

Developing a Pedestrian-Scale Lighting Resource to Improve Safety for Vulnerable Road Users

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NJDOT Bicycle and Pedestrian Resource Center (BPRC) and our project partners



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Participating in NJ State Transportation
Innovation Council's (NJ STIC) Every Day
Counts, Round 7 (EDC-7) Initiative in the
Nighttime Visibility for Safety focus area



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Project Team



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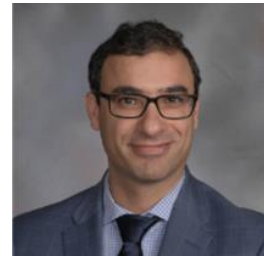


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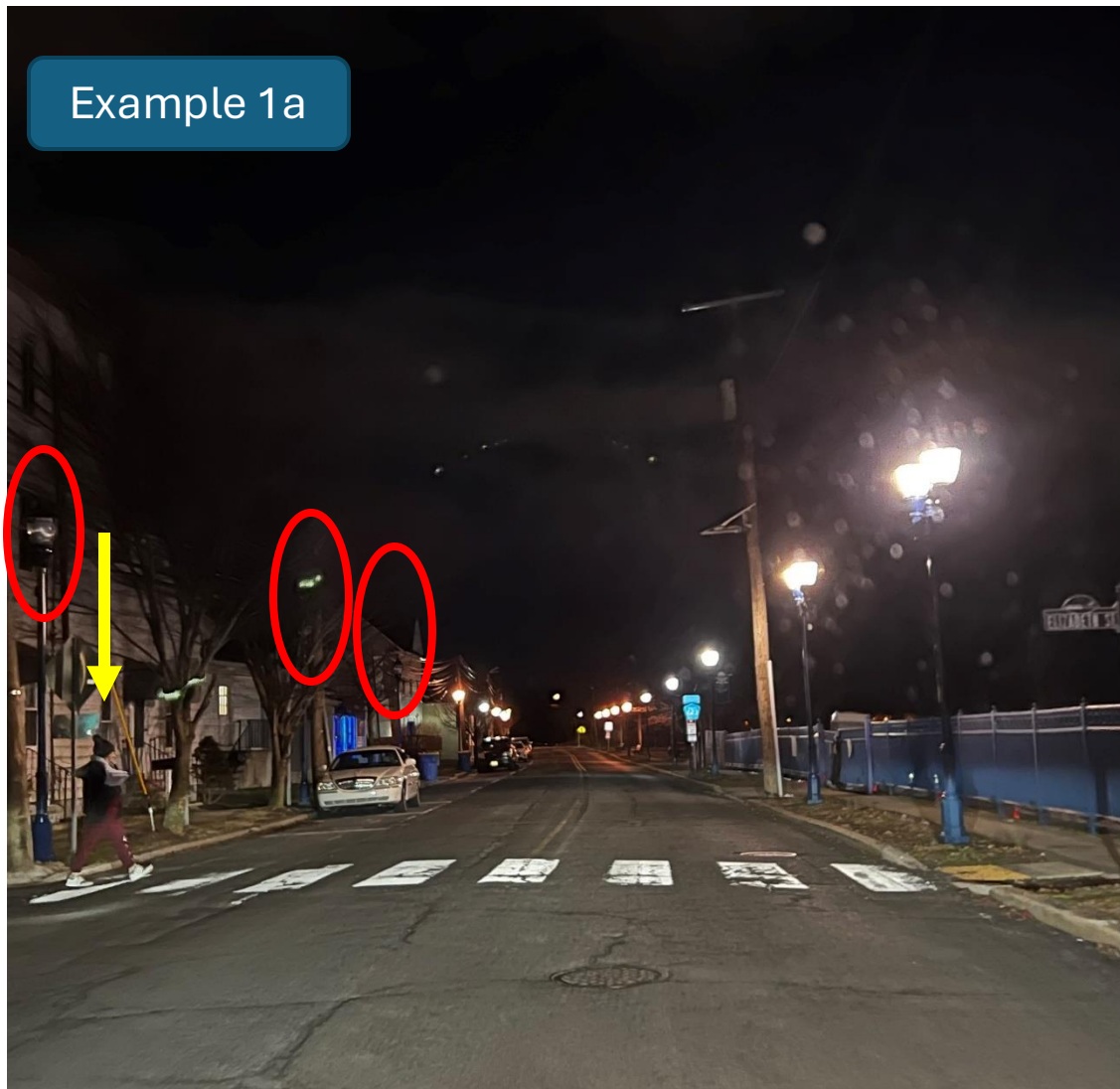


Content

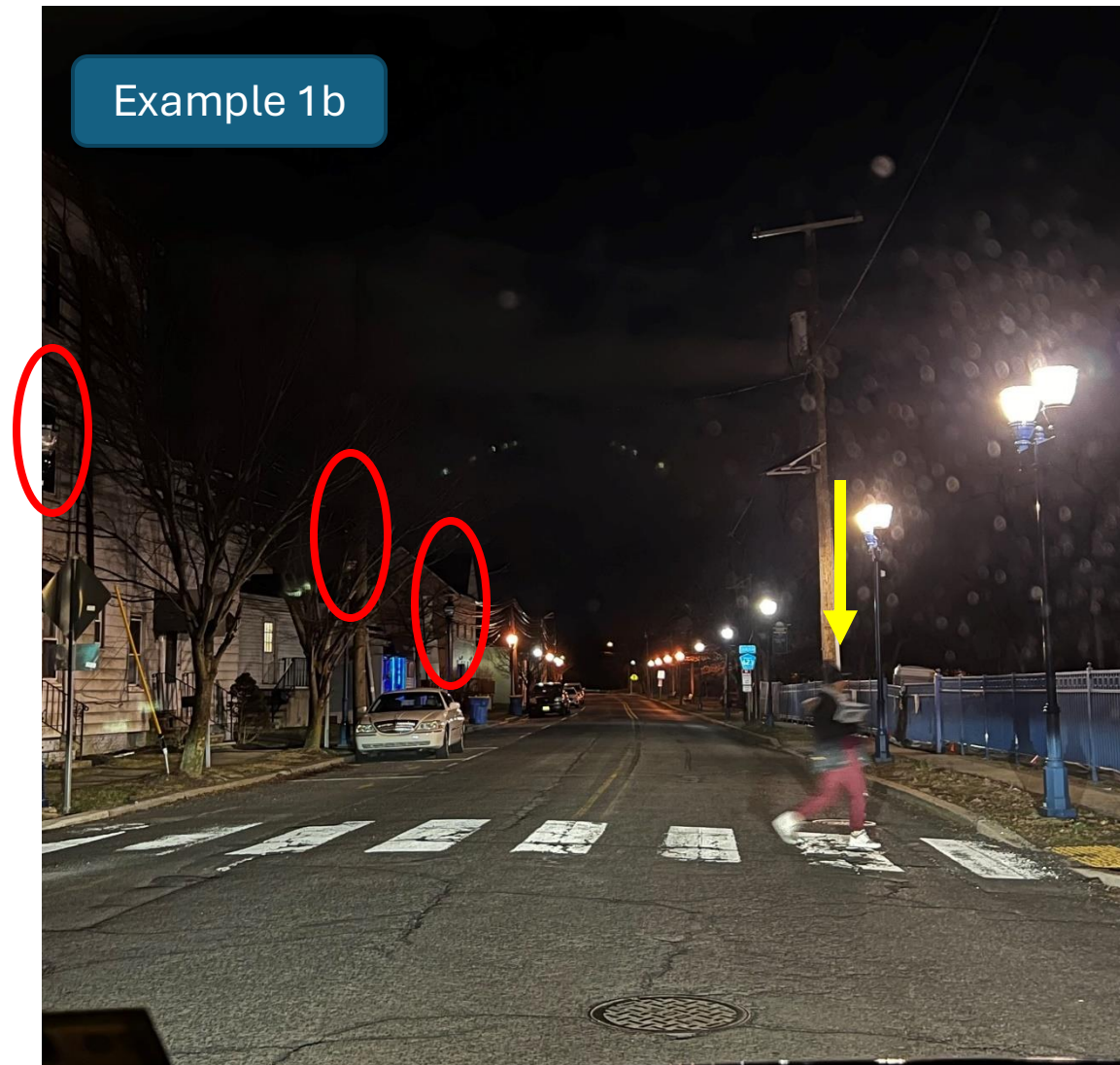
- Background
- Study Scope
- Design Considerations
- Design Criteria
- Takeaways
- What's Next?



