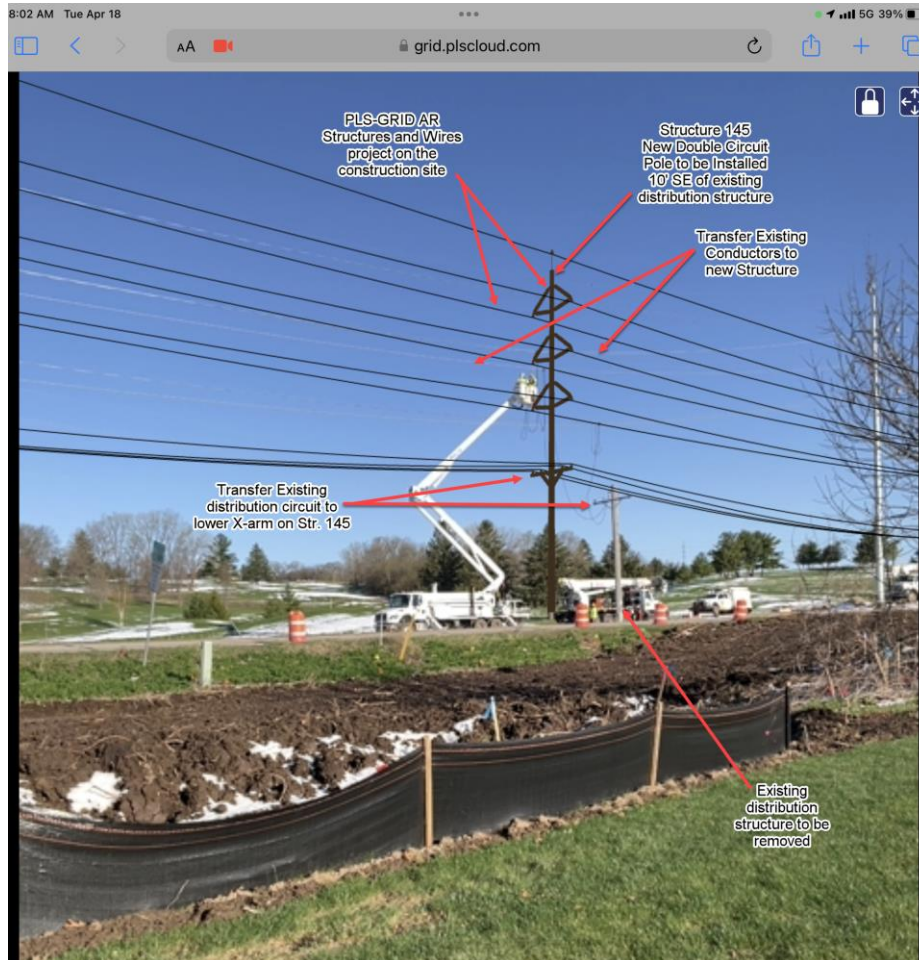# Augmented Reality with PLS-GRID

Introduction to PLS-GRID AR

With the release of **PLS-GRID**, Power Line Systems has developed an enterprise system that provides users of the PLS software a new way to organize, index, track model changes, view project drawings and better collaborate and share information regarding **PLS-CADD**, **PLS-POLE** and **TOWER** models. For more information on **PLS-GRID** please see https://www.powerlinesystems.com/pls-grid. One of the new features that we have incorporated into the **PLS-GRID Web Client (WC)** is Augmented Reality.

PLS-GRID Augmented reality (AR) is a system that fuses a combination of technologies on a mobile device which includes a camera, GPS, motion/ orientation sensor and **PLS-CADD** projects to create a real-time 3D experience for a user. With **AR**, **PLS-CADD** projects that contain structures, wires, and other information are overlaid in the camera view. This experience creates an interwoven reality between the **PLS-CADD** projects and the physical world thru a mobile device. The device can also access information associated with the project that is located on the **PLS-GRID Server**. The user can interact with the graphical entities in **AR** mode to display or retrieve information regarding the overhead line modeled in **PLS-CADD** or structures modeled in **PLS-POLE** and **TOWER**. This document describes the features and current capabilities of **PLS-GRID AR**.

