3D Nation Requirements and Benefits Study

Introduction

This questionnaire is sponsored by the National Oceanic and Atmospheric Administration (NOAA) Office of Coast Survey (OCS) and the U.S. Geological Survey (USGS) National Geospatial Program (NGP). The questionnaire covers a wide range of business uses that depend on 3D data to inform policy, regulation, scientific research, and management decisions. For purposes of this questionnaire, 3D data refers to topographic data (precise three-dimensional measurements of the terrestrial terrain) and bathymetric data (three-dimensional surface of the underwater terrain). Questions will be asked about how 3D data relate to other data types, such as the shoreline; characteristics of tides, currents, and waves; and the physical and chemical properties of the water, itself. A series of questions will be asked as they relate to specific Mission Critical Activities. These will include questions about the area (geographic extent), 3D data accuracy requirements, linkages to other data to support a wide range of analysis, and benefits of having the required data.

We are working to improve our technology systems, data, and services that provide information about 3D data and related applications within the United States. By learning more about your business uses and associated benefits that would be realized from improved 3D data, we will be able to prioritize and direct investments that will best serve your needs. This questionnaire is part of an effort to develop and refine future program alternatives that would provide enhanced 3D data to meet many Federal, State, and other national business needs.

Because 3D data are collected and used to meet a wide range of mission critical needs, we are seeking input from managers and data users from a variety of government entities (e.g., Federal, State, local, Tribal) as well as not-for-profit, academic, and private/commercial entities). The findings are expected to establish a baseline of national business needs and associated benefits for 3D data and associated technologies. This baseline will enhance the responsiveness of NOAA, USGS, and partner agency programs to stakeholder needs, and inform the design of directed future programs that balance requirements, benefits, and costs at a national scale.

We would like to thank you in advance for participating in this study. We will aggregate collected responses at the agency and national levels. We will not distribute responses associated with you as an individual. We ask you for some basic organizational and contact information to help us interpret the results and, if needed, to contact you for clarification.

Instructions

Add any additional specific instructions that are specific to the survey software used

This questionnaire should not take more than xx minutes to complete. This will include the time that you may need to read explanatory FAQs and supporting information that will help you to respond to the questionnaire. Although you are not expected to spend a great deal of time researching the response for each question, you will have the option to exit the questionnaire and return at a later time.
The responses to the questions are in two formats – open-ended and single (or multiple) response. Responses to the open-ended questions will be entered in a text box below the question. All single (or multiple) response questions will be entered by using drop-down or check boxes where you will choose the best response(s) for your agency and data uses.

It is recommended that you first review two tutorials available from this web site:

1. The first is a list of frequently asked questions (FAQs) pertaining to 3D data terms used throughout the questionnaire. Even if all the terms in the FAQs are familiar to you, reviewing this material will help ensure that all respondents are thinking of the same definitions when answering the questions.
2. The second tutorial provides examples of the kinds of benefits one might receive from improved topographic and/or bathymetric information. These benefits are organized into three categories: (1) Operational Improvements, (2) Customer Service Improvements, and (3) Societal Benefits. This tutorial also demonstrates methods for estimating financial benefits, which you will be asked to assess in dollar amounts wherever possible.

Part 1: A Little About You and Your Agency or Organization

Please tell us a little about yourself so that we can contact you for clarification, if needed, and so we can aggregate responses by Agency, program, State, organization, etc.

Question 1. Please enter your contact information.

Your name (Last, First, MI).

<table>
<thead>
<tr>
<th>Last:</th>
<th>First:</th>
<th>Middle Initial:</th>
</tr>
</thead>
</table>

Your Agency, State, or organization.

Name of your program supported by 3D data (topographic and/or bathymetric data/information).

Your job title.

Your telephone number. Enter text as xxx-xxx-xxxx (ext.)
Question 2. Which type of organization do you represent? Please select one of the following seven options.

- [ ] Federal Agencies and Commissions (link to Questions 2a and 2b)
- [ ] State or U.S. Territorial government (link to Questions 2c)
- [ ] Tribal government (link to Question 2d)
- [ ] Regional, County, City or other local government (link to Questions 2e)
- [ ] Academic or Not-for-Profit (link to Question 2f)
- [ ] Private or Commercial (link to Question 2g)

Question 2a. What is the name of the Federal agency or Commission for which you are defining 3D data/information requirements? Please select one from the list. If you do not see your Agency listed, please choose “Other” and enter your Agency name.

**Department of Agriculture (USDA)**

- [ ] Agricultural Research Service (ARS)
- [ ] Animal and Plant Health Inspection Service (APHIS)
- [ ] Farm Service Agency (FSA)
- [ ] Foreign Agriculture Service (FAS)
- [ ] Natural Resources Conservation Service (NRCS)
- [ ] U.S. Forest Service (USFS)

**Department of Commerce (DOC)**

- [ ] Economic Development Administration
- [ ] National Institute of Standards and Technology (NIST)
- [ ] National Oceanic and Atmospheric Administration (NOAA)
- [ ] National Telecommunications and Information Administration (NTIA)
- [ ] U.S. Census Bureau (USCB)

**Department of Defense (DOD)**

- [ ] Defense Installations Spatial Data Infrastructure (DISDI)
- [ ] Defense Threat Reduction Agency (DTRA)
- [ ] Department of the Navy
- [ ] National Geospatial-Intelligence Agency (NGA)
- [ ] U.S. Army Corps of Engineers (USACE)

**Department of Energy (DOE)**

- [ ] Bonneville Power Administration (BPA)
- [ ] Office of Energy Efficiency and Renewable Energy (EERE)
- [ ] Southeastern Power Administration (SEPA)
- [ ] Southwestern Power Administration (SWPA)
- [ ] Western Area Power Administration (WAPA)
Department of Health and Human Services

