(*This section is labeled "A" in Qualtrics.*)

Landsat 2022 | Current and Future Landsat User Requirements

Thank you for participating in this study of Landsat satellite imagery! We estimate that this survey may require up to 20 minutes to complete. To move through the survey, click only on the "Next" and "Back" buttons at the bottom of the page in the survey**.** Do not use browser navigation buttons to move through the survey – only use the buttons in the survey. When you click on the "Next" button, your answer will save (*Note: if the "save & continue" feature is enabled, under Survey Options in Qualtrics*).

To pause at any time, close the window and your answers will be saved (*Note: must send out individual links using the Qualtrics emailer*). To resume and complete the survey, click on the link to the survey in the email you received. At that point, you can answer any remaining questions. When you have answered all of the questions and are satisfied with your responses, click on the "SUBMIT" button at the end of the survey.

If you want to receive a link to the final report (when published), please contact Crista Straub (cstraub@usgs.gov).

Privacy Act Statement

AUTHORITY: Land Remote Sensing Policy Act of 1992 (15 U.S.C. 5652)

PRINCIPAL PURPOSE: The survey will assess the current and future needs of Landsat imagery users as related to the use of Landsat imagery in their work. The information collected in this survey will be used to improve the provision of Landsat imagery, data products, and the development of future Landsat satellites.

ROUTINE USE: No Personally Identifiable Information (PII) will be collected in this survey.

DISCLOSURE IS VOLUNTARY: All responses to the survey are voluntary. No individuals are required to answer the questions.

OFFICE OF MANAGEMENT & BUDGET (OMB) CONTROL NUMBER: 1028-0123
OMB CONTROL NUMBER EXPIRATION DATE: 00/00/0000

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(*This section is labeled "B" in Qualtrics.*)

SECTION 1: Use of Landsat Imagery

In **Section 1**, we would like to know about how you use Landsat in your work. The questions in this survey are only about Landsat use related to your work, not personal Landsat use. Please continue to the next page to start **Section 1**.

----------PAGE BREAK----------

1. **Have you used Landsat imagery in your work during the past 12 months**? *Please select only one answer.*
   - ◻ Yes
   - ◻ No → *DISPLAY LOGIC for SECTION 5: WORK EXPERIENCE; CONTINUE TO Q59*

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2. **In the past 12 months, what percentage of your work hours used Landsat imagery in any way?** *Please write a whole number from 1 to 100 in the box below OR check "Don't know".*

   Check "Don't know" if you are unsure how much of your work used Landsat imagery.

   Percentage

   [ ] ☐ Don't know

   (*Text Entry Validation – Numerical Value in Qualtrics.*)

3. **What other remotely sensed imagery have you used in your work during the past 12 months**? *Please check "None" or all that apply.*
   - ◻ None, I only use Landsat.
   - ◻ Low-resolution multispectral satellite imagery, such as MODIS
   - ◻ Other moderate-resolution multispectral satellite imagery, such as Sentinel
   - ◻ High-resolution multispectral satellite imagery, such as WorldView
   - ◻ Airborne multispectral imagery
   - ◻ LiDAR
   - ◻ Radar
   - ◻ Other (*please explain in the text box below*) _____

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4. **At what scales was your work that used Landsat imagery during the past 12 months**? *Please check all that apply.*
   - ☐ Local (for example, county, city)
   - ☐ More than one local entity (for example, multi-county)
   - ☐ State/Province/Department/Region
   - ☐ Multi-state, province, department, or region
   - ☐ National
   - ☐ Continental
   - ☐ Global

5. In what regions was your work that used Landsat imagery focused during the past 12 months? *Please check all that apply.*

- ☐ Africa
- ☐ Antarctic
- ☐ Arctic
- ☐ Asia (including the Middle East)
- ☐ Europe
- ☐ North America (including the Caribbean)
- ☐ Oceania (Australia/New Zealand/Melanesia/Micronesia/Polynesia)
- ☐ South America

Q18_A. Please rank future Landsat improvements in order of importance to you. *Based on your preference, rank from 1 to 5 where 1 is most important to you and 5 is least important to you.*

(*Choices are Randomized in Qualtrics.*)

☐ Reflective Band Spatial Resolution	☐ Reflective Band Spectral Resolution	☐ Temporal Revisit Rate	☐ Thermal Spatial Resolution	☐ Thermal Spectral Resolution

Q18_B. Please explain why you selected your ranking order for improvements in future Landsat. *Please explain in text box below.*

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6. In the past 12 months, what percentage of your work hours was operational in any way?

Operational work is defined as ongoing work that relies on consistently available Landsat imagery OR is mandated (e.g., crop reports, routine mapping, monitoring). Non-operational work is defined as one-time projects OR other work that is not mandated (e.g., most scientific research).

Please enter a whole number from 0 to 100 in the box below or check "Don't know".

Check "Don't know" if you are unsure how much of your work was operational.

☐ Don't know

(*Text Entry Validation – Numerical Value in Qualtrics.*)

7. **How many unique Landsat scenes did you use in your work during the past 12 months**? Unique scenes are used only one time. *Please enter a whole number (best estimate) in the box below or check "Don't know".*

Check "Don't know if you are unsure how many scenes you used.