The ability to view structures and wires of a **PLS-CADD** model and all associated data within the camera view of a mobile device is the foundation of what **PLS-GRID AR** is built upon. This is not a new technology as many users have seen this technology deployed on mobile games like Pokémon Go over the last decade or so. With **PLS-GRID AR** users have the ability to visualize the design of overhead line models in **PLS-CADD** overlaid with a real world view enabling users to communicate details of the overhead line in ways that can't be done with traditional methods and design drawings.
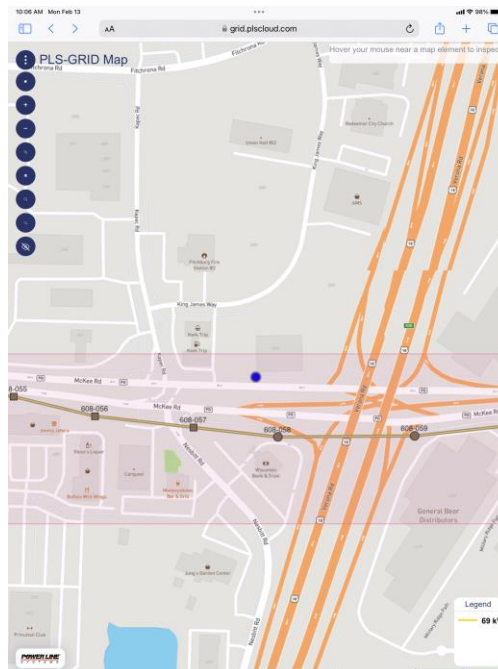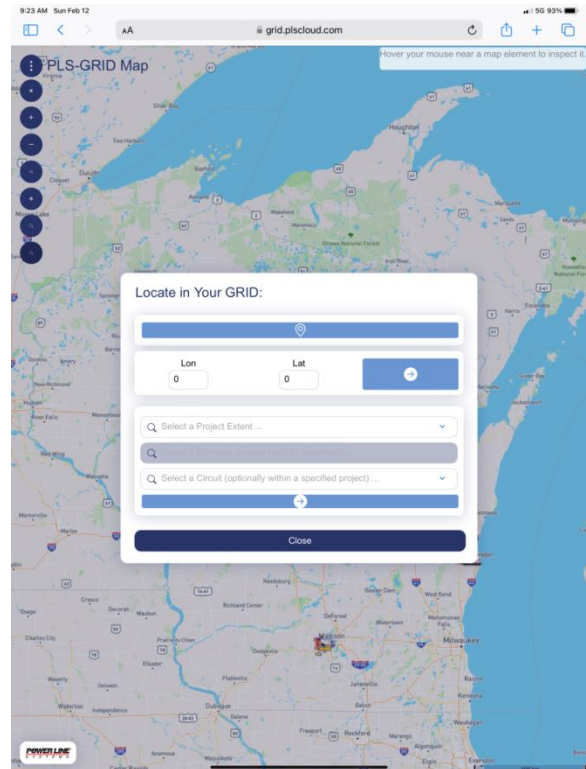
PLS-GRID Web Client – Accessing user location

PLS-GRID WC has the ability to access the GPS position of a device and display this positon on the **PLS-GRID Map**. This is done by using the 🔍 button in the GRID toolbar. This brings up the Locate in Your GRID window shown to the right.

Using the 📍 button will prompt the user for permission to use your current location. The user is required to select Allow to utilize this feature.
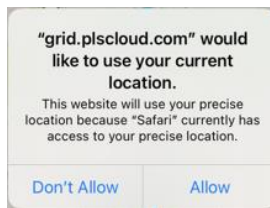

This command will toggle the location button to green and will look like this, 📍. The location according the GPS sensor of the device will be shown on the map with a blue dot as shown in the image below. Users can toggle the location button to reveal and hide the location of the user.

PLS-GRID Web Client – Accessing Augmented Reality Mode

PLS-GRID AR requires a device that can use an modern web browser and to connect to **PLS-GRID Web Client (WC)** thru cellular or Wi-Fi connections. The device must also have a camera, motion and orientation sensor and GPS sensor on the device. **PLS-GRID AR** will prompt the user for permissions when this feature has been launched.

In order to see the **PLS-CADD** Projects in **PLS-GRID AR** the projects must have been added to **PLS-GRID** with the option to *Export Reports to PLS-GRID Map* selected as highlighted in the figure below.
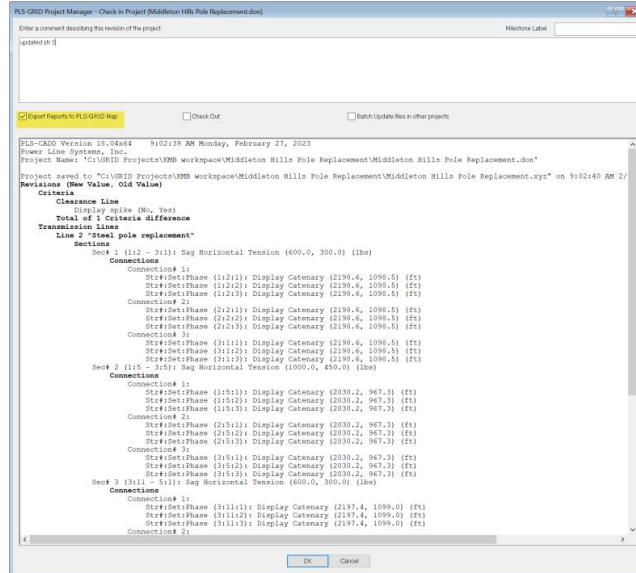

