

# Eagle Eye Application Note - AN033

## Camera Installation Considerations for LPR/ANPR

2024-06-18 Revision 2.0

### Target Audience

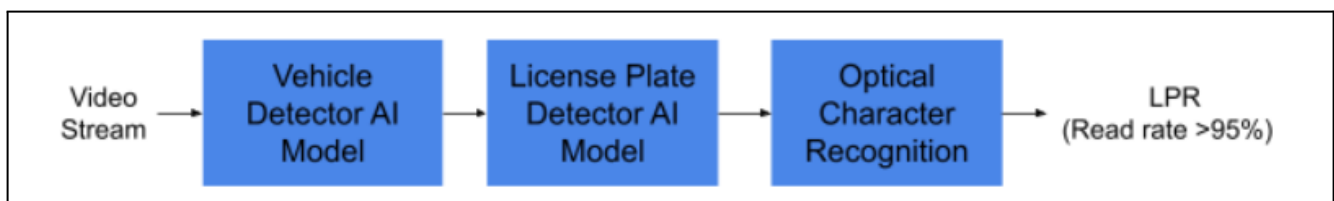
This Application Note is intended for installers and technicians who will be performing LPR camera installations in conjunction with the Eagle Eye Cloud VMS and is intended to share best practices in regard to camera specifications and placement.

### LPR Overview

License Plate Recognition (LPR), or Automatic Number Plate Recognition, is a technique by which a vehicle's license plate data is extracted using camera and vision technology. Camera placement plays a key role in getting a high-accuracy read, and this Application Note outlines best practices for installation and configuration.

### Theory of Operation

License plate recognition systems work directly on the camera stream and the system does not use an external sensor to detect vehicles. Instead, the detection of vehicles and license plates, and license plate reads, are all done by AI models that run on a pipeline. The following chart provides a high-level overview of the LPR engine:



#### Vehicle Detection

The detection of vehicles is done by an AI model as opposed to using an inductive loop, which is the common mode of operation for traditional LPR systems.

## License Plate Detection

Traditional LPR systems simply read all the characters that are seen on one image captured when the inductive loop determines the presence of a vehicle. This results in errors if the vehicle has other characters written on its body. Eagle Eye Networks uses an advanced AI model that is trained with millions of images to accurately identify the license plate and read only those characters, avoiding other characters present on the vehicle.

## Camera Specification & Camera Installation Considerations

The right choice of camera is crucial to attaining high accuracy for LPR reads. Factors like resolution, lens, image enhancement, and Infrared (IR) power determine the quality of the imaging. The major factors in camera choice are distance from the camera to the vehicle license plate capture position, and width of the lane. These two factors affect the choice of lens and IR power. The greater the distance from the camera to the vehicle imaging area, the higher the need for increased zoom and higher-power IR.

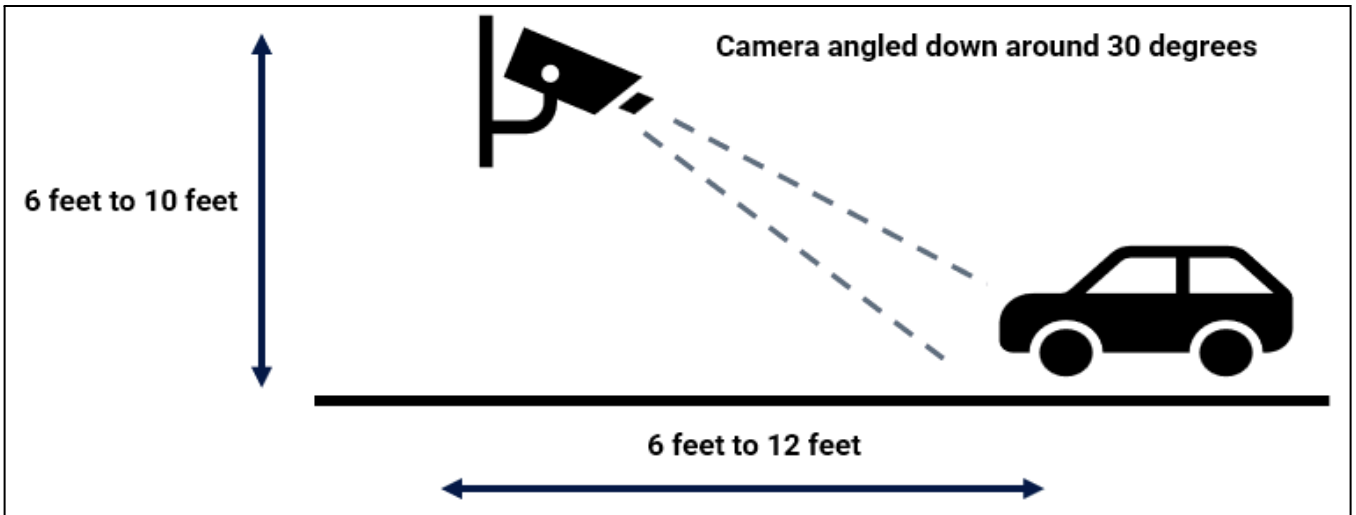
Similar to camera choice, how the camera is installed determines the success of LPR reads. Factors like the angle of imaging, height of installs, and pan angle affect the LPR accuracy. If local law dictates having license plates on the front of vehicles, install the cameras to read front plates. Front plates provide better results, as the camera can track the vehicle across multiple frames as it approaches the camera to get the best image possible. Also, the distance between the camera and the vehicle is always the same for front plates. To read rear license plates, the trigger point has to be chosen based on the longest vehicle, which may not be optimal for all vehicles. Optimal camera placement varies from site to site based on the layout and the camera mounting location (ground, ceiling, wall, etc.).

