JOPLIN CITY COUNCIL
INFORMAL MEETING
MONDAY, APRIL 7, 2025
5TH FLOOR COUNCIL CHAMBERS
602 S. MAIN ST.
5:15 PM

This meeting can be livestreamed at http://www.joplinmo.org/182/Video-Multimedia

AGENDA

1. Mowing Update
2. Streetlights

Notice posted at 12:00 p.m. on this 3rd day of April 2025. (RSMo 610.020)

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Ad Omnia Parata

Parks Mowing Comparison
City Staff vs. Contractor
Informal Presentation
April 7, 2025

Parks Mowing Comparison
City Staff vs. Contractor

Total Parks Maintenance Budget for 2025: $1,248,500.00

Acres Mowed per year

- 25 weeks of mowing = 175 days
- Mow 933 acres every 10 days or 17.5 times per year
- 16,327.50 acres mowed/year

City of Joplin Mowing Operation Expenses

Staff	*Hours worked per week*	*Total staff expense*
9 FTE Mowing & Trimming	32.50 hrs/wk	$7,690.50
8 PTE Mowing & Trimming	32.50 hrs/wk	$3,832.40
FTE and PTE Total:		$11,522.90
Mowing Season Length:		x25 weeks
Average Staff Expense:		$288,073.00

City of Joplin Maintenance Expenses

Fuel	$17,000.00	
Equipment PM	$46,491.00	avg. over 3 years
Tractors (2)	$15,500.00	avg. of 10 years; total cost of tractors $155,000
Zero Turn Mowers (5)	$22,000.00	avg. of 5 years; total cost of zero turns $110,000
Truck (3)	$19,286.00	avg. of 7 years used 8 mo. of year; total cost $135,000
Trailers (3)	$900.00	avg. of 10 years used 8 mo. of year; total cost $9,000
Trimmers (12)	$1,800.00	avg. of 2 years; total cost of trimmers $3,600
Leaf Blowers (4)	$550.00	avg. of 2 years; total cost of blowers $1,100
Avg. Maintenance Expense:	$123,527.00	
Avg. City Total Cost:	$411,600.00 per mowing season	

Average cost per acre per year

$411,600.00 staff/maintenance cost divided by 16,327.50 acres mowed = $25.20 cost per acre per year

Contractor (Outsourced)

We received three quotes on the average of mowing and trimming per acre. The lowest quote was $60 per acre with the highest being $140 per acre.

Lowest cost:	$60/acre x 16,327.50 acres	=	$979,650.00
Highest cost:	$140/acre x 16,327.50 acres	=	$2,285,850.00

Savings In-House vs. Outsourced

Outsourced:	$979,650.00 ($60/acre)	$2,285,850.00 ($140/acre)
In-House:	$411,600.00 ($25.20/acre)	$411,600.00 ($25.20/acre)
Savings:	$568,050.00	$1,874,250.00

ResearchGate

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The impact and policy relevance of street lighting for crime prevention: A systematic review based on a half-century of evaluation research

Article *in* Criminology & Public Policy · April 2022

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CRIMINOLOGY & Public Policy

ORIGINAL ARTICLE

The impact and policy relevance of street lighting for crime prevention: A systematic review based on a half-century of evaluation research

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Abstract

Research Summary: This article reports on an updated systematic review and meta-analysis of the effects of street lighting interventions on crime in public places. Following Campbell Collaboration guidelines, it uses robust criteria for inclusion of studies, comprehensive search strategies to identify eligible studies, a detailed protocol for coding key study characteristics, and rigorous methods for analyzing studies. A total of 21 studies met the inclusion criteria, originating in four countries (United States, United Kingdom, Brazil, and South Korea) and covering almost 50 years (1974–2021). The review finds that street lighting interventions are associated with a significant desirable effect on total crime (14% reduction in treatment areas compared with comparable control areas); desirable effects are greater in studies that measured both night and day crimes than in studies that only measured night crimes; and street lighting is followed by a significant reduction in property crimes, but not in violent crimes.

Policy Implications: Compared to past years, it would seem that an even stronger case can be made today for street lighting interventions to be part of crime-prevention policy. A larger body of high-quality

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evaluation research, implemented in a range of high-crime public places, some evidence of value for money, and a continued desirable impact on crime, especially property crime, all point to the policy relevance of street lighting interventions.

KEYWORDS
crime prevention, public policy, street lighting, systematic review

1 | INTRODUCTION

Street lighting may be considered part of the physical landscape—the infrastructure even—of urban and suburban life in most industrialized countries. It serves several key purposes, including traffic and pedestrian safety and the prevention of crime (see Beyer & Ker, 2009; Welsh & Farrington, 2009). Its connection to crime prevention is documented by a longstanding interest in its effects on crime, support from a number of theoretical perspectives, and the historical record.

Beginning in the United States in the 1970s, there has been a half-century of research on the impact of street lighting on crime, as well as some modest policy interest on the part of federal/central and local governments. There is also something of an enduring effect of street lighting on crime in public places, as shown in studies from the 1970s to the present day. As we find in the current article, based on a systematic review and meta-analysis of the best available research evidence, street lighting is associated with a significant decrease in crime.

Explanations of the way street lighting can prevent crime are grounded in situational crime prevention, with a focus on reducing opportunity and increasing risk (Clarke, 2009), natural, informal surveillance (Clarke, 1997), and investment in neighborhood conditions (Taub et al., 1984; Taylor & Gottfredson, 1986). (We return to theoretical perspectives in the next section.) With respect to history, according to Zahm (2004, p. 536), public street lighting for the purpose of crime prevention dates from 1667 in France during the reign of Louis XIV. Ellis (2007, as cited in Chalfin, Kaplan et al., 2021) notes that the historical record of street-lights used for public safety may go as far back as the Greco-Roman era in 500 B.C.

In more recent years, several other factors have also played a role in the use of street lighting for crime prevention in public places. One of these factors has to do with financial austerity on the part of local government. Some governments faced with budget shortfalls have resorted to a number of measures to curtail financial costs associated with operating and maintaining public street lights, including switching off lighting, part-night lighting, dimming, and white light (Davies & Farrington, 2020; Perkins et al., 2015). Sometimes these measures are implemented in the name of energy conservation (Mihale-Wilson et al., 2019). In reported cases in U.S. cities and towns, these measures have often had the effect of galvanizing public support for maintaining existing street lighting, with personal safety and fear of crime being the most important motivations (Aued, 2008; Walter, 2011; see also Perkins et al., 2015).

Another factor is the concern that street lighting may contribute to light pollution (Pease, 1999). This has environmental implications, as well as impacts on nighttime viewing of the skies. These factors are important in policy debates about street lighting and crime prevention, and we consider them alongside the research evidence on lighting's impact on crime.

The main aim of this article is to report on the results of an updated systematic review and meta-analysis of the effects of street lighting interventions on crime in public places. Prior reviews were completed in 2000 and 2006, and the current review represents a 14-year update.

2 | BACKGROUND

2.1 | Theoretical perspectives

As noted above, several key theoretical perspectives inform street lighting interventions to prevent crime. One is situational crime prevention, specifically the approach that emphasizes increasing risk through provision of "more or better guardianship to increase the likelihood of detection" (Smith & Clarke, 2014, p. 306). This approach is also supported by theories that emphasize natural, informal surveillance as a key to crime prevention (Clarke, 1997).