The **PLS-GRID Augmented Reality (AR)** is accessed by logging into a **PLS-GRID WC** and then using the "AR" button that appears as [AR] in the sidebar.
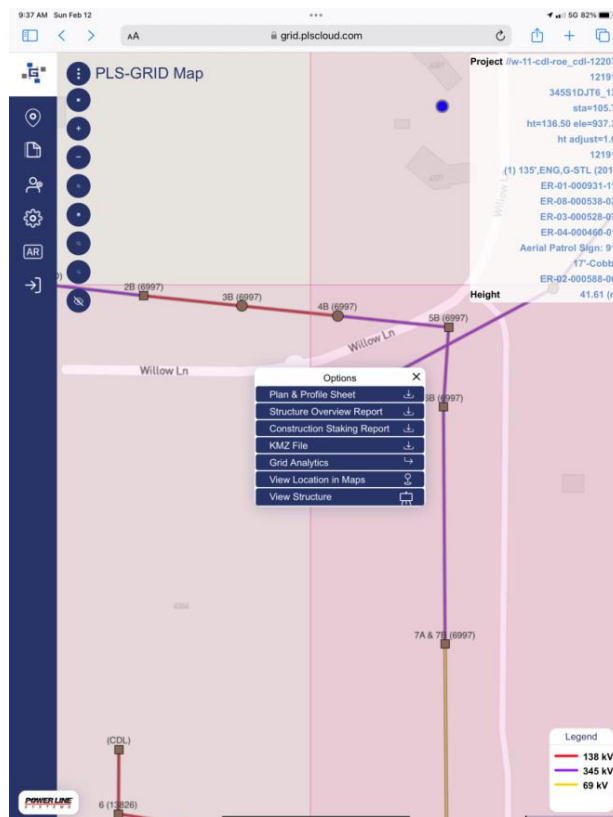
Once the **AR** button has been pressed the first screen that will appear is the screen with the "Enter AR" button. A user must click this button to enter **AR**.
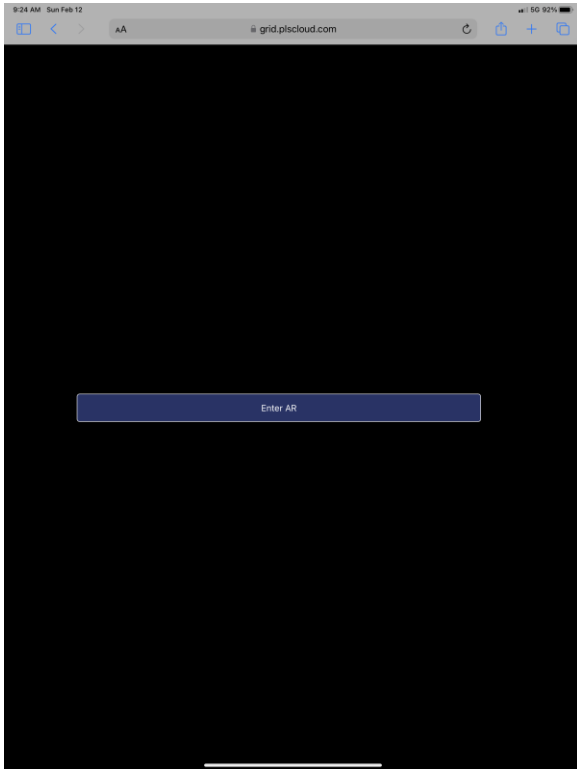
Once you enter **AR** then your device will also prompt the user for permissions to access the camera. Allow is required for **AR** to use the camera on the device.
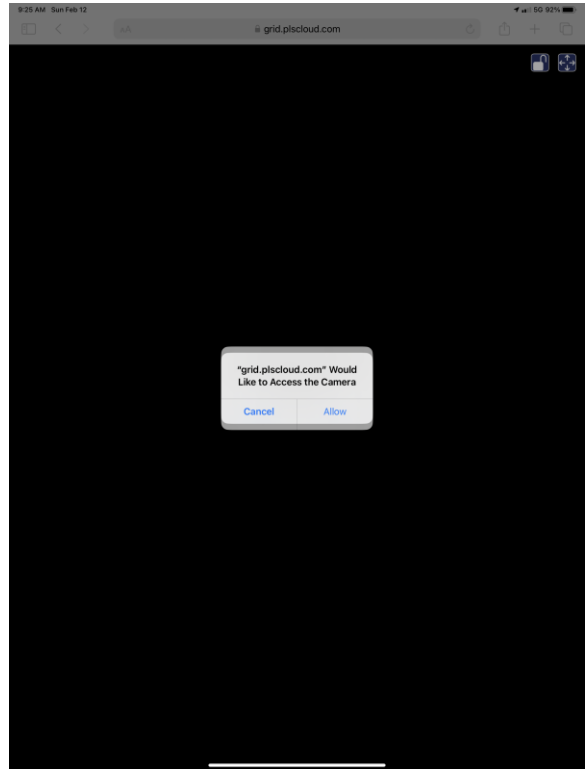
The Camera should then be active. Next **AR** will ask to Access Motion and Orientation as shown in the image to the right. A user must hit the *Allow* button to utilize this sensor on the device and enter **PLS-GRID AR** mode. **AR** will also ask for permission to use you location if this has not previously been asked for.