- Centers for Disease Control (CDC)

Department of Homeland Security (DHS)

- Directorate for National Protection and Programs (DNPP)
- Domestic Nuclear Detection Office (DNDO)
- Federal Emergency Management Agency (FEMA)
- Office of Intelligence and Analysis (OIA)
- Office of Operations Coordination (OOC)
- Transportation Security Administration (TSA)
- U.S. Coast Guard (USCG)
- U.S. Customs and Border Protection (USCBP)
- U.S. Secret Service (USSS)

Department of Housing and Urban Development (HUD)

Department of Interior (DOI)

- Bureau of Indian Affairs (BIA)
- Bureau of Land Management (BLM)
- Bureau of Ocean Energy Management (BOEM)
- Bureau of Reclamation
- Bureau of Safety and Environmental Enforcement (BSEE)
- National Park Service (NPS)
- Office of Surface Mining Reclamation and Enforcement (OSMRE)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Geological Survey (USGS)

Department of Justice (DOJ)

Department of Labor (DOL)

Department of State (DOS)

Department of Transportation (DOT)

- Federal Aviation Administration (FAA)
- Federal Highway Administration (FHA)
- Federal Railway Administration (FRA)
- Pipeline and Hazardous Materials Safety Administration (PHMSA)

Department of the Treasury

- Environmental Protection Agency (EPA)
- Federal Bureau of Investigation (FBI)
- Federal Communications Commission (FCC)
- Federal Energy Regulatory Commission (FERC)
- Great Lakes Commission (GLC)
- International Boundary and Water Commission (IBWC)
- International Joint Commission (IJC)
DRAFT -- Comments welcome to ashley.chappell@noaa.gov

☐ Marine Mammal Commission (MMC)
☐ National Aeronautics and Space Administration (NASA)
☐ National Science Foundation (NSF)
☐ Nuclear Regulatory Commission (NRC)
☐ U.S. Agency for International Development (USAID)
☐ U.S. Arctic Research Commission
☐ Tennessee Valley Authority (TVA)
☐ Other Federal Agency (please specify)

**Question 2b.** What is the name of the sub-agency, division, department and/or branch for which your requirements pertain? Please enter text.

**Question 2c.** What is the name of your State, territory, or Washington, D.C.? Please select one.

☐ Alabama
☐ Alaska
☐ American Samoa
☐ Arizona
☐ Arkansas
☐ California
☐ Colorado
☐ Connecticut
☐ Delaware
☐ Florida
☐ Georgia
☐ Guam
☐ Hawaii
☐ Idaho
☐ Illinois
☐ Indiana
☐ Iowa
☐ Kansas
☐ Kentucky
☐ Louisiana
☐ Maine
☐ Maryland
☐ Massachusetts
☐ Michigan
☐ Minnesota
☐ Mississippi
☐ Missouri
☐ Montana
☐ Nebraska
☐ Nevada
☐ New Hampshire
☐ New Jersey
☐ New Mexico
☐ New York
☐ North Carolina
☐ North Dakota
☐ Northern Mariana Islands
☐ Ohio
☐ Oklahoma
☐ Oregon
☐ Pennsylvania
☐ Puerto Rico
☐ Rhode Island
☐ South Carolina
☐ South Dakota
☐ Tennessee
☐ Texas
☐ Utah
☐ Vermont
☐ Virgin Islands
☐ Virginia
☐ Washington
☐ Washington D.C.
☐ West Virginia
☐ Wisconsin
☐ Wyoming

**Question 2d.** What is your Tribal name? Please enter text.
Question 2e. What is the name of your county, regional, city or other local government agency? Please enter text.

Question 2f. What is the name of your academic or not-for-profit organization? Please enter text.

Question 2g. What is the name of your private or commercial organization? Please enter text.

Part 2: Mission Critical Activity and Business Use
In part 2 of the questionnaire, we would like to learn about your Mission Critical Activities that support your Business Uses, which require 3D data and related information products. Your first iteration through this questionnaire refers to your primary Mission Critical Activity. You will be allowed to repeat the questionnaire for additional (up to 5) Mission Critical Activities.

Mission Critical Activity – an activity or process that uses some form of digital 3D data, including derivative products, to accomplish a Business Use. Example: Tsunami modeling is an example Mission Critical Activity for the Coastal Zone Management Business Use.

Business Use – the ultimate use of services or products from Mission Critical Activities to accomplish an organized mission. Example: Coastal Zone Management.

Question 3. What is the mission of your Agency or organization?

Question 4. What is your primary Business Use? You must select at least one Business Use from the list below. You may select additional Business Uses that apply to your Mission Critical Activity, but your reported benefits will be aggregated with the primary Business Use you select. You will be allowed to select additional Mission Critical Activities after this primary section is completed. Examples of Mission Critical Activities that correlate with these Business Uses are provided below. Select at least one Business Use from the list below. If your Mission Critical Activity supports multiple Business Uses, you may designate additional Business Uses as secondary.
<table>
<thead>
<tr>
<th>Business Uses</th>
<th>Examples of Mission Critical Activities</th>
<th>1st</th>
<th>2nd</th>
</tr>
</thead>
<tbody>
<tr>
<td>BU 02 - Water Supply and Quality</td>
<td>Fate and transport of contaminants. Pollution risk mitigation. Runoff and sedimentation analyses. Non-point source pollution modeling. Management of contaminants and marine debris - point, non-point, vessel, and atmospheric pollution; spills; trash.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>BU 06 – Rangeland Management</td>
<td>Assessment of rangeland health. Mapping for soil erosion potential due to grazing.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>BU 08 – Agriculture and Precision Farming</td>
<td>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.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>BU 09 – Aquaculture and Fish Farming</td>
<td>Management of fisheries. Sustainable aquaculture.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Business Uses</td>
<td>Examples of Mission Critical Activities</td>
<td>1st</td>
<td>2nd</td>
</tr>
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<td>--------------------------------------------------</td>
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</tr>
<tr>
<td>BU 14 - Cultural Resources Preservation and Management</td>
<td>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.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>BU 15 – Flood Risk Management</td>
<td>Flood risk modeling and mapping of riverine and coastal areas. Dam/dike/levee safety analysis. Emergency management. Flood forecasts.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>BU 17 – Wildfire Management, Planning, and Response</td>
<td>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.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Business Uses</td>
<td>Examples of Mission Critical Activities</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
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</tr>
<tr>
<td>BU 19 – Land Navigation and Safety</td>
<td>Route selection for new roads. Slope analysis for autonomous cars. GPS navigation visualization.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>BU 25 – Real Estate, Banking, Mortgage, and Insurance</td>
<td>Assessment of risk for natural hazards (e.g., sinkholes, flooding) to inform insurance policy rates and the determination of mandatory insurance. Building permit compliance.</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
### Business Uses

