 16:

- **Table E.16d** color-codes those organizations having an MCA with BU 16 as Primary, Secondary, or Tertiary.
- **Table E.16e** summarizes the 38 MCAs with primary benefits for BU 16, rank ordered from the highest to the lowest tangible benefits.

Table E.16d. Organizations having an MCA with BU 16 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	**CDC**	**CMTS**	DHS	*DISDI*	DTRA
	EPA	**FAA**	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	**NASA**	NGA	**NOAA**	**NPS**	**NRC**	NRCS	NREL
	ORNL	OSMRE	PHMSA	**SI**	TVA	USACE	**USAF**	USARC	USBR	USCB
	USCG	USFS	*USGS*	USMC	USN					

State/Ter	AL	**AK**	AR	AZ	**CA**	CO	**CT**	*DC*	**DE**	**FL**	*GA*	**HI**	IA	ID
	IL	**IN**	KS	KY	LA	**MA**	**MD**	**ME**	MI	MO	**MN**	MS	MT	**NC**
	ND	NE	**NH**	**NJ**	NM	NV	**NY**	**OH**	OK	**OR**	*PA*	**RI**	*SC*	SD
	TN	**TX**	**UT**	**VA**	VT	**WA**	WI	WV	WY	PR	**VI**	**GU**	**AS**	**CNMI**

Table E.16e. MCA summaries for BU 16, rank ordered from the highest to the lowest tangible benefits.

Organization	NOAA		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60665						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$189,312,424	Major	Moderate	Moderate	Moderate
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	EPA		Sea level rise and subsidence. Elevation data are needed for spatially explicit vulnerability maps and estimates of populations, land cover types, infrastructure and economic activity affected by sea level rise, and steps taken to mitigate these vulnerabilities. Environmental Impact Assessments (EIAs) depend upon accurate elevation data for vulnerability mapping and estimates of SLR threats to human populations, infrastructure, and the natural environment, including coastal wetlands, marshes, and sub-aquatic vegetation that affect the fish and shellfish industries. Credible EIAs cannot be performed without accurate elevation data.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	50010						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$34,644,173	don't know	don't know	don't know	don't know
Inland Bathy	QL2B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Offshore B.	Order 1a	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Alaska		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60014						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$30,753,521	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 2	6-10 yrs.	Major	Major	Major	Major	Moderate

Organization	Texas		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60444						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$13,936,419	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major

Organization	California		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60049						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$8,326,016	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	Oregon		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60357						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$5,109,129	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	Delaware		Identifying, modeling, and mapping the effects of future scenarios of sea level rise and local land subsidence. This includes determination of future sea level rise scenarios for Delaware, impacts on groundwater, extent of potential flooding into communities, and effects of tidal saltmarshes, among others. Salt marsh resiliency, impacts to communities from SLR, Impacts to communities from subsidence.				
MCA Name	MCA No.						
Identifying, Modeling, and Mapping the Effects of Future Scenarios of Sea Level Rise and Local Land Subsidence	1381						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$326,058	Major	Minor	Moderate	Moderate
Inland Topo	QL2	2-3 yrs.	$4,693,942	Major	Minor	Moderate	Moderate
Nearshore B.	QL2B	6-10 yrs.	Major	Moderate	Minor	Minor	Minor
Offshore B.	Order 2	6-10 yrs.	Major	Moderate	Minor	Minor	None

Organization	Minnesota		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60613						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$4,442,244	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	Utah		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60473						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$4,400,751	Major	Moderate	Moderate	Moderate

Organization	Washington		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60517						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$3,556,739	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 2	6-10 yrs.	Major	Major	Major	Major	Moderate

Organization	Illinois		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60143						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$2,966,211	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 2	6-10 yrs.	Major	Major	Major	Major	Moderate

Organization	Florida		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment. The Florida Department of Environmental Protection's Division of State Lands is responsible for the Florida Forever land acquisition program. This year, the portfolio of lands targeted for acquisition includes a significant proportion of properties whose acquisition would directly support stakeholder impacts for sea-level rise. These data will help target future properties for acquisition in response to sea-level rise and subsidence. Elevation data are needed to support these initiatives.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60083						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$2,954,336	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	Ohio		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60345						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$2,172,064	Major	Moderate	Moderate	Moderate
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 2	6-10 yrs.	Major	Major	Major	Major	Moderate

Organization	Virginia		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60500						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$2,125,960	Major	Moderate	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 2	6-10 yrs.	Major	Major	Major	Major	Moderate

Organization	CDC		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60646						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$250,000	$250,000	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	$250,000	$250,000	Major	Major	Major
Nearshore B.	QL1B	2-3 yrs.	$250,000	$250,000	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	$250,000	$250,000	Major	Major	Moderate

Organization	Indiana		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60156						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$1,904,948	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	Maine		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60209						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$1,706,237	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 2	6-10 yrs.	Major	Major	Major	Major	Moderate

Organization	North Carolina		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60326						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,700,000	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL0B	4-5 yrs.	Major	Major	Major	Major	Minor
Offshore B.	I don't know	4-5 yrs.	Major	Major	Major	Major	Moderate

Organization	Massachusetts		Coastal Hazard Mitigation; Coastal Resilience Planning; Virtual City Creation; Inland bathymetry is needed for Cape Cod's kettle ponds; these are windows into the Cape's groundwater resource. Having inland bathy data helps understand the groundwater resource.				
MCA Name	MCA No.						
Coastal Hazard Mitigation and Coastal Resilience Planning	21571						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$854,270	Major	Moderate	Moderate	Moderate
Inland Bathy	QL2B	2-3 yrs.	Major	Major	Minor	Moderate	Minor
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Minor	Major	Minor

Organization	Air Force		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60634						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$488,879	Major	Moderate	Moderate	Moderate
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	New Jersey		Sea level rise planning. Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment. Sea Level Rise Analysis/Climate/Resiliency has recently become a major focus of NJDEP with the forming of the Climate and Flood Resilience Program and the governor's Executive Order establishing a statewide Climate Change Resilience Strategy.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60299						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$396,532	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 2	6-10 yrs.	Major	Major	Major	Major	Moderate

Organization	Maryland		Coastal hazard mitigation, facility/assets/roads vulnerability with sea level change, line of site analysis, storm water network modeling. Harbor dredging and dredging for the Chesapeake Bay, Ocean City, Salisbury, etc. Also sediment analysis.				
MCA Name	MCA No.						
Multi-Modal Transportation Asset Management	21676						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$291,681	$5,155	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	$82,144	$5,240	Major	Major	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Major	Major	Major
Offshore B.	Order 1a	6 months	Major	Major	Major	Major	Major
Offshore B.	Order 1	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Guam		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60101						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$338,764	Major	Moderate	Moderate	Moderate
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	Hawai'i		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60122						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$338,764	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	Connecticut		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60069						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$261,757	Major	Moderate	Moderate	Moderate
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	Rhode Island		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60383						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$57,011	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	SI		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60676						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$18,931	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	Major	Major	Major	Major	Moderate

Organization	Northern Mariana Islands		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60341						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$9,609	Major	Moderate	Moderate	Moderate
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	U.S. Virgin Islands		Major coastal infrastructure exists in the U.S. Virgin Islands with the potential for damage from sea level rise. Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60458						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$7,045	Major	Moderate	Moderate	Moderate
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	New York		Land Use and Environmental Planning, 3D rendering of built environment in urban areas (6 cities in county). Planimetric mapping done separately from imagery, also Land Use/Land Cover. Elevation data are needed for Sea Level Rise planning.				
MCA Name	MCA No.						
Land Use and Environmental Planning	1255						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Has not been determined	$4,673	Moderate	Moderate	Moderate	Moderate

Organization	American Samoa		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60030						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$4,227	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Major	Minor

Organization	NASA		Map ice sheets and glaciers and their interactions with sea level rise				
MCA Name	MCA No.						
Map Ice Sheets and Glaciers and their Interactions with Sea Level Rise	1158						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Seasonally	don't know	don't know	don't know	don't know	Major
Inland Bathy	QL1B	Seasonally	don't know	don't know	don't know	don't know	Major

Organization	NPS		Provide strategic planning, technical assistance and climate adaptation coordination to coastal parks. Shoreline monitoring/predicting, coastal geomorphologic change measurement. We use elevation data for coastal analysis. We use it to look at potential inundation areas, potential hazards to infrastructure and potential impact to cultural resources. We use it map cultural resources, for instance finding things like trails that may be hard to see from air photos. We use it determine watershed boundaries				
MCA Name	MCA No.						
Shoreline Monitoring and Analysis	1318						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Moderate	Moderate	Major
Nearshore B.	QL0B	Annually	Major	Major	Moderate	Moderate	Moderate

Organization	Florida		Development of science-based climate resilience policy and adaptation plans.				
MCA Name	MCA No.						
South Florida Adaptation Planning	22157						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Major	Moderate	don't know
Inland Topo	QL1	4-5 yrs.	Major	Major	Major	Moderate	don't know
Inland Bathy	X-Sec meet needs	6-10 yrs.	Major	Major	Major	Major	don't know
Nearshore B.	X-Sec meet needs	Annually	Major	Major	Major	Major	don't know

Organization	NRC		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60669						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	Major	Major	Major	Major	Moderate

Organization	FAA		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60690						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Moderate	Moderate	Moderate
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	Major	Major	Major	Major	Moderate

Organization	CMTS		Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment.				
MCA Name	MCA No.						
Sea Level Rise and Subsidence	60698						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	Major	Major	Major	Major	Moderate

Organization	New Hampshire		Coastal zone modeling to include salt marsh migration and wildlife habitat models				
MCA Name	MCA No.						
Coastal Zone Modeling	1218						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Moderate	Moderate	Minor	Minor	Moderate
Inland Bathy	X-Sec meet needs	>10 yrs.	Moderate	Moderate	don't know	don't know	don't know
Nearshore B.	QL0B	4-5 yrs.	Moderate	Moderate	don't know	don't know	don't know

BU 17 - Wildfire Management, Planning, and Response

BU 17 Scope

Business Use #17 (BU 17) includes determination of forest fuel and fire susceptibility; fire behavior modeling to support wildfire suppression activities; wildland/urban interface building identification; and post-fire analysis to determine landslide-prone areas.

There is no single champion for this Business Use, but the National Interagency Fire Center (NIFC) coordinates activities and resources of the U.S. Department of Agriculture (USFS), Department of Defense (all services), Department of Commerce (NOAA/NWS), Department of Homeland Security (U.S. Fire Administration), and Department of Interior (BIA, BLM, FWS, and USGS) – all of whom support different kinds of emergency responses but with their primary focus on wildland firefighting.

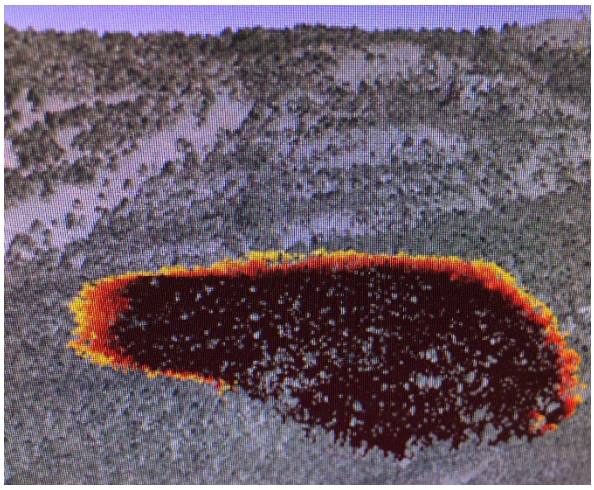

Figure E.17a. Wildfire modeling is largely performed with knowledge of the topography, fuel, and wind directions. Both topography and fuel can come from lidar. Image courtesy of USGS.

BU 17 Background Information

The American public regularly sees images of devastating wildfires and firefighters without recognizing that digital elevation data have anything to do with fighting those fires. Wildfire modeling software requires multiple data/information inputs: (1) DEMs, (2) slope, (3) aspect, (4) canopy cover, (5) fuel models, (6) weather, (7) wind, and (8) fuel moisture. Items (1) through (5) all come from lidar which is well known for determining fuel biomass statistics. In addition to the obvious damages and threats to homes and communities, wildfires also leave the terrain more susceptible to landslides.

BU 17 Elevation Data Uses

Using their own words, respondents documented 31 Mission Critical Activities (MCAs) that identified BU 17 as their primary Business Use and identified the following 30 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table 15.a. BU 17 Elevation Data Uses

Data Use
Emergency Management
1. Firefighter safety zone and escape route mapping and evacuation planning
Forestry
2. Elevation data are needed for growing conditions, seed zone selection and delineation with elevation breaks for reforestation
3. Forest health for wildfire mitigation and management
4. Provide technical assistance to private landowners for developing sustainable forests that enhance quality of life

Data Use
5. Providing tree care training, distributing low-cost seedlings, developing forest stewardship plans, and forest health project funding
Hazard Assessment and Mitigation
6. Assessment of potential for floods after fires
7. Develop a wildland fire risk assessment portal which requires a lifeform vegetation GIS layer to be used for development of a fuel map
8. Evaluate lands and forests most at risk to wildfire by developing appropriate land management and restoration programs and implementing mitigation projects
9. Fire behavior analysis tool input for risk assessment
10. Hazard and risk analysis (fire burns faster uphill)
11. Natural disaster risk assessment
12. Post-fire analysis to determine landslide-prone areas
Mapping/Boundary Delineation
13. Determination of standing inventory of forest resources
14. Input to maps (hillshades and topo maps) used as a base for incident action plan maps
15. Track vegetation changes over time
16. Wildland/urban interface building identification
Modeling
17. Elevation data are needed to improve wind speed models
18. Fire behavior modeling to support wildfire suppression activities
19. Improve the modeling of debris flow likelihood and provide support to other states
20. Post wildfire management to model potential debris flows
21. Tree canopy, forest density, chaparral, understory, etc. are needed for fire modeling
Research
22. Semi-arid ecosystem research to include the transition areas between natural and cultural conditions
Wildfire Management
23. Determination of forest fuel and fire susceptibility
24. Fire management and wildlife management planning and response
25. Fire suppression on non-municipal, non-federal, and non-tribal lands across the state
26. Management of incidents, elevation, fire spread
27. Scientific research, skills training, wildfire fuel mapping, forest health assessment, forest and rangeland fire severity assessment
28. Support federal and state agencies in post-wildfire management and rehabilitation planning to include post-event debris flows
29. Wildfire management, planning, and response
30. Wildland fire protection

BU 17 Tangible and Intangible Benefits

For the 31 MCAs that list Wildfire Management, Planning, and Response as their primary Business Use:

- **Table E.17b** summarizes the reported future annual dollar benefits by geography type, totaling $32.81 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.17c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.17e.
- **Table E.17d** shows (in blue) the four federal agencies, 25 states and territories, and two non-governmental entities that submitted MCAs with BU 17 as the primary Business Use. MCAs for which BU 17 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.17d.
- **Table E.17e** documents all the MCAs that listed BU 17 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.17e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 17 Reported Future Annual Dollar Benefits

Of the 31 MCAs that listed Wildfire Management, Planning, and Response as their primary Business Use, no MCAs estimated their tangible annual benefits totally in financial terms; 26 MCAs had a combination of tangible and "Major" intangible benefits; and three MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.17b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 31 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.17b. BU 17 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$32,814,505	$0	$32,814,505
Inland Bathymetry	$0	$0	$0
Nearshore Bathymetry	$0	$0	$0
Offshore Bathymetry	$0	$0	$0
Totals	**$32,814,505**	**$0**	**$32,814,505**

BU 17 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.17c. BU 17 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	29	28	27	28	28
Inland Bathymetry	6	6	6	6	6
Nearshore Bathymetry	0	0	0	0	0
Offshore Bathymetry	0	0	0	0	0
Totals	**35**	**34**	**33**	**34**	**34**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 17 Reported Future Annual Dollar Benefits Maps

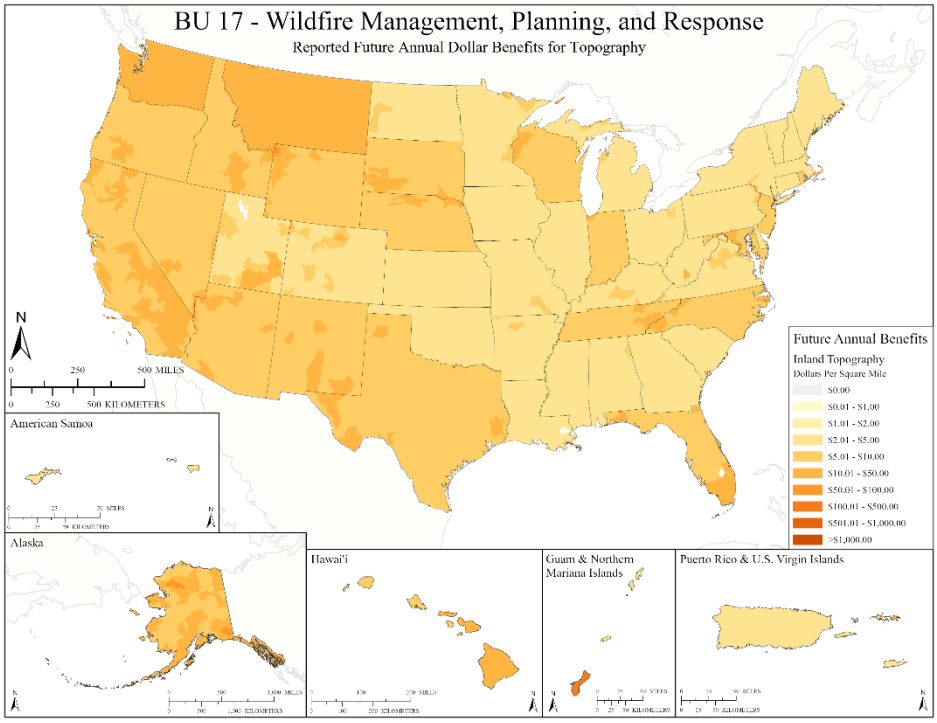

Figure E.17b. Reported Future Annual Dollar Benefits for Topography

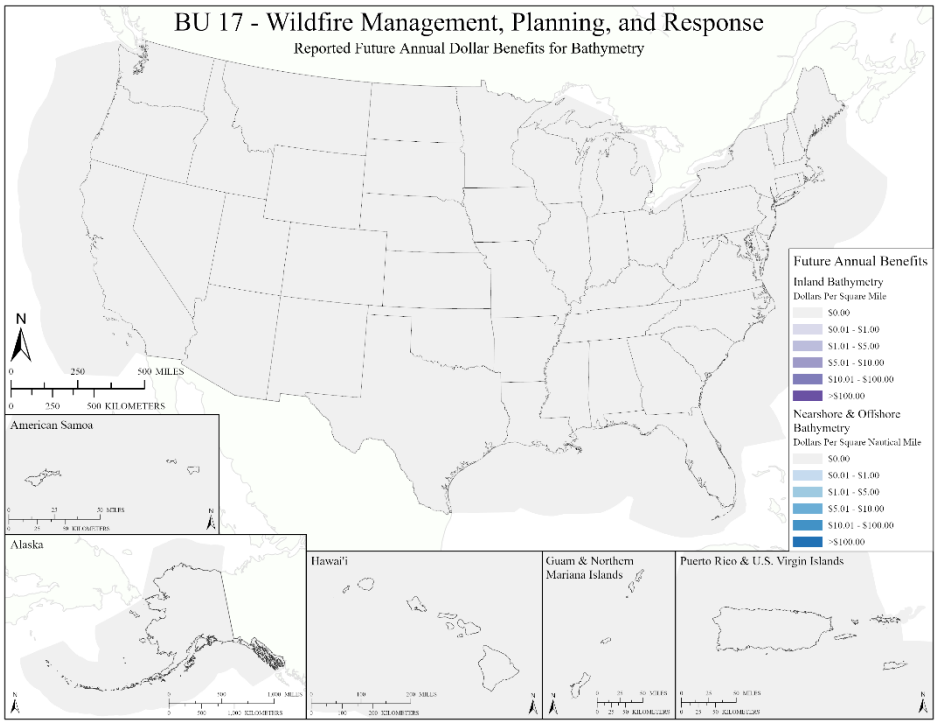

Figure E.17c. Reported Future Annual Dollar Benefits for Bathymetry

BU 17 Benefits Analysis

The total combined future annual benefits ($32.81 million per year) reported for BU 17 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 17 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, four federal agencies (NPS, USAF, USFS, and USGS) submitted MCAs listing BU 17 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the four federal MCAs listing BU 17 as primary:
    - Inland Topography: Four provided dollar benefits and none indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits and one indicated "Major" benefits.
    - Nearshore and Offshore Bathymetry: None listed benefits for nearshore or offshore bathymetry.
    - The USMC submitted an MCA with BU 17 as secondary, and NASA submitted an MCA with BU 17 as tertiary; but no benefits accrued to BU 17 from these MCAs.
    - Members of the NIFC were expected to submit MCAs specifying BU 17 as primary, secondary or tertiary, but no such MCAs were obtained from DHS, BIA, BLM, or FWS.

- State/Local/Tribal and U.S. Territory MCAs: Twenty-five (25) states and territories submitted MCAs listing BU 17 as primary:
    - Inland Topography: 25 provided dollar benefits and none indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits and four indicated "Major" benefits.
    - Nearshore and Offshore Bathymetry: No MCA listed benefits for nearshore or offshore bathymetry.
- Non-governmental MCAs: There were two MCAs submitted by non-governmental agencies (HERE Technologies and Leading Edge Geomatics) listing BU 17 as primary. Maxar Technologies submitted an MCA listing BU 17 as tertiary.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.17b and E.17c:
    - 69 "Major" Operational and Customer Service benefits and 101 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 17 for which "Major" benefits are documented, this could easily be translated into hundreds of thousands of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 17 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 17:

- **Table E.17d** color-codes those organizations having an MCA with BU 17 as Primary, Secondary, or Tertiary.
- **Table E.17e** summarizes the 31 MCAs with primary benefits for BU 17, rank ordered from the highest to the lowest tangible benefits.

Table E.17d. Organizations having an MCA with BU 17 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	NOAA	**NPS**	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	**USAF**	USARC	USBR	USCB
	USCG	**USFS**	**USGS**	*USMC*	USN					

State/Ter	*AL*	**AK**	AR	**AZ**	**CA**	*CO*	CT	DC	DE	**FL**	GA	**HI**	IA	**ID**
	IL	**IN**	KS	KY	LA	MA	**MD**	ME	MI	MO	**MN**	MS	**MT**	**NC**
	ND	**NE**	NH	**NJ**	**NM**	**NV**	NY	OH	*OK*	**OR**	PA	**RI**	SC	**SD**
	TN	**TX**	**UT**	*VA*	VT	**WA**	**WI**	*WV*	**WY**	PR	VI	**GU**	AS	CNMI

Non-Gov	**HERE Technologies**	**Leading Edge Geomatics**	Maxar Technologies	

Table E.17e. MCA summaries for BU 17, rank ordered from the highest to the lowest tangible benefits.

Organization	USGS		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60684						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$14,787,434	Major	Major	Major	Major

Organization	NPS		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60705						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$5,152,023	Major	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Alaska		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60015						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$3,138,503	Major	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Texas		To develop a wildland fire risk assessment portal which requires a lifeform vegetation GIS layer to be used for development of a fuel map.				
MCA Name	MCA No.						
Texas Wildfire Risk Assessment	22088						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$132,127	Major	Moderate	Major	Major
Inland Topo	QL1	4-5 yrs.	$1,290,133	Major	Moderate	Major	Major

Organization	Montana		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60262						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,250,000	Major	Major	Major	Major

Organization	Washington		Forest health for wildfire mitigation and management. The Wildfire Division looks at disease, fuel load, and fire susceptibility on all forest lands in Washington including state lands. For this Mission Critical Activity, it is extremely important to be able to track vegetation changes over time. This is currently most effectively accomplished through 3D elevation data. It is part of the Division's strategic plan, therefore 3D topography data is needed to meet the operational and mission goals.				
MCA Name	MCA No.						
Forest Health for Wildfire Mitigation and Management	21708						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	>10 yrs.	$1,018,090	Major	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Major	Major	Major

Organization	California		Wild land Fire Protection. Elevation data are needed for managing incidents – elevation, fire spread, informing maps (hillshades and topo maps used as a base for incident action plan maps, also as fire behavior analysis tool input). The data are also used for risk assessments – fire burns faster uphill – to identify hazard and risk. For forestry, elevation data are needed for growing conditions, seed zone selection and delineation with elevation breaks for reforestation after harvest. There are many other uses, including analytical uses such as to improve wind speed models.				
MCA Name	MCA No.						
Wild Land Fire Protection	21739						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$849,698	Moderate	Moderate	Moderate	Moderate

Organization	New Mexico		Forestry is responsible for fire suppression on 43 million acres of non-municipal, non-federal, and non-tribal land across the state. Forestry also assists New Mexico's communities by evaluating those lands and forests most at risk to wildfire, disease, and insect infestation by developing appropriate land management and restoration programs, and implementing mitigation projects. Forestry staff provides technical assistance to private landowners for developing sustainable forests that enhance quality of life by providing tree care training, distributing low-cost seedlings, developing Forest Stewardship plans, and delivering insect and disease identification assistance as well as forest health project funding.				
MCA Name	MCA No.						
New Mexico Forest Management	1245						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$653,285	don't know	don't know	don't know	don't know

Organization	Wyoming		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60542						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$525,532	Major	Major	Major	Major

Organization	Oregon		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60358						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$521,404	Major	Major	Major	Major

Organization	Idaho		RECOVER: support federal and state agencies in post-wildfire management and rehabilitation planning to include post-event debris flows. BU 17 Wildfire management. For post-wildfire management, elevation data are needed to model potential debris flows. Elevation data would improve the modeling of debris flow likelihood, and provide additional support to Idaho and other states. The data are also needed for semi-arid ecosystem research, to include the transition areas between natural and cultural conditions.				
MCA Name	MCA No.						
Wildfire Management	1403						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$449,002	Moderate	Moderate	don't know	Minor

Organization	Nebraska		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60275						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$415,603	Major	Major	Major	Major

Organization	South Dakota		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60417						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$414,327	Major	Major	Major	Major

Organization	Florida		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas. Fire management is a vital part of Florida's wildlife management planning and response. Elevation data will support fine-tuning models to better understand the local hydrology and habitats in support of this business goal.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60084						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$301,500	Major	Major	Major	Major

Organization	Wisconsin		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60530						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$301,222	Major	Major	Major	Major

Organization	USFS		Natural disaster risk assessment				
MCA Name	MCA No.						
Natural Disaster Risk Assessment	50009						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$300,000	Major	Major	Major	Major

Organization	Nevada		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60289						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$300,000	Major	Major	Major	Major

Organization	North Carolina		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60327						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$265,244	Major	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL0B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Tennessee		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60430						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$226,425	Major	Major	Major	Major

Organization	Indiana		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60157						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$194,406	Major	Major	Major	Major

Organization	Arizona		In Arizona, the two primary disasters that require a specified mission-critical activity are fires & floods. Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post-fire analysis to determine landslide-prone areas. Elevation data are needed for assessment of potential for flood after fire. Tree canopy, forest density, chapparal, understory, etc. are also needed for fire modeling. Building heights would also be used jointly with the National Guard. The primary responsibility of the Division of Emergency Management is disasters such as flood and fire.				
MCA Name	MCA No.						
Emergency Preparedness, Response, and Recovery	1116						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	$120,000	Major	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Maryland		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60218						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$53,123	Major	Major	Major	Major

Organization	New Jersey		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60300						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$40,467	Major	Major	Major	Major

Organization	Air Force		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60635						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$38,186	Major	Major	Major	Major

Organization	Guam		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60102						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$34,572	Major	Major	Major	Major

Organization	Hawai'i		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60123						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$34,572	Major	Major	Major	Major

Organization	Rhode Island		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60384						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$5,818	Major	Major	Major	Major

Organization	Utah		Scientific research, skills training, wildfire fuel mapping, forest health assessment, forest and rangeland fire severity assessment, firefighter safety zone and escape route mapping, and evacuation planning.				
MCA Name	MCA No.						
Wildfire Management, Fire Safety, and Forest Health	21555						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,809	Major	Major	Major	Major

Organization	Minnesota		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60614						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	HERE Technologies		Determination of standing inventory of forest resources.				
MCA Name	MCA No.						
Determination of Standing Inventory of Forest Resources	60723						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Annually	Major	Major	Major	Major	Major

Organization	Leading Edge Geomatics		Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.				
MCA Name	MCA No.						
Wildfire Management, Planning, and Response	60731						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Major	Major	Major

BU 18 - Homeland Security, Law Enforcement, Disaster Response, and Emergency Management

BU 18 Scope

Business Use #18 (BU 18) includes infrastructure and border protection; coastal search and rescue; population dynamics; emergency fuel supply and movement; line-of-sight analysis in urban areas; disaster response; and flood risk analysis resulting from acts of terrorism. The Department of Homeland Security (DHS), which includes the Federal Emergency Management Agency (FEMA), is a logical champion for this Business Use. For this Business Use, the DHS is assisted by other federal, state, and local agencies.

Figure E.18a. Texas Emergency Operations Center (Austin) during Hurricane Harvey. In addition to flood inundation mapping, lidar was used to estimate the volume of debris to be removed. Image courtesy of Texas Division of Emergency Management.

BU 18 Background Information

Many agencies responsible for homeland security use lidar data for viewshed analyses to determine "what can be seen from where" because many threats are based on intervisibility between points with different elevations; this application is relevant to most aspects of infrastructure protection, border protection, search and rescue, and special security events.

High-resolution population distribution data are critical for homeland security because operational activities and policy decisions are significantly influenced by the number of people impacted at different times of the day when incidents occur. LandScan USA data, produced from lidar and census data as well as ancillary datasets (e.g., land cover, roads, slope, urban areas, village locations, and image analysis), are used to estimate the number of people in residential and non-residential structures at different hours of the day, with phased increases in populations in the morning hours and phased decreases in the evening hours. These models are used for planning and execution of emergency response plans for major urban areas.

BU 18 Elevation Data Uses

Using their own words, respondents documented 60 Mission Critical Activities (MCAs) that identifies BU 18 as their primary Business Use and identified the following 80 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.18a. BU 18 Elevation Data Uses

Data Use
Data Development and Management
1. View large datasets spatially to identify source recruitment opportunities and perform predictive analysis
2. Centralized enterprise GIS platform for the state as a core framework layer for multiple applications
3. Coordinated data acquisition and dissemination
4. Provide GIS services to all State Cabinets for inundation plans, building footprint extraction, etc.

Data Use
5. Serve state agencies and citizens as a centralized clearinghouse and referral center for natural resource data, census data, data related to emergency management, and socioeconomic data
6. Support GIS activities at the State Office of Emergency Management; provide accurate and up-to-date elevation data to support emergency management activities
7. Support the immediate and long-term goals of the public safety community requiring geographic and location-based information
8. Urban structure models are needed in voxel-based software
Emergency Management
9. Answer urgent questions regarding flooding during a specific event
10. Bottoms of lakes and rivers are needed by emergency divers; also river channels and currents
11. Coastal search and rescue
12. Coordinate with DPW on landslides from wet weather and storms
13. Disaster response, especially due to hurricane and flood events
14. Emergency fuel supply and movement
15. Emergency management, response, and recovery
16. Flood risk analysis resulting from acts of terrorism
17. Flood surveillance and coordination with State Emergency Operations Center
18. Geologic emergency response
19. Homeland security, law enforcement, disaster response, and emergency management
20. Landfill maintenance including post-disaster debris removal
21. Law enforcement and national security matters; infrastructure and border protection
22. Law enforcement; first responder actions
23. Locate, communicate, and connect people in an emergency with the help they need
24. Logistical supply and support to locals as needed
25. Oil spill prevention, contingency planning, emergency response, and natural resource damage assessment
26. Operate the State Emergency Operations Center in response to flooding or other natural hazard events and support post event activities
27. Operation of the statewide public safety radio system, including towers
28. Pre-event exposure and post-event rapid damage assessments for disaster response
29. Public safety investigation and real time analysis under water, in air, and on land
30. Public safety pre-planning, hazardous materials response, dam Emergency Action Plans (EAPs) for evacuation planning
31. Real-time analyses and investigations
32. Respond to and recover from incidents, emergencies, and natural and man-made disasters
33. Response to water system shut-downs from physical damages or biohazards
34. Scientific support for environmental emergency response
35. Situational awareness – awareness of the terrain and how it may affect flow, travel time on foot; technology's relationship to the terrain, e.g., viewsheds, line-of-sight
36. Statewide enhanced 9-1-1 system to help locate calls to E911 on a specific floor of a building
37. Support planning, preparation, response, and recovery activities through all aspects of the emergency management cycle
38. Support State security enforcement and emergency response
39. Support statewide emergency operations for state, regional, and local agencies

Data Use
40. Tornado storm shelter protection
Environmental Protection
41. Environmental monitoring and remediation
42. Sewage, Hazmat, stormwater, and groundwater management
Hazard Assessment and Mitigation
43. Counter threats posed by growing, evolving categories of improvised threats, including improvised explosive devices, car bombs, and weaponized consumer drones
44. Determine inundation and producing maps illustrating the threat to facilities and neighborhoods
45. Disaster preparedness and response to flooding, wildfires, domestic search and rescue, border security and law enforcement
46. Disaster preparedness, mitigation, and management
47. Earthquake and tsunami analysis, high tide run up, monitoring, assessments, outreach and mitigation programs
48. Ensure public safety for residents and visitors with attention to life safety and property
49. Fire operations plans; hazard mitigation plans
50. Flood mitigation activities
51. Inundation mapping and identifying at risk populations and critical infrastructure
Mapping/Boundary Delineation
52. Bathymetry for bottom composition (rock, sand, etc.) and shape
53. Before and after crime scene investigations (terrain change can indicate burials)
54. Change detection, analyses, and investigations
55. Elevation data for landmark recognition, e.g., lighthouses, navigation towers, for managing port infrastructure and for situational awareness
56. Mapping in support of criminal, counterintelligence, counterterrorism, and cyber threats
57. Measure landscape change following cataclysmic events such as major landslides or coastal erosion
58. Orthorectification of aerial imagery to produce orthoimages
59. Population distribution and dynamics
Military/Defense
60. National defense; national security; intelligence
Modeling
61. Airborne contaminant and explosives modeling and analysis
62. Habitat modeling and disease prevention; defining boundaries for health advisories for swimming and fishing
63. High performance geo-computing; critical infrastructure modeling, resiliency and data development
64. Input for flood inundation models and novel applications such as identifying isolated communities during a flood
65. Public safety, mitigation planning, flood and debris flow modeling, dam inundation modeling, before and after fire analysis for post fire erosion management
66. Radio frequency (RF) propagation modeling; telecommunications tower site locations
Navigational Safety
67. Improve mariner safety; advancements and enhancements to maritime charting
Planning

Data Use
68. Determine new sites for facilities
69. Determine personnel recovery, continuity of operations planning
70. Enhanced situational awareness, planning, and change detection
71. Helicopter landing site selection
72. Identify potential sniper positions
73. Identify structures that would impede flight and for search and rescue
74. Line-of-sight analysis in urban and rural areas; blast radius
75. National Special Security Event planning and protection
76. Planning and analysis for seawalls for storm surge protection, debris planning, and mitigation activities
77. Special event planning, criminal investigations
78. Tactical operational planning for disaster response
Regulatory Reviews and Enforcement
79. Hydroelectric dam regulation
Research
80. Basic and applied R&D in GeoComputation/site-wide environmental monitoring

BU 18 Tangible and Intangible Benefits

For the 60 MCAs that list Homeland Security, Law Enforcement, Disaster Response, and Emergency Management as their primary Business Use:

- **Table E.18b** summarizes the reported future annual dollar benefits by geography type, totaling $2.15 billion per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.18c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.18e.
- **Table E.18d** shows (in blue) the 11 federal agencies, 38 states and territories, and one non-governmental entities that submitted MCAs with BU 18 as the primary Business Use. MCAs for which BU 18 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.18d.
- **Table E.18e** documents all the MCAs that listed BU 18 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.18e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 18 Reported Future Annual Dollar Benefits

Of the 60 MCAs that listed Homeland Security, Law Enforcement, Disaster Response, and Emergency Management as their primary Business Use, 33 MCAs estimated their tangible annual benefits totally in financial terms; 6 MCAs had a combination of tangible and "Major" intangible benefits; and 16 MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.18b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 60 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.18b. BU 18 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$133,182,513	$2,001,119,972	$2,134,302,485
Inland Bathymetry	$9,116,412	$790,378	$9,906,790
Nearshore Bathymetry	$1,123,516	$266,286	$1,389,802
Offshore Bathymetry	$261,157	$250,320	$511,477
Totals	**$143,683,598**	**$2,002,426,956**	**$2,146,110,554**

BU 18 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.18c. BU 18 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	49	50	30	4	51
Inland Bathymetry	30	30	20	4	31
Nearshore Bathymetry	22	21	3	4	22
Offshore Bathymetry	11	13	7	7	11
Totals	**112**	**114**	**60**	**19**	**115**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 18 Reported Future Annual Dollar Benefits Maps

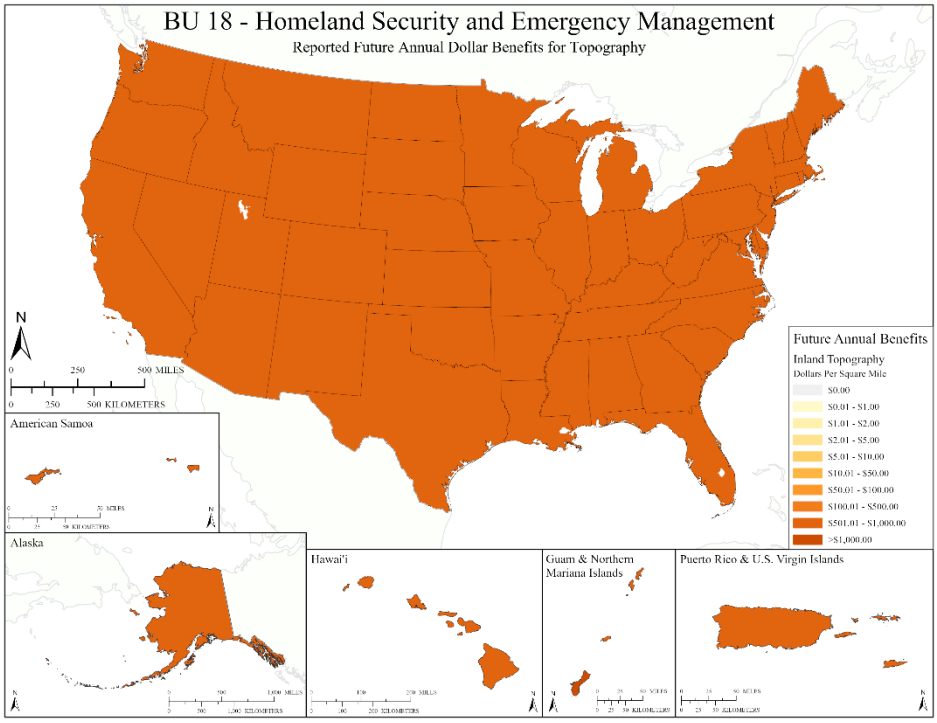

Figure E.18b. Reported Future Annual Dollar Benefits for Topography

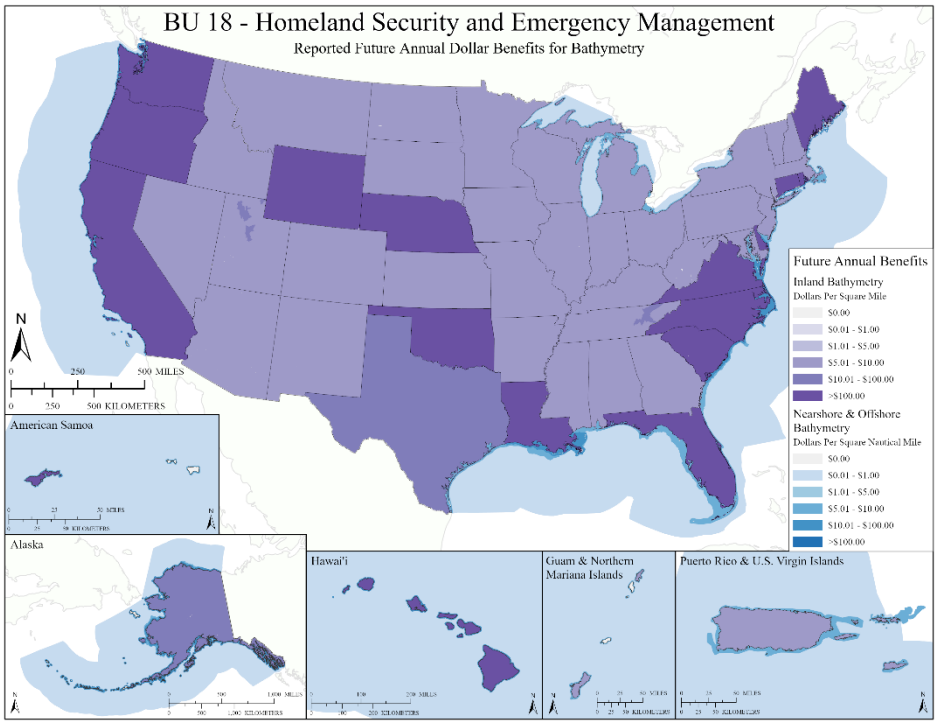

Figure E.18c. Reported Future Annual Dollar Benefits for Bathymetry

BU 18 Benefits Analysis

The total combined future annual benefits ($2.15 billion per year) reported for BU 18 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 18 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, 11 federal agencies (CDC, CMTS, DHS, DTRA, FBI, FEMA, FERC, NGA, ORNL, USAF, and USCG) submitted a total of 15 MCAs listing BU 18 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry and offshore bathymetry. Of the 15 total federal MCAs listing BU 18 as primary:
    - Inland Topography: Seven provided dollar benefits and six indicted "Major" benefits.
    - Inland Bathymetry: Two provided dollar benefits and seven indicated "Major" benefits.
    - Nearshore Bathymetry: One provided dollar benefits and six indicated "Major" benefits.
    - Offshore Bathymetry: One provided dollar benefits and six indicated "Major" benefits.
    - The federal dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.
- State/Local/Tribal and U.S. Territory MCAs: Thirty-eight (38) states and territories submitted a total of 44 MCAs that designated BU 18 as their primary BU. Of the 44 MCAs listing BU 18 as primary:
    - Inland Topography: 33 provided dollar benefits and nine indicated "Major" benefits.
    - Inland Bathymetry: 21 provided dollar benefits and four indicated "Major" benefits.
    - Nearshore Bathymetry: 14 provided dollar benefits and two indicated "Major" benefits.
    - Offshore Bathymetry: One provided dollar benefits and five indicated "Major" benefits.
    - Two states submitted MCAs with BU 18 as secondary, and four states submitted MCAs with BU 18 as tertiary; these do not accrue any benefits to BU 18.
    - The state dollar benefits are understated because we have no way to translate "Major" benefits into dollar benefits.
- Non-governmental MCAs: One non-governmental organization (HERE Technologies) submitted an MCA with BU 18 as primary, indicating "Major" benefits that cannot be translated into dollar benefits.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.18b and E.18c:
    - 226 "Major" Operational and Customer Service benefits and 194 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 18 for which "Major" benefits are documented, this could easily be translated into billions of additional dollars in annual savings. But we do

not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 18 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 18:

- **Table E.18d** color-codes those organizations having an MCA with BU 18 as Primary, Secondary, or Tertiary.
- **Table E.18e** summarizes the 60 MCAs with primary benefits for BU 18, rank ordered from the highest to the lowest tangible benefits.

Table E.18d. Organizations having an MCA with BU 18 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	**BLM**	BOEM	**CDC**	**CMTS**	**DHS**	DISDI	**DTRA**
	EPA	FAA	**FBI**	FCC	**FEMA**	**FERC**	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	**NASA**	**NGA**	NOAA	NPS	NRC	NRCS	NREL
	ORNL	OSMRE	*PHMSA*	SI	*TVA*	*USACE*	**USAF**	USARC	USBR	**USCB**
	USCG	*USFS*	*USGS*	USMC	USN					

State/Ter	**AL**	**AK**	AR	**AZ**	**CA**	**CO**	**CT**	*DC*	**DE**	**FL**	**GA**	**HI**	**IA**	ID
	IL	**IN**	**KS**	**KY**	**LA**	MA	**MD**	**ME**	**MI**	MO	**MN**	**MS**	MT	**NC**
	ND	**NE**	**NH**	*NJ*	**NM**	**NV**	**NY**	**OH**	**OK**	**OR**	PA	**RI**	**SC**	SD
	TN	**TX**	**UT**	**VA**	VT	**WA**	**WI**	WV	**WY**	PR	VI	**GU**	**AS**	CNMI

Non-Gov	**HERE Technologies**			

Table E.18e. MCA summaries for BU 18, rank ordered from the highest to the lowest tangible benefits.

Organization	ORNL		Population Distribution & Dynamics, High Performance GeoComputing, Critical Infrastructure Modeling, Resiliency, and Data Development. ORNL requires elevation data of urban areas to extract building footprints, heights, and characteristics to model populations at risk for emergency response and evacuation planning and execution. The data allows for the study and modeling of buildings, nighttime and daytime population distributions, and seasonal and special event distributions, as well as intercensal population growth areas nationwide. Operational activities on the ORNL reservation include environmental monitoring and remediation as well as emergency management and response and recovery. This includes dispersion modeling, flood analysis, and mapping.				
MCA Name	MCA No.						
Basic and Applied Research and Development in GeoComputation/Site-Wide Environmental Monitoring	21573						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$15,453	$61,369,264	Minor	Moderate	Major
Inland Topo	QL2	4-5 yrs.	$488,165	$1,938,630,736	Minor	Moderate	Major
Inland Bathy	QL0B	2-3 yrs.	$1,206	Moderate	Minor	Moderate	Moderate
Nearshore B.	X-Sec meet needs	2-3 yrs.	Moderate	Moderate	Minor	Minor	Minor

Organization	DHS		DHS components on Disaster preparedness and response to flooding, wildfires, domestic search and rescue, border security and Law Enforcement. Additional Business Uses include the following: BU 02, 03, 10, 15 - 25, and 28-30.				
MCA Name	MCA No.						
Disaster Preparedness and Response	21673						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$46,114,681	Major	Moderate	don't know	Major
Inland Topo	QL0	Annually	$28,894,002	Major	Moderate	don't know	Major
Inland Bathy	QL1B	Annually	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	Annually	don't know	don't know	don't know	don't know	Moderate
Offshore B.	Order 1b	2-3 yrs.	Moderate	Major	don't know	don't know	Minor

Organization	Kentucky		Our agency is situated within the Executive Branch as an umbrella agency that provides GIS Service to all Cabinets. Individual Cabinet uses of the data statewide vary considerably. Lidar data are currently used for inundation plans, building footprint extraction, archaeology, highway design, and many more.				
MCA Name	MCA No.						
Statewide Geospatial Data Coordination and Support	1151						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$9,000,000	Moderate	Moderate	Moderate	Moderate

Organization	California		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60050						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$4,665,352	$82,458	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$1,313,882	$83,827	Major	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	$7,487	$214	Moderate	Moderate	Major

Organization	Utah		Local government geologic support and geologic emergency response.				
MCA Name	MCA No.						
Geologic Support and Emergency Response	1126						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$3,779,745	$43,583	Major	Moderate	Major
Inland Bathy	QL0B	6-10 yrs.	$13,463	$859	Major	Moderate	Major

Organization	Wyoming		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60543						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$2,885,487	$50,999	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$812,626	$51,846	Major	Moderate	Major

Organization	Oregon		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60359						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$2,862,820	$50,599	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$806,243	$51,439	Major	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	$2,482	$71	Moderate	Moderate	Major

Organization	New Mexico		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60313						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$3,586,927	$63,397	Major	Moderate	Major

Organization	Arizona		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60039						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$3,362,989	$59,439	Major	Moderate	Major

Organization	Nevada		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60290						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$3,261,565	Major	Major	Moderate	Major

Organization	Nebraska		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60276						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$2,281,909	$40,331	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$642,643	$41,001	Major	Moderate	Major

Organization	Oklahoma		BU 18 - Homeland Security, Law Enforcement, Disaster Response, and Emergency Management Statutory Authority Definition O.S 47 § 2-117.A Full Police Powers O.S 47 § 2-117.B.1 Enforce Traffic Laws and when directed by Governor O.S 47 § 2-117.B.2 Arrest any person detected violating the law O.S 47 § 2-117.B.3 Pursue fleeting violations in state and out of state O.S 47 § 2-117.B.4 Assist in the location of stolen property O.S 47 § 2-117.B.5 Traffic control at emergency scenes O.S 47 § 2-117.B.6 Inspect livestock moving on the highways O.S 47 § 2-117.B.7 Inspect vehicles of registration and equipment O.S 47 § 2-117.B.8 Inspect public garages and salvage yards for stolen cars O.S 47 § 2-117.B.9 Serve district court traffic warrants O.S 47 § 2-117.B.10 Investigate collisions, secure testimony of witnesses O.S 47 § 2-117.B.11 Investigate reported stolen vehicles, trailers and semitrailers O.S 47 § 2-117.B.12 Conduct mechanical inspections to ensure road safety. O.S 47 § 2-117.B.13 Enforce the general laws on vehicles operating on the roadways O.S 47 § 2-117.B.14 Enforce registration and licensing laws O.S 47 § 2-117.B.15 Enforce all laws regarding the operation of vehicles on a highway O.S 47 § 2-117.B.16 Perform size and weights enforcements to prevent damage to roads O.S 47 § 2-117.B.17 Investigate/Report to OCC/OTC any violation of their rules ref to transportation O.S 47 § 2-117.B.18 Investigate violation of laws regulated to excise tax and motor fuels O.S 47 § 2-117.B.19 Regulate the movement of traffic on the highway system O.S 47 § 2-117.B.20 Investigate damage to state property along the highway system O.S 47 § 2-117.B.21 Investigate all incidents involving department employees in the course of their duty O.S 47 § 2-117.B.22 Initiate or assist in manhunt/fugitive investigations O.S 47 § 2-105.3.A Dignitary Protection for the Governor O.S 47 § 2-105.7 Capitol Patrol Functions O.S 47 § 2-105.4B Bomb Squad O.S 47 § 2-105.6 Marine Enforcement O.S 47 § 2-106.3 Fraudulent Document Investigations O.S 47 § 2-118 Training Division O.S 47 § 954 Wrecker Inspection O.S 21 § 99A Assist Law Enforcement O.S 47 § 2-117.E.3 Conduct speed trap investigations O.S 47 § 2-118 Administration of the department O.S 74 § 150.12A Take reports on missing persons O.S 4 § 85.5 Responding to and investigate stray animals on highway (livestock) O.S 12A § 4-1-102.9.c Hazardous material spills outside of a municipality The Oklahoma Department of Public Safety is responsible by law for the above activities. Elevation data are needed for real world operations under water, in air, and on land. The data are used to identify structures that would impede flight and for search and rescue. Bottoms of lakes and rivers are needed by divers, also watersheds, river channels and their currents. On-the-scene sonar is often collected, but existing data are also needed for change detection, to identify changes in land, wells or ponds that have changed including hand dug wells, before and after crime scene investigations (new depressions can indicate burials, etc.); altitude is also needed for real time analysis and investigation. Urban structures are needed for use in voxel based software. Drone units are coming on line for use within the department as well.					
MCA Name	MCA No.						
Public Safety Investigation and Real Time Analysis	21646						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$2,062,066	$36,446	Moderate	don't know	Major
Inland Bathy	X-Sec meet needs	2-3 yrs.	$580,730	$37,051	don't know	don't know	don't know

Organization	Washington		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60518						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,992,963	$35,224	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$561,269	$35,809	Major	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	$14,111	$405	Moderate	Moderate	Major
Offshore B.	Order 2	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Florida		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism. Elevation data are needed to support Florida's security enforcement and emergency response.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60085						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,655,416	$29,258	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$466,207	$29,744	Major	Moderate	Major

Organization	Alaska		Natural Disaster Response, Disaster Preparedness, Mitigation, and Management.				
MCA Name	MCA No.						
Natural Disaster Response	1365						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$683,254	$14,509	Major	Minor	Major
Inland Bathy	QL1B	4-5 yrs.	$683,254	$13,906	Major	Minor	Major
Nearshore B.	X-Sec meet needs	6-10 yrs.	$683,254	$10,891	Major	Minor	Major

Organization	CDC		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60647						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$250,000	$250,000	Moderate	Moderate	Major
Inland Bathy	QL0B	2-3 yrs.	$250,000	$250,000	Minor	Moderate	Major
Nearshore B.	QL1B	2-3 yrs.	$250,000	$250,000	Minor	Minor	Major
Offshore B.	Order 2	2-3 yrs.	$250,000	$250,000	Minor	Minor	Major