Once the proper permissions on the device have been provided by the user then **AR** will display **PLS-CADD** model information on the camera display using the location and orientation of the device. The images below show some example of **PLS-GRID AR** screen shots from an Apple iPad Pro (2022) enabled with a cellular connection.

Both method 4 (**PLS-POLE** and **TOWER**) and method 1 and 2 structures (**PLS-CADD** stick types) can be displayed in AR as shown in the examples below. Method 4 structures can be displayed color coded by structure usage results or rendered with their material color.


# PLS-GRID Augmented Reality – What can we use it for?

This section describes some of the features within **PLS-GRID AR** that are available in version 2.63 of **PLS-GRID**. As more users adopt this technology we receive more suggestions to enable ever more use cases for this tool.

Engineers tasked with design of overhead lines can use this technology on field visits to help with project scope discussions with field or construction crews. The technology can be helpful for use in field inspections or as-built field visits where the geometry of the structures, danger tree results or conductor phasing can be verified using **PLS-GRID AR**. Users can access files, reports, pictures and other data associated with the project without connecting to the **PLS-CADD** project or pulling out piles of paper drawings. **PLS-GRID AR** is a tool that overlays the digital twin concept on the real world while also accessing all design data.

Others have used **PLS-GRID AR** to present exactly what new lines will look like to property owners during discussions at public forums or during talks about work within the Right-of-Way. Below are two examples of using **PLS-GRID AR** to show how a design in **PLS-CADD** will look in the field. The image on the left shows the replacement of an existing guyed dead-end wood