Number of scenes

[ ] ☐ Don't know

(*Text Entry Validation – Numerical Value in Qualtrics.*)

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CloudDetect Question. How important is the ability to detect cloud from Landsat to you? (i.e., scene-based cloud cover, pixel-based cloud identification)

- ☐ Very important
- ☐ Somewhat important
- ☐ Slightly important
- ☐ Not at all important

8. **As part of the free and open data policy, there are no restrictions on distributing Landsat imagery. Beyond using Landsat in your own work, did you distribute Landsat imagery or products to others during the past 12 months**? *Please check only one.*
   - ☐ Yes
   - ☐ No → *DISPLAY LOGIC for Q13*

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9. **What type of Landsat imagery or products did you distribute**? *Please check all that apply.*
   - ☐ Raw or minimally processed Landsat imagery (e.g., Level 0 uncalibrated raw data, Level 1 radiometrically calibrated and orthorectified data)
   - ☐ Landsat products developed by USGS (e.g., Surface Reflectance, Land Surface Temperature, Burned Area)
   - ☐ Landsat products I developed myself

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10. **During the past 12 months, how many people did you distribute Landsat imagery or products to**? *Please enter a number (best estimate) in the box below or check"Don't know".*

Number of people

[ ] ☐ Don't know

(*Text Entry Validation – Numerical Value in Qualtrics.*)

11. In which sectors did these people work? *Please check all that apply.*

- ☐ Academic institution as faculty, staff, or student (e.g., university, college, technical/vocational)
- ☐ International government (e.g., United Nations, European Union)
- ☐ National/Federal government
- ☐ State/Provincial/Departmental government
- ☐ Local government (for example, county, city)
- ☐ Tribe/Nation/Indigenous government
- ☐ Private business
- ☐ Non-profit organization
- ☐ Other (*please explain*) _____

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12. During the past 12 months, how many total Landsat scenes (processed into a product or not) did you distribute to these other people? *Please enter a best estimate number in the box below or check "Don't know". Count all scenes you distributed, even if you distributed the same scene multiple times.*

Check "Don't know" if you are unsure how many Landsat scenes you distributed to other people.

Number of scenes

[ ] ☐ Don't know

(*Text Entry Validation – Numerical Value in Qualtrics.*)

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13. What is the primary application for which you have used Landsat imagery in your work during the past 12 months? *Please select only one. You will be able to select a secondary application in a subsequent question.*

- ☐ Agricultural forecasting
- ☐ Agricultural management/production/conservation
- ☐ Biodiversity conservation
- ☐ Climate science/change
- ☐ Coastal science/monitoring/management
- ☐ Cryospheric science (for example, sea ice, ice caps, glaciers, permafrost)
- ☐ Ecological/ecosystem science/monitoring
- ☐ Fish and wildlife science/management
- ☐ Fire science/management

- ☐ Forest science/management
- ☐ Geology/volcanology
- ☐ Land use/land cover change
- ☐ Range/grassland science/management
- ☐ Recreation science/management
- ☐ Water resources (for example, watershed management, water rights, hydrology)
- ☐ Energy (for example, oil, natural gas, coal)/metals/minerals exploration/extraction/development
- ☐ Alternative energy exploration/development (e.g., wind, solar, geothermal)
- ☐ Rural planning and development (for example, zoning, economic development, land use)
- ☐ Urban planning and development (for example, zoning, economic development, land use)
- ☐ Urbanization (for example, growth, sprawl)
- ☐ Engineering/construction/surveying
- ☐ Assessments and taxation
- ☐ Real estate/property management
- ☐ Art/media
- ☐ Cultural resource management/anthropology/archaeology
- ☐ Software development
- ☐ Telecommunications
- ☐ Transportation
- ☐ Utilities
- ☐ Education: K-12
- ☐ Education: university/college
- ☐ Technical training (for example, workshops, short courses)
- ☐ Emergency/disaster management
- ☐ Hazard insurance (for example, crop, flood, fire)
- ☐ Humanitarian aid
- ☐ Public health
- ☐ Defense/national security
- ☐ Environmental regulation
- ☐ Law enforcement
- ☐ Other application (*please explain*) _____

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14. Which <u>observable</u> (things that you want to observe or measure) have you derived most often from Landsat for your primary application during the past 12 months? *Please select only one.*

- ☐ Land use/land cover/vegetation type

- ☐ Vegetation index/phenology/leaf area index
- ☐ Vegetation condition/stress/disturbance
- ☐ Canopy cover/biomass
- ☐ Crop stage/crop yield
- ☐ Non-photosynthetic vegetation
- ☐ Land surface elements/infrastructure (natural and man-made elements)
- ☐ Surface reflectance/albedo
- ☐ Surface composition/mineral type/geology
- ☐ Land skin temperature
- ☐ Active fires
- ☐ Burned area extent/severity
- ☐ Surface water extent
- ☐ Lake/river ice extent
- ☐ Lake/river water temperature
- ☐ Water quality/water chemistry
- ☐ Bathymetry
- ☐ Optically shallow water features/coral reefs
- ☐ Snow cover extent
- ☐ Glacier/ice sheet extent
- ☐ Other observables (*please explain*) _____

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15. In addition to the primary application, in what <u>secondary application</u> have you used Landsat imagery in your work during the past 12 months? *Please select only one.*