Street lighting may encourage increased street usage, which intensifies natural surveillance. The change in routine activity patterns may reduce crime because it increases the flow of potentially capable guardians who can intervene to prevent crime (Cohen & Felson, 1979). From a potential offender's perspective, the proximity of other pedestrians acts as a deterrent because the risks of being recognized or interrupted when attacking personal or property targets are increased. From a potential victim's perspective, the perceived risks and fears of crime are reduced.

Another perspective emphasizes the importance of investment to improve neighborhood conditions as a means of strengthening community confidence, cohesion, and social control (Taub et al., 1984; Taylor & Gottfredson, 1986). As a highly visible sign of investment, street lighting interventions might reduce crime if they were perceived to improve the environment and signal to residents that efforts were being made to invest in and improve the neighborhood. In turn, this might lead residents to have a more positive image of their area and to have increased community pride, optimism, and cohesion. This might lead residents to exert greater informal social control over potential offenders in an area, even going so far as to intervene on behalf of their neighbors or for the common good (Sampson et al., 1997).

It is important to note that not all of the different types of street lighting interventions under consideration in the current review may be fully supported by the aforementioned theoretical perspectives. For example, the dimming or switching off of street lights during certain times of the night (to reduce public expenditure) does not signal an investment in neighborhood conditions or lead to improved informal social control and community cohesion. Also, the replacement of incandescent lights with light-emitting diodes or LEDs (to improve energy efficiency) might signal an investment in neighborhood conditions, but may not lead to greater informal social control and community cohesion (owing to concerns about decreased visibility from a reduction in brightness).

2.2 | Intervention variability

The first generation of evaluations of the impact of street lighting on crime, stretching from the 1970s through the early 2000s, focused exclusively on lighting improvements in the form of increased illumination compared to standard lighting. Known as "improved" street lighting, brightness was increased by two, three, four, or more times (Welsh & Farrington, 2009). Today, there is more variability in street lighting interventions. Cities and towns in many parts of the

world have begun to implement a range of new lighting technologies (e.g., LEDs, smart lights) and applications (e.g., temporary or permanent switching off, lighting towers) and, increasingly, these have been evaluated for their impact on crime. Of the eight new studies that met the criteria for inclusion in the current update of the review (not including the 13 studies that were part of the first review; see below), seven focused on these types of interventions; the other focused on improved street lighting.

2.3 | Prior reviews

The first systematic review of the effects of street lighting on crime, covering research reported up to December 2000, identified a total of 13 studies (eight from the United States and five from the United Kingdom) that met the inclusion criteria (Farrington & Welsh, 2002a, 2002b). Improved street lighting was the focus in each of the studies. A meta-analysis of the 13 studies found that the intervention produced a significant and rather sizeable (20%) reduction in crime. Narrative reviews of the literature by Cozens et al. (2003) and Clarke (2008), based on a slightly larger group of studies (but not distinguishing them by evaluation quality), reached similar conclusions about the effectiveness of street lighting in preventing crime.

The first update of the systematic review, covering a period of six years (January 2001–December 2006), did not identify any new study that met the inclusion criteria (Farrington & Welsh, 2007; Welsh & Farrington, 2008). We reported that research on the topic "appears to have come to a standstill" (Farrington & Welsh, 2007, p. 25). This is no longer the case. As we find in the current update of the review, there has been a renewed interest in evaluation research on street lighting for crime prevention.

3 | METHODOLOGY

The systematic review was carried out in accordance with the guidelines of the Campbell Collaboration (2014).

3.1 | Criteria for inclusion of evaluation studies

In selecting evaluations for inclusion in this review, the following criteria were used:

Nature of intervention: Street lighting was the focus of the intervention. This included improved street lighting (e.g., increasing brightness) and a range of lighting technologies (e.g., LEDs, smart lights) and applications (e.g., switch-off lighting schemes). For evaluations involving one or more other interventions, only those evaluations in which lighting was the main intervention were included. The determination of what was the main intervention was based on the author identifying it as such or, if the author did not do this, the importance that the report gave to the lighting intervention relative to other interventions.

Type of place: The intervention was implemented in a public place. By public place, we mean those places that individuals can make use of or visit in a free and unencumbered way. Typical public places include city and town centers, parking lots or car parks that are available for public use, residential neighborhoods, and commercial areas. For residential neighborhoods and

commercial areas, it is important to note that lighting schemes that are operated in private space (e.g., exterior lighting censors on homes or businesses) are not included.

Outcome of interest: There was an outcome measure of crime. The most relevant crime outcomes were property and violent crimes.

Evaluation design: The evaluation design was of high quality methodologically, with the minimum design involving before-and-after measures of crime in treatment and comparable control areas.

Number of crimes: The total number of crimes in each area before the intervention was at least 20. The main measure of effect size was based on changes in numbers of crimes between the before and after time periods. It was considered that a measure of change based on a *N* below 20 was potentially misleading. Also, any study with less than 20 crimes before would have insufficient statistical power to detect changes in crime. The criterion of 20 is probably too low, but we were reluctant to exclude studies unless their numbers were clearly inadequate.

3.2 | Search strategies

The following search strategies were used to locate studies meeting the inclusion criteria:

Electronic bibliographic databases: The following 11 databases were searched: Criminal Justice Abstracts; National Criminal Justice Reference Service (NCJRS) Abstracts; Sociological Abstracts; Educational Resources Information Clearinghouse (ERIC); Government Publications Office Monthly Catalogue (GPO Monthly); Psychology Information (PsychInfo); HeinOnline; Dissertation Abstracts; Social, Psychological, Educational, and Criminological Trials Register (C2-SPECTR); Google Scholar; and Medline. These databases were selected on the basis of the most comprehensive coverage of criminological, criminal justice, and social and behavioral science literatures. They are also the top databases recommended by the Campbell Collaboration Crime and Justice Group.

The following terms were used to search the databases: street lighting, lighting, illumination, and natural surveillance. When applicable, "crime" and "crime prevention" were added to each of these terms (e.g., street lighting and crime) to narrow the search parameters.

Reviews of the literature on street lighting: Three new literature reviews were identified and assessed: Beyer and Ker (2009), Lester (2010), and Struyf (2020).

References of studies: We examined the references of all of the studies that met the inclusion criteria, as well as all of the excluded reports that we determined to be evaluations.

Forward citations: We used the "cited by" function in Google Scholar to conduct forward citation searches of all of the studies that met our inclusion criteria. We also conducted forward citation searches of the earlier systematic reviews on street lighting.

ResearchGate: This is a scholarly networking site that allows researchers to promote and share their published and unpublished works. We used the platform's search function and the aforementioned key terms to identify eligible studies.

Both published and unpublished reports were considered in these searches and they were international in scope and were not limited to the English language. The searches were completed from March to April 2021, and reflect material reported during a 14-year period, between January 2007 and March 2021.

3.3 | Coding and protocol

The following key features of the included studies were coded: author and date; outlet (published or not); location; context of intervention; type of intervention (and any secondary interventions); sample size; outcome measure, when crimes were measured (night and day or night only), and data source; and evaluation design (with before and after periods of time).

A coding protocol was established by the research team, which consisted of two senior researchers and one doctoral student. Each of the members of the research team has extensive training in the conduct of systematic reviews and has carried out multiple systematic reviews. The first step involved the researchers confirming the inclusion criteria and the measures to be coded. Next, studies were collected (see below for full details) and the coding was carried out by the doctoral student in consultation with one of the senior researchers. In addition, all three members of the research team met and communicated periodically to discuss the coding of all of the studies and resolve any questions.