<table>
<thead>
<tr>
<th>Business Uses</th>
<th>Examples of Mission Critical Activities</th>
<th>1st</th>
<th>2nd</th>
</tr>
</thead>
<tbody>
<tr>
<td>BU 27 – Recreation</td>
<td>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.</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>BU 30 – Maritime and Land Boundary Management</td>
<td>Delimitation of legal and other coastal boundaries, inland boundaries, and ordinary high water lines (OHWL).</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

**Question 5.** What is the name of the program supported by your specified Mission Critical Activity? This question is about Mission Critical Activities that are performed by your organization. *Mission Critical* is defined herein as “indispensable for mission accomplishment and/or essential for effective/efficient operations in accomplishing the core mission of the organization.” Using examples from above as a guide, describe your primary Mission Critical Activity in your own words. We prefer a higher level activity, e.g., coastal hazard mitigation, rather than a lower level activity, e.g., SLOSH modeling (used in coastal hazard mitigation).
Question 6. What is the name of the program supported by your specified Mission Critical Activity? A program is a major component of your organization that has a well-defined mission and goals and which is supported by one or more Mission Critical Activities.


Question 7. What is the approximate total annual program budget supported by this Mission Critical Activity? The program budget includes all annual operating expenses to include staff, equipment, travel, materials, overhead, etc. Enter number without dollar sign.


Question 8. In this section, please identify your geographic area requirements for the Mission Critical Activity described above. We need to understand geographic area requirements for each Mission Critical Activity. Questionnaire respondents are encouraged to describe their geographic (area of coverage) requirements using the provided administrative and watershed boundary pick lists. Alternatively, shapefiles for your geographic areas of interest may be provided. My geographic area requirements are:

- Nationwide, terrestrial (go to Question 8a)
- One or more national maritime boundaries (go to Question 8b)
- One or more states, territories, or counties, including waters offshore (go to Question 8c)
- One or more Watersheds (go to question 8d)
- Federally-owned lands nationwide or select large land holding agencies (go to Question 8e)
- Marine sanctuaries and marine national monuments (go to Question 8f)
- None of the above; I will provide my own shapefile or geodatabase (go to question 8g)

Question 8a. If your geographic area requirements for 3D data for your Mission Critical Activity are nationwide, please check the items below that best represent your nationwide requirements. Please select all that apply.

- 48 conterminous states
- Alaska
- Hawaii
- American Samoa
- Guam
- Northern Mariana Islands
- Puerto Rico
- Virgin Islands

Question 8b. If your geographic area requirements pertain to maritime boundaries, please designate from the list below. Please select all that are required.

- State waters
- Federal waters
- Navigationally significant areas
Question 8c. If your geographic area requirements for 3D data for your Mission Critical Activity are for one or more states or counties, please check the state(s) below that are required. After you select the state(s) you will be allowed to identify sub-regions (counties) where 3D data are required.

<table>
<thead>
<tr>
<th>Alabama</th>
<th>Louisiana</th>
<th>Ohio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>Maine</td>
<td>Maine</td>
</tr>
<tr>
<td>Arizona</td>
<td>Maryland</td>
<td>Oregon</td>
</tr>
<tr>
<td>Arkansas</td>
<td>Massachusetts</td>
<td>Pennsylvania</td>
</tr>
<tr>
<td>California</td>
<td>Michigan</td>
<td>Rhode Island</td>
</tr>
<tr>
<td>Colorado</td>
<td>Minnesota</td>
<td>South Carolina</td>
</tr>
<tr>
<td>Connecticut</td>
<td>Mississippi</td>
<td>South Dakota</td>
</tr>
<tr>
<td>Delaware</td>
<td>Missouri</td>
<td>Tennessee</td>
</tr>
<tr>
<td>Florida</td>
<td>Montana</td>
<td>Texas</td>
</tr>
<tr>
<td>Georgia</td>
<td>Nebraska</td>
<td>Utah</td>
</tr>
<tr>
<td>Hawaii</td>
<td>Nevada</td>
<td>Vermont</td>
</tr>
<tr>
<td>Idaho</td>
<td>New Hampshire</td>
<td>Virginia</td>
</tr>
<tr>
<td>Illinois</td>
<td>New Jersey</td>
<td>Washington</td>
</tr>
<tr>
<td>Indiana</td>
<td>New Mexico</td>
<td>Washington D.C.</td>
</tr>
<tr>
<td>Iowa</td>
<td>New York</td>
<td>West Virginia</td>
</tr>
<tr>
<td>Kansas</td>
<td>North Carolina</td>
<td>Wisconsin</td>
</tr>
<tr>
<td>Kentucky</td>
<td>North Dakota</td>
<td>Wyoming</td>
</tr>
</tbody>
</table>

When a state is selected, there will be an option to list counties in a text box.

