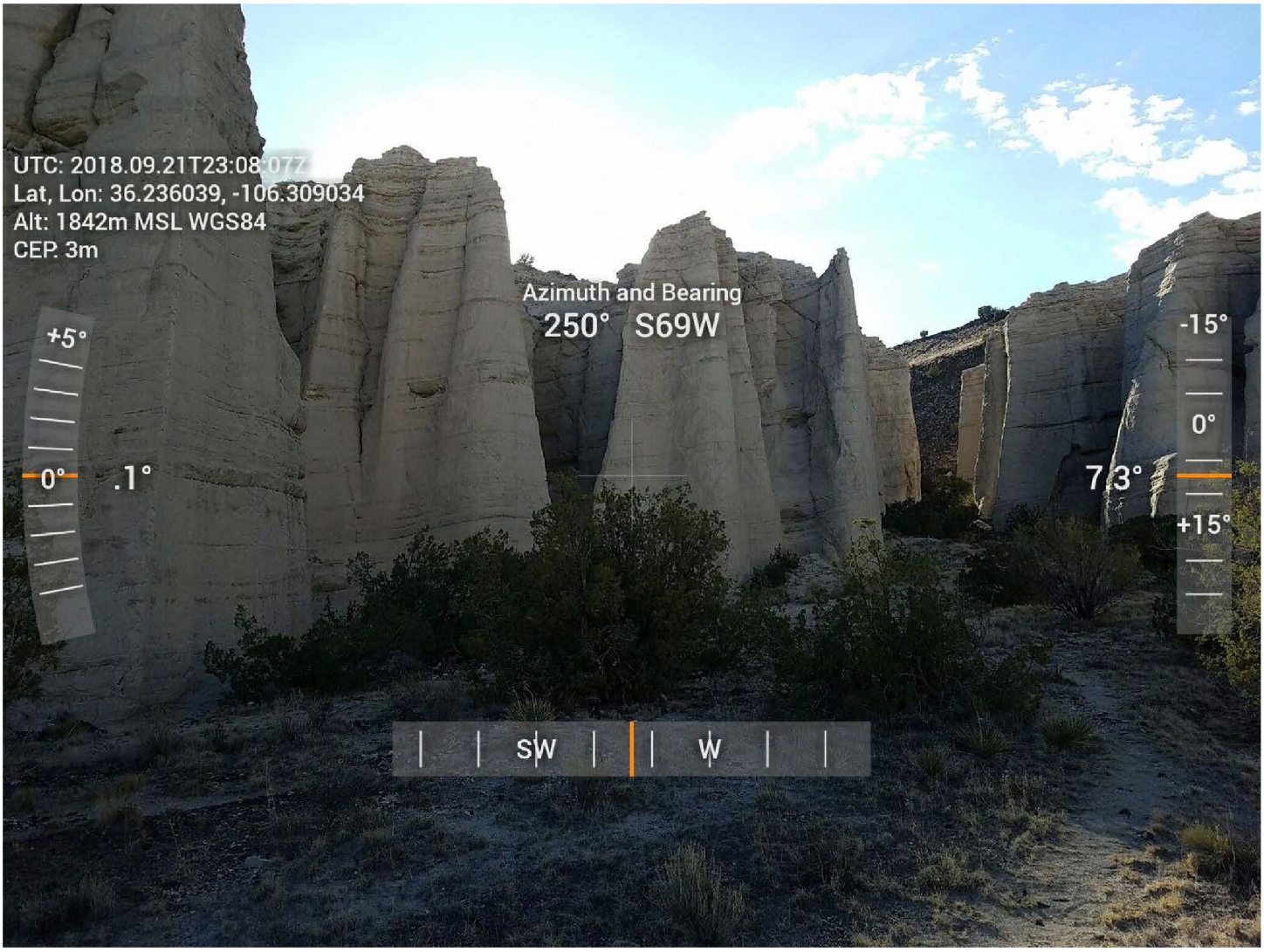

Georgia O'Keeffe Museum Viewshed Project

Database Construction Research (P17AP00238)

February 2019

Principle Investigator: Ben Finberg

Project Team: Trust for Public Land

Contact: Kira Randolph, Grant Writer

Contact: Dr. Kira Randolph, Grant Writer, krandolph@okeeffemuseum.org, (505) 946-1062

Georgia O'Keeffe Museum

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Georgia O'Keeffe Museum

Executive Summary

Thanks to grant funding from the National Center for Preservation Technology and Training, the Georgia O'Keeffe Museum (the O'Keeffe) is in the beta stage for two viewshed applications: The Georgia O'Keeffe 3D Landscape Viewer and the Georgia O'Keeffe Decision Support Tool. These applications realize the project's goals of engaging audiences in participatory experiences and strengthening communities by connecting people with the broader environmental context for inspiration behind O'Keeffe's paintings. Both tools document geography and art connections for interpretation and scholarship, and each application has the potential to preserve culturally important landscapes.

Now that these two applications are in the testing phase, the Museum is able to extend usage to interested parties, such as: The State Historic Preservation Office, the Forest Service, as well as oil and gas companies. By empowering visitors to familiarize themselves with the iconic viewsheds portrayed in O'Keeffe's New Mexican landscape paintings, people become stewards of these significant cultural landscapes.