If motorcycles are to be captured, rear license plates are preferred, as many of them do not have front license plates and, if present, the size is typically much smaller than typical vehicles. The mounting varies depending on the application. See below for the preferred mounting suggestions to achieve optimal imaging and the best LPR reading.

The document explains two types of installation conditions and their recommended camera specifications. If your application is not mentioned here, please reach out to your sales engineer for help.

### Gated Installation - Maximum distance from the camera to the plate is 4 meters/12 feet

Maximum Distance from Camera to Plate	12 feet / 4 meters
Maximum width of road	12 feet / 4 meters
Preferred height of install	6 - 10 feet / 2 - 3 meters



Specification	Recommended Specifications
Resolution	1920 x 1080
FPS	25
Lens	2.8 to 12mm or better
Exposure & Gain	Manually Controlled
Image Enhancement	HLC, BLC
IR	40 meters or better

**Table 1: Use Case Camera Specifications**

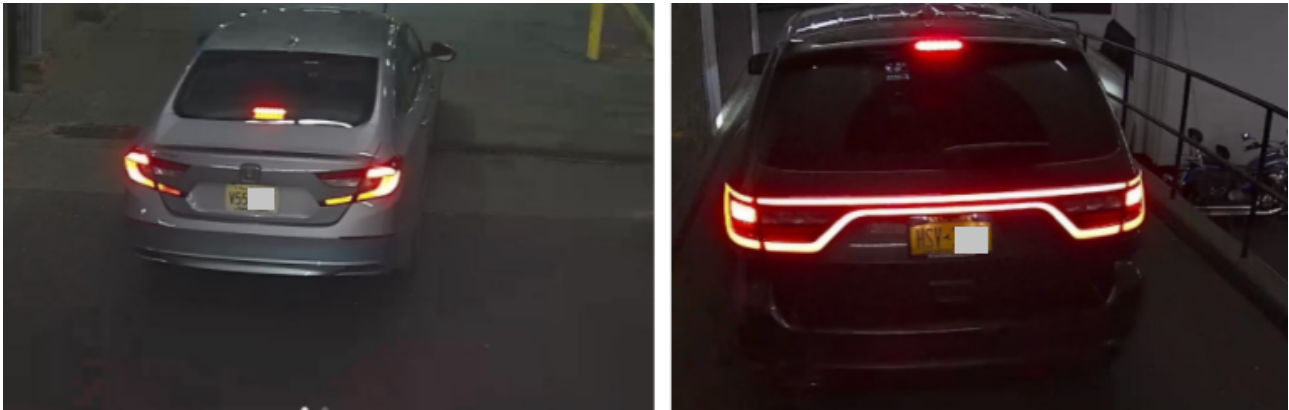