pole with a self-supported dead-end steel pole within a residential neighborhood. It shows the location of the steel pole within the design and shows how the new steel pole will not be taller than the existing structure and the guy wires will be removed adjacent to a residential home. The image on the right shows how the **PLS-CADD** project can be viewed in **AR** view during construction activities. In this shot the actual structure was taken down by the construction crew and wires are being transferred. The structure shown and dark wires shown are renderings from the **PLS-CADD** model live during construction with **PLS-GRID AR**.
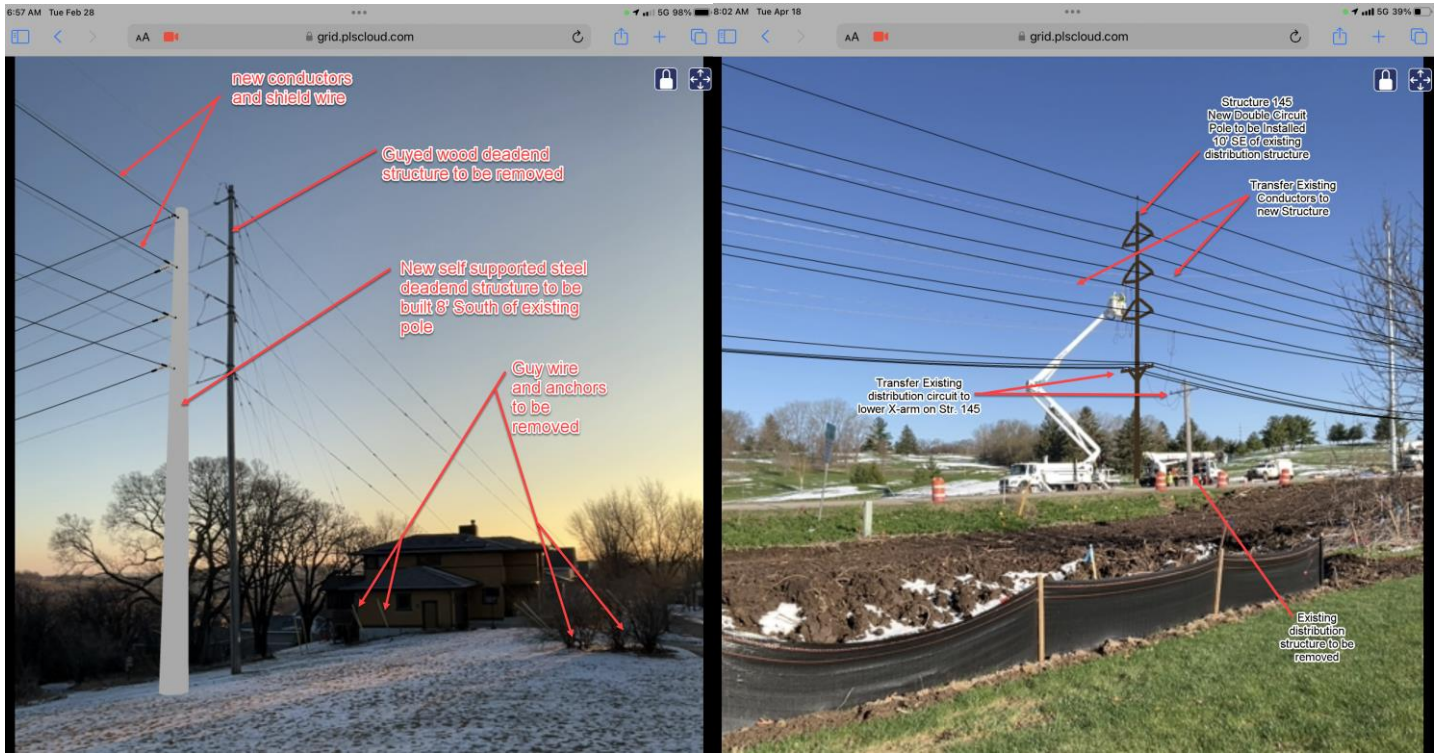
Construction crews and field ops can utilize AR to download and view structure drawings, Bill of Material, plan and profile drawings, construction staking information or anything else associated with a **PLS-CADD** project that may be helpful in the field during construction and inspections. For crews during storm restoration **PLS-GRID WC** and **AR** can be helpful to visualize what assets were there originally before damage. The image to the below shows an example of how a field crew can use a mobile tablet to visualize a new pole being installed on a caisson and also the ability to download plan & profile sheets, construction staking data, structure drawings, phasing information and more for a new structure being installed. Users can also View Structure or use the 📺 button to open up a separate animated view that rotates the structure model for the user.
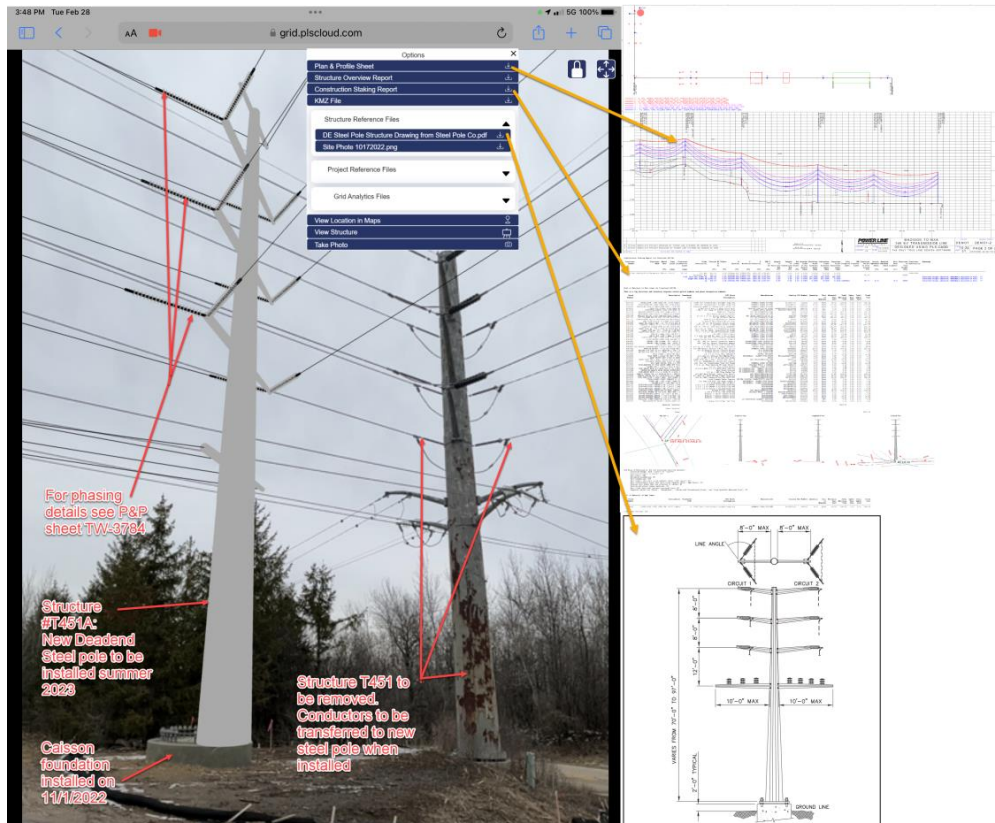
Users of **PLS-GRID** also have the ability to access the **PLS-GRID** Analytics feature which enables running multi-project reporting for **PLS-CADD** projects without having to open each project. Many of these reports have results that can be displayed graphically in the **PLS-GRID** Map View as controlled by map layer options.