3.4 | Analytical approach

Meta-analytic techniques were used to determine the size, direction, and statistical significance of the impact of street lighting interventions on crime. A comparable measure of effect size and an estimation of its variance are needed in each evaluation. In the case of street lighting evaluations, the measure of effect size had to be based on the number of crimes in the treatment and control areas before and after the intervention, because this was the only information that was regularly provided in these evaluations.

Here, the relative effect size (RES) is used as the measure of effect size.[1] The RES was described in Farrington et al. (2007). The RES is best suited for this type of data, and it has a straightforward and meaningful interpretation. It indicates the proportional change in crime in the control area compared with crime in the treatment area. A RES greater than 1.0 indicates a desirable effect of the intervention, and a RES less than 1.0 indicates an undesirable effect. A RES of 1.20, for example, indicates that crime increased by 20% in the control area relative to the treatment area. A RES of 1.20 could also indicate that crime decreased by 17% in the treatment area relative to the control area, since the change in the treatment area compared with the control area is the inverse of the RES, or (1/1.20) here. RES is calculated from the following equation:

$$\mathrm{RES} = (a \times d) / (b \times c)$$

where a is the number of before crimes in the treatment area, b is the number of after crimes in the treatment area, c is the number of before crimes in the control area, and d is the number of after crimes in the control area.

The variance of the RES is calculated from the variance of LRES (the natural logarithm of RES) based on the following equation:

$$\mathrm{V}(\mathrm{LRES}) = 1/a + 1/b + 1/c + 1/d$$

where LRES = Ln(RES). This estimate of the variance is based on the assumption that the total numbers of crimes (a, b, c, d) have a Poisson distribution. If the number of crimes has a Poisson

distribution, its variance should be the same as its mean. However, a large number of changing extraneous factors may cause over-dispersion (D); that is, where the variance of the number of crimes (V) exceeds the number of crimes (N). Where there is over-dispersion, V(LRES) should be multiplied by D. In the previous systematic review, Farrington and Welsh (2007) used an over-dispersion equation derived by Farrington et al. (2007):

$$D = .0008 \times N + 1.2$$

Farrington and Welsh (2007) concluded that the mean value of D was about 1.56. In the interests of drawing conservative conclusions in the current review, we assume a D value of 2.0 in estimating the variance of each effect size. Where monthly numbers of crimes are available, D can be estimated from the ratio of the monthly variance to the monthly mean. In the evaluation by Davies and Farrington (2020), the average of D over four types of crimes was 2.15. This D value is an overestimate because the monthly variance is inflated by seasonal variations. Nevertheless, we assumed a D value of 2.0.

In deriving the weighted mean effect size ($\overline{ES}$) for various analyses, we used the multiplicative variance adjustment (MVA) model, which overcomes some problems associated with the fixed effects and random effects models when using numbers of crimes (Farrington & Welsh, 2013). In the MVA model, V(LRES) is multiplied by Q/df, where Q is the measure of study heterogeneity and df is the number of degrees of freedom (or the number of studies minus 1). The MVA model exactly adjusts for heterogeneity (yielding $Q = df$). It also overcomes the problem of adjusting for overdispersion, because it does not matter whether D is 1.5, 2.0, or any other value up to Q/df; the weighted mean effect size and its variance will be unchanged.

Also important to this review is an assessment of any displacement of crime or diffusion of crime-prevention benefits associated with the effects of street lighting interventions. Displacement is commonly defined as the unintended increase in crimes in other locations following the implementation of a crime-prevention project. This is the notion that offenders simply move around the corner or to a different neighborhood. This form of displacement—known as spatial or territorial—is but one of a number of ways it can occur. Other forms of displacement include temporal (change in time), tactical (change in method), target (change in victim), and functional (change in type of crime) (Reppetto, 1976). Diffusion of benefits, on the other hand, can be defined as the "complete reverse" of displacement (Clarke & Weisburd, 1994). Here, the project's crime-prevention benefits are diffused to the surrounding area, for example. As with displacement, diffusion of benefits is not limited to a physical place.

4 | RESULTS

Figure 1 summarizes the process of identifying, collecting, and screening new studies that met the inclusion criteria. The search strategies yielded an estimated 10,000 references.[2] Based on a review of titles, 95 studies (74 from electronic bibliographic databases and 21 from other search strategies) were identified as potentially relevant. Upon retrieval and review of abstracts, more than one-half of the studies ($n = 50$) were excluded, because of an ineligible intervention ($n = 24$) or outcome measure ($n = 14$) or because of no impact evaluation ($n = 12$). The next stage involved full-text screening of the remaining 45 studies. From these studies, eight met the inclusion criteria. The other 37 studies were excluded for the following reasons: not an impact evaluation ($n = 12$); ineligible intervention ($n = 12$); ineligible outcome measure ($n = 8$); no control area ($n = 4$); and

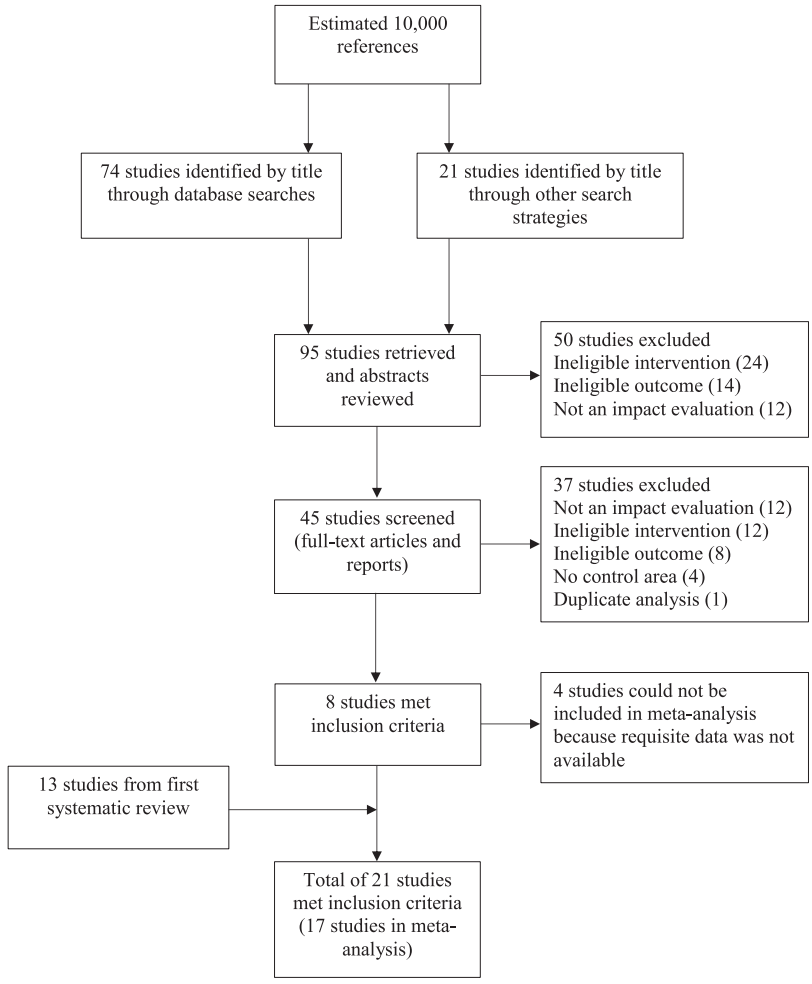

FIGURE 1 Flowchart for selection of studies

duplicate sample and analysis ($n = 1$). With the addition of 13 studies from the first systematic review, the current update reports on the findings of a total of 21 studies. Seventeen studies provided the requisite data for inclusion in the meta-analysis.[3]