- ☐ I have not used it in another area→*DISPLAY LOGIC for "C" SECTION 2: LANDSAT FEATURES & then Q17*
- ☐ Agricultural forecasting
- ☐ Agricultural management/production/conservation
- ☐ Biodiversity conservation
- ☐ Climate science/change
- ☐ Coastal science/monitoring/management
- ☐ Cryospheric science (e.g., sea ice, ice caps, glaciers, permafrost)
- ☐ Ecological/ecosystem science/monitoring
- ☐ Fish and wildlife science/management
- ☐ Fire science/management
- ☐ Forest science/management
- ☐ Geology/volcanology
- ☐ Land use/land cover change

- ☐ Range/grassland science/management
- ☐ Recreation science/management
- ☐ Water resources (for example, watershed management, water rights, hydrology)
- ☐ Energy (for example, oil, natural gas, coal)/metals/minerals exploration/extraction/development
- ☐ Alternative energy exploration/development (for example, wind, solar, geothermal)
- ☐ Rural planning and development (for example, zoning, economic development, land use)
- ☐ Urban planning and development (for example, zoning, economic development, land use)
- ☐ Urbanization (for example, growth, sprawl)
- ☐ Engineering/construction/surveying
- ☐ Assessments and taxation
- ☐ Real estate/property management
- ☐ Art/media
- ☐ Cultural resource management/anthropology/archaeology
- ☐ Software development
- ☐ Telecommunications
- ☐ Transportation
- ☐ Utilities
- ☐ Education: K-12
- ☐ Education: university/college
- ☐ Technical training (for example, workshops, short courses)
- ☐ Emergency/disaster management
- ☐ Hazard insurance (for example, crop, flood, fire)
- ☐ Humanitarian aid
- ☐ Public health
- ☐ Defense/national security
- ☐ Environmental regulation
- ☐ Law enforcement
- ☐ Other application (*please explain*) _____

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16. Which <u>observable</u> (things that you want to observe or measure) have you derived most often from Landsat for your secondary application during the past 12 months? *Please select only one.*

- ☐ Land use/land cover/vegetation type
- ☐ Vegetation index/phenology/leaf area index
- ☐ Vegetation condition/stress/disturbance
- ☐ Canopy cover/biomass

- ☐ Crop stage/crop yield
- ☐ Non-photosynthetic vegetation
- ☐ Land surface elements/infrastructure (natural and man-made elements)
- ☐ Surface reflectance/albedo
- ☐ Surface composition/mineral type/geology
- ☐ Land skin temperature
- ☐ Active fires
- ☐ Burned area extent/severity
- ☐ Surface water extent
- ☐ Lake/river ice extent
- ☐ Lake/river water temperature
- ☐ Water quality/water chemistry
- ☐ Bathymetry
- ☐ Optically shallow water features/coral reefs
- ☐ Snow cover extent
- ☐ Glacier/ice sheet extent
- ☐ Other observables (*please explain*) _____

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(*This section is labeled "C" in Qualtrics.*)

SECTION 2: Landsat Characteristics

In **Section 2**, we want to know what your current requirements are for Landsat imagery and what improvements could be made to better meet your needs. Please continue to the next page to start **Section 2**.

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17. During the past 12 months, which of the <u>spectral bands</u> of Landsat imagery have you used in deriving the main observable for your primary application? *Please check all that apply.*

- ☐ Ultra Blue (coastal/aerosol)
- ☐ Blue
- ☐ Green
- ☐ Red
- ☐ Near Infrared (NIR)
- ☐ Shortwave Infrared (SWIR)
- ☐ Panchromatic
- ☐ Cirrus

☐ Thermal → *If "Thermal" IS checked, DISPLAY LOGIC for SET of THERMAL QUESTIONS, STARTING WITH "D" / If "Thermal" NOT checked, "G" and then Q26…*

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(*This section is labeled "D" in Qualtrics.*)

You indicated that you have used thermal bands in your work during the past 12 months. The next few questions ask specifically about your preferences for thermal imagery. Current Landsat thermal band information is as follows:

Current Thermal Bands	Wavelength (micrometers)	Resolution (meters)
Thermal Infrared (TIRS) 1 Band 10	10.60 - 11.19	100
Thermal Infrared (TIRS) 2 Band 11	11.50 - 12.51	100

Please continue to the next page to answer thermal band questions.

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18. Note: This question was moved to include all users (not just thermal users) and now includes 1-5 categories. Please rank the following in order of importance to you – according to the most important improvements you would like to see in thermal band resolution. *Based on your preference, rank the importance of improvement to spatial resolution, spectral resolution, and temporal resolution from 1 to 3 where 1 is most important to you and 3 is least important to you.*

___ Spatial resolution
___ Spectral resolution
___ Temporal resolution

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19. What changes in or additions to the current Landsat thermal bands would result in a significant improvement in deriving the main observable for your primary application? Provide specific / detailed information – including band center and width if known. *Write your response in the box below OR check "No significant improvement would occur."*

Check below if no significant improvement would occur as a result of changes to the thermal bands.

☐ No significant improvement would occur if the current thermal bands changed.

If Q19 has a written response, DISPLAY LOGIC for "E" and Q20. If Q19 has box checked and no written response, go to "E" and Q21.

(This question has Custom Validation in Qualtrics.)

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(*This section is labeled "E" in Qualtrics.*)

The next set of questions ask about the *benefits* you would expect to see if your suggested changes in the thermal bands of Landsat imagery occurred. Please consider scientific, management, economic, and social benefits.