One of the reports available with this feature is the Danger Tree Report. The results from the Danger Tree Reports in **PLS-CADD** can be stored and retrieved by users of **PLS-GRID WC**. When reports are run with **PLS-GRID** Analytics feature the results from the Danger Tree Report are saved with the project. As part of this feature, if the Danger Tree Centroid options are enabled then vegetation centroids that resulted with a "NG" or *No Good* result are saved on their own layer. This enables users of **PLS-GRID WC** to show the location of the user in the ROW in relation to the Danger Tree centroids that have been flagged in **PLS-CADD**. The user can then see information such as tree height, clearance distance, lat/long and more about the vegetation point of interest. Below is an example of a danger tree centroid shown in **PLS-CADD**, **PLS-GRID WC** and **PLS-GRID AR.**
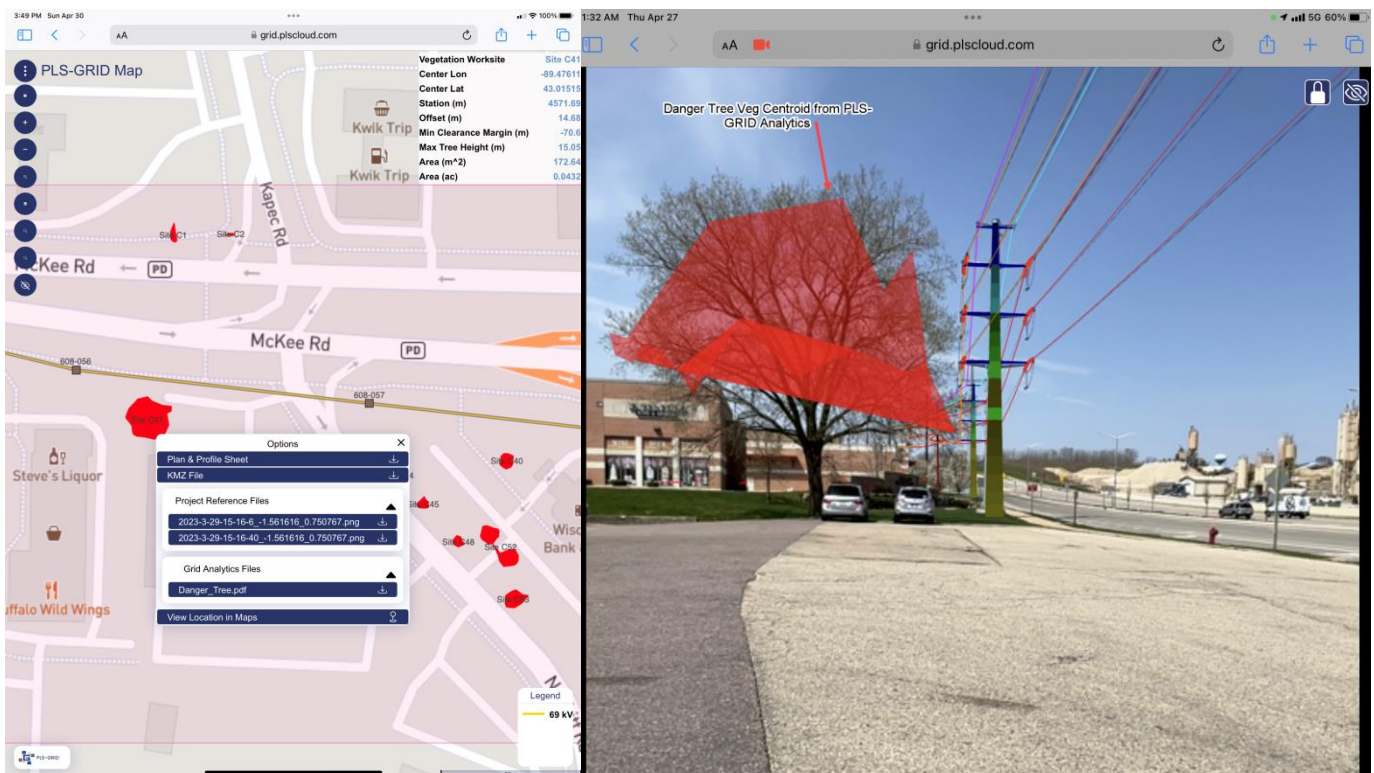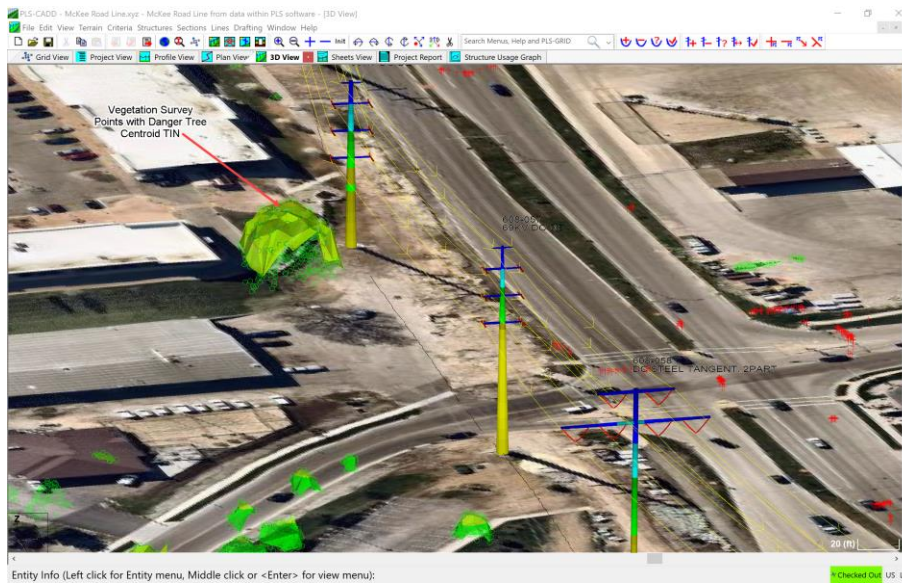
The **PLS-GRID WC** Map view also can provide information and tools for users. **PLS-GRID WC** users also have the ability to upload pictures from their mobile device to the **PLS-GRID Server** with the *Take Photo* button when snapping to a structure