4.1 | Details of the included studies

Table 1 summarizes key characteristics of the 21 included studies. The first 13 studies are the studies that were reviewed before. The studies originated in four countries (the United States, the United Kingdom, Brazil, and South Korea), with the vast majority taking place in the United States (n = 12) and the United Kingdom ($n = 7$). A full two-thirds of the studies ($n = 14$) are more than 20 years old, with the other seven reported in the last 7 years. There was much variability in the context of intervention, with most of the studies implemented in either residential areas ($n = 6$) or city centers ($n = 6$). Regarding the type of intervention, two-thirds of the studies ($n = 14$) focused on improved lighting, but only eight specified the degree of improvement in the lighting:

TABLE 1 Summary of street lighting evaluations

Author, publication date, location	Context of intervention	Type of intervention (other interventions)	Sample size	Outcome measure, time, and data source	Research design	Results and displacement/ diffusion
Atlanta Regional Commission (1974), Atlanta (GA), USA	City center (high robbery)	Improved (4×) street lighting (none)	T = selected streets in census tract 27; C = rest of streets in census tract 27	Crime (robbery, assault, and burglary); ND; police records	Before-after, experimental-control; before and after = 12 months	Desirable effect; no displacement
Department of Intergovernmental Fiscal Liaison (1974), Milwaukee (WI), USA	Residential and commercial area (older residents)	Improved (7×) street lighting (none)	T = 1 area (3.5 miles of streets); C = 1 adjacent area	Crime (property and person categories); ND; police records	Before-after, experimental-control; before and after = 12 months	Desirable effect; some displacement
Inskeep and Goff (1974), Portland (OR), USA	Residential neighborhood (high crime)	Improved (2×) street lighting (none)	T = 2 areas; A = 2 areas; C = surrounding areas	Crime (robbery, assault, and burglary); N; police records	Before-after, experimental-control; before and after = 6 or 11 months	Null effect; displacement and diffusion did not occur
Wright et al. (1974), Kansas City (MO), USA	Residential and commercial areas (high crime)	Improved street lighting (none)	T = 129 relit blocks in 4 relit areas; C = 600 nonrelit blocks in same areas	Crime (violent and property offenses); N; police records	Before-after, experimental-control; before and after = 12 months	Desirable effect (for violence); some displacement
Harrisburg Police Depart. (1976), Harrisburg (PA), USA	Residential neighborhood	Improved street lighting (none)	T = 1 high crime area; C = 1 adjacent area	Crime (violent and property offenses); N; police records	Before-after, experimental-control; before and after = 12 months	Null effect; no displacement

(Continues)

TABLE 1 (Continued)

Author, publication date, location	Context of intervention	Type of intervention (other interventions)	Sample size	Outcome measure, time, and data source	Research design	Results and displacement/ diffusion
Sternhell (1977), New Orleans (LA), USA	Residential and commercial areas	Improved street lighting (none)	T = 2 high crime areas; C = 2 adjacent areas	Crime (burglary, vehicle theft, and assault); N; police records	Before-after, experimental-control; before = 51 months, after = 29 months	Null effect; no displacement
Lewis and Sullivan (1979), Fort Worth (TX), USA	Residential neighborhood	Improved (3×) street lighting (none)	T = 1 high crime area; C = 1 adjacent area	Crime (total); ND; police records	Before-after, experimental-control; before and after = 12 months	Desirable effect; possible displacement
Poyner (1991), Dover, UK	Parking garage (in town center)	Improved lighting (at entrance/exit) (fencing, office constructed)	T = 1 parking garage; C = 2 open parking lots close to T	Crime (total and theft of and from vehicles); ND; police records	Before-after, experimental-control; before and after = 24 months	Desirable effect (for theft of vehicles); no displacement
Shaftoe (1994), Bristol, UK	Residential neighborhood	Improved (2×) street lighting (none)	T = 2 police beats; C = 2 adjacent police beats	Crime (total); ND; police records	Before-after, experimental-control; before and after = 12 months	Desirable effect; displacement and diffusion not measured
Poyner and Webb (1997), Birmingham, UK	City center market	Improved lighting (none)	T = 1 market; C = 2 markets	Thefts; ND; police records	Before-after, experimental-control; before and after = 12 months (6 months in each of 2 years)	Desirable effect; no displacement and some diffusion

(Continues)

TABLE 1 (Continued)

Author, publication date, location	Context of intervention	Type of intervention (other interventions)	Sample size	Outcome measure, time, and data source	Research design	Results and displacement/ diffusion
Painter and Farrington (1997), Dudley, UK	Local authority housing estate	Improved (2×) street lighting (none)	T = 1 housing estate; C = 1 adjacent estate	Crime (total and types of offenses); ND; victim survey and self-reports	Before-after, experimental-control and statistical analyses; before and after = 12 months	Desirable effect; no displacement
Quinet and Nunn (1998), Indianapolis (IN), USA	Residential neighborhood	Improved street lighting (police initiatives)	T = 2 multiblock areas; C = 2 areas with no new lights	Calls for service (violent and property crime); ND; police records	Before-after, experimental-control; before and after = 7–10 months	Null effect; no displacement
Painter and Farrington (1999), Stoke-on-Trent, UK	Local authority housing estate	Improved (5×) street lighting (none)	T = 1 housing estate; A = 2 adjacent estates; C = 2 nonadjacent estates	Crime (total and types of offenses); ND; victim survey	Before-after, experimental-control, stat. analyses; before and after = 12 months	Desirable effect; diffusion, no displacement
Morrow and Hutton (2000), Chicago (IL), USA	City center (high crime)	Improved (4×) lighting in alleys (none)	T = 1 multiblock area; C = 1 nonadjacent multiblock area	Crime (total and types of offenses); ND; police records	Before-after, experimental-control; before and after = 6 months	Null effect; displacement and diffusion not measured

(Continues)

TABLE 1 (Continued)

Author, publication date, location	Context of intervention	Type of intervention (other interventions)	Sample size	Outcome measure, time, and data source	Research design	Results and displacement/ diffusion
Perkins et al. (2015), UK	Local authority areas in England and Wales	Switch-off lighting (permanent), part-night lighting (12–6 am), white lights/LEDs, dimming lights (none)	62 local authorities (approx. 3,200 households each)	Crime (burglary, theft of or from a vehicle, robbery, and violence); N; police records and victim survey data	Controlled-interrupted time series analysis; study = 36 months	Mixed effects (white light and dimming weakly associated with reductions in total crime); displacement and diffusion not measured
Arvate et al. (2018), Brazil	Local municipalities	Improved access to electricity in municipalities with less than 85% coverage (none)	5457 municipalities (approx. 20,000 residents each)	Homicide (homicides per 100,000 residents); ND; hospital records	Panel design with instrumental variables	Desirable effect; displacement and diffusion not measured
Kang and Yeom (2019), Seoul, South Korea	Single autonomous city district	Installation of LED street lights (none)	T = 7 multiblock areas; C = 7 adjacent multiblock areas	Crime (theft, violence, and sexual violence); N; police records	Before-after, experimental-control; before and after = 12 months	Desirable effect; some displacement
Mihale-Wilson et al. (2019), San Diego (CA), USA	City center	Smart lights installed at experimental street corners (none)	T = 14 street corners; C = 78 street corners	Crime (total and types of offenses); ND; police records	Before-after, experimental-control; before and after = 6 months	Desirable effect; displacement and diffusion not measured

(Continues)

TABLE 1 (Continued)