Question 8d. If your geographic area requirements pertain to hydrologic units, please check the major basin area (HUC-2) below. This will lead you to select individual HUC-4 codes for your specific hydrologic units.

<table>
<thead>
<tr>
<th>01 New England</th>
<th>08 Lower Mississippi</th>
<th>15 Lower Colorado</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 Mid Atlantic</td>
<td>09 Souris-Red-Rainy</td>
<td>16 Great Basin</td>
</tr>
<tr>
<td>03 South Atlantic-Gulf</td>
<td>10 Missouri</td>
<td>17 Pacific Northwest</td>
</tr>
<tr>
<td>04 Great Lakes</td>
<td>11 Arkansas-White-Red</td>
<td>18 California</td>
</tr>
<tr>
<td>05 Ohio</td>
<td>12 Texas – Gulf</td>
<td>19 Alaska</td>
</tr>
<tr>
<td>06 Tennessee</td>
<td>13 Rio Grande</td>
<td>20 Hawaii</td>
</tr>
<tr>
<td>07 Upper Mississippi</td>
<td>14 Upper Colorado</td>
<td>21 Caribbean</td>
</tr>
</tbody>
</table>

Expanded list of watersheds not shown here – HUC 4 watersheds can be an additional drop down menu that is associated with each HUC 2 watershed above.
Question 8e. If your geographic area requirements pertain to selected Federally-owned lands, please designate below. Please select all that are required.

- [ ] All Federally owned lands
- [ ] All lands of U.S. Tribes
- [ ] Bureau of Land Management (BLM)
- [ ] Bureau of Reclamation
- [ ] Department of Defense (DOD)
- [ ] National Park Service (NPS)
- [ ] Tennessee Valley Authority (TVA)
- [ ] U.S. Forest Service (USFS)
- [ ] U.S. Fish and Wildlife Service (USFWS)
- [ ] Other (enter name and or description)

Question 8f. If your geographic area requirements pertain to marine sanctuaries and/or marine national monuments, please designate from the list below. Please select all that are required.

- [ ] American Samoa
- [ ] Channel Islands
- [ ] Cordell Bank
- [ ] Florida Keys
- [ ] Flower Garden Banks
- [ ] Gray’s Reef
- [ ] Greater Farallones
- [ ] Hawaiian Islands Humpback Whale
- [ ] Monitor
- [ ] Monterey Bay
- [ ] Olympic Coast
- [ ] Papahanaumokuakea
- [ ] Rose Atoll
- [ ] Stellwagen
- [ ] Thunder Bay

Question 8g. If Applicable, please submit your geographic area requirements by posting your shapefile(s) to the project site at xxxxxxxxxxx and provide a unique filename that includes your name and organization, or abbreviations thereof. The projection and datum (.prj file) information must be included. Please enter the filename below.

Part 3: 3D Data Requirements
In this section you will identify your mission critical requirements for 3D data. Mission Critical is defined as “indispensable for mission accomplishment and/or essential for effective/efficient operations in accomplishing the core mission of the organization.” Therefore, please do not specify a requirement
that is “nice to have” (unless requested) but focus instead on what you must have to support your Mission Critical Activity.

**Question 9.** For your Mission Critical Activity, how would you characterize the area for which you need 3D data? Check all that apply.

- [ ] Inland, including inland waters
- [ ] Nearshore/Beaches
- [ ] Offshore/Outer Continental Shelf/EEZ

**Question 10.** For your Mission Critical Activity, what do you need/want to measure in 3D? Check all that apply.

- [ ] Bare earth ground
- [ ] Tops of buildings, structures, objects (including submerged)
- [ ] Tops of vegetation (including submerged)
- [ ] Subcanopy of vegetation/understory
- [ ] River/lake bottom
- [ ] Nearshore elevation
- [ ] Ocean/sea bottom

**Question 11.** What is the approximate size of the features you trying to resolve in 3D? Check all that apply.

- [ ] Survey-level features (less than 1 meter)
- [ ] Individual features (1-3 meters)
- [ ] Plot-level scales (3-10 meters)
- [ ] Regional scales (features 10-30 meters)
- [ ] Other (please specify)
Question 12. What is the average size of the area you work with on a day to day basis for your Mission Critical Activity?

☐ Individual Feature (e.g. single tree, single structure)
☐ Plot
☐ County
☐ State
☐ Regional
☐ National

Question 13. What is the needed horizontal accuracy of your 3D data? Check one.

☐ Better than 10 cm of 'actual ground position'
☐ Within 10 cm of 'actual ground position'
☐ Within 20 cm of 'actual ground position'
☐ Within .5 meter of 'actual ground position'
☐ Within 1 meter of 'actual ground position'
☐ Within 10 meters of ‘actual ground position’
☐ Within 20 meters of ‘actual ground position’
☐ Within 50 meters of ‘actual ground position’

Question 14. What is the needed vertical accuracy of your 3D data? Check one.

☐ Less than 5 cm
☐ 5 cm
☐ 10 cm
☐ 20 cm
☐ 0.5 m
☐ 1 m
☐ Greater than 1 m

Question 15. For the Mission Critical Activity that you specified, how frequently do the 3D data need to be updated to satisfy your requirements? Stated another way, your Mission Critical Activity requires data no older than:

☐ Annually (one year)
☐ 2-3 years
☐ 4-5 years
☐ 6-10 years
☐ >10 years
☐ Event driven – Data need to coincide with a specific event

Question 16. For the Mission Critical Activity that you specified, please describe the importance of seamless integration of your topographic, bathymetric and/or topobathymetric datasets.