Improvements to the thermal bands could impact scientific research and management decisions. For instance, better thermal bands could be used to help build more accurate crop hydrology models that compare management practices and identify strategies that lead to more sustainable use of groundwater resources. They could also be used to improve a formula to rank the suitability of coastal waters for oyster farming. Both of these examples would provide additional benefits at the economic and social level by supporting the livelihoods of farmers.

When possible, provide as much quantitative detail as you can. For example, better crop hydrology models could result in a decrease in water drawn from an aquifer by 20-30%. Farmers might see a 10% increase in yield with better water management, which translates into thousands of dollars of profit every year. Within the research itself, improved thermal bands might increase the accuracy of your models by a certain percentage.

These are all examples of potential *benefits* you might expect to see if changes in the *thermal* bands of Landsat imagery occurred. **Please provide information specific to what *you* might expect to see!**

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20. What benefits would you expect to see if these changes to the thermal bands of Landsat imagery occurred? *Please consider scientific, management, economic, and social benefits. Provide as much quantitative detail as you can. You can review the examples provided on the previous page by using the "Back" button. (Open-ended – limit 1500 characters)*

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21. For the thermal bands only, what spatial resolution would result in a significant improvement in deriving the main observable for your primary application? *Please select only one.*

- ☐ No significant improvement would occur with spatial resolution better than 100 meters. → *SECTION "F" & DISPLAY LOGIC for Q23*
- ☐ 60 meters
- ☐ 30 meters
- ☐ 20 meters
- ☐ 10 meters
- ☐ 5 meters

☐ <5 meters

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22. What benefits would you expect to see if this improvement in spatial resolution of the thermal bands occurred? *Please consider scientific, management, economic, and social benefits. Provide as much quantitative detail as you can. You can review the examples provided three pages prior by using the "Back" button. (Open-ended – limit 1500 characters)*

----------PAGE BREAK----------

(*This section is labeled "F" in Qualtrics.*)

The next questions ask about your thoughts on usable Landsat scenes. For example, you may think usable scenes need to be 20% cloud-free, or 80% cloud-free, etc. Usability means sufficiently cloud-free to serve the purpose – usable for the application. The actual percentage does not matter, just answer based on what a usable scene is to you.

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23. During the past 12 months, on average, approximately how many days elapsed between obtaining usable Landsat thermal imagery to derive the main observable for your primary application? Depending on the location and time of year, usable imagery may have been available 8 days, 16 days, 32 days, or longer. *Please enter number of days in the box below.*

☐ days

24. How often would you need usable Landsat thermal imagery to significantly improve in deriving the main observable for your primary application? *Please enter number of days in the box below or check "No significant improvement would occur."*

☐ days

Check the box below if significant improvement would not occur if Landsat thermal imagery were available more often.

☐ No significant improvement would occur if usable Landsat thermal imagery were available more often.

If Q24 has a written response, DISPLAY LOGIC for Q25.

If Q24 has box checked and no written response, go to "G" & then Q26. SURVEY FLOW in Qualtrics "checks" Q17 to see if ANY OTHER SPECTRAL BANDS ARE SELECTED. IF THEY

ARE SELECTED, DISPLAY LOGIC for "SPECTRAL BANDS SECTION" of "G" & then Q26. IF NO OTHER SPECTRAL BANDS ARE SELECTED, go to Q33…

(*This question has Custom Validation in Qualtrics.*)
(*Text Entry Validation – Numerical Value in Qualtrics.*)

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25. What benefits would you expect to see if this improvement in the availability of usable Landsat thermal imagery occurred? *Please consider scientific, management, economic, and social benefits. Provide as much quantitative detail as you can.*

(Open-ended) →
SURVEY FLOW in Qualtrics "checks" Q17 to see if ANY OTHER SPECTRAL BANDS ARE SELECTED. IF THEY ARE SELECTED, DISPLAY LOGIC for "SPECTRAL BANDS" of "G" & then Q26. IF NO OTHER SPECTRAL BANDS ARE SELECTED, go to Q33…

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(*This section is labeled "G" in Qualtrics.*)

The next few questions ask specifically about your preferences for all other Landsat spectral bands (not thermal bands). The current spectral band information is provided below.

Current Spectral Bands	Wavelength (micrometers)	Resolution (meters)
Ultra Blue (coastal/aerosol) Band 1	0.435 - 0.451	30
Blue Band 2	0.452 - 0.512	30
Green Band 3	0.533 - 0.590	30
Red Band 4	0.636 - 0.673	30
Near Infrared (NIR) Band 5	0.851 - 0.879	30
Shortwave Infrared (SWIR) 1 Band 6	1.566 - 1.651	30
Shortwave Infrared (SWIR) 2 Band 7	2.107 - 2.294	30
Panchromatic Band 8	0.503 - 0.676	15
Cirrus Band 9	1.363 - 1.384	30

Please continue to the next page to answer all other Landsat spectral band questions.

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26. What changes in or additions to the current Landsat spectral bands would result in a significant improvement in deriving the main observable for your primary application?
Provide specific / detailed information – including band center and width if known. *Write your response in the box below OR check "No significant improvement would occur."*

OR

☐ No significant improvement would occur if the current spectral bands changed.

If Q26 has a written response, DISPLAY LOGIC for "H" & Q27. If Q26 has box checked and no written response, go to "H" & Q28.

This question has Custom Validation in Qualtrics.