Organization	North Carolina		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60328						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,456,348	$25,740	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$410,144	$26,167	Major	Moderate	Major
Nearshore B.	QL0B	4-5 yrs.	$39,541	$1,135	Moderate	Moderate	Major
Offshore B.	Dependent	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Louisiana		Oil spill 1) prevention, 2) contingency planning, 3) emergency response, and 4) natural resources damage assessment.				
MCA Name	MCA No.						
Oil Spill Prevention, Planning, and Response	21558						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$1,359,474	$24,028	Major	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$382,862	$24,427	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	$55,977	$1,606	Major	Major	Major
Offshore B.	Order 2	6-10 yrs.	Major	Major	Major	Major	Major

Organization	Iowa		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60178						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,660,040	$29,340	Major	Moderate	Major

Organization	Wisconsin		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60531						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,653,888	$29,231	Major	Moderate	Major

Organization	Virginia		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60501						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,191,248	$21,054	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$335,486	$21,404	Major	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	$18,007	$516	Moderate	Moderate	Major

Organization	Mississippi		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60247						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,406,162	$24,853	Major	Moderate	Major

Organization	Louisiana		Disaster Response, especially due to hurricane and flood events				
MCA Name	MCA No.						
Disaster Response	1236						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$214,862	$61,808	Major	don't know	Major
Inland Bathy	QL1B	4-5 yrs.	$1,071,090	$71,808	Major	Moderate	Major

Organization	Maine		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60210						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$956,063	$16,897	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$269,251	$17,178	Major	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	$8,136	$233	Moderate	Moderate	Major
Offshore B.	Order 2	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Tennessee		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60431						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,243,208	$21,973	Major	Moderate	Major

Organization	South Carolina		Coordinated data acquisition and dissemination				
MCA Name	MCA No.						
Coordinated Data Acquisition and Dissemination	21883						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$913,133	$16,139	don't know	Moderate	Major
Inland Bathy	QL0B	6-10 yrs.	$257,161	$16,407	Major	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	$11,157	$320	Moderate	Moderate	Major
Offshore B.	Order 2	4-5 yrs.	$11,157	$320	Major	Major	Major

Organization	Indiana		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60158						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$1,067,408	$18,865	Major	Moderate	Major

Organization	New York		While our main role is as a GIS data producer and provider including for LIDAR and elevation data, we are required to support GIS activities at the State Office of Emergency Management. Thus, we need to provide accurate and up-to-date elevation data to support emergency management activities.				
MCA Name	MCA No.						
Data Distribution and Emergency Management Data Support	1177						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	>10 yrs.	$1,038,618	Moderate	don't know	don't know	don't know
Nearshore B.	QL3B	6-10 yrs.	$2,110	don't know	don't know	don't know	don't know

Organization	Texas		Serve Texas agencies and citizens as a centralized clearinghouse and referral center for: (1) natural resource data; (2) census data; (3) data related to emergency management; and (4) other socioeconomic data. Acquire and improve digital geographic data for statewide mapping applications. The Texas Natural Resources Information System (TNRIS) acquires data and distributes it to state users, supports emergency management, and tries to unify data across the state. The goal is to provide common data with common parameters. TNRIS also extracts data products from the raw data as needed by state users (e.g. building footprints, building heights, contours, and other derivative products). TNRIS is involved in planning water projects across the state and flood risk management with the Texas Water Development Board (TWDB). Post event sonar bathymetry is currently captured for debris management.					
MCA Name	MCA No.						
Texas Data Acquisition and Clearinghouse	1344						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$334,472	$60,100	don't know	don't know	Major
Inland Bathy	QL0B	4-5 yrs.	$138,090	$9,799	don't know	don't know	Major

Organization	Hawai'i		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60124						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$189,821	$3,355	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$53,458	$3,410	Major	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	$4,010	$115	Moderate	Moderate	Major

Organization	Connecticut		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60070						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$146,671	$2,592	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$41,306	$2,635	Major	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	$2,315	$66	Moderate	Moderate	Major

Organization	Guam		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60103						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$189,821	$3,355	Major	Moderate	Major

Organization	Air Force		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60636						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	3-5 yrs.	$167,159	$1,320	Moderate	Moderate	Major

Organization	Delaware		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60078						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$58,158	$1,027	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$16,379	$1,045	Major	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	$23,253	$667	Moderate	Moderate	Major

Organization	FBI		Law Enforcement and national security matters. Infrastructure and border protection. Population dynamics. Line-of-sight analysis in urban areas. Emergency fuel supply and movement. Flood risk analysis resulting from acts of terrorism. Critical infrastructure monitoring. Coastal search and rescue. Mapping in support of criminal, counterintelligence, counterterrorism, and cyber threats. Law enforcement: View large data sets spatially to identify source recruitment opportunities and perform predictive analysis. Tactical operational planning. Disaster response. To protect the American people, the FBI requires the routine use of 3D elevation data. The FBI leverages this data for everything from identifying possible sniper positions, to determining personnel recovery, to continuity of operations planning, to determining new sites for facilities. Without this data, the FBI would have less confidence in many of its assessments on a multitude of threats.				
MCA Name	MCA No.						
Law Enforcement and National Security Matters	1234						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$53,064	Major	don't know	don't know	Major
Inland Bathy	QL0B	2-3 yrs.	Major	Moderate	None	None	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Moderate	None	None	Major
Offshore B.	Order 2	2-3 yrs.	Major	Moderate	None	None	Major

Organization	Rhode Island		Scientific support for environmental emergency response. Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60385						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$31,945	$564	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$8,996	$574	Major	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	$1,667	$47	Moderate	Moderate	Major
Offshore B.	Order 2	4-5 yrs.	Major	Major	Major	Major	Major

Organization	American Samoa		Infrastructure and border protection. Coastal search and rescue (incl drone rescue buoy). Population dynamics. Emergency fuel supply and movement. Line-of-sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism. Earthquake and tsunami analysis (especially for Ta'u), high tide run up, monitoring, assessments, outreach, and mitigation programs. Landslides from wet weather and storms are major concern. Coord with DPW (MCA 33077), DOC (MCA 21567), and Coral Reefs (MCA 21509)				
MCA Name	MCA No.						
Emergency Management and Disaster Response	33084						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$2,368	$41	Major	Moderate	Major
Inland Bathy	QL2B	2-3 yrs.	$667	$42	Major	Major	Major
Nearshore B.	QL2B	2-3 yrs.	$9	Major	Major	Major	Major
Offshore B.	Order 2	2-3 yrs.	Major	Major	Major	Major	Major

Organization	FBI		Radio Frequency (RF) propagation modeling; Telecommunications-tower site locations				
MCA Name	MCA No.						
Telecommunications Propagation Modeling and Tower Siting	22002						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	$1,447	$1,447	None	None	None
Inland Bathy	QL0B	2-3 yrs.	Major	Major	Minor	Moderate	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Minor	Minor	Major
Offshore B.	Order 2	2-3 yrs.	Major	Major	Minor	Minor	Major

Organization	Ohio		Flood mitigation activities. Tornado Storm shelter protection (safe rooms). Response to Potential Radiation fallout from Nuclear Power Plants. Response to Water system shut downs from physical damages or bio-hazards. Logistical supply and support to locals, as needed. Maintenance of MARCS radios and Towers. Upkeep, testing and maintenance of the Statewide EAS broadcast network. Testing, maintenance and system expansion of the statewide rainfall and river gauge system known as STORMS. Emergency Management and Communication center. Training and planning for the locals to respond or mitigate emergencies.				
MCA Name	MCA No.						
Statewide Emergency Management and Response	21605						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$2,533	Minor	don't know	don't know	Moderate
Inland Bathy	QL4B	4-5 yrs.	Minor	Minor	don't know	don't know	don't know
Nearshore B.	Coarser bathymetric data satisfies my needs	4-5 yrs.	Minor	Minor	None	None	Minor
Offshore B.	Coarser bathymetric data satisfies my needs	4-5 yrs.	Minor	Minor	don't know	don't know	Minor

Organization	FEMA		Pre-event exposure and post-event rapid damage assessments for disaster response. An integral part of both pre-event impact prediction and post-event damage assessment, elevation data provide a vital input into flood inundation models as well as in novel applications such as identifying isolated communities during a flood. Moreover, repeat, high-resolution elevation datasets measure landscape change following cataclysmic events such as major landslides or coastal erosion.				
MCA Name	MCA No.						
Rapid Damage Assessments for Emergency Response Planning	1340						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$1,809	Major	Moderate	Major	Moderate
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Moderate	Major	Moderate
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Moderate	Major	Major

Organization	USCG		Homeland Security, Law Enforcement, Disaster Response, and Emergency Management; Marine and Riverine Navigation and Safety; Aviation Navigation and Safety; Military; Environmental Protection; Coastal search and rescue. Elevation data are needed to improve mariner safety, improve the accuracy of maritime navigation, for advancements and enhancements to maritime charting, and to support our customers (public, commercial and private sector, military, and USCG districts). Elevation data are also needed for landmark recognition (e.g. lighthouses, navigation towers), for managing port infrastructure, and for situational awareness.				
MCA Name	MCA No.						
Homeland Security Navigation	1165						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Event driven	don't know	Major	None	None	Moderate
Inland Bathy	QL0B	Annually	Major	Major	don't know	don't know	don't know
Nearshore B.	QL0B	Annually	Major	Major	None	None	None
Offshore B.	Order 1a	2-3 yrs.	Moderate	Major	None	None	None

Organization	Illinois		Line-of-sight analysis in urban and rural areas, Disaster response, Critical infrastructure protection, Special event planning, Criminal investigations				
MCA Name	MCA No.						
Disaster Planning and Response	1175						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Event driven	Moderate	Major	don't know	None	Major
Inland Bathy	X-Sec meet needs	2-3 yrs.	don't know	Moderate	don't know	don't know	Moderate

Organization	New York		Respond to and recover from incidents, emergencies, and disasters.				
MCA Name	MCA No.						
New York State Emergency Management	1178						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Minor	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	Moderate	Moderate	Minor	Minor	Moderate
Nearshore B.	QL1B	Event driven	Moderate	Moderate	Minor	Minor	Moderate

Organization	North Carolina		Aerial imagery rectification. Aerial imagery is collected on a 4-year cycle, with one quarter of the state being collected per year. Elevation data are needed for orthorecitification of the imagery.				
MCA Name	MCA No.						
Aerial Imagery Rectification	1468						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	None	None	Major

Organization	Maryland		The Maryland Department of Information Technology, Geographic Information Office provides a centralized enterprise GIS platform to store and serve GIS data. Additionally, we have initiatives that include the collection and dissemination of core framework layers such as LiDAR and Imagery. We provide services for the majority of the BUs listed.				
MCA Name	MCA No.						
Statewide Geospatial Services	11478						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Minor	Moderate	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Minor	Major	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Moderate	Major	Major

Organization	DTRA		Protect critical infrastructure. Mission Assurance. Force protection. Major event planning. Elevation data are needed for airborne contaminant and explosives modeling and analysis. Bathymetry is needed for underwater explosives and how blasts reflect, etc. Bottom composition (rock, sand, etc.) as well as shape are important. Elevation data are also needed for the following: Health emergency response. Habitat modeling and disease prevention. Defining boundaries for health advisories for swimming and fishing. Marine-based bioproducts and pharmaceuticals. Public health and safety. Prevention of waterborne diseases. To counter the threats posed by the full spectrum of weapons of mass destruction (WMD), including chemical, biological, radiological, nuclear, and high-yield explosives. To counter the threats posed by the growing, evolving categories of improvised threats, including improvised explosive devices, car bombs and weaponized consumer drones, as well as the tactics, technologies and networks that put them on the battlefield. To ensure the U.S. military maintains a safe, secure, effective and credible nuclear weapons deterrent. Elevation data are most critically needed near U.S. bases, major cities, and major ports.						
MCA Name	MCA No.						
Protection of Critical Infrastructure, Public Health and Safety, and Force Protection	21580						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	None	Moderate	Major
Inland Bathy	QL3B	4-5 yrs.	Major	Major	None	don't know	Major
Nearshore B.	QL3B	4-5 yrs.	Major	Major	None	don't know	Major
Offshore B.	I don't know	4-5 yrs.	Major	Major	None	don't know	Major

Organization	Illinois		Flood surveillance and coordination with State Emergency Operations Center. OWR uses elevation data to answer urgent questions regarding flooding during a specific event. This includes using elevation data to determine inundation and producing maps illustrating the threat to facilities and neighborhoods.				
MCA Name	MCA No.						
Flood Surveillance and Coordination with State Emergency Operations Center	21652						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	None	None	Major
Inland Topo	QL2	4-5 yrs.	Major	Major	None	None	Major
Inland Bathy	QL0B	4-5 yrs.	Major	Major	None	None	Major

Organization	DHS		National Special Security Event planning and protection. Line of Sight analysis in urban areas. Blast radius. Helicopter landing.				
MCA Name	MCA No.						
National Special Security Event Protection	21675						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	Major	Major	Major	don't know	Major

Organization	New Hampshire		To locate, communicate and connect people in an emergency with the help they need. More specifically we use various types of GIS data to support statewide emergency operations for state, regional and local agencies on a daily basis. Additionally, we support planning, preparation, response and recovery activities through all aspects of the emergency management cycle and support the immediate and long term goals of the public safety community requiring geographic and location based information. Elevation data are needed for the statewide enhanced 9-1-1 system, to help locate cell calls to 9-1-1 on a specific floor of a building. For operations of the statewide public safety radio system, including towers, elevation data are needed to analyze the range of towers. The department also enhances the topo layer for situational awareness. They also operate the state Emergency Operations Center in response to flooding or other natural hazard events and support post event activities. Boating operations in Lake Winnepasaukee require bathymetric data for navigation and safety, safe boating. Elevation data are also needed for planning and analysis for seawalls for storm surge protection, debris planning, and mitigation activities.					
MCA Name	MCA No.						
Statewide Emergency Communications and Operations	21746						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	Major	Major	Minor	Minor	Major
Inland Bathy	QL0B	4-5 yrs.	Moderate	Major	Minor	Minor	Moderate
Nearshore B.	QL0B	4-5 yrs.	Moderate	Moderate	None	None	Minor

Organization	Colorado		Ensuring public safety for residents and visitors, with attention to life safety and property. New QL2 lidar data were recently acquired and are being used for public safety, mitigation planning, flood and debris flow modeling, dam inundation modeling, and before and after fire analyses for post fire erosion management.				
MCA Name	MCA No.						
Emergency Planning, Mitigation, Response and Recovery - Risk Assessment and Critical Infrastructure Analysis	22124						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Moderate	Major	Major

Organization	California		Law Enforcement. First responder actions. Sewage, stormwater management, Hazmat, groundwater management, agriculture, fire, solar development, line of sight analysis, drone integration, and landfill maintenance. City and county functions. Engineering level requirements.				
MCA Name	MCA No.						
Law Enforcement	22266						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	Major	Major	Major	Major	Major

Organization	DHS		Situational awareness - awareness of the terrain and how it may affect flow, travel time on foot. Technology's relationship to the terrain in any given area - viewsheds, line of sight to provide situational awareness.				
MCA Name	MCA No.						
Border Protection	22435						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Moderate	None	None	None
Inland Bathy	QL1B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	CMTS		Homeland Security, Law Enforcement, Disaster Response, and Emergency Management; Marine and Riverine Navigation and Safety; Aviation Navigation and Safety; Military; Environmental Protection; Coastal search and rescue. Elevation data are needed to improve mariner safety, improve the accuracy of maritime navigation, for advancements and enhancements to maritime charting, and to support our customers (public, commercial and private sector, military, and USCG districts). Elevation data are also needed for landmark recognition (e.g. lighthouses, navigation towers), for managing port infrastructure, and for situational awareness.				
MCA Name	MCA No.						
Homeland Security Navigation	50005						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Event driven	don't know	Major	None	None	Moderate
Inland Bathy	QL0B	Every 6 months	Major	Major	don't know	don't know	don't know
Nearshore B.	QL0B	Every 6 months	Major	Major	None	None	None
Offshore B.	Order 1a	2-3 yrs.	Moderate	Major	None	None	None

Organization	Minnesota		Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60615						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Major	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Major	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	Major	Major	Moderate	Moderate	Major

Organization	FERC		Hydroelectric dam regulation. Infrastructure and border protection. Coastal search and rescue. Population dynamics. Emergency fuel supply and movement. Line of sight analysis in urban areas. Disaster response. Flood risk analysis resulting from acts of terrorism.				
MCA Name	MCA No.						
Homeland Security, Law Enforcement, Disaster Response, and Emergency Management	60656						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Moderate	Moderate	Major
Inland Bathy	QL0B	2-3 yrs.	Major	Major	Minor	Moderate	Major

Organization	HERE Technologies		Enhanced situational awareness, planning, and change detection capabilities.				
MCA Name	MCA No.						
Enhanced Situational Awareness, Planning, and Change Detection Capabilities	60724						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	Major	Major	Moderate	Moderate	Major

Organization	Colorado		Ensuring public safety for residents and visitors, with attention to life safety and property. Emergency Planning, Mitigation, Response and Recovery, Risk Assessment and Critical Infrastructure Analysis. Elevation data are needed for public safety pre-planning, hazardous materials response, dam Emergency Action Plans (EAPs) for evacuation planning, fire operations plans, hazard mitigation plans.				
MCA Name	MCA No.						
Emergency Planning, Mitigation, Response and Recovery - Risk Assessment and Critical Infrastructure Analysis	1349						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Moderate	Moderate	don't know	Minor	Moderate
Inland Bathy	X-Sec meet needs	2-3 yrs.	Moderate	Moderate	None	None	Moderate

Organization	DTRA		National Defense				
MCA Name	MCA No.						
National Defense	21644						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	4-5 yrs.	Moderate	Moderate	don't know	don't know	don't know
Inland Bathy	X-Sec meet needs	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Georgia		Inundation mapping and identifying at risk populations and critical infrastructure.				
MCA Name	MCA No.						
Emergency Management	22018						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	NGA		National Security, Intelligence				
MCA Name	MCA No.						
National Security, Intelligence	32713						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Annually	don't know	don't know	don't know	don't know	don't know

BU 19 - Land Navigation and Safety

BU 19 Scope

Business Use #19 (BU 19) includes road and railroad route selection and maintenance; slope analysis for autonomous cars; and GPS navigation visualization. State Departments of Transportation (DOTs) and the private automotive industry serve as champions for the use of enhanced elevation data to satisfy requirements for this Business Use.

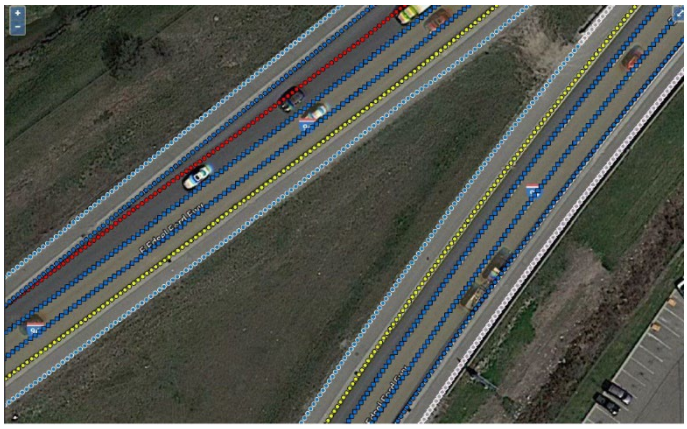

Figure E.19a. A high definition (HD) map, generated from lidar, used in automated and autonomous driving. Each colored dot has 3D coordinates. Image courtesy of General Motors.

BU 19 Background Information

From the state DOT perspective, DEMs from lidar or photogrammetry are ideal for road design as well as mapping as-built transportation infrastructure, to include heights of highway signs and lights. High-density DEMs are used to map existing and proposed roads, avoiding land surveys where surveyors are frequently injured or killed by passing motorists. These DEMs are used to select routes for new roads, design new roads with proper grades and curves, estimate cut/fill for earthmoving operations, and provide data for conventional construction stakeout or modern GPS machine control where grade stakes are not required.

From the automotive industry perspective, Type 1 digital road maps started with basic maps of road networks with a focus on road connectivity and addressing scheme so that GPS receivers in cars and trucks (and subsequently smart phones) could provide simple driving directions.

Digital road maps then progressed into Type 2 Advanced Driver Assist System (ADAS) maps and Active Safety, where the road grade and curvature play a major role in vehicle operations, from notifying the driver of dangerous situations, to actively applying inputs to vehicle controls (including predictive shifting and adaptive cruise control) and providing active safety warnings. Type 2 ADAS maps were considered during the NEEA study in 2012 when TomTom and automotive engineers in Germany estimated major savings in fuel consumption from predictive shifting in advance of changing grades and curves ahead.

Type 3 digital road maps are high definition (HD) maps used in automated and autonomous driving. General Motors provided an MCA with nearly $13 million in annual savings from HD lane-level mapping of publicly-accessible roads and trails, to include electric vehicle efficiency, powertrain efficiency, predictive shifting, chassis safety, improved adaptive cruise control, reduced braking on long downslopes, and other benefits for cars now under development. In addition to their MCA, General Motors provided a presentation from the Society of Automotive Engineers (SAE) International that explained these three types of digital road maps and documented HD data requirements and benefits. HD maps are required for automated driving, and HD maps are thought of as a sensor in a vehicle – not just data. By comparison to the other sensors on vehicles:

1. HD maps have the longest range of detection (HD Maps can indicate decision points miles ahead of the vehicle).
2. HD maps are the most accurate sensor on the car (lidar based maps can achieve centimeter level accuracy).

3. HD maps are the only sensor that can detect certain road features (i.e. complete road architecture, complex curvature, super-elevation, over a hill, or around a blind corner, etc.)
4. HD maps are the only sensor that can pre-establish a smooth arc for all curves. Paint lines have irregular distances causing constant steering corrections, pre-calculating the precise radius of the curve allows smooth curve turn-in, transition, and exit.
5. HD maps are the only sensor that is frequently enhanced in the field (regular map updates).
6. HD maps are the only sensor that can geo-fence the autonomous vehicle.
7. HD maps are a core component of primary localization (what lane is the vehicle in / what path is desired?)
8. HD maps are the only sensor that can relay unmarked traffic patterns and rules (virtual lane lines through intersections).
9. HD maps are the only sensor that can accurately correlate traffic management signs and lights to the lanes they control.
10. HD maps are not impacted by weather.
11. Most importantly, HD maps are the fundamental safety layer for an autonomous system, i.e., the only input that can independently verify that the live sensor suite is reporting logical and consistent localized information.

BU 19 Elevation Data Uses

Using their own words, respondents documented 41 Mission Critical Activities (MCAs) that identified BU 19 as their primary Business Use and identified the following 43 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.19a. BU 19 Elevation Data Uses

Data Use
Engineering Design and Construction
1. Bridge design and construction
2. Cut and fill analysis for earth-moving
3. Increase speed with which DOT projects can be developed and constructed
4. Lidar for preliminary and final design, augmented with field surveys
5. Preliminary and final design of transportation construction projects
6. Transportation engineering
7. Transportation surveying, designing, building, and maintenance
Hazard Assessment and Mitigation
8. Traffic engineering and geohazard identification
Infrastructure Management
9. Deliver services that promote and enhance a healthy rail transportation system
10. DOT asset data inventory and management
11. Highway maintenance and right-of-way management
12. Maintenance and monitoring of existing roadways
13. Road and railroad route selection and maintenance
14. Road infrastructure management
15. Structure maintenance
Mapping/Boundary Delineation
16. Build and verify a highly accurate lane-level map of all roads and trails that support safety and increasing vehicle autonomy

Data Use
17. Create accurate, fresher maps as the building blocks of autonomous driving; Original Equipment Manufacturer (OEM) customers require end-to-end HAD (Highly Automated Driving) and connected ADAS solutions
18. DOT needs to be able to identify water features in order to avoid them or construct culverts or bridges over them when necessary
19. Locating culverts
20. Mapping publicly accessible roads and trails
Modeling
21. Environmental mitigation and hydrology
22. Hydraulic analysis to model the expected flows so culverts/structures are built with sufficient stream width and freeboard with an appropriate safety factor
23. Hydrologic and hydraulic (H&H) modeling for transportation engineering
24. Planning for culverts and bridges, design, H&H modeling
Navigational Safety
25. Automotive powertrain efficiency and chassis safety (fuel/charge), especially for trailering uses.
26. GPS navigation and visualization
27. Highly automated driving (highway autopilot), autonomous driving, and connected ADAS opportunities (dynamic speed, signs, traffic, safety hazards, etc.)
28. Predictive shifting, improved adaptive cruise control, reduced braking on long downslopes
29. Rail safety evaluation and enforcement; inform speed limits and enforcement on railroads
30. Slope analysis for autonomous cars
31. Traffic control and safety analysis
32. Understanding highway slope/undulation and many applications
33. Vehicle-to-infrastructure data broadcasts at intersections
Planning
34. Bathymetry for bridge and culvert planning and design
35. Electric vehicle efficiency and convenience, including range estimation, route planning including charging stops, and charging station placement
36. FRA national rail strategy, planning and policy; assessment of passenger and freight rail performance, investments and policy issues
37. Ground surface and benthic elevation data collection for highway design; with better data, we do better analyses, save field time, and produce higher quality roadways and freight systems with fewer environmental impacts
38. Highway planning and preliminary design
39. Planning for development and impact studies
40. Road, bridge, and culvert planning and design
41. Site analysis
42. Support rail stakeholder planning and development of high-performance rail services
43. Transportation network and infrastructure planning

BU 19 Tangible and Intangible Benefits

For the 41 MCAs that list Land Navigation and Safety as their primary Business Use:

- **Table E.19b** summarizes the reported future annual dollar benefits by geography type, totaling $45.21 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.19c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.19e.
- **Table E.19d** shows (in blue) the four federal agencies, 35 states and territories, and two non-governmental entities that submitted MCAs with BU 19 as the primary Business Use. MCAs for which BU 19 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.19d.
- **Table E.19e** documents all the MCAs that listed BU 19 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.19e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 19 Reported Future Annual Dollar Benefits

Of the 41 MCAs that listed Land Navigation and Safety as their primary Business Use, 31 MCAs estimated their tangible annual benefits totally in financial terms; one MCA had a combination of tangible and "Major" intangible benefits; and seven MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.19b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 41 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.19b. BU 19 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$41,971,111	$2,397,870	$44,368,981
Inland Bathymetry	$841,021	$8,698	$849,719
Nearshore Bathymetry	$0	$0	$0
Offshore Bathymetry	$0	$0	$0
Totals	**$42,812,132**	**$2,406,568**	**$45,218,700**

BU 19 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.19c. BU 19 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	37	36	0	33	35
Inland Bathymetry	1	1	1	2	2
Nearshore Bathymetry	0	0	0	0	0
Offshore Bathymetry	0	0	0	0	0
Totals	**38**	**37**	**1**	**35**	**37**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 19 Reported Future Annual Dollar Benefits Maps

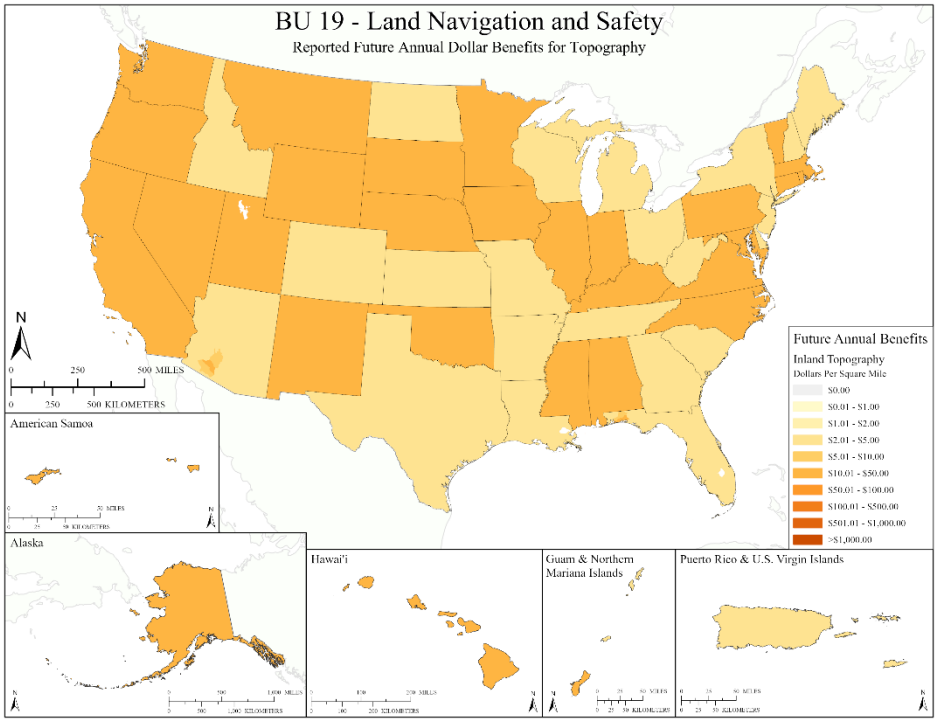

Figure E.19b. Reported Future Annual Dollar Benefits for Topography

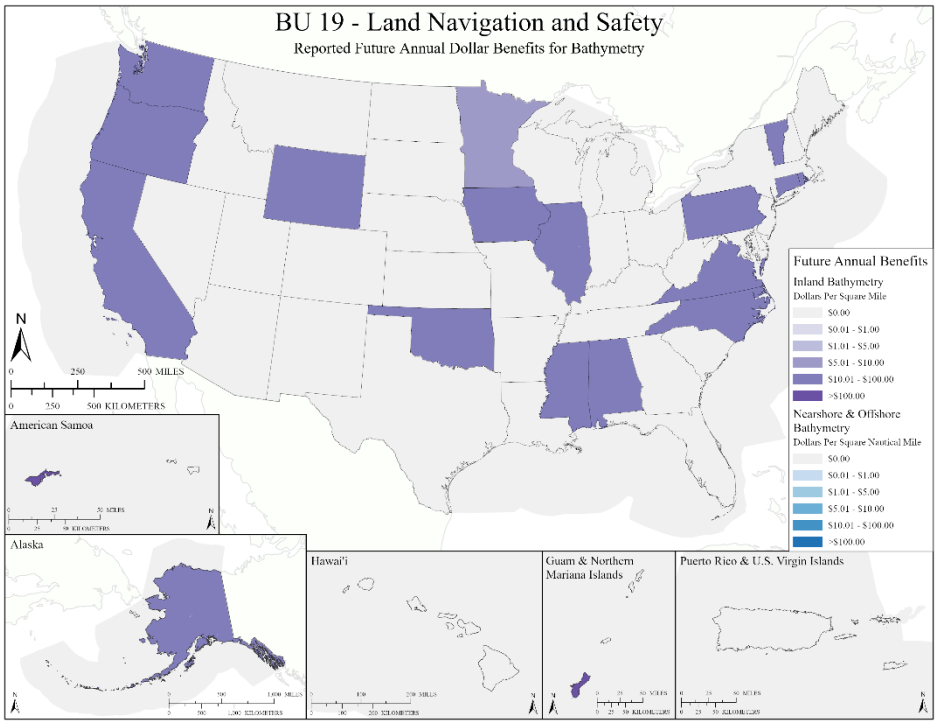

Figure E.19c. Reported Future Annual Dollar Benefits for Bathymetry

BU 19 Benefits Analysis

The total combined future annual benefits ($45.21 million per year) reported for BU 18 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe the BU 19 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, four federal agencies (FBI, FRA, NOAA, USAF) submitted four MCAs listing BU 19 as their primary Business Use, with differing requirements for inland topography an inland bathymetry.
    - Inland Topography: One provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits and none indicated "Major" benefits.
    - Nearshore and Offshore Bathymetry: None provided benefits for nearshore or offshore bathymetry.
    - The FHWA submitted an MCA listing BU 19 as secondary, meaning no benefits accrued to BU 19.
- State/Local/Tribal and U.S. Territory MCAs: Thirty-four (34) states and territories submitted 35 MCAs listing BU 19 as their primary Business Use.
    - Inland Topography: 31 provided dollar benefits and four indicated "Major" benefits.
    - Inland Bathymetry: 19 provided dollar benefits and one indicated "Major" benefits.
    - Nearshore and Offshore Bathymetry: None provided benefits for nearshore or offshore bathymetry.
    - Twenty-two (22) states and territories did not include an MCA with BU 19 as primary even though lidar data are widely used nationwide for the large number of elevation data uses tabulated above for land navigation and safety.
- Non-governmental MCAs: General Motors and HERE Technologies submitted detailed MCAs listing BU 19 as primary. One provided dollar benefits for inland topography and the other indicated "Major" benefits.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.19b and E.19c:
    - 75 "Major" Operational and Customer Service benefits and 73 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 19 for which "Major" benefits are documented, this could easily be translated into significant additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.
    - TomTom did not submit an MCA for the 3D Nation Study, although TomTom previously submitted an MCA with the highest potential benefits for the NEEA study, based on its

estimates of fuel savings from the use of DEMs for automated transmission control and predictive shifting as vehicles approached changing gradients and curves ahead.

BU 19 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 19:

- **Table E.19d** color-codes those organizations having an MCA with BU 19 as Primary, Secondary, or Tertiary.
- **Table E.19e** summarizes the 41 MCAs with primary benefits for BU 19, rank ordered from the highest to the lowest tangible benefits.

Table E.19d. Organizations having an MCA with BU 19 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	**FBI**	FCC	FEMA	FERC	*FHWA*	**FRA**	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	**NOAA**	NPS	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	**USAF**	USARC	USBR	USCB
	USCG	USFS	USGS	USMC	USN					

State/Ter	**AL**	**AK**	*AR*	*AZ*	**CA**	**CO**	**CT**	DC	DE	*FL*	**GA**	**HI**	**IA**	**ID**
	IL	**IN**	KS	**KY**	LA	**MA**	**MD**	ME	MI	MO	**MN**	**MS**	**MT**	**NC**
	ND	**NE**	NH	NJ	**NM**	**NV**	NY	OH	**OK**	**OR**	**PA**	**RI**	SC	**SD**
	TN	TX	**UT**	**VA**	**VT**	**WA**	**WI**	WV	**WY**	PR	VI	**GU**	**AS**	CNMI

Non-Gov	*American Association of Port Authorities*	**General Motors**	**HERE Technologies**	Pennsylvania State University
	Vitus Energy			

Table E.19e. MCA summaries for BU 19, rank ordered from the highest to the lowest tangible benefits.

Organization	General Motors		Mapping publicly-accessible roads and trails (including privately-maintained roads and long driveways in campuses, building complexes, and residential communities). Build and verify a highly accurate lane-level map of all publicly-accessible roads and off-road trails that will support safety and increasing vehicle autonomy. Electric vehicle efficiency and convenience, including range estimation, route planning including charging stops, charging station placement. Powertrain efficiency and chassis safety (fuel/charge), especially for trailering use cases, including predictive shifting, improved adaptive cruise control, reduced braking on long downslopes. Vehicle-to-Infrastructure data broadcasts at intersections.				
MCA Name	MCA No.						
Mapping at GM	51003						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$12,931,650	Moderate	None	Moderate	Moderate

Organization	Alaska		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60016						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$7,567,181	$611,087	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$322,773	$3,339	Minor	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Moderate	Moderate	None	Moderate	Moderate

Organization	California		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60051						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$2,048,691	$165,442	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$87,385	$904	Minor	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Moderate	Moderate	None	Moderate	Moderate

Organization	Montana		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60263						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$1,904,801	$153,822	Minor	Major	Major

Organization	New Mexico		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60314						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$1,575,123	$127,199	Minor	Major	Major

Organization	Wyoming		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60544						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$1,267,101	$102,324	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$54,047	$559	Minor	Moderate	Moderate

Organization	Oregon		We have many mission critical activities throughout the transportation engineering process. They cover many of the business uses and MCAs. Stream channel analysis and mapping. Environmental Management. Land use and environmental planning. Geologic mapping and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities. Post-fire analysis to determine landslide-prone areas. Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Storm water modeling. Cut and fill analysis for earth-moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects Land development and zoning. Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL). BU 20 – Marine and Riverine Navigation and Safety would be an additional Business Use.					
MCA Name	MCA No.						
Transportation Engineering	21870						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$1,257,147	$101,520	Minor	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$53,622	$554	don't know	Major	Major
Nearshore B.	QL0B	4-5 yrs.	Minor	Moderate	Minor	Minor	Minor

Organization	Alabama		Preliminary and Final Design of Construction Projects. Maintenance and monitoring of existing roadways. Lidar can be used for preliminary design, may be able to be used in rural areas for actual design augmented with field surveys. Bathymetry is needed for bridge and culvert planning and design.				
MCA Name	MCA No.						
Transportation Maintenance and Construction	1142						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$1,301,598	$55,174	None	Moderate	Moderate
Inland Bathy	QL2B	Event driven	$28,618	$302	None	None	Moderate

Organization	Minnesota		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization. BU 29 – Military and BU 30 - Maritime and Land Boundary Management are additional Business Uses for this activity.				
MCA Name	MCA No.						
Land Navigation and Safety	60616						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$1,093,054	$88,269	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$46,623	$482	Minor	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Moderate	Moderate	None	Moderate	Moderate

Organization	Utah		Land Navigation and Safety Activities include, but are not limited to: Roadway Design and Construction, Roadway Maintenance, Traffic & Safety analysis, and Structure Maintenance.				
MCA Name	MCA No.						
Transportation Design and Maintenance	22429						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Annually	$1,082,844	$87,445	Minor	Major	Major

Organization	Nebraska		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60277						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$1,002,052	$80,920	Minor	Major	Major

Organization	South Dakota		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60418						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$998,977	$80,672	Minor	Major	Major

Organization	Oklahoma		Transportation network and infrastructure planning, surveying, designing, building and maintaining.				
MCA Name	MCA No.						
Transportation Network and Infrastructure	22384						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$905,513	$73,124	don't know	don't know	don't know
Inland Bathy	QL0B	2-3 yrs.	$38,624	$399	don't know	don't know	don't know

Organization	Washington		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60519						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$875,167	$70,674	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$37,329	$386	Minor	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Moderate	Moderate	None	Moderate	Moderate
Offshore B.	I don't know	I don't know	Moderate	Moderate	None	Moderate	Moderate

Organization	Illinois		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60144						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$729,863	$58,940	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$31,131	$322	Minor	Moderate	Moderate

Organization	Iowa		Highway design and construction Bridge design and construction Highway asset management Highway traffic control and safety Highway maintenance Right of Way management Delivers services that promote and enhance a healthy air transportation system Delivers services that promote and enhance a healthy rail transportation system				
MCA Name	MCA No.						
Transportation Planning, Design, and Construction	21582						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$728,971	$58,868	don't know	don't know	don't know
Inland Bathy	QL0B	2-3 yrs.	$31,093	$321	Minor	Minor	Minor

Organization	Nevada		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60291						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$690,000	$115,661	Minor	Major	Major

Organization	North Carolina		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60329						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$639,524	$100,000	Minor	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$27,278	$282	Minor	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	Moderate	Moderate	None	Moderate	Moderate
Offshore B.	I don't know	4-5 yrs.	Moderate	Moderate	None	Moderate	Moderate

Organization	Mississippi		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60248						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$617,486	$49,865	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$26,338	$272	Minor	Moderate	Moderate

Organization	Pennsylvania		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60365						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$586,837	$47,390	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$25,031	$258	Minor	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Moderate	Moderate	None	Moderate	Moderate

Organization	Virginia		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60502						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$523,111	$42,243	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$22,313	$230	Minor	Moderate	Moderate

Organization	Kentucky		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60193						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$523,484	$42,273	Minor	Major	Major

Organization	Indiana		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60159						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$468,729	$37,852	Minor	Major	Major

Organization	Vermont		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60487						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$124,545	$10,057	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$5,312	$54	Minor	Moderate	Moderate

Organization	Maryland		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60219						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$128,085	$10,343	Minor	Major	Major

Organization	Air Force		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60637						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	3-5 yrs.	$120,293	$4,857	Minor	Major	Major

Organization	Massachusetts		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60228						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$105,057	$8,483	Minor	Major	Major

Organization	Hawai'i		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60125						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$83,356	$6,731	Minor	Major	Major

Organization	Connecticut		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60071						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$64,407	$5,201	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$2,747	$28	Minor	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Moderate	Moderate	None	Moderate	Moderate

Organization	Rhode Island		Cut and fill analysis. Road, bridge, and culvert planning and design. Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60386						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$14,028	$1,132	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$598	$6	Minor	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Moderate	Moderate	None	Moderate	Moderate

Organization	Wisconsin		Ground surface and benthic elevation data collection for highway and airport design. With better data we can do better analysis, save field time, and produce higher quality roadways, airports, harbors and freight systems, with fewer environmental impacts.				
MCA Name	MCA No.						
Multimodal Transportation Design	1214						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Event driven	$8,683	Moderate	None	Moderate	Moderate
Inland Bathy	QL1B	Annually	Moderate	Moderate	None	Moderate	None
Nearshore B.	QL1B	Event driven	Moderate	Moderate	None	Moderate	Moderate
Offshore B.	Special Order	Event driven	Moderate	Moderate	None	Moderate	Moderate

Organization	Guam		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60104						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$2,713	$219	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$115	$1	Minor	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Moderate	Moderate	None	Moderate	Moderate

Organization	American Samoa		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60031						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$1,040	$83	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$44	Moderate	Minor	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Moderate	Moderate	None	Moderate	Moderate

Organization	Oklahoma		Providing the citizens of Ardmore a well-planned, developed safe community with ample community resources. Planning for development, impact studies, H&H modeling, FIRM data, finished floor elevations, ensuring new construction is built above the BFE. Oklahoma survey data are used for four lakes within the city for volume calculations, search and recovery (diving), etc.				
MCA Name	MCA No.						
Urban Planning	1134						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	Major	Major	Moderate	Moderate	Major
Inland Bathy	QL1B	>10 yrs.	Major	Major	Major	Major	Major

Organization	Colorado		Asset data management. Elevation data can be used for traffic engineering (backslope along roadways for signage, budgeting); geohazard identification (slope for avalanche, rockfall); locating culverts; understanding highway slope/undulation; and many other applications. Some regions use the data for H&H modeling for pre-engineering design. The data also has environmental (wetlands identification) and stormwater uses. Mobile lidar data were recently collected as a pilot project for asset management; got high-resolution data (1600 pts/square meter).				
MCA Name	MCA No.						
DOT Asset Data Inventory and Management	1351						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Moderate	Major	Major

Organization	Georgia		Road route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization. Elevation data are needed for planning for culverts and bridges, design, H&H modeling, etc. BU 21 – Aviation Navigation and Safety is an additional Business Use. All Business Uses could be considered to apply.				
MCA Name	MCA No.						
Transportation	22423						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	Major	Major	Minor	Minor	Major
Inland Bathy	QL0B	2-3 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL0B	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Idaho		Highway design, construction, and related activities such as environmental mitigation and hydrology. Highway design requires survey grade lidar. The department has performed aerial lidar collections for routes in District 5 and District 6; other districts have not done this. These aerial lidar collects are being used for planning and preliminary design. Districts collect lidar independent of any statewide collections. Mobile lidar is planned for asset collection, along with a pavement photo log. Survey grade depth of water is needed for bridge projects as they come up. DOT needs to be able to identify water features in order to avoid them or construct culverts or bridges over them when necessary. As a mission critical part of those projects, we require hydraulics analysis and reports to model the expected flows as part of the capacity determination so that our culverts/structures are built with sufficient stream width and freeboard, with an appropriate safety factor. To the extent that the National LiDAR dataset can be captured at a vertical precision of +/- 0.1', and such LiDAR would accurately describe the dry stream channel, this would be a significant boon to the topographic requirements that feed into ITD's projects involving roads crossing water channels, and this would increase the speed with which our projects could be developed and constructed.				
MCA Name	MCA No.						
Highway Design, Construction, and Related Activities	22502						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Moderate	Major	Moderate
Inland Bathy	X-Sec meet needs	4-5 yrs.	Moderate	Moderate	Minor	Moderate	Minor

Organization	NOAA		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60666						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	Major	Major	Minor	Major	Major

Organization	FBI		Road and railroad route selection and maintenance. Slope analysis for autonomous cars. GPS navigation visualization.				
MCA Name	MCA No.						
Land Navigation and Safety	60712						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Major	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	Moderate	Moderate	Minor	Moderate	Moderate
Nearshore B.	QL1B	2-3 yrs.	Moderate	Moderate	None	Moderate	Moderate
Offshore B.	Order 1	2-3 yrs.	Moderate	Moderate	None	Moderate	Moderate

Organization	HERE Technologies		Highly Automated Driving (Highway autopilot, etc.), autonomous driving, and connected ADAS opportunities (Dynamic speed signs, traffic, safety hazards, etc.). Creating accurate, fresher maps as the building blocks of autonomous driving (together with cameras, radar, and lasers, etc.). OEM customers require end to end HAD (Highly Automated Driving) and connected ADAS solutions including this map. HERE are currently providing a Cloud service (HD Live Map), and there is a strong gap in the client side (car), currently covered by OEMs or other suppliers.				
MCA Name	MCA No.						
Automated Driving Systems	60725						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	Major	Major	Minor	Major	Major

Organization	FRA		The Federal Railway Administration's Office of Policy & Planning leads development of national rail strategy, policy and planning, including assessment of passenger and freight rail performance, investments and policy issues, and provides support to rail stakeholders planning and developing high-performance rail services. While the FRA does not currently use aerial lidar for many of its initiatives, it makes use of mobile lidar, primarily train mounted, for several activities, including analysis of train weight and hump crossings, for identification of optimal routes and time of day to transport hazardous cargo, and for track inspection. Aerial lidar can be used for accident investigation, and for safety evaluation and enforcement. Elevation data (slope) in combination with track curvature and train weight could inform speed limits and enforcement.				
MCA Name	MCA No.						
National Rail Strategy, Planning, and Policy	21902						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL3	Event driven	don't know	don't know	don't know	don't know	don't know

BU 20 - Marine and Riverine Navigation and Safety

BU 20 Scope

Figure E.20a. With wide ships and narrow channels at Port of Long Beach, CA, lidar and sonar combine to provide safety of marine navigation, including under-keel clearance and air-gap beneath bridges, pushing the safety envelope above and below the water level. Images courtesy of Jacobsen Pilot.

Business Use #20 (BU 20) includes nautical charting; bathymetric measurements of nearshore submerged coastal topography; identification of hazards to navigation; sediment management at coastal navigation projects; precision marine navigation; and movement of goods and fishing vessels. NOAA and USACE serve as champions for this Business Use. NOAA is responsible for nautical charts, accurate positioning services, and operational oceanographic products and services, including products and services for safe operations at ports and harbors. USACE is responsible for safety of navigation on coastal and inland waterways.

BU 20 Background Information

Topobathymetric (topobathy) lidar can map both the topographic and bathymetric surfaces down to about two times the *Secchi depth*, an intuitive water clarity measure that is the depth at which a standard black and white disc, deployed over the side of a boat, is no longer visible to the human eye. Topobathy lidar does not work in turbid waters; but, where and when waters are clear, topobathy lidar provides NOAA and USACE with modern, accurate hydrographic survey data with which to update nautical charts and seamlessly map the entire intertidal zone. It also provides relative seabed reflectivity for habitat mapping.

For inland bathymetry, nearshore bathymetry, and offshore bathymetry, regardless of water clarity, there are many forms of sonar sensors deployed on multiple platforms from crewed surface vessels to uncrewed surface vessels (USVs), autonomous surface vessels (ASVs), and underwater autonomous vessels (UAVs), often operated remotely from over-the-horizon. The rapidly-expanding use of sonar on USVs and ASVs is expected to significantly reduce the large backlog of survey requirements in support of the National Strategy for Mapping, Exploring, and Characterizing the U.S. Economic Zone (NOMEC) and the Alaska Coastal Mapping Strategy (ACMS) developed in response to the Presidential Memorandum of November 2019 and placed priority on these two strategies.

Marine navigation and safety in coastal areas is important for both commerce and recreation. Business Use #3, Coastal Zone Management, previously described NOAA's Coastal Mapping and Modeling and USACE's National Coastal Mapping Program Functional Activity that overlap with Business Use #20 for Marine and Riverine Navigation and Safety.