Author, publication date, location	Context of intervention	Type of intervention (other interventions)	Sample size	Outcome measure, time, and data source	Research design	Results and displacement/ diffusion
Davies and Farrington (2020), Essex, UK	Local council districts	Part-night lighting (off 11:30 p.m. to 5:30 a.m.) (none)	T = 1 district (Maldon); C = 1 district (Braintree)	Crime (burglary, criminal damage, vehicle crime, violence); ND; police records	Before-after, experimental-control; before and after = 12 and 36 months	Desirable effect (for burglary and vehicle crime); displacement and diffusion not measured
Chalfin, Hansen et al. (2021), New York City (NY), USA	Residential neighborhoods (high crime)	397 temporary lighting towers installed in T areas (none)	T = 40 public housing developments; C = 40 nonadjacent public housing developments	Crime (murder, robbery, felony assault, burglary, grand larceny, vehicle theft); N; police records	Randomized controlled experiment; before = 24 months, after = 6 months	Desirable effect; displacement and diffusion did not occur
Chalfin, Kaplan et al. (2021), Chicago (IL), USA	City streets with lighting outages	Minor outages (1–2 lights out) and major outages (more than 2 lights out) (none)	368,000 outages at ~50,000 street segments over 2808 days (8 years)	Crime (violent crimes, property crimes, robbery, assault, and motor vehicle theft); ND; police records	Natural experiment comparing crime before and after repair of lighting outage; before = up to 7 days, after = 4 days	Null effect; some displacement, no diffusion

Notes: T, treatment; C, control; A, adjacent; ×, times increase in lighting; ND, night and day; N, night only.

by five times in Milwaukee and Stoke-on-Trent, four times in Atlanta and Chicago (Morrow & Hutton, 2000), three times in Fort Worth, and two times in Portland, Bristol, and Dudley. One study examined smart lights with adaptive brightness capabilities on city street corners (in San Diego), and another evaluated the impact of improved access to electricity in rural municipalities (across Brazil). Three studies assessed the *absence* of lighting through the evaluation of switch-off lighting interventions ($n = 2$) or street lighting outages ($n = 1$). Only two of the 21 studies involved other interventions, which are considered secondary to the lighting intervention.

There was some variability in sample size and in the (spatial) unit of analysis, which included high crime areas, police beats, housing estates or public housing developments, and municipalities. Two-thirds of the studies ($n = 14$) measured crimes during both night and day, and most of the studies ($n = 17$) used police records as a measure of crime. Three studies used victim surveys as the measure of crime, one in combination with police records (Perkins et al., 2015) and another with self-reported delinquency (Painter & Farrington, 1997). Arvate et al. (2018) used hospital records as a measure of homicide. All of the studies used high-quality designs to evaluate the impact of street lighting on crime, and among the eight new studies was the first randomized controlled experiment of street lighting (Chalfin, Hansen et al., 2021).

4.2 | Narrative synthesis of effects of the eight new studies

As shown in Table 1, five of the eight new studies found that that street lighting interventions were effective in preventing crime (Brazil, Seoul, San Diego, Essex, and New York City), two studies found that lighting had no significant effect on crime (both Chicago studies), and the other study reported mixed effects across a wide range of crimes (United Kingdom).

The first Chicago study (Morrow & Hutton, 2000) evaluated the effects of improved lighting in alleyways. Initiated by the Mayor's Office in 1998, the project involved converting all existing alley lamps from 90 to 250 W bulbs, as well as installing additional lighting fixtures on telephone poles in alleys across the entire city (increasing the total number of alley lamps from 46,000 to 63,000). An eight-square block zone located in the 28th ward served as the treatment area, and a similar sized zone (and similar in resident demographics) on the city's south side served as the control area. To evaluate the impact of the lighting improvements, crime counts in the treatment and control areas were compared 6 months before and after improvements were made in the treatment area. Results indicate that violent crimes increased by almost one-third (31.6%) in the treatment area and increased marginally (1.3%) in the control area. Property crimes increased in both conditions: by 76.9% in the treatment area and by 37.5% in the control area. Crimes during the night-time hours increased by two-fifths (40.0%) in the treatment area and by one-fifth (19.3%) in the control area, while crimes during the day-light hours decreased by one-fifth (20.8%) in the treatment area and by 23.0% in the control area. Overall, improved lighting in alleys in Chicago did not lead to a reduction in crimes, and increases in crimes in the treatment area compared to the control area were not significant.

In the United Kingdom study (Perkins et al., 2015), which was carried out across England and Wales, reduced street lighting was found to have an overall nonsignificant effect on crime. This study evaluated four different street lighting adaptations, three of which were designed to reduce lighting on road segments: switch-off lighting (permanently switching off street lights); part-night lighting (reducing the number of hours street lights are switched on at night); and dimmed lighting (reducing the power output or wattage of street lights). The fourth lighting adaptation was designed to increase lighting levels on street segments via the installation of LEDs (or white light)

in place of traditional sodium lamps. An interrupted controlled time series design was used to estimate the association between the proportion of total road/street coverage of each lighting intervention and crime in 62 local authorities during the 36-month study period.

Based on rate ratios (RR) and 95% confidence intervals (CI), which indicate the expected change in crime if 100% of roads in an area had one of the four lighting adaptations, the authors found that dimmed lighting (RR = 0.84, CI: 0.70–1.02) and white light (RR = 0.89, CI: 0.77–1.03) were weakly associated with reductions in total crime. Switching-off (RR = 0.11, CI: 0.01–2.75) and part-night lighting (RR = 0.96, CI: 0.86–1.06) were not significantly associated with changes in total crime. There was some evidence that part-night lighting may increase robberies (RR = 1.48, CI: 0.99–2.21) and dimmed lighting may decrease total violent crimes (RR = 0.78, CI: 0.60–1.01).

The study in Brazil (Arvate et al., 2018) evaluated the impact of an electrification program designed to improve street lighting coverage in rural municipalities on homicide rates in those communities. Known as Luz Para Todos, or "Light for All," this program was implemented by the Brazilian federal government in 2003, with the aim to improve electricity coverage in rural areas. Using the program's eligibility criterion of municipalities with less than 85% household electricity access (in the year 2000) to approximate the prevalence of street lighting, electricity coverage and homicide rates (in the years 2000 and 2010) were compared across eligible and noneligible municipalities (5457 municipalities were included in the sample). On average, electricity coverage increased from 86% to 97%.

The use of instrumental variables and a regression discontinuity design allowed an assessment of the effects of the electrification program on homicide rates (measured using hospital records). After dividing the country into five macroregions (North, Northeast, Southeast, South, and Midwest), the electrification program was found to be primarily concentrated in municipalities in the North and Northeast regions, where coverage had been lowest in 2000 and increased the most between 2000 and 2010. On average, the eligible municipalities experienced a reduction of 91.76 homicides on public streets and 17.61 homicides in hospitals (per 100,000 inhabitants). The authors suggest that electrification may have a greater desirable impact on homicide rates in municipalities with large rural populations, such as those in the Northeast region, than in those that had high levels of electrification prior to 2000.

The study in Seoul, South Korea (Kang & Yeom, 2019), compared crime counts across 14 multiblock residential areas (seven treatment and seven control) 12 months before and after the installation of LEDs (a total of 893) in the treatment areas. The authors found that night-time crimes decreased by 4.3% in the treatment areas and increased by 9.1% in the control areas. Regarding specific crime types, thefts decreased by one-third (33.6%) in treatment areas and increased by 6.6% in control areas; conversely, violent crimes increased in both condition: by 25.5% in treatment areas and by 29.0% in control areas. It is important to note that only the decrease in thefts reached statistical significance. The authors also found that some crime was displaced from the centers of treatment areas (where most of the lighting interventions were implemented) toward their boundaries.

