

Statement of Work

Data Capture

Cyclomedia will capture data using our patented proprietary recording system mounted on the roof of each vehicle. The main components of this recording system—cameras, positioning technology, and data processing unit—are described in detail on the following pages.

Vehicles and recording systems are operated by trained Cyclomedia collection specialists, many of whom are veterans recruited through the Veteran's Staffing Network. Each vehicle is equipped with a map-based interface that displays drive areas of 80-120 miles each. These drive areas provide street-level detail and are prioritized and optimized for efficiency before being uploaded to the vehicle's collection software. As drive areas are captured, their status is updated accordingly. Any system errors are immediately flagged, ensuring that the operator recaptures the data before leaving the area.

Features

- Intuitive map-based user interface.
- Red markers indicate that an image needs to be recaptured or equipment requires attention. These issues will be addressed and resolved before proceeding to the next area.
- Green markers indicate successful collection points.
- Periodic visual checks and cleaning of lenses.
- For optimal lighting, data collection begins two hours after sunrise and stops two hours before sunset.
- Data capture is halted in the event of rain, snow, ice, or hail.
- Daily progress updates and verification of QA/QC practices are sent to our Data Operations Manager.



Figure 1: A single property can be viewed from multiple recording points, allowing users to visualize key features from different angles.

Imaging Technology

Cyclomedia was founded 40 years ago with a focus on developing and enhancing leading technologies for image capture. Today, our data capture solution remains centered around our patented, cutting-edge imaging technology.

As the data capture vehicle passes over a recording point, the imaging system triggers its five individual cameras to fire in sequence: to the front, right, up, left, and rear. These five images are stitched together to create a GeoCyclorama™—a panoramic photograph with ultra-high resolution, excellent positioning, orientation, and superior image continuity.

The location and orientation of each GeoCyclorama are recorded precisely. Georeferencing allows users to perform measurements in GeoCycloramas that can be exported to any Geographic Information System (GIS). Additionally, 2D and 3D geographical data can be displayed as data layers in the GeoCycloramas.

GeoCycloramas are easily accessible and manageable through Cyclomedia's Street Smart application, which hosts the images as a standard service. Local hosting on the customer's server is also available upon request.

Image Quality

- Resolution 14400 x 7200 pixels (100 MP)
- Field of view: Horizontal (HFOV) 360°, Vertical (VFOV): 180°
- Spatial pixel size: 0.025° (= 0.44 cm [0.17 in] at 10m [33 ft] from the capture location)
- Good sharpness
- Clear and realistic colors
- Good appearance and visibility of objects, including shadowed areas
- Low noise level, including in shadowed areas
- No negative impact from direct sunlight, such as smearing or blooming
- Embedded LiDAR data for measurements
- Blurring of human faces and vehicle license plates

Recording Interval

- A GeoCyclorama is taken every 5 m (16.4 ft) on all public roads accessible to vehicles.

Positioning Quality

- Excellent georeferencing: The average standard deviation of the recording position is 10 cm (4 in), while the orientation deviation is 0.1°*.

Metric Quality

- Good image continuity: There are no visible transitions (parallaxes) between sections of the image.
- Upright image: When a GeoCyclorama is captured on a slope, it is automatically corrected to appear as if the image was taken horizontally (level).
- Geometrically correct: The accuracy of the spatial angle between 2 pixels is 0.025°
- Precise measurements of objects: X, Y, and Z coordinates have an average absolute standard deviation of 10 cm (4 in).*



Figure 2: Manufacturing and designing our own camera system eliminates dependencies on third party manufacturers.

- Precise measurements of distances: Measurement of heights, lengths, or widths have a relative standard deviation of around 2 cm (0.79 in).

**Excluding in long tunnels, forested areas, and urban canyons.*

JPG Image of Improved Parcels

Image Cut-Outs

Cyclomedia's team is proposing three options for the County to review to determine the approach that best meets their needs and budget.

Option 1: Cyclomedia Provided Cut Outs

Our analytics team uses our GeoCyclorama imagery via Street Smart to align property images and assign attributes to each valid tax object present in the customer GDB. Once saved, the image parameters are used to generate high-resolution cutout images and an accompanying CSV which describes the point the image was taken from, the central point of the tax object, and the attributes applicable to the image.