Link to Georgia O'Keeffe Museum webpage: https://www.okeeffemuseum.org/okeeffe-experiments/
Link to Trust for Public Land hosting page for Georgia O'Keeffe 3D Landscape Viewer and Georgia O'Keeffe Decision Support Tool: https://web.tplgis.org/gokmuseum/

Due to data licensing regulations, the creation of a free profile is requisite for access to the Georgia O'Keeffe Decision Support Tool. Please visit the second URL, above, to view contact information.

Introduction

Georgia O'Keeffe's artistic representations of diverse New Mexican landscapes evoke a strong sense of place, identity, and character, deeply felt by locals and visitors alike. The protection of these sites is of critical cultural and historic importance on a local, state, and national scale. In the past several years, the State of New Mexico has seen an increase in exploratory drilling for petroleum and natural gas and other forms of development, which pose threats to several sites depicted in O'Keeffe's oil paintings. Beginning in 2015, the Georgia O'Keeffe Museum began investigating database models for documenting the viewsheds depicted in O'Keeffe's iconic southwest paintings. The O'Keeffe Viewshed Project was born from a desire to put information about these geographical areas in the hands of both Museum visitors and land stakeholders to deepen public understanding of its cultural significance.

The grant deliverables are two applications: The Georgia O'Keeffe 3D Landscape Viewer and the Georgia O'Keeffe Decision Support Tool. The Landscape Viewer prototype is appealing to general audiences by juxtaposing O'Keeffe's artwork with contemporary site photography against a backdrop of three-dimensional terrain. Connecting artworks with their geographical sites enables visitors to see O'Keeffe's artworks as authentic representations of New Mexican landscapes, effectively creating a personal connection to the same places O'Keeffe admired. This connection is valuable in allowing visitors to better understand the broader environment that inspired O'Keeffe.

Using the same GPS coordinates employed in the Landscape Viewer, the Decision Support tool additionally utilizes programming and a custom script to create viewshed wedges that are visible in the pilot. This powerful tool aggregates extensive data from open sources, documenting recreation trails, forest roads, land ownership, wilderness areas, fire potential, mineral ownership, and others. Because open sourcing has been used, the Museum is able to adopt technological advances to enhance education, analysis, stewardship, tourism, and enjoyment across sectors. Users may run queries into land characteristics by selecting criteria, then export the results into a personal PDF.

Methods and Materials

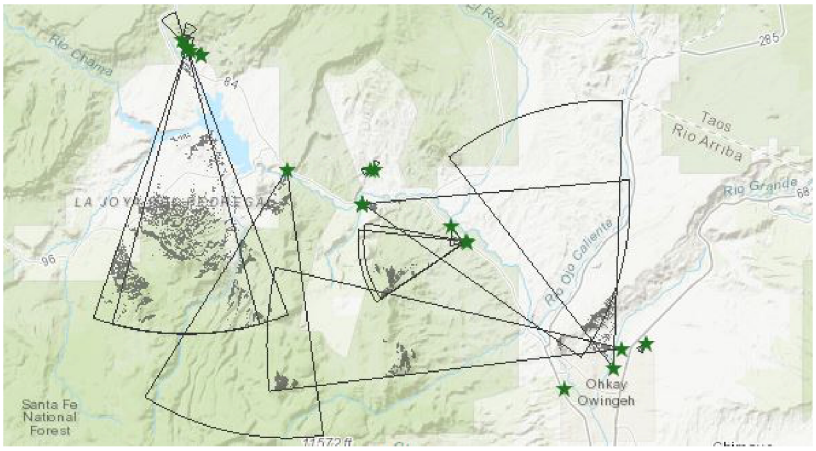
1. Viewshed selection: Comparative landscape photography was taken for the O'Keeffe's publication, *Georgia O'Keeffe and New Mexico: A Sense of Place* (2004), which was the basis for selecting the sites featured in the apps. The Museum's original application sought to include 25 landscapes. The Museum's Principle Investigator, Ben Finberg travelled to each site of interest, and the beta applications include data associated with 28 sites. Example below features the artwork, *Purple Hills Ghost Ranch*, 1934, alongside landscape photography.

2. Contemporary landscape photography and position registration: Ben Finberg photographed each viewshed using the application, Dioptra. In the Google app store, Dioptra is defined as, "a camera position and angle measurement tool for navigation, surveying, positioning, and measurement." This application registers the altitude, latitude, longitude and bearing of the image (bearing refers to the direction in which the camera is pointed, relative to north). The sample Dioptra image, below, is associated with the painting, *Sand Hill, Alcalde*, 1930.

3. Image mapping: At this point, the Georgia O'Keeffe Museum secured the Trust for Public Land as a project partner. Their teams used the data associated with the Dioptra image, namely the latitude and longitude, to place images on a map.

4. Viewshed location: ArcGIS online is geographic information system software that offers a specialized Viewshed tool. Using the Dioptra coordinates and National Elevation Dataset, ArcGIS was utilized to locate each of the 28 viewsheds.

5. Viewshed boundaries/positioning: A python script was used to create “wedges” indicating the exact scene visible in artworks. Wedges were created using the bearing from the Dioptra image, a “swath” which is the number of degrees on either side of the bearing that is viewable in the image and the radius, which is the farthest distance from the point the image is visible. These wedges were used to cut out the piece of the viewshed that is in the painting.