in the GRID Map View. The Take Photo button or 📷 button allows a user select photos from camera roll, select a file or take photos/video on the device and associate it to a specific structure. Once a photo is added a preview is added as seen and then users can add a comment and use the ☁ button to upload the selected photo to **PLS-GRID**. The **PLS-GRID Server** can then associate the image with the correct project, structure and give the **PLS-GRID Desktop Client** users the ability to insert these field photos into the **PLS-CADD** project. Photos are able to be uploaded to **PLS-GRID** and users of the **PLS-GRID DC** application will get notified that pictures are ready to be added to the project. This ability to upload photos and other data is the initial step for **PLS-GRID** to accept data from the field. Below shows how the **PLS-CADD** user can associate a field photo with a structure in **PLS-CADD DC.** Power Line Systems hopes to expand this feature to be able to upload other file types for inspection reports, marked up field drawings or other forms of information.
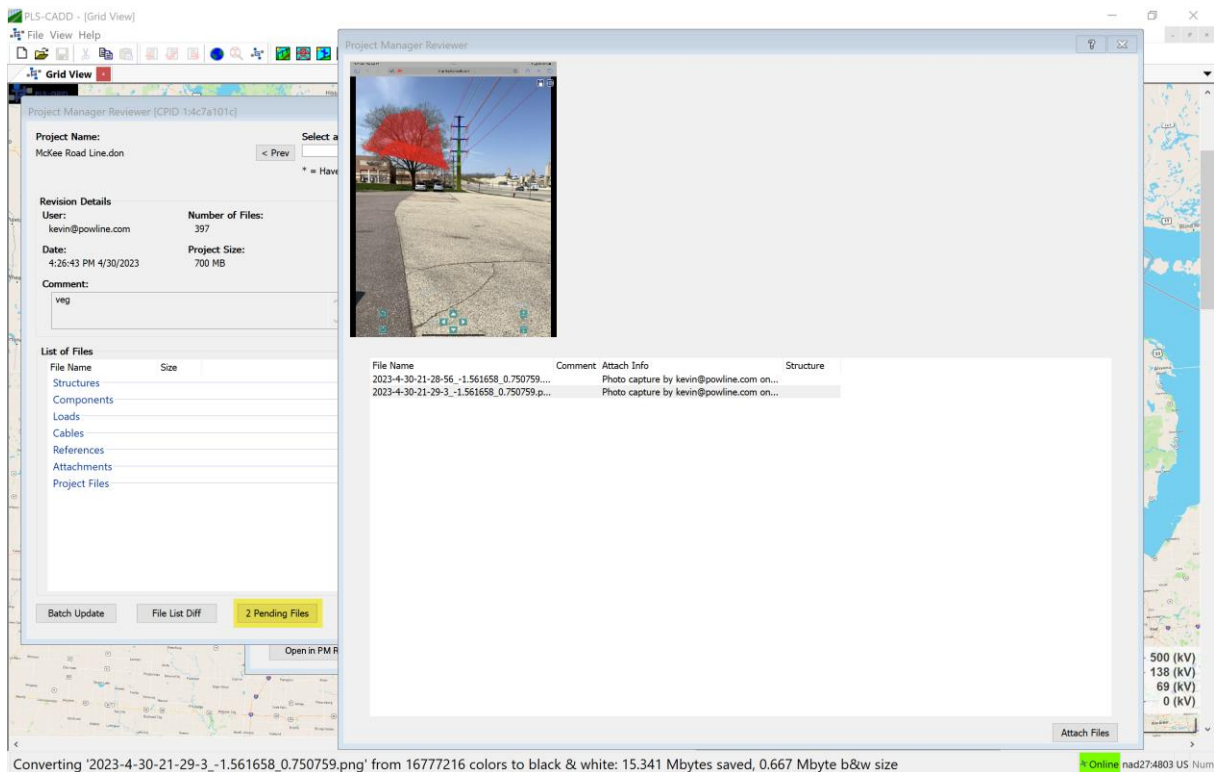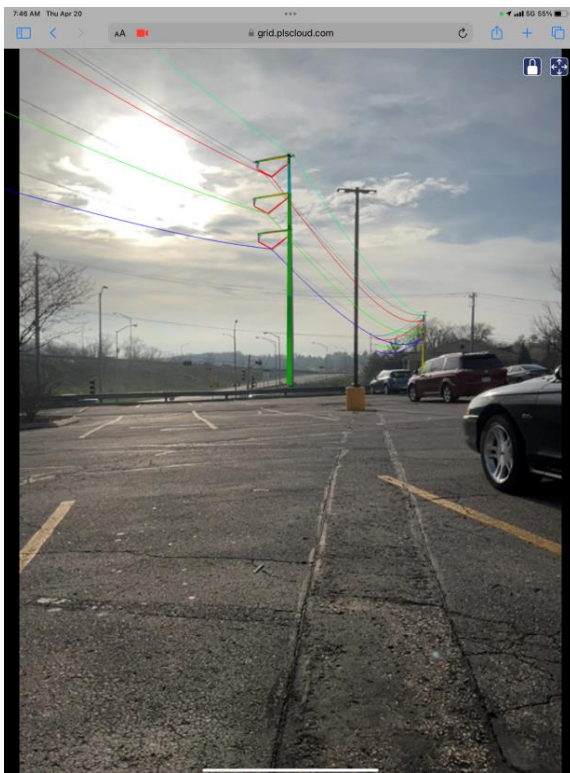
PLS-GRID Augmented Reality – Recommended devices