BU 20 Elevation Data Uses

Using their own words, respondents documented 51 Mission Critical Activities (MCAs) that identified BU 20 as their primary Business Uses and identified the following 54 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.20a. BU 20 Elevation Data Uses

Data Use
Coastal Resource Management
1. Collect beach profiles and nearshore multibeam to support coastal management decisions
2. Data acquisition and analysis of the coastal zone, sea surface, and seafloor for multiple disciplines
3. Multibeam bathymetry and sub-bottom/seismic data to support beach renourishment projects.
4. Protect and preserve coastal lands and waters within and around California ports
5. Protect life, property, and the environment along our nation's coasts
Data Development and Management
6. Acquisition, processing, visualization and analysis of time-based xyz information for navigation, seafloor mapping, oil & gas, dredging, academic research, offshore renewables, defense
7. Assure access to accurate nautical charts including reliable information regarding port channel depths
8. Bathymetric measurements of nearshore submerged coastal topography
9. Create customized marine GIS products for users in government, academia and a broad range of marine related activities.
10. Data analysis and deliverables using various sources of marine spatial data
11. Data and services that enable mariners to navigate U.S. waterways safely and efficiently
12. Develop best practices for acoustic bathymetry.
13. Develop hi-res MBES and lidar technologies for coastal and shallow water environments, addressing coastal resiliency, shoreline change, and restoration
14. Develop technologies for seafloor characterization, critical habitat evaluation, seafloor change analysis, electronic chart development modeling, marine mineral resources.
15. Facilitate safe navigation for commercial, recreational, government, and other vessels through continuously updated nautical charts and related products
16. Future plans for the use of hydro drones for bathymetric mapping of estuarine navigation channels
17. Innovate and develop technologies for mapping and hydrography
18. Planning, acquiring, integrating, and disseminating ocean and coastal geospatial data
19. Topographic and bathymetric data support specific to vessel traffic including Automatic Identification System (AIS)
Education
20. Advance ocean mapping hydrography and hydrographer training
Emergency Response
21. Response and recovery efforts of U.S. coastal impacts from hurricanes
Habitat Analysis and Management
22. Collect multibeam bathymetry to support benthic habitat mapping and fisheries management
Hazard Assessment and Mitigation
23. Understand infrastructure needs at U.S. ports as they relate to storm surges and sea level rise
Infrastructure Management
24. Harbor maintenance
25. Hydrographic surveys for dredging harbors for navigation
26. Maintaining channel depths along coastal channels and harbors

Data Use
27. Maintenance and construction of navigation channels including dredging, dredged material management, provision of aids to navigation, public outreach and education for shallow draft vessels
28. Maintenance of transportation infrastructure
29. Maritime channel and harbor improvements, ecological restoration, and navigation
30. Planning and constructing new navigation channels, ports, and harbors
31. Port and waterway oversight
32. Port infrastructure development
33. Sediment management at coastal navigation projects and ports
Mapping/Boundary Delineation
34. Determining the official shoreline and nearshore bathymetry of the U.S. that supports NOAA nautical charts, inundation mapping and modeling, nearshore and benthic habit mapping, the Marine Cadastre, and other coastal resilience and intelligence applications
35. High resolution seafloor mapping to support the preservation of submerged cultural resources
36. Map changes in coastal elevations and depths along one-mile wide swath along open U.S. coasts
37. Nautical charting
38. Navigational charting from open water to the water's edge for coastal villages in Alaska; eliminate need for sounding skiffs to identify depths for near-shore approaches
39. Support potential claims for extended jurisdiction by the U.S. under United Nations Convention on the Law of the Sea (UNCLOS) Article 76.
Navigational Safety
40. Assess channel shoaling conditions
41. Commercial navigation, predominantly deep-draft navigation
42. Global maritime safety; collaboration with international partners to acquire needed elevation information, standards, technology
43. Identification of hazards to navigation
44. Marine navigation services including underkeel and under-bridge clearance
45. Maritime issues to include shipping at ports and coastal and inland waterways
46. Movement of goods and vessels
47. Navigating in shallow waters; teaching navigation to new mariners
48. Navigation of sounds and rivers
49. Navigational safety and marine mapping
50. Offshore surveys to support naval sub-sea operations and training
51. Precision marine navigation
52. Resolve maritime issues within DOT, including shipping and all ports
53. Shipping of critical diesel and gasoline from refineries on the Pacific Rim to destinations along Alaska's west coast and interior rivers
54. Support the National Port Readiness Network (NPRN), a cooperative designed to ensure the readiness of commercial ports to support U.S. military movements

BU 20 Tangible and Intangible Benefits

For the 51 MCAs that list Marine and Riverine Navigation and Safety as their primary Business Use:

- **Table E.20b** summarizes the reported future annual dollar benefits by geography type, totaling $577 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.20c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.20e.
- **Table E.20d** shows (in blue) the 11 federal agencies, 28 states and territories, and 12 non-governmental entities that submitted MCAs with BU 20 as the primary Business Use. MCAs for which BU 20 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.20d.
- **Table E.20e** documents all the MCAs that listed BU 20 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.20e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 20 Reported Future Annual Dollar Benefits

Of the 51 MCAs that listed Marine and Riverine Navigation and Safety as their primary Business Use, 30 MCAs estimated their tangible annual benefits totally in financial terms; three MCAs had a combination of tangible and "Major" intangible benefits; and 13 MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.20b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 51 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.20b. BU 20 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$182,710,334	$394,965	$183,105,299
Inland Bathymetry	$107,748,705	$48,148,341	$155,897,046
Nearshore Bathymetry	$181,153,441	$25,142,410	$206,295,851
Offshore Bathymetry	$31,434,089	$283,410	$31,717,499
Totals	**$503,046,569**	**$73,969,126**	**$577,015,695**

BU 20 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.20c. BU 20 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	23	9	1	6	8
Inland Bathymetry	35	35	1	8	10
Nearshore Bathymetry	41	38	2	30	37
Offshore Bathymetry	16	15	1	6	10
Totals	**115**	**97**	**5**	**50**	**65**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 20 Reported Future Annual Dollar Benefits Maps

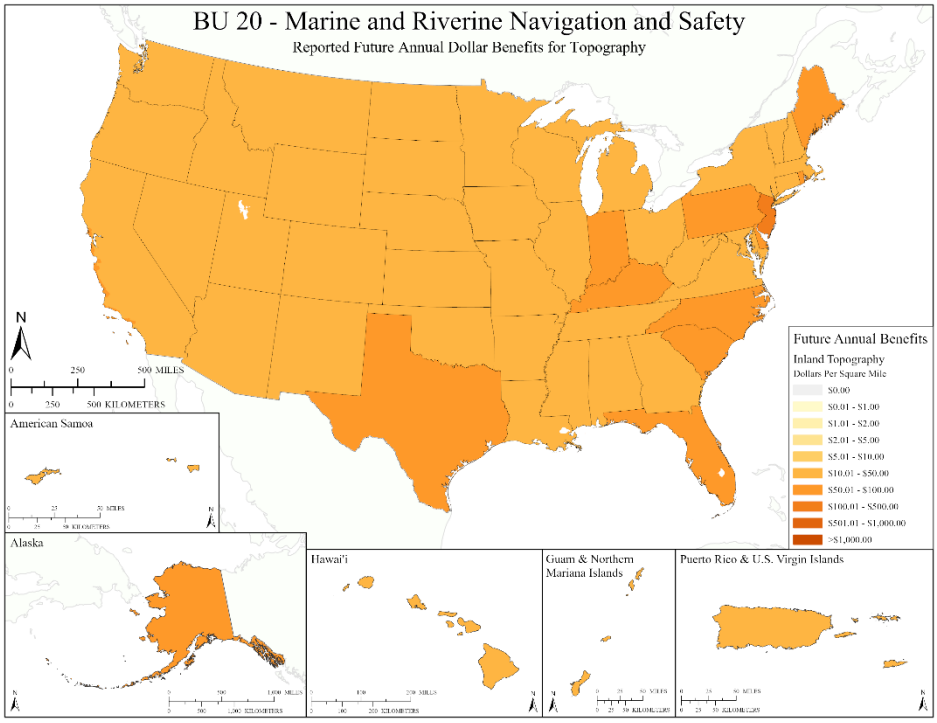

Figure E.20b. Reported Future Annual Dollar Benefits for Topography

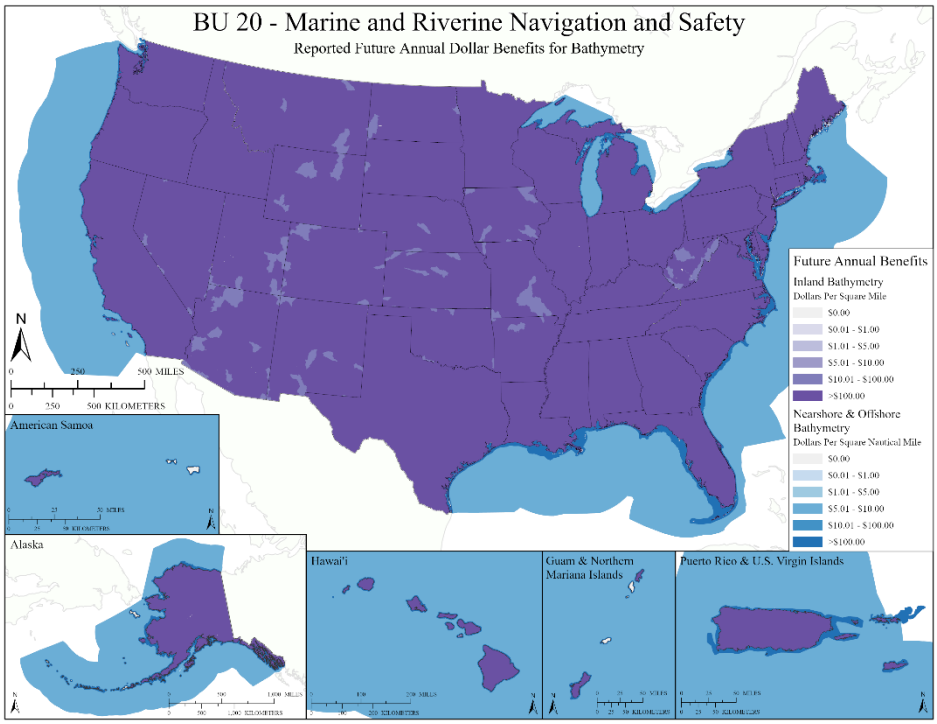

Figure E.20c. Reported Future Annual Dollar Benefits for Bathymetry

BU 20 Benefits Analysis

The total combined future annual benefits ($577 million per year) reported for BU 20 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 20 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, six federal agencies (CMTS, FBI, MARAD, NGA, NOAA, and USACE) submitted 11 MCA listing BU 20 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the 11 federal MCAs listing BU 20 as primary:
    - Inland Topography: Two provided dollar benefits and five indicated "Major" benefits.
    - Inland Bathymetry: Four provided dollar benefits and six indicated "Major" benefits.
    - Nearshore Bathymetry: Four provided dollar benefits and six indicated "Major" benefits.
    - Offshore Bathymetry: Four provided dollar benefits and five indicated "Major" benefits.
    - Six other federal agencies (DHS, TVA, USARC, USCG, USGS, USN) submitted MCAs with BU 20 as secondary, meaning benefits did not accrue to BU 20.
- State/Local/Tribal and U.S. Territory MCAs: Twenty-eight (28) states and territories submitted MCAs listing BU 20 as primary:
    - Inland Topography: 13 provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: 20 provided dollar benefits and two indicated "Major" benefits.
    - Nearshore Bathymetry: 32 provided dollar benefits and two indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and one indicated "Major" benefits.
    - Eleven states and territories with ports did not submit MCAs with BU 20 as primary, including AL, GA, HI, MD, MS, NH, NY, OR, WI, Puerto Rico, and American Samoa though we assume navigation safety is important for each of them; this means their requirements and benefits were not counted.
- Non-governmental MCAs: Eleven (11) non-governmental organizations submitted 12 MCAs listing BU 20 as primary, including Fugro, Vitus Energy, Sounding Science, University of New Hampshire (CCOM/JHC), American Association of Port Authorities, Leidos, Lake Carriers Association, Geodynamics, Quality Positioning Services, ESGplus, and United States Power Squadrons.
    - Inland Topography: One provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: Two provided dollar benefits and four indicated "Major" benefits.
    - Nearshore Bathymetry: Three provided dollar benefits and seven indicated "Major" benefits.
    - Offshore Bathymetry: Two provided dollar benefits and seven indicated "Major" benefits.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.20b and E.20c:

- 212 “Major” Operational and Customer Service benefits and 120 “Major” benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate “Major” benefits into dollar savings. For example, if “Major” could be translated into a one percent savings for all of the total program budgets for BU 20 for which “Major” benefits are documented, this could easily be translated into tens of millions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.
- Six federal agencies, one state and one non-governmental organization (TCarta Marine) submitted MCAs that listed BU 20 as secondary, meaning benefits did not accrue to BU 20.

BU 20 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 20:

- **Table E.20d** color-codes those organizations having an MCA with BU 20 as Primary, Secondary, or Tertiary.
- **Table E.20e** summarizes the 51 MCAs with primary benefits for BU 20, rank ordered from the highest to the lowest tangible benefits.

Table E.20d. Organizations having an MCA with BU 20 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	**CMTS**	*DHS*	DISDI	DTRA
	EPA	FAA	**FBI**	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	**MARAD**	NASA	**NGA**	**NOAA**	NPS	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	*TVA*	**USACE**	USAF	*USARC*	USBR	USCB
	USCG	USFS	*USGS*	USMC	*USN*					

State/Ter	AL	**AK**	AR	AZ	**CA**	CO	**CT**	*DC*	**DE**	**FL**	GA	HI	IA	**ID**
	IL	**IN**	KS	**KY**	**LA**	**MA**	MD	**ME**	**MI**	MO	**MN**	MS	MT	**NC**
	ND	NE	NH	**NJ**	NM	NV	NY	**OH**	OK	OR	**PA**	**RI**	**SC**	SD
	TN	**TX**	UT	**VA**	**VT**	**WA**	WI	WV	WY	PR	**VI**	**GU**	AS	**CNMI**

Non-Gov	**American Association of Port Authorities**	**ESGplus**	**Fugro**	**Geodynamics**
	Lake Carriers' Association	**Leidos**	**Quality Positioning Services**	**Sounding Science**
	TCarta Marine	**United States Power Squadrons**	**University of New Hampshire Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC)**	**Vitus Energy**

Table E.20e. MCA summaries for BU 20, rank ordered from the highest to the lowest tangible benefits.

Organization	MARAD						
MCA Name	MCA No.						
Data Collection and Analysis of Maritime Geospatial Data	22364						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$137,750,984	Moderate	Moderate	Major	Major

Marine and Riverine Navigation and Safety. MARAD deals with all maritime issues within the Department of Transportation, including shipping and all ports, both coastal and on inland waterways. Topographic and bathymetric data are used in conjunction with other datasets that are specific to vessel traffic, such as the Automatic Identification Systems (AIS) data transmitted by vessels about where and when they are traveling on the water.

MARAD is one of nine agencies that participates in the National Port Readiness Network (NPRN); a cooperative designed to ensure the readiness of commercial ports to support U.S. military movements. In addition, MARAD plays a key role in the realm of strategic sealift and is a maintainer of a fleet of government-owned vessels. Due to these responsibilities, access to accurate nautical charts, including reliable information regarding port/channel depths is important for assessing port readiness and ensuring that our agency can carry out its strategic sealift responsibilities.

Port infrastructure development is a topic of great interest to MARAD. Elevation data could play a role in helping us to better understand infrastructure needs at U.S. ports especially as they relate to storm surges and sea level rise.

Monitoring sea level rise is not a major function in the organization, but elevation information is critical to the management of risk related to port and infrastructure investment supported by DOT/MARAD's discretionary grant programs.

BU 12 – Renewable Energy Resources, BU 13 – Oil and Gas Resources, BU 15 – Flood Risk Management, and BU 18 – Homeland Security, Law Enforcement, Disaster Response, and Emergency Management are additional Business Uses for this activity.

MARAD monitors vessel activity near oil and gas platforms in U.S. waters. As water depths can dictate what types of offshore supply vessels are used to carry out certain activities near a platform, we have had to rely on depth information to better understand which vessels can best fulfill certain roles with respect to offshore oil production.

As offshore wind development increases, MARAD will need to monitor activity in these areas in much the same way the agency currently does for the oil and gas industry.

MARAD does not have a lead role in flood risk management, but elevation information is critical to the management of risk related to port and infrastructure investment supported by DOT/MARAD's discretionary grant programs.

Homeland Security and Disaster Response could be considered a tertiary use of elevation data within MARAD. Although we actively monitor port conditions during emergency events, including hurricanes, we have not utilized elevation data during our monitoring/analysis of past events. However, incorporating elevation data into future disaster response activities at MARAD could be beneficial.

Inland Bathy	X-Sec meet needs	6-10 yrs.	$32,843,495	$4,319,054	Moderate	Major	Major
Nearshore B.	X-Sec meet needs	6-10 yrs.	$60,104,205	$592,365	Moderate	Major	Major
Offshore B.	X-Sec meet needs	6-10 yrs.	$8,322,080	Major	Moderate	Major	Major

Organization	USACE		Mapping changes in coastal elevations and depths, in a one-mile wide swath along the sandy open US coasts. Coastal zone management. Sea Level Rise and Subsidence. Modeling and mapping the effects of sea level rise or subsidence. Population and economic vulnerability assessments. Coastal inundation and infrastructure assessment. Harbor dredging. BU 15 - Flood Risk Management is an additional Business Use.				
MCA Name	MCA No.						
Coastal Zone Mapping	21512						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$77,989	Major	Minor	Minor	Moderate
Inland Bathy	QL1B	2-3 yrs.	$11,714,143	$33,768,379	Minor	Minor	Minor
Nearshore B.	QL0B	4-5 yrs.	$19,778,611	$21,328,019	Minor	Minor	Moderate
Offshore B.	Order 1b	4-5 yrs.	Major	Moderate	Minor	Minor	Moderate

Organization	Alaska		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60017						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$22,377,442	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	$10,655,214	$1,402,349	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$30,920,455	$1,046,877	Minor	Major	Major

Organization	NOAA		Navigational safety and marine mapping. This includes the following: Providing data and services that enable mariners to navigate U.S. waterways safely and efficiently. Facilitating safe navigation for commercial, recreational, government other vessels through continuously updated nautical charts and related products. Providing marine navigation services (forecasts, real-time oceanographic conditions and navigationally-critical information such as underkeel and under-bridge clearance). Identification of hazards to navigation. Bathymetric measurements of nearshore submerged coastal topography. Sediment management at coastal navigation projects. Determining the official shoreline and nearshore bathymetry of the U.S. that primarily supports NOAA Nautical Charts but also numerous other applications including inundation mapping and modeling, nearshore and benthic habitat mapping, the Marine Cadastre, and other coastal resilience and intelligence applications. Response and recovery efforts of U.S. coastal impacts from hurricanes and other natural and manmade events using pre- and post-event georeferenced imagery. Planning, acquiring, integrating, and disseminating ocean and coastal geospatial data.					
MCA Name	MCA No.						
Navigational Safety and Marine Mapping	22525						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	Major	Major	don't know	Major	Major
Inland Bathy	QL0B	Annually	Major	Major	Minor	Minor	Minor
Nearshore B.	QL0B	Annually	$40,000,000	Major	don't know	Minor	Minor
Offshore B.	Order 1a	Annually	$20,000,000	Major	don't know	don't know	don't know

Organization	USACE		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60681						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	2-3 yrs.	$32,843,495	$4,319,054	Moderate	Major	Major

Organization	Texas		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60445						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$10,140,673	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	$4,828,570	$635,495	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$3,045,610	$103,115	Minor	Major	Major

Organization	Florida		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60086						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$2,149,688	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	$1,023,593	$134,716	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$9,691,986	$328,142	Minor	Major	Major

Organization	Fugro		Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance. Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels Alternate energy development solar, tidal, wind, wave, and ocean current. Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Onshore or offshore mineral extraction. Environmental impact assessment and site restoration.				
MCA Name	MCA No.						
Data Acquisition and Analysis of the Coastal Zone, Sea Surface, and Seafloor for Multiple Disciplines	21796						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$1,399,990	$394,965	Minor	Minor	Minor
Inland Bathy	QL0B	2-3 yrs.	$763,114	$741,200	Minor	Minor	Minor
Nearshore B.	QL0B	2-3 yrs.	$654,066	$151,956	Minor	Minor	Minor
Offshore B.	Per IHO Standards for Hydrographic Surveys (S-44) Edition 5	Depends on variables	$1,128,391	$283,410	Minor	Minor	Minor

Organization	Michigan		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60237						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	2-3 yrs.	$1,059,525	$139,445	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$2,834,249	$95,959	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	California		To protect and preserve the coastal lands and waters within and around California ports. We need 3D elevation data and related information products for two very simple reasons: Looking down, we need to know where the bottom is and where the water level is to ensure ships don't run aground. Looking up, we need to know where the water level is and where bridges, power lines, and other overhead obstructions are so ships can pass safely underneath. Both are increasingly challenging as ships get bigger, deeper, wider, and taller... all dimensions! Elevation and bathymetry are also used for planning and engineering, dredging, maintenance, environmental, and railway development. Included in this activity are the Port of Long Beach, the San Diego Unified Port District, and the Marine Exchange of Southern California. The Marine Exchange is responsible for the ports at Port Hueneme, Los Angeles, Long Beach, San Diego, Seal Beach Naval Weapons' Station, and El Segundo Refinery Chevron Offshore Moorings. The exchange is also responsible for vessel traffic service for Los Angeles and Long Beach out to a 25 mile radius, (like air traffic control). Additional Business Uses include BU 01 – Water Supply and Quality, BU 06 – Natural Resources Conservation, BU 18 – Homeland Security, BU 23 – Urban and Regional Planning, BU 27 – Recreation, and BU 30 – Maritime and Land Boundary Management.					
MCA Name	MCA No.						
Management of California Ports	21591						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$128,742	Major	Minor	Minor	Moderate
Inland Bathy	QL0B	2-3 yrs.	$623,007	$379,663	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$2,884,726	$21,093	Minor	Major	Major
Offshore B.	Order 1a	4-5 yrs.	Major	Major	Minor	Major	Major

Organization	Vitus Energy		Vitus ships critical diesel and gasoline from refineries on the Pacific Rim to destination along Alaska's west coast and interior rivers. Vitus also has fuel terminal and road distribution business in several hub locations in Western AK. All population centers need to have a definitive navigation chart from "open water" to their local water's edge. Additionally, tidal datum and wind direction are very important. NOAA nautical charts often do not include information shallower than 3 meters below mean low water. The Alaska near-shore approaches to villages are almost exclusively shallower than that. Lacking good shallow water bathymetry, we self-collect on-the-fly using sounding skiffs to identify depths as our ships are navigating waters.				
MCA Name	MCA No.						
Fuel Distribution to Western Alaska Villages	32708						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL4B	4-5 yrs.	$903,980	$1,000,000	don't know	Major	Major
Nearshore B.	QL4B	6-10 yrs.	$903,980	$1,000,000	don't know	Major	Major

Organization	North Carolina		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels. Navigation of sounds and rivers is a major concern.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60330						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$900,000	Moderate	None	None	Minor
Inland Bathy	QL0B	4-5 yrs.	$1,400,000	$118,516	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$928,000	$111,397	Minor	Major	Major
Offshore B.	I don't know	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Louisiana		We are the State sponsor/overseer of Port and Waterway projects.				
MCA Name	MCA No.						
Port and Waterway Oversight	32936						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	X-Sec meet needs	Event driven	$1,262,628	$167,285	Major	Major	Major
Nearshore B.	X-Sec meet needs	Event driven	$1,258,105	$167,285	Major	Major	Major

Organization	South Carolina		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60402						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$1,185,776	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	$564,617	$74,310	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$928,416	$31,433	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Pennsylvania		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60366						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$1,735,377	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	$826,315	$108,752	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$56,313	$1,906	Minor	Major	Major

Organization	New Jersey		Maintenance and construction of navigation channels including dredging, dredged material management, provision of aids to navigation, public outreach and education for shallow draft vessel (commercial and recreational) use. Maintenance of transportation infrastructure.				
MCA Name	MCA No.						
Maintenance and Construction of Navigation Channels and Transportation Infrastructure	21486						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$198,412	Minor	None	None	None
Inland Topo	QL2	2-3 yrs.	$372,588	Minor	None	None	None
Inland Bathy	QL0B	2-3 yrs.	Moderate	Minor	None	None	None
Nearshore B.	QL0B	2-3 yrs.	$2,100,000	Minor	None	None	Minor

Organization	Maine		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60211						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$1,241,523	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	$591,162	$77,803	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$677,066	$22,923	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Kentucky		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60194						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$1,548,031	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	$737,108	$97,012	Moderate	Moderate	Moderate

Organization	Indiana		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60160						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$1,386,113	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	$660,010	$86,864	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$29,616	$1,002	Minor	Major	Major

Organization	Sounding Science		Marine Navigation. Sounding Science provides post processing data analysis and deliverables using various sources of marine spatial data. Processed bathymetric data are used to create customized marine GIS products for users in government, academia and a broad range of marine related activities.				
MCA Name	MCA No.						
Marine Navigation	21966						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	Most recent	$200,000	Major	Moderate	Minor	Moderate
Offshore B.	Order 1b	Most recent	$1,800,000	Major	don't know	don't know	don't know

Organization	Idaho		Port of Lewiston. Bathymetric measurements of submerged topography. Identification of hazards to navigation. Sediment management at ports. Movement of goods and vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60135						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	2-3 yrs.	$1,524,362	$200,623	Moderate	Moderate	Moderate

Organization	Ohio		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60346						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	2-3 yrs.	$752,558	$99,045	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$686,633	$23,247	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Virginia		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60503						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	2-3 yrs.	$1,498,381	$50,730	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Illinois		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60145						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	2-3 yrs.	$1,027,707	$135,258	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$85,262	$2,886	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Massachusetts		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60229						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	2-3 yrs.	$892,458	$30,216	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Tennessee		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60432						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	2-3 yrs.	$768,712	$101,171	Moderate	Moderate	Moderate

Organization	Guam		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60105						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	2-3 yrs.	$333,714	$11,298	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Connecticut		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60072						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	2-3 yrs.	$90,691	$11,936	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$192,714	$6,524	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Delaware		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60000						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$75,523	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	$35,961	$4,732	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$177,496	$6,009	Minor	Major	Major

Organization	USACE		Hydrographic survey for dredging the harbors for navigation. Flood risk management. Maritime channel and harbor improvements, ecological restoration, and navigation. Harbor maintenance. Planning and constructing new navigation channels, ports, and harbors, and maintaining channel depths along coastal channels, and harbors. We conduct hydrographic surveys on a daily basis to assess channel shoaling conditions for our 1500 miles of navigation channels. BU 22 – Infrastructure and Construction Management is an additional Business Use				
MCA Name	MCA No.						
Harbor Management and Navigation	22396						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	Annually	don't know	don't know	don't know	don't know	don't know
Inland Bathy	QL0B	2-3 yrs.	$53,618	Moderate	None	None	Minor
Nearshore B.	QL0B	Annually	$54,221	Moderate	don't know	Moderate	Moderate
Offshore B.	Special Order	2-3 yrs.	$133,618	Moderate	don't know	don't know	Minor

Organization	Rhode Island		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60387						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$41,483	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	$19,752	$2,599	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	$138,793	$4,699	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Vermont		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60488						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	2-3 yrs.	$175,369	$23,080	Moderate	Moderate	Moderate

Organization	U.S. Virgin Islands		Future plans for the use of hydro drone for bathymetric mapping of estuarine navigation channels. Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60459						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	2-3 yrs.	$91,104	$3,084	Minor	Major	Major

Organization	CMTS		Nautical charting. Bathymetric measurements of submerged inland topography. Identification of hazards to navigation. Precision marine navigation. Hydrographic survey for dredging the harbors for navigation. Flood risk management, Maritime channel and harbor improvements, ecological restoration, and navigation. Harbor maintenance. Planning and constructing new navigation channels, ports, and harbors, and maintaining channel depths along coastal channels, and harbors.				
MCA Name	MCA No.						
Navigation, Charting, and Harbor Management	21556						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	Major	Minor	Moderate	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Moderate	Major	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Minor	Major	Major
Offshore B.	Order 2	2-3 yrs.	$50,000	Moderate	don't know	don't know	Minor

Organization	Northern Mariana Islands		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60342						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	2-3 yrs.	$7,261	$245	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	University of New Hampshire Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC)		The major focus of CCOM/JHC is to develop tools to advance ocean mapping and hydrography. As such, much of the work at CCOM/JHC is directed at evaluating or developing technologies, algorithms, or best practices for acoustic bathymetry (multibeam and single beam) for hydrographic mapping and seafloor characterization (including acoustic backscatter). In addition, this effort is not limited to acoustics, but also includes airborne LIDAR. Therefore, the primary mission is to innovate and develop, rather than mapping surveys directly. However, the development of expanded high resolution mapping using both MBES and LIDAR for the nation enhances this effort significantly. There are also significant efforts directed at developing technologies for applications such as seafloor characterization, critical habitat evaluation, seafloor change analysis, electronic chart development, modeling, marine mineral resources, among others, that require high resolution multibeam echosounder (MBES) bathymetry and backscatter, both newly acquired for a specific study or existing (archived). Similarly, there are applications concerned with coastal and shallow water environments addressing coastal resiliency, shoreline change, restoration, etc., that need high resolution topographic and bathymetric LIDAR. These examples do not cover all of the applications but are meant to show areas of focus. These applications also evolve over time. Furthermore, deep ocean applications are important (e.g., Law of the Sea).					
MCA Name	MCA No.						
Advance Ocean Mapping and Hydrography and Train Hydrographers	21515						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Depends on variables	Major	Major	Major	Major	Major
Nearshore B.	QL0B	Annually or event driven	Major	Major	Major	don't know	Major
Offshore B.	Depends on the applica-tion	Depends on variables	Major	Major	Major	don't know	don't know

Organization	NGA		Safety of Navigation. NGA is responsible for maritime safety globally in non-U.S. waters. NOAA is responsible for the U.S. waters. NGA provides nautical charting information to the Navy. The charts provide surface and sub-surface navigation information similar to the NOAA nautical charts. NGA collaborates with international partners and data providers to acquire the needed elevation information. NGA also partners with NOAA and the IHO on standards, technology, etc.				
MCA Name	MCA No.						
Safety of Navigation	21693						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL2B	28 days if change is detected, regular updates per Navy schedule	Major	Major	Minor	Moderate	Major
Offshore B.	Order 2	28 days if change is detected, regular updates per Navy schedule	Major	Major	Minor	Moderate	Major

Organization	American Association of Port Authorities		Commercial navigation, predominantly deep draft navigation				
MCA Name	MCA No.						
Commercial Navigation	21867						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	Annually	Major	Major	Minor	Major	Major
Offshore B.	Special Order	4-5 yrs.	Major	Major	Minor	Major	Major
Offshore B.	Order 1a	4-5 yrs.	Major	Major	Minor	Major	Major
Offshore B.	Order 2	4-5 yrs.	Major	Major	Minor	Major	Major

Organization	NOAA		The Center for Operational Oceanographic Products and Services (CO-OPS) and its predecessors have gathered oceanographic data along our nation's coasts for over 200 years to protect life, property, and the environment. Serving both the public and other government agencies, CO-OPS is the authoritative source for accurate, reliable, and timely water-level and current measurements that support safe and efficient maritime commerce, sound coastal management, and recreation. The combined efforts, knowledge, and experience of CO-OPS's technicians, scientists, and engineers working to carry out a central mission has led to the development of a reliable center of expertise for coastal physical oceanography.				
MCA Name	MCA No.						
Tides and Currents Supporting Safe Navigation and Coastal Engineering	22146						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	X-Sec meet needs	2-3 yrs.	Major	Major	don't know	don't know	don't know
Nearshore B.	X-Sec meet needs	2-3 yrs.	Major	don't know	don't know	don't know	don't know

Organization	Leidos		Collection and analysis of bathymetric data for the use of identifying hazards to navigation, updating nautical products. Additionally have conducted surveys to support a potential claim for extended jurisdiction by the United States under United Nations Convention on the Law of the Sea (UNCLOS) Article 76.				
MCA Name	MCA No.						
Collection and Analysis of Bathymetric Data	22199						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL4B	>10 yrs.	Major	Major	Moderate	Moderate	Moderate
Offshore B.	Order 1a	6-10 yrs.	Major	Major	Moderate	Moderate	Moderate

Organization	Lake Carriers' Association		Movement by vessels over water of dry bulk materials throughout the Great Lakes and connecting channels.				
MCA Name	MCA No.						
Great Lakes Shipping	32570						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	Annually	don't know	don't know	Moderate	Moderate	Major
Nearshore B.	QL0B	Annually	don't know	don't know	Moderate	Moderate	Major
Offshore B.	Order 1a	As driven by fluctuating water levels and dredging of channels	don't know	don't know	Moderate	Moderate	Major

Organization	Geodynamics		Collection of yearly beach profiles and nearshore multibeam to support coastal management decisions. Collection of multibeam bathymetry to support benthic habitat mapping and fisheries management. Multibeam bathymetry and sub-bottom / seismic data to support beach renourishment projects. High resolution seafloor mapping to support the preservation of submerged cultural resources. High resolution seafloor mapping to aid in basin retention for flood plain mapping and flood risk management. Nautical charting. Offshore surveys to support Naval sub-sea operations / training.				
MCA Name	MCA No.						
Hydrographic and Coastal Surveying	32591						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Moderate	Major	don't know	don't know	don't know
Inland Bathy	QL0B	2-3 yrs.	Moderate	Major	don't know	don't know	don't know
Nearshore B.	QL0B	2-3 yrs.	Major	Major	don't know	don't know	don't know
Offshore B.	Order 1a	2-3 yrs.	Major	Major	don't know	don't know	don't know

Organization	Quality Positioning Services		Any and all marine based applications that involve the acquisition, processing, visualization and analysis of time based xyz information. This includes but is not limited to Navigation, Seafloor Mapping, Oil & Gas, Dredging, Academic Research, Offshore Renewables, Defense, etc.				
MCA Name	MCA No.						
Marine Navigation and Seafloor Mapping	32593						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	Event driven	Major	Major	Moderate	Moderate	Moderate
Nearshore B.	QL0B	Event driven	Major	Major	Moderate	Moderate	Moderate
Offshore B.	Order 2	Event driven	Major	Major	Moderate	Moderate	Moderate

Organization	CMTS		Navigational safety and marine mapping. Bathymetric measurements of near-shore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels. Planning, acquiring, integrating, and disseminating ocean and coastal geospatial data.				
MCA Name	MCA No.						
Navigational Safety and Marine Mapping	50004						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	Major	Major
Inland Bathy	QL0B	Annually	Major	Major	don't know	don't know	don't know
Nearshore B.	QL0B	Annually	Major	Major	don't know	don't know	don't know
Offshore B.	Order 1a	Annually	Major	Major	don't know	don't know	don't know

Organization	CMTS		Maritime issues to include shipping and all ports, both coastal and on inland waterways. Topographic and bathymetric data are used in conjunction with other datasets that are specific to vessel traffic, such as the Automatic Identification Systems (AIS) data transmitted by vessels about where and when they are traveling on the water.				
MCA Name	MCA No.						
Data Collection and Analysis of Maritime Geospatial Data	50006						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Moderate	Moderate	Major	Major
Inland Bathy	X-Sec meet needs	6-10 yrs.	Major	Major	Moderate	Major	Major
Nearshore B.	X-Sec meet needs	6-10 yrs.	Major	Major	Moderate	Major	Major
Offshore B.	X-Sec meet needs	6-10 yrs.	Major	Major	Moderate	Major	Major

Organization	Washington		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60520						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	Major	Major	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Major	Major	Minor	Major	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Minnesota		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60617						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Moderate	None	None	Minor
Inland Bathy	QL0B	2-3 yrs.	Major	Major	Moderate	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Major	Major	Minor	Major	Major

Organization	FBI		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60713						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Major	Minor	Major	Major
Inland Bathy	QL0B	2-3 yrs.	Major	Major	Moderate	Major	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Minor	Major	Major
Offshore B.	Order 1	2-3 yrs.	Major	Major	Moderate	Major	Major

Organization	ESGplus		Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.				
MCA Name	MCA No.						
Marine and Riverine Navigation and Safety	60732						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	Annually	Major	Major	Moderate	Major	Major
Nearshore B.	QL0B	Annually	Major	Major	Minor	Major	Major
Nearshore B.	QL0B	2-3 yrs.	Major	Major	Minor	Major	Major
Nearshore B.	QL0B	4-5 yrs.	Major	Major	Minor	Major	Major
Offshore B.	Order 1a	Annually	Major	Major	Moderate	Major	Major
Offshore B.	Order 1a	2-3 yrs.	Major	Major	Moderate	Major	Major
Offshore B.	Order 1a	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	United States Power Squadrons		Marine Navigation (BU 20). Navigating in shallow waters (Galveston Bay, etc.) Teaching navigation to new mariners.				
MCA Name	MCA No.						
Marine Navigation	22456						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL2B	6-10 yrs.	Minor	Moderate	None	None	Moderate
Nearshore B.	QL2B	6-10 yrs.	Moderate	Moderate	None	None	Moderate
Offshore B.	Order 2	>10 yrs.	Minor	Minor	None	None	Minor

Organization	United States Power Squadrons		Geodetic Recovery				
MCA Name	MCA No.						
Geodetic Recovery	22530						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	6-10 yrs.	Minor	Moderate	Minor	don't know	Minor

BU 21 - Aviation Navigation and Safety

BU 21 Scope

Business Use #21 (BU 21) includes determination of in-flight hazards and path obstructions; aeronautical charting; and runway construction and repair. The Federal Aviation Administration (FAA) is the champion for the use of enhanced elevation data to satisfy requirements for this Business Use.

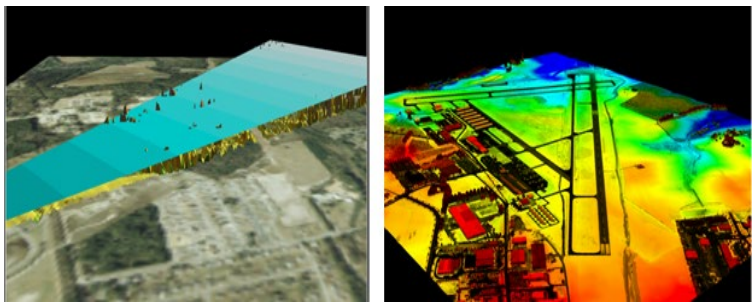

Figure E.21a. Lidar is popularly used for many forms of airfield obstruction surveys. Images courtesy of FAA. Topographic data supports in-flight aviation safety; bathymetric data supports potential incidents in water.

BU 21 Background Information

The FAA, supported by the National Geodetic Survey (NGS), utilizes lidar data for preparation of aeronautical surveys, Airport Obstruction Charts (AOCs) and related products used in development of instrument approach and departure procedures at airfields. With examples shown in Figure E.21a, lidar DSMs are ideal for digital airspace obstruction analysis, which includes modeling the mathematical airspace surfaces defined by FAA FAR Part 77 that depicts airspaces surrounding and emanating from airports. These include (1) approach and departure surfaces, (2) transitional zones, (3) primary zones, and (4) horizontal surfaces above the airport; these surfaces must be free of trees, towers, and other obstructions. High-density lidar is used to detect potential obstacles that penetrate Obstruction Identification Surfaces (OISs), as shown at Figure E.21a (left). AOCs are graphics that depict OISs as well as aircraft movement and apron areas, navigational aids, prominent airport buildings, and a selection of roads and other planimetric detail in the airport vicinity; also included are tabulations of runway and other operational data. Figure E.21a (right) shows an airfield map that can be viewed from any perspective to see what the airfield and runway ought to look like as an aircraft is approaching the runway.

Many education/training programs use 3D simulations of the terrain for diverse purposes. Flight simulators are probably the best known, and they are needed in Alaska more than anywhere else.

Alaska is a larger landmass than all of central Europe, and 82 percent of its villages have no connection to the national road system. In nearly 600,000 square miles of Alaska's land, there are less than 5,000 miles of roads, and only one single-track railroad-line. Most commerce and essential services, and personal transportation between villages, is done by airplanes. These are mostly small, piston-engine airplanes that are not pressurized and lack power to fly above the mountains. Instead, small planes fly through mountain passes and they cannot use Instrument Flight Rule IFR-airways or radio-navigation while doing that unless they have accurate elevation data and modern avionics tools for terrain avoidance. Often a flight through a pass is like flying through a tunnel that has numerous dendritic dead-end junctions. One wrong turn can lead into a dead-end box canyon, too narrow to turn around in and too steep to climb out of. Due to all these factors, Alaska's pilots require different skill sets than pilots elsewhere. Most flight-training in the U.S. is done with Common Flight Simulators made to simulate IFR conditions and aircraft system failures. They are made to train the turbine-engine-airline-IFR environment (high above all terrain and weather). In harsh contrast, aircraft simulators for Alaska are made to simulate Alaska's unforgiving mountains and passes in photo-realism and harsh weather conditions that too-often lead to Controlled Flight Into Terrain (CFIT) accidents. Flight simulators in Alaska require elevation data draped with imagery. In a sense of "look-before-you-fly," Alaska's pilots learn their way through the mountains in the simulator and gain experience easily that otherwise would require a steep learning curve.

BU 21 Elevation Data Uses

Using their own words, respondents documented 31 Mission Critical Activities (MCAs) that identified BU 21 as their primary Business Use and identified the following 27 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.21a. BU 21 Elevation Data Uses

Data Use
Data Development and Management
1. Compliance with FAA requirements to develop and maintain the Airfield Layout Plan (ALP) data in a specific GIS format
2. Enhanced information sharing
3. High resolution and current data to make our airports as viable and safe as possible
Economic Development
4. Facilitate economic development
Infrastructure Management
5. Expand cargo development services
6. Optimize general aviation operations and services
7. Planning and infrastructure management
8. Runway construction and repair
Navigational Safety
9. Flooding and transportation modeling for passenger and public safety
10. Aeronautical charting
11. Airport security and public safety
12. Analysis of tall structures, sight-lines, and vegetation
13. Determination of in-flight hazards and path obstructions
14. Develop instrument procedures in the National Airspace System (NAS)
15. Ensure safety during flight operations
16. Evaluate vertical obstructions
17. Flight planning for aerial surveys and UAVs
18. Instrument Flight Procedure (IFP) publications
19. Maintain constant distance above the ground for diverse data collection flights
20. Maintain optimal quality for aeronautical data products
21. Minimum Safe Altitude Warning (MSAW)
22. Sector Design Analysis Tool (SDAT)
23. Simulate possible maritime obstacles to aviation (the tallest ships are placed in waters at high tide within the approach course to identify possible impacts to flight approaches)
Planning
24. Better airport data analysis
25. Improved decision making
26. Increased air services
27. Potential operational cost reductions

BU 21 Tangible and Intangible Benefits

For the 31 MCAs that list Aviation Navigation and Safety as their primary Business Use:

- **Table E.21b** summarizes the reported future annual dollar benefits by geography type, totaling $68.56 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.21c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.21e.
- **Table E.21d** shows (in blue) the four federal agencies, 27 states and territories, and zero non-governmental entities that submitted MCAs with BU 21 as the primary Business Use. MCAs for which BU 21 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.21d.
- **Table E.21e** documents all the MCAs that listed BU 21 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.21e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 21 Reported Future Annual Dollar Benefits

Of the 31 MCAs that listed Aviation Navigation and Safety as their primary Business Use, 28 MCAs estimated their tangible annual benefits totally in financial terms; no MCAs had a combination of tangible and "Major" intangible benefits; and three MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.21b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 31 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.21b. BU 21 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$45,152,040	$22,769,198	$67,921,238
Inland Bathymetry	$646,142	$0	$646,142
Nearshore Bathymetry	$0	$0	$0
Offshore Bathymetry	$0	$0	$0
Totals	**$45,798,182**	**$22,769,198**	**$68,567,380**

BU 21 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.21c. BU 21 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	31	31	0	1	6
Inland Bathymetry	9	9	0	8	9
Nearshore Bathymetry	2	2	0	0	2
Offshore Bathymetry	2	2	0	0	2
Totals	**44**	**44**	**0**	**9**	**19**

The types of benefits that are included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 21 Reported Future Annual Dollar Benefits Maps

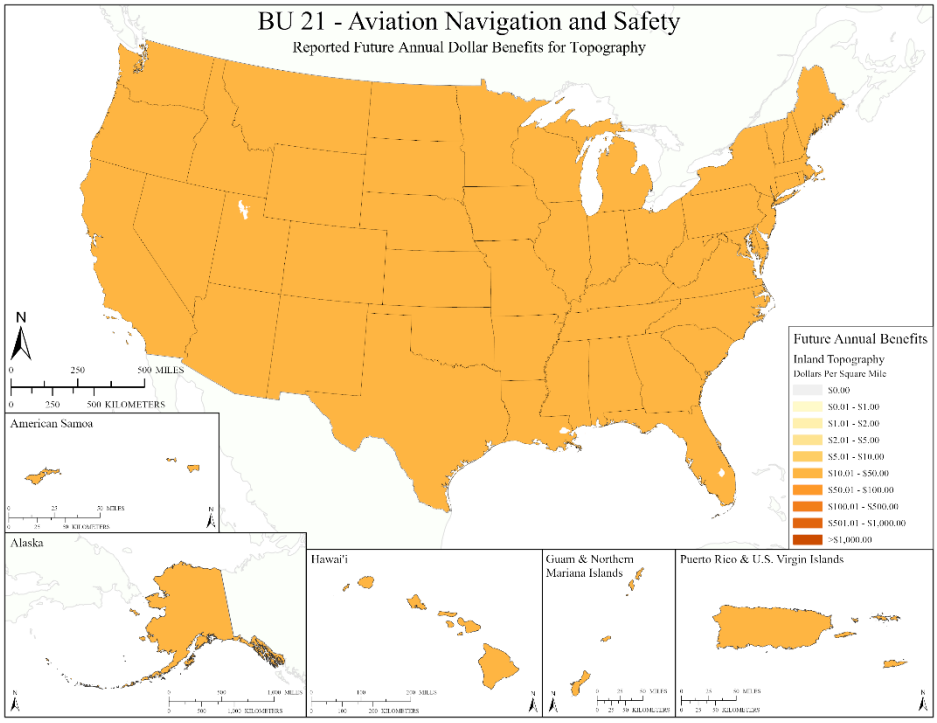

Figure E.21b. Reported Future Annual Dollar Benefits for Topography

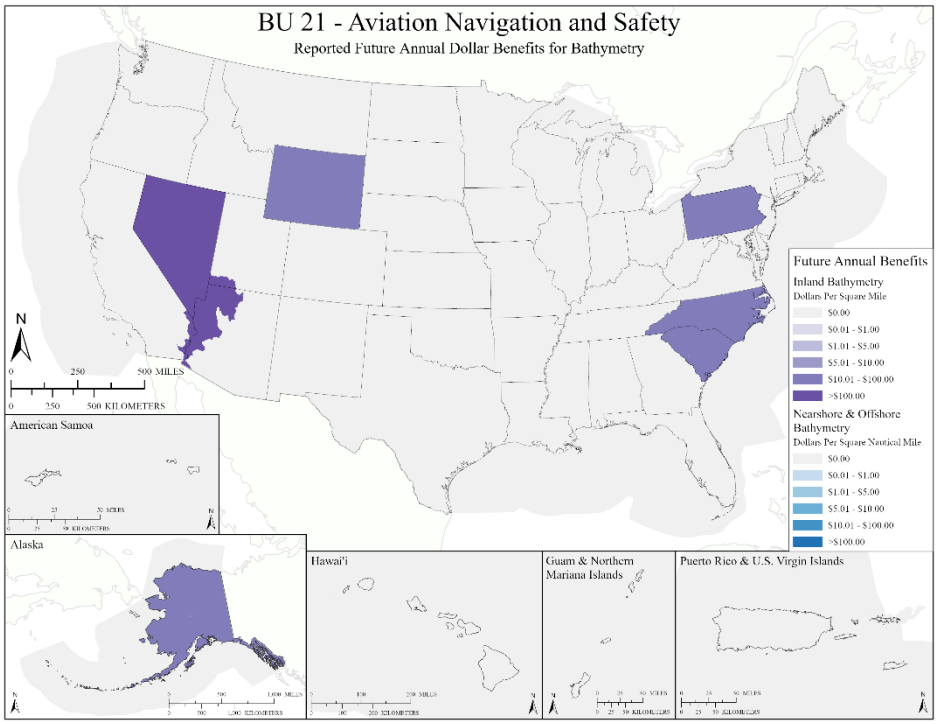

Figure E.21c. Reported Future Annual Dollar Benefits for Bathymetry

BU 21 Benefits Analysis

The total combined future annual benefits ($68.56 million per year) reported for BU 21 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies)were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 21 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, four federal agencies (FAA, FBI, NOAA, USAF) submitted MCAs listing BU 21 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry and offshore bathymetry.
    - Inland Topography: Three provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits and two indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and two indicated "Major" benefits.
- State/Local/Tribal and U.S. Territory MCAs: Twenty-six (26) states and territories submitted 27 MCA listing BU 21 as their primary Business use.
    - Inland Topography: 25 provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: Six provided dollar benefits and two indicated "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits and none indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and none indicated "Major" benefits.
- Non-governmental MCAs: One non-governmental agency (3GLP E-Terra) submitted an MCA listing BU 21 as secondary; thus, no financial benefits accrued to BU 21.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.21b and E.21c:
    - 88 "Major" Operational and Customer Service benefits and 28 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 21 for which "Major" benefits are documented, this could easily be translated into hundreds of thousands of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 21 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 21:

- **Table E.21d** color-codes those organizations having an MCA with BU 21 as Primary, Secondary, or Tertiary.
- **Table E.21e** summarizes the 31 MCAs with primary benefits for BU 21, rank ordered from the highest to the lowest tangible benefits.

Table E.21d. Organizations having an MCA with BU 21 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	**FAA**	**FBI**	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	**NOAA**	NPS	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	**USAF**	USARC	USBR	USCB
	USCG	USFS	**USGS**	USMC	**USN**					

State/Ter	AL	**AK**	AR	AZ	**CA**	CO	CT	DC	**DE**	**FL**	GA	**HI**	IA	**ID**
	IL	**IN**	*KS*	**KY**	LA	**MA**	**MD**	ME	**MI**	MO	**MN**	**MS**	**MT**	**NC**
	ND	NE	NH	*NJ*	**NM**	**NV**	NY	**OH**	OK	OR	**PA**	**RI**	**SC**	SD
	TN	**TX**	**UT**	**VA**	*VT*	WA	*WI*	WV	**WY**	PR	VI	**GU**	AS	CNMI

Non-Gov	*3GLP E-Terra*			

Table E.21e. MCA summaries for BU 21, rank ordered from the highest to the lowest tangible benefits.

Organization	NOAA		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60667						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$15,579,236	$9,070,111	Minor	Moderate	Major

Organization	FAA		Aeronautical Information includes obstacle evaluation of structures. Develop instrument procedures in the NAS; evaluate vertical obstructions. Validating obstacle heights for purposes of charting and electronic flight management systems. Critical to this process is accurate ground elevation and accurate horizontal positioning. BU-21 Aviation Navigation and Safety - Minimum Safe Altitude Warning (MSAW)/-Sector Design Analysis Tool (SDAT)/-Instrument Flight Procedure Publication (IFP). For simulating possible maritime obstacles to aviation, the tallest ships are placed in waters at high tide within the approach course to identify possible impacts to flight approaches.				
MCA Name	MCA No.						
Airway and Instrument Flight Procedure Development and Instrument Flight Procedure Impact, Aeronautical Charting	1192						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$15,567	$2,423	None	Moderate	Major
Inland Topo	QL2	Annually	$21,184,433	$3,297,577	None	Moderate	Major
Nearshore B.	QL4B	Annually	Major	Major	None	Moderate	Major
Offshore B.	Order 2	Annually	Major	Major	None	Moderate	Major

Organization	Alaska		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60018						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$1,974,715	$2,459,441	Minor	Moderate	Moderate
Inland Bathy	QL0B	Annually	$393,226	Major	Moderate	Major	Major
Nearshore B.	I don't know	Annually	Moderate	don't know	don't know	don't know	don't know

Organization	California		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60052						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$1,495,056	$1,862,004	Minor	Moderate	Moderate

Organization	Texas		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60446						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$894,872	$1,114,532	Minor	Moderate	Moderate

Organization	Montana		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60264						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$497,072	$619,087	Minor	Moderate	Moderate

Organization	Nevada		Airport Security and Public Safety, Planning and Infrastructure Management. Comply with Federal Aviation Administration (FAA) requirements to develop and maintain the Airport Layout Plan (ALP) data in a specific GIS format. This action is also in support of Strategic Initiatives: Expand Cargo Development and Service, Increase Air Service, Optimize General Aviation Operations and Services, and Facilitate Economic Development. The enterprise GIS, related datasets and applications are expected to provide timely, accurate data for airport users, leading to better data analysis, enhanced information sharing, improved decision making, and potential operational cost reductions. Airport GIS data is critical in many aspects of our community. From flooding to transportation modeling to passenger ease of use and most everything in between, all available data is used at a critical level for passenger and public safety. Having the highest resolution, latest data available will make our airport as viable and safe as possible. And will enhance passenger experience and future business.				
MCA Name	MCA No.						
Airport Security and Public Safety, Planning and Infrastructure Management	32891						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$379,882	$470,895	Moderate	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$102,510	Major	Moderate	Major	Major

Organization	New Mexico		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60315						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$411,040	$511,937	Minor	Moderate	Moderate

Organization	Wyoming		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60545						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$330,660	$411,825	Minor	Moderate	Moderate
Inland Bathy	QL0B	Annually	$65,844	Major	Moderate	Major	Major

Organization	Utah		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60474						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$282,576	$351,939	Minor	Moderate	Moderate

Organization	Idaho		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60136						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$282,507	$351,854	Minor	Moderate	Moderate

Organization	Michigan		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60238						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$196,360	$244,560	Minor	Moderate	Moderate

Organization	Illinois		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60146						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$190,463	$237,215	Minor	Moderate	Moderate

Organization	Florida		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair. Lidar data supports analysis of tall structures, sight-lines, and vegetation.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60087						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$189,701	$236,266	Minor	Moderate	Moderate

Organization	North Carolina		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60331						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$166,889	$207,854	Minor	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$33,232	Major	Moderate	Major	Major
Nearshore B.	QL0B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Pennsylvania		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60367						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$153,139	$190,730	Minor	Moderate	Moderate
Inland Bathy	QL0B	Annually	$30,494	Major	Moderate	Major	Major
Nearshore B.	I don't know	Annually	Moderate	don't know	don't know	don't know	don't know

Organization	Mississippi		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60249						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$161,138	$200,691	Minor	Moderate	Moderate

Organization	Ohio		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60347						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$139,470	$173,705	Minor	Moderate	Moderate

Organization	Kentucky		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60195						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$136,607	$170,139	Minor	Moderate	Moderate

Organization	Virginia		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60504						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$136,510	$170,018	Minor	Moderate	Moderate

Organization	Indiana		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60161						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$122,318	$152,343	Minor	Moderate	Moderate

Organization	South Carolina		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60403						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$104,639	$130,325	Minor	Moderate	Moderate
Inland Bathy	QL0B	Annually	$20,836	Major	Moderate	Major	Major
Nearshore B.	I don't know	Annually	Moderate	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Maryland		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60220						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$33,424	$41,629	Minor	Moderate	Moderate

Organization	Air Force		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60638						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	3-5 yrs.	$40,231	$23,422	Minor	Moderate	Major

Organization	Massachusetts		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60230						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$27,415	$34,145	Minor	Moderate	Moderate

Organization	Hawai'i		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60126						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$21,752	$27,091	Minor	Moderate	Moderate
Nearshore B.	I don't know	Annually	Moderate	don't know	don't know	don't know	don't know

Organization	Rhode Island		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60388						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$3,660	$4,559	Minor	Moderate	Moderate

Organization	Guam		UAV flight planning. Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60106						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$708	$881	Minor	Moderate	Moderate

Organization	Hawai'i		Our mission critical activity is flight planning for aerial surveys. Accurate, high resolution elevation information is required to ensure safety during flight operations as well as maintain optimal quality for our data products. Our data collection flights are conducted at low altitudes and often require following the terrain to maintain a constant distance from the ground.				
MCA Name	MCA No.						
Flight Planning for Remote Sensing Aerial Surveys	21983						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL3	Annually	Major	Major	None	None	None
Inland Bathy	I don't know	Annually	Major	Major	don't know	don't know	don't know
Nearshore B.	I don't know	Annually	Moderate	don't know	don't know	don't know	don't know

Organization	Minnesota		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60618						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	Major	Major	Minor	Moderate	Moderate
Inland Bathy	QL0B	Annually	Major	Major	Moderate	Major	Major
Nearshore B.	I don't know	Annually	Moderate	don't know	don't know	don't know	don't know

Organization	FBI		Determination of in-flight hazards and path obstructions. Aeronautical charting. Runway construction and repair.				
MCA Name	MCA No.						
Aviation Navigation and Safety	60714						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Major	Minor	Moderate	Major
Inland Bathy	QL0B	2-3 yrs.	Major	Major	Moderate	Major	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	None	Moderate	Major
Offshore B.	Order 1	2-3 yrs.	Major	Major	None	Moderate	Major

BU 22 - Infrastructure and Construction Management

BU 22 Scope

Business Use #22 (BU 22) includes marine construction; bridge design and construction; engineering and construction of dams, levees, dikes, reservoirs, and coastal structures; shipyard and port construction; water, sewer or power line planning and vegetation analysis; pump, drain, and well placement; stormwater modeling; cut and fill analysis for earth-moving; building site analysis; road infrastructure; and infrastructure hardening or mitigation for climate change effects, e.g., sea level change.