Cyclomedia will deliver JPEG images. These will be available through our browser-based web viewer, Street Smart™. Cyclomedia can also deliver images on external hard drives or in another format requested by the agency and agreed upon by all parties.

Cyclomedia will provide front images of all buildings, residential, parking lots, erected structures, and fenced parcels from the public right of way. During collection, Cyclomedia will not go onto private property unless specifically instructed to by the Appraisers office. If the property is not visible from the public roadway, Cyclomedia will make note of the address and indicate when an image was no accessible.

Imagery is clear, with 100-megapixel resolution and realistic colors.

Images may include a clearly visible date and time stamp in the bottom right corner of the image, as well as PIN. Options will be reviewed and decided upon by the County.

JPEG images will be compatible for upload to existing integration with Tyler CAMA application.

Cyclomedia will provide 100-megapixel, GIS compatible, 360° street-level imagery. Each JPEG image will be between 0.5 and 3 MB in size.



Figure 3: Example of primary image of a single-family home with main structure.

By capturing a distortion free 360° image from multiple angles, we can see a property from multiple perspectives and save a JPEG of the best view with the desired quality, detail, and characteristics. This allows the selection of the best front-facing image without the need to rely on a single person's perspective. The images will be generated to result in the building, taking up a minimum 40% of the frame.

The structure will be oriented so that two sides of the structure are captured, with the front of the structure comprising a majority of the image, not to exceed a 45° angle.

Images are captured at the appropriate distance from the subject structure(s) so that the image is adequately captured within the full frame of the picture and the following image details may be distinguished:

- Building height: image shows the proportionate height of the structure.
- Building shape: image shows the proportionate length and width of the structure.
- Construction type: image shows construction detail of siding and roofing material.
- General exterior condition: image shows general soundness and degree of structural maintenance.

Image “cut-outs” from a GeoCyclorama comply with the IAAO MARP Standard 3.3.5 for street-view images. These standards include, but are not limited to:

- Adequate focus, color, tint, brightness, and contrast
- Proper framing of the structure including appropriate horizontal and vertical levelness
- Images free of digital artifacts, excessive shadow, radiometric and tonal imbalance, glare, extreme contrast, smearing, warping or distortion of features, ghosting, voids, and artificial colorations.
- Images are captured from public roads and suitable to distinguish structure height and shape that enables quality grade and physical condition to be verified.

Data acquisition will be performed with a high-definition, vehicle-mounted camera system, comprised of five individual cameras (front, rear, left, right, and up) using Cyclomedia’s patented technology to fire individually over a single recording point as the vehicle travels forward. More information on Cyclomedia’s collection methodology can be found in the Technical Approach section of this document.

Any potential issues within the photo, such as obstructions, foliage, gates, etc., will be noted. Each image will have one of the six attributes listed below associated to the corresponding data file:

- Best View – The view of the structure captured in the image does not meet the standard requirements for a quality image due to obstructions.
- Not Accessible
 - The primary structure for the parcel is not visible from public access.
 - The parcel will be imaged from a point where access to the parcel meets the public right of way, and as much of any structure as may be visible.
- Gated – The structure is located behind a secure gate and access could not be gained.
- This stipulation excludes gated areas that the Appraiser’s office would like collected and that your staff can provide access to.
- Primary – the primary image is of the most significant structure on the parcel. Other significant structures will be captured as secondary images.

The Assessor’s office will own all JPEG images created as part of this project.

Option 2: Enterprise Assessment & Tax

Tyler and Cyclomedia partner to provide your organization with an industry leading CAMA system integrated with world class street-level imagery. Tyler has integrated Cyclomedia’s Street Smart API into

the Enterprise Assessment & Tax CAMA system so you can have easy access where it matters most for viewing properties at high-resolution and taking measurements to confirm dimensions. After Cyclomedia's panoramic imagery is collected and processed for your project, a process in Enterprise Assessment & Tax can be developed to create a front-facing street-level image of properties that can be associated to a property record.

Using Cyclomedia's API, the process will utilize the coordinates of the location of the property, a job process can be implemented in Enterprise Assessment & Tax to retrieve a cut out image of the property. The job can then associate that image to the property so it can be printed on the property record card and shown the summary tab.