In the San Diego study (Mihale-Wilson et al., 2019), smart lights with adaptive brightness capabilities were found to produce a significant reduction in crimes. These smart lights were capable of adjusting brightness levels according to external conditions (including the movement of cars and pedestrians), and utilized built-in cameras and microphones to communicate with other smart lights and initiate service requests. The lights were installed on 14 street corners within a single multiblock area in downtown San Diego, representing the treatment condition. The remainder of the street corners in this area ($n = 78$) maintained their regular lighting and served as the control condition. Total crimes and specific crime types (including property and violent crimes) at

treatment and control corners were compared 6 months before and after the implementation of the smart lights. It was found that total crimes (night and day) decreased by more than half (52.8%) at treatment corners, with a smaller decrease of 2.5% at control corners. Night-time crimes decreased by almost one-quarter (23.8%) at treatment corners and increased by more than half (57.6%) at control corners. Property crimes (occurring at night) decreased by one-fifth (20.0%) in treatment areas and increased by four-fifths (79.2%) in control areas. Violent crimes decreased in both treatment and control areas.

In the study in Essex, England (Davies & Farrington, 2020), street lights were switched off in the treatment area and left on in the control area. Considered a part-night lighting intervention, lights were turned off in the treatment area between 11.30 p.m. and 5.30 a.m. Monthly counts of several crime types were compared across two adjacent council districts (one treatment and one control) 36 months before and after the implementation of the intervention. The results showed that switching off the street lights had undesirable effects on burglary and vehicle crimes but desirable effects on violent crimes. For example, the authors found that vehicle crimes decreased by 2.7% in the treatment area, but decreased by 29.0% in the control area. Another analysis focused on the period of 12 months before and after the intervention, finding that burglaries decreased by 12.8% in the treatment area, but decreased by 30.0% in the control area. However, violence decreased by 14.7% in the treatment area, but increased by 7.4% in the control area. Davies and Farrington (2020) suggested that the switching off of street lighting might have deterred people from going out at night, resulting in fewer violent incidents.

The New York City study (Chalfin, Hansen et al., 2021) represents the first randomized controlled experiment of a street lighting intervention. A total of 80 public housing developments that were identified as high priority by the New York City Housing Authority were randomly assigned to treatment and control conditions. Temporary lighting towers (a minimum of two per housing development) were installed in the treatment areas during February and March 2016, and the towers remained illuminated during all night-time hours for six subsequent months.

In order to evaluate the effects of the lighting intervention on crime, the average count of index[4] crimes occurring between March and August in 2011 to 2015 (a total of 24 months before implementation) were compared with the period of March to August in 2016 (a total of 6 months after implementation). It was found that the treatment area experienced a 35% reduction in outdoor night-time crimes, which equated to a reduction of approximately 4% in total index crimes in the housing developments. The authors found no evidence of crime displacement.

The most recent study in Chicago (Chalfin, Kaplan et al., 2021) evaluated the short-term impact of street light outages on crime at city street segments. Based on the knowledge that the repair and maintenance of street lights are a municipal responsibility and that they tend to be repaired very quickly in most cities, the study examined changes in reported crimes at street segments for up to 7 days before and 4 days after a street light is repaired. Using crime records and 311 call data from the Chicago Police Department during a period of 8 years, it was found that street segments experienced a small and nonsignificant increase in total crimes (2%), violent crimes (1%), and property crimes (1%). The authors found some evidence of crime displacement.

4.3 | Meta-analysis

Figure 2 summarizes the results of the 17 studies in a forest-plot graph. It shows the RES for total crime in each study plus its 90% confidence interval (p values are one-tailed, because of the clear directional prediction). The 17 studies are ordered according to the magnitude of their RESs. It

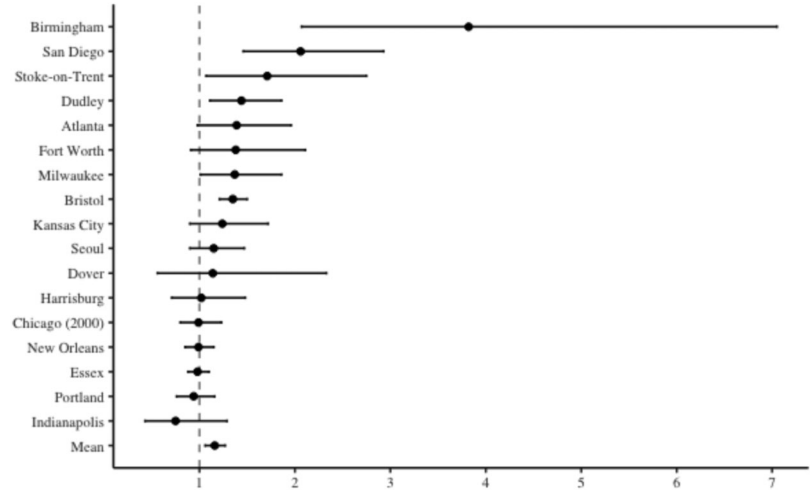

FIGURE 2 Effects of street lighting interventions on total crime

can be seen that five studies (Portland, New Orleans, Indianapolis, Chicago [Morrow & Hutton, 2000], and Essex) had a RES less than 1.0, meaning that street lighting was followed by an increase in crime, and in no case was this increase significant. The other 12 studies had a RES greater than 1.0, meaning that street lighting was followed by a decrease in crime, and in seven studies this decrease was significant (or nearly so).

It is important to note that most values of RES are based on similar calculations. However, in Essex, street lights were switched off in the treatment area. Therefore, the lights were on in the before period and off in the after period. There were 1359 crimes in the treatment area before and 1111 after, compared with 3489 crimes in the control area before and 2897 after. In order to measure the effect of this intervention the usual formula was inverted, so that RES = (1111 × 3489)/(1359 × 2897) = 0.98 (CI: 0.88–1.10, n.s.), indicating no overall effect on crime of the switching off of street lights.

Figure 2 also shows the overall effect of street lighting interventions on crime. In pooling the effects of the 17 studies, it was found that street lighting had a significant desirable effect on total crime, with a weighted mean RES = 1.16 (CI: 1.06–1.17, $p = 0.003$). This means that crimes increased 16% after street lighting in control areas compared with treatment areas or, conversely, crimes decreased 14% (1/1.16) in treatment areas compared with control areas.

As in the prior review, this review found that the desirable effects of street lighting interventions were greater in studies that measured both night and day crimes than in studies that only measured night crimes (see Table 2). For the 12 night/day studies, RES = 1.22 (CI: 1.09–1.37, $p = 0.002$), meaning that crimes decreased by 18% (1/1.22) in treatment areas compared with control areas. In contrast, for the five night-only studies, RES = 1.03 (CI: 0.95–1.11, n.s.), indicating a nonsignificant 3% (1/1.03) decrease in crimes.