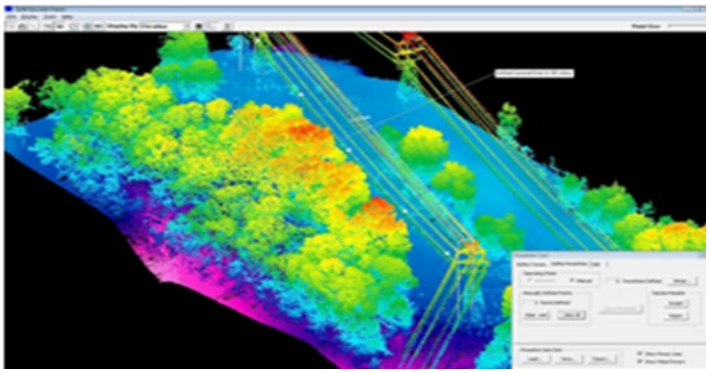

Figure E.22a. Baltimore Gas and Electric (BGE) lidar data for power line vegetation management. Image courtesy of Exelon Corp.

Business Use #22 is defined in terms of Mission Critical Activities (MCAs) that support all forms of infrastructure and construction management needs of federal, state, local, and tribal governments, not-for-profits, private industry, and individuals. As used herein, *infrastructure* consists of the basic physical structures or systems needed for the operation of a society or enterprise. There is no clear champion for this Business Use because no one organization is responsible for nationwide management of water, sewer, telephone and electric utilities; buildings, roads, railroads, dams, reservoirs, and levees, for example. Furthermore, no one organization is responsible for management of construction projects that could extend from a major U.S. Army Corps of Engineers project to a private landowner wanting to improve drainage on their property. Infrastructure and construction projects are ubiquitous – present nearly everywhere.

BU 22 Background Information

Nationwide, accurate topographic surveys and lidar point clouds have become mission-critical in support of infrastructure and construction management. Here's why:

- The electric power industry relies on lidar point clouds for *line rating* and *transmission line vegetation management* (Figure E.22a) for reliability of the electric power grid.
- Infrastructure projects such as water and sewer projects, reservoirs, dams, levees, and seawalls, require accurate topographic data.
- Construction projects, especially those that include earth-moving, require accurate topographic data to solve drainage issues, to estimate cut and fill requirements, and to develop preliminary construction plans and design grades.
- Complex hydrologic models, or simple assessments of "where water will go," are *killer-apps* for lidar.
- When lidar data are readily available, the needs for traditional topographic land surveys are minimized at great cost savings to the public.
- Modern earth-moving equipment (dozers, scrapers, graders) utilize GPS machine control guidance systems that have tolerances as small as two to three centimeters, making them extremely accurate in achieving design grades compared to relying on the operator's skill level. Because the machine's GPS system knows when it is off the design grade determined from lidar data rather than traditional construction surveys, this reduces time and costs. The lidar data, used for determining design grades, often eliminates the requirement for construction stake-out surveys that construction machine operators traditionally used for visual reference.

The North American Electric Reliability Corporation (NERC) regulates the *bulk power system*, the facilities and control systems necessary for operating an interconnected electric energy supply and transmission network, including over 450,000 miles of bulk transmission lines but excluding smaller lines used for local distribution of electricity. Without specifically requiring lidar, NERC standards are commonly interpreted to endorse the use of airborne lidar for: (1) *line rating*, based on actual field conditions that determine changes in power line catenaries due to thermal and mechanical loads, and (2) *transmission line vegetation management*, based on monitoring of transmission line vegetation clearance to proactively prevent line-vegetation arcs and subsequent cascade system failures.

NERC Standard FAC-003-1 became mandatory and enforceable on June 18, 2007. The current version, FAC-003-4, became effective on October 1, 2016. FAC-003-4 requirements are aimed at preventing vegetation-related outages that could lead to cascading outages. FAC-003-4 accomplishes this by requiring applicable registered entities to manage vegetation located on transmission ROWs and minimize encroachments from vegetation located adjacent to the ROW. FAC-003-4 requires that all Sustained Outages of applicable lines be identified and reported quarterly through Periodic Data Submittals. Each of the Sustained Outages is categorized as one of the following:

- Category 1A — Grow-ins: Sustained Outages caused by vegetation growing into applicable lines that are identified as an element of an Interconnection Reliability Operating Limit (IROL) or Major Western Electricity Coordinating Council (WECC) Transfer Path by vegetation inside or outside the ROW.
- Category 1B — Grow-ins: Sustained Outages caused by vegetation growing into applicable lines but are not identified as an element of an IROL or Major WECC Transfer Path by vegetation inside or outside of the ROW.
- Category 2A — Fall-ins: Sustained Outages caused by vegetation falling into applicable lines that are identified as an element of an IROL or Major WECC Transfer Path from within the ROW.
- Category 2B — Fall-ins: Sustained Outages caused by vegetation falling into applicable lines but are not identified as an element of an IROL or Major WECC Transfer Path from within the ROW.
- Category 3 — Fall-ins: Sustained Outages caused by vegetation falling into applicable lines from outside the ROW.
- Category 4A — Blowing together: Sustained Outages caused by vegetation and applicable lines that are identified as an element of an IROL or Major WECC Transfer Path blowing together from within the ROW.
- Category 4B — Blowing together: Sustained Outages caused by vegetation and applicable lines but are not identified as an element of an IROL or Major WECC Transfer Path blowing together from within the ROW.

NERC Standards state: “Each Transmission Owner shall execute a flexible annual vegetation work plan to ensure no vegetation encroachments occur within the MVCD (Minimum Vegetation Clearance Distance).” Satisfied most cost-effectively with lidar, this would otherwise cost hundreds of millions of dollars annually for America’s electric utility companies and consumers who pay their electric bills. These costs would be greatly reduced whenever there is a fresh collect of lidar for individual areas. For lidar surveys of bulk transmission lines, the acquisition date and time for each flight line must be available so that operators can reconstruct the ambient temperature and power line loading at the time the lidar was acquired because these factors all impact the transmission line sag which is compared with the designed sag.

BU 22 Elevation Data Uses

Using their own words, respondents documented 96 Mission Critical Activities (MCAs) that identified BU 22 as their primary Business Use and identified the following 157 uses of elevation data. In some

cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.22a.. BU 22 Elevation Data Uses

Data Use
Cultural Resources Management
1. Discovery and analysis of Native American and other historical cultural sites and subsistence activities
Data Development and Management
2. Civil engineering and spatial data development
3. Enhancing Streamstats Program and providing data for flow regression equations nationwide
4. GIS library information access
5. Maintain the National Spatial Reference System (NSRS) required for all infrastructure/construction projects
6. Provide vertical datums for fiduciary control for heights and coordinates
Economic Development
7. Advance economic development
Engineering Design and Construction
8. Architectural and engineering services (transportation, general civil, geospatial, environmental)
9. Bankfull width as needed for sizing of infrastructure
10. Construction design, dam rehabilitation, dam safety, pipelines
11. Construction surveys; route planning for pipelines, cables, outfalls
12. Cut and fill analysis for earth moving and cost estimation
13. Design of river structures and borrow areas
14. Elevation data for pre-design and cut and fill analysis
15. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures
16. Engineering and drainage design
17. Engineering design, construction, and maintenance of roads, bridges, and utilities
18. Engineering, architecture, survey, environmental and geospatial services consulting
19. Engineering, planning, and construction
20. Levee analysis, construction, and maintenance
21. Marine construction
22. Planning, bridge/culvert design, modeling, resilience, hydraulic work, and layout of preliminary design
23. Planning, building, and operating the statewide highway system
24. Site civil design projects; residential/commercial site prep and design activities
25. Site design and planning for infrastructure projects including utilities (power, water, wastewater, buildings, roads)
26. Transportation engineering to include highway, railroad and bridge planning, land acquisition, design, and construction
27. Transportation facility design and construction on federal and Indian lands, Transportation infrastructure management
28. Water, sewer utility design
Environmental Protection
29. Environmental analyses including stormwater modeling and spill response, site planning and analysis of obstructions, and construction management

Data Use
30. Environmental review and construction of dams, levees, dikes, reservoirs, and coastal structures
31. Fate and transport of contaminants
32. Review of environmental impacts and flood resiliency of municipal and DOT road/stream crossings
Erosion/Sediment Control
33. Erosion control
34. Monitoring of sedimentation in reservoirs
35. Runoff and sedimentation analysis
36. Stream bank erosion analysis
Floodplain Management
37. Emergency management and flood mitigation planning
38. Local flood protection and infrastructure mapping
39. Stream channel analysis and mapping
Habitat Analysis and Management
40. Conservation of critical habitats
41. Ensure no adverse impacts to at-risk species
Hazard Assessment and Mitigation
42. Dam safety
43. Damage assessment and coastal resilience
44. Determine the maximum storage capacity behind dams for dam failure analysis
45. Development of emergency action plans and inundation maps for significant and high hazard dams
46. Evaluate potential downstream impacts and possible erosion of dams
47. Inland bathymetry for channels, ditches, fill ponds, foundations and risers for stormwater management and flood control
48. Pollution risk mitigation
49. Risk management for transportation infrastructure
50. Storm planning and management of landslides and post-wildfire mud flows
Infrastructure Management
51. Analyze flow under bridges
52. Assess powerline or tree clearance around critical facilities
53. Assess runoff in culverts
54. Asset inventory, condition assessments to validate feature locations including signs, overpass height above roads, land width, median width, widening feasibility assessment
55. Bridge scour and submerged aquatic vegetation
56. Cell tower microwave interference studies
57. Energy development and delivery – electric, wind, water, hydroelectric, geothermal
58. Engineering and facilities management
59. Geotech assessment and asset management
60. Infrastructure design, construction, maintenance, and mapping
61. Infrastructure management of marine terminals that receive oceangoing vessels
62. Inventory, monitoring, operations and maintenance of water delivery features and infrastructure such as canals, dams, reservoirs, ditches and laterals

Data Use
63. Management and modification of the state multimodal transportation systems
64. Management of bridges in the transportation network
65. Management of highways, railroads, transit, airports, and general aviation
66. Management of hydroelectric dams and reservoirs
67. Management of infrastructure, including water, port facilities, and transportation
68. Management of ports, airports, and harbor dredging
69. Management of sanitary sewer, stormwater and transportation (sidewalks and streets)
70. Meet mission critical activities including aviation rail, highways and public transportation
71. Planning, design, construction, and maintenance of transportation facilities (roads, bridges, airports, spaceports, railroads, marine highway ferries and terminals, and other public facilities
72. Power, water, and wastewater services
73. Roadway, bridge, and storm water infrastructure improvements
74. Shipyard and port construction
75. Terrain modeling and analysis for water, sewer and transportation infrastructure placement and routing
76. Transportation asset management
77. Tribal infrastructure management
78. USAF installation management; site analysis, facility, runway and road planning and construction
79. Utility system planning and installation
80. Watershed analysis and drought monitoring, and maintain canals and other infrastructure
Mapping/Boundary Delineation
81. Catalog features to remove and/or rebuild
82. Continuous topobathy dataset to facilitate coastal planning and infrastructure work along the shoreline
83. Creation of derivative products such as transportation asset design models, geospatial datasets, reports, maps or graphics
84. During project scoping, look for wetlands, historic sites, etc. impacted
85. Extracting building footprints
86. Geometric geodesy for accurate positioning and measurement activities
87. Identification of geomorphologic units
88. Identification of submerged sandbars and locations where dams may be needed
89. Identify sinkholes and burial mounds for transportation pre-planning
90. Identify wetlands and depth to the water table
91. Karst mapping and sand/gravel mining operation monitoring
92. Land use mapping
93. Landslide hazard mapping and assessment
94. Maintain road centerlines
95. Mapping and 3D modeling of transportation system infrastructure
96. Produce map products for customers for multiple uses
97. Satellite derived bathymetry (SDB)
98. Sinkhole mapping, monitoring, and analysis
99. Snow survey, snow volume, snow water equivalent information
100. Soils and wetlands mapping and characterization
101. Understand the terrain as a tool for describing mass variations

Data Use
102. Z-values for road networks and fuel tax program
Military/Defense
103. Entry and exit slopes of rivers for site selection of USMC amphibious vehicle crossings
104. Military planning
105. Navy facilities engineering
Modeling
106. Coastal hazard modeling, marine navigation, and engineering planning
107. Create flood models that evaluate structure, flood control and damage reduction designs
108. Create models which predict changes in inland and coastal flooding elevations
109. Dam break modeling and inundation mapping
110. Derive stream profiles for hydraulic modeling
111. H&H analysis of rivers for flood damage reduction assessment.
112. H&H and coastal modeling for the ferry system in NC's Outer Banks
113. H&H modeling and stage storage analysis for reservoirs.
114. H&H modeling for bridge and culvert design
115. H&H modeling for engineering projects including drainage master planning and transportation infrastructure design and modeling, and building site analysis
116. H&H modeling of dam break inundation
117. H&H study and mapping
118. Hydraulic modeling for structure design and stormwater assessments
119. Hydraulic modeling for transportation, land development, and architecture applications
120. Input into 2D hydraulic models
121. Modeling of biological and ecological systems
122. Modeling of obstructions for aviation approaches
123. Scour identification
124. SLOSH modeling
125. Stormwater modeling and design; pollution point and non-point source modeling
126. Stream profiles for H&H analyses
127. Supplement field survey data for H&H analysis
Natural Resources Conservation
128. Conservation engineering
129. Management of water resources
130. Site protection and preservation planning
131. Vegetation management
Navigational Safety
132. Airport construction; identify where UAVs are most likely to damage property and invest in appropriate counter measures
133. Calculate the grade on road surfaces to identify vertical curvature, which affects speed limits, signage requirements, regrading needs, and road restrictions.
134. Support FAA requirements of Airport Obstruction Surveys for the state DOT
Permitting
135. Hydroengineering permitting and modeling of downstream consequences
Planning
136. Building site analysis, transportation infrastructure, and power line planning

Data Use
137. Dam inspections prior to on-site physical inspections; verify field observations
138. Data for pre-project or pre-disaster conditions
139. Drainage planning for new and reconstruction projects such as culverts and stormwater management
140. Ensure clear zones and identify trees or other obstructions in transportation Right-of-Ways (ROWs); identify widening obstacles such as needed ROW acquisition or structures that would prevent widening
141. Ocean Thermal Energy Conversion (OTEC) planning
142. Planning for new and maintenance projects (5-, 20- and 100-year plans)
143. Planning, design, and risk management of structures
144. Precision locating and placement of existing and new utility infrastructure related to telecommunications
145. Project planning and environmental screening in advance of projects
146. Pump, drain and well placement
147. Targeting of field surveys
148. Transportation concept studies
149. Visualization studies
150. Water, sewer, or power line planning and vegetation analysis
Regulatory Reviews and Enforcement
151. Regulatory review of interstate transmission of electricity, natural gas and oil
152. Review proposals to build liquefied natural gas (LNG) terminals and interstate natural gas pipelines and licensing hydropower projects
153. Underwater pipeline reviews
Sea Level Rise/Subsidence
154. Assessment of subsidence and ground instability
155. Bridge surfaces and bridge deck elevations for evaluation of potential sea level rise effects on bridges
156. Infrastructure hardening or mitigation for climate change effects, e.g., sea level change
Water Supply and Delivery
157. Water storage and delivery

BU 22 Tangible and Intangible Benefits

For the 96 MCAs that list Infrastructure and Construction Management as their primary Business Use:

- **Table E.22b** summarizes the reported future annual dollar benefits by geography type, totaling $1.17 billion per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.22c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.22e.
- **Table E.22d** shows (in blue) the 18 federal agencies, 69 states and territories, and nine non-governmental entities that submitted MCAs with BU 22 as the primary Business Use. MCAs for which BU 22 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.22d.
- **Table E.22e** documents all the MCAs that listed BU 22 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.22e documents the MCA name

and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 22 Reported Future Annual Dollar Benefits

Of the 96 MCAs that listed Infrastructure and Construction Management as their primary Business Use, 53 MCAs estimated their tangible annual benefits totally in financial terms; 12 MCAs had a combination of tangible and "Major" intangible benefits; and 19 MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.22b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 96 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.22b. BU 22 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$520,798,293	$493,331,787	$1,014,130,080
Inland Bathymetry	$140,362,947	$9,576,864	$149,939,811
Nearshore Bathymetry	$5,829,469	$808,613	$6,638,082
Offshore Bathymetry	$0	$0	$0
Totals	**$666,990,709**	**$503,717,264**	**$1,170,707,973**

BU 22 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.22c. BU 22 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	69	60	8	19	50
Inland Bathymetry	40	14	1	9	13
Nearshore Bathymetry	20	7	0	4	18
Offshore Bathymetry	0	0	0	6	1
Totals	**129**	**81**	**9**	**38**	**82**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 22 Reported Future Annual Dollar Benefits Maps

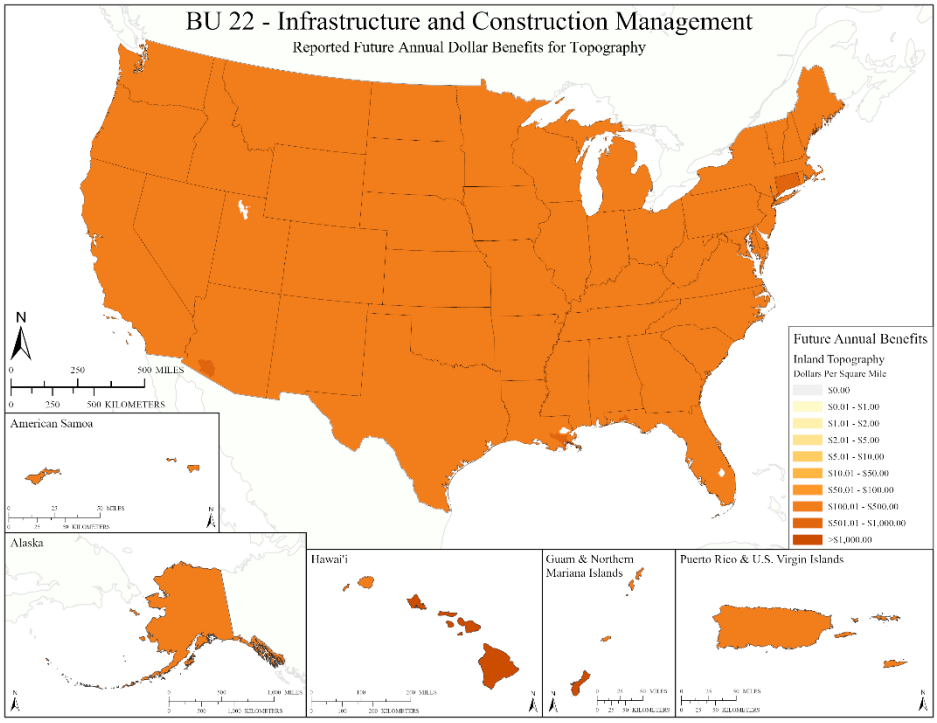

Figure E.22b. Reported Future Annual Dollar Benefits for Topography

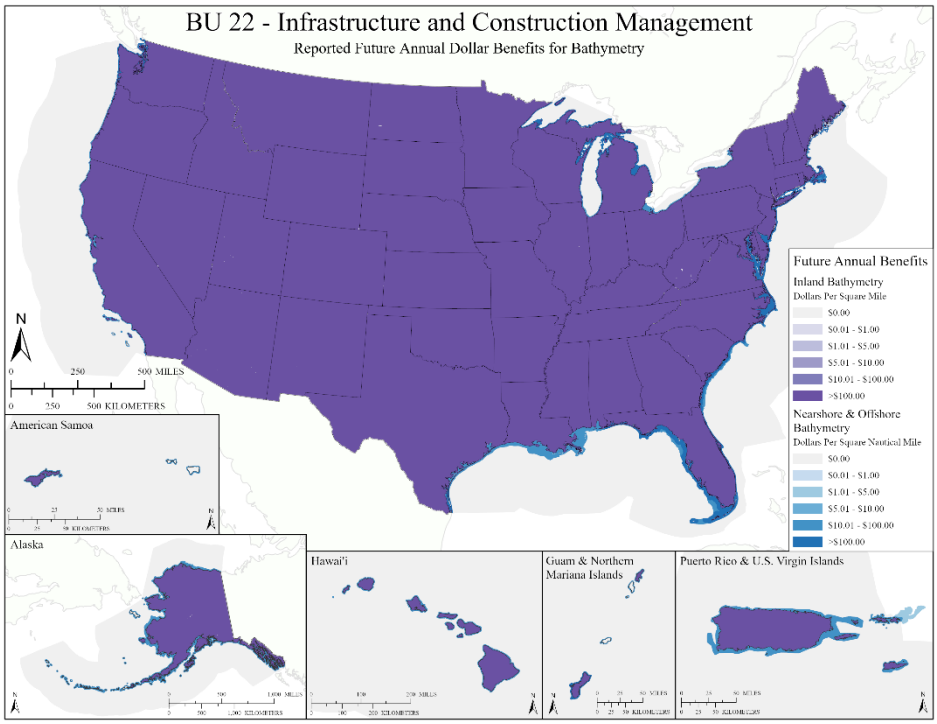

Figure E.22c. Reported Future Annual Dollar Benefits for Bathymetry

BU 22 Benefits Analysis

The total combined future annual benefits ($1.171 billion per year) reported for BU 22 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 22 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, 17 federal agencies (CMTS, DISDI, FAA, FBI, FERC, FHWA, IBWC, NOAA, NPS, NRC, TVA, USACE, USAF, USBR, USGS, USMC, and USN) submitted 18 MCAs listing BU 22 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry and offshore bathymetry.
    - Inland Topography: Ten provided dollar benefits and seven indicated "Major" benefits.
    - Inland Bathymetry: Eight provided dollar benefits and six indicated "Major" benefits.
    - Nearshore Bathymetry: Three provided dollar benefits and one indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits or "Major" benefits.
- State/Local/Tribal and U.S. Territory MCAs: Forty-seven (47) states and territories submitted 69 MCAs listing BU 22 as their primary Business Use.
    - Inland Topography: 54 provided dollar benefits and ten indicated "Major" benefits.
    - Inland Bathymetry: 31 provided dollar benefits and eight indicated "Major" benefits.
    - Nearshore Bathymetry: 19 provided dollar benefits and two indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and five indicated "Major" benefits.
    - Nine states and territories submitted no MCA with BU 22 as primary, even though infrastructure and construction management if known to be critical everywhere, but five states submitted MCAs with BU 22 as secondary or tertiary.
- Non-governmental MCAs: Nine non-governmental organizations (3GLP E-Terra, Ayres Associates, GIS Engineering, Great Lakes Dredge and Dock Company, HERE Technologies, MSA Professional Services, TCarta Marine, TerraSond, and TetraTech) submitted MCAs listing BU 22 as primary. Eight non-governmental organizations submitted MCAs listing BU 22 as secondary or tertiary, meaning benefits do not accrue to BU 22.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.22b and E.22c:
    - 210 "Major" Operational and Customer Service benefits and 129 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 22 for which "Major" benefits are documented, this could easily be translated into billions of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.
    - Eighty-seven (87) MCAs were submitted by federal, state/territory, or local governmental organizations with over 200 different uses for topographic and/or bathymetric data. Those

tasks are largely managed and funded by government agencies but executed by private-sector surveying, mapping or engineering firms contracted by the government. Of the 24,000+ private sector engineering firms in the U.S. and the 16,000+ private-sector survey firms in the U.S., very few engineering or surveying firms responded to the 3D Nation questionnaire, indicating significant annual savings from the availability of accurate and authoritative elevation data in the public domain routinely used for engineering studies and engineering design services, surveying and mapping, negating their company's need for costly field surveys to obtain topographic and bathymetric data required for construction planning. NOAA and USGS had no way to contact 40,000 engineering and surveying companies to document their elevation data requirements and benefits, and it would have been impractical to do so. However, if many of those 40,000 firms had similarly responded, the annual benefits of public domain elevation data would have been billions of dollars higher for BU 22 as well as many other Business Uses.

BU 22 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 22:

- **Table E.22d** color-codes those organizations having an MCA with BU 22 as Primary, Secondary, or Tertiary.
- **Table E.22e** summarizes the 96 MCAs with primary benefits for BU 22, rank ordered from the highest to the lowest tangible benefits.

Table E.22d. Organizations having an MCA with BU 22 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	**CMTS**	DHS	**DISDI**	DTRA
	EPA	**FAA**	**FBI**	FCC	FEMA	**FERC**	**FHWA**	FRA	FSA	FWS
	IBWC	IJC	*MARAD*	NASA	NGA	**NOAA**	**NPS**	**NRC**	NRCS	NREL
	ORNL	*OSMRE*	PHMSA	SI	**TVA**	**USACE**	**USAF**	USARC	**USBR**	USCB
	USCG	USFS	**USGS**	**USMC**	**USN**					

State/Ter	*AL*	**AK**	**AR**	**AZ**	**CA**	*CO*	**CT**	DC	**DE**	**FL**	**GA**	**HI**	**IA**	*ID*
	IL	**IN**	**KS**	**KY**	**LA**	**MA**	**MD**	**ME**	**MI**	**MO**	**MN**	MS	**MT**	**NC**
	ND	NE	**NH**	**NJ**	**NM**	**NV**	**NY**	**OH**	*OK*	**OR**	**PA**	**RI**	**SC**	**SD**
	TN	**TX**	**UT**	**VA**	**VT**	**WA**	**WI**	**WV**	**WY**	PR	**VI**	**GU**	**AS**	**CNMI**

Non-Gov	**3GLP E-Terra**	AECOM	**Ayers Associates**	Cooke Aquaculture
	Fugro	**GIS Engineering**	**Great Lakes Dredge & Dock Company**	**HERE Technologies**
	MSA Professional Services	National Tribal Geographic Information Support Center	*Oregon State University*	*Pennsylvania State University*
	Quality Positioning Services	**TCarta Marine**	**TerraSond**	**Tetra Tech**
	Wilson & Company			

Table E.22e. MCA summaries for BU 22, rank ordered from the highest to the lowest tangible benefits.

Organization	USACE		Infrastructure Maintenance. Engineering services. BU 07 – Wildlife and Habitat Management is an additional Business Use.				
MCA Name	MCA No.						
Infrastructure and Construction Management	21648						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Annually	$142,660,531	$91,455,985	Minor	Moderate	Minor
Inland Bathy	QL0B	2-3 yrs.	$38,932,187	$2,432,927	Minor	Moderate	Moderate
Nearshore B.	QL2B	Annually	$2,384,782	$327,905	Minor	Minor	None

Organization	FERC		The Federal Energy Regulatory Commission, or FERC, is an independent agency that regulates the interstate transmission of electricity, natural gas, and oil. FERC also reviews proposals to build liquefied natural gas (LNG) terminals and interstate natural gas pipelines as well as licensing hydropower projects. FERC generally reviews data submitted by the applicant data, and makes little use of USGS/NOAA data; the applicant would be the primary user of topographic and/or inland bathymetry. Building lowest floor elevation information would also be used for flood reviews. Inland bathy is needed for H&H modeling and stage storage analysis for reservoirs. However, water elevation is more important than bathymetry. Bathymetry would be used for volumetric input into dam breach analysis (volume of water released). It could also be used for underwater pipeline reviews. Note that all needs are project specific.				
MCA Name	MCA No.						
Regulatory Review of Hydroelectric, Pipeline, and Natural Gas Projects	1292						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	Event driven	$142,607,338	$91,421,885	Moderate	Moderate	Moderate
Inland Bathy	X-Sec meet needs	Event driven	$38,921,023	$2,432,230	Minor	Minor	Major
Nearshore B.	X-Sec meet needs	Event driven	$2,374,075	$326,433	None	None	None
Offshore B.	X-Sec meet needs	Event driven	None	Minor	None	None	Minor

Organization	USGS		Enhancing Streamstats Program and providing data for flow regression equations nationwide				
MCA Name	MCA No.						
StreamStats	22155						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$142,660,531	$91,455,985	None	None	None
Inland Bathy	QL1B	6-10 yrs.	$38,932,187	$2,432,927	None	None	None

Organization	Texas		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60447						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$11,896,097	$35,007,816	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$4,007,986	$416,182	Minor	Moderate	Moderate

Organization	New Mexico		Civil Engineering and Spatial Data Development. Elevation data are needed for hydraulic and hydrologic modeling for engineering projects including drainage master planning, and transportation infrastructure design and modeling, and building site analysis. We contract for imagery and lidar collection, then post process the data, and acquire photogrammetry data as well.				
MCA Name	MCA No.						
Civil Engineering and Spatial Data Development	1400						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$5,464,225	$16,080,115	don't know	don't know	don't know

Organization	Arizona		The Arizona Department of Transportation (ADOT) is a multimodal transportation agency serving one of the fastest-growing areas of the country. A major component of the organization is the Motor Vehicle Division, which provides title, registration and driver-license services to the general public throughout the state of Arizona. ADOT is also responsible for planning, building and operating a complex highway system in addition to building and maintaining bridges and the Grand Canyon Airport. Elevation data are used for project planning; field surveys are done for pre-design and cut and fill. Cut and fill is the most expensive and requires highly accurate data before construction starts. Elevation data are also needed for asset inventory; condition assessments to validate feature locations including signs, overpass height above roads, lane width, median width, widening feasibility assessments especially in urban areas. The data are also needed for drainage planning for new and reconstruction projects such as culverts, stormwater management, etc, The department is responsible for one airport – the Grand Canyon airport – for which the department only manages the financials. Subsidence is an issue in parts of state (up to 2 meters in some areas). Elevation data are needed for assessments of ground instability and post–event storm planning, and management of landslides and post-wildfire mud flows, etc. The department drives the roads with GPS and terrestrial lidar.				
MCA Name	MCA No.						
Transportation Planning and Pre-design	1112						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	6-10 yrs.	$5,123,085	$15,076,208	Minor	Moderate	Major

Organization	Wyoming		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60546						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$4,395,671	$12,935,575	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$1,480,972	$153,781	Minor	Moderate	Moderate

Organization	Minnesota		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60619						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$3,791,890	$11,158,769	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$1,277,548	$132,658	Minor	Moderate	Moderate
Nearshore B.	QL1B	4-5 yrs.	$1,135	$156	Minor	Moderate	Major
Offshore B.	X-Sec meet needs	2-3 yrs.	Moderate	Moderate	Minor	Major	Moderate

Organization	Utah		Construction Design, dam rehabilitation, dam safety, pipelines. Additionally, our division would be very interested in seeing Lidar acquisitions that can aid in producing snow survey/snow volume/snow water equivalent information over a larger area verses the current methods.				
MCA Name	MCA No.						
Water Resources Construction Design	22103						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$3,756,472	$11,054,540	None	don't know	don't know
Inland Bathy	QL2B	6-10 yrs.	$1,265,615	$131,419	None	None	None

Organization	South Dakota		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60419						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$3,465,530	$10,198,358	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$1,167,592	$121,240	Minor	Moderate	Moderate

Organization	IBWC		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60694						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$7,236,148	$4,638,908	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$1,973,486	$123,326	Minor	Minor	Moderate
Nearshore B.	QL1B	4-5 yrs.	$25,598	$3,519	Minor	Moderate	Moderate

Organization	Washington		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60521						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$3,036,025	$8,934,410	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$1,022,885	$106,214	Minor	Moderate	Moderate
Nearshore B.	QL1B	4-5 yrs.	$32,010	$4,401	Minor	Moderate	Major
Offshore B.	X-Sec meet needs	2-3 yrs.	Moderate	Moderate	Minor	Major	Moderate

Organization	Michigan		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60239						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$2,610,341	$7,681,709	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$879,466	$91,322	Minor	Moderate	Moderate
Nearshore B.	QL1B	4-5 yrs.	$77,263	$10,623	Minor	Moderate	Major
Offshore B.	X-Sec meet needs	2-3 yrs.	Moderate	Moderate	Minor	Major	Moderate

Organization	Montana		Information Access. Elevation data are needed for the GIS library for Montana to meet state user needs. The library maintains and publishes standardized data layers for statewide use. We would also benefit from an enhanced 3D coverage of Montana to assign z-values to our road network. We currently do this using the statewide coverage of the 10-meter DEM. However, certain programs such as our annual Fuel Tax program (where funds are distributed to counties and cities based on road mileages) would greatly benefit from enhanced vertical data.				
MCA Name	MCA No.						
Creation, Dissemination, and Maintenance of Statewide Standardized Datasets	21651						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$2,152,690	$6,334,932	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$2,226,308	$231,176	don't know	don't know	don't know

Organization	Iowa		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60179						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$2,528,860	$7,441,925	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$852,013	$88,471	Minor	Moderate	Moderate

Organization	North Carolina		Transportation Infrastructure. Requirements for elevation data are project specific. Bathymetry is needed for H&H modeling and coastal modeling, to address navigation concerns for the ferry system in the Outer Banks, for water quality modeling, bridge scour, and submerged aquatic vegetation. SHOALS data used transects for previous Outer Banks studies. Topographic data are needed for project planning, environmental screening in advance of projects, and as input into 2D hydraulic models along with velocities in a mesh (not XS). The data are also used to improve transportation facilities. NC DOT self collects data if needed. MicroStation CADD is mainly used and for more efficient workflows, breaklines collected where there are changes to the surface (e.g. curb, road crest, etc.) instead of lidar points. 10' DEMs are used for planning, then photogrammetrically derived breaklines are used in conjunction with mobile lidar collection of pavement information for Right-of-Way acquisition and detailed plans. Typical scale in urban areas is 1"=20'. Orthoimagery collected on a 4-year cycle (twice yearly on the Outer Banks) is used for asset management, also Geiger Mode lidar. Culverts are collected from field surveys, although lidar is also used to predict culvert locations. The use of lidar for this application has yielded some improvement prior to field work. NC DOT reviews 20% of its 80,000-mile system annually. Culverts that are 54' and larger are most important to know locations, smaller ones are are nice to know. Lidar can facilitate locating the culverts, but field survey data are still needed. Adding DOT assets to the hydrography as connectors would be a great future use.						
MCA Name	MCA No.						
Transportation Infrastructure	21578						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$208,181	$612,634	don't know	don't know	don't know
Inland Topo	QL0HD	4-5 yrs.	$1,986,088	$5,844,657	don't know	don't know	don't know
Inland Bathy	X-Sec meet needs	Event driven	$747,468	$77,615	don't know	don't know	don't know
Nearshore B.	QL1B	4-5 yrs.	$89,694	$12,332	don't know	don't know	don't know

Organization	Pennsylvania		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60368						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$2,035,783	$5,990,900	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$685,888	$71,221	Minor	Moderate	Moderate

Organization	Montana		Infrastructure design, construction, maintenance, and mapping.				
MCA Name	MCA No.						
Infrastructure Design, Construction, Maintenance, and Mapping	22507						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Event driven	$2,153,434	$6,334,932	don't know	Moderate	Moderate

Organization	Montana		Bridge design and construction. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Transportation Planning.				
MCA Name	MCA No.						
Transportation Infrastructure Planning, Design, and Construction	21697						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	$2,152,690	$6,334,932	Moderate	Moderate	Moderate

Organization	Tennessee		Management and modification of the multimodal transportation systems in Tennessee. The Department of Transportation manages highways, railroads, transit, airports (commercial), and general aviation. Elevation data are needed for transportation planning and preliminary design, engineering work, and hydrologic analysis. For evaluation of obstructions in airport approach and takeoff, annual photogrammetry collections are required (by UAVs). Watersheds derived from elevation data are input into hydrologic models, and to analyze scour around structures that cross streams. The profile of the stream bed is also needed for the H&H analyses.				
MCA Name	MCA No.						
Management and Modification of the Multimodal Transportation Systems in Tennessee	21753						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$241,045	$709,347	don't know	don't know	Major
Inland Topo	QL2	6-10 yrs.	$1,652,823	$4,863,927	don't know	don't know	Major
Inland Bathy	X-Sec meet needs	6-10 yrs.	$638,074	$66,256	None	Major	don't know

Organization	Virginia		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60505						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$1,814,715	$5,340,342	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$611,406	$63,487	Minor	Moderate	Moderate
Nearshore B.	QL1B	4-5 yrs.	$40,847	$5,616	Minor	Moderate	Major

Organization	Kentucky		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60196						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$1,816,006	$5,344,141	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$611,841	$63,532	Minor	Moderate	Moderate

Organization	FAA		Airport construction. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change. The integration of Unmanned Aircraft Systems (UAS) into the National Air Space (NAS) poses several challenges to public safety. One of the most widespread is possible damage to property within the United States. Identifying where UAS are most likely to damage property and investing in appropriate counter measures could yield significant savings to both the FAA and the public. ArcGIS's BU 22 Infrastructure and Construction Management overlays help FAA professionals to identify areas where UAS are likely to cause significant damage to structures. Moreover, other ArcGIS overlays are likely to contribute to limiting the damage caused by UAS operations as well. However, BU 22 Infrastructure and Construction Management overlays is the most likely to have the greatest impact.					
MCA Name	MCA No.						
Infrastructure and Construction Management	60691						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$4,578,240	$2,935,120	Minor	Moderate	Major
Nearshore B.	QL1B	4-5 yrs.	$76,000	$10,640	Minor	Moderate	Moderate
Offshore B.	Special Order	2-3 yrs.	Moderate	Moderate	Minor	Moderate	Minor

Organization	Indiana		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60162						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$1,626,060	$4,785,167	Minor	Moderate	Major

Organization	South Carolina		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60404						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$1,391,043	$4,093,559	Minor	Moderate	Major
Inland Bathy	QL0B	6-10 yrs.	$468,664	$48,665	Minor	Moderate	Moderate
Nearshore B.	QL1B	6-10 yrs.	$25,309	$3,480	Minor	Moderate	Major

Organization	Florida		Planning, design, construction, and maintenance of transportation infrastructure, including roads, seaports, airports, spaceports, and railroads. Operation and monitoring of transportation systems. Statewide elevation data are needed for planning for new and maintenance projects (including 5-, 10-, and 20-year plans). Consistent data is important for planning, Field Survey data are used for construction. FDOT's work includes managing ports, airports, and dredging. River profiles under bridges are needed to analyze flow under bridges. SLOSH modeling is also used. BU 18 - Homeland Security, Law Enforcement, Disaster Response, and Emergency Management is an additional Business Use.				
MCA Name	MCA No.						
Planning, Design, Construction, and Maintenance of Transportation Infrastructure	22188						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$687,468	$1,866,844	None	Major	Major
Inland Topo	QL1	2-3 yrs.	$678,965	$1,843,753	None	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$424,820	$44,112	don't know	Moderate	Major
Nearshore B.	X-Sec meet needs	6-10 yrs.	$132,106	$18,164	None	Moderate	Major

Organization	Florida		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change. Stream channel analysis and mapping. Stream bank erosion analysis. Aquatic and terrestrial species habitat management. Environmental management.				
MCA Name	MCA No.						
Infrastructure Planning, Design, and Construction	33009						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,260,908	$3,710,597	don't know	don't know	don't know
Inland Bathy	QL1B	4-5 yrs.	$424,820	$44,112	don't know	don't know	don't know
Nearshore B.	QL1B	4-5 yrs.	$132,106	$18,164	don't know	don't know	don't know

Organization	Hawai'i		Energy development and delivery – electric, wind, water, hydroelectric, geothermal. Vegetation management. Slope analysis, zoning, all factor into infrastructure management. Ensure no adverse impacts to at-risk species.				
MCA Name	MCA No.						
Energy Development and Delivery	21730						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$1,000,000	$4,200,000	Major	Major	Major

Organization	Connecticut		Transportation engineering to include highway, railroad, and bridge planning; land acquisition; and design. Also includes H&H modeling for bridge and culvert design. (Ports and airports are no longer under CT DOT.)				
MCA Name	MCA No.						
Transportation Engineering	1419						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$2,686,832	don't know	Minor	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$75,279	$7,816	Minor	Major	Major
Nearshore B.	QL2B	2-3 yrs.	$5,253	$722	Minor	Major	Major

Organization	DISDI		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60649						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$1,370,130	$878,355	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$373,670	$23,351	Minor	Minor	Moderate

Organization	Maryland		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60221						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$444,339	$1,307,601	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$149,705	$15,545	Minor	Moderate	Moderate
Nearshore B.	QL1B	4-5 yrs.	$3,671	$504	Minor	Moderate	Major

Organization	California		To provide high accuracy elevation data for designing and building transportation systems. Provide lower accuracy elevation data for transportation project planning and hydraulic studies for bridge design.				
MCA Name	MCA No.						
Designing and Building of Transportation Systems	1371						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Event driven	$955,975	Moderate	don't know	don't know	Moderate
Inland Bathy	QL0B	Event driven	$930,900	Moderate	Minor	Minor	Moderate
Nearshore B.	QL0B	Event driven	Major	Major	None	Moderate	Moderate

Organization	Massachusetts		Dam break modeling and inundation mapping, Engineering review and construction of dams, levees, dikes, reservoirs, and coastal structures. Development of Emergency Action Plan and Inundation Maps for all significant and high hazard dams.				
MCA Name	MCA No.						
Dam Safety	1099						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	$427,738	$677,682	Minor	Major	Major
Inland Bathy	X-Sec meet needs	2-3 yrs.	$543,718	$36,180	None	Major	Major
Nearshore B.	QL1B	4-5 yrs.	$22,894	$3,148	Minor	Moderate	Major

Organization	Maine		Infrastructure Management - The Maine Port Authority is responsible for a marine terminal that receives oceangoing vessels to import and export freight.				
MCA Name	MCA No.						
Infrastructure Management	32707						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	2-3 yrs.	$350,102	$1,038,968	don't know	don't know	None
Inland Bathy	X-Sec meet needs	6-10 yrs.	$118,950	$12,351	don't know	don't know	don't know
Nearshore B.	X-Sec meet needs	4-5 yrs.	$17,776	$2,443	don't know	don't know	don't know
Offshore B.	X-Sec meet needs	2-3 yrs.	Moderate	Moderate	Minor	Major	Moderate

Organization	New Jersey		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60301						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$338,479	$996,075	Minor	Moderate	Major

Organization	Air Force		Site Analysis, facility, runway and road planning and construction. Stormwater modelling. Utility system planning and installation. Elevation data are needed for environmental analyses including stormwater modeling and spill response, site planning and analysis of obstructions, and construction management.				
MCA Name	MCA No.						
Air Force Installation Management and Airborne Collection	1065						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	3-5 yrs.	$1,000,000	$236,175	None	Moderate	Major

Organization	Louisiana		Levee Analysis, Construction, and Maintenance				
MCA Name	MCA No.						
Levee Analysis, Construction, and Maintenance	50013						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$1,150,720	Major	Minor	Moderate	Major

Organization	Guam		Electric utility: Activities support high system reliability, mobile workforce development, effective use of technology, and product affordability. Elevation data are needed to help identify wetlands, and to identify the depth to the water table. This is needed in order to understand where water would seep into the coral if the land was drilled into. Elevation data and water table depth are also needed for placing power poles, underground cable placement (electric cables cannot be placed below the water table), possible siting of renewable energy infrastructure in the future, and for vegetation management.				
MCA Name	MCA No.						
Delivering Electric Utility Services to Our Customers	21667						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$289,168	$850,965	don't know	don't know	don't know
Inland Bathy	QL1B	Event driven	don't know	Moderate	don't know	don't know	Minor
Nearshore B.	QL1B	4-5 yrs.	$9,097	$1,250	Minor	Moderate	Major

Organization	USBR		Deliver irrigation water to farmers, and drinking water to others, in the 17 western states. Produce hydroelectric power for the 17 western states. Water storage and delivery. Inventory, monitoring, operations and maintenance of water delivery features and infrastructure such as canals, dams, reservoirs, ditches and laterals. Elevation data are needed for specific projects within the USBR 17-state mission area. Bathymetric data are needed to monitor sedimentation within the larger reservoirs (e.g. Lake Mead, Lake Powell) as well as for river restoration for salmon habitat. Topographic data are needed for watershed analysis, drought monitoring, and to maintain canals and other infrastructure. Data are also needed for post fire management; fire increases sedimentation in streams, rivers, canals, and reservoirs, and affects their operation and maintenance. In the Lower Colorado River basin, lidar is being used to monitor vegetation growth and the tree canopy. Data are collected at project-based frequency, not on a regular review cycle. USBR starts with publicly available data or their own acquisitions. If better data are needed for a project, they will acquire lidar, photogrammetry, or send a field crew to collect it depending on project requirement. In addition to the listed Business Uses, the following also apply: BU 01 - Water Supply and Quality, BU 06 - Natural Resources Conservation, BU 07 - Wildlife and Habitat Management, and BU 08 - Agriculture and Precision Farming.				
MCA Name	MCA No.						
Management of Water Resources	21616						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$551,122	$60,300	Minor	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$61,783	$30,150	don't know	Major	Major

Organization	Great Lakes Dredge & Dock Company		Coastal Zone Management, Geologic Resource Mining and Extraction, Marine and Riverine Navigation and Safety, Infrastructure and Construction Management,				
MCA Name	MCA No.						
Ports and Harbor Dredging	22355						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	X-Sec meet needs	Annually	$288,087	$45,225	don't know	don't know	don't know
Nearshore B.	X-Sec meet needs	Twice annually	$288,087	$45,225	don't know	don't know	don't know

Organization	Nevada		Provide and maintain an updated, reliable water delivery system to a large urban area.				
MCA Name	MCA No.						
Provide and Maintain an Updated, Reliable Water Delivery System to a Large Urban Area	21653						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$658,004	Major	None	None	None

Organization	Montana		Infrastructure and Construction Management				
MCA Name	MCA No.						
Tribal Infrastructure Mapping	22069						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	6-10 yrs.	$149,834	$440,931	don't know	Major	don't know

Organization	Minnesota		Transportation planning and road/bridge infrastructure. Existing lidar have been used for planning but not design and construction. The agency spends $400K (300 linear miles of highway corridor) annually to collect QL0 HD lidar for pre-construction survey instead of photogrammetry. The agency uses all forms of collection (aerial, drone, mobile). Lidar data are also used for geotech assessment and asset management. Mobile lidar is used for asset management and centerline mapping. QL3 lidar is sufficient for archaeological modeling of Indian burial mounds and other cultural resources. Bathymetry is needed for management of ports.				
MCA Name	MCA No.						
Minnesota Multimodal Transportation Planning and Design	22173						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Event driven	$582,750	Major	don't know	don't know	don't know
Inland Bathy	Varies by project	Varies by project	don't know	don't know	don't know	don't know	don't know
Nearshore B.	Varies by project	Varies by project	don't know	don't know	don't know	don't know	don't know

Organization	Massachusetts		Surface elevation. Elevation data which requires high accuracy elevation on manhole size features and surrounding topography. This data is critical for determining risk to assets due to flooding and ongoing hydraulic modeling of the water network. Inland bathymetry would also be beneficial for reservoir monitoring for water quality.				
MCA Name	MCA No.						
Drinking Water Supply and Management	1120						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$131,818	$387,913	don't know	don't know	don't know
Inland Bathy	QL0B	4-5 yrs.	Major	Moderate	Minor	Moderate	Moderate
Nearshore B.	QL1B	4-5 yrs.	$1,435	$197	Minor	Moderate	Major

Organization	Washington		Road and Bridge infrastructure, maintenance, design and construction.				
MCA Name	MCA No.						
Road and Bridge Infrastructure, Maintenance, Design and Construction	1185						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	2-3 yrs.	$120,049	$34,070	Major	Minor	Major
Inland Bathy	X-Sec meet needs	2-3 yrs.	$176,712	$9,045	Major	Minor	don't know

Organization	Delaware		Sea Level Rise and Subsidence, Aviation Navigation and Safety, Infrastructure and Construction Management. BU 23 - Urban and Regional Planning is an additional Business Use.				
MCA Name	MCA No.						
Transportation Infrastructure Management	22234						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	$44,307	$130,386	Moderate	Major	Moderate
Inland Bathy	QL0B	2-3 yrs.	$14,927	$1,550	Moderate	Major	Minor
Nearshore B.	X-Sec meet needs	2-3 yrs.	$52,747	$7,252	Moderate	Major	Moderate
Offshore B.	X-Sec meet needs	2-3 yrs.	Moderate	Moderate	Minor	Major	Moderate

Organization	New York		Mapping and 3D modeling of Transportation System Infrastructure				
MCA Name	MCA No.						
Mapping and 3D Modeling of Transportation System Infrastructure	1138						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$122,194	$45,823	Minor	Moderate	Moderate
Inland Topo	QL2	4-5 yrs.	$37,806	$14,177	Minor	Moderate	Moderate
Inland Bathy	X-Sec meet needs	4-5 yrs.	Moderate	Minor	None	Minor	Minor
Nearshore B.	QL2B	4-5 yrs.	Moderate	Minor	None	Minor	Minor

Organization	Rhode Island		Transportation asset management. Statewide elevation data can be used for planning, project information purposes; detailed survey grade site specific or project specific data are needed for design and construction. Engineering and drainage design are done outside of GIS. Point clouds are needed for bridge surfaces and bridge deck elevations for evaluation of potential sea level rise effects on bridges. Accurate and updated 3D elevation data is also required by RIDOT's contractors to create derivative products such as transportation asset design models, geospatial datasets, reports, maps, or graphics. RIDOT relies upon the work performed by other state and federal agencies that use 3D elevation data to create models which predict changes in inland and coastal flooding elevations.				
MCA Name	MCA No.						
Transportation Asset Management	21678						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$48,665	$143,211	Minor	Major	Moderate
Inland Bathy	QL0B	4-5 yrs.	$16,396	$1,702	Minor	Moderate	Moderate
Nearshore B.	QL1B	4-5 yrs.	$3,783	$520	Minor	Moderate	Major

Organization	Vermont		Risk management for the transportation infrastructure, hydraulic modeling for structure design, assessment of aviation approach obstructions, terrain data for highway design, and stormwater assessments. VTrans has many areas that terrain data and bathymetry are used to meet mission critical activities. These include planning for aviation, rail, highways, and public transportation, as well as resiliency of infrastructure. Terrain models are used to assess runoff in culverts. Bankfull width is needed for sizing of infrastructure. Lidar data are used for planning, bridge/culvert design, modeling, resilience, hydraulic work, and layout of preliminary design; then field surveys can be more targeted. Obstructions can be modeled for aviation approaches. Intermediate data collection is also needed. Bathymetry would aid in the work that we do with structures and their planning, design, and risk management.				
MCA Name	MCA No.						
Management of Transportation Infrastructure	21535						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$200,000	Moderate	don't know	Moderate	Moderate
Inland Bathy	QL2B	4-5 yrs.	Moderate	Moderate	None	Minor	Minor

Organization	Delaware		Managing bridges in the transportation network. Elevation data are needed to supplement field survey data for H&H analysis, to identify scour, etc. for bridges and culverts. The data can be used for planning and preliminary design. Field survey data are still needed for final design and construction. Inland bathymetry would be used to derive the stream profile for hydraulic modeling.				
MCA Name	MCA No.						
Managing Bridges in the Transportation Network	1239						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Event driven	$44,290	$130,338	Major	don't know	Moderate
Inland Bathy	QL1B	Event driven	$14,922	$1,549	don't know	don't know	don't know

Organization	Alaska		Planning, design, construction, and maintenance of transportation facilities (roads, bridges, airports, marine highway ferries and terminals, and other public facilities)				
MCA Name	MCA No.						
Transportation Infrastructure Management	1369						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$43,658	$128,477	Major	Moderate	Moderate
Inland Bathy	I don't know	Event driven	$14,709	$1,527	Moderate	Minor	don't know
Nearshore B.	I don't know	Event driven	$1,014	$139	Moderate	Moderate	don't know

Organization	GIS Engineering		GIS Engineering provides engineering design and construction management services. Our main focus is on infrastructure projects, including water management, port facilities, and transportation.				
MCA Name	MCA No.						
Engineering Design and Construction Management Services	43181						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	4-5 yrs.	$101,296	$10,000	Minor	None	None
Inland Bathy	X-Sec meet needs	4-5 yrs.	Minor	Minor	None	None	None
Nearshore B.	X-Sec meet needs	2-3 yrs.	Minor	Minor	None	None	None

Organization	North Carolina		Roadway, bridge, and storm water infrastructure improvements.				
MCA Name	MCA No.						
Roadway, Bridge, and Storm Water Infrastructure Improvements	22158						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Annually	$24,293	$71,488	Major	Major	Major

Organization	MSA Professional Services		Municipal engineering and planning including: road infrastructure design, water/sewer utility design, stormwater modeling, pollution point and non-point source modeling, floodplain modeling, new development site analysis, agricultural design, airport design, park/recreational planning, architectural design, and municipal comprehensive planning. Additional Business Uses are BU 15 – Flood Risk Management and BU 27 – Recreation. Engineering design can be significantly improved with improved 3D elevation data and provide greater confidence that designs will perform as desired. Elevation data have improved significantly in recent years -- moving from USGS 10-ft contours to LiDAR derivatives; more accurate/frequent datasets would simply help improve projects for our clients. However, making the data more accessible is key. Our clients are often small municipalities who do not have funding to complete their own elevation surveys. Data that is free to publicly download in readily accessible formats greatly improves our project designs and therefore benefits our clients.				
MCA Name	MCA No.						
Engineering and Planning Consulting Services	1467						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$38,497	$18,090	Minor	Major	Major
Inland Bathy	X-Sec meet needs	4-5 yrs.	$8,056	$5,427	Minor	Moderate	Major
Nearshore B.	X-Sec meet needs	4-5 yrs.	$13,015	$3,015	Minor	Moderate	Major