6. Data overlay: Open source information was located and imported into the Decision Maker. Data pertains to: recreation trails, forest roads, NDOT roads, land ownership, elevation, flood zones, land cover, large fire potential, wilderness areas, areas of

critical environmental concern, mineral ownership, grazing allotments, housing density, counties, cities and places, businesses, and block groups with 2018 demographics.

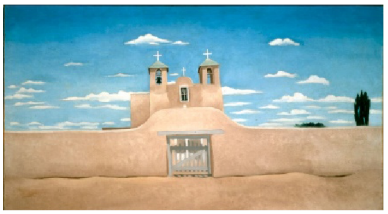
Data	Source	Description	URL (if available)
Recreation Trails	Santa Fe and Carson National Forests	Trails in Carson and Santa Fe National Forests	https://www.fs.usda.gov/detail/r3/landmanagement/gis/?cid=stelprdb5202766 or https://www.fs.usda.gov/detail/r3/landmanagement/gis/?cid=stelprdb5203736
Forest Roads	Santa Fe and Carson National Forests	Forest Roads in Carson and Santa Fe National Forests	https://www.fs.usda.gov/detail/r3/landmanagement/gis/?cid=stelprdb5202766 or https://www.fs.usda.gov/detail/r3/landmanagement/gis/?cid=stelprdb5203736
NMDOT Roads	NMDOT	Major roads and their functional classes	https://www.arcgis.com/home/item.html?id=e1114c2368374dc3911b03bdbf501233
Land Ownership	New Mexico Statewide Geospatial data from BLM	Ownership including BLM, BOR, DOD, Forest Service, National Park Service, Private, State, State Game and Fish, State Park, and Tribal	https://www.nm.blm.gov/shapeFiles/state_wide/spatial_data_metadata.html
Elevation (meters)	USGS	10-m resolution digital elevation model	https://www.usgs.gov/core-science-systems/national-geospatial-program/national-map
Flood Zones	FEMA	100-yr and 500-yr flood zones	https://msc.fema.gov/portal/advanceSearch#searchresultsanchor
Land Cover	NLCD 2011	National Land Cover Dataset	https://www.mrlc.gov/data?f%5B0%5D=category%3Aland%20cover
Large Fire Potential	USGS	Percent chance estimate, given a source of ignition, that a fire will grow to 100+ acres	https://www.usgs.gov/land-resources/lcsp/fire-danger-forecast
Wilderness Areas	New Mexico Statewide Geospatial data from BLM	Wilderness areas in New Mexico	https://www.nm.blm.gov/shapeFiles/state_wide/spatial_data_metadata.html
Areas of Critical Environmental Concern	New Mexico Statewide Geospatial data from BLM	ACEC designations are for lands where special management attention is needed to protect important historical, cultural, and scenic values, or fish and wildlife or other natural resources.	https://www.nm.blm.gov/shapeFiles/state_wide/spatial_data_metadata.html
Mineral Ownership	New Mexico Statewide Geospatial data from BLM	Federal mineral ownership information provided by BLM. This information reflects federal mineral (or subsurface) interest of land parcels in NM.	https://www.nm.blm.gov/shapeFiles/state_wide/spatial_data_metadata.html
Grazing Allotments	New Mexico Statewide Geospatial data from BLM	Grazing allotments in NM	https://www.nm.blm.gov/shapeFiles/state_wide/spatial_data_metadata.html
Housing density	Dave Theobald 2005	Estimated housing density for 2010 and 2050, as well as an analysis predicting where land will be converted from undeveloped in 2010 to developed in 2050 indicating development risk.	Theobald, D. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. Ecology and Society 10(1): 32. [online] URL: http://www.ecologyandsociety.org/vol10/iss1/art32/
Counties	ESRI 2018 Demographic Forecasts	Rio Arriba, San Juan, and Taos Counties	https://www.esri.com/en-us/arcgis/products/esri-demographics/overview

Cities and Places	ESRI 2018 Demographic Forecasts	All cities and towns in the study area	https://www.esri.com/en-us/arcgis/products/esri-demographics/overview
Businesses	ESRI's Business Analyst	All businesses in the study area	https://www.esri.com/en-us/arcgis/products/esri-demographics/overview
Block Groups with 2018 Demographics	ESRI 2018 Demographic Forecasts	Block groups are a relatively small geographical unit at which to aggregate demographic information	https://www.esri.com/en-us/arcgis/products/esri-demographics/overview

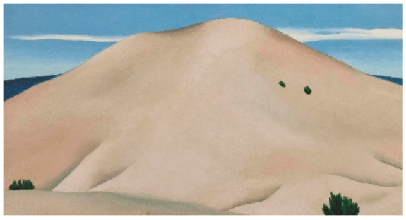
Results and Discussion

Both applications include data associated with 28 of Georgia O'Keeffe's viewsheds in the geographical area in and surrounding Ghost Ranch, New Mexico. List of viewsheds and thumbnail images, follows.