Example 1a



Example 1b



South Bound Brook, NJ
Photo: NJDOT BPRC

Background



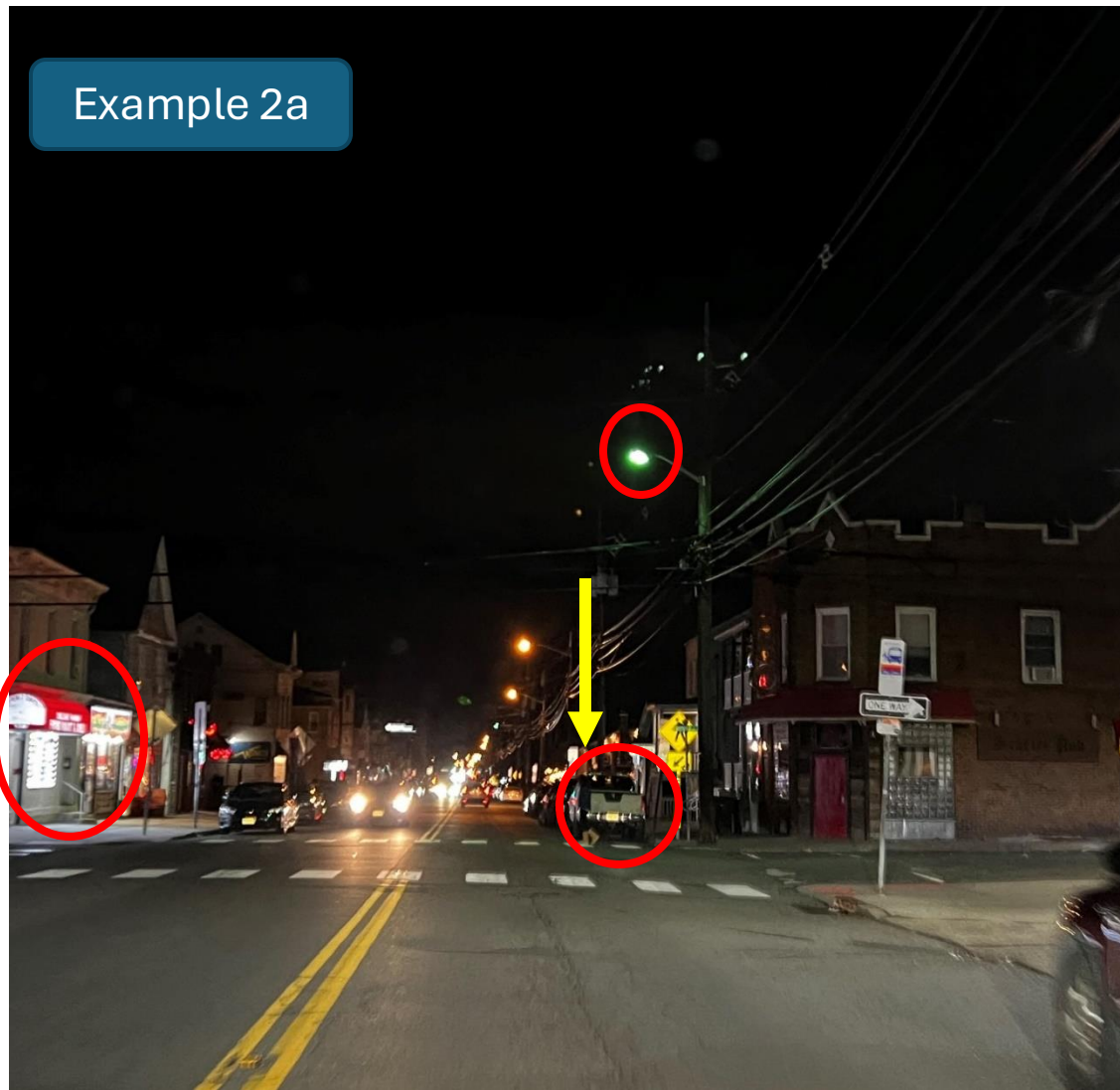
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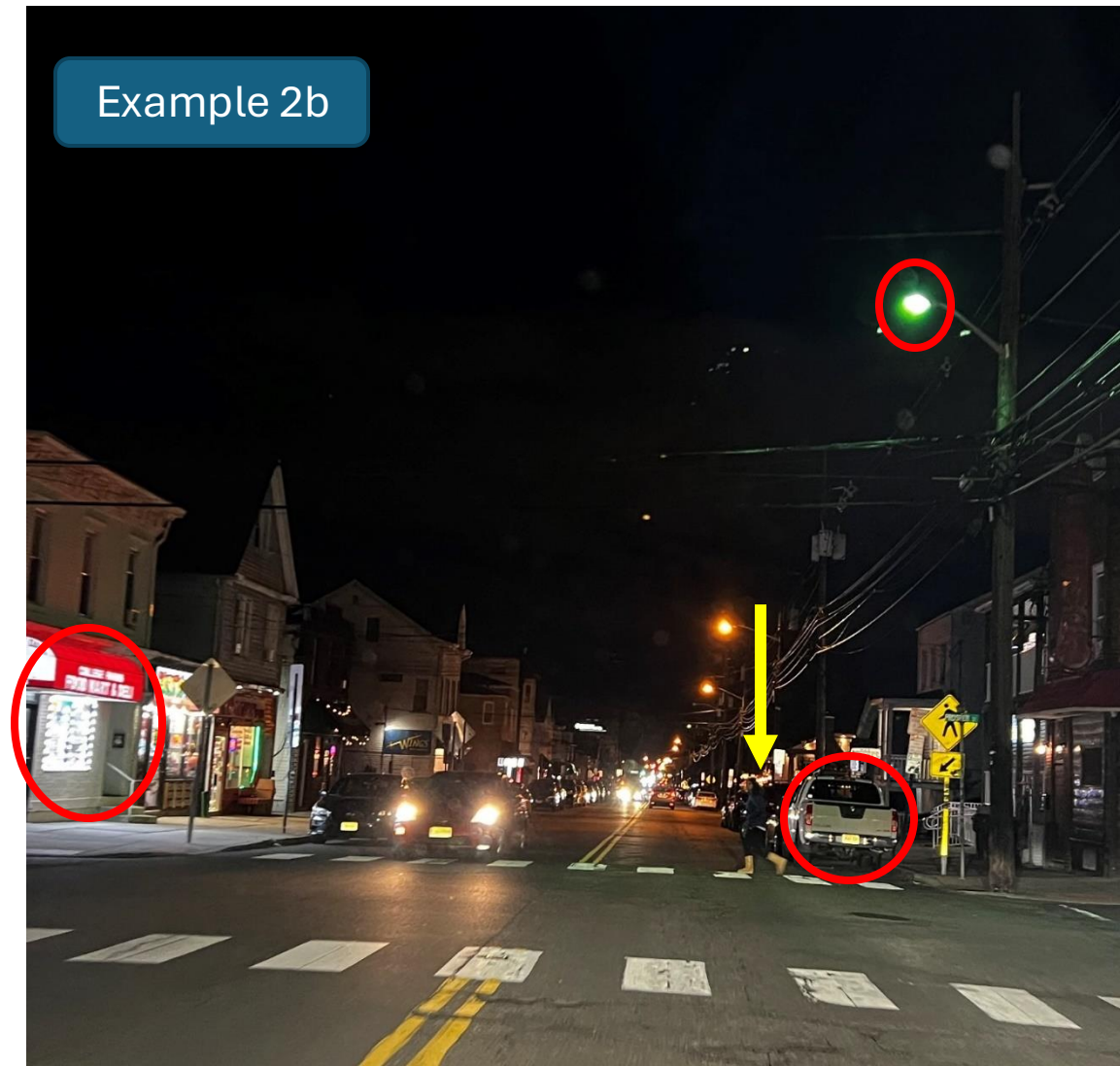