Organization	Oregon		Engineering and facilities management. Site planning and infrastructure development, Engineering and facilities management. Site design and planning for infrastructure projects including utilities (power, water, wastewater), buildings, roads.				
MCA Name	MCA No.						
Engineering and Facilities Management	21664						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$61,708	None	None	None	None

Organization	Wisconsin		Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Building site analysis. Road infrastructure. Discovery and analysis of terrestrial archaeological and historical cultural sites. Site protection and preservation planning. Discovery and analysis of Native American and other historical cultural sites and subsistence activities. Line-of-sight analysis in recreational and cultural-sensitive areas. Parks planning. Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; Trail and vista site planning, Site protection and preservation planning. Conservation planning for wildlife refuges and marine sanctuaries. Conservation of critical habitats. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth-moving.				
MCA Name	MCA No.						
Conservation Engineering	1421						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$2,809	$5,427	None	Minor	Minor
Inland Bathy	X-Sec meet needs	4-5 yrs.	$17,206	$12,362	don't know	Moderate	Moderate
Nearshore B.	X-Sec meet needs	4-5 yrs.	$17,206	$2,412	don't know	Moderate	Moderate

Organization	Georgia		Transportation Concept Studies, Transportation Design Support, Large Site Civil Design Projects, Residential / Commercial Site Prep and Design Activities				
MCA Name	MCA No.						
Topo to Support State and Local Government	21495						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	$36,873	Major	don't know	don't know	Major

Organization	U.S. Virgin Islands		A continuous topobathy dataset would facilitate coastal planning and infrastructure work along the shoreline. Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60460						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$6,014	$17,699	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	$2,026	$210	Minor	Moderate	Moderate
Nearshore B.	QL1B	4-5 yrs.	$2,483	$341	Minor	Moderate	Major

Organization	Illinois		Dam inspections. Dam inspectors use elevation data to gather dam and vicinity parameters before going out on an inspection. Then they check elevation data to verify and check field observations. In the case where there may be a potential failure, elevation data are used to evaluate potential downstream impacts and possible erosion.				
MCA Name	MCA No.						
Dam Inspections	21665						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	$27,500	Major	None	None	Major

Organization	Missouri		Deliver Transportation Solutions of Great Value. Operate a Reliable and Convenient Transportation System. Use Resources Wisely. Advance Economic Development. Elevation data are broadly used for all scales of projects including small projects (individual intersections) to very large ones (Missouri River bridge design). Stationary lidar are used to catalog features to remove and/or rebuild features and identify historic structures impacted by projects. During project scoping, lidar data are used to look for wetlands, historic sites impacted, etc. Lidar and inland bathy are also needed for roadway and bridge design and construction. MDOT manages over 34,000 centerline miles of roads.				
MCA Name	MCA No.						
Transportation System Infrastructure Improvement	21699						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$25,000	Major	Moderate	Major	Major
Inland Bathy	X-Sec meet needs	4-5 yrs.	Major	Moderate	Minor	Minor	don't know

Organization	Northern Mariana Islands		Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Point - or non -point source pollution modeling. Management of contaminants and marine debris - point, non- point, vessel, and atmospheric pollution; spills; trash. EXAMPLE of possible contaminants are the fuel, chlorine, transformer storage and transportations.				
MCA Name	MCA No.						
Power, Water, and Waste Water Services	21757						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	I don't know	Event driven	$5,862	$17,252	Moderate	Major	Major
Nearshore B.	I don't know	Event driven	$84	$11	Moderate	Major	Major

Organization	Missouri		Our mission critical activity is Infrastructure and Construction Management. This is something we do on a daily basis for sanitary sewer, stormwater, and transportation (sidewalks and streets). Inland bathymetry is required for the Missouri River and is highly desirable elsewhere.				
MCA Name	MCA No.						
City of Jefferson Infrastructure Management and City Engineering	1346						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$20,000	Moderate	None	None	None
Inland Bathy	QL0B	4-5 yrs.	None	None	None	None	None

Organization	USBR		Dam break inundation modeling. Flood Risk Management. Heavy civil construction of dams. Elevation data are needed for H&H modeling for dam break inundation, Emergency Action Plans (EAPS) for dams, and identification of the number of structures downstream of high and significant hazard dams. Elevation data are also needed for the design and construction of dams.				
MCA Name	MCA No.						
Dam Break Inundation Modeling	22110						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$5,714	$2,412	None	None	Minor
Inland Bathy	QL3B	>10 yrs.	$3,412	Minor	None	None	Moderate

Organization	Wisconsin		Engineering and construction of dams; determining the size of a dam (bathymetric data is needed to determine the maximum storage capacity behind a dam in order to determine whether or not the dam is "large" or "small"); dam failure analyses.				
MCA Name	MCA No.						
Dam Safety	1254						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	>10 yrs.	$8,683	Major	Minor	None	Moderate
Inland Bathy	I don't know	>10 yrs.	$241	Moderate	None	None	Minor
Nearshore B.	I don't know	6-10 yrs.	Minor	Minor	None	None	None

Organization	Minnesota		Construction management for roads and bridges. Used heavily in Emergency Management and flood mitigation planning. We use elevation data for karst mapping and sand/gravel mining operation monitoring. Also for trail development for recreational use, flood modeling, extracting building footprints for 9-1-1, identifying sinkholes and burial mounds, and transportation pre-planning. Bathymetry are used for patrolling the St Croix River, identification of submerged sandbars, and locations where dams may be needed. Data are also used for solar capacity modeling for the installer community,				
MCA Name	MCA No.						
County Government Services	22222						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$7,538	Major	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	Major	don't know	don't know	don't know	Major
Nearshore B.	QL1B	6-10 yrs.	Major	don't know	don't know	don't know	Major

Organization	NOAA		The Geodesy Program at NGS is a mission critical area that focuses on positioning and measurement activities across the entire country. When another government agency or private entity seeks to do any of the below listed Business Uses, they almost always have a positional accuracy requirement. About 95% of all activities require to know when and WHERE something was located to compare to a different time and (possibly) place. Elements of the Geodesy program ensure that the National Spatial Reference System (NSRS) is maintained and can be accessed using standards that NGS provides to ensure that all users of the NSRS can accomplish all the below Business Uses. Geodesy underpins ALL activities listed below. It provides the datums for measuring coordinates and the accuracy of derived positions. NGS defines the datums from which observations are made. NGS relies on Digital Elevation Models (DEMs) and Digital Bathymetric Models (DBMs) to evaluate the mass effects, and ultimately provides the fiducial control for determining heights and coordinates. There is a need for particularly physical, geodesy to understand the terrain as a tool for describing mass variations. Likewise offshore, the difference in density between water and sediment/rock also contributes to the gravity signal and, hence, determination of physical heights. DEMs are less required by geometric positioning (i.e., from GPS). Nevertheless, the change in geometric coordinates of the surface describe the deformation models required to provide precise positioning. It should be noted that the more accurate the models provided, the more refined the geodetic control will be. However, there is a point of diminishing returns. The overall goal of the coordinates derived from geodetic control is at about the cm-level. However, the input values do not necessarily need to be of that caliber of precision. A meter to dm- level uncertainty in the terrain model may be sufficient to resolve the reference frame to the cm-level. I listed below primary BU for infrastructure (generally geometric geodesy), with determination of heights above a flood plain as secondary (physical geodesy) and ties to MSL as tertiary (since the vertical datum is nominally considered to be MSL.					
MCA Name	MCA No.						
The Geodesy Program at National Geodetic Survey (NGS)	1321						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Event driven	$6,030	Major	Moderate	Moderate	Moderate
Nearshore B.	QL3B	Event driven	Moderate	Moderate	None	None	don't know

Organization	New Hampshire		Transportation - including safe design, operation & planning of state roads and bridges that enhance the quality of life with projects and assets that foster a strong economy in balance with the environment. Includes damage assessment and coastal resilience, post storm data collection. Transportation planning as well as infrastructure. In house surveys used to acquire high accuracy data. DOT acquires its own data as needed per project using surveyed cross sections; statewide survey grade data is not needed. Bridge abutments are needed, and cannot be captured with lidar.				
MCA Name	MCA No.						
Transportation Planning, Design, and Construction	1168						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	6-10 yrs.	$3,618	Major	Moderate	Major	Major
Inland Bathy	QL1B	>10 yrs.	Major	Major	Minor	Major	Major

Organization	TVA		Energy (generation and transmission) - "As the nation's largest government-owned power provider, TVA delivers safe, reliable, clean, competitively priced electricity to local power companies and to large, energy-intensive industrial customers and federal facilities." This MCA includes hydroelectric dams and reservoirs, monitoring of sedimentation in reservoirs, also flow, hydroengineering permitting, modeling of downstream consequences, preparation of Emergency Action Plans (EAPs), H&H modeling for dam breach modeling, and providing data to FEMA. Seamless bathymetry and topography are needed.				
MCA Name	MCA No.						
Energy Generation and Transmission	1064						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	Major	Major	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	Major	Major	Moderate	Moderate	Major

Organization	Wisconsin		Review of the environmental impact and flood resiliency of municipal and Department of Transportation road stream crossings.				
MCA Name	MCA No.						
Environmental Impact and Flood Resiliency of Road Stream Crossings	1250						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	Major	Moderate	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	Arkansas		Hydrology and Hydraulic Study and Mapping, Transportation design, and Municipal consulting. Inland bathymetry for channels, ditches, fill ponds, foundations, and risers are needed for stormwater management and flood control. Field survey data are needed for final design work. QL2 lidar is good for planning only.				
MCA Name	MCA No.						
Engineering Consulting for Municipal Infrastructure	1361						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Moderate	Minor	Moderate	Minor

Organization	USMC		Infrastructure and Construction Management. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change. Entry and exit slopes of rivers are needed for site selection for amphibious vehicle crossings.				
MCA Name	MCA No.						
USMC Infrastructure and Construction Management	1454						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL2B	6-10 yrs.	Major	Major	Minor	Minor	Minor
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Minor	Minor	Minor

Organization	West Virginia		Terrain modeling and analysis for water, sewer and transportation infrastructure placement and routing.				
MCA Name	MCA No.						
Water, Sewer and Transportation Infrastructure Placement and Routing	11472						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	None	Moderate	Moderate
Inland Bathy	QL0B	Event driven	don't know	don't know	don't know	don't know	don't know

Organization	Illinois		Hydrologic and hydraulic analysis of rivers for flood damage reduction assessment. The OWR Engineering Studies uses elevation and bathymetric data to create flood models that evaluate structure, flood control and damage reduction designs. The Design and Construction Section uses elevation and bathymetric data in the design of structures and borrow areas.				
MCA Name	MCA No.						
Hydrologic and Hydraulic Analysis of Rivers for Flood Damage Reduction Assessment	21603						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	None	None	Moderate
Inland Topo	QL2	4-5 yrs.	Major	Major	None	None	Moderate
Inland Bathy	QL0B	4-5 yrs.	Major	Major	None	None	Moderate

Organization	TCarta Marine		Coastal hazard modeling, marine navigation, and engineering planning. Coastal zone management, Satellite Derived Bathymetry production.				
MCA Name	MCA No.						
Marine Geospatial Product Development	21842						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	Coarser bathymetric data satisfies my needs	Annually	Major	Major	None	None	None

Organization	Nevada		Provide engineering services for designing and supporting transportation network and infrastructure for the State of Nevada.				
MCA Name	MCA No.						
Engineering for Transportation and Other Infrastructure	22019						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Event driven	Major	Major	None	None	None

Organization	TerraSond		Construction Survey; wind farm siting; shipping route planning; survey planning; route planning for pipelines, cables, outfalls; Ocean Thermal Energy Conversion (OTEC) planning.				
MCA Name	MCA No.						
Design Survey	22075						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Event driven	Moderate	Moderate	Minor	Major	Major
Inland Bathy	QL0B	Event driven	Moderate	Moderate	Minor	Major	Major
Nearshore B.	QL0B	Event driven	Moderate	Moderate	Minor	Major	Major
Offshore B.	Order 1	>10 yrs.	Moderate	Moderate	Minor	Major	Major

Organization	Kansas		We support most of the items on this list other than those that involve the Coast or the Ocean. Lidar data can be used to calculate the grade on road surface to identify vertical curvature, which affects speed limits, signage requirements, regrading needs, and restrictions on roads. The standard for 3D data for transportation Right-of-Ways (ROWs) is more restrictive than that for flood modeling. Lidar can also be used to ensure clear zones in the ROW, identify trees or other obstructions in the ROW. For statewide planning initiatives, lidar can be used to identify widening obstacles such as needed ROW acquisition or structures that would prevent widening. Within the airspace, lidar can be used to identify airspace obstructions near airports and air ambulance sites. Planning activities can be done using lidar, but design and construction require survey grade elevation data. Inland bathymetry is typically self-collected as needed for projects. BU 29 – Military would be an additional Business Use.				
MCA Name	MCA No.						
Highway Safety Improvement Planning and Airspace Protection	22121						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	Major	Major	Moderate	Moderate	Moderate

Organization	Minnesota		Hydrologic modeling for environmental and engineering services. LiDAR acquisition services for clientele. Elevation data are needed for the following: Hydrologic modeling. Runoff and sedimentation analyses. Engineering design/construction: roads, bridges, utilities, etc. Stormwater modeling/design. Cut and fill analysis for cost estimation. Land Use mapping. Visualization studies. Cell tower microwave interference studies.				
MCA Name	MCA No.						
Engineering, Architecture, Survey, Environmental, and Geospatial Services Consulting	22150						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Moderate	Major	Moderate
Inland Bathy	QL1B	>10 yrs.	Major	Major	Minor	Major	Moderate

Organization	Georgia		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure				
MCA Name	MCA No.						
County GIS Services	22258						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	Major	Major	Minor	Moderate	Major

Organization	3GLP E-Terra		We use 3D data to produce map products for customers that use the data for a variety of purposes. Much data is cost shared around multiple uses between multi agencies and levels of government. We also collect high resolution lidar and imagery at airports (QL0) data to support FAA requirements of Airport Obstruction Surveys for the Alaska DOT.				
MCA Name	MCA No.						
Aviation Safety Program in Alaska	22455						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Moderate	Moderate	Moderate

Organization	American Samoa		Underground Locating/Toning. Precision locating and placement of existing and new utility infrastructure related to telecom.				
MCA Name	MCA No.						
Underground Location of Infrastructure	22526						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	don't know	don't know	don't know	don't know
Inland Bathy	QL2B	4-5 yrs.	Major	don't know	don't know	don't know	don't know

Organization	FHWA		Survey data for transportation facility design and construction. The Federal Lands Highway Program provides financial resources and transportation engineering assistance for public roads that service the transportation needs of federal and Indian lands. This includes the design and construction of highway and bridge projects and the original planning, design and construction of roads within our National Parks and National Forests. This response is based solely on one perspective within FHWA and may not accurately represent all concerns and issues within FHWA with respect to terrestrial and bathymetric elevation needs. Additionally, any identified needs attributed to FHWA do not necessarily support any funding requests to meet those needs.				
MCA Name	MCA No.						
Transportation Facility Design and Construction	33044						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Event driven	Major	Major	None	Minor	Major
Inland Bathy	QL0B	Annually	Moderate	Moderate	None	Minor	Minor

Organization	NRC		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change. Unable to provide most benefits due to irregularity of flood analyses. Program costs are very rough estimates. Use of the term "required" is not appropriate for NRC. Please assume for those questions, NRC means "preferred". Requirements are site-specific and risk-informed. Estimated annual budget does not include costs or cost savings of business uses for elevation data outside of those described above. That is to say that those costs do not include costs for facility construction or oversight such as new plants, plant decommissioning of fuel cycle facilities.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60670						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	Major	Moderate	Minor	Minor	Moderate
Nearshore B.	QL1B	4-5 yrs.	Moderate	Moderate	Minor	Moderate	Moderate

Organization	CMTS		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60699						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Minor	Moderate	Major
Inland Bathy	QL0B	4-5 yrs.	Major	Moderate	Minor	Minor	Moderate
Nearshore B.	QL1B	4-5 yrs.	Moderate	Moderate	Minor	Moderate	Moderate
Offshore B.	Special Order	2-3 yrs.	Moderate	Moderate	Minor	Moderate	Minor

Organization	NPS		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60706						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Minor	Moderate	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Moderate	Minor	Minor	Moderate
Nearshore B.	QL1B	4-5 yrs.	Moderate	Moderate	Minor	Moderate	Moderate

Organization	FBI		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Infrastructure and Construction Management	60715						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Major	Minor	Moderate	Major
Inland Bathy	QL0B	2-3 yrs.	Major	Moderate	Minor	Minor	Moderate
Nearshore B.	QL1B	2-3 yrs.	Moderate	Moderate	Minor	Moderate	Moderate
Offshore B.	Order 1	2-3 yrs.	Moderate	Moderate	Minor	Moderate	Minor

Organization	HERE Technologies		Building site analysis, road infrastructure, and power line planning. Some focus on Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures.				
MCA Name	MCA No.						
Building Site analysis, Road Infrastructure, and Power Line Planning	60726						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	Major	Major	Minor	Moderate	Major

Organization	Arkansas		Transportation planning-route selection and design. Elevation data are needed for H&H models for watersheds to ensure bridge height and deck are adequately sized. Inland bathymetry (channel depth, etc.) is needed for engineering construction. DOT may hire boat surveys to collect bathymetry as needed for projects. Inland bathymetry is only needed for perennial streams (highest two orders of stream classification in NHD). Inland bathymetry is needed for bridge construction				
MCA Name	MCA No.						
Route Selection and Design for Transportation Planning	1443						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Moderate	Moderate	Minor	Moderate	Moderate
Inland Bathy	QL2B	6-10 yrs.	Moderate	Minor	Minor	Moderate	Moderate

Organization	Minnesota		Runoff and sedimentation analyses. Point- or non-point source pollution modeling. Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Flood forecasts. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Road infrastructure. H&H studies				
MCA Name	MCA No.						
Civil Engineering and Water Resource Modeling	21731						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	Moderate	Minor	None	None	None
Inland Bathy	X-Sec meet needs	6-10 yrs.	don't know	Minor	None	None	None

Organization	Navy		Marine construction. Bridge design and construction. Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures. Shipyard and port construction. Water, sewer, or power line planning and vegetation analysis. Pump, drain, and well placement. Stormwater modeling. Cut and fill analysis for earth moving. Building site analysis. Road infrastructure. Airfields. Utilities in the coastal zone. Infrastructure hardening or mitigation for climate change effects, e.g. sea level change.				
MCA Name	MCA No.						
Navy Facilities Engineering	22004						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Moderate	Moderate	don't know	don't know	don't know
Inland Bathy	QL1B	Event driven	Moderate	Moderate	Moderate	Moderate	Moderate
Nearshore B.	QL1B	Event driven	Moderate	Moderate	Moderate	don't know	Minor
Offshore B.	Special Order	Event driven	Moderate	Moderate	Moderate	don't know	Minor
Offshore B.	Order 1a	Event driven	Moderate	Moderate	Moderate	don't know	Minor
Offshore B.	Order 2	Event driven	Moderate	Moderate	Moderate	don't know	Minor

Organization	West Virginia		Transportation Planning, Design, and Construction BU 22 Infrastructure and Construction Management				
MCA Name	MCA No.						
Transportation Planning, Design, and Construction	22338						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	Moderate	Moderate	None	Minor	Moderate
Inland Bathy	X-Sec meet needs	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Ohio		Maintain transportation systems (highways, state routes, etc.) so they provide the motoring public with safe and efficient routes.				
MCA Name	MCA No.						
Transportation Infrastructure Planning, Design, and Maintenance	1277						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Event driven	don't know	don't know	don't know	don't know	don't know
Inland Bathy	X-Sec meet needs	Event driven	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL1B	Event driven	don't know	don't know	don't know	don't know	don't know

Organization	Ayers Associates		Architectural & engineering services firm specializing in transportation, general civil, geospatial, environmental, and architecture. Hydraulic modeling requires elevation data for transportation, land development, and architecture applications. Requirements for elevation data vary by project. Recent inland bathymetry is required for transportation design and flood hazard modeling. Older NOAA nearshore data are OK for modeling but cannot be used for design.				
MCA Name	MCA No.						
Architectural and Engineering Services	1440						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	don't know	don't know	don't know	don't know	don't know
Inland Bathy	I don't know	Event driven	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	Event driven	don't know	don't know	don't know	don't know	don't know

Organization	Connecticut		Local Flood Protection and Infrastructure Mapping				
MCA Name	MCA No.						
Local Flood Protection and Infrastructure Mapping	22330						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Kansas		Geologic mapping and analysis. Sinkhole mapping, monitoring, and analysis. Identification of geomorphologic units. Landslide hazard mapping and assessment. Karst mapping, including springs and caves. Bridge design, construction and maintenance. Stormwater modeling. Road infrastructure design, construction and maintenance. Cut and fill analysis for earth-moving. The Kansas DOT is responsible for the state's highways, railroads, and airports. Lidar can be used for transportation planning and preliminary design. Actual construction requires survey grade elevation data. Elevation data are used for H&H modeling and identification of bridge scour. Lidar can also be used to analyze aviation airport approaches and clearances. Analysis of railroad grade crossings and their slope may require field surveys.				
MCA Name	MCA No.						
Transportation System Planning and Design	22399						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Tetra Tech		Water, sewer, or power line planning and vegetation analysis. Infrastructure assessment. Military planning. Point clouds or DEMs are used to get manhole inverts, also to assess powerline or tree clearance around critical facilities. Available data that meet needs are used although more recently, field collection with UAV or mobile lidar scanner is taking precedence. Field collection is required for Ground Penetrating Radar (GPR) so collecting ground markings for GPR at the same time as the imagery or lidar is more efficient. Having historic data available that reflects pre-project or pre-disaster conditions is helpful. Other groups within Tetra Tech use mobile lidar technology for BIM applications – mostly for indoor as-built modeling as well as lidar for floodplain mapping for FEMA.				
MCA Name	MCA No.						
Infrastructure Condition Assessment and Mapping	22485						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

BU 23 - Urban and Regional Planning

BU 23 Scope

Business Use #23 (BU 23) includes land development and zoning; municipal mapping of building footprints and elevations; port resilience planning; parks and transportation planning; virtual city creation; and urban ecology planning.

Figure E.23a. Hillsborough County Florida aerial lidar fused with terrestrial scanned data of the library and other buildings at the University of South Florida. Image courtesy of USF. Many planners develop 3D virtual models of the built environment for urban and regional planning and visualization of proposed construction projects

BU 23 Background Information

Whether called 3D virtual models, "digital twins" or other terms, high-fidelity replicas of the built and the natural environment, including trees, are instrumental in over a hundred elevation data uses listed below, all of which support urban and regional planners in one way or another.

BU 23 Elevation Data Uses

Using their own words, respondents documented 77 Mission Critical Activities (MCAs) that identified BU 23 as their primary Business Use and identified the following 98 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.23a. BU 23 Elevation Data Uses

Data Use
Data Development and Management
1. 3D building models
2. Adoption and use of high resolution and accurate data for decision makers and geospatial practitioners in the state
3. American Community Survey (ACS) and USCB's Population Estimates Program
4. Citywide geospatial data provisioning
5. Coordinate policy and assure quality through setting standards
6. County and regional geospatial data coordination
7. County GIS support to municipalities, residential, and business communities
8. Enterprise GIS support for county government and NGO activities
9. Government services including property valuation, emergency preparedness, land cover, drainage, greenspace, parcel alignment
10. Management of the state's spatial data infrastructure, a node of the National Spatial Data Infrastructure
11. Provision of data acquisition and development, data analysis, and planning services for the Councils of Government

Data Use
12. Regional GIS and data services
13. Set priorities and direction; set example of data stewardship and manage expectations
14. Statewide geospatial data coordination, distribution, and access
15. Virtual city creation
Emergency Management
16. Emergency planning and hazard assessment (coastal flooding and sea level, landslide risk, flooding, search and rescue)
17. Emergency shelter evaluation, evacuation routes.
18. Identify staging locations for crisis events (public safety)
Engineering Design and Construction
19. Stormwater best management practice (BMP) prioritization and design
Environmental Protection
20. Preserve land and protect water quality
Floodplain Management
21. Floodplain management and emergency management
22. Floodplain management, stormwater management, sea level rise, permitting in coastal communities
23. Perform watershed delineations for drainage districts and for administering FEMA floodplain programs
Habitat Analysis and Management
24. Benthic habitat mapping used to assess and quantify native and aquatic invasive species distribution
25. Elevation studies, flood risk management, building first floor elevations
26. Hazard mitigation planning
27. Hazard mitigation projects, environmental planning and protection, tracking impervious surfaces, road maintenance
28. Protect people, parks, resources, and facilities from the risks of flooding
29. Scenario modeling to prioritize coastal hazard mitigation and adaptation strategies
30. Slope analysis and rockfall mitigation
Infrastructure Management
31. Boat ramp and landings maintenance
32. Drinking water system management, wastewater collection and treatment, transportation network design, recreation facility management
33. Ecosystem management of electric utilities, drinking water, data sharing consortium and real estate/property management
Mapping/Boundary Delineation
34. 3D light capture (solar energy) and analysis of terrain, cliffs and boulders
35. Assessment of change over time
36. Assessment of community green infrastructure
37. Bathymetry in reservoirs for river dynamics
38. Building footprints for analysis of structure cost per area
39. Classify building features for real estate assessment and taxation purposes
40. Geolocation of satellite imagery

Data Use
41. Impervious surface classification, used to quantify and regulate development and parking
42. Land surveying work for other government agencies and answer surveying and land ownership questions
43. Land use/land cover mapping.
44. Map, monitor, and analyze tree canopy changes
45. Mapping for the golf industry; redesign of golf courses; prediction of drainage issues; identify ponding, wet areas, and areas where irrigation may not be properly spaced; increase irrigation efficiency; show creeks in heavily wooded areas; calculate seed, fertilizer and water requirements; identify above ground features such as trees and tall vegetation
46. Municipal mapping of building footprints and elevations
47. Municipal mapping of city/county transportation systems, impervious surface mapping, city infrastructure (water, sewer, storm water systems, flood analysis for emergency management)
48. Public Land Survey System (PLSS) corner monument resurveying and land ownership questions
49. Review of subdivision plats and certified survey maps
50. Urban tree inventory and maintenance
51. Vegetation classification used to plan and assess forest health treatments and model fuel loads and wildfire risk
52. Verifying the slope and clearance of pedestrian paths, sidewalks, and curb ramps
Modeling
53. Travel demand modeling for the region
54. Tree canopy assessment and stormwater modeling
55. Urban hydrology for surface water flow, capital planning, shoreline change detection, inland change detection
56. Water modeling, stormwater drainage sizing, and municipal planning applications
57. Watershed analysis for trash and runoff in streambeds and riparian buffers during heavy rains
Natural Resource Conservation
58. Analysis regarding the status, vulnerability, threat, and stability of rural resource lands
59. Ecological and cultural asset conservation
60. Future data preparation for carbon sequestration of trees in conservation areas
Navigational Safety
61. Nearshore nautical navigation
Planning
62. 3D analysis for city planning, building footprints
63. 9-1-1/public safety support, transportation planning, hazard mitigation
64. Analysis of intermodal transportation systems leading to projects
65. Analysis of urban land and roads, and nearshore data for causeways and bridges
66. Analyze regional relationships with land use, coastal programs, environmental programs and other infrastructure projects
67. Assessment, support, and recommendations for regional well-being and economic development
68. City and county government operations
69. City land management including development and zoning
70. County planning and development activities

Data Use
71. Development capacity analysis
72. Development planning, public health and safety, police and fire, infrastructure maintenance
73. Development review, damage assessment (tidal flooding), water and sewer service, water and sewer service extension planning, well head protection
74. Development review, floodplain management, property mapping, and parks planning and management
75. Economic development; foster capital investment and job growth
76. Evaluation of impacts of new development on the D.C. skyline, views of the White House and Capitol; building height restrictions
77. Improve recreational opportunities, shipping on navigable waters, and attract quality investors and new residents
78. Land conservation (easements and fee simple purchases), municipal/regional planning
79. Land development and zoning
80. Land use analysis, including residential growth and density analysis
81. Land use and transportation planning
82. Parks and transportation planning
83. Planning of coastal infrastructure and land use regulations
84. Port resilience planning
85. Preliminary design and pre-planning for jobs to be built
86. Prioritize fiscally constrained transportation infrastructure projects on the federal aid system
87. Public event viewsheds and resource siting
88. Regional and local community planning assistance
89. Regional planning for parking lots and trail heads for which viewshed analysis and line-of-sight are used
90. Site analysis for planning and zoning
91. Site selection services, incentives, research and technical assistance to help companies locate, stay, and expand existing operations
92. Statewide and local planning missions to provide appropriate development based on numerous environmental and land use variables (sea level rise, wetlands, zoning, coastal issues, etc.)
93. Transportation planning, sustainability planning, educational activities, and general data development and aggregation in support of regional planning programs and activities
94. Trust land management: archaeology, minerals, planning and development
95. Urban and regional planning for economic development activities
96. Urban ecology planning
97. Viewshed analysis
98. Visualizing the city to enable effective decision-making in urban planning, including urban design and risk mitigation, historic preservation, and guiding local zoning and land use decisions

BU 23 Tangible and Intangible Benefits

For the 77 MCAs that list Urban and Regional Planning as their primary Business Use:

- **Table E.23b** summarizes the reported future annual dollar benefits by geography type, totaling $818.8 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.23c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.23e.
- **Table E.23d** shows (in blue) the five federal agencies, 44 states and territories, and two non-governmental entities that submitted MCAs with BU 23 as the primary Business Use. MCAs for which BU 23 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.23d.
- **Table E.23e** documents all the MCAs that listed BU 23 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.23e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 23 Reported Future Annual Dollar Benefits

Of the 77 MCAs that listed Urban and Regional Planning as their primary Business Use, 43 MCAs estimated their tangible annual benefits totally in financial terms; six MCAs had a combination of tangible and "Major" intangible benefits; and 18 MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.23b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 77 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.23b. BU 23 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$628,543,283	$76,985,738	$705,529,021
Inland Bathymetry	$23,151,292	$22,178,620	$45,329,912
Nearshore Bathymetry	$13,948,078	$14,013,755	$27,961,833
Offshore Bathymetry	$32,250,612	$7,825,000	$40,075,612
Totals	**$697,893,265**	**$121,003,113**	**$818,896,378**

BU 23 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.23c. BU 23 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	62	57	13	39	44
Inland Bathymetry	33	31	5	4	28
Nearshore Bathymetry	21	20	1	1	2
Offshore Bathymetry	7	7	7	7	7
Totals	**123**	**115**	**26**	**51**	**81**

The types of benefits that are included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 23 Reported Future Annual Dollar Benefits Maps

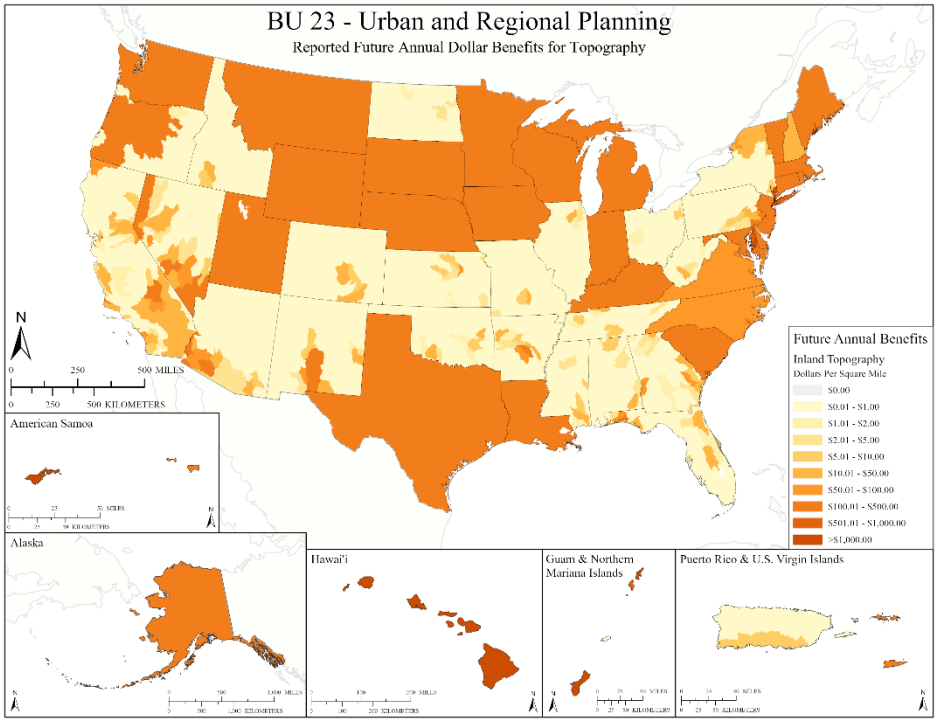

Figure E.23b. Reported Future Annual Dollar Benefits for Topography

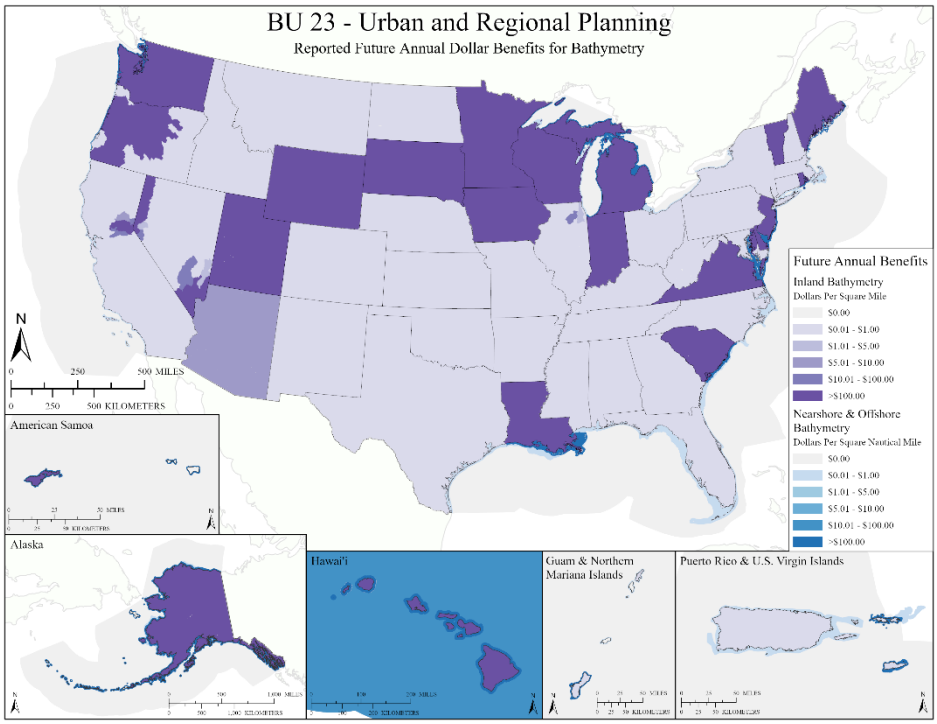

Figure E.23c. Reported Future Annual Dollar Benefits for Bathymetry

BU 23 Benefits Analysis

The total combined future annual benefits ($818.8 million per year) reported for BU 23 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 23 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal Agencies participating in the study, only five federal agencies (DISDI, FBI, SI, TVA, USCB) submitted a total of six MCA's listing BU 23 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. Of the six total federal MCAs listing BU 23 as primary:
    - Inland Topography: Two provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: One provided dollar benefits and two indicated "Major" benefits.
    - Nearshore Bathymetry: One provided dollar benefits and one indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and one indicated "Major" benefits.
- State/Local/Tribal and U.S. Territory MCAs: Forty-four (44) states and territories submitted a total of 68 MCAs that designated BU 23 as their primary BU. Of the 68 MCAs listing BU 23 as primary:
    - Inland Topography: 45 provided dollar benefits and 15 indicated "Major" benefits.
    - Inland Bathymetry: 26 provided dollar benefits and five indicated "Major" benefits.
    - Nearshore Bathymetry: 18 provided dollar benefits and three indicated "Major" benefits.
    - Offshore Bathymetry: Two provided dollar benefits and five indicated "Major" benefits.
    - Nine states or territories submitted MCAs listing BU 23 as secondary or tertiary, meaning no benefits accrued to BU 23; two states and one territory did not include an MCA with BU 23 as either primary, secondary, or tertiary.
- Non-governmental MCAs: Two non-governmental organizations (HERE Technologies and JMS Geomatics) submitted MCAs listing BU 23 as their primary BU. For Inland Topography, one provided dollar benefits and the other indicated "Major" benefits. No benefits were indicated for inland bathymetry, nearshore bathymetry, or offshore bathymetry.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.23b and E.23c:
    - 238 "Major" Operational and Customer Service benefits and 158 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 23 for which "Major" benefits are documented, this could easily be translated into hundreds of thousands of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 23 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 23:

- **Table E.23d** color-codes those organizations having an MCA with BU 23 as Primary, Secondary, or Tertiary.
- **Table E.23e** summarizes the 77 MCAs with primary benefits for BU 23, rank ordered from the highest to the lowest tangible benefits.

Table E.23d. Organizations having an MCA with BU 23 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	CMTS	*DHS*	**DISDI**	DTRA
	EPA	FAA	**FBI**	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	NOAA	NPS	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	**SI**	**TVA**	USACE	USAF	USARC	USBR	**USCB**
	USCG	USFS	USGS	USMC	USN					

State/Ter	AL	**AK**	**AR**	**AZ**	**CA**	**CO**	**CT**	**DC**	**DE**	*FL*	**GA**	**HI**	**IA**	*ID*
	IL	**IN**	**KS**	**KY**	**LA**	**MA**	**MD**	**ME**	**MI**	*MO*	**MN**	*MS*	**MT**	**NC**
	ND	**NE**	**NH**	**NJ**	NM	**NV**	**NY**	*OH*	*OK*	**OR**	**PA**	**RI**	**SC**	**SD**
	TN	**TX**	**UT**	**VA**	**VT**	**WA**	**WI**	**WV**	**WY**	PR	**VI**	**GU**	**AS**	CNMI

Non-Gov	Esri	*Fugro*	**HERE Technologies**	**JMS Geomatics**
	MSA Professional Services	Sapphos Environmental, Inc.		

Table E.23e. MCA summaries for BU 23, rank ordered from the highest to the lowest tangible benefits.

Organization	Alaska		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60019						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$157,169,570	$18,145,298	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$6,401,242	$8,098,125	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$7,382,568	$7,788,320	Moderate	Moderate	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Major	Major	Major

Organization	New York		Municipal mapping of building footprints, virtual city creation. Elevation data are needed for urban hydrology for surface water flow, capital planning, shoreline change detection, inland change detection, Identify staging locations for crisis events (public safety), elevation studies, flood risk management, building first floor elevations, public event viewsheds and resource siting, 3D building models. Elevation data support many city government agencies. Elevation data are a vital part of the city's geospatial data coordination activities.				
MCA Name	MCA No.						
Operational Data Support for City of New York Agencies	1140						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	$101,081,405	Major	Moderate	Moderate	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Moderate	Moderate	Moderate
Nearshore B.	QL1B	4-5 yrs.	Major	Major	Moderate	Moderate	Moderate

Organization	Texas		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60448						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$71,223,748	$8,222,814	Moderate	Major	Major

Organization	Hawai'i		Adoption and use of high resolution and accurate data for decision makers and Geospatial practitioners in Hawaii.				
MCA Name	MCA No.						
Statewide Geospatial Data Coordination	21626						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$2,991,658	$12,675,000	Moderate	Major	Major
Inland Bathy	QL0B	2-3 yrs.	$2,044,120	$775,000	Minor	Major	Major
Nearshore B.	QL0B	2-3 yrs.	$2,536,180	$1,975,106	Major	Major	Major
Offshore B.	Order 1	4-5 yrs.	$32,250,612	$7,825,000	Major	Major	Major

Organization	Wyoming		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60547						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$26,317,556	$3,038,373	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$1,071,868	$1,356,005	Moderate	Moderate	Major

Organization	Minnesota		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60620						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$22,702,626	$2,621,028	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$924,638	$1,169,747	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$9,947	$10,494	Moderate	Moderate	Moderate

Organization	Utah		Providing communities with the appropriate GIS data, maps, and/or information to aid municipal management and informed decision making.				
MCA Name	MCA No.						
Statewide Geospatial Data Provisioning	32859						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$22,490,572	$2,596,546	Moderate	Minor	Minor
Inland Bathy	QL1B	6-10 yrs.	$916,001	$1,158,821	Moderate	Moderate	Major

Organization	South Dakota		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60420						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$20,748,661	$2,395,442	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$845,056	$1,069,069	Moderate	Moderate	Major

Organization	Nebraska		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60278						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$20,812,527	$2,402,815	Moderate	Major	Major

Organization	Washington		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60522						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$18,177,146	$2,098,559	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$740,323	$936,573	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$280,360	$295,769	Moderate	Moderate	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Montana		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60265						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$19,781,262	$2,283,755	Moderate	Major	Major

Organization	Michigan		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60240						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$15,628,514	$1,804,319	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$636,522	$805,255	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$676,705	$713,897	Moderate	Moderate	Moderate

Organization	Iowa		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60180						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$15,140,671	$1,747,997	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$616,653	$780,119	Moderate	Moderate	Major

Organization	Wisconsin		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning. Public Land Survey System (PLSS) corner monument re-establishment and protection. Reviews of subdivision plats and Certified Survey Maps. Land surveying work for other government agencies and answer surveying and land ownership questions. BU 30, Maritime and Land Boundary Management is an additional Business Use.				
MCA Name	MCA No.						
County Planning and Development Activities	1083						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$15,084,557	$1,741,519	Major	Major	Major
Inland Bathy	QL3B	6-10 yrs.	$614,367	$777,228	Major	Minor	Major

Organization	Oregon		Oregon's Councils of Governments provide data acquisition and development, data analysis, and planning services for a diverse set of agencies. The mission critical activities fall primarily into BU 23 (Urban and Regional Planning) and 25 (Real Estate) and related cases. Individual agencies provide data back as well. Elevation data are needed for ecosystem management for electric utilities, drinking water, data sharing consortium, and real estate/property management. Bathymetry in reservoirs is used for river dynamics.				
MCA Name	MCA No.						
Regional GIS and Data Services	21615						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2 yrs.	$226,707	$26,173	Minor	Moderate	don't know
Inland Topo	QL2	2-4 yrs.	$14,077,486	$1,625,252	Minor	Moderate	don't know
Inland Bathy	QL1B	2-3 yrs.	$582,585	$737,020	Minor	Moderate	Moderate
Nearshore B.	QL1B	2-3 yrs.	$25,870	$27,292	don't know	don't know	don't know

Organization	Louisiana		Urban and regional planning for economic development activities. Site selection for economic development projects.				
MCA Name	MCA No.						
Urban and Regional Planning for Economic Development Activities	21536						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$12,399,307	$1,431,505	Minor	Minor	Major
Inland Bathy	QL1B	>10 yrs.	$505,002	$638,871	Minor	Moderate	Major
Nearshore B.	QL2B	6-10 yrs.	$1,112,130	$1,173,253	Moderate	Moderate	Major

Organization	Kentucky		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60197						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$10,872,708	$1,255,259	Moderate	Major	Major

Organization	Indiana		IGIC's mission is to lead the effective application of geographic information across Indiana and our vision to provide a modern, accurate, documented, and accessible geospatial information infrastructure for Indiana. IGIC's cornerstone initiative to accomplish this is IndianaMap. IndianaMap is a single statewide map for Indiana. It includes the information people need most in a format that is accessible to both expert GIS users and the general public. (www.indianamap.org). This IGIC survey response represents input from our statewide IndianaMap private business power-users of our existing statewide Lidar & DEM data.				
MCA Name	MCA No.						
Indiana Statewide Data Coordination, Distribution, and Access	1288						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$9,735,469	$1,123,964	don't know	don't know	don't know
Inland Bathy	QL1B	6-10 yrs.	$396,508	$501,617	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$7,071	$7,459	Moderate	Moderate	Moderate

Organization	Maine		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60212						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$8,719,930	$1,006,719	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$355,147	$449,292	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$161,656	$170,541	Moderate	Moderate	Moderate

Organization	South Carolina		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60405						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$8,328,386	$961,516	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$339,200	$429,118	Moderate	Moderate	Major
Nearshore B.	QL1B	6-10 yrs.	$221,668	$233,851	Moderate	Moderate	Moderate
Offshore B.	X-Sec meet needs	6-10 yrs.	Major	Major	Major	Major	Major

Organization	Hawai'i		Urban tree inventory and maintenance. Map, monitor, and analyze canopy changes. Watershed analysis for trash and runoff in streambeds and riparian buffers during heavy rains. Future data preparation for carbon sequestration of trees in conservation areas.				
MCA Name	MCA No.						
Urban Forest Inventory and Maintenance	1363						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$3,033,151	$1,310,545	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$4,837,584	$1,204,000	Major	don't know	don't know

Organization	DISDI		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60650						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$9,292,037	$660,166	Moderate	Major	Major

Organization	Nevada		Stormwater best management practice (BMP) prioritization and design. Impervious surface classification used to quantify and regulate development and parking. Vegetation classification used to plan and assess forest health treatments and model fuel loads and wildfire risk. Benthic habitat mapping used to assess and quantify native and aquatic invasive species distribution. Nearshore nautical navigation.				
MCA Name	MCA No.						
Ecosystem Approach for Lake Tahoe and Las Vegas Environmental Restoration Goals	1354						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-8 yrs.	$4,403,162	$518,319	Major	Major	Major
Inland Bathy	QL0B	4-8 yrs.	$149,495	$33,165	Major	Major	Major

Organization	Virginia		Virginia Base Mapping Data Stewardship. Support discoverability and access to GIS data resources for Virginia stakeholders (state and local government, education and community) to publically available statewide Lidar and Bathymetry data available covering the Commonwealth. Virginia stakeholders use the data for many mission critical activities including, Sea level rise analysis, road and rail, military operations, building footprints, elevation/contours, mapping of riverine and coastal areas, emergency management, infrastructure, flood risk and modeling, runoff and sediment analysis, erosion, coastal inundation, forest health analysis, conservation of marine and wildlife habitat, geologic mapping, mining, pipeline routing, cultural preservation, education, recreation planning, and telecommunications. This is not a comprehensive list but does cover many of the important mission critical activities Virginia stakeholders utilize Virginia Lidar and Bathymetry Data to accomplish through the service available on the Virginia GIS Data Clearinghouse.					
MCA Name	MCA No.						
Virginia Base Mapping Data Stewardship	1386						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$932,489	$627,183	Major	Moderate	Moderate
Inland Bathy	QL2B	4-5 yrs.	$442,511	$559,815	Moderate	Moderate	Moderate
Nearshore B.	QL2B	4-5 yrs.	$357,753	$377,416	don't know	don't know	don't know
Offshore B.	X-Sec meet needs	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Vermont		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60489						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$2,586,790	$298,646	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$105,355	$133,283	Moderate	Moderate	Major

Organization	Maryland		Land use analysis (includes residential growth and density analyses; land use/land cover mapping; analyses regarding the status, vulnerability, threat and stability of rural resource lands; and development capacity analyses)				
MCA Name	MCA No.						
Land Use Planning and Analysis	1263						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$2,660,327	$307,136	don't know	don't know	don't know
Inland Bathy	QL2B	4-5 yrs.	Moderate	Moderate	don't know	don't know	don't know
Nearshore B.	QL2B	4-5 yrs.	Moderate	Moderate	don't know	don't know	don't know

Organization	New Jersey		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60302						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$2,026,525	$233,963	Moderate	Major	Major
Inland Bathy	QL2B	6-10 yrs.	$82,536	$104,416	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$184,365	$194,498	Moderate	Moderate	Moderate

Organization	Maryland		The GIS staff in Talbot County Maryland actively supports all county departments including Emergency Services, Planning and Zoning, Permits and Inspections, Public Works, Parks and Recreation. We also provide GIS support to the municipalities, residential and business communities. Our primary engagement with issues regarding the need for high resolution elevation data include floodplain management, stormwater management, sea level rise, permitting in coastal communities, hazardous mitigation project, environmental planning and protection, tracking impervious surfaces, road maintenance, development review, damage assessment (tidal flooding), water and sewer service, water and sewer service extension planning, well head protection, emergency shelter evaluation, evacuation routes, boat ramp and landings maintenance, etc.				
MCA Name	MCA No.						
Talbot County Government	1113						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$396,215	$711,808	Moderate	Moderate	Moderate
Inland Bathy	QL2B	6-10 yrs.	$392,982	$414,125	Moderate	Moderate	Moderate
Nearshore B.	QL2B	>10 yrs.	$392,982	$414,125	Moderate	Moderate	Moderate

Organization	North Carolina		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning. Building footprints are a major business need.				
MCA Name	MCA No.						
Urban and Regional Planning	60332						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,000,000	$1,533,512	Moderate	Major	Major
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Moderate	Moderate	Major
Nearshore B.	QL0B	4-5 yrs.	Major	Major	Moderate	Moderate	Moderate
Offshore B.	I don't know	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Massachusetts		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60231						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$2,182,027	$251,916	Moderate	Major	Major

Organization	Guam		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60107						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,731,298	$199,879	Moderate	Major	Major
Nearshore B.	QL2B	4-5 yrs.	$79,677	$84,056	Moderate	Moderate	Moderate

Organization	Delaware		Statewide and local planning missions to provide appropriate development based on a lot of environmental and land use variables (sea level rise, wetlands, zoning, coastal issues etc.)				
MCA Name	MCA No.						
Statewide and Local Planning	22063						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$530,447	$61,240	don't know	don't know	don't know
Inland Bathy	QL1B	6-10 yrs.	$21,604	$27,331	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$461,980	$487,371	don't know	don't know	don't know

Organization	Virginia		To assist communities in developing strategies for protecting and conserving their ecological and cultural assets through environmentally-sensitive decisions, lifestyles and planning. Urban tree canopy assessment and stormwater modeling. Assessment of community green infrastructure. Also includes state forestry requirements for which leaf-on data is needed.				
MCA Name	MCA No.						
Ecological and Cultural Asset Conservation	22040						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$933,531	$627,183	Moderate	Major	Moderate

Organization	Connecticut		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60073						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,337,744	$154,443	Moderate	Major	Major

Organization	New Hampshire		Land development and zoning. Parks and transportation planning.				
MCA Name	MCA No.						
Land Use and Transportation Planning	21534						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$281,286	$220,000	Major	Major	Major
Nearshore B.	X-Sec meet needs	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Pennsylvania		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Regional Planning for Citizens of Pennsylvania	21719						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Unlike our aerial imagery, we have no set update cycle for LiDAR-derived data	$501,206	Major	don't know	don't know	don't know

Organization	Rhode Island		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning. Elevation data are needed for development of land use, land cover, and impervious surfaces.				
MCA Name	MCA No.						
Urban and Regional Planning	60389						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$291,364	$33,638	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$11,866	$15,012	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$33,138	$34,959	Moderate	Moderate	Moderate
Offshore B.	X-Sec meet needs	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Arkansas		Typical city and county government operations: development planning, public health, public safety, police & fire, infrastructure maintenance, drinking water system management, wastewater collection and treatment, transportation network design, recreation facility management, etc.				
MCA Name	MCA No.						
County and Regional Geospatial Data Coordination	1402						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$298,340	Major	None	Moderate	Moderate
Inland Bathy	QL1B	>10 yrs.	Minor	Minor	Minor	Minor	Minor

Organization	New Jersey		Land use and transportation system planning Highly detailed elevation data would be very helpful (more mobile than aerial lidar).				
MCA Name	MCA No.						
Land Use and Transportation System Planning	1393						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$12,538	$5,427	Minor	Minor	Moderate
Inland Bathy	X-Sec meet needs	>10 yrs.	$109,045	$1,508	Minor	Minor	Moderate

Organization	SI		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60677						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$96,750	$6,874	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$3,943	$2,993	Moderate	Moderate	Major
Nearshore B.	QL1B	4-5 yrs.	$2,089	$2,203	Moderate	Moderate	Moderate

Organization	Hawai'i		It's honestly a mix of several below given the wide range of tasks our data services assist, but BU 23 encompasses the most important. Also utilities, emergency management, real property, and watershed conservation.				
MCA Name	MCA No.						
Enterprise GIS Support for County Government and NGO Activities	22291						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$100,000	Major	Minor	Moderate	Moderate

Organization	U.S. Virgin Islands		Building footprints are needed for structure cost per area analysis. Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Land Use Planning and Development	1395						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$36,008	$4,157	don't know	don't know	don't know
Nearshore B.	QL1B	2-3 yrs.	$21,752	$22,947	None	None	None

Organization	Illinois		Land Management Including; development and zoning, municipal mapping of building footprints, elevations, floodplain management, and emergency management.				
MCA Name	MCA No.						
City Land Management	21593						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$49,467	$1,960	Moderate	Moderate	Moderate
Inland Bathy	I don't know	6-10 yrs.	$1,055	Major	Moderate	Moderate	Major