☐ Required
☐ Highly desirable
☐ Nice to have
Question 17. For the Mission Critical Activity that you specified, please describe the importance of concurrent collection of your topographic, bathymetric and/or topobathymetric datasets.

☐ Required
☐ Highly desirable
☐ Nice to have
☐ Not required

Question 18. For the Mission Critical Activity that you specified, please describe the importance of having 3D data archived/stored in such a way that it is freely available to the public.

☐ Required
☐ Highly desirable
☐ Nice to have
☐ Not required

Questions for Inland Requirements

Question 19. What 3D data Quality Level (QL) do you require for your Mission Critical Activity? Check one QL only, chosen from the table below.

<table>
<thead>
<tr>
<th>Quality Level (QL)</th>
<th>Aggregate Nominal Pulse Spacing (ANPS) (m)</th>
<th>Aggregate Nominal Pulse Density (ANPD) (pts/m²)</th>
<th>RMSEz (non-vegetated) (cm)</th>
<th>NVA at 95% confidence level (cm)</th>
<th>VVA at 95th percentile (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>QL0</td>
<td>≤0.35</td>
<td>≥8</td>
<td>≤5</td>
<td>≤9.8</td>
<td>≤14.7</td>
</tr>
<tr>
<td>QL1</td>
<td>≤0.35</td>
<td>≥8</td>
<td>≤10</td>
<td>≤19.6</td>
<td>≤29.4</td>
</tr>
<tr>
<td>QL2</td>
<td>≤0.71</td>
<td>≥2</td>
<td>≤10</td>
<td>≤19.6</td>
<td>≤29.4</td>
</tr>
</tbody>
</table>

☐ QL0: RMSEz ≤ 5 cm and aggregate nominal pulse density ≥8 points/square meter
☐ QL1: RMSEz ≤ 10 cm and aggregate nominal pulse density ≥8 points/square meter
☐ QL2: RMSEz ≤ 10 cm and aggregate nominal pulse density ≥2 points/square meter
☐ I do not need any of the Quality Levels listed. Existing 3D data of lesser quality satisfies my needs.

Question 20. For your Mission Critical Activity, do you have requirements for hydrologic conditioning of your 3D data? Check all that apply.

☐ No hydrologic conditioning
☐ Hydro flattened
☐ Hydro enforced

Question 21. For your Mission Critical Activity, which of the following 3D products do you use? Check all that apply.

☐ Raw point cloud data
☐ Classified point cloud data (LAS classes)
☐ Full waveform
☐ Digital Elevation Model (DEM)
☐ Digital Terrain Model (DTM) of the bare-earth terrain
Digital Surface Model (DSM) of the top reflective surface  
Breaklines required for standard hydro-flattening  
Additional breaklines required for hydro-enforcement of culverts  
Intensity imagery  
Ground control  
Other (please specify)

**Question 22.** For your Mission Critical Activity, which of the following 3D data derivatives do you need? Check all that apply.
- Triangulated Irregular Network (TIN) or Esri Terrain
- Contours
- Hillshades
- Slope maps
- Aspect maps
- Curvature maps
- Cross sections
- Building footprints
- Breaklines for road edge of pavement
- Other (please specify)

**Question 23.** Do you have requirements for tide-coordinated 3D data to support your Mission Critical Activity? Check all that apply.
- No requirement
- Tide-coordinated data, below Mean High Water (MHW)
- Tide-coordinated data, below Mean Lower Low Water (MLLW)

**Question 24.** For the Mission Critical Activity that you specified, please describe the importance of integration of your 3D data with other datasets. For each data type, identify how important the data integration is to your program. Examples of data integration would be data you require for geospatial analysis or data you need for visual inspection.

*Importance rating: 1) Required, 2) Highly desirable, 3) Nice to have, 4) Not required*

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Required</th>
<th>Highly Desirable</th>
<th>Nice to Have</th>
<th>Not Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topobathymetric data</td>
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<tr>
<td>Bathymetric data</td>
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<tr>
<td>Aerial and satellite imagery</td>
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<tr>
<td>Geologic and seismic data</td>
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<tr>
<td>Surface water features</td>
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</tbody>
</table>
### Question 25. Do you require bathymetry for inland water features (e.g. lakes, reservoirs, large rivers)?

- [ ] Yes
- [ ] No

*If “yes,” go to question 32 for bathymetry requirements.*

### Questions for Nearshore Requirements

**Question 26.** What bathymetric or topobathymetric Quality Level (QL) do you require for your Mission Critical Activity? Check one QL only, chosen from the table below. Note that QL0 and QL1 are equivalent to the International Hydrographic Organization (IHO) Special Order standard, and the vertical accuracy specification for QL4 is equivalent to the IHO Order 1 standard for vertical accuracy.

<table>
<thead>
<tr>
<th>Aggregate Nominal Pulse Spacing</th>
<th>QL0&lt;sub&gt;N&lt;/sub&gt;</th>
<th>QL1&lt;sub&gt;N&lt;/sub&gt;</th>
<th>QL2&lt;sub&gt;N&lt;/sub&gt;</th>
<th>QL3&lt;sub&gt;N&lt;/sub&gt;</th>
<th>QL4&lt;sub&gt;N&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate Nominal Pulse Density</td>
<td>≥2.0 pts/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>≥0.25 pts/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>≥2.0 pts/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>≥0.25 pts/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>≥0.04 pts/m&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depth Examples (m)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>0</th>
<th>10</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth Accuracy at 95% Confidence Level (cm)</td>
<td>25.0</td>
<td>26.1</td>
<td>29.2</td>
<td>25.0</td>
<td>26.1</td>
<td>29.2</td>
<td>30.0</td>
<td>32.7</td>
<td>39.7</td>
</tr>
</tbody>
</table>

| Applications | Detailed site surveys requiring the highest accuracy and highest resolution seafloor definition; dredging and inshore engineering surveys; high-resolution surveys of ports and harbors | Charting surveys; regional sediment management; general bathymetric mapping; coastal science and management applications; change analysis; deep water surveys; environmental analyses | Recon/planning; all general applications not requiring higher resolution and accuracy |

- [ ] QL0<sub>N</sub>
- [ ] QL1<sub>N</sub>
- [ ] QL2<sub>N</sub>
- [ ] QL3<sub>N</sub>
Question 27. For your Mission Critical Activity, do you have requirements for hydrologic conditioning of your 3D data? Check all that apply.