Reference images below

Image 1: Front License Plate Capture



Front-facing camera installation for gate LPR

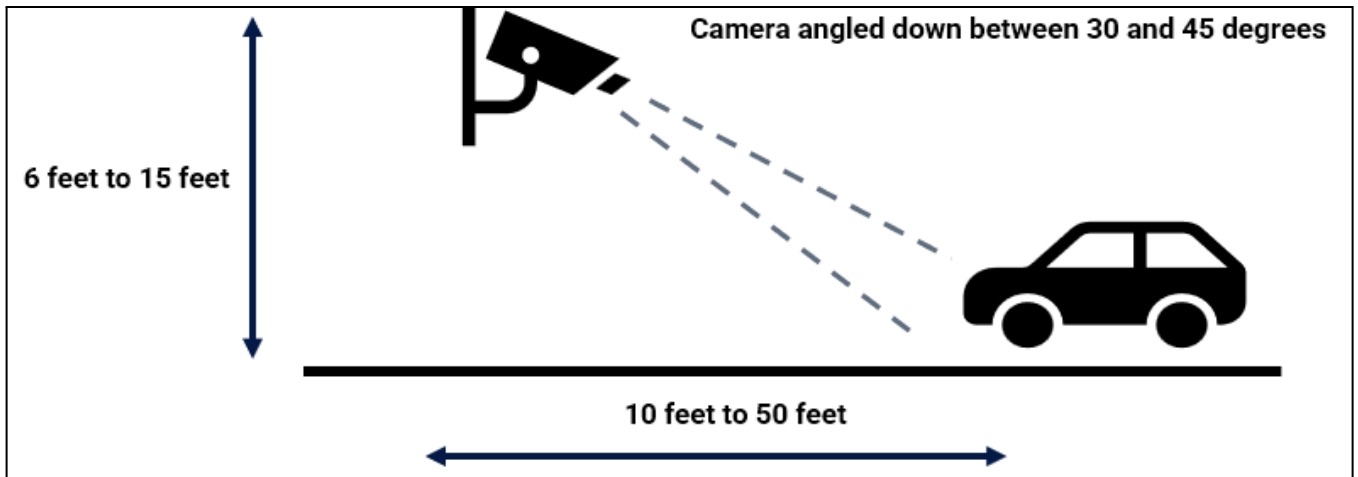
Images 2 & 3: Rear License Plate Capture



Reference images for a rear-facing camera installation for gate LPR

**Gate/Street Installations - Maximum distance from camera to plate is 50 feet / 15 meters**

Maximum Distance from Camera to Plate	50 feet / 15 meters
Maximum width of road	20 feet / 6 meters
Preferred height of install	6 - 15 feet / 2 - 5 meters



Installation recommendations apply for both front & rear LP capture

Image 4: Reference image from a street install



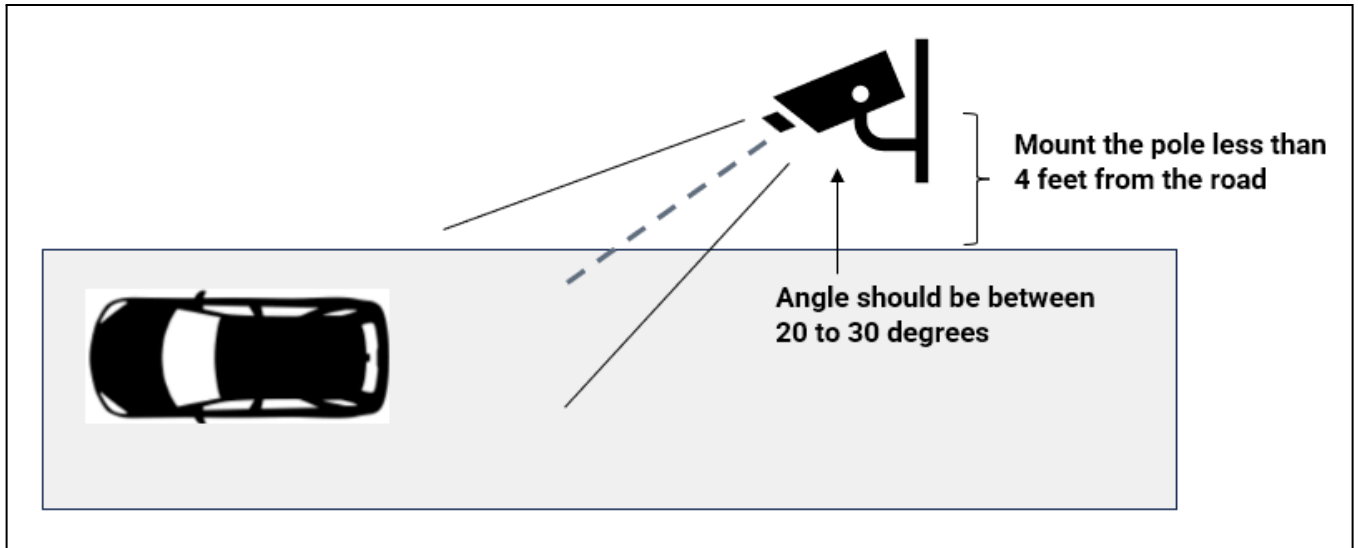
Specification	Recommended Specifications
Resolution	1920 x 1080
FPS	30
Lens	8 to 32 mm or 5 to 50mm
Exposure & Gain	Manually Controlled
Image Enhancement	HLC, BLC
IR	70 meters or better

**Table 2: Use Case Camera Specifications**

The angle of camera installation is crucial for LPR to avoid license plate readings at an acute angle.