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(*This section is labeled "H" in Qualtrics.*)

The next set of questions ask about the benefits you would expect to see if your suggested changes in all other Landsat spectral bands (excluding thermal bands) of Landsat imagery occurred. Please consider scientific, management, economic, and social benefits.

Improvements to all other spectral bands could impact scientific research and management decisions. For instance, better spectral bands could be used to improve industrial forest inventory and management - such as map insect and disease risk. They could also be used to help decision makers pinpoint and minimize health risks - such as view where water has accumulated in depressions to become breeding grounds for disease-carrying insects. Although these examples are focused on forest and human health, both would provide additional benefits at the economic level by reducing loss of ecosystem services and decreasing medical expenses.

When possible, provide as much quantitative detail as you can. For example, improved mapping of forest insect disease and risk could result in pest reduction by 15-25% and would save affected areas billions of dollars (economic benefits). Minimizing health risks from mosquito-borne diseases might decrease the patients that contract illnesses by 20-30% resulting in saving millions of dollars to the region battling disease, thousands of dollars per family, and potential a 15% increase in tourism dollars. Within the research itself, improved spectral bands might increase the accuracy of your models by a certain percentage.

These are all examples of potential benefits you might expect to see if changes in Landsat spectral bands (excluding thermal bands) of Landsat imagery occurred. **Please provide information specific to what you might expect to see!**

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27. What benefits would you expect to see if these changes in the spectral bands of Landsat imagery occurred? *Please consider scientific, management, economic, and social benefits. (Open-ended – limit 1500 characters)*

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28. What spatial resolution would result in a significant improvement in deriving the main observable for your primary application? *Please select only one.*

- ☐ No significant improvement would occur with spatial resolution better than 30 meters. → *Go to "I" and then Q30; If ANY of the remaining options are selected, then DISPLAY LOGIC FOR Q29*
- ☐ 20 meters
- ☐ 15 meters
- ☐ 10 meters
- ☐ 5 meters
- ☐ <5 meters

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29. What benefits would you expect to see if this improvement in spatial resolution occurred? *Please consider scientific, management, economic, and social benefits. (Open-ended)*

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(This section is labeled "I" in Qualtrics.)

The next questions ask about your thoughts on usable Landsat scenes. For example, you may think usable scenes need to be 20% cloud-free, or 80% cloud-free, etc. Usability means sufficiently cloud-free to serve the purpose – usable for the application. The actual percentage does not matter, just answer based on what a usable scene is to *you*.

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30. During the past 12 months, on average, approximately how many days elapsed between obtaining usable Landsat scenes to derive the main observable for your primary application? *Depending on the location and time of year, usable imagery may have been available 8 days, 16 days, 32 days, or longer. Please enter number of days in the box below.*

☐ days

31. How often would you need usable Landsat imagery to significantly improve in deriving the main observable for your primary application? *Please enter number of days in the box below or check "No significant improvement would occur."*

☐ days

OR

☐ No significant improvement would occur if usable Landsat imagery were available more often.

If Q31 has a number, DISPLAY LOGIC for Q32. If Q31 has box checked and no number, go to Q33.

(*Text Entry Validation – Numerical Value in Qualtrics.*)

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32. What benefits would you expect to see if this improvement in the availability of usable Landsat imagery occurred? *Please consider scientific, management, economic, and social benefits. (Open-ended – limit 1500 characters)*

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NOTE TO REVIEWERS: Respondents will be able to loop through Qs 17-32 twice more (total of three times / observables) if they would like, based on their responses to Qs 33 and 34; however, this is not required and respondents can choose to move on to the rest of the survey instead.

33. The previous questions about spatial resolution, frequency of cloud-free usable imagery, and spectral bands asked you to consider only one observable, but we realize most people measure multiple parameters within their applications. Would you like to respond to the previous questions for a <u>different observable</u>? *If you check "Yes", you will have the chance to answer these questions for two additional observables (total of three). If not, check "No" below and you will move on to the remainder of the questions in the survey.*

- ☐ Yes
- ☐ No → *Q 35*

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34. What <u>other observable</u> have you frequently derived from Landsat imagery for your primary application during the past 12 months? *Please select only one.* → *Q 17*

- ☐ Land use/land cover/vegetation type
- ☐ Vegetation index/phenology/leaf area index
- ☐ Vegetation condition/stress/disturbance
- ☐ Canopy cover/biomass
- ☐ Crop stage/crop yield
- ☐ Non-photosynthetic vegetation
- ☐ Land surface elements/infrastructure (natural and man-made elements)
- ☐ Surface reflectance/albedo

- ☐ Surface composition/mineral type/geology
- ☐ Land skin temperature
- ☐ Active fires
- ☐ Burned area extent/severity
- ☐ Surface water extent
- ☐ Lake/river ice extent
- ☐ Lake/river water temperature
- ☐ Water quality/water chemistry
- ☐ Bathymetry
- ☐ Optically shallow water features/coral reefs
- ☐ Snow cover extent
- ☐ Glacier/ice sheet extent
- ☐ Other observables (*please explain*) _____

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35. Does current Landsat geometric accuracy meet your needs? *Please select only one answer.*

- ☐ Yes → *QUESTION 37*
- ☐ No → *DISPLAY LOGIC for Q36*

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36. What geometric accuracy improvement would result in a significant improvement in your application? *(Open-ended – limit 1500 characters)*