- No hydrologic conditioning
- Hydro flattened
- Hydro enforced

Question 28. For your Mission Critical Activity, which of the following 3D products do you use? Check all that apply.

- Raw point cloud data
- Classified point cloud data (LAS classes)
- Full waveform
- Digital Elevation Model (DEM)
- Digital Terrain Model (DTM) of the bare-earth terrain
- Digital Surface Model (DSM) of the top reflective surface
- National Vertical Datum Transformation Tool (V-Datum)
- Tide Predictions
- Tidal Constituent And Residual Interpolation (TCARI)
- required for standard hydro-flattening
- Additional breaklines required for hydro-enforcement of culverts
- Intensity imagery
- Ground control
- Other (please specify)

Question 29. For your Mission Critical Activity, which of the following 3D data derivatives do you need? Check all that apply.

- Triangulated Irregular Network (TIN) or Esri Terrain
- Contours
- Hillshades
- Slope maps
- Aspect maps
- Curvature maps
- Cross sections
- Building footprints
- Breaklines for road edge of pavement
- Other (please specify)

Question 30. Do you have requirements for tide-coordinated 3D data to support your Mission Critical Activity? Check all that apply.

- No requirement
Question 31. For the Mission Critical Activity that you specified, please describe the importance of integration of your 3D data with other datasets. For each data type, identify how important the data integration is to your program. Examples of data integration would be data you require for geospatial analysis or data you need for visual inspection.

Importance rating: 1) Required, 2) Highly desirable, 3) Nice to have, 4) Not required

<table>
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<tr>
<th>Data Type</th>
<th>Required</th>
<th>Highly Desirable</th>
<th>Nice to Have</th>
<th>Not Required</th>
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<tbody>
<tr>
<td>Topographic data</td>
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<td>Bathymetric data</td>
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<tr>
<td>Hydrographic survey data</td>
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<td>Nautical and/or navigation charts</td>
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<tr>
<td>Bottom texture</td>
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<tr>
<td>Bottom type - roughness and hardness, sediment type, density, grain size, color, contaminants, composition (organic, shell and mineral, sand percentage)</td>
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<td>Submerged features - shipwrecks, archaeological sites, rock outcrops, debris, pipelines, cables, wellheads, piles,</td>
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<td>Water column properties – Biological properties</td>
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<tr>
<td>Currents</td>
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<tr>
<td>Tide heights, wave heights</td>
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<tr>
<td>Offshore cadastral</td>
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<tr>
<td>Data Type</td>
<td>Required</td>
<td>Highly Desirable</td>
<td>Nice to Have</td>
<td>Not Required</td>
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<td>--------------------------------------------------------------------------</td>
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<td>Lease areas – Outer Continental Shelf (OCS), oil and gas, or sand resource lease blocks; renewable energy leases; dredge areas</td>
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<tr>
<td>Fixed obstructions – aids to navigation, beacons, landmarks, wind turbines, drilling platforms and equipment,</td>
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<tr>
<td>Floating observation and navigation systems – buoys, monitoring stations, etc.</td>
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<tr>
<td>Shorelines - current, historic, change rates</td>
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<tr>
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<tr>
<td>Surface water features</td>
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<tr>
<td>Bridges/culverts</td>
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<tr>
<td>Landmark features</td>
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<tr>
<td>Cultural resources</td>
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<tr>
<td>Coastal and riverine structures - shoreline stabilization structures, levees, dams, jetties, piers, weirs, etc.</td>
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<tr>
<td>Overhead structures – bridge, overhead cable, overhead pipeline, etc.</td>
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<tr>
<td>Lowest floor elevation of buildings</td>
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<tr>
<td>Other (please specify)</td>
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</tr>
</tbody>
</table>

**Questions for Offshore Requirements**

**Question 32.** Does your Mission Critical Activity require data that meet International Hydrographic Organization charting standards?

- [ ] Yes (go to Question 18a)
- [ ] No
- [ ] I don't know

**Question 32a.** What IHO Order do you require for your Mission Critical Activity? Check one Order only, chosen from the table below.

<table>
<thead>
<tr>
<th>IHO Order</th>
<th>Special</th>
<th>1a</th>
<th>1b</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Horizontal Uncertainty (THU) (95% Confidence Level)</td>
<td>2m</td>
<td>5m + 5% of depth</td>
<td>5m + 5% of depth</td>
<td>20m + 10% of depth</td>
</tr>
<tr>
<td>Total Vertical Uncertainty (TVU) (95% Confidence Level) 1</td>
<td>a = 0.25m, b = 0.0075</td>
<td>a = 0.5m, b = 0.013</td>
<td>a = 0.5m, b = 0.013</td>
<td>a = 1.0m, b = 0.023</td>
</tr>
<tr>
<td>Full Seafloor Search</td>
<td>Required</td>
<td>Required</td>
<td>Not required</td>
<td>Not required</td>
</tr>
</tbody>
</table>
## IHO Order

### Feature Detection Capability

<table>
<thead>
<tr>
<th>IHO Order</th>
<th>Special</th>
<th>1a</th>
<th>1b</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cubic features &gt; 1m</td>
<td>Cubic features &gt; 2m in depths up to 40m; 10% of depth beyond 40m</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