Organization	Arizona		Trust Land Management. Trust lands are state owned (covering 14% of the state), monies go to K-12 schools. Elevation data are needed for archaeology, minerals, planning, and development. Also sovereign lands are managed (not owned) but include areas that were underwater when the state was formed. For these areas, change must be assessed over time.				
MCA Name	MCA No.						
Trust Lands Management	1196						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$26,281	$4,522	None	None	None
Inland Bathy	X-Sec meet needs	4-5 yrs.	$3,206	don't know	None	None	None

Organization	American Samoa		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60032						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$21,603	$2,494	Moderate	Major	Major
Inland Bathy	QL1B	6-10 yrs.	$879	$1,113	Moderate	Moderate	Major
Nearshore B.	QL2B	4-5 yrs.	$187	$198	Moderate	Moderate	Moderate

Organization	West Virginia		There is a high need for building footprint and height data for our city to produce 3D analysis for light capture (solar energy) and to better analyze the terrain, cliffs, and boulders of Needleseye Park, which requires high-quality LiDAR data.				
MCA Name	MCA No.						
3D Analysis for City Planning	1293						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$25,854	Major	Major	Major	don't know
Inland Bathy	X-Sec meet needs	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Arizona		Assessment, support, and recommendations for regional well-being and economic development to member jurisdictions. Encompasses transportation planning, sustainability planning, educational activities, and general data development and aggregation in support of regional planning programs and activities.				
MCA Name	MCA No.						
Regional Planning	32963						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$24,472	$1,206	Moderate	Major	Major

Organization	Arkansas		We serve as Arkansas' spatial data infrastructure, the Arkansas node of the national spatial data infrastructure.				
MCA Name	MCA No.						
Statewide Geospatial Data Coordination	21724						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	>10 yrs.	$8,640	$5,668	None	None	None

Organization	JMS Geomatics		Mapping, CAD and GIS for the golf industry. Elevation data are used for redesign of golf courses and prediction of drainage issues. Lidar from 2012 and newer with the higher point density works well for this. The data can help identify ponding, wet areas, and areas where irrigation may not be properly spaced. The data can help increase irrigation efficiency. Lidar can be used independent from imagery to show creeks, etc. in heavily wooded areas. Historic data are also useful. Imagery is also needed to evaluate change, calculate fertilizer requirements, etc. Environmental improvements are realized if application (e.g. seed, fertilizer, and water) is precisely calculated. Lidar also provides value in the ability to identify above ground features such as trees and tall vegetation.				
MCA Name	MCA No.						
Mapping for the Golf Industry	21931						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Event driven	$13,266	Major	None	Moderate	None

Organization	Arkansas		NWARPC is focusing on transportation and land use planning. Transportation planning is done to characterize movement, not for engineering design. AR DOT builds the roads, NWARPC models the movement along the highways. NWARPC also advises smaller jurisdictions re: land use planning in flood prone areas.				
MCA Name	MCA No.						
Transportation and Land Use Planning	1081						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Major	Major	Major
Inland Bathy	I don't know	6-10 yrs.	Major	Major	Major	Major	Major

Organization	New Jersey		Preserve land and protect water quality				
MCA Name	MCA No.						
Preserve Land and Protect Water Quality	1154						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Moderate	Minor	Major	None

Organization	Hawai'i		Slope analysis and rockfall mitigation. Used in preplanning for construction, which requires high accuracy. Urban areas and conservation areas may be right next to each other without buffer areas so lidar will help in planning.				
MCA Name	MCA No.						
Slope Analysis and Rockfall Mitigation	1307						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	Major	Major	Major	Major	Major

Organization	Colorado		Urban and regional planning. Elevation data are needed for project planning. Projects may include parking lots and trail heads, for which viewshed analysis and line of sight are used. One-foot contours are often used. Elevation data are also needed for water modeling, stormwater drainage sizing, and municipal planning applications.				
MCA Name	MCA No.						
Urban and Regional Planning	1376						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Moderate	don't know	don't know	Moderate
Inland Bathy	X-Sec meet needs	6-10 yrs.	Moderate	Moderate	don't know	don't know	don't know

Organization	Maryland		The Washington County GIS Office is the enterprise GIS hub for Washington County government. It supports all the other departments that have their own GIS staff and those smaller ones without any GIS staff. It establishes the Mission – Vision – Goals – and Objectives for the GIS on the county level. It also sets priorities and direction, sets an example of data stewardship and manages expectations. It coordinates policy, and assures quality through setting standards.				
MCA Name	MCA No.						
Mapping and GIS Support of Elevation Dependent County Government Activities	11480						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	Major	Major	Major	Major	Major
Inland Bathy	X-Sec meet needs	Event driven	Major	Major	Major	Major	Major

Organization	Pennsylvania		Transportation planning				
MCA Name	MCA No.						
Transportation Planning	21586						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	Major	Major	Minor	Minor	Moderate

Organization	Kansas		9-1-1 / Public Safety Support, Transportation Planning, Hazard Mitigation.				
MCA Name	MCA No.						
Urban and Regional Planning	21622						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Moderate	Minor	Moderate
Inland Bathy	QL2B	4-5 yrs.	Major	Major	don't know	don't know	Moderate

Organization	TVA		Economic Development - TVA Economic Development serves the seven states that make up the TVA service area—almost all of Tennessee and parts of Mississippi, Alabama, Georgia, North Carolina, Virginia and Kentucky. Through our partnerships with other economic development organizations, we help foster capital investment and job growth in the area. TVA Economic Development works to attract new companies—which results in more jobs and investments in the Valley—and to engage existing businesses and industries to help them grow in a sustainable way. Working in concert with our partners—regional, state and community organizations—we offer site selection services, incentives, research and technical assistance to help companies locate, stay and expand existing operations in the Tennessee Valley. Elevation data are needed to improve recreation opportunities, shipping on navigable waters, and to help attract quality investors and new residents.					
MCA Name	MCA No.						
Economic Development	21683						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Moderate	Moderate	Major

Organization	South Dakota		Municipal mapping of city/county transportation systems, impervious surface mapping, city infrastructure planning (all water, sewer and storm water systems), flood analysis for emergency management.				
MCA Name	MCA No.						
Municipal Planning and Mapping	21704						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Major	don't know	Major

Organization	Michigan		Geographic Information Services, Geospatial Services. Provide county GIS services to municipal entities. Elevation data are needed to perform watershed delineations for drainage districts and for administering FEMA floodplain programs.				
MCA Name	MCA No.						
Geospatial Services	21709						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Major	don't know	don't know	don't know	don't know

Organization	Utah		Regional and local community planning assistance (in addition to many other non-planning related activities). Hazard mitigation planning. Site analysis for planning and zoning.				
MCA Name	MCA No.						
Regional and Local Community Planning Assistance	21866						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Louisiana		Analysis of intermodal transportation systems in the region and their relationships with land use, coastal programs, environmental programs, and other infrastructure projects. Prioritization of fiscally constrained transportation infrastructure projects on the federal aid system and travel demand modeling for the region - transportation, economic, and land use planning. RPC has no zoning or land use regulatory authority. Elevation data are given to consultants for preliminary design and pre-planning for jobs to be built. LA NORPC works with the USACE New Orleans District. Also lets imagery contracts and needs lidar for orthorectification. Urban land and roads are the areas of greatest need, also need nearshore data for causeways and bridges. Ports come to LA NORPC for data such as imagery, parcels, leasing sites, some lidar, but mainly the ports do their own thing. LA NORPC distributes data to anyone that needs it. There are similar metro planning organizations in Baton Rouge, Lafayette, Lake Charles, Alexandria, and other metropolitan areas. Their requirements and benefits would be similar, but only the state planning council could say for sure that NORPC's requirements and benefits would apply elsewhere.						
MCA Name	MCA No.						
Analysis of Intermodal Transportation Systems Leading to Projects	21913						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	Major	Major	Moderate	Moderate	Major
Nearshore B.	QL3B	6-10 yrs.	Major	Major	Moderate	Minor	Moderate

Organization	Hawai'i		Land development and zoning				
MCA Name	MCA No.						
Land Development and Zoning	21927						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	Major	Major	Moderate	Moderate	Major

Organization	Georgia		Full feature extraction (elevation, contours, 3D features, land use, orthos) from lidar data.				
MCA Name	MCA No.						
Planning and Economic Development	22090						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Annually	Major	Major	None	None	None

Organization	Alaska		Property valuation, emergency preparedness, land cover, drainage, greenspace, parcel alignment. Roads, hydro and coastline are the baseline for a large percentage of our data. These features often define survey boundaries, which serve as the basis for all of our datasets. Accurate elevation data are needed in order to better align these features to reality.				
MCA Name	MCA No.						
Kodiak Island Borough Government Services	22348						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	Major
Inland Bathy	I don't know	Event driven	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL1B	I don't know	Major	Major	Moderate	don't know	Moderate

Organization	District of Columbia		Visualizing the city to enable effective decision-making in urban planning, including urban design and risk mitigation, historic preservation, and guiding local zoning and land use decisions. Classified mass points are very important to us for delineation of buildings, vegetation, etc. 3D building extraction and building elevations tied accurately to known ground surfaces are needed for visualization. Consistent elevation data sets through time are also needed for change detection.				
MCA Name	MCA No.						
Urban Planning	22505						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	Major	Major	Minor	Minor	Minor

Organization	FBI		Land development and zoning. Municipal mapping of building footprints and elevations. Port resilience planning. Parks and transportation planning. Virtual city creation. Urban ecology planning.				
MCA Name	MCA No.						
Urban and Regional Planning	60716						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Major	Moderate	Major	Major
Inland Bathy	QL0B	2-3 yrs.	Major	Major	Moderate	Moderate	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Moderate	Moderate	Moderate
Offshore B.	Order 1	2-3 yrs.	Major	Major	Major	Major	Major

Organization	HERE Technologies		Verifying the slope and clearance of pedestrian paths, sidewalks, and curb ramps. Classifying buildings' features for real estate assessment and taxation purposes.				
MCA Name	MCA No.						
Urban Landscape Modeling	60727						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	Moderate	Major	Major

Organization	Census		Georectification of satellite imagery at C-95 accuracy. The requirement is for seamless nationwide elevation data served on a web server sufficient to georectify SRTM imagery in ERDAS to a circular error at 95% of 5 meters to true.				
MCA Name	MCA No.						
Geolocation of Satellite Imagery	1067						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL4	2-3 yrs.	Moderate	Moderate	None	None	None

Organization	Census		Enumeration of population and the dissemination of statistical data. (Which include using and maintaining legal and statistical boundaries built from physical and political features, e.g. roads, rivers, railroads, incorporated place boundaries etc.). Geographic update activities. Help maintain the Census Bureau's geographic framework for data collection, tabulation, and dissemination between the decennial censuses and to support ongoing programs such as the ACS and the Population Estimates Program. Identification of change in the built environment is a primary function of this activity. Elevation and other datasets are needed to identify new building footprints and add addresses. Ideally, data are needed every 2-3 years.				
MCA Name	MCA No.						
Identification of Change Within Census Geographic Framework	1391						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Moderate	Moderate	don't know	don't know	don't know

Organization	Massachusetts		In the planning of coastal infrastructure and land use regulations we utilize high resolution data along with scenario modeling to prioritize coastal hazard mitigation and adaptation strategies.				
MCA Name	MCA No.						
Coastal Planning for Hazard Mitigation and Adaptation	1463						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	Moderate	Minor	Moderate	Moderate	Moderate
Nearshore B.	X-Sec meet needs	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	District of Columbia		Urban and Regional Planning; Homeland Security, Law Enforcement, Disaster Response, and Emergency Management				
MCA Name	MCA No.						
District-wide Geospatial Data Provisioning	21906						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	Moderate	don't know	don't know	don't know	don't know
Nearshore B.	X-Sec meet needs	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Pennsylvania		Land conservation (easements and fee simple purchases), municipal/regional planning.				
MCA Name	MCA No.						
Land Conservation and Planning	22066						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	don't know	Moderate	don't know	don't know	don't know

Organization	California		Planning				
MCA Name	MCA No.						
Regional Planning	22342						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	don't know	Moderate	don't know	don't know	don't know

Organization	New York		Support GIS Enterprise Platform				
MCA Name	MCA No.						
Suffolk County Enterprise GIS Services	1183						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Maryland		We are responsible for development review, floodplain management, property mapping, and parks planning and management. All require accurate elevation information.				
MCA Name	MCA No.						
Development Review, Floodplain Management, Property Mapping, and Parks Planning and Management	21525						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	District of Columbia		Urban and Regional Planning. Protect people, parks, resources and facilities from the risks of flooding. Elevation data are needed for viewshed analysis; evaluation of impacts of new development on the skyline, views of the White House and Capitol; building height restrictions.				
MCA Name	MCA No.						
Urban and Regional Planning	22181						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	California		Emergency planning and hazard assessment (coastal flooding and sea level, landslide, risk, flooding, search and rescue, etc.). General regional planning and development				
MCA Name	MCA No.						
Emergency Planning and Hazard Assessment	22318						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Inland Bathy	QL1B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL1B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

BU 24 - Health and Human Services

BU 24 Scope

Business Use #24 (BU 24) includes health emergency response; habitat modeling and disease prevention; defining boundaries for health advisories for swimming and fishing; marine-based bioproducts and pharmaceuticals; public health and safety; and prevention of waterborne diseases.

Figure E.24a. Lidar is widely used in Florida to map mosquito control ditches. Image courtesy of the South Walton County Mosquito Control District.

Within the Department of Health and Human Services (HHS), the Centers for Disease Control (CDC) serve as the nationwide champion for this Business Use. Lidar and IfSAR data enable the CDC to respond to public health emergencies with the best available 3D geospatial data needed to assess conditions that caused the emergency and/or to respond decisively with corrective actions.

BU 24 Background Information

Vectors are agents that spread disease, e.g., ticks, mosquitoes, flies, animals, humans, and birds . Whereas both lidar and IfSAR have value for mapping of specific habitats, lidar is especially effective in mapping the structure of forests, vegetation, and wildlife habitat. Differential lidar, collected in different years, enables the mapping of changes to wildlife habitat including vector habitat. Centimeter-level digital terrain model (DTM) data can be derived from lidar data that enable the CDC to detect fine-scale sinkholes that can hold standing water. The CDC can determine how long sinkhole water remains stagnant enough to be utilized as mosquito habitats in geographic information system (GIS) environments with lidar-derived fine-scale DTM, soil characteristics (e.g., water penetration rate), climatic variables such as wind direction and speed, and other potential data sets.

Lidar data enable the modeling of cities and rural areas that could be subjected to chemicals from crop dusting, smog, and unclean air conditions. Elevation data are also used for modeling areas affected by accidental chemical spills or terrorist activities that could include the use of chemical, biological, or radiological weapons. Lidar provides ancillary information for extracting buildings from remote sensing imagery in a more accurate manner. Extracted buildings can be utilized to estimate population at a local scale, which in turn will be valuable input data for human exposure analysis against environmental pollution. Lidar building footprints and heights of individual buildings are essential data to use in spatial epidemiology research in urbanized areas, e.g., traffic noise research. Lidar enables the modeling of dam breaks and plans for mitigating the effects of potential breaks. Lidar provides significant benefits for occupational safety and health by enabling many tasks to be performed in an office environment that were previously performed in the field under dangerous or unhealthy conditions. For example, the need for land surveys for highway construction projects (with numerous traffic deaths annually) is largely eliminated by using lidar surveys. Similarly, the need for on-site visits and collection of sample data for environment-related activities is often replaced by using lidar and other forms of remote sensing, reducing human exposure to field hazards.

BU 24 Elevation Data Uses

Using their own words, respondents documented 13 Mission Critical Activities (MCAs) that identified BU 24 as their primary Business Use and identified the following 17 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.24a. BU 24 Elevation Data Uses

Data Use
Emergency Management
1. Assist state and local authorities to save lives and protect Americans including emergency and disaster events
2. Health emergency response
Hazard Assessment and Mitigation
3. Abandoned Mine Lands Program inventory; monitor and secure abandoned mine hazard sites that pose a physical safety risk
4. Assist communities in assessing public health risks and resilience
5. Bathymetry is used to address concerns related to red tides, harmful algal blooms, waterborne diseases, and microplastics
6. Defining boundaries for health advisories for swimming and fishing
7. Monitor and analyze ambient air quality data; air quality dispersion modeling, photochemical modeling
Mapping/Boundary Delineation
8. Accurately locate structures and services
Modeling
9. Air and meteorological modeling (dispersion models, etc.) and conditions analyses
10. Data from both leaf on and leaf off conditions help with modeling to see vegetation contribution to Volatile Organic Compounds (VOCs)
11. GIS support for modeling, monitoring, and predicting hazardous events
12. Habitat modeling and disease prevention
13. Monitor, model, and estimate air pollution emissions
Public Health
14. Marine-based bioproducts and pharmaceuticals
15. Mosquito abatement
16. Prevention of waterborne diseases
17. Public health and safety

BU 24 Tangible and Intangible Benefits

For the 13 MCAs that list Health and Human Services as their primary Business Use:

- **Table E.24b** summarizes the reported future annual dollar benefits by geography type, totaling $2.51 million per year in tangible future benefits if all MCA requirements are satisfied.
- **Table E.24c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.24e.

- **Table E.24d** shows (in blue) the three federal agencies and ten states and territories that submitted MCAs with BU 24 as the primary Business Use. MCAs for which BU 24 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.24d.
- **Table E.24e** documents all the MCAs that listed BU 24 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.24e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 24 Reported Future Annual Dollar Benefits

Of the 13 MCAs that listed Health and Human Services as their primary Business Use, nine MCAs estimated their tangible annual benefits totally in financial terms; one MCA had a combination of tangible and "Major" intangible benefits; and three MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.24b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 13 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.24b. BU 24 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$735,366	$270,040	$1,005,406
Inland Bathymetry	$250,000	$250,000	$500,000
Nearshore Bathymetry	$250,000	$250,000	$500,000
Offshore Bathymetry	$250,000	$250,000	$500,000
Totals	**$1,485,366**	**$1,020,040**	**$2,505,406**

BU 24 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.24c. BU 24 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	13	1	1	1	13
Inland Bathymetry	2	0	0	0	2
Nearshore Bathymetry	2	0	0	0	2
Offshore Bathymetry	2	0	0	0	2
Totals	**19**	**1**	**1**	**1**	**19**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 24 Reported Future Annual Dollar Benefits Maps

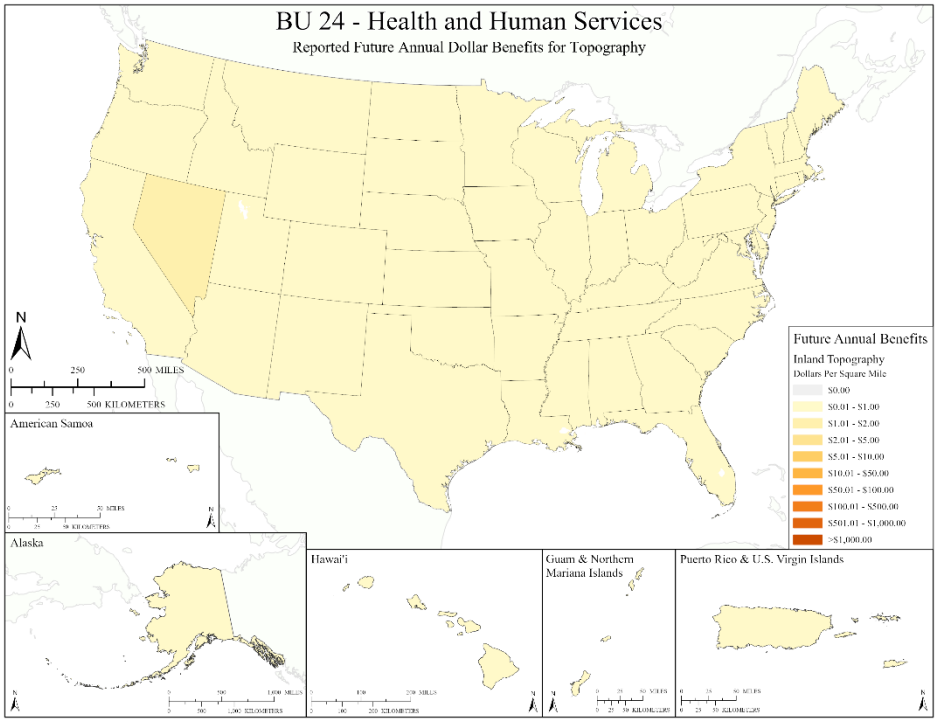

Figure E.24b. Reported Future Annual Collar Benefits for Topography

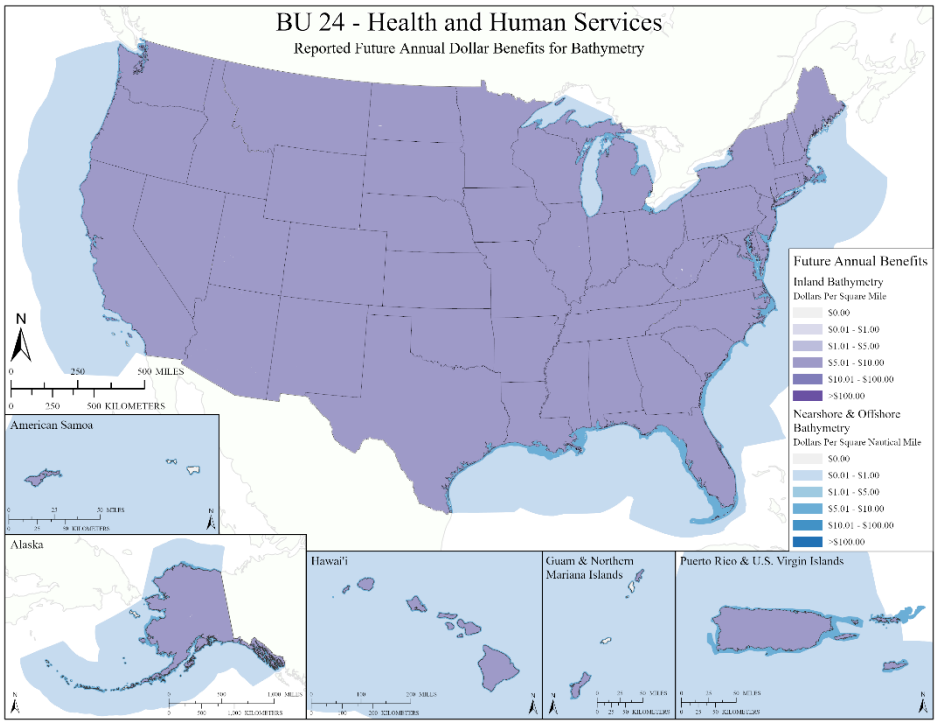

Figure E.24c. Reported Future Annual Dollar Benefits for Bathymetry

BU 24 Benefits Analysis

The total combined future annual benefits ($2.505 million per year) reported for BU 24 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 24 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, three federal agencies (CDC, EPA, FBI) submitted MCAs listing BU 24 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry and offshore bathymetry. Of the three federal MCAs listing BU 24 as primary:
    - Inland Topography: One provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: One provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: One provided dollar benefits and one indicated "Major" benefits.
    - Offshore Bathymetry: One provided dollar benefits and one indicated "Major" benefits.
- State/Local/Tribal and U.S. Territory MCAs: Of the 10 states and territories that submitted MCAs listing BU 24 as primary:
    - Inland Topography: Nine provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits or "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits or "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits or "Major" benefits.
- Non-governmental MCAs: No non-governmental organizations submitted an MCA listing BU 24 as primary, secondary, or tertiary.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.24b and E.24c:
    - 20 "Major" Operational and Customer Service benefits and 21 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 24 for which "Major" benefits are documented, this could easily be translated into significant additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 24 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 24:

- **Table E.24d** color-codes those organizations having an MCA with BU 24 as Primary, Secondary, or Tertiary.
- **Table E.24e** summarizes the 13 MCAs with primary benefits for BU 24, rank ordered from the highest to the lowest tangible benefits.

Table E.24d. Organizations having an MCA with BU 24 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	**CDC**	CMTS	DHS	DISDI	DTRA
	EPA	FAA	**FBI**	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	NOAA	NPS	*NRC*	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	USAF	USARC	USBR	USCB
	USCG	USFS	USGS	USMC	USN					

State/Ter	AL	**AK**	*AR*	AZ	**CA**	CO	CT	DC	DE	FL	GA	HI	IA	ID
	IL	**IN**	KS	KY	LA	MA	MD	ME	MI	MO	**MN**	MS	MT	NC
	ND	**NE**	NH	**NJ**	NM	**NV**	NY	OH	**OK**	*OR*	PA	**RI**	SC	SD
	TN	TX	UT	**VA**	VT	**WA**	WI	WV	**WY**	PR	VI	GU	AS	CNMI

Table E.24e. MCA summaries for BU 24, rank ordered from the highest to the lowest tangible benefits.

Organization	CDC		Assist state and local authorities to save lives and protect Americans. CDC is involved with response to emergency and disaster events, including those involving riverine and coastal flooding, providing GIS support. Response activities require elevation data along with imagery and other satellite data to help visualize and respond to the events. Elevation data are also used for modeling, monitoring, and predicting flooding. The data are also of interest for assisting communities in assessing public health risks and their resilience to sea level rise. Bathymetry is of interest for addressing concerns related to red tides, harmful algal blooms, waterborne disease, and microplastics. Additional Business Uses include BU 04 - Forest Resources Management; BU 05 – Rangeland Management; BU 06 - Natural Resources Conservation; BU 08 - Agriculture and Precision Farming; BU 09 - Fisheries Management and Aquaculture; BU 11 - Geologic Resource Mining and Extraction; BU 13 - Oil and Gas Resources; BU 14 - Cultural Resources Preservation and Management; BU 17 - Wildfire Management, Planning, and Response; BU 19 – Land Navigation and Safety; BU 22 - Infrastructure and Construction Management; BU 23 - Urban and Regional Planning; BU 25 - Real Estate, Banking, Mortgage, and Insurance; BU 27 – Recreation; and BU 30 - Maritime and Land Boundary Management.					
MCA Name	MCA No.						
Assist State and Local Authorities to Save Lives and Protect Americans Including During Emergency and Disaster Events	1200						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$250,000	$250,000	Minor	Moderate	Major
Inland Bathy	QL1B	2-3 yrs.	$250,000	$250,000	Minor	Moderate	Major
Nearshore B.	QL1B	Annually	$250,000	$250,000	Minor	Moderate	Major
Offshore B.	Order 2	2-3 yrs.	$250,000	$250,000	Minor	Moderate	Major

Organization	Alaska		Health emergency response. Habitat modeling and disease prevention. Defining boundaries for health advisories for swimming and fishing. Marine-based bioproducts and pharmaceuticals. Public health and safety. Prevention of waterborne diseases.				
MCA Name	MCA No.						
Health and Human Services	60020						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$208,429	$26	Moderate	Moderate	Major

Organization	Nevada		The Abandoned Mine Lands program inventories, monitors and secures abandoned mine hazard sites that pose a physical safety risk. These hazards are the result of historic mining practices that predate the reclamation laws established in the 1970s. The features include shafts, adits (tunnels) and open pits, often with interconnected features. Hundreds of thousands of these features exist in Nevada, with 10's of thousands believed to be hazardous. Fatalities due to bad air, falls and other accidents have occurred in past at these sites. Many features remained un-inventoried in our database as they are very numerous and span the entirety of the state. They are located throughout Nevada: near towns, near occupied structures and in close proximity to roads to rural and hard-to-access federally owned or private lands. The Nevada Division of Minerals works to inventory these hazards and determine the proper method of securing them, with thoughtful respect to wildlife and cultural features, throughout the state. Often these features are hard to access and we have recently began to use remote sensing, such as unmanned aerial systems (UAS) to identify hazards that are hard to reach or many in numbers. We have seen in existing LiDAR scans that it may be possible to remotely identify abandoned mine features of interest using this method.					
MCA Name	MCA No.						
Abandoned Mine Lands Inventory	1221						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$100,199	$19,995	Moderate	Moderate	Major

Organization	California		Health emergency response. Habitat modeling and disease prevention. Defining boundaries for health advisories for swimming and fishing. Marine-based bioproducts and pharmaceuticals. Public health and safety. Prevention of waterborne diseases.				
MCA Name	MCA No.						
Health and Human Services	60053						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$56,428	$7	Moderate	Moderate	Major

Organization	Wyoming		Health emergency response. Habitat modeling and disease prevention. Defining boundaries for health advisories for swimming and fishing. Marine-based bioproducts and pharmaceuticals. Public health and safety. Prevention of waterborne diseases.				
MCA Name	MCA No.						
Health and Human Services	60548						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$34,900	$4	Moderate	Moderate	Major
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Minnesota		Health emergency response. Habitat modeling and disease prevention. Defining boundaries for health advisories for swimming and fishing. Marine-based bioproducts and pharmaceuticals. Public health and safety. Prevention of waterborne diseases.				
MCA Name	MCA No.						
Health and Human Services	60621						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$30,106	$3	Moderate	Moderate	Major
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Nebraska		Health emergency response. Habitat modeling and disease prevention. Defining boundaries for health advisories for swimming and fishing. Marine-based bioproducts and pharmaceuticals. Public health and safety. Prevention of waterborne diseases.				
MCA Name	MCA No.						
Health and Human Services	60279						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$27,600	$3	Moderate	Moderate	Major

Organization	Virginia		Health emergency response. Habitat modeling and disease prevention. Defining boundaries for health advisories for swimming and fishing. Marine-based bioproducts and pharmaceuticals. Public health and safety. Prevention of waterborne diseases.				
MCA Name	MCA No.						
Health and Human Services	60506						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$14,408	$1	Moderate	Moderate	Major
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Indiana		Health emergency response. Habitat modeling and disease prevention. Defining boundaries for health advisories for swimming and fishing. Marine-based bioproducts and pharmaceuticals. Public health and safety. Prevention of waterborne diseases.				
MCA Name	MCA No.						
Health and Human Services	60163						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$12,910	$1	Moderate	Moderate	Major

Organization	Rhode Island		Health emergency response. Habitat modeling and disease prevention. Defining boundaries for health advisories for swimming and fishing. Marine-based bioproducts and pharmaceuticals. Public health and safety. Prevention of waterborne diseases. Mosquito abatement.				
MCA Name	MCA No.						
Health and Human Services	60390						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$386	Minor	Moderate	Moderate	Major
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	EPA		Monitor and analyze ambient air quality data. Model ambient air quality e.g. Air Quality Dispersion Modeling, Photochemical Modeling. Monitor air pollution emissions. Model and estimate air pollution emissions – Air and meteorlogical modeling (dispersion models, etc.) and conditions analyses require elevation data. Chemical models are larger scale (whole U.S.); less detail is required. Vegetation has volatile emissions. Data for both leaf on and leaf off conditions could help with modeling to see vegetation contribution to Volatile Organic Compounds (VOCs).				
MCA Name	MCA No.						
Air Quality Monitoring and Modeling	22436						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	Major	Major	Major

Organization	Washington		Health emergency response. Habitat modeling and disease prevention. Defining boundaries for health advisories for swimming and fishing. Marine-based bioproducts and pharmaceuticals. Public health and safety. Prevention of waterborne diseases. Elevation data are used to accurately locate structures and services.				
MCA Name	MCA No.						
Health and Human Services	60523						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	Major	Minor	Moderate	Moderate	Major

Organization	FBI		Health emergency response. Habitat modeling and disease prevention. Defining boundaries for health advisories for swimming and fishing. Marine-based bioproducts and pharmaceuticals. Public health and safety. Prevention of waterborne diseases.				
MCA Name	MCA No.						
Health and Human Services	60717						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	Major	Moderate	Moderate	Moderate	Major
Inland Bathy	QL0B	2-3 yrs.	Major	Moderate	Minor	Moderate	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Moderate	Minor	Moderate	Major
Offshore B.	Order 1	2-3 yrs.	Major	Moderate	Minor	Moderate	Major

BU 25 - Real Estate, Banking, Mortgage, and Insurance

BU 25 Scope

Business Use #25 (BU 25) includes assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance; and building permit compliance. There is no nationwide champion for this Business Use.

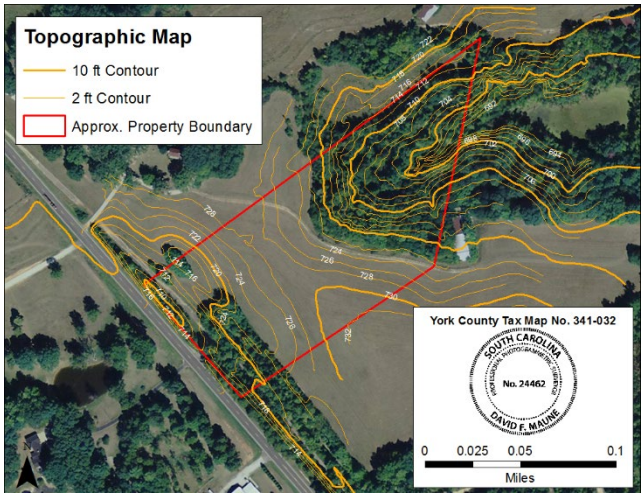

Figure E.25a. ALTA surveys are needed when purchasing land, and topographic surveys and maps are needed when planning construction. Topographic maps, with contour lines as shown here, are most cost-effectively produced from lidar. Image courtesy of Dewberry Engineers.

BU 25 Background Information

Natural disasters are of critical importance to the real estate, banking, mortgage, and insurance industries. For the past decade, the Insurance Information Institute estimated insured property losses of $56.3 billion in 2011, $72.3 million in 2012, $27.2 billion in 2013, $25.6 billion in 2014, $25.3 billion in 2015, $34.5 billion in 2016, $133.1 billion in 2017, $62.7 billion in 2018, $29.6 billion in 2019, and $74.4 billion in 2020. Most losses occur from storms (hurricanes and tornadoes), followed by floods, wildfires, earthquakes, landslides, and drought. In 2021, the insurance industry will take major hits from Hurricane Ida as well as the worst wildfires in history – largely caused by climate change.

For the real estate, banking, mortgage, and insurance industries to properly serve American homeowners, all must recognize risks from natural disasters, and many of those risks depend on the geographic location and/or topography of the terrain on which homes are built. For the most damaging natural hazards:

- BU 15 (Flood Risk Management) addressed how lidar data are vital for flood risk determinations.
- BU 17 (Wildfire Management) addressed how lidar data are vital for wildfire risk determinations.
- BU 10 (Geologic Assessment and Hazard Mitigation) addressed how lidar data are vital for earthquake fault, sinkhole, and landslide hazard determinations.

Natural disasters are not the only reason why elevation data are critical for this Business Use. Daily, in every county in America, lands are purchased for which American Land Title Association (ALTA) surveys are required to establish legal boundaries (see red polygon in Figure E.25a). However, if the owner decides to build something on that property or get the property zoned for an intended use, topographic maps must be provided so city or county officials can issue building or zoning permits. The topographic map shown in Figure E.25a was produced from public domain lidar data for the landowner to get this land zoned for development of a wholesale flower nursery. However, only a third of this property (southwest of the "saddle") was zoned for its intended purpose because the county wanted to ensure that plant fertilizer runoff northeast of the "saddle" did not drain into the pond visible on the adjacent property.

BU 25 Elevation Data Uses

Using their own words, respondents documented 15 Mission Critical Activities (MCAs) that identified BU 25 as their primary Business Use and identified the following 14 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.25a. BU 25 Elevation Data Uses

Data Use
Data Development and Management
1. Host a web mapping application that provides all users with complete site and situation analysis for all property in the state
Hazard Assessment and Mitigation
2. Assessment of risk from natural hazards
3. Assessment of risk from sinkholes, flooding, etc.
4. Enable users to clearly see and potentially mitigate physical hazards for any subject structure
5. Seismic hazards
6. Tsunami modeling
7. Wildfire hazards
Planning
8. Elevation data for county planning and construction
Real Estate
9. Inform insurance policy rates and determination of mandatory insurance
10. Mortgage and building loans
Regulatory Reviews and Enforcement
11. Building permit compliance
12. Certification of structures for flood insurance and buy out
13. Compliance with FIRM zones and base flood elevations (BFEs)
14. Determine if houses and structures are in a flood zone for applicability of flood insurance rules

BU 25 Tangible and Intangible Benefits

For the 15 MCAs that list Real Estate, Banking, Mortgage, and Insurance as their primary Business Use:

- **Table E.25b** summarizes the reported future annual dollar benefits by geography type, totaling $39.9 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.25c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.25e.
- **Table E.25d** shows (in blue) the zero federal agencies, 15 states and territories, and zero non-governmental entities that submitted MCAs with BU 25 as the primary Business Use. MCAs for which BU 25 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.25d.
- **Table E.25e** documents all the MCAs that listed BU 25 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.25e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 25 Reported Future Annual Dollar Benefits

Of the 15 MCAs that listed Real Estate, Banking, Mortgage, and Insurance as their primary Business Use, one MCA estimated their tangible annual benefits totally in financial terms; 13 MCAs had a combination

of tangible and "Major" intangible benefits; and one MCA listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.25b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 15 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.25b. BU 25 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$38,406,048	$1,500,000	$39,906,048
Inland Bathymetry	$0	$0	$0
Nearshore Bathymetry	$0	$0	$0
Offshore Bathymetry	$0	$0	$0
Totals	**$38,406,048**	**$1,500,000**	**$39,906,048**

BU 25 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.25c. BU 25 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	15	14	1	0	14
Inland Bathymetry	0	0	0	0	0
Nearshore Bathymetry	4	4	4	0	4
Offshore Bathymetry	0	0	0	0	0
Totals	**19**	**18**	**5**	**0**	**18**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 25 Reported Future Annual Dollar Benefits Maps

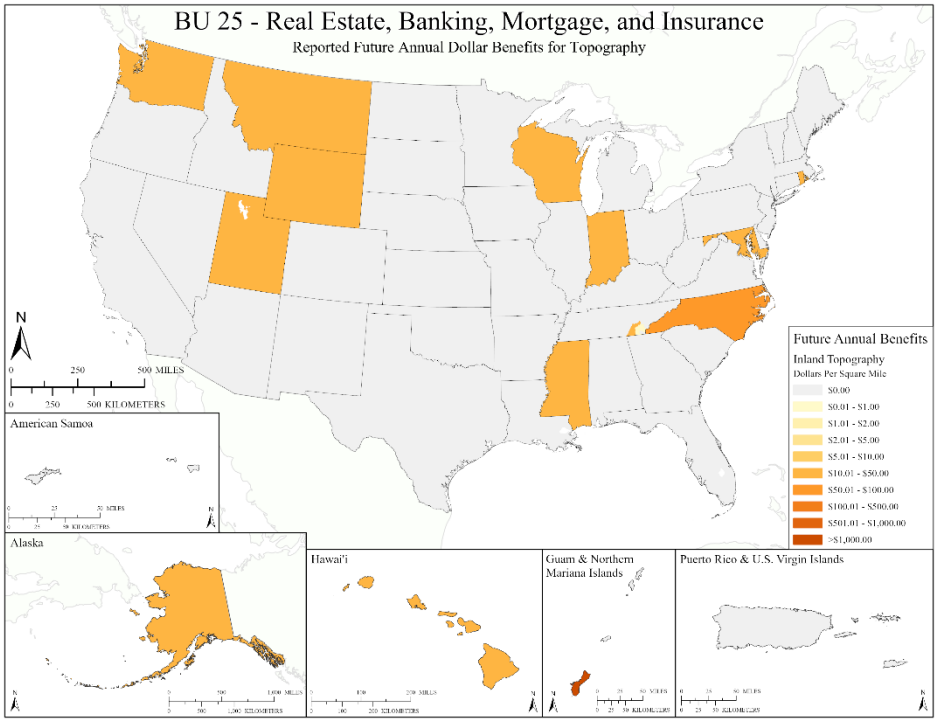

Figure E.25b. Reported Future Annual Dollar Benefits for Topography

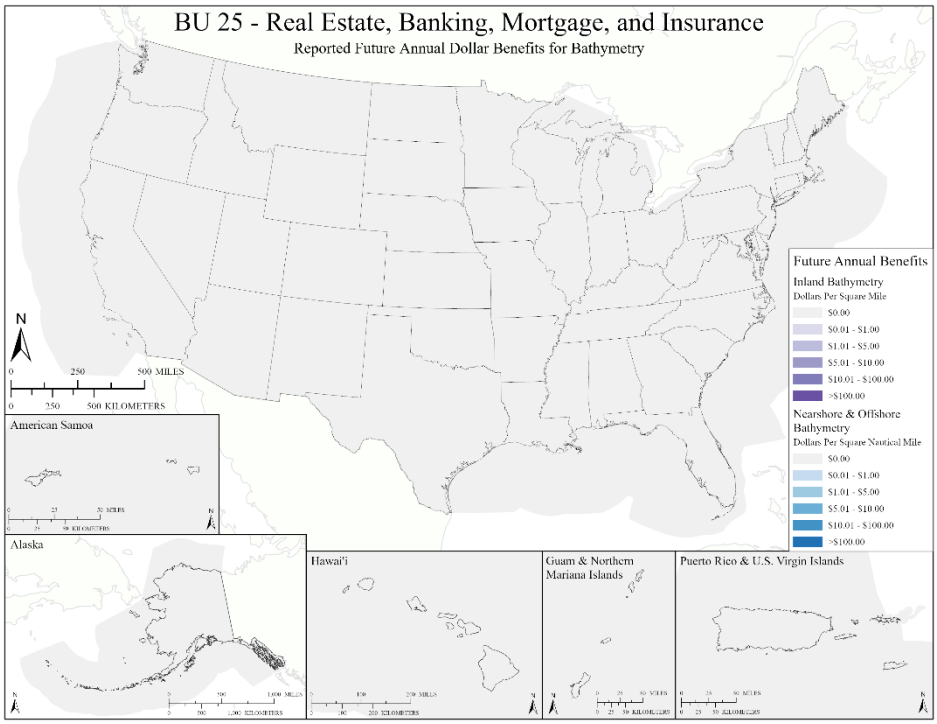

Figure E.25c. Reported Future Annual Dollar Benefits for Bathymetry

BU 25 Benefits Analysis

The total combined future annual benefits ($39.90 million per year) reported for BU 25 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 25 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: There were no federal MCAs for BU 25. Two federal agencies submitted MCAs listing BU 25 as tertiary.
- State/Local/Tribal and U.S. Territory MCAs: Fifteen (15) states and territories submitted MCAs listing BU 25 as their primary Business Use:
    - Inland Topography: Fourteen provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: None provided either dollar or "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits and four indicated "Major" benefits.
    - Offshore Bathymetry: None provided either dollar or "Major" benefits.
    - Two states submitted MCAs listing BU 25 as secondary and one state submitted an MCA listing BU 25 as tertiary, meaning no benefits accrue to BU 25.
- Non-governmental MCAs: There were no non-governmental MCAs listing BU 25 as primary, but one submitted an MCA listing BU 25 as secondary.
- Increased Combined Benefits: There are several factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.25b and E.25c:
    - 37 "Major" Operational and Customer Service benefits and 23 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 25 for which "Major" benefits are documented, this could easily be translated into significant additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 25 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 25:

- **Table E.25d** color-codes those organizations having an MCA with BU 25 as Primary, Secondary, or Tertiary.
- **Table E.25e** summarizes the 15 MCAs with primary benefits for BU 25, rank ordered from the highest to the lowest tangible benefits.

Table E.25d. Organizations having an MCA with BU 25 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	NOAA	NPS	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	USAF	USARC	USBR	USCB
	USCG	USFS	USGS	USMC	USN					

State/Ter	AL	**AK**	AR	AZ	CA	CO	CT	DC	DE	FL	GA	**HI**	IA	ID
	IL	**IN**	KS	KY	LA	MA	**MD**	ME	MI	MO	MN	**MS**	**MT**	**NC**
	ND	NE	NH	NJ	NM	*NV*	NY	OH	OK	*OR*	PA	**RI**	SC	SD
	TN	TX	**UT**	VA	VT	**WA**	**WI**	WV	**WY**	PR	VI	**GU**	AS	CNMI

Non-Gov	*HERE Technologies*			

Table E.25e. MCA summaries for BU 25, rank ordered from the highest to the lowest tangible benefits.

Organization	Alaska		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60021						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$20,296,209	Major	Minor	Minor	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Moderate	Major

Organization	Wyoming		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60549						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$3,398,537	Major	Minor	Minor	Major
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Utah		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60475						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$2,904,336	Major	Minor	Minor	Major

Organization	Montana		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60266						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$2,750,000	Major	Minor	Minor	Major

Organization	North Carolina		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60333						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,000,000	$1,500,000	Minor	Minor	Major

Organization	Washington		Our mission critical activity is to develop and host a web mapping application that provides all users with complete site and situation analysis for property in Washington state. This enables users to clearly see and potentially mitigate physical hazards for any subject structure.				
MCA Name	MCA No.						
Situational Analysis for Real Property	22353						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$2,347,319	Major	Major	Minor	Major
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Moderate	Major

Organization	Wisconsin		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60532						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$1,947,955	Major	Minor	Minor	Major

Organization	Mississippi		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60250						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$1,656,183	Major	Minor	Minor	Major

Organization	Indiana		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60164						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$1,257,197	Major	Minor	Minor	Major

Organization	Maryland		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60222						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$343,543	Major	Minor	Minor	Major

Organization	Guam		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60108						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$223,572	Major	Minor	Minor	Major

Organization	Hawai'i		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60127						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$223,572	Major	Minor	Minor	Major
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Moderate	Major

Organization	Rhode Island		Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance. Tsunami modeling. Wildfire hazards. Seismic hazards.				
MCA Name	MCA No.						
Real Estate, Banking, Mortgage, and Insurance	60391						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$37,625	Major	Minor	Minor	Major
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	QL2B	2-3 yrs.	Major	Major	Major	Moderate	Major
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Tennessee		To provide elevation data to various Hamilton County, TN departments as needed. Projects include construction, long term planning, etc. Data acquired under a BAA in 2015-2016 are served on a public web site.				
MCA Name	MCA No.						
Coordination and Support of Government Agencies and Utilities Within Hamilton County	1461						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$20,000	Moderate	None	Minor	Minor

Organization	Illinois		Classification of structures for flood insurance and buy out. The OWR Mitigation Section routinely and frequently uses elevation data to determine if houses and structures are in a flood zone for the applicability of flood insurance rules. This affects mortgage and building loans. Ground elevations are needed for compliance with FIRM zones and base flood elevation.				
MCA Name	MCA No.						
Classification of Structures for Flood Insurance and Buy Out	21663						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	4-5 yrs.	Major	Major	None	None	don't know
Inland Topo	QL2	4-5 yrs.	Major	Major	None	None	don't know

BU 26 - Education K12 and Beyond, Basic Research

BU 26 Scope

Business Use #26 (BU 26) includes development of 3D visualizations to help students understand the Earth they live on; understanding of continental-scale climate change impacts; ocean science; ocean education; scientific research; data dissemination; and development of training simulators. The Smithsonian Institution is a nationwide champion for this Business Use because their mission is to promote understanding of the natural world and our place in it.

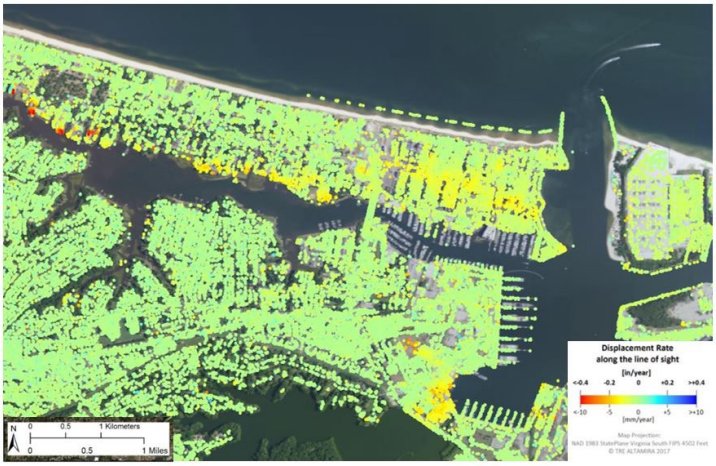

Figure E.26a. Differential Interferometric Synthetic Aperture Radar (DInSAR) from 130 Cosmo-SkyMed SAR images were used for a total of 4,150,000 measurement points to map mm-level coastal subsidence rates of Hampton Roads, Virginia. Image courtesy of Dewberry Engineers and NOAA/NGS. Many elevation products are relevant to a large variety of research projects.

BU 26 Background Information

Why are continents shaped the way they are? How and why are the continents moving; how fast are they moving? Why does the North Pole keep moving? How did the Ice Age shape today's topography? What happens when glaciers melt? How can you tell when mountains are relatively new or old? What will the land look like in the future? Why does the Earth's gravity field and magnetic field keep changing? Why does climate change cause sea level rise in most places but sea level drop in Alaska? How will the changing climate also change our lives? What can we do about it? Are humans reshaping the biosphere and physical environment, triggering potentially devastating and currently unpredictable consequences? What do I need to know about the world that might save lives? How can I use high resolution topographic/bathymetric information to my advantage?

Educators start answering basic geography questions in elementary school. The Smithsonian Institution; National Park Service (NPS) Visitor Centers; and many federal, state, and local agencies, and not-for-profit and private companies have educational programs that address many of these questions, often with the assistance of 3D map displays and simulators. Many of these questions deal with geodesy and geophysics taught in graduate school, often accompanied by university research programs. Understanding the size and shape of the Earth and its gravity field – or more appropriately, understanding the changing size and shape of the Earth and its changing gravity field – is necessary for answering these types of questions.