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37. Does current Landsat radiometric resolution meet your needs? *Please select only one answer.*

- ☐ Yes → *QUESTION 39*
- ☐ No → *DISPLAY LOGIC for Q38*

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38. What radiometric resolution improvement would result in a significant improvement in your application? *(Open-ended – limit 1500 characters)*

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(*The table below is a static image. In Qualtrics, every attribute level is assigned separately for each respondent – based on a statistical analysis. This includes 10 attribute levels per respondent.*)

39. We are interested in knowing how Landsat users would value various potential improvements in satellite imagery. We want you to consider the three options below. The first option contains the features of Landsat 8 imagery, which is offered at no charge, as it is now. The other two options represent potential imagery products that you could purchase in the private market. These options have various improvements over Landsat 8 data, such as better spatial resolution or higher frequency of acquisition, but they also cost money. While considering your current or most recent project/organizational budget and the observables you need to derive for your primary application, **please select which of the three options is your most preferred and which of the three options is your least preferred**.

Features of the imagery	**Landsat 8**	**Option A**	**Option B**
Spatial resolution	30 meters	5 meters	10 meters
Cloud-free, usable imagery	32 days	7 days	14 days
Spectral bands	Landsat 8 bands	Landsat 8 bands plus additional TIRS bands (8-14 µm)	Landsat 8 bands plus red edge (680-730 nm)
Thermal band spatial resolution	100 meters	30 meters	60 meters
Cost per image downloaded	$0	$27	$195

Select your single **Most Preferred Option.**	Landsat 8 ☐	Option A ☐	Option B ☐
Select your single **Least Preferred Option**	Landsat 8☐	Option A☐	Option B☐

39.A Same question as 39, but without cost as a consideration. All content remains the same, except for $0 values are the only values in the Cost per Image Downloaded row.

39.B. We are interested to know why you selected Landsat 8. We want your honest answers, so please let us know. Please select the most important reasons that apply to you or type in your own reasons.

- ☐ The improvement in Landsat imagery in Option A and Option B is not worth the added cost
- ☐ My projects/organization cannot afford to pay for imagery even if they are improvements over Landsat imagery
- ☐ Even if I wanted to, I do not have a way to pay for the cost of the improved imagery (e.g., do not have a credit card or other electronic method of payment available)
- ☐ Improvements in Landsat imagery should be provided free of charge since my tax dollars are already paying for Landsat imagery
- ☐ Other satellites (e.g., Sentinel-2) already provide some of the enhancements that I need, so I do not need to pay extra to get them from Landsat
- ☐ Other (*please explain in the text box below*)

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(*This section is labeled "J" in Qualtrics.*)

SECTION 3: Landsat Processing and Distribution

You are more than halfway through the survey! In **Section 3**, we would like to know more about your preferences for Landsat imagery distribution and products.

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40. How soon would you need Landsat imagery after it has been acquired? *Please check only one.*

- ☐ Near real time/Same day
- ☐ Within 2-3 days
- ☐ Within one week
- ☐ Within a month
- ☐ In the same season it was acquired
- ☐ In the same year it was acquired
- ☐ Does not matter

41. During the past 12 months, what has been your primary source of the Landsat imagery you have used in your work? *Please check only one.*

- ☐ USGS portals such as Earth Explorer and GloVIS
- ☐ NASA Earthdata
- ☐ Google Earth Engine
- ☐ Amazon Web Services
- ☐ AmericaView
- ☐ University/college
- ☐ Other (*please explain*)_____

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42. How likely would you be to use the following imagery options if they were offered by USGS? *Please select one option in each row.*

Landsat imagery options	Very unlikely	Somewhat unlikely	Somewhat likely	Very likely	Don't Know
A subset of specific bands (e.g., downloading only red, green, and blue bands)	-2	-1	1	2	99
A portion of a scene (e.g., a crop or shapefile tool for selection of a specific area within a scene)	-2	-1	1	2	99

Time series data cube (e.g., tiled co-registered data cube ideal for time series analysis)	-2	-1	1	2	99

If ARD item has "Somewhat likely" or "Very likely" selected, DISPLAY LOGIC for Q43; otherwise, go to Q44.

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43. How would your use of time series data cube change your work, if it was available?
Please check all that apply.

- ☐ Time series data cube would not change my work.
- ☐ The geographic scale of my work would expand (e.g., do analysis over a larger area or in more locations).
- ☐ The temporal scale of my work would expand (e.g., do analysis over a longer period of time or do analysis farther back in time).
- ☐ The type of work I do would change (e.g., new applications or types of analyses such as change detection).
- ☐ My work would take less time to complete.
- ☐ My work would be more accurate.
- ☐ Other (*please explain*)_____

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44. How often do you use (or would use, once developed) the following Landsat data products for your work? *Please select one option in each row.*

How often do you use the following Landsat data products for your work?					
Landsat data product	**Never**	**Rarely**	**Occasionally**	**Often**	**All the time**
Uncalibrated raw data (Level 0)	0	1	2	3	4
Radiometrically calibrated and orthorectified data (Level 1)	0	1	2	3	4
Landsat data mosaics such as web-enabled Landsat data composited mosaics (Level 1)	0	1	2	3	4
Surface Reflectance (Level 2)	0	1	2	3	4
Land Surface Temperature (Level 2)	0	1	2	3	4

Burned Area (provisional – Level 3)	0	1	2	3	4
Dynamic Surface Water Extent (provisional – Level 3)	0	1	2	3	4
Fractional Snow Covered Area (provisional – Level 3)	0	1	2	3	4

How often would you use the following Landsat data products for your work?