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Example 2a



Example 2b



Background

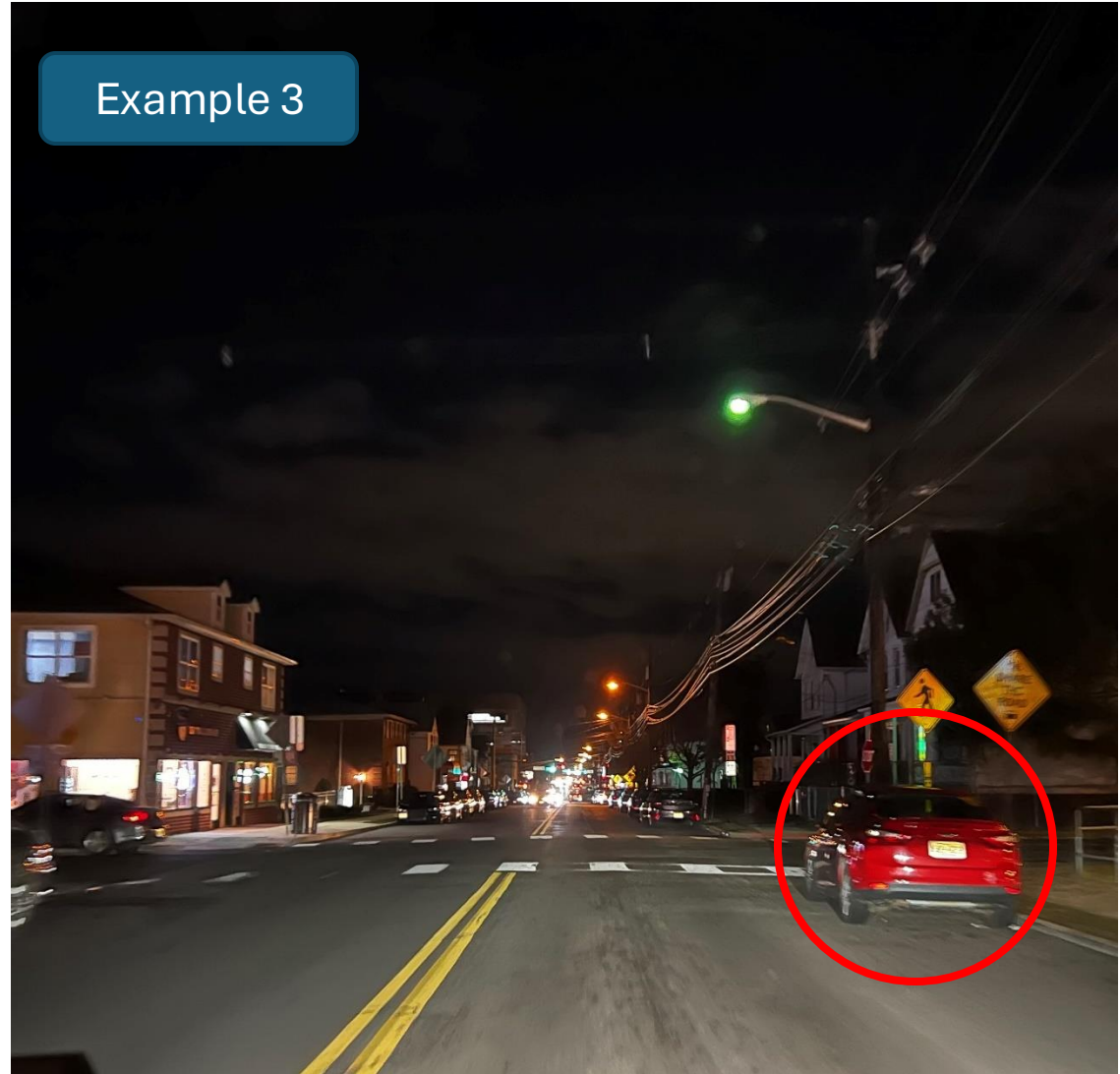
*New Brunswick, NJ
Photo: NJDOT BPRC*



Already, we know...

1. Crossing the street as a pedestrian is already difficult in daylight
2. Road lighting does not necessarily serve pedestrians
3. Illegal parking is a compounding factor to poor pedestrian visibility
4. Visibility can change by the foot