BU 26 Elevation Data Uses

Using their own words, respondents documented 39 Mission Critical Activities (MCAs) that identified BU 26 as their primary Business Use and identified the following 46 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.26a. BU 26 Elevation Data Uses

Data Use
Climate Change Analysis
1. Understanding continental-scale climate change impacts
Data Development and Management
2. Administration of the CORS program as well as marine program activities
3. Define the geologic framework, creating 3D databases that define the spatial relationships between rock and soil from the surface to depth across the state
4. Distribution of elevation and other data to academic and research community
5. Geospatial and cartographic data dissemination, management, production, and analysis
6. Geospatial data distribution and education; share data with state and local agencies
7. House and serve data for the state; provide application development in addition to university programs
8. Provide statewide centralized location for data acquisition, collection, clearinghouse services, and data dissemination
Education
9. 3D visualizations to help students understand the Earth they live on
10. CAT A hydrographic survey education for M.S. in Hydrographic Science degree; CAT B hydrographic survey education for B.S. Marine Science (Hydrography) degree
11. Development of training simulators
12. Educating the undergraduate and graduate level workforce for geospatial industry, government and academia, interdisciplinary basic and applied geospatial research and services
13. Education about sampling and surveying the marine and aquatic environments
14. Education in precision agriculture, forestry, invasive species management, and other programs that aid the state in managing its lands
15. Education of students in 3D engineering design and modeling
16. Education, training, and outreach to support lifelong learning
17. Help students understand elevation data – how to import, visualize, and use in analyses
18. Inland and coastal hazards wetlands mitigation education through GIScience courses
19. Ocean science; ocean education, scientific research
20. Providing education to researchers and professionals regarding topographic analysis as it relates to water movement, vegetation, erosion, cold air drainage, pollution and flooding
21. Training for bathymetric data collection
Forestry
22. Evaluation of vegetative health, tree crowns and canopies, and biogeophysical processes and pattern recognition
23. Study forest changes, vegetation structure, biomass, species mapping and growing status
Hazard Assessment and Mitigation
24. Population, ecological, and economic vulnerability assessments
25. Risk assessment or coastal hazards (storm surge, tidal inundation, rainfall and hydrologic runoff, and risk assessments)
Infrastructure Management
26. Coastal inundation and infrastructure assessment
Mapping/Boundary Delineation
27. Orthorectification of imagery

Data Use
Modeling
28. Environmental modeling and research
29. Fish habitat modeling and circulation modeling
30. Geospatial modeling and mapping the effects of sea level rise or subsidence
31. H&H modeling, hazard identification, study of flooding and the flow of water
32. Inland bathymetry for freshwater biologists' H&H modeling and watersheds
33. Ocean circulation modeling to help students better understand the world's oceans
Research
34. Coastal research; predictive understanding of environmental systems
35. Earth datasets are used for analogue studies of evolution on Mars
36. Geomatics research to find new ways to use and analyze data for different applications and requirements
37. Interdisciplinary research to develop advanced application of geospatial information science and technology for societal benefit
38. Natural science research, social science research, urban planning, cartography, development of training materials, campus planning, and facilities management
39. Numerous research applications ranging from coastal erosion analysis, post-earthquake/hazard damage assessment, infrastructure management, landslide mapping and analysis
40. Oceanographic research related to fisheries and coral reef conservation and management
41. Research and education programs and support
42. Research in hydrographic hardware, software, techniques, data management
43. Research including geography, archaeology, natural resources, and multiple applications across the state
44. Research, public service
45. Scientific research, mapping, and estimating forest resources using lidar; native and invasive tree species mapping
46. Technical capacity building to support climate science adaptation and research

BU 26 Tangible and Intangible Benefits

For the 39 MCAs that list Education K12 and Beyond, Basic Research as their primary Business Use:

- **Table E.26b** summarizes the reported future annual dollar benefits by geography type, totaling $81.02 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.26c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.26e.
- **Table E.26d** shows (in blue) the one federal agency, 31 states and territories, and seven non-governmental entities that submitted MCAs with BU 26 as the primary Business Use. MCAs for which BU 26 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.26d.
- **Table E.26e** documents all the MCAs that listed BU 26 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.26e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 26 Reported Future Annual Dollar Benefits

Of the 39 MCAs that listed Education K12 and Beyond, Basic Research as their primary Business Use, 30 MCAs estimated their tangible annual benefits totally in financial terms; one MCA had a combination of tangible and "Major" intangible benefits; and seven MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.26b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 39 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.26b. BU 26 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$30,298,513	$46,181,921	$76,480,434
Inland Bathymetry	$2,443,453	$501,206	$2,944,659
Nearshore Bathymetry	$810,052	$404,113	$1,214,165
Offshore Bathymetry	$319,003	$70,822	$389,825
Totals	**$33,871,021**	**$47,158,062**	**$81,029,083**

BU 26 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.26c. BU 26 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	31	27	30	23	25
Inland Bathymetry	24	23	27	18	17
Nearshore Bathymetry	21	22	22	14	5
Offshore Bathymetry	14	14	15	2	1
Totals	**90**	**86**	**94**	**57**	**48**

The types of benefits that are included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 26 Reported Future Annual Dollar Benefits Maps

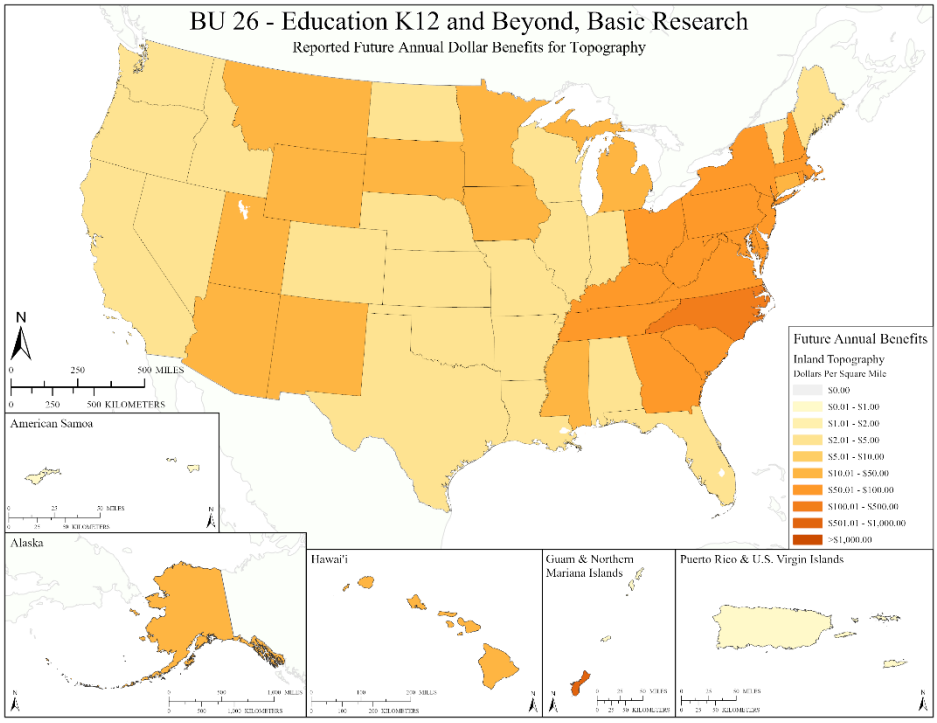

Figure E.26b. Reported Future Annual Dollar Benefits for Topography

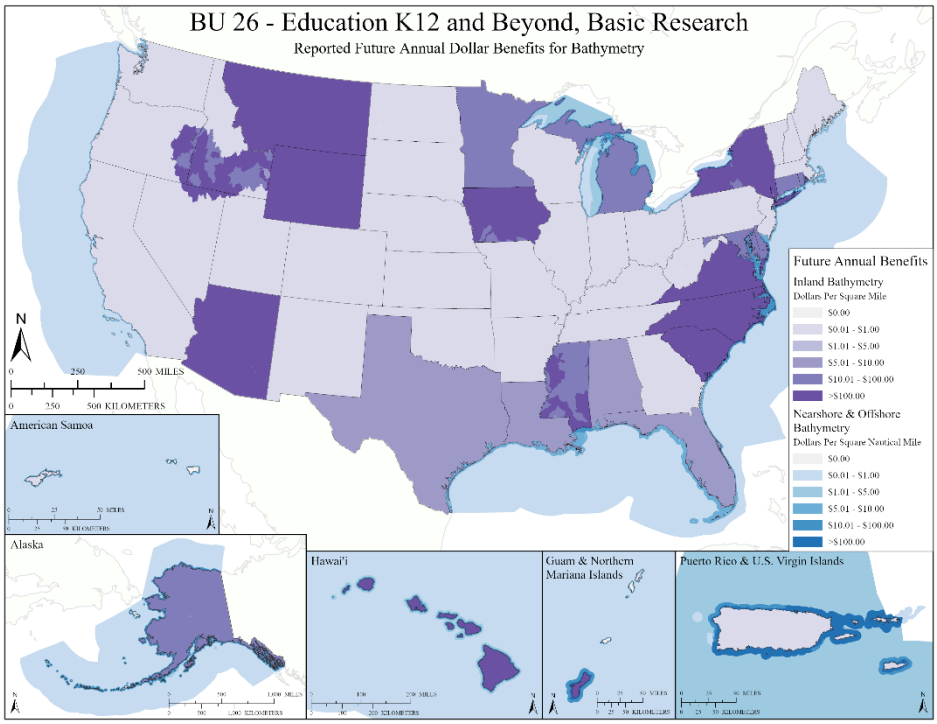

Figure E.26c. Reported Future Annual Dollar Benefits for Bathymetry

BU 26 Benefits Analysis

The total combined future annual benefits ($81.02 million per year) reported for BU 26 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 26 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, one federal agency (Smithsonian Institution [SI]) submitted an MCA listing BU 26 as their primary Business Use, whereas MARAD and NASA submitted MCAs listing BU 26 as secondary and tertiary. SI submitted dollar benefits for inland topography, inland bathymetry, nearshore bathymetry and offshore bathymetry.
- State/Local/Tribal and U.S. Territory MCAs: Twenty-five (25) states and territories submitted 31 MCAs listing BU 26 as primary:
    - Inland Topography: 24 provided dollar benefits and three indicated "Major" benefits.
    - Inland Bathymetry: 21 provided dollar benefits and three indicated "Major" benefits.
    - Nearshore Bathymetry: 18 provided dollar benefits and two indicated "Major" benefits.
    - Offshore Bathymetry: Ten provided dollar benefits and four indicated "Major" benefits.
- Non-governmental MCAs: Seven universities (Brown University, North Carolina State University, Oklahoma State University, Oregon State University, Pennsylvania State University, University of Maine, and University of Missouri) submitted MCAs listing BU 26 as primary; and Esri and Old Dominion University submitted MCAs listing BU 26 as secondary. Of the seven MCAs listing BU 26 as primary:
    - Inland Topography: Two provided dollar benefits and four indicated "Major" benefits.
    - Inland Bathymetry: Two provided dollar benefits and four indicated "Major" benefits.
    - Nearshore Bathymetry: One provided dollar benefits and four indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and three indicated "Major" benefits.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.26b and E.26c:
    - 176 "Major" Operational and Customer Service benefits and 199 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 26 for which "Major" benefits are documented, this could easily be translated into significant additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 26 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 26:

- **Table E.26d** color-codes those organizations having an MCA with BU 26 as Primary, Secondary, or Tertiary.
- **Table E.26e** summarizes the 39 MCAs with primary benefits for BU 26, rank ordered from the highest to the lowest tangible benefits.

Table E.26d. Organizations having an MCA with BU 26 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	*MARAD*	NASA	NGA	NOAA	NPS	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	**SI**	TVA	USACE	USAF	USARC	USBR	USCB
	USCG	USFS	USGS	USMC	USN					

State/Ter	AL	**AK**	AR	**AZ**	**CA**	CO	**CT**	DC	**DE**	FL	GA	**HI**	**IA**	**ID**
	IL	*IN*	KS	KY	LA	MA	**MD**	ME	**MI**	**MO**	**MN**	**MS**	**MT**	**NC**
	ND	NE	NH	*NJ*	**NM**	NV	**NY**	OH	OK	OR	PA	**RI**	**SC**	**SD**
	TN	TX	**UT**	**VA**	VT	WA	WI	WV	**WY**	PR	**VI**	**GU**	AS	CNMI

Non-Gov	**Brown University**	**CARES - University of Missouri Extension**	*Esri*	**North Carolina State University**
	Oklahoma State University	*Old Dominion University*	**Oregon State University**	**Pennsylvania State University**
	University of Maine System			

Table E.26e. MCA summaries for BU 26, rank ordered from the highest to the lowest tangible benefits.

Organization	Virginia		Interdisciplinary research to develop advanced applications of geospatial information science and technology for societal benefit				
MCA Name	MCA No.						
Interdisciplinary Research to Develop Advanced Applications of Geospatial Information Science and Technology for Societal Benefit	21659						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$10,631,650	$25,361,800	Major	Major	Major
Inland Bathy	QL2B	2-3 yrs.	$4,522	Major	Major	Major	Moderate
Nearshore B.	QL3B	Annually	$3,015	Major	Major	Moderate	Minor
Offshore B.	Order 1b	4-5 yrs.	$1,206	Moderate	Minor	Minor	Minor

Organization	Alaska		Development of 3D visualizations to help students understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific research. Data dissemination. Development of training simulators.				
MCA Name	MCA No.						
Education K12 and Beyond, Basic Research	60022						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$3,069,728	$7,337,545	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$802,769	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	$264,552	$10,440	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	$66,659	Major	Major	Minor	Minor

Organization	Idaho		Education, training, and outreach to support lifelong learning. Elevation data supports undergraduate and graduate research. The data are used for H&H modeling, hazard identification, and to study flooding and the flow of water.				
MCA Name	MCA No.						
Education, Training, and Outreach to Support Lifelong Learning	22118						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	$10,140,980	$804,824	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$60,302	None	Major	Major	Major

Organization	Montana		Development of 3D visualizations to help students understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific research. Data dissemination. Development of training simulators.				
MCA Name	MCA No.						
Education K12 and Beyond, Basic Research	60267						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$772,708	$1,846,997	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$202,072	Major	Major	Major	Major

Organization	Arizona		Geospatial and cartographic data dissemination, management, production, and analysis. The State Library is an end user and redistributes elevation and other data to the academic and research community. The library supports academic research needs. The Phoenix metro area is the highest priority. High density elevation data are needed to evaluate vegetative health, tree crowns and canopies, and biogeophysical processes and pattern recognition.				
MCA Name	MCA No.						
Geospatial and Cartographic Data Dissemination	22427						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$599,078	$1,431,971	Major	Major	Major
Inland Bathy	QL4B	Annually	$156,665	Major	Major	Major	Major

Organization	New Mexico		Development of 3D visualizations to help students understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific research. Data dissemination. Development of training simulators.				
MCA Name	MCA No.						
Education K12 and Beyond, Basic Research	60316						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$638,970	$1,527,324	Major	Major	Major

Organization	North Carolina State University		Educating the undergraduate and graduate level workforce for geospatial industry, government and academia, interdisciplinary basic and applied geospatial research and services. Geospatial services cover the following relevant Business Uses: Environmental, agriculture, natural resources, forestry, water quality, air quality, hazards, and coastal change.				
MCA Name	MCA No.						
Education, Research, and Services	21516						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	$588,918	$14,472	Major	don't know	don't know
Inland Bathy	QL1B	2-3 yrs.	$249,195	$500,000	Major	don't know	don't know
Nearshore B.	QL0B	Annually	$276,582	$320,000	Major	don't know	don't know

Organization	Wyoming		WyGISC (Wyoming Geographic Information Science Center) is involved in research and service activities that involve a wide range of end products and solutions to natural resource and other problems. The main thread that ties our work is 'geospatial', which means we work directly with state and federal agencies as well as other University of Wyoming departments and NGO's to support their research or applied management needs. Due to this wide variety of support for geospatial needs, WyGISC is involved is supporting many mission critical activities for other agencies. Below is a list of topic-specific areas where we work and support: BU 01 – Water Supply and Quality BU 02 – Riverine Ecosystem Management BU 04 – Forest Resources Management BU 05 – Rangeland Management BU 06 – Natural Resources Conservation BU 07 – Wildlife and Habitat Management BU 10 – Geologic Assessment and Hazard Mitigation BU 11 – Geologic Resource Mining and Extraction BU 12 – Renewable Energy Resources BU 13 – Oil and Gas Resources BU 14 – Cultural Resources Preservation and Management BU 23 – Urban and Regional Planning BU 24 – Health and Human Services BU 26 – Education K-12 and Beyond, Basic Research BU 27 – Recreation. WYGISC houses and serves data for the state, provides application development, in addition to university programs.				
MCA Name	MCA No.						
Academic and Applied Research Programs and Support	22082						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	Annually	$514,016	$1,228,649	Moderate	Major	Major
Inland Bathy	QL3B	>10 yrs.	$134,421	Major	Major	Major	Major

Organization	Minnesota		Development of 3D visualizations to help students understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific research. Data dissemination. Development of training simulators.				
MCA Name	MCA No.						
Education K12 and Beyond, Basic Research	60622						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$443,412	$1,059,884	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$115,957	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	$356	$14	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	$4,580	Major	Major	Minor	Minor

Organization	Utah		Development of 3D visualizations to help students understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific research. Data dissemination. Development of training simulators.				
MCA Name	MCA No.						
Education K12 and Beyond, Basic Research	60476						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$439,270	$1,049,984	Major	Major	Major

Organization	South Dakota		Development of 3D visualizations to help students understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific research. Data dissemination. Development of training simulators.				
MCA Name	MCA No.						
Education K12 and Beyond, Basic Research	60421						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$405,248	$968,662	Major	Major	Major

Organization	North Carolina		Development of 3D visualizations to help students understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific research. Data dissemination. Development of training simulators.				
MCA Name	MCA No.						
Education K12 and Beyond, Basic Research	60334						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$500,000	$620,117	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$67,844	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	$28,150	$1,110	Major	Major	Minor
Offshore B.	Order 1a	4-5 yrs.	$1,204	Major	Major	Minor	Minor

Organization	Michigan		Development of 3D visualizations to help students understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific research. Data dissemination. Development of training simulators.				
MCA Name	MCA No.						
Education K12 and Beyond, Basic Research	60241						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$305,245	$729,625	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$79,825	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	$24,249	$956	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	$64,550	Major	Major	Minor	Minor

Organization	Iowa		The Office of the Chief Information Officer provides geospatial data coordination through the State Geospatial Coordinator. Our organization works with multiple state agencies that benefit from a centralized location for data acquisition, collection and dissemination. The OCIO is not a user of elevation data, but a data provider, and also provides clearinghouse services and data dissemination. The expressed requirements are representative of those provided to the Lidar/Elevation Working Group and the Iowa Geographic Information Council, as well as other user requests.				
MCA Name	MCA No.						
Iowa Geospatial Clearinghouse	1285						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$296,312	$707,148	Moderate	Major	Major
Inland Bathy	X-Sec meet needs	6-10 yrs.	$77,339	Minor	don't know	don't know	don't know

Organization	Mississippi		Our primary mission critical activity centers around all things geospatial. There is no one MCA that is deemed more primary than another. The funding determines what's primary today. Given the BUs, the MCA that best describes what we do would be: Scientific research. Data dissemination. Our basic research, applied research, process development, and data/information dissemination includes: Fate and transport of contaminants. Runoff and sedimentation analyses. Point and non-point source pollution modeling. Stream channel analysis and mapping. Stream bank erosion analysis. Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Land use and environmental planning. Coastal resiliency. Forest health assessment. Determination of standing inventory of forest resources. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Detailed site analysis to support precision farming. Flood risk modeling and mapping of riverine and coastal areas. Flood forecasts. Modeling and mapping the effects of sea level rise or subsidence. Post fire analysis to assess regrowth. Bathymetric measurements of near-shore submerged coastal topography. Under the ASSURE drone program, the University is working on rules-based drone management. MSU is a leader in the ASSURE consortium. MSU is a land grant university involved in precision agriculture, forestry, invasive species management, and other programs that aid the state in managing its lands.					
MCA Name	MCA No.						
Geospatial Education and Research	22056						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Depends on research project	$250,491	$598,748	Major	don't know	Major
Inland Bathy	QL1B	2-3 yrs.	$63,124	Major	Major	don't know	Major
Nearshore B.	QL3B	Annually	$2,694	$106	Major	Major	Major

Organization	South Carolina		Inland and Coastal Hazards Wetlands Mitigation Education through GIScience courses				
MCA Name	MCA No.						
Inland and Coastal Hazards Wetlands Mitigation Education Through GIScience Courses	21942						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$162,664	$388,815	Major	Major	Major
Inland Bathy	QL0B	6-10 yrs.	$42,538	Major	Major	Major	Major
Nearshore B.	QL1B	6-10 yrs.	$7,943	$313	Major	Major	Major
Offshore B.	Order 1a	6-10 yrs.	Major	Major	Major	Major	Major

Organization	U.S. Virgin Islands		Ocean circulation modeling to be used in helping students better understand the world's oceans and for use in oceanographic research related to fisheries, and coral reef conservation and management. Data are used for fish habitat modeling and circulation modeling, Given the limited availability of higher resolution bathymetric data, and the bottom substrate characterization in the region, this is a priority for our program due to the difficulty of developing data products and ocean models with Global gridded bathymetry data.				
MCA Name	MCA No.						
Coastal Zone Research and Management	21602						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	X-Sec meet needs	6-10 yrs.	$125,417	$69,194	Minor	don't know	Minor
Offshore B.	X-Sec meet needs	>10 yrs.	$163,999	$70,822	Moderate	Minor	Minor

Organization	Michigan		Providing education to researchers and professionals regarding topographic analysis as it relates to water movement, vegetation, erosion, cold air drainage, pollution and flooding.				
MCA Name	MCA No.						
Higher Education and Research	21932						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$282,612	$107,538	Major	Moderate	None

Organization	New York		Geological Mapping is our Mission Critical Activity. The goal of this work is to define the geologic framework. Historically this has been represented by 2D geologic maps, but within the last 10 years we have been striving to create 3D databases that define the spatial relationships between rock and soil from the surface to depth across NY State. Examples of this data and its derivative uses are farming, soil erosion, slope failures (landslides, bluff erosion, etc.), aggregate resources and mining, natural resource conservation, and groundwater protection.				
MCA Name	MCA No.						
Geological Mapping	21621						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$31,332	Major	Major	Moderate	Major
Inland Bathy	QL1B	6-10 yrs.	$252,412	Moderate	Major	Minor	Minor
Nearshore B.	QL3B	6-10 yrs.	$603	Minor	Major	Minor	None
Offshore B.	Order 1	6-10 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Maryland		Development of 3D visualizations to help students understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific research. Data dissemination. Development of training simulators.				
MCA Name	MCA No.						
Education K12 and Beyond, Basic Research	60223						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$51,959	$124,198	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$13,588	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	$1,152	$45	Major	Major	Minor

Organization	Mississippi		Geodetic monitoring, geospatial modeling and mapping the effects of sea level rise or subsidence. Population, ecological, and economic vulnerability assessments. Coastal inundation and infrastructure assessment. Elevation data are needed to administer the CORS program as well as for marine program activities.				
MCA Name	MCA No.						
Geodetic Monitoring and Geospatial Modeling and Mapping the Effects of Sea Level Rise or Subsidence	1469						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	$48,972	$7,538	Major	None	None
Inland Bathy	QL0B	Annually	$85,316	Major	Major	Major	Moderate
Nearshore B.	X-Sec meet needs	Annually	$3,015	Major	Major	Major	Major

Organization	Hawai'i		Mapping and estimating forest resources using LiDAR; Native and invasive tree species mapping. Scientific research. Study forest changes. Better elevation data are needed where gaps exist, including the higher elevations in Oahu, also the Big Island. The data are needed for identification and mapping of vegetation, including native vs. invasive species, vegetation structure, biomass, species mapping, and growing status, Elevation data are also important for orthorectification of imagery.				
MCA Name	MCA No.						
Vegetation Mapping and Inventory	21671						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	2-3 yrs.	$33,814	$80,826	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$8,842	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	$2,855	$112	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	$7,576	Major	Major	Minor	Minor

Organization	Guam		Research and education. Technical capacity building to support climate science adaptation and research in the region. Inland bathymetry are needed for freshwater biologists, H&H modeling, and watersheds.				
MCA Name	MCA No.						
Research and Education	21910						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$33,814	$80,826	Major	Major	None
Inland Bathy	QL0B	4-5 yrs.	$8,842	Major	Major	Major	Major
Nearshore B.	QL1B	4-5 yrs.	$2,855	$112	Major	Major	Major
Offshore B.	Order 3	4-5 yrs.	$7,576	Major	Major	Major	Minor

Organization	Connecticut		As a University, the mission critical activity is education and research. Elevation data is used in many disciplines in research including geography, archaeology, natural resources and more. As a data provider, elevation data is accessed and downloaded across the state for more applications than I am even aware of.				
MCA Name	MCA No.						
Education and Research	21745						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	As often as possible	$26,127	$62,453	Major	Major	don't know
Inland Bathy	QL1B	4-5 yrs.	$6,832	Major	Major	Major	Major

Organization	Delaware		Education. Help students understand elevation data - how to import, visualize and use in analysis.				
MCA Name	MCA No.						
Geospatial Support to Education and Research	22497						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	6-10 yrs.	$10,360	$24,763	Major	Major	None
Inland Bathy	QL1B	6-10 yrs.	$2,709	don't know	Major	don't know	don't know
Nearshore B.	QL2B	4-5 yrs.	$16,554	$653	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	$245	Major	Major	Minor	Minor

Organization	Virginia		Coastal research. In coastal systems where a change of only 10 cm in vertical relief can lead to biome level differences in vegetation (e.g., from salt marsh to shrub land, or tidal flat to marsh) topographic and bathymetric data are a key component that need to be integrated into our analyses and models. Without that baseline data it is impossible to develop a predictive understanding of the environmental systems.				
MCA Name	MCA No.						
Coastal Research	21631						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	4-5 yrs.	$37,060	$603	Major	Major	Minor

Organization	Rhode Island		Development of 3D visualizations to help students understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific research. Data dissemination. Development of training simulators.				
MCA Name	MCA No.						
Education K12 and Beyond, Basic Research	60392						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	$5,690	$13,602	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	$1,488	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	$1,187	$46	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	$554	Major	Major	Minor	Minor

Organization	Oklahoma State University		Environmental Modeling and Research				
MCA Name	MCA No.						
Environmental Modeling and Research	1145						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$13,254	Moderate	Moderate	Moderate	Minor
Inland Bathy	Coarser bathymetric data satisfies my needs	4-5 yrs.	$3,974	$1,206	Moderate	Minor	Minor

Organization	Virginia		Risk assessment for coastal hazards (storm surge, tidal inundation, rainfall and hydrologic runoff, and risk assessments.)				
MCA Name	MCA No.						
Risk Assessment for Coastal Hazards	1199						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL2B	4-5 yrs.	$9,045	$302	Moderate	Minor	Minor

Organization	SI		Development of 3D visualizations to help the public understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific earth and space research. Data dissemination. Development of training simulators. For the study of evolution on Mars, Earth datasets are used for analogue studies.				
MCA Name	MCA No.						
Museum and Research Centers	1323						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$1,890	$3,613	Moderate	don't know	don't know
Inland Bathy	QL0B	Event driven	$494	Moderate	Moderate	Moderate	don't know
Nearshore B.	QL0B	4-5 yrs.	$75	$1	don't know	don't know	don't know
Offshore B.	I don't know	Event driven	$854	None	don't know	don't know	don't know

Organization	Mississippi		CAT A hydrographic Survey education for M.S. in Hydrographic Science degree. CAT B hydrographic survey education for B.S. Marine Science (Hydrography) degree. Research in hydrographic hardware, software, techniques, data management.				
MCA Name	MCA No.						
Hydrographic Survey Education and Research	22191						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	4-5 yrs.	$2,382	Major	Major	Minor	None
Nearshore B.	QL0B	4-5 yrs.	$2,694	$106	Major	None	don't know
Offshore B.	Order 1a	6-10 yrs.	Major	Major	Major	None	don't know

Organization	Oregon State University		Numerous research applications ranging from coastal erosion analysis, post-earthquake/hazard damage assessment, infrastructure management, landslide mapping and analysis. At OSU there are researchers using elevation data for research activities for most of the business uses listed below. A very large mixture of data are needed for research and classroom activities. Consistent quality across broader geographies rather than “Best available” is best for many projects. Projects include coastal erosion and landslides. The university collects mobile lidar for some projects, also airborne lidar, drones, and SFM. The respondent's core research and teaching interests are in geomatics; as a result, we are always looking at new ways to use and analyze data for different applications and the requirements aren't really well fleshed out. We are also collaborating with others on a wide range of applications and they all have different requirements. While the many derivative products are nice to have for a few projects - the core requirement is to have the point cloud and DEM and we can create the rest as needed. However, there are many others at the university that would simply prefer to have the various products created for them to use directly to minimize processing time.				
MCA Name	MCA No.						
Education and Research	1103						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	Major	Major	Major	don't know	don't know
Inland Bathy	QL1B	2-3 yrs.	don't know	don't know	Major	don't know	don't know
Nearshore B.	QL1B	2-3 yrs.	don't know	don't know	Major	don't know	don't know
Offshore B.	Order 1b	2-3 yrs.	don't know	don't know	Major	don't know	don't know

Organization	Brown University		Natural Science Research, Social Science Research, Urban Planning, Cartography, Development of Training Materials, Campus Planning, and Facilities Management. For research activities, the best available data is used; projects can be anywhere in the world.				
MCA Name	MCA No.						
High Resolution Elevation Data Supporting Research, Teaching, Planning, and Facilities Management	1265						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	Major	Major	Major	Major	Major
Inland Bathy	I don't know	Project by project basis	Major	Moderate	Major	None	None
Nearshore B.	X-Sec meet needs	Depends on specific project at any given time.	don't know	Major	Major	don't know	don't know
Offshore B.	I don't know	Event driven	don't know	don't know	Major	don't know	don't know

Organization	Pennsylvania State University		Education of undergraduate and graduate students in 3D engineering design and modeling.				
MCA Name	MCA No.						
Undergraduate and Graduate Education and Academic Research	1314						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Annually	Major	Moderate	Major	Minor	Moderate
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Moderate	Minor	Minor
Nearshore B.	X-Sec meet needs	I don't know	Major	Major	Minor	Moderate	Moderate

Organization	Missouri		Geospatial data distribution and education. Share data with state and local agencies.				
MCA Name	MCA No.						
Geospatial Data Distribution and Education	1431						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL1B	2-3 yrs.	Major	Major	Major	Major	Major

Organization	North Carolina		Education about sampling and surveying the marine and aquatic environments. Training for bathymetric data collection.				
MCA Name	MCA No.						
Education About Sampling and Surveying the Marine and Aquatic Environments	21629						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	Annually	Major	None	Major	None	None
Inland Bathy	X-Sec meet needs	Event driven	Major	Major	Major	None	None
Nearshore B.	X-Sec meet needs	2-3 yrs.	None	Major	Major	don't know	don't know
Offshore B.	X-Sec meet needs	2-3 yrs.	Major	Major	Major	don't know	don't know

Organization	University of Maine System		Education and basic and applied research using geospatial applications in any number of BUs. This response reflects information provided by a sampling of researchers within the University of Maine System and does not reflect an official comprehensive response from the system as a whole.				
MCA Name	MCA No.						
Education and Applied Research	21716						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	4-5 yrs.	Major	Major	Major	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Major	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	Major	Major	Major	Moderate	Moderate
Offshore B.	Special Order	4-5 yrs.	Major	Major	Major	Moderate	Moderate

Organization	California		Development of 3D visualizations to help students understand the Earth they live on. Understanding of continental-scale climate change impacts. Ocean science. Ocean education. Scientific research. Data dissemination. Development of training simulators.				
MCA Name	MCA No.						
Education K12 and Beyond, Basic Research	60054						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	2-3 yrs.	Major	Major	Major	Major	Major
Inland Bathy	QL1B	4-5 yrs.	Major	Major	Major	Major	Major
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Major	Major	Minor
Offshore B.	Order 1a	6-10 yrs.	Major	Major	Major	Minor	Minor

Organization	CARES - University of Missouri Extension		Research, public service, and education. This response reflects input related to the University of Missouri Extension applications of the data and may not completely represent the entirety of the University of Missouri.				
MCA Name	MCA No.						
Research, Public Service, and Education	22414						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Minor	Minor	Moderate	Minor	None

BU 27 – Recreation

BU 27 Scope

Business Use #27 (BU 27) includes planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas, ski slopes, and golf courses; location-based products and services such as maps and guides for tourism; trail and vista site planning; and orienteering. There is no nationwide champion for this Business Use.

Figure E.27a. For golf courses, lidar data are combined with imagery for accurate and realistic mapping and navigation systems and simulators. Images courtesy of Tera Imaging. Images from www.3dgolfcourse.com/3d-technology.

BU 27 Background Information

Lidar data have long been used for design of lakes and ski slopes, but lidar data are also used for design and mapping of golf courses, professional auto racetracks, and trails used by hikers, bikers, snowmobiles, or all-terrain vehicles (ATVs). If elevation data or derivative products (e.g., slope, aspect, and curvature) are important, or if detailed information regarding forests or vegetation is needed, lidar is the technology of choice. DTMs are often required with centimeter level precision for design of professional golf courses and subsequently for golf course mapping, navigation, and simulation systems. Not all recreational facilities are privately funded; many of the larger recreational lakes in the U.S., for example, were built with taxpayer dollars for better management of water resources.

The images at Figure E.27a were obtained from a 3D Golf Course web site which advertises 3D golf course technology for golf GPS systems and other applications. Golf course terrain and topographic data from lidar are vital features in production of patented golf course mapping and navigation systems and simulators. Instead of artificial landscape creations or artist renditions, accurate 3D terrain and 3D object models are produced of mapped golf courses. Lidar is used to geo-process 3D terrain and imagery models for maximum horizontal and vertical accuracy and realism. Mobile GPS devices, such as Apple iPhone or Apple iPad, are used to see the course ahead and plan strategies.

Many video games, including *Microsoft Flight Simulator*, model the 3D earth as realistically as possible and become even more realistic when they use actual 3D data.

BU 27 Elevation Data Uses

Using their own words, respondents documented 26 Mission Critical Activities (MCAs) within the scope of BU 27 and identified the following 18 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.27a. BU 27 Elevation Data Uses

Data Use
Coastal Resource Management
1. Beach monitoring
Mapping/Boundary Delineation
2. Creation of bathymetry maps and vegetation height maps to serve state management and public service needs
3. Mapping existing hiking and off-road trails
Modeling
4. Inland bathymetry for modeling entire rivers, sand, and gravel permitting processes, and emergency response activities
Natural Resources Conservation
5. Provide recreational opportunities while implementing best management and conservation practices for the natural and cultural resources of the state
Planning
6. Help land managers more successfully monitor and tweak projects
7. Microtopography is needed to see small elevation changes and find the best route for trails and vistas
8. Parks and recreation site landscape evaluations
9. Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas (includes input from many state MCAs)
10. State forest preserve trail planning and implementation
11. Watershed planning
Recreation
12. Development of golf courses
13. Development of ski slopes
14. Enormous value to the tourism industry
15. Management of state parks and public managed lands for recreation
16. Orienteering
Stakeholder Engagement
17. Location-based products and services such as maps and guides
18. Updating recreational maps

BU 27 Tangible and Intangible Benefits

For the 26 MCAs that list Recreation as their primary Business Use:

- **Table E.27b** summarizes the reported future annual dollar benefits by geography type, totaling $9.8 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.27c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.27e.
- **Table E.27d** shows (in blue) the one federal agencies, 25 states and territories, and zero non-governmental entities that submitted MCAs with BU 27 as the primary Business Use. MCAs for which BU 27 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.27d.

- **Table E.27e** documents all the MCAs that listed BU 27 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.27e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 27 Reported Future Annual Dollar Benefits

Of the 26 MCAs that listed Recreation as their primary Business Use, no MCAs estimated their tangible annual benefits totally in financial terms; 25 MCAs had a combination of tangible and "Major" intangible benefits; and one MCA listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.27b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 26 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.27b. BU 27 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$817,136	$0	$817,136
Inland Bathymetry	$485,147	$0	$485,147
Nearshore Bathymetry	$8,498,200	$0	$8,498,200
Offshore Bathymetry	$0	$0	$0
Totals	**$9,800,483**	**$0**	**$9,800,483**

BU 27 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.27c. BU 27 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	24	23	1	1	1
Inland Bathymetry	22	22	21	21	1
Nearshore Bathymetry	14	14	13	13	1
Offshore Bathymetry	0	0	0	0	0
Totals	**60**	**59**	**35**	**35**	**3**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 27 Reported Future Annual Dollar Benefits Maps

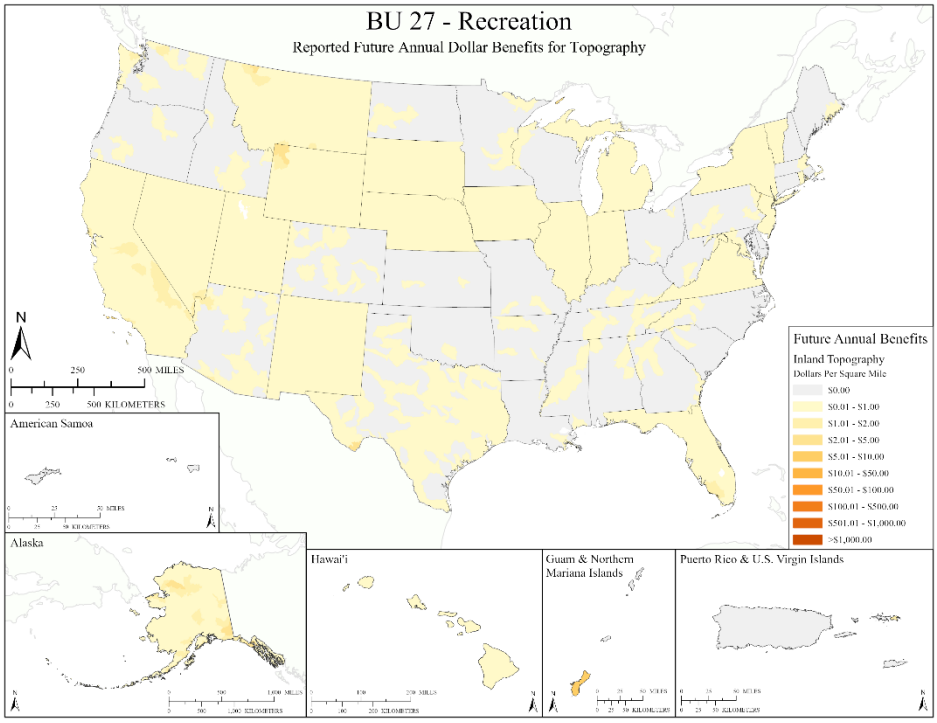

Figure E.27b. Reported Future Annual Dollar Benefits for Topography

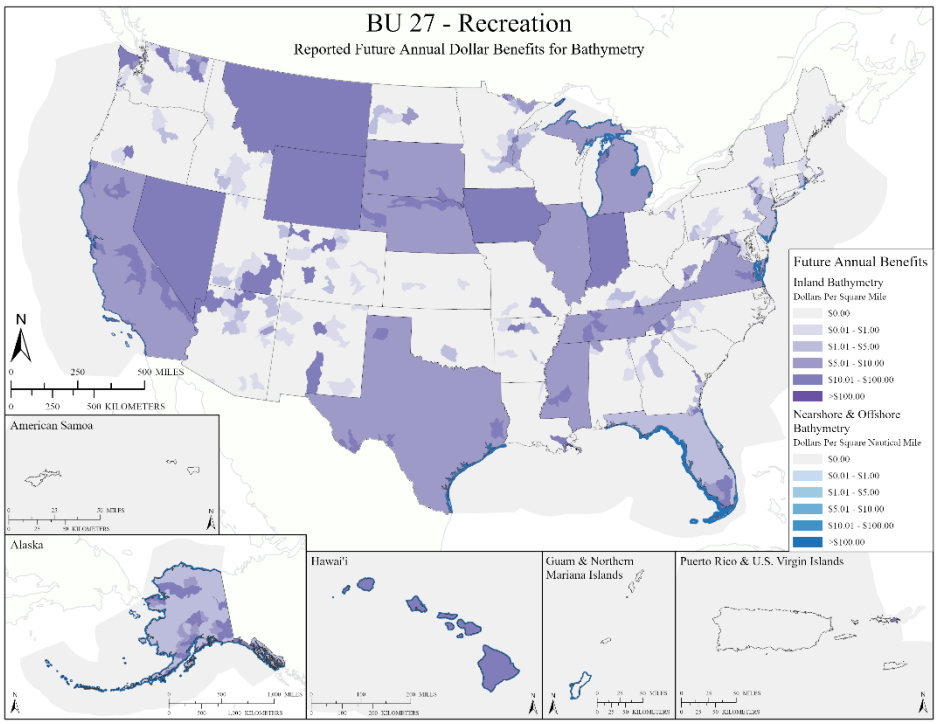

Figure E.27c. Reported Future Annual Dollar Benefits for Bathymetry

BU 27 Benefits Analysis

The total combined future annual benefits ($9.8 million per year) reported for BU 27 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 27 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in this study, only one federal agency (NPS) submitted an MCA listing BU 27 as their primary Business Use, providing dollar benefits for Inland Topography and Inland Bathymetry and indicating "Major" benefits for Nearshore Bathymetry.

  With thousands of recreation areas at over 450 lakes and waterways, the U.S. Army Corps of Engineers (USACE) provides fishing, boating, hiking and camping opportunities in 43 states, but USACE did not submit an MCA listing BU 27 as either primary, secondary, or tertiary, even though topographic and bathymetric data are vital for design and operation of these facilities.

  NOAA, TVA, USFS, and USGS all submitted MCAs listing BU 27 as tertiary, meaning no benefits accrued to this Business Use.
- State/Local/Tribal and U.S. Territory MCAs: Twenty-five (25) states and territories submitted MCAs listing BU 27 as their primary Business Use:
  - Inland Topography: 22 provided dollar benefits and one indicated "Major" benefits.
  - Inland Bathymetry: 20 provided dollar benefits and one indicated "Major" benefits.
  - Nearshore Bathymetry: 12 provided dollar benefits and one indicted "Major" benefits.
  - Offshore Bathymetry: None provided dollar benefits or "Major" benefits.
- Non-governmental MCAs: JMS Geomatics submitted an MCA (Mapping for the Gulf Industry), but listed BU 23 (Urban and Regional Planning) as primary and BU 27 as secondary; and the Appalachian Mountain Club submitted an MCA listing BU 27 as tertiary. No benefits accrue to BU 27 from either of these two MCAs.

  No MCA was received from the Recreational Boating community, a huge community of users that rely on inland bathymetry, nearshore bathymetry, and offshore bathymetry for safety of navigation.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.27b and E.27c:
  - 119 "Major" Operational and Customer Service benefits and 73 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 27 for which "Major" benefits are documented, this could easily be translated into significant additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 27 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 27:

- **Table E.27d** color-codes those organizations having an MCA with BU 27 as Primary, Secondary, or Tertiary.
- **Table E.27e** summarizes the 26 MCAs with primary benefits for BU 27, rank ordered from the highest to the lowest tangible benefits.

Table E.27d. Organizations having an MCA with BU 27 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	CMTS	DHS	DISDI	DTRA
	EPA	FAA	FBI	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	NOAA	**NPS**	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	USAF	USARC	USBR	USCB
	USCG	USFS	USGS	USMC	USN					

State/Ter	AL	**AK**	AR	AZ	**CA**	CO	CT	DC	DE	**FL**	*GA*	**HI**	**IA**	ID
	IL	**IN**	KS	KY	LA	MA	MD	ME	**MI**	MO	**MN**	**MS**	**MT**	NC
	ND	**NE**	NH	**NJ**	**NM**	**NV**	**NY**	*OH*	OK	*OR*	*PA*	**RI**	*SC*	**SD**
	TN	**TX**	**UT**	**VA**	**VT**	WA	*WI*	*WV*	**WY**	PR	VI	**GU**	AS	CNMI

Non-Gov	Appalachian Mountain Club	*JMS Geomatics*		

Table E.27e. MCA summaries for BU 27, rank ordered from the highest to the lowest tangible benefits.

Organization	Alaska		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60023						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$134,037	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$80,720	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$5,220,226	Major	Major	Major	Moderate

Organization	Florida		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering. The State of Florida includes 175 state parks in addition to significant, public managed lands for recreation. This resource would help land managers more successfully monitor and tweak projects. The value to Florida from the tourism industry is enormous.				
MCA Name	MCA No.						
Recreation	60088						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$12,876	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$7,754	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$1,636,274	Major	Major	Major	Moderate

Organization	Texas		Provide recreational opportunities while implementing best management and conservation practices for the natural and cultural resources of Texas. Inland bathymetry is needed for modeling entire rivers, sand and gravel permitting processes, and for emergency response activities.				
MCA Name	MCA No.						
Recreational Planning, Habitat Modeling, and Species Monitoring	22057						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$516	Major	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$36,579	Major	Major	Major	Major
Nearshore B.	QL0B	Event driven	$514,183	Major	Major	Major	Major

Organization	Michigan		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60242						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$13,328	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$8,026	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$478,499	Major	Major	Major	Moderate
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	NPS		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60707						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$287,471	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$173,122	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	Major	Major	Major	Major	Moderate

Organization	Virginia		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60507						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$9,265	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$5,580	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$252,968	Major	Major	Major	Moderate

Organization	Montana		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60268						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$132,000	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$60,000	Major	Major	Major	Moderate

Organization	California		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60055						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$36,288	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$21,853	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$105,180	Major	Major	Major	Moderate

Organization	New Jersey		Beach monitoring. Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location- based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60303						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,728	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$1,040	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$130,365	Major	Major	Major	Moderate
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Hawai'i		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60128						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,476	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$889	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$56,340	Major	Major	Major	Moderate
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Guam		Elevation data are needed for mapping existing hiking and off-road trails, updating recreational maps, and watershed planning. Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; golf courses. Location- based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60109						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,476	Major	Moderate	Moderate	Moderate
Nearshore B.	QL0B	4-5 yrs.	$56,340	Major	Major	Major	Moderate

Organization	Nevada		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60292						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$25,369	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$15,277	Major	Major	Major	Moderate

Organization	Indiana		Creation of bathymetry maps and potentially vegetation height maps/use in the future for purposes of serving our organization's management and public service needs, use by other agencies, and for use by the general public.				
MCA Name	MCA No.						
Fisheries Management	50000						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	$19,000	Major	Moderate	Minor	None
Inland Bathy	QL1B	4-5 yrs.	$9,999	Major	Moderate	Minor	None
Nearshore B.	QL1B	4-5 yrs.	$9,999	Major	Moderate	Minor	None

Organization	Wyoming		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60550						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$22,444	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$13,516	Major	Major	Major	Moderate

Organization	Illinois		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60147						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$12,928	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$7,785	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$14,394	Major	Major	Major	Moderate
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Nebraska		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60280						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$17,749	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$10,689	Major	Major	Major	Moderate

Organization	South Dakota		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60422						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$17,694	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$10,656	Major	Major	Major	Moderate

Organization	New Mexico		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60317						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$27,900	Major	Moderate	Moderate	Moderate

Organization	Rhode Island		Elevation data are needed for parks and recreation site landscape evaluation. Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60393						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$248	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$149	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$23,432	Major	Major	Major	Moderate

Organization	Iowa		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60181						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$12,912	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$7,776	Major	Major	Major	Moderate

Organization	Utah		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60477						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$19,180	Major	Moderate	Moderate	Moderate

Organization	New York		State forest preserve trail planning and implementation. Microtopography is needed to find the best route for trails; we need to see small elevation changes. High vertical accuracy is needed.				
MCA Name	MCA No.						
State Forest Preserve Trail Planning and Implementation	1217						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	>10 yrs.	$9,045	Moderate	None	Moderate	Moderate

Organization	Mississippi		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60251						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	4-5 yrs.	$6,586	Major	Major	Major	Moderate

Organization	Tennessee		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60433						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL0B	4-5 yrs.	$5,823	Major	Major	Major	Moderate

Organization	Vermont		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60490						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$2,206	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	$1,328	Major	Major	Major	Moderate

Organization	Minnesota		Planning and development of recreational facilities such as rafting, boating, swimming, diving, and fishing areas; ski slopes; and golf courses. Location-based products and services such as maps and guides. Tourism. Trail and vista site planning. Orienteering.				
MCA Name	MCA No.						
Recreation	60623						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	Moderate	Moderate	Moderate
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	Major	Major	Major	Major	Moderate
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

BU 28 - Telecommunications

BU 28 Scope

Business Use #28 (BU 28) includes telecommunication tower site selection; design of radio and radar systems; interference analysis; path profiles; and undersea telecommunications route selection and deployment. The Federal Communications Commission (FCC) is the champion for the use of elevation data to satisfy requirements for this Business Use.

Figure E.28a. Using a lidar DSM, a 9.5-foot antenna would have line-of-sight to the areas shown in red. The simulated antenna viewpoint can be elevated to any level necessary to achieve line-o-sight coverage to a large percentage of the total service area desired. Image courtesy of USGS.

BU 28 Background Information

Elevation data are needed to determine line-of-sight conditions between transmit and receive locations for broadcast, microwave, cellular, WiFi, and other users. Digital Surface Models (DSMs) are used as inputs to automated propagation prediction software and to determine where the vegetated terrain and buildings could interfere with wireless telecommunications.

Figure E.28a demonstrates how elevation data can be used to determine where line-of-sight exists and doesn't exist for antenna viewpoints simulated at different heights. This example demonstrates a short antenna, only 9.5-feet high; as the antenna is elevated by simulation, much broader areas become visible.

Because the FCC is a regulatory agency, primary benefits would accrue to FCC's customers.

BU 28 Elevation Data Uses

Using their own words, respondents documented 30 Mission Critical Activities (MCAs) that identified BU 28 as their primary Business Use and identified the following 27 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.28a. BU 28 Elevation Data Uses

Data Use
Data Development and Management
1. Bathymetry data for verification of depth to undersea cables
2. Location and elevation for call locations, including floor and unit in high rise buildings, elevation of campers, etc.
3. Provide 3D models for 5G networks
4. Provide customers with terrain models and nearshore bathymetry
5. Support the continued development and improvement of 9-1-1 data for Next Generation 9-1-1 services and wireless 9-1-1 call mapping to provide accurate civic addresses
Emergency Management
6. Disaster response and wildfires to help pinpoint responders to the right locations
7. Emergency response out to nine nautical miles offshore

Data Use
8. Telecommunications for state emergency response
Infrastructure Management
9. Critical infrastructure protection to include telecommunications, dam failure modeling, flooding, and likelihood of electric power outages
10. Increase submarine cable awareness with mariners and other users of the marine space to protect the global communications network
Modeling
11. 5G telecommunications modeling which is highly sensitive to vegetation and any changes to the surface model
Planning
12. Digital site survey of street furniture assets in urban environments for 5G network planning
13. Identify new siting locations as well as areas at risk of flooding or wind-shear
14. Radio frequency planning and network design based on high precision geodata models.
15. Telecommunication tower site selection (repeated for most states)
16. Undersea telecommunication route selection and deployment
Telecommunication
17. Analysis of advanced radio and radar systems
18. Design of radio and radar systems
19. Design, manufacture, and installation of submarine fiber optic cable systems
20. Ensure all Americans have access to robust, affordable broadband and voice services
21. Evaluate devices and technologies to determine interference risk potential and applicable standards
22. Evaluation of signal quality over service areas for cellular and broadband wireless data
23. Harmonize frequencies with Canada
24. Incumbent wireless provider coverage analysis
25. Interference analysis
26. Path profiles
27. Understand the oceanographic and marine geological environment in order to design underwater cables and armor those cables where necessary

BU 28 Tangible and Intangible Benefits

For the 30 MCAs that list Telecommunications as their primary Business Use:

- **Table E.28b** summarizes the reported future annual dollar benefits by geography type, totaling $0.0 per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.28c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.28e.
- **Table E.28d** shows (in blue) the four federal agencies, 23 states and territories, and three non-governmental entities that submitted MCAs with BU 28 as the primary Business Use. MCAs for which BU 28 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.28d.
- **Table E.28e** documents all the MCAs that listed BU 28 as the primary Business Use. They are not rank ordered from the highest to the lowest tangible benefits because all MCAs listed "Major"

benefits rather than dollar benefits. Table E.28e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 28 Reported Future Annual Dollar Benefits

Of the 30 MCAs that listed Telecommunications as their primary Business Use, no MCAs estimated their tangible annual benefits totally in financial terms; and 29 MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.28b, totaling $0 benefits because MCAs listed "Major" benefits only.

Table E.28b. BU 28 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$0	$0	$0
Inland Bathymetry	$0	$0	$0
Nearshore Bathymetry	$0	$0	$0
Offshore Bathymetry	$0	$0	$0
Totals	**$0**	**$0**	**$0**

BU 28 Intangible Benefits

All MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.28c. BU 28 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	28	27	0	0	0
Inland Bathymetry	8	8	0	0	8
Nearshore Bathymetry	1	1	1	0	2
Offshore Bathymetry	1	1	1	1	1
Totals	**38**	**37**	**2**	**1**	**11**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 28 Reported Future Annual Dollar Benefits Maps

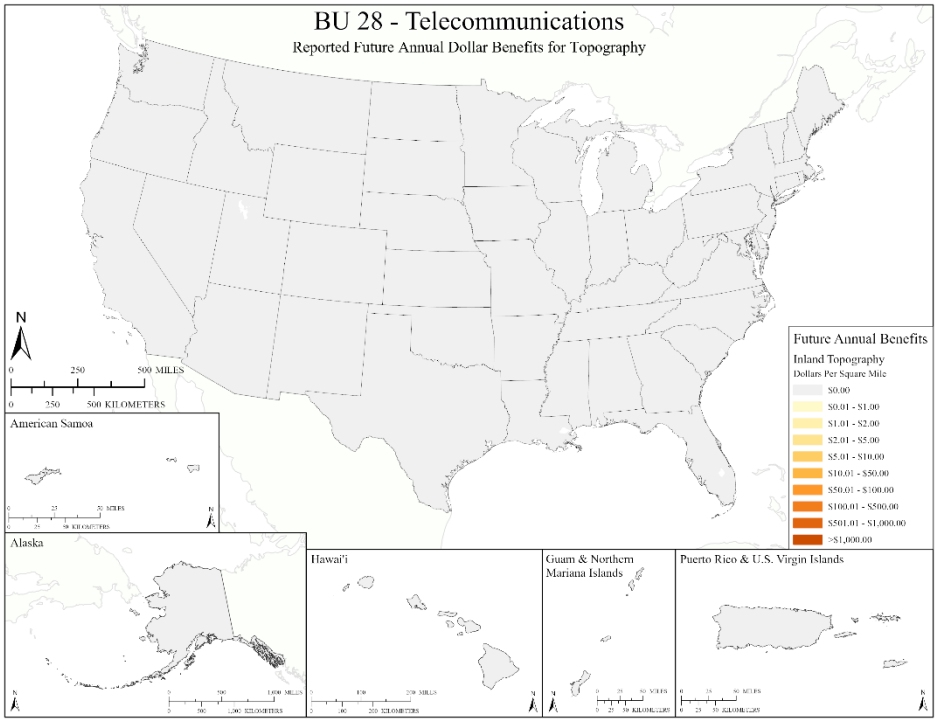

Figure E.28b. Reported Future Annual Dollar Benefits for Topography

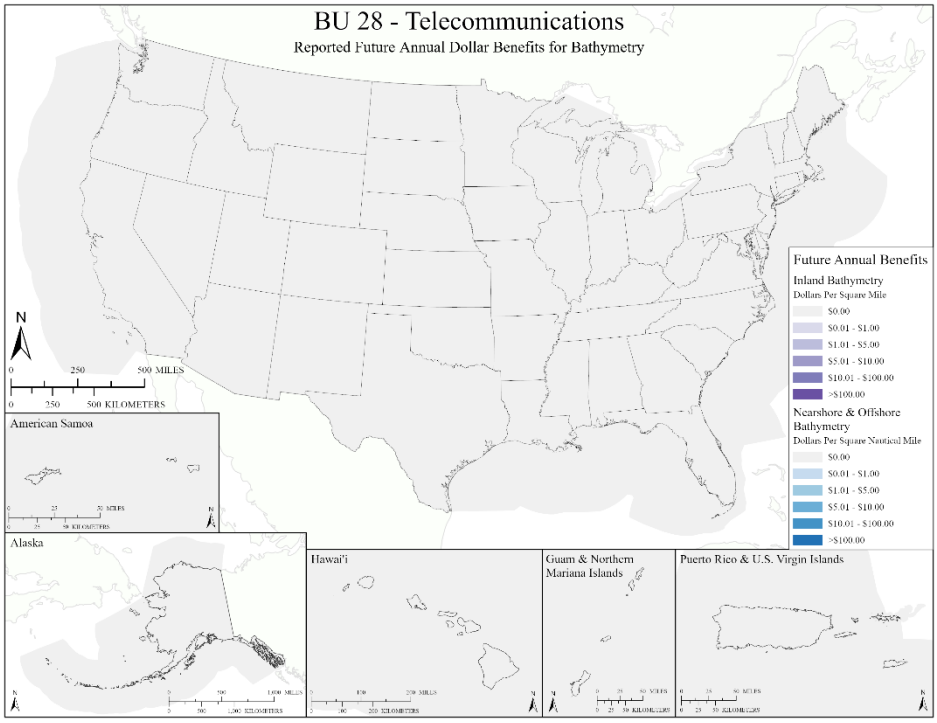

Figure E.28c. Reported Future Annual Dollar Benefits for Bathymetry

BU 28 Benefits Analysis

We believe that the BU 28 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, four (DHS, FBI, FCC, and USAF) submitted MCAs listing BU 28 as primary.
    - Inland Topography: None provided dollar benefits and three indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: None provided either dollar benefits or "Major" benefits.
    - Offshore Bathymetry: None provided either dollar benefits or "Major" benefits.
- State/Local/Tribal and U.S. Territory MCAs: Twenty-three (23) states and territories submitted MCAs listing BU 28 as their primary Business Use:
    - Inland Topography: None provided dollar benefits and 23 indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits and seven indicated "Major" benefits.
    - Nearshore Bathymetry: None provided either dollar benefits or "Major" benefits.
    - Offshore Bathymetry: None provided either dollar benefits or "Major" benefits.
- Non-governmental MCAs: Three non-governmental organizations (HERE Technologies, Maxar Technologies, and SubCom) submitted MCAs listing BU 28 as their primary Business Use:
    - Inland Topography: None provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: None provided either dollar benefits or "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits and one indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and one indicated "Major" benefits.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.28b and E.28c:
    - 75 "Major" Operational and Customer Service benefits and 14 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits could be significant if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 29 for which "Major" benefits are documented, this could easily be translated into significant dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 28 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 28:

- **Table E.28d** color-codes those organizations having an MCA with BU 28 as Primary, Secondary, or Tertiary.
- **Table E.28e** summarizes the 30 MCAs with primary benefits for BU 28, rank ordered from the highest to the lowest tangible benefits.