Your parcel data and address data will be used to create a default view from the closest recording point at the front of the parcel, even if a closer image exists to the side or in an alley. There may be times where this original default view is at a less desirable angle or has an obstruction such as a vehicle or vegetation. In an upcoming product release, authorized Enterprise Assessment & Tax end users will be able to adjust and save the view by panning and zooming as desired and/or moving to a new GeoCyclorama. This saved view becomes the default view for the parcel and can be used to make a new cut-out.

Option 3: County Provided Cut-Outs

Street Smart allows you to download and create as many views of a property as possible with two clicks of a mouse when you are looking at the property in question.



Figure 4: Resulting cut-out image.

GeoCycloramas & IAAO Compliance

IAAO Mass Appraisal of Real Property standard, revised in 2017, states the following:

“Provided that initial physical inspections are timely, completed, and that an effective system of building permits or other methods of routinely identifying physical changes is in place, jurisdictions may employ a set of digital imaging technology tools to supplement field re-inspections with a computer assisted office review. These imaging tools should include the following:

- *Current high-resolution street-view images at a sub-inch pixel resolution that enables quality grade and physical condition to be verified.*
- *Orthophoto images with a minimum 6” pixel resolution in urban/suburban and 12” resolution in rural areas, updated every 2 years in rapid growth areas, or 6-10 years in slow growth areas.*
- *Low level oblique images capable of being used for measurement verification four cardinal directions with a minimum 6” pixel resolution in urban/suburban and 12” pixel resolution in rural areas, updated every 2 years in rapid growth areas, or 6-10 years in slow growth areas.*

Cyclomedia’s imagery meets and exceeds the IAAO 3.3.5 requirements by overlaying measurement functionality and allowing remote evaluation of property grade and condition.

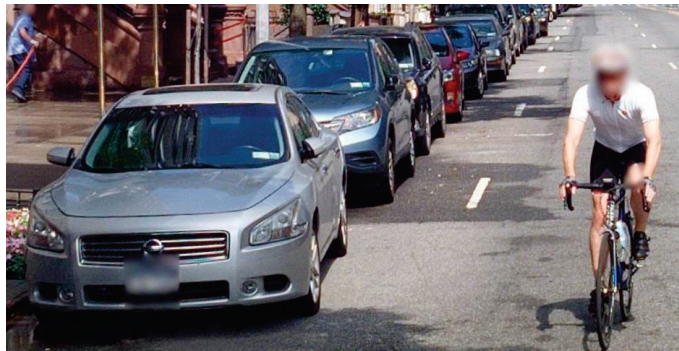


Figure 5: Example of human face and vehicle license plate blurring.

Benefits to the Jurisdiction

- Streamline costs by performing audits and field assessments remotely
- Maximize onsite audit efficiency by planning what to focus on in advance
- Improve assessment accuracy by viewing a selected property from multiple angles
- Increase the number of audits that can be performed with geolocational searches
- Provide visual evidence in defending values during appeals

Imagery Software

Street Smart™

Value provided by Cyclomedia’s solutions doesn’t end after collection is completed. Once the imagery and LiDAR have been collected and processed, users begin to recognize the enhanced value of the Cyclomedia solution through the use of our web-based Street Smart viewing application. Complete with

measurement and other analytical tools, Street Smart can be used “stand-alone” (often used by non-GIS users) or within the framework of their existing GIS system (for traditional GIS users).

To integrate GeoCyclorama imagery into Esri’s ArcGIS platform, Cyclomedia provides add-ins for ArcGIS Desktop software including ArcGIS Pro and ArcMap as well as a widget for Web AppBuilder for integration with ArcGIS Online. Cyclomedia can also provide COTS based plug-ins for both MicroStation and AutoCAD.

Cyclomedia provides an unlimited number of user licenses of Street Smart. Built on HTML5 technology and providing Cloud access to 3D GeoCyclorama images and GIS tools, Street Smart is device agnostic and mobile friendly. It also includes our Measure Smart feature, which utilizes LiDAR already integrated with our GeoCyclorama to increase measuring precision to within 2cm accuracy.