Landsat data product	**Never**	**Rarely**	**Occasionally**	**Often**	**All the time**
Land cover and land change time series products (in development – Level 3)	0	1	2	3	4

45. Aside from those listed above, what other Landsat products would be most beneficial to you? *Please describe your ideal Landsat product(s) below. (Open-ended – limit 1,500 characters)*

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(*This section is labeled "K" in Qualtrics.*)

SECTION 4: Value of Landsat

Two more short sections to go! In **Section 4**, we ask no more than 5 questions about the value of Landsat imagery to you.

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NOTE TO REVIEWERS: The dollar amounts used in the willingness to pay (WTP) questions were developed based on the following factors. The WTP questions were used in a previous survey (2012). The range of costs were tested for that survey and were initially developed based on the average cost per scene that Landsat users paid for Landsat imagery prior to 2008. These values are used in the current survey and have been adjusted for inflation. We have a lookup table created with the "assigned bid" and an "up / down" value. The "up / down" values are referenced from the lookup table based on the participant response. The initial "assigned bid" is randomly assigned to each participant – again using the lookup table that was developed with all the WTP values. We are using the Qualtrics survey platform. In Qualtrics, we are able to create an "assigned bid" for each participant by referencing a lookup table that contains the assigned bids and the "up / down" values.

46. (a) In the event that Landsat imagery was no longer available, you may have to obtain imagery elsewhere. Assume that you are restricted to your current project or organization

budget level and that the money to pay any cost for replacement imagery and additional software or training would have to come out of your existing budget. **If you had to pay for imagery that was equivalent to currently available Landsat imagery, would you pay $*XXX* for one scene covering the area equivalent to a Landsat scene?** NOTE TO REVIEWERS: 50% of the respondents will view (a) content when answering this question.

If they say Yes, the dollar amount steps up with the same wording above repeated.
If they say No, the dollar amount steps down, with the same wording above repeated.
If they say No again, we ask the $1 question.
(View in Q47-Q58)

(b) The current and proposed federal budgets provide sufficient funding to maintain the current Landsat program, but not for building and launching the replacement to Landsat 8, namely Landsat 9. Landsat 9 is equivalent to Landsat 8 with a likely launch in 2021. The cost of building and launching Landsat 9 has increased in recent years. In order to provide funding for building and launching Landsat 9, a trust fund would be established. The per image download fee would provide money that would be used exclusively for the purpose of building and launching Landsat 9. Assume that you are restricted to your current project or organization budget level and that the money to pay any cost for replacement imagery and additional software or training would have to come out of your existing budget. If Landsat 9 is not built there may be no Landsat satellite images after Landsat 8 becomes inoperable, sometime during the 2023 time period. **Would you pay $XXX per image into this trust fund for building and launching Landsat 9, and replacing Landsat 8?** NOTE TO REVIEWERS: 25% of the respondents will view (b) content when answering this question.

If they say Yes, the dollar amount steps up with the same wording above repeated.
If they say No, the dollar amount steps down, with the same wording above repeated.
If they say No again, we ask the $1 question.
(View in Q47-Q58 – the text/wording changes in Qualtrics to match (b) content)

(c) In the event that Landsat imagery was no longer available, you may have to obtain imagery elsewhere. Think about what would be the minimum increase in your typical project budget that would be required to purchase a replacement for Landsat imagery you currently use in your typical projects. **Would a minimum increase in a typical project budget of $XXX for a typical Landsat scene be sufficient?** NOTE TO REVIEWERS: 25% of the respondents will view (c) content when answering this question.

If they say Yes, then GO DOWN TO A LOWER $ AMOUNT.
If they say NO, then GO UP TO A HIGHER $ AMOUNT.
(View in Q47-Q58 – the text/wording changes in Qualtrics to match (c) content)

- ☐ Yes
- ☐ No → *Q53*

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47. Since in your response to the previous question you indicated you would pay $XXX for imagery, please indicate how you would pay this added cost in terms of categories from your existing budget you would reduce or your ability to pass this cost onto your clients, whether inside your organization/agency or outside your organization/agency. *Please check only one*.

- ☐ Reduce money spent on travel
- ☐ Reduce money spent on other computer software or hardware
- ☐ Reduce amount spent on hiring of personnel or salaries
- ☐ Attempt to pass cost onto clients
- ☐ Other (please explain): _____

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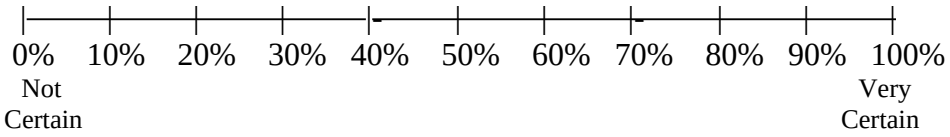
48. How certain are you that you would pay $XXX for the imagery? *Please slide the circle to the percentage that best represents your answer. (This is a slider bar in Qualtrics.)*



49. Assume that you are restricted to your current project or organization budget level and that the money to pay any cost for replacement imagery and additional software or training would have to come out of your existing budget. **Approximately how many fewer scenes (if any) would you buy per year if each scene cost $XXX**? *Please write a whole number in the box below. (Open-ended – limit 10 characters)*
(*Text Entry Validation – Numerical Value in Qualtrics.*)

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50. If the cost was $*(1.25x bid amount in Q46)*, would you pay this amount for one scene covering the area equivalent to a Landsat scene?