PLS-GRID Web Client requires a mobile device to have a cellular or Wi-Fi internet connection to access the application. The strength and speed of the internet connection must be considered for the use of this feature. In locations where no internet service is available then this feature will not currently work, but we have plans to work offline with this feature one day.

Mobile devices accessing **PLS-GRID AR** will require the same type of Internet connection. **PLS-GRID AR** also requires a device to have a camera, GPS, and a motion/orientation sensor. The **PLS-GRID AR** application must also have permissions to access each sensor and will prompt the user for permissions.

In testing this feature at Power Line Systems it is clear that not all mobile devices are created equal. Newer phones with updated hardware and sensors typically work better than older phones. Phones can also be limited with the amount of RAM supplied and can have trouble loading large amounts of data. Devices like iPads or Surface tablets with a cellular connection have also been proven useful with the higher amounts of RAM and memory available. Most of the photos in this presentation were taken on an IPad Pro (2022) with 8GB of RAM.

Screen size should also be a consideration. On smaller devices the screen size can make it difficult to see details of the overhead line or read reports. Devices with larger screen enhance the overall **PLS-GRID AR** experience. Below shows a comparison of images obtained on a tablet vs. a phone.

PLS-GRID Augmented Reality – Configuration Point of View of PLS information

During the development of **PLS-GRID AR** it was apparently clear that some devices meet the minimum required sensors to utilize the **AR** feature. However, the accuracy or results could orientate the point of view of the **PLS-CADD** model in a way that doesn't align with what the camera of the device is looking at. For this reason there are configuration buttons within the **AR** view. These buttons are shown in the upper right portion of the screen. The Show **AR** position

configuration options button will open up new commands at the bottom of the **AR** view as shown in the image below. These configuration options allows the user to orientate the point of view of the PLS-CADD model

These commands allow a user to manipulate the **PLS-CADD** project in the **AR** view to align with the real world camera. Keep in mind that what we adjust is the Point of View of the **PLS-CADD** model space. Below is a summary of what each command does.

= GPS Position is locked, meaning the position of the user cannot be updated based on the GPS sensor.

= GPS Position is unlocked, meaning the position of the user can be updated based on the GPS sensor.

= Show AR position configuration options at the bottom of the screen.

= Hide AR position configuration options at the bottom of the screen.

= rotate to the left about vertical axis. Each click of the button moves Point of View (POV) 2 degrees.

= rotate to the right about the vertical axis. Each click of the button moves POV 2 degrees.

= Move model Point of View (POV) back. Each click of the button moves POV 2 meters.

= Move model POV right. Each click of the button moves POV 2 meters.

= Move model POV forward. Each click of the button moves POV 2 meters.

= Move model POV left. Each click of the button moves POV 2 meters.

= Move model elevation up in relation to POV. Each click of the button moves POV 1 meter.

= Move model elevation down in relation to POV. Each click of the button moves POV 1 meter.