Georgia O'Keeffe
Ranchos Church, Front, 1930
Oil on canvas, 20 x 36 inches
Private collection, San Francisco, California, 1995
© Georgia O'Keeffe Museum



Georgia O'Keeffe
Sand Hill, Alcalde, 1930
Oil on canvas, 16 x 30 inches
Private collection, Los Angeles, California, 1972, extended loan, Fine Arts Museum of San Francisco, San Francisco, California
© Georgia O'Keeffe Museum

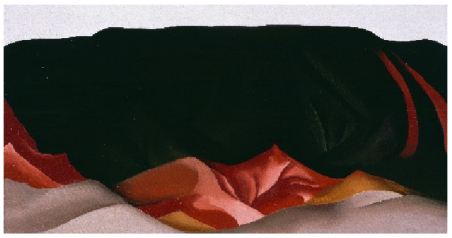


Georgia O'Keeffe
Black Mesa Landscape, New Mexico / Out Back of Marie's II, 1930
Oil on canvas, 24 1/4 x 36 1/4 inches
Georgia O'Keeffe Museum
Gift of The Burnett Foundation
© Georgia O'Keeffe Museum

Georgia O'Keeffe
New Mexican Landscape, 1930
Oil on canvas, 16 x 30 inches
Museum of Fine Arts, Springfield, Massachusetts
© Georgia O'Keeffe Museum

Georgia O'Keeffe
Near Abiquiu, N.M. 2, 1930
Oil on canvas, 10 x 24 1/8 inches
Metropolitan Museum of Art
© Metropolitan Museum of Art

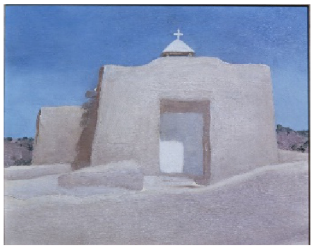
Georgia O'Keeffe
Dark Mesa with Pink Sky, 1930
Oil on canvas, 16 x 29 7/8 inches
Amon Carter Museum of American Art
© Amon Carter Museum of American Art



Georgia O'Keeffe
Hills Before Taos, 1930
Oil on canvas, 16 x 30 inches
Montgomery Museum of Art
© Georgia O'Keeffe Museum

Georgia O'Keeffe
Taos Mountain, New Mexico, 1930
Oil on canvas, 16 x 30 inches
Hood Museum of Art, Dartmouth College
© Georgia O'Keeffe Museum

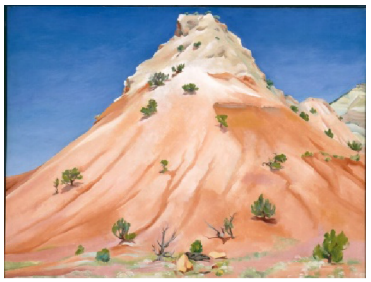
Georgia O'Keeffe
Near Alcalde, New Mexico, 1931
Oil on board, 7 x 8 5/8 inches
Yale University Art Gallery, Bequest of Doris M. Brixey (1984.32.21)



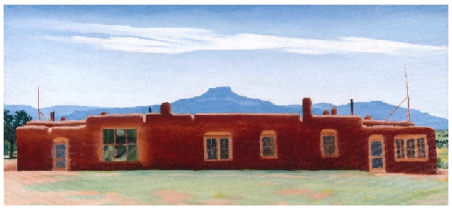
Georgia O'Keeffe
Back of Marie's No. 4, 1931
Oil on Canvas, 16 x 30 inches
Georgia O'Keeffe Museum
Gift of The Burnett Foundation

Georgia O'Keeffe
Purple Hills Ghost Ranch - 2 / Purple Hills No I, 1934
Oil on Canvas, 16 1/4 x 30 1/4 inches
Georgia O'Keeffe Museum
Gift of The Burnett Foundation

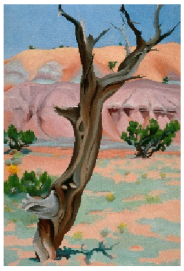
Georgia O'Keeffe
Hill, New Mexico, 1935
Oil on canvas, 30 x 40 inches



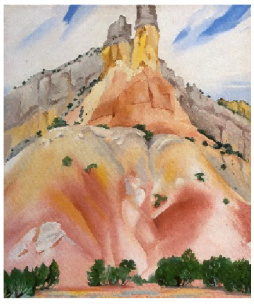
Georgia O'Keeffe
The House I Live In, 1937
Oil on canvas, 14 x 30 inches
Private collection, New Haven, Connecticut, 1967



Georgia O'Keeffe
Chama River, Ghost Ranch, 1937
Oil on canvas, 30 1/4 x 16 inches
Museum of Fine Arts, Museum of New Mexico, Santa Fe,
Gift of the Estate of Georgia O'Keeffe, 1988 (88.312.1)
© Museum of Fine Arts, Museum of New Mexico

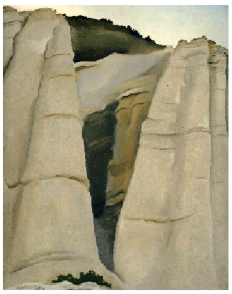


Georgia O'Keeffe
Cedar Tree with Lavender Hills, 1937
Oil on canvas, 30 x 19 ½ inches
© Georgia O'Keeffe Museum

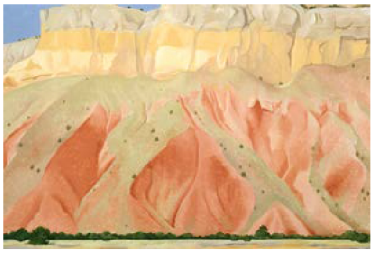


Georgia O'Keeffe
The Cliff Chimneys, 1938
Oil on canvas, 36 x 30 inches
Milwaukee Art Museum
© Milwaukee Art Museum