Example 3

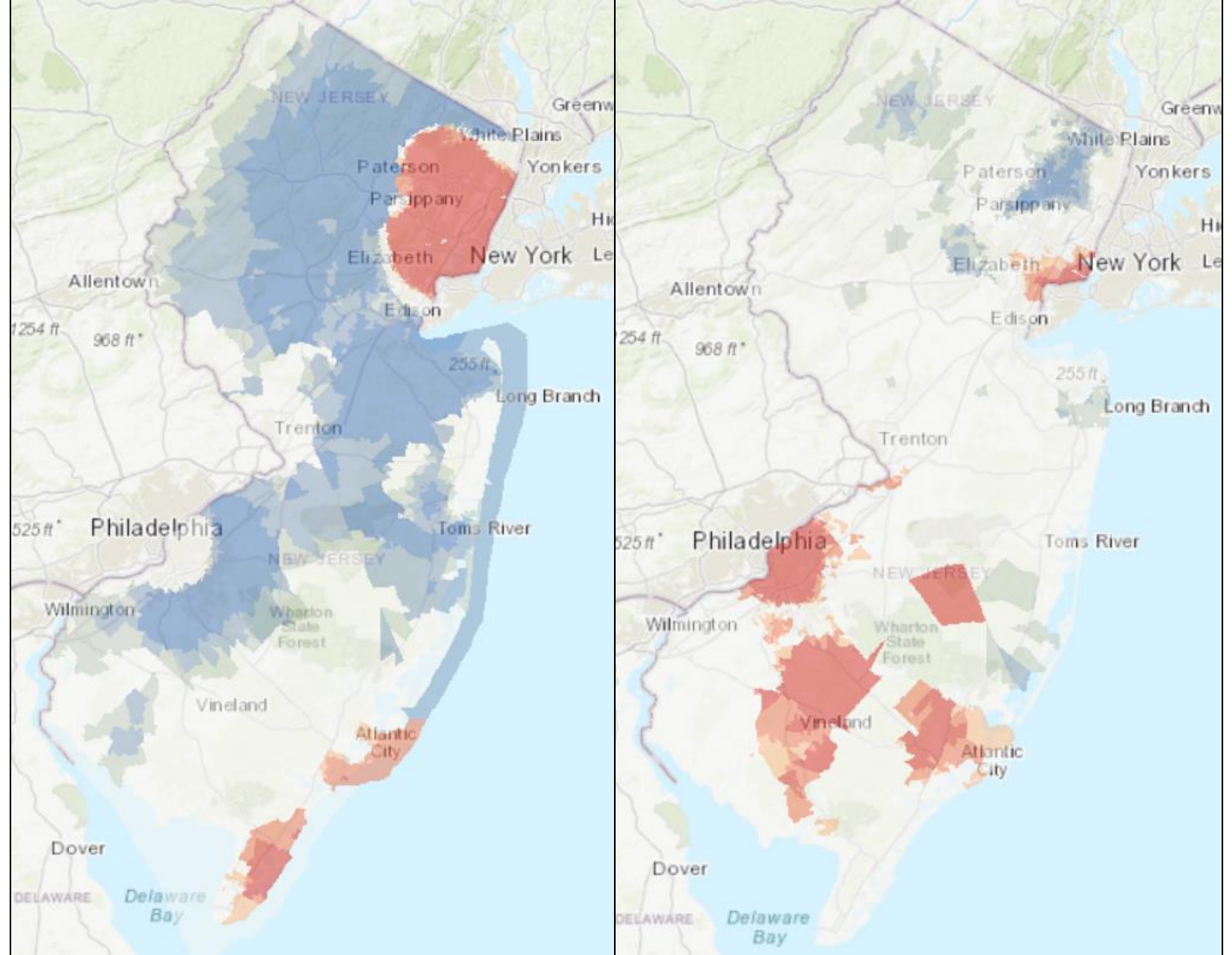


*New Brunswick, NJ
Photo: NJDOT BPRC*



Hotspots for bike/ped crashes per capita (2016-2020)

- All crashes (left)
- Fatal Crashes (right)



Data: Safety Voyager Bicycle and/or
Pedestrian Involved Crashes from
2016-2020



Lighting is a Proven Safety Countermeasure

- In New Jersey¹, crashes are:
 - 6.5x – 7x more likely in dark conditions
 - 2x more likely without lighting
- Key areas for improvement
 - School zones
 - Transit stops
 - Busy intersections/corridors
 - Marked crosswalks (mid-block)



Photo: NJDOT BPRC

¹ Hannah Younes, Ph.D., Robert Noland, Ph.D., Leigh Ann Von Hagen, AICP/PP, Sean Meehan (2023). “Pedestrian- and bicyclist-involved crashes: associations with spatial factors, pedestrian infrastructure, and equity impacts.”



Prior VTC Work

- Identifies gaps in expertise in pedestrian lighting in most localities
- Identifies a lack of relevant planning and design guidance
- Recommendation: Integrate pedestrian lighting into all planning and design



Pedestrian Lighting in New Jersey: *A Means to Improve Pedestrian Safety*

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Key Resources

Numerous agencies and organizations have published research and guidance concerning pedestrian-scale lighting best practices. Some are listed below:

- New Jersey Department of Transportation Pedestrian Compatible Planning and Design Guidelines
<https://www.state.nj.us/transportation/about/publicat/pdf/PedCompPedIntro.pdf>
- New Jersey Outdoor Lighting Ordinance Guide
https://www.nj.gov/dep/ocsp/docs/Sample_Lighting_Ordinance.pdf
- Voorhees Transportation Center Report on Pedestrian Lighting in New Jersey: A Means to Improve Pedestrian Safety
http://vtc.vtc.org/vtc-center/reports/2011/07/Pedestrian_Lighting_NJ_Final_Report.pdf
- Pedestrian and Bicycle Information Center
http://www.pedbikeinfo.org/webinars/webinar_details.cfm?id=13
- FHWA Informational Report on Lighting Design for Midblock Crosswalks
<https://www.fhwa.dot.gov/publications/research/safety/08053/>
- U.S. Department of Energy Report on Pedestrian Friendly Outdoor Lighting
https://www1.eere.energy.gov/buildings/publications/pdfs/ssl/2013_outdoor_pedestrian.pdf
- Seattle Pedestrian Lighting Citywide Plan
<http://www.seattle.gov/Assets/Documents/Departments/SDOT/About/Documents/Library/FinalMasterPlanPedLightingFINAL.pdf>
- Chandler (AZ) Report on Crime Prevention Through Environmental Design
<http://www.chandlerpd.com/wp-content/uploads/2010/12/CPTED-Handbook-v1-2010627.pdf>

Importance

Pedestrian-scale lighting does more than make a neighborhood look good. Most street lighting in New Jersey was designed with motorists' in mind, assuring there was proper lighting to navigate roads at high speeds. This lighting does not take into account pedestrians. Pedestrian-scale lighting is first and foremost a safety concern, helping to improve pedestrian safety, security and comfort.

i The presence of adequate pedestrian lighting helps promote visibility between motorists and pedestrians, reducing the frequency of crashes

Crashes

- bike/ped fatalities in New Jersey disproportionately occur at night

i Pedestrian-scale lighting helps illuminate sidewalks and improve pedestrian safety, security and comfort. Properly designed and installed pedestrian-scale lighting can both help define a streetscape and create a sense of place in a community.

Siting

Factors to Consider

- Proximity** should light sidewalks and crosswalks without blocking them
- Height** Poles should be shorter than street lights; 12-16 feet
- Spacing** evenly distributed approximately 60 feet apart
- Brightness** 20 lux measured at a height of five feet from the road surface
- Direction** fixtures faced downward to direct light onto pedestrians and avoid causing nuisance
- Glare** brighter is not always better; glare factors include fixture and background luminance, and size and angle of the fixture
- Energy Efficiency** due to light depreciation, initial light levels should be above what is required; adaptive technology can allow to operate at maintained level for longer times

Pedestrian-Scale Lighting Guide for New Jersey

Study Scope

Pedestrian Scale Lighting
(Research Problem)

Review and Inventory



**Design Consideration and
Criteria**



Lighting System Design Considerations

Lighting system design consider



Safety and comfort for all
road users



Environmental impact



Energy consumption

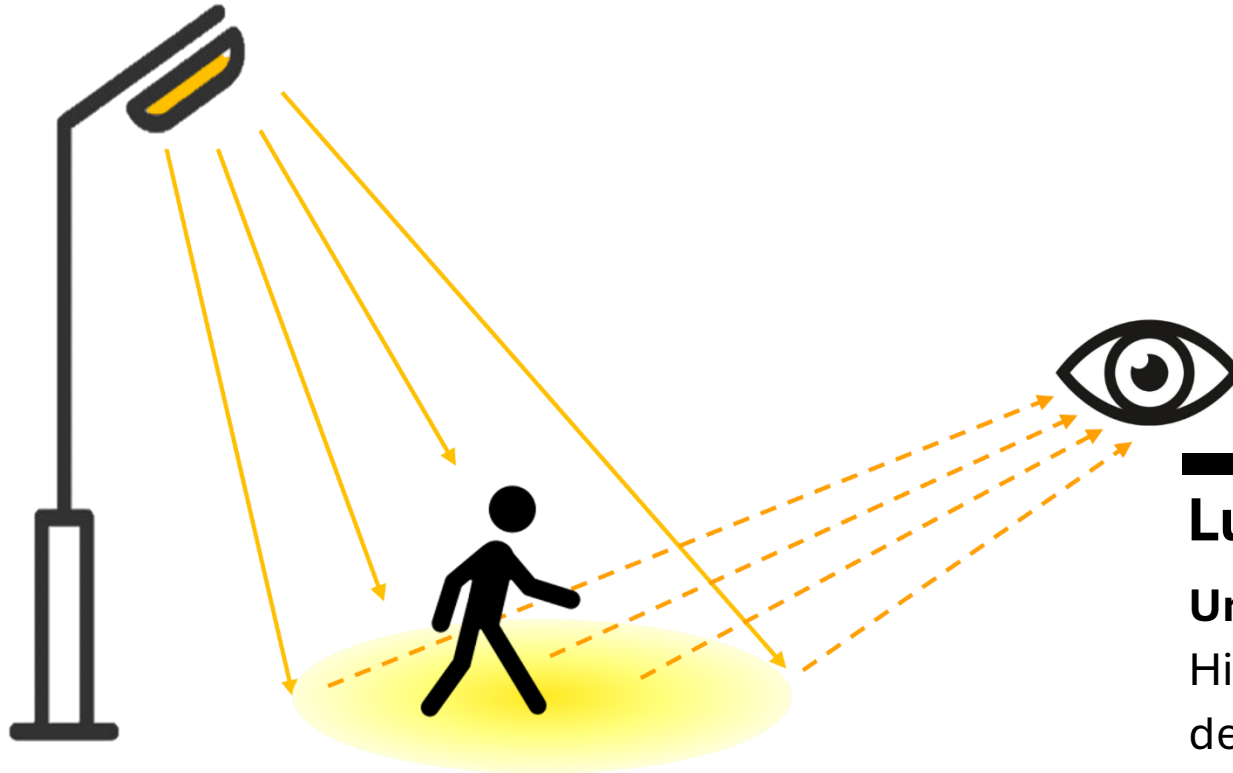
Design selection criteria consideration include:

Primary Criteria
Lighting levels

Secondary Criteria
Characteristics of lighting system



Primary Criteria : Luminance and Illuminance



Illuminance

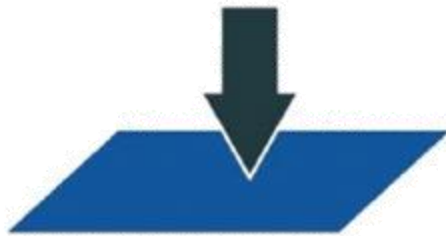
Unit: lux or foot-candle (fc)

Luminance

Unit: candela per square meter (cd/m²)
Higher luminance → Sooner and easier detection

Primary Criteria : Illuminance

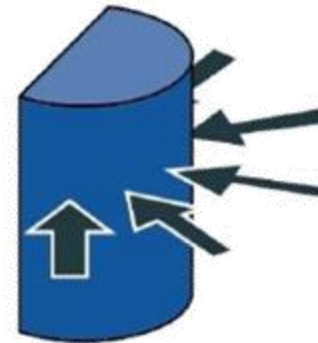
Measuring indicators



Horizontal



Vertical

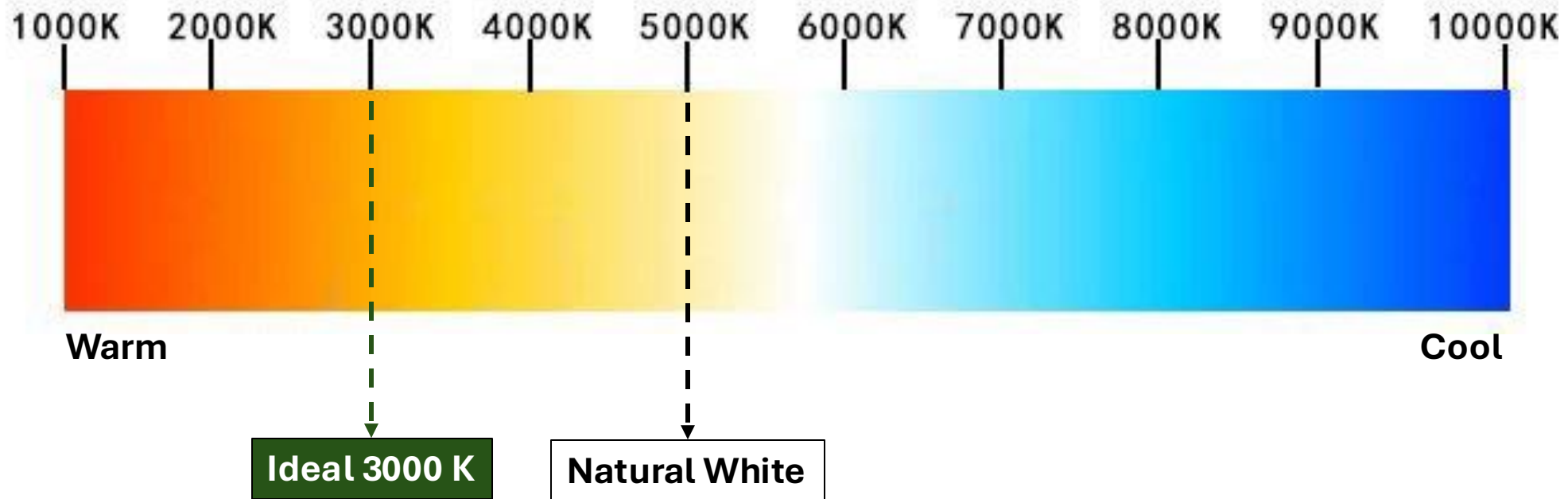


Semi-Cylindrical

Secondary Criteria

Corrected Color Temperature (CCT) of light source: color output of a light source

- **Unit:** degrees Kelvin (K)



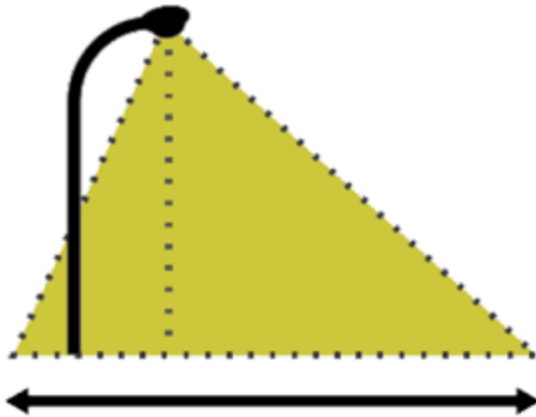
Secondary Criteria

Surround Ratio

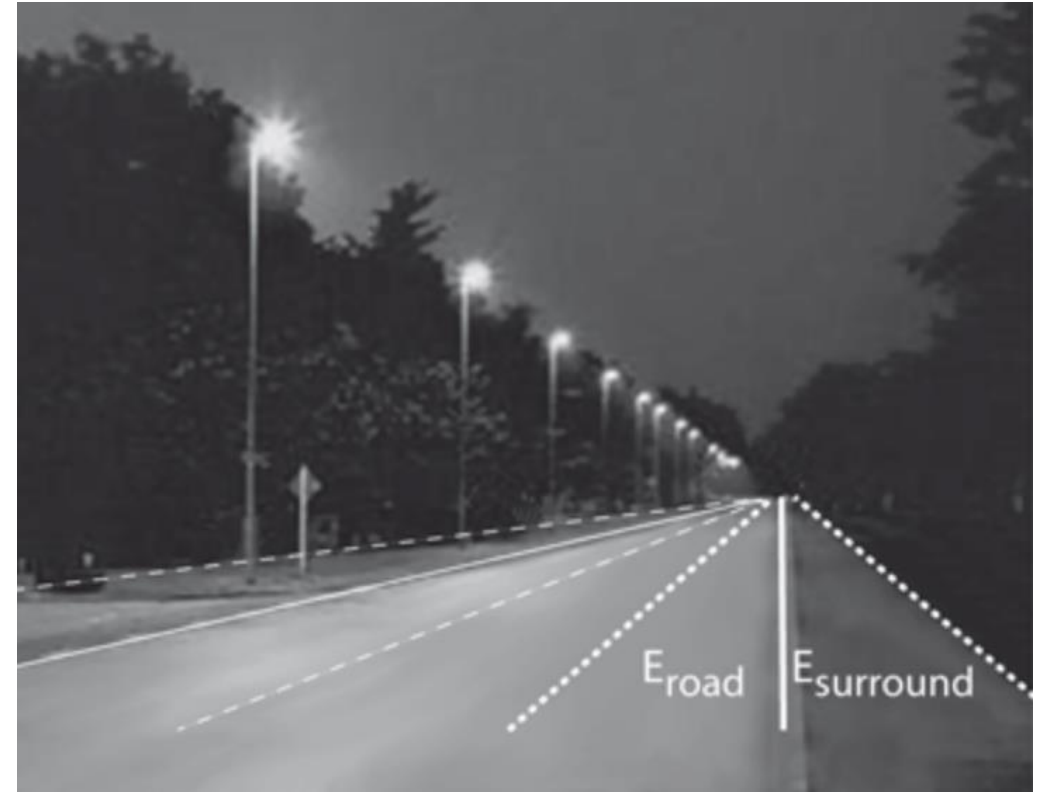
Illuminance spilling over the edge of the path or roadway