- ☐ Yes
- ☐ No → *"L", Q59*

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51. Approximately how many fewer scenes (if any) would you buy per year if each scene cost $(1.25x original)? *Please write a whole number in the box below. (Open-ended – limit 10 characters)*
(*Text Entry Validation – Numerical Value in Qualtrics.*)

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52. At what price per scene would it not be possible to complete a typical task or project you work on? → *"L", Q59*

Price per Scene ☐

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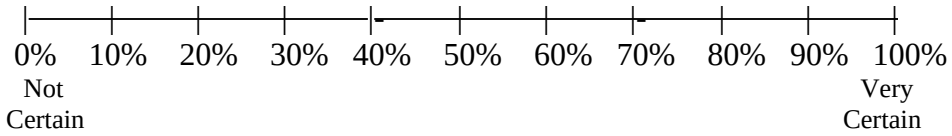
53. How certain are you that you would not pay $XXX for the imagery? *Please select the percentage that best represents your answer.*



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54. If the cost was $(*0.75x bid amount in Q46*), would you pay this amount for one scene covering the area equivalent to a Landsat scene?

☐ Yes → *DISPLAY LOGIC for Q55*

☐ No → *Q56*

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55. Approximately how many fewer scenes (if any) would you buy per year if each scene cost $(0.75x original)? *Please write a whole number in the box below. (Open-ended – limit 10 characters)* → *"L", Q59*

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56. If the cost was $1, would you pay this amount for one scene covering the area equivalent to a Landsat scene?

☐ Yes → *DISPLAY LOGIC for Q57*

☐ No → *Q58*

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57. Approximately how many scenes would you buy per year if each scene cost $1? *Please write a whole number in the box below. (Open-ended – limit 10 characters)* → *"L", Q59*
(*Text Entry Validation – Numerical Value in Qualtrics.*)

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58. Why you would not pay $1 (or pay with reverse wording) for the imagery? *Please check all that apply.* NOTE TO REVIEWERS: all respondents view this question, but the

choice content will change depending on which version of the initial question #46 they receive when initiating the survey.

- ☐ Landsat imagery is not worth that much money to me. (b) Text – New imagery is not worth that much to me on my projects. (c) Text – I do not have a good idea of what it would cost me, as I nearly always rely upon free imagery such as Landsat.
- ☐ My projects/organization cannot afford to pay that much for Landsat imagery. (b) Text – My projects/organization cannot afford to pay that much for replacement imagery. (c) Text – It is unlikely that I would get a budget increase large enough to pay for replacement imagery.
- ☐ Even if I wanted to, I do not have a way to pay for the imagery (e.g., do not have a credit card or other electronic method of payment available). (b) Text – Even if I wanted to, I do not have a way to pay for other imagery (e.g., do not have a credit card or other electronic method of payment available).
- ☐ Landsat imagery should be provided free of charge since my tax dollars already paid for it.
- ☐ I would use other imagery available at no cost.
- ☐ Our projects would not be possible without access to Landsat imagery.
- ☐ This function of our agency, organization, business, etc. would no longer be viable if we had to pay for imagery.
- ☐ I am concerned that my answer will be used to set a price to charge for Landsat in the future.
- ☐ Other (*please explain*)_____

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(*This section is labeled "L" in Qualtrics.*)

SECTION 5: Work experience

This is the last section and it only has a couple questions! In **Section 5**, we would like to know a bit more about your work experience.

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59. In what sector do you work? *Please select only one answer. If you work for more than one entity, select the sector in which you spend the majority of your time working.*

- ☐ Academic institution as faculty, staff, or student (e.g., university, college, technical/vocational) → *DISPLAY LOGIC for Q60 (all other responses → Q61)*
- ☐ International government (e.g., United Nations, European Union)
- ☐ National/Federal government (of any country)
- ☐ State/Provincial/Departmental government (in any country)
- ☐ Local government (in any country) (for example, county, city)
- ☐ Tribe/Nation/Indigenous government
- ☐ Private business

- ☐ Non-profit organization
- ☐ Other (please explain) _____

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60. What is your current role at your academic institution?

- ☐ Faculty or staff (e.g., administrator, professor, researcher, postdoctoral researcher)
- ☐ Graduate student
- ☐ Undergraduate student

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61. How many years have you been using remotely sensed imagery? *Please write a whole number in the box below. If less than one year, just write 1.*

Years ☐

(*Text Entry Validation – Numerical Value in Qualtrics.*)

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(*This section is labeled "Q62" in Qualtrics.*)

Thank you for completing this survey! The space below is provided for any additional comments you may have. Please contact Crista Straub (cstraub@usgs.gov) with any questions, or to receive a link to the final report (when published). Please click the "SUBMIT" button when you are finished. *(Open-ended - limit 1500 characters)*

Additional Notes:

1. *Survey questions with "don't know" are side by side questions within Qualtrics.*
2. *"Application" and "Observable" respondent selections are piped into additional questions throughout the survey. In the word document, those selections are not indicated in the additional questions, but are just plain text "Application" and "Observable".*