For the two main countries in which street lighting interventions have been evaluated, it was found that desirable effects were greater in U.K. studies than in U.S. studies (see Table 2). For the six U.K. studies, RES = 1.21 (CI: 1.03–1.42, $p = 0.024$). For the 10 U.S. studies, RES = 1.10 (CI: 0.98–1.23, $p = 0.099$). However, a like-with-like comparison of the night/day studies for the two countries ($n = 6$ for each country) shows quite similar desirable effects of street lighting

TABLE 2 Effects of street lighting on total crime

	RES	90% Confidence interval	Z Score	*p* Value
US/SK N Studies				
Portland	0.94	0.76–1.16	−0.47	n.s.
Kansas City	1.24	0.90–1.72	1.10	n.s.
Harrisburg	1.02	0.71–1.48	0.10	n.s.
New Orleans	0.99	0.85–1.15	−0.14	n.s.
Seoul	1.15	0.90–1.47	0.95	n.s.
US ND Studies				
Atlanta	1.39	0.98–1.96	1.57	0.058
Milwaukee	1.37	1.01–1.86	1.67	0.047
Fort Worth	1.38	0.91–2.11	1.27	n.s.
Indianapolis	0.75	0.43–1.29	−0.88	n.s.
Chicago (2000)	0.99	0.80–1.23	−0.04	n.s.
San Diego	2.06	1.46–2.93	3.41	0.0003
UK ND Studies				
Dover	1.14	0.56–2.33	0.30	n.s.
Bristol	1.35	1.21–1.50	4.67	0.0001
Birmingham	3.82	2.07–7.05	3.60	0.0002
Dudley	1.44	1.11–1.86	2.30	0.011
Stoke-on-Trent	1.71	1.07–2.75	1.89	0.029
Essex	0.98	0.88–1.10	−0.23	n.s.
Summary Results				
5 U.S./SK N studies	1.03	0.95–1.11	0.59	n.s.
6 U.S. ND studies	1.25	1.02–1.53	1.81	0.035
6 U.K. ND studies	1.21	1.03–1.42	1.98	0.024
10 U.S. studies	1.10	0.98–1.23	1.29	0.099
12 ND studies	1.22	1.09–1.37	2.85	0.002
All 17 studies	1.16	1.06–1.27	2.78	0.003

Notes: Chicago (2000) is by Morrow and Hutton (2000); U.S. = United States; SK = South Korea; U.K. = United Kingdom; N = only night crimes measured; ND = night and day crimes measured; RES = relative effect size; n.s. = nonsignificant; *p* values are one-tailed.

interventions on crime: U.K. RES = 1.21 (CI: 1.03–1.42, $p = 0.024$) versus U.S. RES = 1.25 (CI: 1.02–1.53, $p = 0.035$).

Meta-analytic techniques were also used to investigate the effects of street lighting interventions on violent and property crimes, the two main types of crimes that were measured in the studies. Violent crimes were measured in 13 studies, and property crimes were measured in 15 studies. Figures 3 and 4 summarize the results of these studies in forest-plot graphs, with the RES for violent crimes or property crimes in each study plus its 90% confidence interval (*p* values are one-tailed). They show that street lighting interventions were followed by a significant reduction in property crimes (RES = 1.14, CI: 1.03–1.27, $p = 0.018$), but not in violent crimes (RES = 0.99, CI: 0.87–1.13, n.s.).

Three points are noteworthy about this effect on property crimes. First, this significant desirable effect closely approximates the overall effect of street lighting interventions on total crimes (RES = 1.16, CI: 1.06–1.27, $p = 0.003$; see Figure 2), suggesting that the overall effect on crime may be largely a function of street lighting's impact on property crimes. Second, as shown in

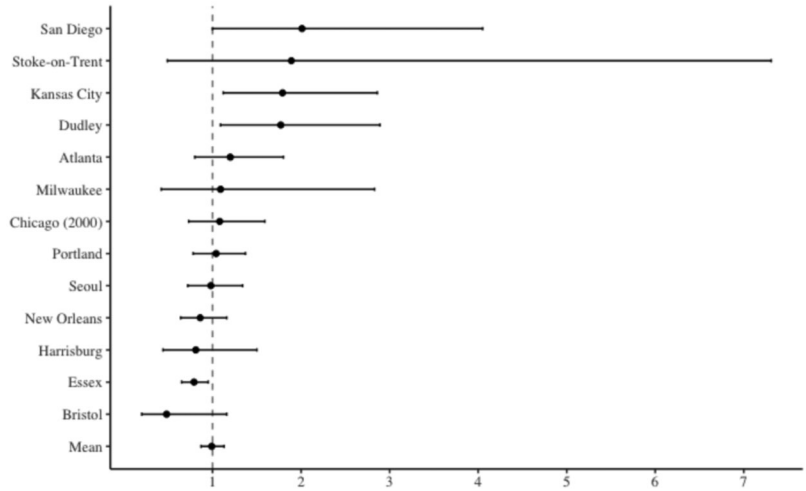

FIGURE 3 Effects of street lighting interventions on violent crimes

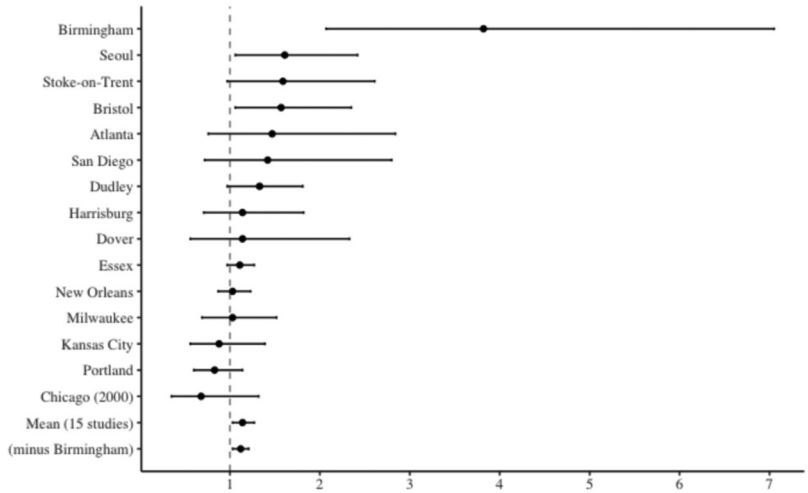

FIGURE 4 Effects of street lighting interventions on property crimes

Figure 4, the effect on property crimes does not change considerably when one study (Birmingham; RES = 3.82, CI: 2.07–7.05, $p = 0.0002$), which could be considered an outlier, is excluded from the analysis. Here, RES = 1.12 (CI: 1.03–1.21, $p = 0.011$) for the effect of the other 14 studies on property crimes.

Third, there were enough studies to assess the effects of street lighting interventions on burglary (seven studies) and vehicle crime (eight studies). Table 3 shows the results. Basically, the studies showed no effect on burglary, but a significant effect on vehicle crime (RES = 1.28, CI: 1.09–1.50, $p = 0.006$). This means that vehicle crimes decreased by 22% after street lighting in treatment areas compared with control areas. Regarding burglary, five of the seven studies showed a desirable effect of street lighting, but the overall effect was minute. In contrast, seven of the eight studies showed a desirable effect on vehicle crimes, and three were significant or nearly

TABLE 3 Effects of street lighting on burglary and vehicle crime

	RES	90% Confidence interval	*Z* Score	*p* Value
Burglary				
Portland	0.83	0.60–1.14	–0.97	n.s.
Harrisburg	1.10	0.63–1.92	0.28	n.s.
New Orleans	0.96	0.75–1.23	–0.29	n.s.
Atlanta	1.47	0.76–2.84	0.96	n.s.
Dudley	1.39	0.69–2.83	0.77	n.s.
Stoke-on-Trent	1.19	0.46–3.04	0.30	n.s.
Essex	1.23	0.88–1.71	1.03	n.s.
All 7 studies	1.01	0.90–1.14	0.19	n.s.
Vehicle Crime				
Kansas City	0.64	0.33–1.23	–1.12	n.s.
Harrisburg	1.17	0.49–2.80	0.30	n.s.
New Orleans	1.09	0.89–1.34	0.69	n.s.
Dover	1.14	0.56–2.33	0.30	n.s.
Bristol	1.57	1.06–2.35	1.87	0.031
Dudley	1.66	0.95–2.90	1.48	0.069
Stoke-on-Trent	1.22	0.43–3.40	0.31	n.s.
Essex	1.76	1.31–2.36	3.19	0.0007
All 8 studies	1.28	1.09–1.50	2.53	0.006

Notes: RES = relative effect size; n.s. = nonsignificant; *p* values are one-tailed.

significant (despite generally small numbers in these analyses, as well as our conservative estimates of the variance).