Illuminance on the path or roadway

Optimal Ratio: 80%



Source: FHWA, 2022



Source: Lighting Quality Parameters, 2014



Secondary Criteria

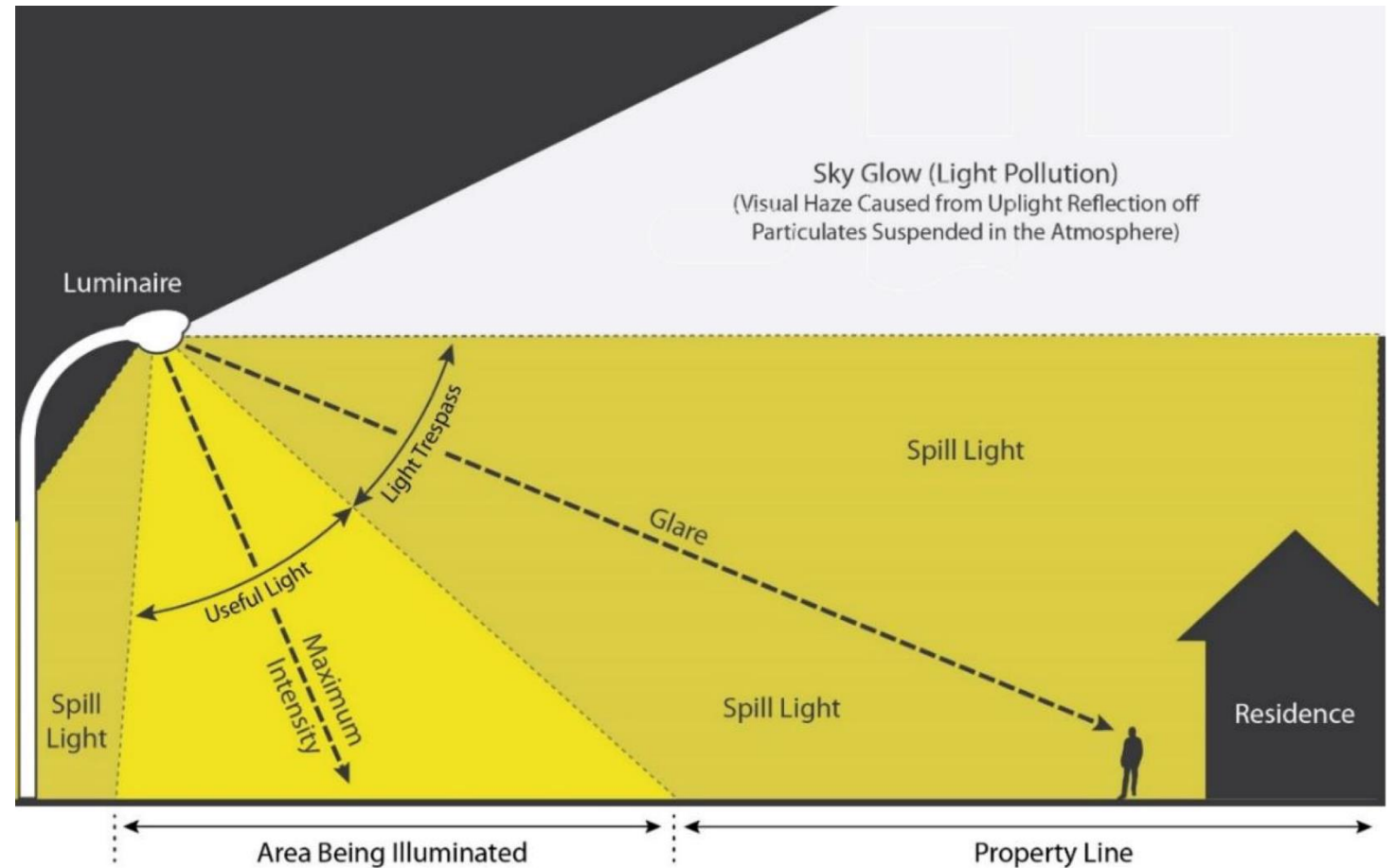
Glare



Source: AGC Lighting, 2020

Light Trespass

Falls on areas not intended to be illuminated



Source: FHWA, 2022



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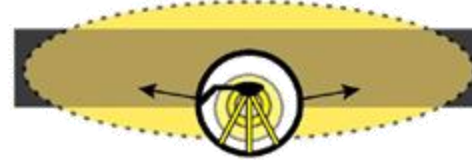


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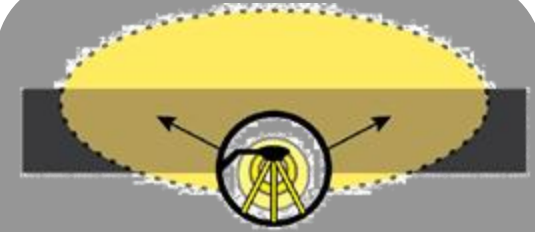
Lighting Type Selection Considerations



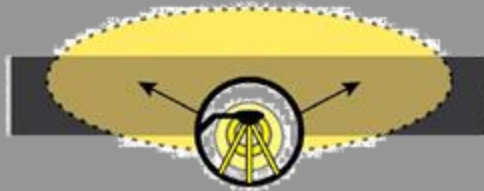
Type I



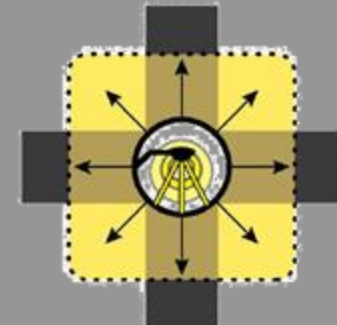
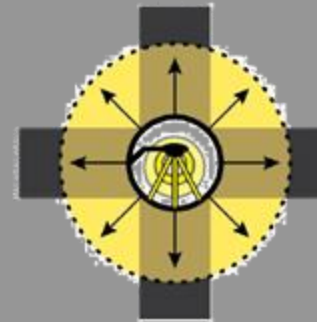
Type II



Type III



Type IV



Type V

Most appropriate distributions for pedestrian scale lighting

Pedestrian Considerations for Design

Type of Pedestrian Facility

- **Crosswalk** (midblock and intersection)
- **Adjacent to roadway:** sidewalks and walkways
- **Separated pedestrian pathway:** no vehicle – pedestrian interaction



Newark, NJ



South Orange, NJ

Photos: NJDOT Bicycle & Pedestrian Resource Center



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Pedestrian Considerations for Design

Level of Pedestrian Activity

Low

≤10 pedestrians/hour

- Suburban streets with single family dwelling
- Low density residential development
- Rural and semi-rural areas

Medium

11-100 pedestrians/hour

- Downtown office areas
- Libraries
- Apartments
- Neighborhood shopping
- Industrial
- Parks
- Near transit lines