1. **Vertical angle** - The camera should always be angled down, to ensure neither sunlight or car headlights fall directly on the camera, and also ensures rain or snow droplets do fall onto the lens
2. **Pan angle** - The pan angle of the camera is to be limited to 30 degrees as the perspective view would impact the plate reading

Image 5: Representation of pan angle and distance from the road to the camera installation pole

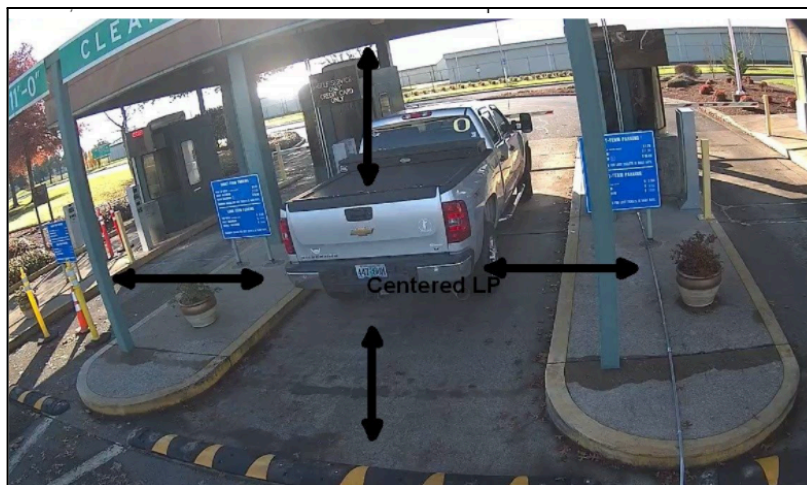


After mounting cameras, it is necessary to make tilt and rotation adjustments to ensure that the license plate is centered and horizontally oriented when the vehicle is at the ideal capture distance. To do this:

1. If possible, position a vehicle in the middle of the lane. Look at the camera view and tilt the camera such that the license plate is at the center of the camera view.
2. Rotate the camera to ensure that the license plate is horizontally aligned with the image. It may be harder to figure out which is horizontal, so use a speed bump or gate entry barrier as a reference.

In the example below and after positioning the vehicle at the preferred area of capture and tilting the camera, the view of the camera indicates that the license plate is centered.

Image 6: Reference image to ensure that the camera is centered for optimal performance



## Day and Night Mode

Ideally, LPR Camera would be configured to capture in color during the daytime, and black & white (IR mode/Night Mode) during the night.



Daytime - Color mode



Nighttime - Night (IR) mode

However, if the performance of LPR is impacted due to bad imaging, especially in dawn/dusk hours, then it is recommended to keep it in black & white (IR mode) at all times.

If the camera does not switch to night mode when required, or if it does not support two modes of operation, it should be configured to full-time black-and-white operation.

Image 9: During the Daytime - Monochrome (IR mode)



The ability of a camera to capture vehicle attributes like the make or body type of the vehicle at night depends on the ambient light, and in many circumstances night-view images will show only the license plate. Reference image below.

Image 10: LP capture at night under zero lux environment



If the camera is unable to provide sufficient illumination at night to make the license plate visible, additional lights (IR illuminator or white light) may be required. These are usually cases when license plates are far away, or where the camera exposure time must be reduced (lowering image brightness) to account for vehicle speed.

## Recommended Camera Settings

Standard cameras may need correction in camera settings to be used for LPR. These cameras by default may have exposure settings set to high, but this introduces motion blur.



The table below covers camera specifications that will help to get optimal readings for license plates for each use case. These settings are configured on the camera separately; LPR does not do any auto configuration.



Specification	Gate LPR 10 mph (20 km/h)	Street LPR 30 mph (50 km/h)	Highway LPR 70 mph (110 km/h)
<b>Day and Night Settings</b>	Switching from day mode to night mode should be set to <b>Auto</b> . If the camera supports profile mode, then two profiles can be set, one for daytime and one for night. If camera performance during low light is affected, then keep the camera in full-time black-and-white (night mode/IR mode).		
<b>Maximum Exposure/Shutter (Maximum exposures are listed; if plates are overexposed, you may reduce the shutter speed.)</b>	1/500 If motion blur is observed, this can be changed to 1/1000.	1/500 - 1/1000 Depends on motion blur. Shutter can be set to 1/1000 to prevent motion blur.	1/1000 - 1/2000 Depends on motion blur. Shutter can be set to 1/2000 to prevent motion blur.
<b>HLC</b>	Turned on.		
<b>Gain</b>	Needs to be kept below 30% to minimize noise in the image. Different cameras have different settings, so you may need to adjust the gain to have proper imaging.		
<b>IR Power</b>	Set to <b>full</b> . It's always advised to keep IR power to a maximum and reduce the gain.		

**Table 3: Additional Camera Specifications**