Street Smart offers the end user various measuring capabilities, such as:

- Location – click a single point
- Distance – measure between two points or more
- Surface – draw a complex polygon
- Orthogonal – ability to make a right angle (90 degree) measurement
- Height – measure from bottom to top or top to bottom of an object

Street Smart Features

- Cloud-hosted (Workstations must have access to internet or WiFi to access SaaS environment)
- Web-based, user friendly for non-technical staff
- Measuring tools (location, distance, surface, orthogonal, height)
 - Reported in multiple units (feet, meters)
- Pan and zoom controls
- Editable text and report formatting
- GIS & CAD Integrations
 - COTS integrations to ArcMap and ArcGIS Pro
 - Web AppBuilder Widget
 - Microstation and AutoCAD plug-ins
 - External GIS layers can be imported and overlaid on top of imagery
- Access to Application Programming Interface (API) and widgets
 - Allows AUS and COA to integrate imagery and Street Smart with other internal apps
 - Code samples and developer resources at Cyclomedia.com
- Direct editing of geodatabase or feature services within the imagery via desktop or web application
- Enterprise-level licensing: unlimited user logins for web-based client and unlimited licenses for GIS integrations are issued to staff for the license term
 - After license term unlimited user logins are issued on a yearly basis

Options for New “Self-Captured Street View” Imagery

Street Smart Snapshot

Street Smart Snapshot extends the functionalities of Street Smart—enabling end users to capture and upload their own photos using a mobile phone or other device. Users can manage their own content and add notes to clarify the situation as recorded.

Snapshot allows you to refresh your dataset between cycle captures with Cyclomedia. Users can share recent Snapshot data within their company and compare it to Cyclomedia's other existing data sources.

The following benefits are available to with Snapshot:

- Documentation and disruption management Snapshot equips users with an easy method to quickly document disruptions and react to them. For example, utility companies might capture imagery inside of cabinets, small cable shacks
- or inside a house where a new connection was established.
- Preservation of evidence
- Companies and governments can use Snapshot to submit reports detailing the condition of a worksite or project before, during, and after to protect themselves from future claims of damage.
- Change detection
- Cities want to document changes in public space. If a street sign gets knocked down during a storm, users can use Snapshot to make sure that those changes are easily being shared with colleagues.
- Expose hidden objects
- Snapshot provides users with a way to add information to Street Smart that is not visible in GeoCycloramas (e.g. Sign is only visible from the back in GeoCyclorama, Objects are obstructing the view to a certain situation...).
- Adding important notes
- Users can add information to critical infrastructure and/or buildings (e.g. add official emergency escape plan to certain buildings).

QA/QC

During the image production phase, Cyclomedia will ensure that every image is of high quality and meets agreed upon QA/QC standards for imagery, including, at a minimum, images free of:

- Digital artifacts
- Excessive shadow
- Radiometric and tonal imbalance
- Glare
- Extreme contrast
- Smearing
- Warping or distortion of features
- Ghosting
- Voids
- Artificial colorations

Factors to be reviewed or incorporated are overall focus, tint, brightness and contrast of the image, proper framing of the structure, with appropriate horizontal and vertical levelness, and adequate zoom level.

Quality reports are automatically generated as soon as images are adjusted. These reports are used in the manual controls to approve a series of images. Images

may be rejected after the automated reporting or after visual inspection. Examples of problems that are caught by the quality control process are over- or underexposure, wide class differences between the front and rear camera, or high inaccuracy in the position. In addition, systematic series of images are randomly checked for visible defects, such as dirt or water on the lenses or glare from low sun angle.

Cyclomedia brings the added benefit of capturing LiDAR data simultaneously with our GeoCyclorama imagery. By this coincident capture method, we ensure the highest levels of both quality and accuracy. We further enhance the LiDAR data by processing it with our proprietary software to increase locational accuracy and perfect alignment in 3D space with their imagery. Given precise imagery co-referencing, Cyclomedia can extract the RGB values to produce a photorealistic colorized point cloud.

Due to the high accuracy of the sub-inch resolution data, validation, precise measurements, and reporting can be handled efficiently in the office from a desktop, allowing staff to be more productive and improving the efficiency and accuracy of asset management and maintenance.

The raw position measurements from the GPS/IMU sensors in the vehicle, plus the reference data from a network of permanent GNSS reference stations, are processed into an accurate position and orientation for each GeoCyclorama.