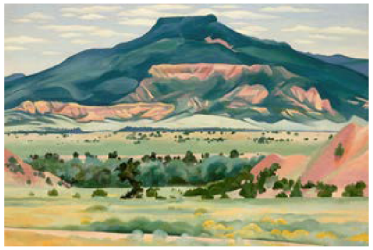
Georgia O'Keeffe
The Patio – No. I, 1940
Oil on canvas, 24 1/2 x 18 1/2 inches
Private collection, Victoria, Texas, 1997
© Georgia O'Keeffe Museum



Georgia O'Keeffe
From The White Place, 1940
Oil on canvas, 30 x 24 inches
The Phillips Collection
© Georgia O'Keeffe Museum



Georgia O'Keeffe
Untitled (Red and Yellow Cliffs), 1940
Oil on canvas, 24 x 36 inches
Georgia O'Keeffe Museum
Gift of The Burnett Foundation
© Georgia O'Keeffe Museum



Georgia O'Keeffe
My Front Yard, Summer, 1941
Oil on canvas, 20 1/16 x 30 1/8 inches
Georgia O'Keeffe Museum
Gift of The Georgia O'Keeffe Foundation
© Georgia O'Keeffe Museum

Georgia O'Keeffe
White Place in Shadow, 1941
Oil on canvas, 30 x 40 inches
Georgia O'Keeffe Museum
© Georgia O'Keeffe Museum

Georgia O'Keeffe
Black Place I, 1944
Oil on canvas, 36 3/16 x 40 1/8 inches
Georgia O'Keeffe Museum
Gift of The Burnett Foundation
© Private Collection

Georgia O'Keeffe
Cebola Church, 1945
Oil on canvas, 20 1/16 x 36 ¼ inches
North Caroline Museum of Art
Gift of the North Carolina State Art Society (Robert F. Phifer Bequest), in honor of Joseph C. Sloane
© Georgia O'Keeffe Museum

Georgia O'Keeffe
In the Patio I, 1948
Oil on canvas, 18 x 30 inches
Georgia O'Keeffe Museum
Gift of The Georgia O'Keeffe Foundation

Georgia O'Keeffe
Cliffs Beyond Abiquiu - Dry Waterfall, 1943
Oil on canvas, 30 x 16 inches
Cleveland Museum of Art

Georgia O'Keeffe
Mesa and Road East, 1952
Oil on canvas, 26 1/16 x 36 inches
Georgia O'Keeffe Museum
Gift of The Georgia O'Keeffe Foundation

Georgia O'Keeffe
Winter Cottonwoods East V, 1954
Oil on canvas, 40 x 36 1/16 inches
Georgia O'Keeffe Museum
Gift of The Burnett Foundation

Georgia O'Keeffe
Black Patio Door, 1955
Oil on canvas, 23 x 14 inches
Private collection

Conclusions

This pilot identifies how this type of visual mapping technology is valuable in protecting at-risk sites in New Mexico and across the nation. Now that both applications are available for testing by external partners, discussions about the usage of data visualization tools may impact policy development with entities such as the Bureau of Land Management.

Moving forward, the Museum has a model available for testing with O'Keeffe's viewsheds in other states, such as Texas, New York, and Colorado. The Museum is also receptive to partnering with other organizations in the inclusion of other artists in the Georgia O'Keeffe 3D Landscape Viewer.

Acknowledgments

The Georgia O'Keeffe acknowledges the assistance of partner, the Trust for Public Land. Originally, the Museum anticipated contracting with multiple entities to execute the project. Working with the Trust for Public Land (TPL) as the sole contract provider streamlined the development.

References

Lynes, Barbara Buhler. *Georgia O'Keeffe: Catalogue Raisonné*. New Haven, Yale University Press, 1999.

Lynes, Barbara Buhler; Poling-Kempes, Lesley; Frederick, Turner W. *Georgia O'Keeffe and New Mexico: A Sense of Place.* Princeton, Princeton University Press, 2004.

User Guide

Follows on next page

Georgia O'Keeffe

DECISION SUPPORT TOOL USER GUIDE

GETTING THERE

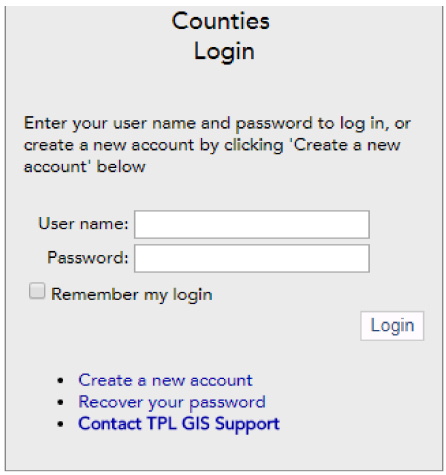
Accessing the site

Use the following link to connect to the Healthy Connected Chattanooga Landing Page

- https://web.tplgis.org/georgiaokeeffesecure

Logging into the site

A username and password is required to access the site, which you can create directly from the link on the login page.