Table E.28d. Organizations having an MCA with BU 28 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	CMTS	**DHS**	DISDI	DTRA
	EPA	FAA	**FBI**	**FCC**	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	MARAD	NASA	NGA	NOAA	NPS	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	**USAF**	USARC	USBR	USCB
	USCG	USFS	USGS	USMC	USN					

State/Ter	AL	**AK**	AR	AZ	**CA**	CO	**CT**	DC	DE	**FL**	GA	**HI**	**IA**	ID
	IL	**IN**	KS	KY	LA	MA	**MD**	ME	MI	MO	**MN**	**MS**	**MT**	NC
	ND	**NE**	*NH*	*NJ*	**NM**	NV	NY	OH	*OK*	OR	**PA**	**RI**	SC	SD
	TN	**TX**	**UT**	**VA**	**VT**	WA	**WI**	WV	**WY**	PR	VI	**GU**	**AS**	CNMI

Non-Gov	**HERE Technologies**	**Maxar Technologies**	**SubCom**	

Table E.28e. MCA summaries for BU 28, rank ordered from the highest to the lowest tangible benefits.

Organization	FCC		Analysis of advanced radio and radar systems. Interference analysis. Incumbent wireless provider coverage analysis. Ensure that all Americans have access to robust, affordable broadband and voice services. Evaluate devices and technologies to determine interference risk potential and applicable standards. Harmonize frequencies with Canada. Bathymetry may also be used for verification of depth to undersea cables.				
MCA Name	MCA No.						
Communication Network Management	1201						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	2-3 yrs.	Major	Moderate	Minor	Minor	Minor
Inland Bathy	X-Sec meet needs	2-3 yrs.	Minor	Minor	Minor	Minor	Minor
Nearshore B.	X-Sec meet needs	>10 yrs.	Minor	Minor	None	None	None
Offshore B.	I don't know	>10 yrs.	don't know	None	None	None	None

Organization	Texas		Support the continued development & improvement of 9-1-1 data for NG9-1-1 services and Wireless 9-1-1 call mapping to provide accurate civic addresses. Responsible for emergency response out to 9 nm offshore (not part of USCG responsibilities). Elevation data are needed for location and elevation for call locations, including floor and unit in high rise buildings, elevation of campers, etc.				
MCA Name	MCA No.						
Support for NG9-1-1 Services	21755						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know
Inland Bathy	QL0B	4-5 yrs.	Major	Major	don't know	don't know	Major
Nearshore B.	QL2B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Offshore B.	X-Sec meet needs	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Maxar Technologies		Telecommunications: Provide 3D models for 5G networks. Maxar Technologies provides its customers with satellite-based terrain models and in conjunction with its partner TCarta, provides satellite-based nearshore bathymetry. In both cases, higher accuracy elevation products are used to calibrate satellite data. Maxar's customers use the elevation data for 5G telecommunications modeling, which is highly sensitive to vegetation and any changes to the surface model, also for placing underwater energy pipelines, and for disaster response to include tsunami and wildfire. In the case of wildfire, short wave infrared sensors can penetrate smoke and combined with higher accuracy elevation models, the data can help pinpoint responders to the right locations.				
MCA Name	MCA No.						
3D Modeling for 5G Telecommunication Networks	21943						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	None	None
Nearshore B.	I don't know	4-5 yrs.	Minor	Minor	None	None	None

Organization	SubCom		SubCom's primary Mission Critical Activity (MCA) is to design, manufacture, and install submarine fiber optic cable systems worldwide. Each component to this overall MCA involves understanding the oceanographic and marine geological environment in order to design the appropriate system for a specific part of the world, armor the cable where necessary, choose an appropriate route, and install the system with cable ships. Each component to this overall MCA involves understanding the oceanographic and marine geological environment in order to design the appropriate system for a specific part of the world, armor the cable where necessary, choose an appropriate route, and install the system with cable ships. It is also important to note that submarine cables are the global communications network, connecting people via the internet around the world. Thus, access to publicly available bathymetric data and improved nautical charts based upon such data are one of the first lines of defense against cable snags by allowing us to increase cable awareness with mariners and other users of the marine space to protect this global network.				
MCA Name	MCA No.						
Design, Manufacture, and Installation of Submarine Fiber Optic Cable Systems	22104						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	X-Sec meet needs	Event driven	Major	Major	Major	None	Major
Offshore B.	X-Sec meet needs	Event driven	Major	Major	Major	Major	Major

Organization	Alaska		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60024						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know
Inland Bathy	QL0B	4-5 yrs.	Major	Major	don't know	don't know	Major
Nearshore B.	QL2B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know
Offshore B.	X-Sec meet needs	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	American Samoa		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60033						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know
Inland Bathy	QL0B	4-5 yrs.	Major	Major	don't know	don't know	Major
Nearshore B.	QL2B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	California		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60056						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Connecticut		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60074						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Florida		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment. Telecommunications are vital to the state's emergency response. Lidar can be used for identifying new siting locations as well as areas at risk of flooding or wind-shear risks.				
MCA Name	MCA No.						
Telecommunications	60089						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Guam		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60110						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Hawai'i		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60129						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know
Nearshore B.	QL2B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Indiana		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60165						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Iowa		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60182						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Maryland		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60224						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Mississippi		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60252						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Montana		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60269						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Nebraska		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60281						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	New Mexico		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60318						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Pennsylvania		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60369						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know
Inland Bathy	QL0B	4-5 yrs.	Major	Major	don't know	don't know	Major

Organization	Rhode Island		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment. Elevation data are needed for evaluating signal quality over service areas for cellular and broadband wireless data.				
MCA Name	MCA No.						
Telecommunications	60394						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Utah		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60478						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Vermont		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60491						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Virginia		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60508						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know
Inland Bathy	QL0B	4-5 yrs.	Major	Major	don't know	don't know	Major

Organization	Wisconsin		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60533						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know

Organization	Wyoming		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60551						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Major	Major	don't know	don't know	don't know
Inland Bathy	QL0B	4-5 yrs.	Major	Major	don't know	don't know	Major

Organization	Minnesota		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60624						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Major	don't know	don't know	don't know
Inland Bathy	QL0B	4-5 yrs.	Major	Major	don't know	don't know	Major
Nearshore B.	QL2B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Air Force		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60639						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	Major	Major	Minor	Minor	Minor

Organization	FBI		Telecommunication tower site selection. Design of radio and radar systems. Interference analysis. Path profiles. Undersea telecommunication route selection and deployment.				
MCA Name	MCA No.						
Telecommunications	60718						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	Major	Major	Minor	Minor	Minor
Inland Bathy	QL0B	Annually	Major	Major	Minor	Minor	Major
Nearshore B.	QL1B	2-3 yrs.	Minor	Minor	None	None	None
Offshore B.	Order 1	2-3 yrs.	don't know	None	None	None	None

Organization	HERE Technologies		Digital Site Survey of street furniture assets in urban environments for 5G Network planning. Radio frequency planning and network design based on the high precision geodata models extracted from remote sensors like lidar and aerial/satellite images.				
MCA Name	MCA No.						
Digital Site Survey of street furniture assets in urban environments for 5G Network planning	60728						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Annually	Major	Major	Minor	Minor	Minor

Organization	DHS		Critical infrastructure protection to include dam failure modeling, likelihood of electric power outages, and inland flooding.				
MCA Name	MCA No.						
Critical Infrastructure Protection	22441						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	Annually	don't know	don't know	don't know	don't know	don't know

BU 29 - Military

BU 29 Scope

Business Use #29 (BU 29) includes tactical military operations; strategic defense; amphibious landings and logistics over-the-shore; operation of ships and submarines; weapons system testing; and management of flight facilities and offshore launch or target areas. Each of the military services (Army, Navy, Air Force, Marine Corps) are champions for their individual service requirements for elevation data in the U.S., working primarily with USGS, USACE, and NOAA for satisfying military requirements in states and territories. The National Geospatial-Intelligence Agency (NGA) addresses their requirements overseas.

Figure E.29a. Military exercises and war games routinely use lidar and radar data and imagery for battlefield simulations as part of the Intelligence Preparation of the Battlefield (IPB) process used in military planning.

BU 29 Background Information

Soldiers, sailors, airmen, and Marines are frequent users of simulators to educate them about the air, land, and sea battlefield environment on which they will train in the U.S. or operate overseas. Lidar data and imagery are used for training of military personnel to understand different landforms and seascapes, to perform viewshed analyses, to determine line-of-sight for our weapon systems used against the enemy and line-of-sight for enemy weapon systems used against us, to position telecommunications and weapon systems for optimal advantage, to perform cross-country movement analyses, to assess the advantages and disadvantages of forested areas, etc. Military teaching points can be best explained and understood when virtual battlefields include real-world elevation datasets combined with imagery.

BU 29 Elevation Data Uses

Using their own words, respondents documented 14 Mission Critical Activities (MCAs) that identified BU 29 as their primary Business Use and identified the following 23 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.29a. BU 29 Elevation Data Uses

Data Use
Data Development and Management
1. Coordinate, integrate, and synchronize geospatial information requirements and standards across the Army
2. Develop and field geospatial, enterprise enabled systems and capabilities to the Army and DOD
3. Develop, maintain, and publish geospatial information products and services in support of National and USACE civil and environmental programs
4. Generate virtual terrain for modeling and simulation
5. Provide direct geospatial support and products to warfighters.
6. Remote sensing data for harbors, ports, channels, and airfields used by the military

Data Use
Education
7. Help the U.S. Merchant Marine Academy or State Maritime Academies supported by MARAD
8. Training support
Environmental Protection
9. Determine best restoration actions on military installations
10. Military land cleanup
Infrastructure Management
11. Management of flight facilities and offshore launch or target areas
Military/Defense
12. Amphibious landings and logistics over-the-shore
13. Provision of logistical support for the military
14. Research, system development, testing, and evaluation
15. Strategic defense
16. Strategic sealift
17. Support exercise scenarios utilizing the full extent of the battlespace and movement across non-DOD space during training exercises
18. Tactical military operations
19. Tactical movements between DOD installations
20. Weapons system testing
Navigational Safety
21. Accurate navigational and depth information for U.S. military installations ensures maritime vessels can safely and effectively access military installations during time of need
22. Operation of ships and submarines
23. Safety of navigation and training on Naval bases, ranges, and support facilities

BU 29 Tangible and Intangible Benefits

For the 14 MCAs that list Military as their primary Business Use:

- **Table E.29b** summarizes the reported future annual dollar benefits by geography type, totaling $13.66 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.29c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.29e.
- **Table E.29d** shows (in blue) the six federal agencies, seven states and territories, and one non-governmental entities that submitted MCAs with BU 29 as the primary Business Use. MCAs for which BU 29 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.29d.
- **Table E.29e** documents all the MCAs that listed BU 29 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.29e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 29 Reported Future Annual Dollar Benefits

Of the 14 MCAs that listed Military as their primary Business Use, one MCA estimated their tangible annual benefits totally in financial terms; three MCAs had a combination of tangible and "Major" intangible benefits; and two MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.29b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 14 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.29b. BU 29 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$13,665,883	$3,075	$13,668,958
Inland Bathymetry	$0	$0	$0
Nearshore Bathymetry	$0	$0	$0
Offshore Bathymetry	$0	$0	$0
Totals	**$13,665,883**	**$3,075**	**$13,668,958**

BU 29 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.29c. BU 29 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	5	5	3	3	4
Inland Bathymetry	1	2	0	0	1
Nearshore Bathymetry	3	3	0	0	2
Offshore Bathymetry	2	3	0	0	2
Totals	**11**	**13**	**3**	**3**	**9**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 29 Reported Future Annual Dollar Benefits Maps

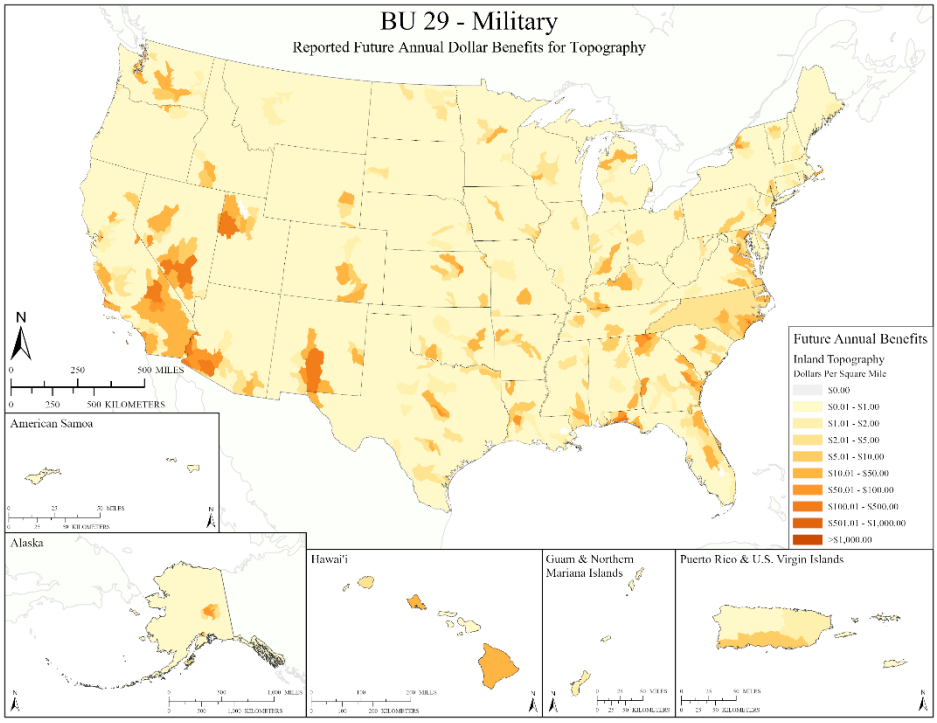

Figure E.29b. Reported Future Annual Dollar Benefits for Topography

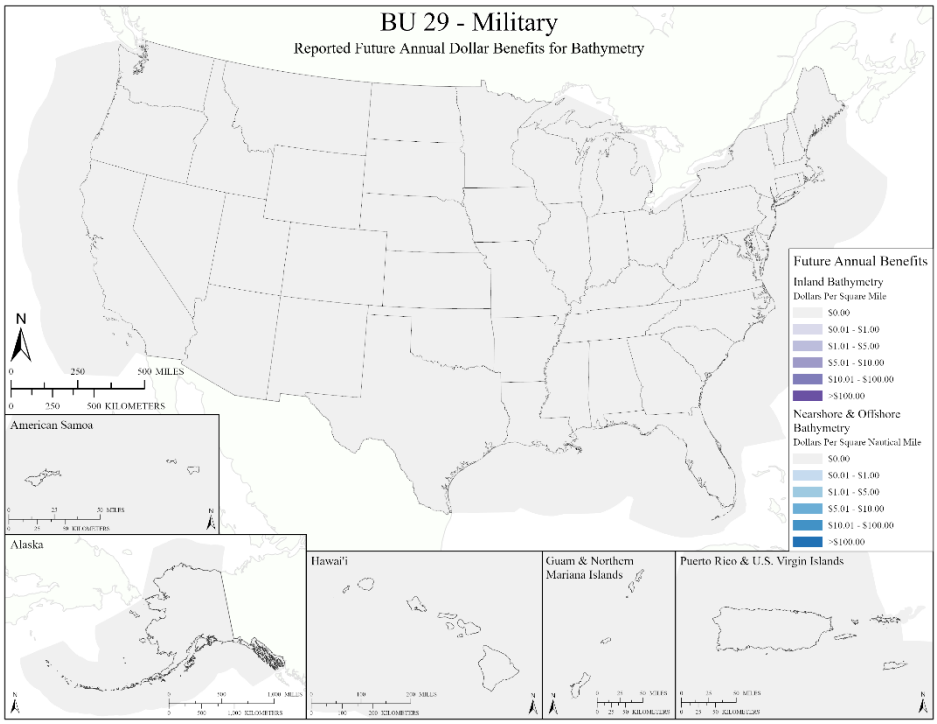

Figure E.29c. Reported Future Annual Dollar Benefits for Bathymetry

BU 29 Benefits Analysis

The total combined future annual benefits ($13.66 million per year) reported for BU 29 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 29 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies participating in the study, six federal agencies (DISDI, MARAD, USACE, USAF, USMC, and USN) submitted MCAs listing BU 29 as their primary Business Use, with different requirements for inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry:
    - Inland Topography: Four provided dollar benefits and one indicated "Major" benefits.
    - Inland Bathymetry: None provided dollar benefits and two indicated "Major" benefits.
    - Nearshore Bathymetry: None provided dollar benefits and three indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and three indicated "Major" benefits.
- State/Local/Tribal and U.S. Territory MCAs: Seven states submitted MCAs listing BU 29 as their primary Business use but most listed benefits as "unknown:"
    - Inland Topography: One provided dollar benefits, and none indicated "Major" benefits.
    - Inland Bathymetry: None provided either dollar benefits or "Major" benefits.
    - Nearshore Bathymetry: None provided either dollar benefits or "Major" benefits.
    - Offshore Bathymetry: None provided either dollar benefits or "Major" benefits.
- Non-governmental MCAs: One non-governmental organization (GSI Service Group, Inc.) submitted an MCA listing BU 29 as primary and providing dollar benefits.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.29b and E.29c:
    - 24 "Major" Operational and Customer Service benefits and 15 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 29 for which "Major" benefits are documented, this could easily be translated into hundreds of thousands of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 29 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 29:

- **Table E.29d** color-codes those organizations having an MCA with BU 29 as Primary, Secondary, or Tertiary.
- **Table E.29e** summarizes the 14 MCAs with primary benefits for BU 29, rank ordered from the highest to the lowest tangible benefits.

Table E.29d. Organizations having an MCA with BU 29 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	BLM	BOEM	CDC	CMTS	DHS	**DISDI**	*DTRA*
	EPA	FAA	*FBI*	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	**MARAD**	NASA	*NGA*	NOAA	NPS	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	**USACE**	**USAF**	USARC	USBR	USCB
	USCG	USFS	USGS	**USMC**	**USN**					

State/Ter	AL	AK	AR	AZ	**CA**	CO	CT	DC	DE	FL	GA	HI	IA	ID
	IL	**IN**	KS	**KY**	LA	MA	MD	ME	MI	MO	**MN**	MS	MT	**NC**
	ND	NE	NH	NJ	NM	NV	NY	OH	OK	OR	PA	**RI**	SC	SD
	TN	TX	UT	VA	VT	WA	WI	WV	WY	PR	VI	**GU**	AS	CNMI

Non-Gov	**GSI Service Group, Inc.**			

Table E.29e. MCA summaries for BU 29, rank ordered from the highest to the lowest tangible benefits.

Organization	USACE		The US Army Geospatial Center (AGC) is a Field Operating Activity under the Commanding General, United States Army Corps of Engineers (USACE). AGC coordinates, integrates, and synchronizes geospatial information requirements and standards across the Army, develops and fields geospatial-enterprise enabled systems and capabilities to the Army and the Department of Defense, and provides direct geospatial support and products to Warfighters. AGC develops, maintain, and publishes geospatial information products and services in support of National and USACE civil and environmental programs.				
MCA Name	MCA No.						
Army Geospatial Coordination	22536						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0	Event driven	$10,725,671	don't know	don't know	don't know	don't know

Organization	GSI Service Group, Inc.		Military land cleanup				
MCA Name	MCA No.						
Military Land Cleanup	22283						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	X-Sec meet needs	4-5 yrs.	$2,602,412	$3,075	Moderate	Moderate	Major

Organization	USMC		Training support. Current and future exercise scenarios utilizing the full extent of the battlespace and movement across non-DOD space during training exercises. Generate virtual terrain for modeling and simulations. Also tactical movements between DoD installations.				
MCA Name	MCA No.						
USMC Modeling and Simulation	21726						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$107,093	Major	Minor	Moderate	Moderate
Inland Bathy	QL0B	2-3 yrs.	Major	Major	Minor	Moderate	Moderate
Nearshore B.	QL0B	2-3 yrs.	Major	Major	Moderate	Moderate	Moderate
Offshore B.	Special Order	2-3 yrs.	Major	Major	Moderate	Moderate	Moderate

Organization	DISDI		Tactical military operations. Strategic defense. Amphibious landings and logistics over-the-shore. Operation of ships and submarines. Weapons system testing. Management of flight facilities and offshore launch or target areas.				
MCA Name	MCA No.						
Military	60651						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	2-3 yrs.	$103,010	Major	Major	Major	Major

Organization	North Carolina		Tactical military operations. Strategic defense. Amphibious landings and logistics over-the-shore. Operation of ships and submarines. Weapons system testing. Management of flight facilities and offshore launch or target areas.				
MCA Name	MCA No.						
Military	60335						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$100,000	don't know	don't know	don't know	don't know
Inland Bathy	QL0B	4-5 yrs.	don't know	don't know	don't know	don't know	don't know

Organization	Air Force		Tactical military operations. Strategic defense. Amphibious landings and logistics over-the-shore. Operation of ships and submarines. Weapons system testing. Management of flight facilities and offshore launch or target areas.				
MCA Name	MCA No.						
Military	60640						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1/QL 2	3-5 yrs.	$27,697	Major	Major	Major	Major

Organization	Navy		Safety of navigation; training; research; system development, testing, and evaluation. Areas of interest are Naval bases, ranges, and support facilities. Harbors, ports, channels and airfields require survey and remote sensing data.				
MCA Name	MCA No.						
Navy Geospatial Information and Services	1294						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Event driven	Major	Major	Major	Major	Major
Inland Topo	QL2	Event driven	Major	Major	Major	Major	Major
Inland Bathy	QL0B	Event driven	Moderate	Major	Minor	Minor	Major
Nearshore B.	I don't know	Event driven	Major	Major	don't know	Moderate	Major
Offshore B.	Order 1a	Event driven	Moderate	Major	Minor	Moderate	Major
Offshore B.	Order 2	Event driven	Moderate	Major	Minor	Moderate	Major

Organization	MARAD		Strategic sealift is a key component of MARAD's mission. MARAD maintains a fleet of government-owned vessels that wait in reserve, in U.S. ports, to provide logistics support for the military. In addition, MARAD administers programs to ensure the availability of privately-owned, commercial vessels to support national defense needs. Having accurate navigational and depth information for U.S. military installations is useful to ensuring that vessels under our purview (or privately-owned vessels that participate in our programs) can safely and effectively access military installations during a time of need. Elevation information could also be useful to the U.S. Merchant Marine Academy or the State Maritime Academies supported in part by MARAD					
MCA Name	MCA No.						
Military	60657						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	2-3 yrs.	Major	Major	Moderate	Moderate	Major
Offshore B.	Order 1a	2-3 yrs.	Major	Major	Moderate	Moderate	Major

Organization	California		Tactical military operations. Strategic defense. Amphibious landings and logistics over-the-shore. Operation of ships and submarines. Weapons system testing. Management of flight facilities and offshore launch or target areas.				
MCA Name	MCA No.						
Military	60057						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Guam		Raw LAS files can be used by NAVFAC to generate forest structure over disturbed limestone forest to determine best restoration actions. Tactical military operations. Strategic defense. Amphibious landings and logistics over-the-shore. Operation of ships and submarines. Weapons system testing. Management of flight facilities and offshore launch or target areas.				
MCA Name	MCA No.						
Military	60111						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Offshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Indiana		Tactical military operations. Strategic defense. Amphibious landings and logistics over-the-shore. Operation of ships and submarines. Weapons system testing. Management of flight facilities and offshore launch or target areas.				
MCA Name	MCA No.						
Military	60166						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Kentucky		Tactical military operations. Strategic defense. Amphibious landings and logistics over-the-shore. Operation of ships and submarines. Weapons system testing. Management of flight facilities and offshore launch or target areas.				
MCA Name	MCA No.						
Military	60198						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Rhode Island		Tactical military operations. Strategic defense. Amphibious landings and logistics over-the-shore. Operation of ships and submarines. Weapons system testing. Management of flight facilities and offshore launch or target areas.				
MCA Name	MCA No.						
Military	60395						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

Organization	Minnesota		Tactical military operations. Strategic defense. Amphibious landings and logistics over-the-shore. Operation of ships and submarines. Weapons system testing. Management of flight facilities and offshore launch or target areas.				
MCA Name	MCA No.						
Military	60625						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Inland Bathy	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know
Nearshore B.	I don't know	I don't know	don't know	don't know	don't know	don't know	don't know

BU 30 - Maritime and Land Boundary Management

BU 30 Scope

Business Use #30 (BU 30) includes delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high-water lines (OHWL).

NOAA is the national champion for establishment of most maritime boundaries, but not water boundaries between states. There is no single national champion for land boundaries, whether or not these boundaries are defined by water.

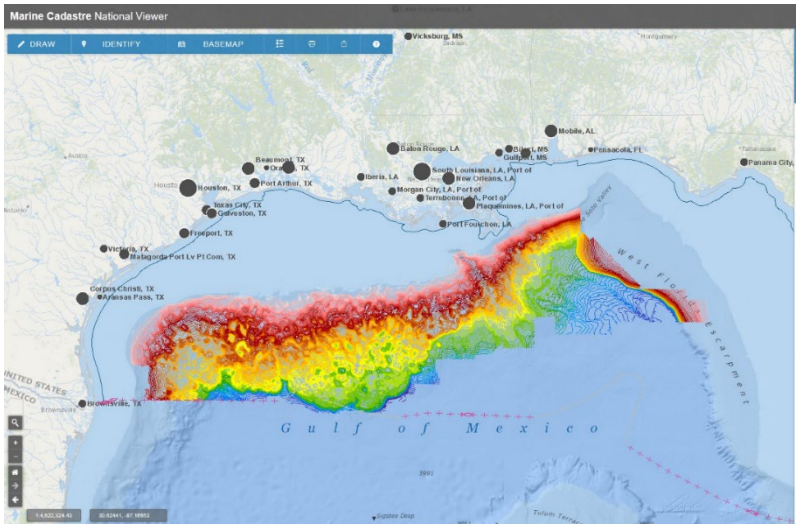

Figure E.30a. These BOEM 100' depth contours of the Gulf of Mexico are derived from NOAA's National Centers for Environmental Information (NCEI), formerly the National Geophysical Data Center (NGDC) bathymetric grids and BOEM's seismic grid. Imagery courtesy of the Marine Cadastre National Viewer.

BU 30 Background Information

NOAA is responsible for collecting observations on water levels, establishing the National Tidal Datum Epoch (NTDE), calculating tidal datum values, and delineating the official shoreline of the U.S. For defining the boundary between privately-owned and state-owned lands, different tidal datums are used by different states; for example, 15 coastal states use Mean High Water (MHW), six coastal states use Mean Lower Low Water (MLLW), and three coastal states use Mean Higher High Water (MHHW) as the boundary between privately-owned and state-owned lands. Different tidal datums are also used to define inland waters, state submerged lands, territorial seas, contiguous zone, exclusive economic zone, federal submerged lands, and the high seas.

MarineCadastre is a cooperative effort by the Department of the Interior's Bureau of Ocean Energy Management (BOEM) and the Department of Commerce's NOAA to provide authoritative ocean data, tools, and support to the offshore renewable energy and marine planning communities.

The mission of the BOEM is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

On land, the Bureau of Land Management (BLM) is responsible for the surveys of public lands only. Individual states are responsible for surveys on private lands. Too numerous to itemize, many state boundaries are defined by water boundaries.

BU 30 Elevation Data Uses

Using their own words, respondents documented 31 Mission Critical Activities (MCAs) that identified BU 30 as their primary Business Use and identified the following 35 uses of elevation data. In some cases, respondents listed more than one use of elevation data applicable to the Business Use. If more than one respondent listed the same data use, it is listed here only once.

Table E.30a. BU 30 Elevation Data Uses

Data Use
Data Development and Management
1. Address and cadastral information management
2. Cadastral survey and inland boundary management
3. Land boundary management and land development zoning
Environmental Protection
4. Resolve water quality issues between neighbors
Floodplain Management
5. Flood protection to U.S. residents
6. Flood risk analysis, flow volumes, and project planning and preliminary design of new facilities
Groundwater Management
7. Manage groundwater along the U.S. Mexico border
Habitat Analysis and Management
8. Habitat restoration and monitoring along boundaries
Infrastructure Management
9. Marine construction; building and maintenance of piers and wharves
10. Port infrastructure and waterway management
Mapping/Boundary Delineation
11. Apply the rights and obligations of the U.S. and Mexico under boundary and water treaties
12. Archaeological documentation and mapping along international boundaries
13. Define state-owned aquatic lands
14. Delimitation of legal and other coastal boundaries, inland boundaries and ordinary high-water lines (OHWL)
15. Delineation of Mean High Water (MHW)
16. Drainage basin mapping
17. Mapping of dynamic shorelines
18. Mapping stone walls and other property monuments.
19. Mapping town boundaries defined by rivers
20. Public Land Survey System (PLSS) cadastral surveys
21. Understanding all aspects of port boundaries
22. Understanding of maritime/land boundaries
Modeling
23. Flood control and hydrology modeling
24. H&H modeling for dam and levee safety
Navigational Safety
25. Navigation
Planning
26. Elevation for planning of mandatory field work
27. Land development
Regulatory Reviews and Enforcement
28. Review for engineering and utilities
29. Storm drain compliance
30. Verification of elevations or development approvals

Data Use
Stakeholder Engagement
31. Benefit the social and economic welfare of people on both sides of the international boundary
32. Improve relations between neighboring countries
Water Supply and Delivery
33. Ensure efficient conveyance, utilization and accurate accounting of boundary and transboundary river waters through the operation and maintenance of flood control structures, dams, reservoirs, power plants, and gaging stations in accordance with domestic law and international agreements
34. Reservoir silt determinations
Wildfire Management
35. Wildfire, forestry, and sovereign lands management

BU 30 Tangible and Intangible Benefits

For the 31 MCAs that list Maritime and Land Boundary Management as their primary Business Use:

- **Table E.30b** summarizes the reported future annual dollar benefits by geography type, totaling $75.44 million per year in tangible future annual benefits if all MCA requirements are satisfied.
- **Table E.30c** summarizes the hundreds of major intangible benefits for operational support, customer service, education and outreach, environmental, public safety, and other intangible benefits by geography type. Moderate and minor intangible benefits were not summarized but are shown individually for the various MCAs in Table E.30e.
- **Table E.30d** shows (in blue) the six federal agencies, 25 states and territories, and zero non-governmental entities that submitted MCAs with BU 30 as the primary Business Use. MCAs for which BU 30 was listed as the secondary or tertiary Business Use are shown in gold and light tan, respectively, in Table E.30d.
- **Table E.30e** documents all the MCAs that listed BU 30 as the primary Business Use, rank ordered from the highest to the lowest tangible benefits. Table E.30e documents the MCA name and number, Quality Level (QL) and Update Frequency (UF), and tangible and intangible benefits for each of the geography types.

BU 30 Reported Future Annual Dollar Benefits

Of the 31 MCAs that listed Maritime and Land Boundary Management as their primary Business Use, 23 MCAs estimated their tangible annual benefits totally in financial terms; three MCAs had a combination of tangible and "Major" intangible benefits; and three MCAs listed "Major" intangible benefits only. Others had "Moderate" or "Minor" intangible benefits.

The reported future annual dollar benefits are summarized in Table E.30b, using the highest value when an MCA specified a range of annual benefits. Note that these benefits will accrue only if the MCA receives both the Quality Level and Update Frequency specified for each MCA for specified Areas of Interest (AOI); these dollar benefits are reduced (by reduced value multipliers) for any implementation scenario when the MCA receives a Quality Level or Update Frequency poorer than required.

Because many of the 31 MCAs specified "Major" intangible operational or customer service benefits, the maximum potential annual dollar benefits could greatly exceed these values.

Table E.30b. BU 30 Reported Future Annual Dollar Benefits by Geography Type

Geography Type	Reported Future Annual Operational Benefits	Reported Future Annual Customer Service Benefits	Total Reported Future Annual Benefits
Inland Topography	$10,854,670	$14,913,594	$25,768,264
Inland Bathymetry	$4,730,959	$372,935	$5,103,894
Nearshore Bathymetry	$44,568,165	$0	$44,568,165
Offshore Bathymetry	$0	$0	$0
Totals	**$60,153,794**	**$15,286,529**	**$75,440,323**

BU 30 Intangible Benefits

Many MCAs specified "Major" operational and customer service benefits and "Major" education and outreach, environmental, public safety, and other intangible benefits as follows. We did not tabulate the number of "Moderate" or "Minor" intangible benefits.

Table E.30c. BU 30 Number of MCA Major Intangible Benefits by Geography Type

Geography Type	Major Intangible Operational Benefits	Major Intangible Customer Service Benefits	Major Education & Outreach Benefits	Major Environ-mental Benefits	Major Public Safety and Other Benefits
Inland Topography	28	2	6	2	3
Inland Bathymetry	24	24	22	22	3
Nearshore Bathymetry	23	23	0	22	1
Offshore Bathymetry	0	0	0	17	0
Totals	**75**	**49**	**28**	**63**	**7**

The types of benefits included under the categories of "Major" Education and Outreach Benefits, "Major" Environmental Benefits, and "Major" Public Safety and Other Benefits are truly significant, but organizations typically do not have procedures for translating such intangible benefits into tangible benefits in dollar terms.

BU 30 Reported Future Annual Dollar Benefits Maps

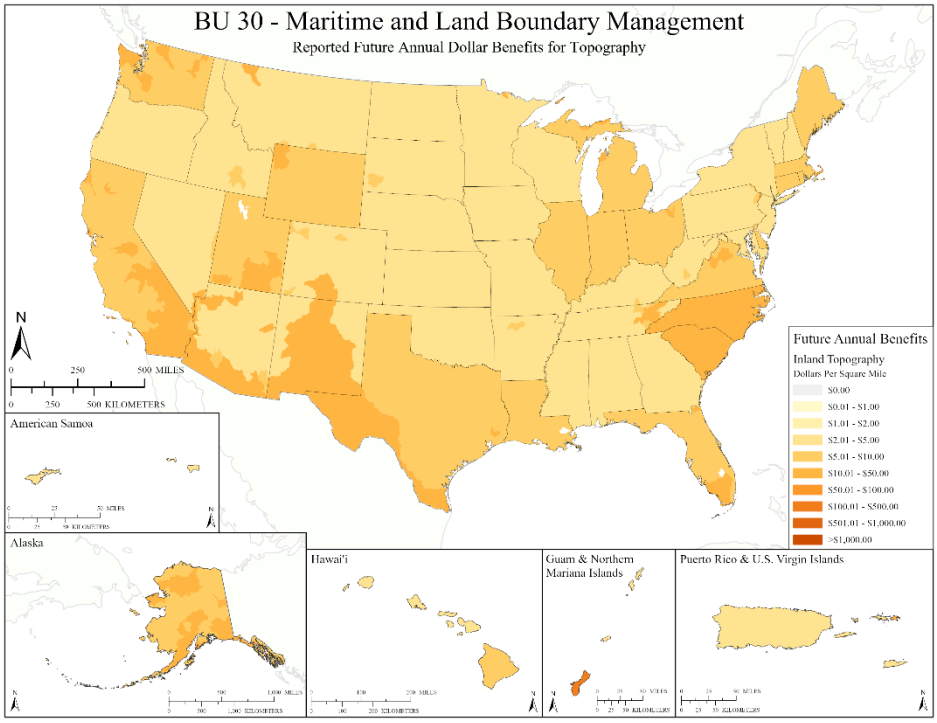

Figure E.30b. Reported Future Annual Dollar Benefits for Topography

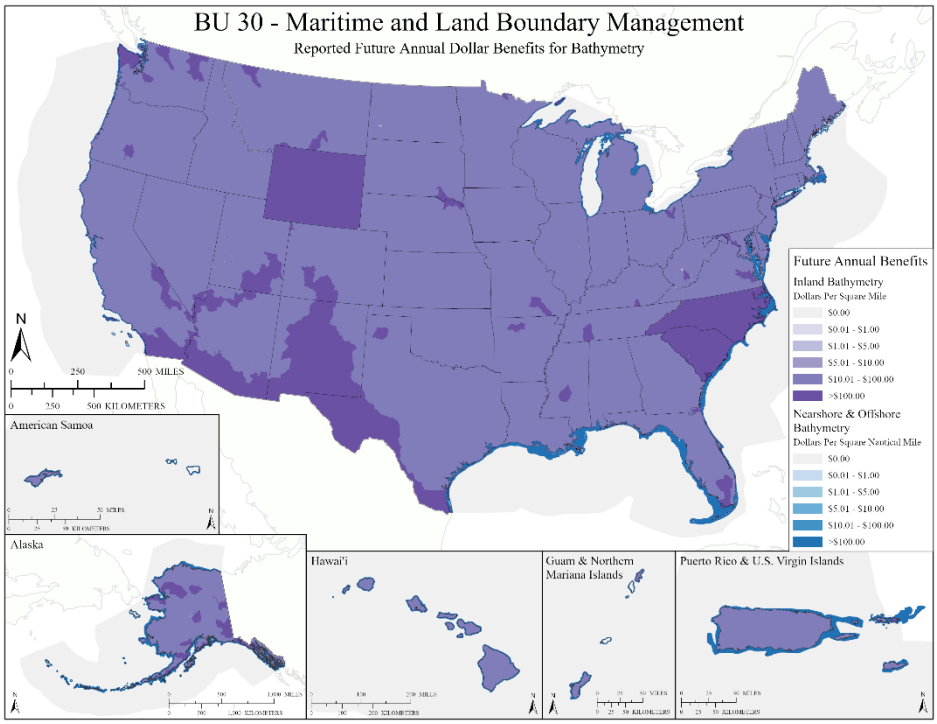

Figure E.30c. Reported Future Annual Dollar Benefits for Bathymetry

BU 30 Benefits Analysis

The total combined future annual benefits ($75.44 million per year) reported for BU 30 could be achieved only if all user requirements (e.g. Quality Levels and Update Frequencies) were met for each MCA. However, it is unlikely that an affordable national elevation program could deliver data that would meet all user requirements.

Regardless, we believe that the BU 30 Reported Future Annual Dollar Benefits are understated for the following reasons:

- Federal MCAs: Of the 45 federal agencies in the study, six federal agencies (BLM, CMTS, FBI, IBWC, MARAD, and NPS) submitted MCAs listing BU 30 as their primary Business Use, with differing requirements for inland topography, inland bathymetry, nearshore bathymetry and offshore bathymetry:
    - Inland Topography: Three provided dollar benefits and two indicated "Major" benefits.
    - Inland Bathymetry: Three provided dollar benefits and two indicated "Major" benefits.
    - Nearshore Bathymetry: One provided dollar benefits and three indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and two indicated "Major" benefits.
    - NOAA submitted an MCA listing BU 30 as secondary, and BOEM's MCA on geologic resources mining and extraction did not include BU 30 as either primary, secondary, or tertiary – meaning no dollar benefits accrued from either federal agency seen as champions for this Business Use.
- State/Local/Tribal and U.S. Territory MCAs: Twenty-five (25) states and territories submitted MCAs that designated BU 30 as their primary BU:
    - Inland Topography: 24 provided dollar benefits and none indicated "Major" benefits.
    - Inland Bathymetry: 17 provided dollar benefits and one indicated "Major" benefits.
    - Nearshore Bathymetry: 18 provided dollar benefits and two indicated "Major" benefits.
    - Offshore Bathymetry: None provided dollar benefits and 13 indicated "Major" benefits.
- Non-governmental MCAs: Two non-governmental organization (Cooke Aquaculture and Leidos) submitted MCAs listing BU 30 as secondary, and the University of New Hampshire Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC) submitted an MCA listing BU 30 as tertiary, meaning no dollar benefits accrued to BU 30 from non-governmental organizations.
- Increased Combined Benefits: There are several significant factors that cause the total combined benefits to be understated, i.e., the total combined benefits should be higher than summarized above in Tables E.30b and E.30c:
    - 124 "Major" Operational and Customer Service benefits and 98 "Major" benefits for Education and Outreach, Environmental, Public Safety and Other benefits indicate that actual benefits would be significantly higher than the total combined Reported Future Annual Benefits reported above if we had a way to translate "Major" benefits into dollar savings. For example, if "Major" could be translated into a one percent savings for all of the total program budgets for BU 30 for which "Major" benefits are documented, this could easily be translated into hundreds of thousands of additional dollars in annual savings. But we do not know all of the program budgets and have no way of knowing if a one percent savings is appropriate or not.

BU 30 Summary Tables for Requirements and Benefits

The following tables summarize the Mission Critical Activities (MCAs) with requirements and benefits for BU 30:

- **Table E.30d** color-codes those organizations having an MCA with BU 30 as Primary, Secondary, or Tertiary.
- **Table E.30e** summarizes the 31 MCAs with primary benefits for BU 30, rank ordered from the highest to the lowest tangible benefits.

Table E.30d. Organizations having an MCA with BU 30 as Primary, Secondary, or Tertiary

Legend	**Primary BU (1st)**	*Secondary BU (2nd)*	Tertiary BU (3rd)	N/A

Federal	APHIS	ARS	BIA	**BLM**	BOEM	CDC	**CMTS**	DHS	DISDI	DTRA
	EPA	FAA	**FBI**	FCC	FEMA	FERC	FHWA	FRA	FSA	FWS
	IBWC	IJC	**MARAD**	NASA	NGA	*NOAA*	**NPS**	NRC	NRCS	NREL
	ORNL	OSMRE	PHMSA	SI	TVA	USACE	USAF	USARC	USBR	*USCB*
	USCG	USFS	USGS	USMC	USN					

State/Ter	AL	**AK**	*AR*	AZ	**CA**	CO	**CT**	DC	**DE**	**FL**	GA	**HI**	IA	ID
	IL	**IN**	KS	KY	**LA**	**MA**	MD	**ME**	**MI**	MO	**MN**	**MS**	*MT*	**NC**
	ND	NE	NH	NJ	NM	NV	*NY*	**OH**	OK	OR	PA	**RI**	**SC**	SD
	TN	**TX**	**UT**	**VA**	VT	**WA**	WI	WV	**WY**	PR	*VI*	**GU**	AS	CNMI

Non-Gov	*Cooke Aquaculture*	*Leidos*	University of New Hampshire Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC)	

Table E.30e. MCA summaries for BU 30, rank ordered from the highest to the lowest tangible benefits.

Organization	MARAD		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL). Understanding all aspects of port boundaries is of great interest to MARAD and access to comprehensive elevation information could help us to better understand maritime/land boundaries as they pertain to ports.				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60658						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$5,161,313	$5,437,701	Major	Minor	Minor
Inland Bathy	QL0B	4-5 yrs.	$2,123,651	$212,214	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$26,214,097	Major	Moderate	Major	Moderate
Offshore B.	Order 1a	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	Alaska		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60025						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$657,314	$2,520,175	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$493,291	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$9,265,541	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	NPS		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60708						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$1,798,230	$1,894,525	Major	Minor	Minor
Inland Bathy	QL0B	4-5 yrs.	$739,422	$73,889	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	Major	Major	Moderate	Major	Moderate

Organization	Florida		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL). Due to Florida's highly dynamic, physical and political state, real-time ground-truthing is needed more than a one-time snapshot of elevation data.				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60090						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$63,144	$242,100	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$47,388	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$2,904,274	Major	Moderate	Major	Moderate

Organization	Texas		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60449						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$297,871	$1,142,055	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$223,542	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$912,639	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	IBWC		The mission of the IBWC is to apply the rights and obligations that the Governments of the United States and Mexico assume under boundary and water treaties, and to do so in way that benefits the social and economic welfare of people on both sides of the boundary and improves relations between the two countries. Elevation data are needed for habitat restoration and monitoring, archaeological documentation and mapping, flood control and hydrology modeling, and water quality issues. IBWC provides flood protection to U.S. residents and ensures the efficient conveyance, utilization, and accurate accounting of boundary and transboundary river waters through the operation and maintenance of flood control structures, dams, reservoirs, power plants, and gaging stations in accordance with domestic law and international agreements. The Transboundary Aquifer Program manages groundwater along the U.S. Mexico border. Elevation data are needed for H&H modeling for dam and levee safety, flood risk analysis, flow volumes, and project planning and preliminary design of new facilities. Bathymetry is needed for reservoir silt determinations.					
MCA Name	MCA No.						
Boundary Preservation, Water Conveyance, and Water Quality Management Along the U.S. Mexico Border	21609						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	2-3 yrs.	$1,513,136	$163,654	Major	Major	Major
Inland Bathy	QL0B	4-5 yrs.	$247,295	$86,832	Major	Major	Major

Organization	Louisiana		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60204						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$51,856	$198,819	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$38,916	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$1,395,786	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	Michigan		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60243						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$65,361	$250,599	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$49,051	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$849,303	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	North Carolina		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60336						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	$200,000	$212,987	Moderate	Minor	None
Inland Bathy	QL0B	4-5 yrs.	$200,000	Major	Major	Major	Moderate
Nearshore B.	QL0B	4-5 yrs.	$278,000	Major	Moderate	Major	Moderate
Offshore B.	I don't know	4-5 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	California		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60058						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$177,957	$682,296	Moderate	Minor	None

Organization	South Carolina		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60406						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$200,000	$133,543	Moderate	Minor	None
Inland Bathy	QL0B	6-10 yrs.	$200,000	Major	Major	Major	Moderate
Nearshore B.	QL1B	6-10 yrs.	$278,206	Major	Moderate	Major	Moderate
Offshore B.	I don't know	6-10 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	Washington		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL). Elevation data are used to define state-owned aquatic lands.				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60524						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$76,020	$291,466	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$57,050	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$351,868	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	Virginia		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60509						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$45,439	$174,217	Moderate	Minor	None
Nearshore B.	QL0B	2-3 yrs.	$449,001	Major	Moderate	Major	Moderate

Organization	Wyoming		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60552						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$110,065	$421,995	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$82,600	Major	Major	Major	Moderate

Organization	Delaware		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60079						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$2,218	$8,505	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$1,664	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$579,812	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	Utah		The following Business Uses are important activities for the Department of Natural Resources: BU 30 - Maritime and Land Boundary Management BU 02 - Riverine Ecosystem Management BU 03 - Coastal Zone Management BU 04 - Forest Resources Management BU 06 - Natural Resources Conservation BU 17 - Wildfire Management, Planning and Response BU 20 - Marine and Riverine Navigation and Safety.				
MCA Name	MCA No.						
Wildfire, Forestry, and Sovereign Lands Management	1169						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	>10 yrs.	$94,320	$360,854	Major	Moderate	don't know
Inland Bathy	QL2B	>10 yrs.	$71,939	Major	Major	Major	Moderate

Organization	Ohio		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60348						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$46,424	$177,995	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$34,840	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$205,754	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	Maine		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60213						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$36,468	$139,821	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$27,368	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$202,887	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	Illinois		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60148						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$63,398	$243,073	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$47,578	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$25,549	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	Massachusetts		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60232						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$9,125	$34,988	Moderate	Minor	None
Nearshore B.	QL0B	2-3 yrs.	$267,431	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	Mississippi		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60253						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Bathy	QL2B	6-10 yrs.	$40,252	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$188,679	Major	Moderate	Major	Moderate

Organization	Indiana		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60167						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$40,715	$156,105	Moderate	Minor	None

Organization	Hawai'i		Stormdrain compliance, drainage basin mapping. Marine construction, building and maintaining piers and wharves. Navigation, port infrastructure and waterway management.				
MCA Name	MCA No.						
Harbor Management and Maintenance	1147						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Nearshore B.	QL0B	2-3 yrs.	$100,000	Moderate	Moderate	Major	Moderate
Offshore B.	Order 1a	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	Tennessee		Address and Cadastral Information Management. Water, sewer, electric, and gas utilities are covered under this activity. Elevation is critical to land development and review for engineering and utilities. Local ordinances address sinkholes, elevation, detention, and water runoff; developers must verify elevations on contour maps in order to get approvals.				
MCA Name	MCA No.						
Address and Cadastral Information Management	22180						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	6-10 yrs.	$90,450	Moderate	Moderate	None	None

Organization	Connecticut		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL). Delineation of Mean High Water. Mapping of stone walls and other property monument. Town boundaries defined by rivers.				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60075						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$5,594	$21,450	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$4,198	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$57,748	Major	Moderate	Major	Moderate

Organization	Rhode Island		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60396						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	$1,218	$4,671	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	$914	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	$41,590	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	Guam		Land Boundary Management and Land development Zoning				
MCA Name	MCA No.						
Land Boundary Management and Land Development Zoning	21519						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1HD	4-5 yrs.	$47,034	Moderate	Moderate	Minor	Minor
Inland Bathy	X-Sec meet needs	2-3 yrs.	Major	Major	Moderate	Minor	Minor
Nearshore B.	QL2B	4-5 yrs.	Major	Major	Minor	Minor	don't know

Organization	Minnesota		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60626						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	6-10 yrs.	Major	Moderate	Moderate	Minor	None
Inland Bathy	QL2B	6-10 yrs.	Major	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	Major	Major	Moderate	Major	Moderate
Offshore B.	I don't know	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	CMTS		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60700						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL1	4-5 yrs.	Major	Moderate	Major	Minor	Minor
Inland Bathy	QL0B	4-5 yrs.	Major	Major	Major	Major	Moderate
Nearshore B.	QL0B	2-3 yrs.	Major	Major	Moderate	Major	Moderate
Offshore B.	Order 1a	2-3 yrs.	Moderate	Moderate	Moderate	Major	Moderate

Organization	FBI		Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).				
MCA Name	MCA No.						
Maritime and Land Boundary Management	60719						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL0HD	Annually	Major	Moderate	Major	Major	Major
Inland Bathy	QL0B	Annually	Major	Major	Minor	Moderate	Major
Nearshore B.	QL1B	2-3 yrs.	Major	Major	Moderate	Moderate	Major

Organization	BLM		Cadastral Survey and inland boundary management. Public Land Survey System (PLSS) cadastral surveys are BLM's responsibility. Surveys are done for PLSS updates when land exchanges to/from federal agencies occur. The conveyance program in Alaska is quite active. NGS sets the coordinate grid and BLM places markers tied to the NGS grid. Physical field surveys are required. Elevation data can help plan the field work but the field work is mandatory.				
MCA Name	MCA No.						
Cadastral Survey and Inland Boundary Management	22109						
	QL	UF	Op. Benefits	C.S. Benefits	Education	Environ.	Safety
Inland Topo	QL2	4-5 yrs.	Minor	None	None	None	None