### Maximum Line Spacing

<table>
<thead>
<tr>
<th>IHO Order</th>
<th>Special</th>
<th>1a</th>
<th>1b</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not applicable, as 100% search is required</td>
<td>Not applicable, as 100% search is required</td>
<td>3 x average depth or 25m, whichever is greater</td>
<td>4 x average depth</td>
</tr>
</tbody>
</table>

### Applications

<table>
<thead>
<tr>
<th>IHO Order</th>
<th>Special</th>
<th>1a</th>
<th>1b</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Harbors, berthing areas, and associated critical channels where under-keel clearance is critical</td>
<td>Harbors, harbor approach channels, recommended tracks, and some coastal areas with depths up to 100 m where under-keel clearance is less critical but of concern to surface shipping may exist.</td>
<td>Areas shallower than 100 m where under-keel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.</td>
<td>Areas generally deeper than 100 m where a general description of the sea floor is considered adequate.</td>
</tr>
</tbody>
</table>

---

1. The formula below is to be used to compute, at the 95% confidence level, the maximum allowable TVU. The parameters “a” and “b” for each Order, together with the depth “d” are used to calculate the maximum allowable TVU for a specific depth:

\[
\pm \sqrt{a^2 + (b \times d)^2}
\]

- **a** represents that portion of the uncertainty that does not vary with depth
- **b** is a coefficient which represents that portion of the uncertainty that varies with depth
- **d** is the depth
- **b \times d** represents that portion of the uncertainty that varies with depth

---

**Question 33.** For your Mission Critical Activity, which of the following 3D products do you use? Check all that apply.

- [ ] Raw point cloud data
- [ ] Classified point cloud data (LAS classes)
- [ ] Full waveform
- [ ] Digital Elevation Model (DEM)
- [ ] Digital Terrain Model (DTM) of the bare-earth terrain
- [ ] Digital Surface Model (DSM) of the top reflective surface
- [ ] National Vertical Datum Transformation Tool (V-Datum)
Question 34. For your Mission Critical Activity, which of the following 3D data derivatives do you need? Check all that apply.
- Triangulated Irregular Network (TIN) or Esri Terrain
- Contours
- Hillshades
- Slope maps
- Aspect maps
- Curvature maps
- Cross sections
- Other (please specify)

Question 35. Do you have a requirement for data to be tide corrected?
- No requirement for tide correction
- Tide correction using Mean High Water (MHW)
- Tide correction using Mean Sea Level (MSL)
- Tide correction using Mean Lower Low Water (MLLW)
- Tide correction using other datum (please specify)

Question 36. For the Mission Critical Activity that you specified, please describe the importance of integration of your 3D data with other datasets. For each data type, identify how important the data integration is to your program. Examples of data integration would be data you require for geospatial analysis or data you need for visual inspection.

Importance rating: 1) Required, 2) Highly desirable, 3) Nice to have, 4) Not required

<table>
<thead>
<tr>
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<tr>
<td>Hydrographic survey data</td>
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<td>Nautical and/or navigation charts</td>
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<td>Highly Desirable</td>
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<tr>
<td>Routes – shipping, ferries, other vessel traffic routes</td>
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<tr>
<td>Offshore cadastral</td>
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<td>Lease areas – Outer Continental Shelf (OCS), oil and gas, or sand resource lease blocks; renewable energy leases; dredge areas</td>
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<td>Floating observation and navigation systems – buoys, monitoring stations, etc.</td>
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<tr>
<td>Other (please specify)</td>
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</tbody>
</table>
Part 4: Benefits

**Question 37.** What benefits relative to your program budget are you now realizing from currently available 3D data? Check the box that most closely describes the benefits for each benefit type.

<table>
<thead>
<tr>
<th>Current Benefits from existing 3D data</th>
<th>Major</th>
<th>Moderate</th>
<th>Minor</th>
<th>None</th>
<th>Don’t know</th>
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<tbody>
<tr>
<td>Time or cost savings (operational benefits)</td>
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<td>Mission compliance (operational benefits)</td>
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<td>Products or services (customer service benefits)</td>
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<tr>
<td>Response or timeliness (customer service benefits)</td>
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<tr>
<td>Customer experience (customer service benefits)</td>
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<tr>
<td>Education or public safety (societal benefits)</td>
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<tr>
<td>Environmental benefits (societal benefits)</td>
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<tr>
<td>Human lives saved (societal benefits)</td>
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<tr>
<td>Other:</td>
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</tbody>
</table>

**Question 38.** What annual dollar benefits do you receive from currently available 3D data that are supporting your information needs for the selected Mission Critical Activity? Enter value below, without dollar sign.

**Question 39.** What benefits relative to your program budget would you likely receive from improved 3D data if all of your requirements could be met for the selected Mission Critical Activity? Check the box that most closely describes the benefits for each benefit type.

<table>
<thead>
<tr>
<th>Future Benefits from improved 3D data</th>
<th>Major</th>
<th>Moderate</th>
<th>Minor</th>
<th>None</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time or cost savings (operational)</td>
<td></td>
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<tr>
<td>Improved mission compliance (operational)</td>
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<tr>
<td>Improved products or services (customer service)</td>
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</tbody>
</table>
**Future Benefits from improved 3D data**

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Major</th>
<th>Moderate</th>
<th>Minor</th>
<th>None</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved response or timeliness (customer service)</td>
<td></td>
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<tr>
<td>Improved customer experience (customer service)</td>
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<tr>
<td>Improved education or public safety (societal benefit)</td>
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<tr>
<td>Environmental benefits (societal benefits)</td>
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<td>Human lives saved (societal benefits)</td>
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<tr>
<td>Other:</td>
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</tbody>
</table>

**Question 40.** Briefly describe any major new benefits from the prior question. Enter text below.


**Question 41.** What annual dollar benefits would you likely receive from improved 3D data if all of your requirements could be met for the selected Mission Critical Activity? Enter value below, without dollar sign. *This is one of your most important responses to this survey and will help build the business case for improving topographic and bathymetric data and information. Careful consideration should be given to identifying potential benefits.*


**Question 42.** Which of these aspects of your 3D data requirements is the most important? Please rank the options from most important (1) to least important (3).