Once you've created a login username and password, you'll be able to access the site using that login each time.

Navigating the Map

Zoom & Pan

- On the left-hand side of the map, click the (+) sign to zoom in and the (-) to zoom out
- To zoom in to a particular area hold down shift, click your mouse on one corner of the desired extent, and drag your mouse to the opposite corner of the desired extent.
- Click and drag your mouse to the right or left to pan around the map (adjusting your view)

Note: As you change the viewer extent the map detail changes. As you zoom in the map becomes more detailed.

- Click the  button to return to the extent of the study area.
- Click the  button to show your location on the map

Change the map background

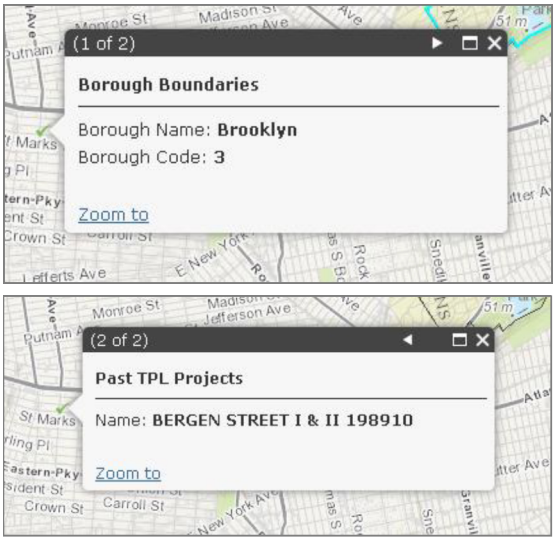
- Click the 

tab to the left of the map. Then click the checkbox next to the basemap you desire.

Interacting in the Map

Selecting features (including parcels)

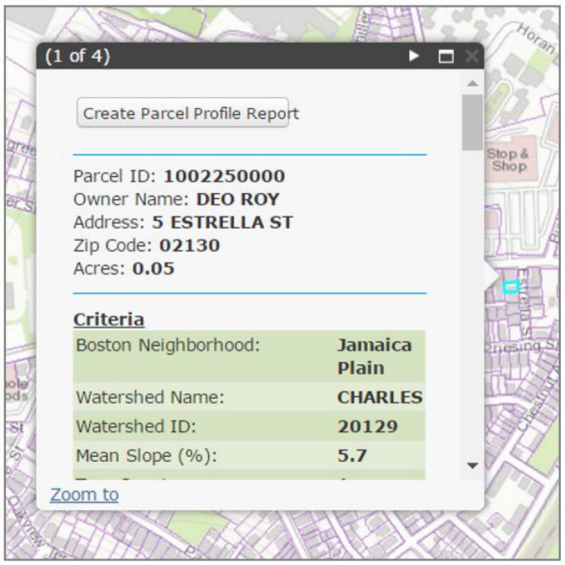
Most of the overlay layers included in the tool have attribute information that you can access through the map.



- Turn on the any layer in the Overlay Data section.
- Click on the map.
- An information box will appear that describes the feature(s) that you clicked.
- *Note:* If multiple layers are turned on, the one that is highest in the table of content will be identified first.
- If there is a ▶ in the info box title you have identified multiple features. Click ▶ to view information on the other selected features.

Creating Parcel Reports

When selecting parcels, you can also create a parcel profile report from the pop-up dialog. These custom reports provide more detail about the climate priorities and physical characteristics of each parcel.



Turn on the “Parcels” layer that's in the Overlay Data section. Parcels are scale dependent and will only appear once you have zoomed in.

Once zoomed in and viewing the parcels click on a parcel to find out more information on it.

You can create a Parcel Profile Report on individual parcels by clicking Create Parcel Profile Report A Parcel Profile Report provides a detailed characterization of all modeled Climate-Smart Cities priorities and filtering criteria for an individual parcel.

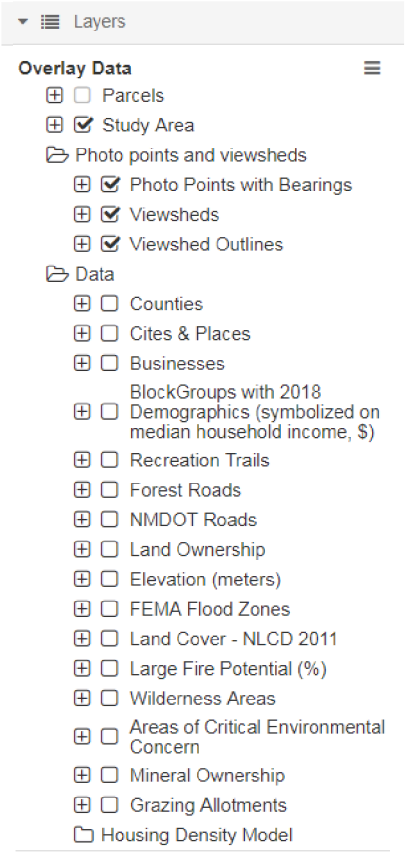
A download window will open. Click “Download File” to obtain the report.

Interacting with the Data

On the left side panel there are a number of "functions" available. Click on the ▸ to open a tool if it is closed. This section will provide guidance for using each of the tools listed on the left hand side of the screen.