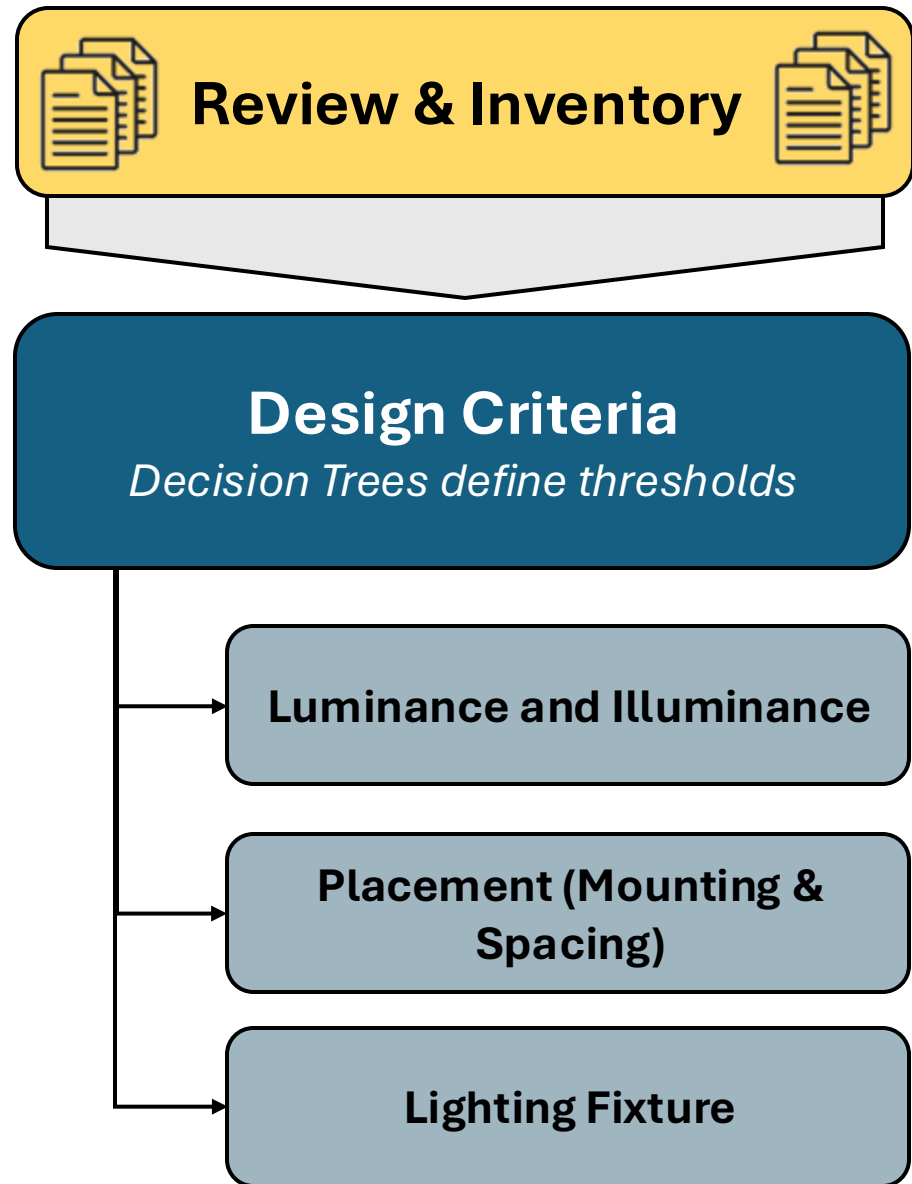
High

>100 pedestrians/hour

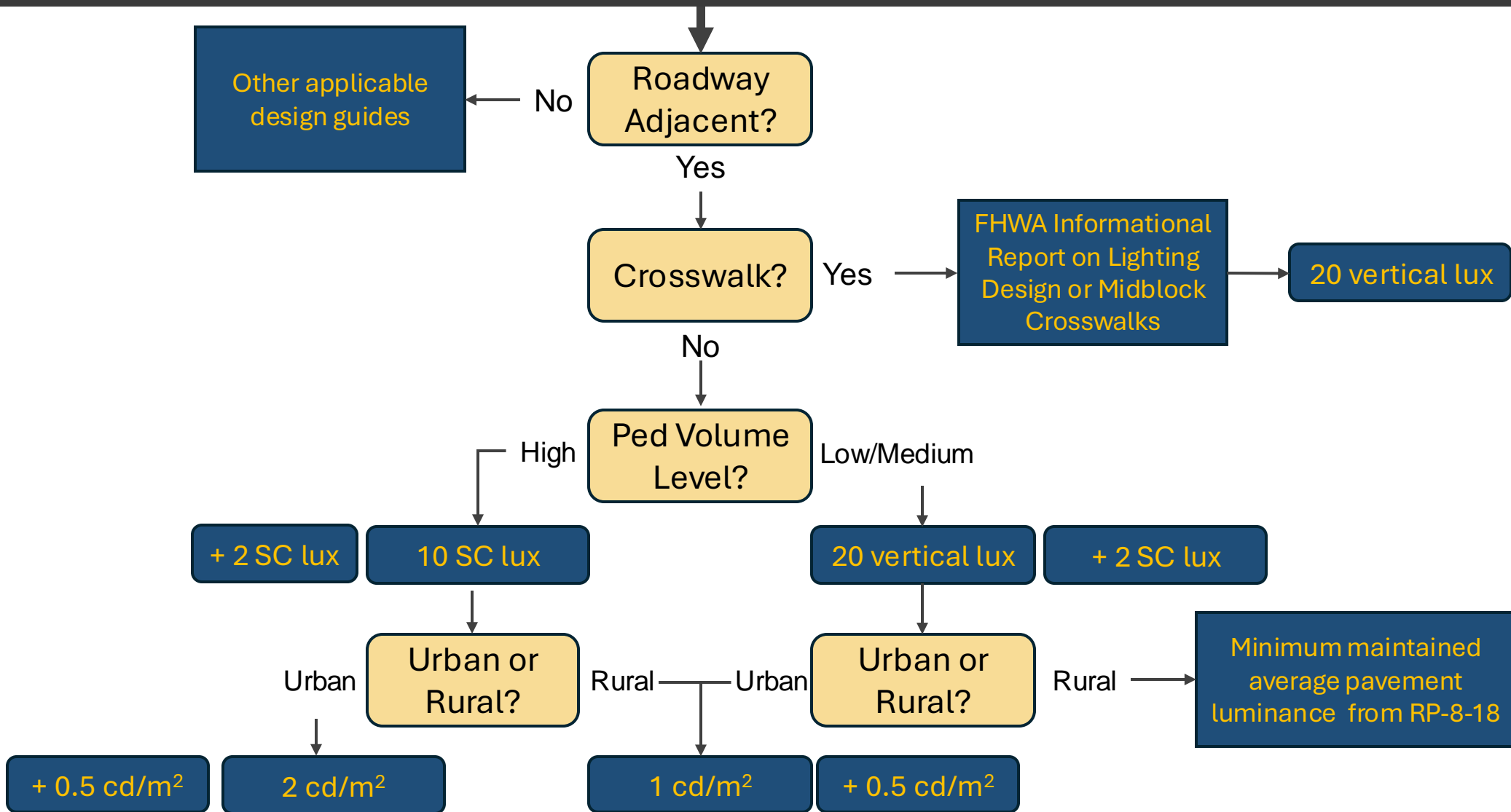
- Downtown retail areas,
- Theaters & concert halls
- Stadiums
- Transit terminals