<table>
<thead>
<tr>
<th>Requirement</th>
<th>1 (Most Important)</th>
<th>2 (Moderately Important)</th>
<th>3 (Least Important)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic coverage</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Vertical accuracy</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Update frequency</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

**Question 43.** Do you have additional Mission Critical Activities requiring 3D data?

Yes [go to Question 4]
Repeat Questions 4 through 43 referring to additional rather than primary Mission Critical Activities

Part 6: Required Data/Information Access Methods
As information technology evolves, the Federal government has worked to keep pace with the most appropriate ways for provisioning 3D data and related information. This last series of questions apply to your program in general and not to the individual Mission Critical Activities.

**Question 44.** For your program (all identified Mission Critical Activities), which 3D data sources are you currently using to address your elevation information needs? Please select all that apply.

- [ ] USGS DEMs (i.e. elevation data from The National Map)
- [ ] USGS lidar point cloud data
- [ ] NOAA coastal lidar data
- [ ] Bathymetric Attributed Grid (BAG) files
- [ ] USACE coastal and/or inland lidar point clouds and DEMs
- [ ] National Ocean Service Hydrographic Database (NOSHDB)
- [ ] MultiBeam Bathymetric Database (MBBDB)
- [ ] NOAA nautical charts, including electronic charts
- [ ] USACE Inland Electronic Navigation Charts
- [ ] Rap sheets
- [ ] Smooth sheets
- [ ] Sidescan sonar mosaics
- [ ] Marine Minerals Program GIS (MMP GIS)
- [ ] Other (please specify) ____________________________

**Question 45.** For your program (all identified Mission Critical Activities), what geographic extents would best address your access requirements? Please select all that are required.

- [ ] Watershed
- [ ] State or Territory
- [ ] Conterminous United States
- [ ] Nationwide including Alaska and Hawaii
- [ ] State waters
- [ ] Federal waters
- [ ] Coastal swath (beach/nearshore, including lakes)
- [ ] Navigationally significant areas
- [ ] Marine sanctuaries and marine national monuments
- [ ] Territorial sea (12 nautical miles)
- [ ] Contiguous zone (24 nautical miles)
- [ ] Exclusive Economic Zone (200 nautical miles)
- [ ] Lease areas
- [ ] User defined map extent
- [ ] User defined irregular area (polygon)
- [ ] Other (please specify) ____________________________
- [ ] I don’t know
Question 46. For your program (all identified Mission Critical Activities), please identify required data types (formats). Check all that are required.

- Vector Data – Open Geospatial Consortium (OGC) conformant
- Vector Data – Esri shapefiles
- Vector Data – Esri file geodatabase
- Mass Points – Triangulated Irregular Network (TIN)
- Mass Points – LAS
- Mass Points – ASCII
- Mass Points – Esri Terrain
- Gridded Data – Esri Grid
- Gridded Data – DEM
- Raster Data – TIFF
- Raster Data – MrSID
- Raster Data – GeoPDF
- Other format, please specify

Question 47. For your program, please rate the importance of each data or service access method using the following criteria:

1) Required, 2) Highly desirable, 3) Nice to have, or 4) Not required

<table>
<thead>
<tr>
<th>Data or Service Access Method</th>
<th>Required</th>
<th>Highly Desirable</th>
<th>Nice to Have</th>
<th>Not Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Services to discover standard data products</td>
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<tr>
<td>Services to download standard data products</td>
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<tr>
<td>Services to create and download customized data products</td>
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<tr>
<td>Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)</td>
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<tr>
<td>Services to visualize cartographically rendered and symbolized 3D data</td>
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<tr>
<td>Services that allow combination of visualizations with other visualization services (mash-ups)</td>
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</tbody>
</table>

Question 48. When you purchase or acquire 3D data, how and where do you currently store these data to support your program? Check all that apply.

- On my local computer
- On my office’s network
- On external hard drive(s) or other physical media
- In the cloud
On my agency’s enterprise geospatial system
Submit to my state’s data repository for use by others
Submit to the National Center for Environmental Information (NCEI) for use by others
Submit to USGS for distribution to others (e.g. via The National Map)
Submit to Marine Cadastre for distribution to others
Submit to NOAA Digital Coast for distribution to others
Other (please specify)

Question 49. When you generate products or analyses using 3D data, how and where do you store these results to support your program? Check all that apply.

- On my local computer
- On my office’s network
- On external hard drive(s) or other physical media
- In the cloud
- On my agency’s enterprise geospatial system
- Submit to my state’s data repository for use by others
- Submit to the National Center for Environmental Information (NCEI) for use by others
- Submit to USGS for distribution to others (e.g. via The National Map)
- Submit to Marine Cadastre for distribution to others
- Submit to NOAA Digital Coast for distribution to others
- Other (please specify)

Question 50. Are there other aspects of using 3D data for which you need help?

- Metadata creation
- Data archiving
- Training
- Other (please specify)

Please provide any final comments that you wish to make that were not covered in the questions asked above:

Thank you for responding to this 3D Nation requirements and benefits questionnaire. The information that you have provided will be summarized for the Federal Agency, State, Territory, Tribe, or non-governmental organization that you represent. The Point of Contact for your organization will then have an opportunity to review and edit the summary requirements that will feed into the final study report.
The final study report will be the primary source of information used to develop recommendations for a 3D Nation program.