Layers

Overlay data provides important context for the region or study area across climate objectives. This data includes the base information used for analysis. If you click on Layers you will see all the layers in the viewer, including all of the *Overlay Data* collected for the tool. The layers are categorized:

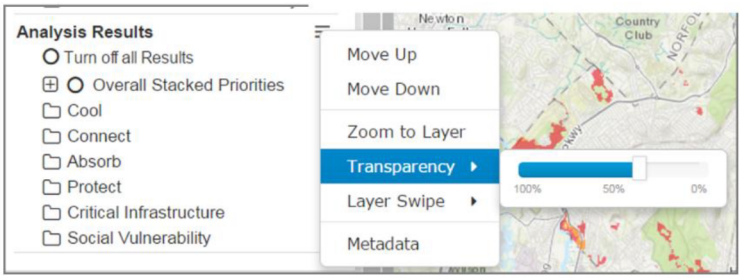


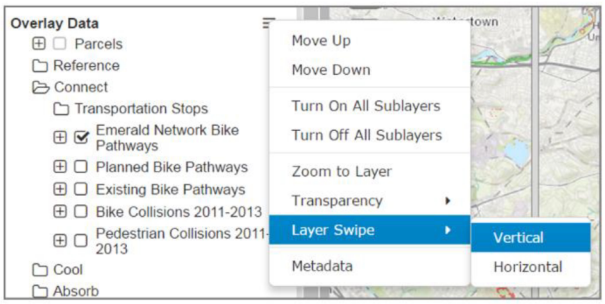
- Each 🗀 symbol indicates that there are multiple layers grouped under that heading. Click the 🗀 to expand and see what layers there are.
- Click ⊞ to show the symbology for an individual layer.

Layers Menu (transparency, layer swipe, metadata)

The layers menu provides tools that adjust the view of overlay data you see on the map as well as metadata that provides information about all of the data included in the tool. Click on the ☰ to the right of the *Overlay* Data to access the following tools:

- *Transparency slider:* Changes the transparency of the overlay data so that you can see mapped features underneath the overlay data. Click the rectangular tab on the slider and hold the mouse down to drag it to the left or right. Experiment with different transparency levels. Notice that the transparency level of all overlay data changes as you change the transparency level.
- *On/off functions:* Turn on all the overlay layers, turn them all off, review metadata, zoom to the layers, and layer swipe.
- *Layer Swipe:* Provides the capability to use a slider to see what the map looks like with a layer on or off
    - If you hover your mouse over the Layer Swipe you can either choose vertical or horizontal. A bar will appear in the viewer and you can slide it up/down or right/left depending on if you selected vertical or horizontal. Sliding this bar will show you what the map looks like with or without the data.
    - To exit *Layer swipe* mode, click on the "Exit Layer Swipe" box at the top of the map

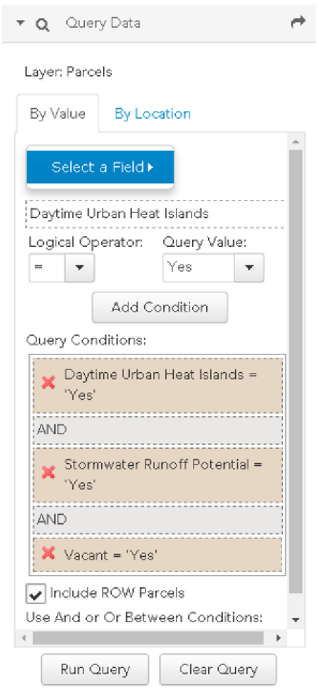




Metadata: Whenever you have a question about the data in the tool, open the metadata to learn more about it.

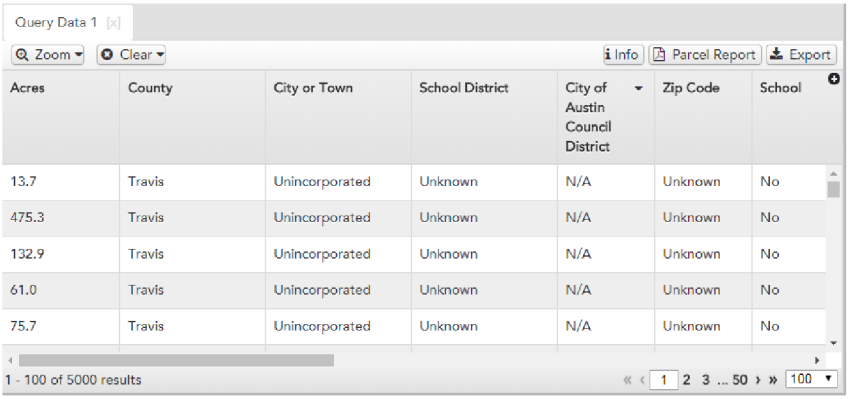
Query

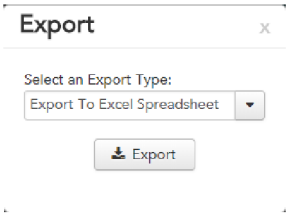
The query function allows users to search for parcels that match the characteristics required by a specific project, interest, or proposal. All modeled climate criteria and important physical characteristics of a site are tagged to parcels and available for export. Users can either query by value (information tagged to the parcel) or by location.