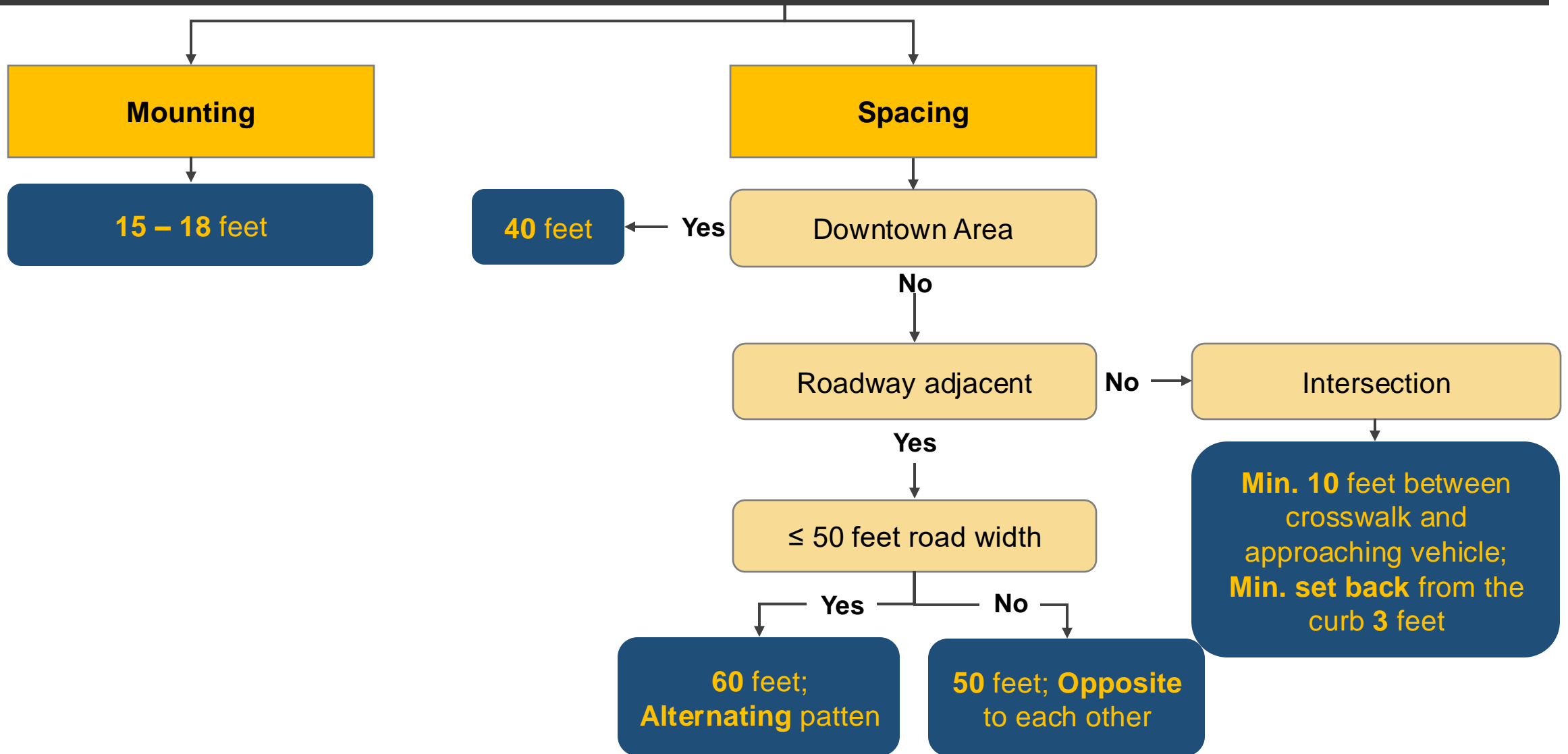
Pedestrian Scale Lighting Design Criteria



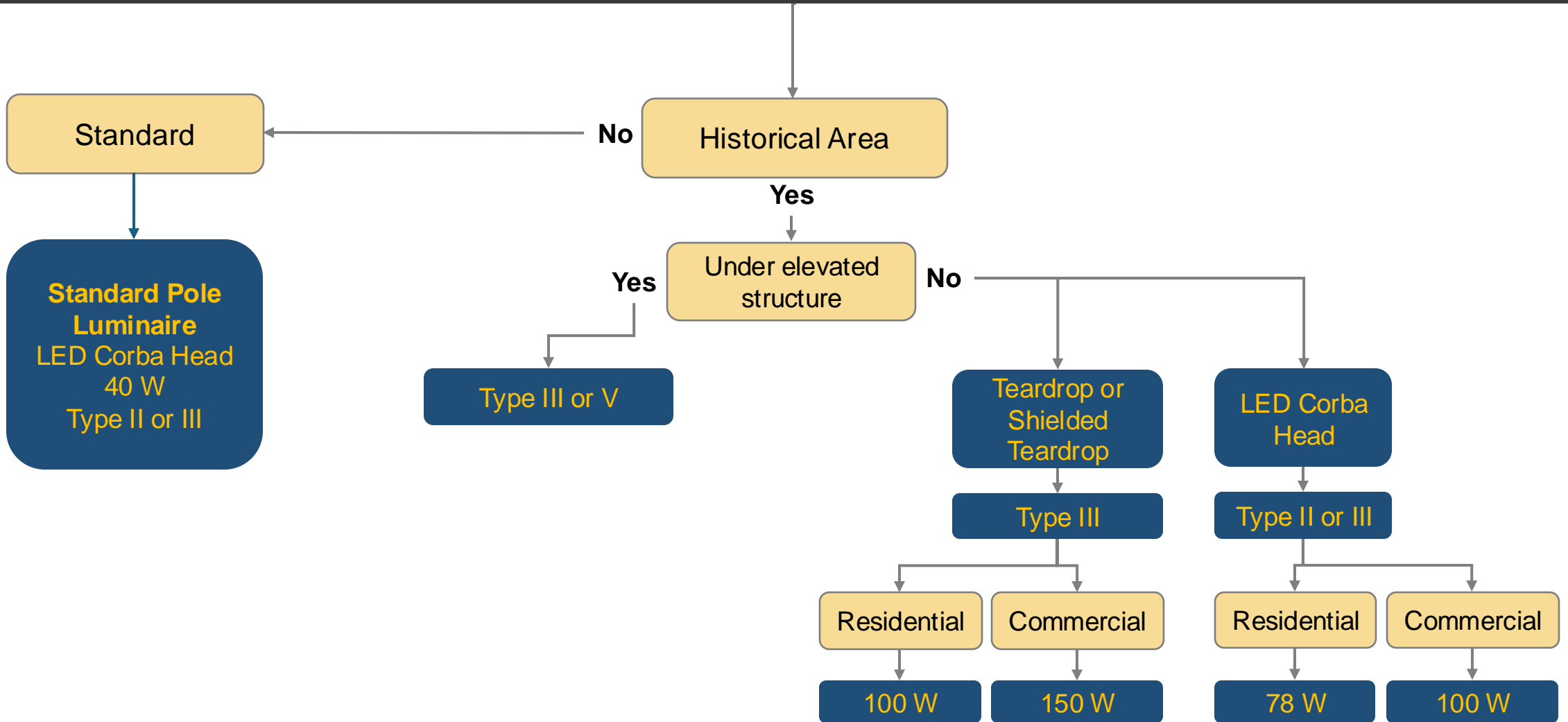
Lighting Levels



Placement



Lighting Fixtures



Takeaways

- Municipalities are asking for better resources on pedestrian scale lighting:
 - Where to place
 - How to work with utilities
 - Best practices in LED conversion, which reduce environmental and operating costs
- Lighting is an equity issue for both roadway and public safety
- Sufficient lighting for vulnerable road users is an approach to sustainability
- Design process must consider the furniture zone and maintain the pedestrian clear zone



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Thank you!



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