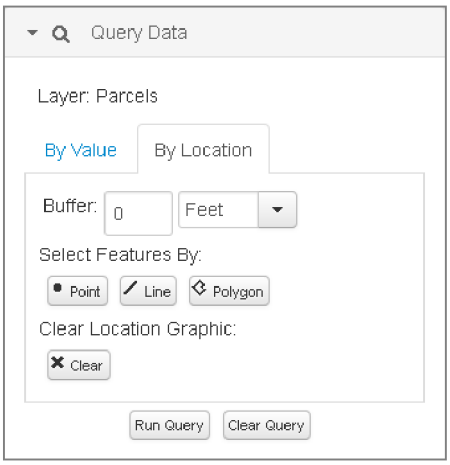
Query by Value

- Select the field you would like to query on from the “Select A Field” menu.
- Select the Logical Operator and query value and press “Add Condition”. The condition will appear. You can remove it at any point by clicking .
- After you have added all the desired queries click Run Query .
- A table will open at the bottom of the viewer showing you the parcels that fit your query.





- *Note:* You can clear a query at any point by clicking the Clear Query tab.
- You can either export this data as an excel/csv or create a pdf report for the queried parcels.
- To further refine a query, you can add another condition. Perform the same steps as above for any additional conditions you would like to include. ***Note:*** Make sure and click “Add Condition” after you have set up your condition. Once this is done a second condition with appear in your query conditions.

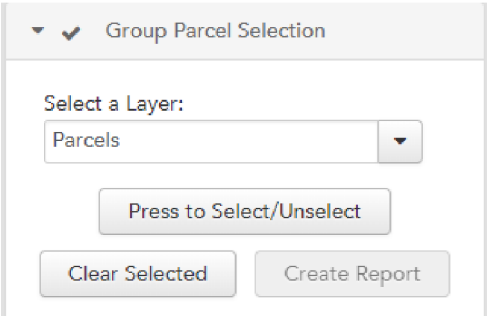


Query by Location

- You can choose point, line, or polygon options to select features and define the buffer of that geometry. Once you have chosen both the buffer and the geometry, you will draw on the map defining the point, line, or area that you would like to query.
- Select Run Query
- *From here, this tool functions the same as Query by Value.* A table will open at the bottom of the viewer showing you the parcels that fit your query. You can either export this data as an excel/csv or create a pdf report for the queried parcels.

Group Parcel Selection

Sometimes users have a number of parcels of which they are interested in. This tool allows users to select multiple parcels at a time.

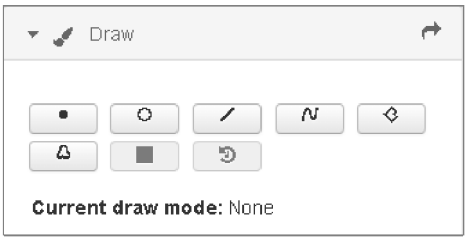


- To select parcels, click the “Press to Select/Unselect” button. Begin clicking on parcels to select them. You can either select an individual parcel or a group of parcels. If you wish to unselect a parcel click it again and the parcel will be removed from the selection.
- You can clear the selected parcels at any point by clicking the “Clear Selected” button.
- You can create a report on any selection of parcels by clicking “Create Report”.
- A download window will open. Click “Download File” to obtain the report.

Additional Tools

Draw

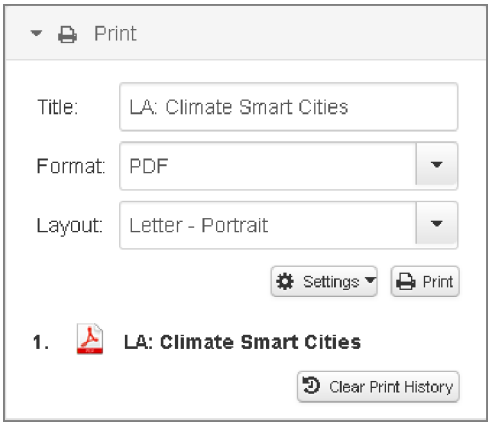
The draw tool allows you to add graphics to your map.



- Click the *Draw* tab on the left panel to add graphics to your map.
- To sketch a polygon on your map, click the  button.
- Begin sketching a shape on your map by clicking on your map. Double click to finish the sketch.
- You can also add points, lines, circles, and freehand polygons to the map by using the other draw buttons.
- If you want to change the graphics, use the  button, and recreate the graphics using the methods described above. **Note:** This action will erase all your drawings.
- To stop drawing click the  button.

Print (a custom map)

Users can print custom maps with a legend and title of your choosing that includes selected parcels, and/or and any overlay layers that match your interests or goals.



- To print a custom map that reflects the data and zoom level that you have chosen above, click the *Print* tab on the left panel.
- Enter a title for your map in the space provided.
- Choose the format and layout you would like.

Click Settings to make other adjustments to your printed map.

Click the Print button once you have completed the above steps.

Be patient while the mapping site generates a map for you. This process can take up to a minute.

In the PRINT tab a file will appear once the export is complete. Click on the link to open your map.

An 8.5 X 11 formatted map will be displayed that you can print or save to your computer hard drive to share with others.

Close the export window to return to the original map.

Return to original map.

Get Help

You can always click the Help button at the top right corner of your map for a copy of this user guide and tutorial.

Still need help? Send an email to gis.support@tpl.org