4.4 | Crime displacement and diffusion of crime-prevention benefits

As shown in Table 1, 15 of the 21 included studies investigated potential crime displacement, diffusion of crime-prevention benefits, or both. In each case, the focus was on geographical or spatial displacement or diffusion, with three studies (Seoul, New York City, and Chicago; Chalfin, Kaplan et al., 2021) also examining temporal displacement, diffusion, or both. Of these 15 studies, 10 reported that displacement did not occur, and five reported that it was evident to some extent. Five of these studies assessed the potential for diffusion as well as displacement, with two studies (Birmingham and Stoke-on-Trent) reporting some evidence of diffusion.

5 | DISCUSSION AND CONCLUSIONS

The main aim of this article was to report on the results of an updated systematic review and meta-analysis of the effects of street lighting interventions on crime in public places. A total of 21 studies met the inclusion criteria. Based on the full complement of studies, it is concluded that street lighting continues to be a highly effective intervention for preventing crime in public places. In pooling the effects of the 17 studies that could be included in the meta-analysis, we found that street lighting led to a significant 14% decrease in crime in treatment areas compared

with comparable control areas. Also important was the finding that street lighting interventions were followed by a significant decrease in property crimes (12%), but not in violent crimes.

5.1 | Limitations

The review has some key limitations. The first is that four of the 21 studies could not be included in the meta-analysis. This is because the studies (and in some cases, secondary sources) did not provide the requisite data to allow for the calculation of an effect size (RES) and its variance. Some authors kindly shared their data, allowing us to calculate the RES and variance and include the study in the meta-analysis. In some instances, failure to include this data in reports (published or unpublished) can be seen as an indicator of poor descriptive validity (Farrington, 2003), and it calls attention to the need for greater transparency in the reporting of evaluation research. It is important to note that the overall descriptive validity of the 21 studies can be considered quite high, with all reporting key characteristics (see Table 1).

It is also important to note that it seems unlikely that the inclusion of these four studies in the meta-analysis would have had an appreciable impact on the meta-analysis results or, at the very least, not caused a drop in the overall mean reduction in total crimes (14%). Two considerations are at play here. The first is that two of the studies reported desirable effects (Arvate et al., 2018; Chalfin, Hansen et al., 2021), one reported mixed effects (Perkins et al., 2015), and the other reported null effects (Chalflin, Kaplan et al., 2021). The second consideration is the particularly strong desirable effects reported by Arvate et al. (2018) coupled with the relatively weaker effects of the other three studies.

Another limitation of this review, and one that we view as more pressing, is that only three of the eight new studies (in contrast to 12 of the 13 original studies) investigated potential displacement of crime, diffusion of crime-prevention benefits, or both. Crime displacement can present a serious threat to street lighting and other situational crime-prevention interventions (Barr & Pease, 1990). Conversely, diffusion of crime-prevention benefits, which studies show is somewhat more likely to occur than crime displacement (Guerette & Bowers, 2009; Johnson et al., 2014), can represent a substantial windfall for these interventions.

5.2 | Priorities for research

The review draws attention to several key research priorities. Future evaluation studies should make a point to include a long time series of crimes, preferably measured each month. This would allow for the investigation of preexisting crime trends (e.g., to account for regression to the mean), as well as to better understand how far any effects of street lighting interventions persist or decay over time. Several of the new studies in the current review made an effort to address one or both of these needs (Arvate et al., 2018; Chalfin, Kaplan et al., 2021; Davies & Farrington, 2020; Perkins et al., 2015).

It is a common refrain of authors of systematic reviews to call for more evaluation research. While such a case can certainly be made here, it is important to note that another area where there has been a noticeable improvement in research on street lighting (especially in the last decade) is in the use of higher quality evaluations. This includes the first randomized controlled experiment of street lighting (Chalfin, Hansen et al., 2021), a natural experiment drawing on lighting outages and repairs (Chalfin, Kaplan et al., 2021), and other high quality quasi-experimental designs. We

recommend that researchers build on these newer studies to (a) expand the overall body of knowledge on the effects of street lighting interventions on crime, and (b) target specific areas where knowledge is lacking, including the effects of some lighting technologies (e.g., smart lights, LEDs) and in other public as well as private places (e.g., public transportation, parking lots of retail and entertainment premises).

Future evaluations of street lighting interventions should also include economic analyses, especially benefit-cost analyses. This would allow for a number of key policy questions to be addressed: Do the monetary benefits to society from decreased crime rates outweigh the monetary costs of implementing and maintaining street lighting projects? To whom do the monetary benefits (or costs) accrue? Only three of the new studies (Chalfin, Hansen et al., 2021; Davies & Farrington, 2020; Perkins et al., 2015[5]) and two of the other studies (Painter & Farrington, 1997; 1999) conducted a benefit-cost analysis. In each case, there was a desirable benefit-to-cost ratio, with some studies reporting ratios on the order of 3 or 4 to 1. For example, in the New York City study, Chalfin et al. (2019) estimated that, during a 10-year period, for every dollar spent on permanent lighting upgrades in high crime residential neighborhoods $4 would be saved from reduced crimes.

It is also recommended that future research investigate plausible explanations for the effects of street lighting on crime. For example, in the present review, we found that desirable effects of street lighting interventions were greater in studies that measured both night and day crimes than in studies that only measured night crimes. Drawing from our prior reviews on the subject, this finding suggests that a theory of street lighting focusing on its role in increasing community pride and informal social control may be more plausible than a theory focusing on increased surveillance or deterrence (see e.g., Farrington & Welsh, 2002b). Crucial to this explanation, however, is the ability to exclude an alternative hypothesis, specifically, that increased community pride comes first, which leads to street lighting interventions and associated reductions in crime. Based on most of the included studies in the present review, it is difficult to exclude this hypothesis. Two studies—carried out in the British towns of Dudley and Stoke-on-Trent (Painter & Farrington, 1997; 1999)—do provide evidence to allow us to exclude this hypothesis.

In Dudley, longstanding complaints by residents (of the treatment area) about the poor street lighting served to motivate the local authority to improve lighting conditions. The improvements were obvious, and residents thought that their quality of life had been improved (Painter & Farrington, 1997). This had the effect of stimulating the tenant's association in the treatment area to obtain substantial government funding for a program of neighborhood improvements throughout the next several years. This chain of events—improvements to lighting occurring first, leading to increased community pride, and acting as a catalyst for further neighborhood improvements—also took place in Stoke-on-Trent (Painter & Farrington, 1999).

This discussion draws attention to the need for qualitative research studies to better understand the contexts in which street lighting projects are implemented, the changing conditions on the ground, and how the behavior of law-abiding citizens and offenders may change in response to changes in lighting. This research could be built into or carried out alongside standard outcome evaluations.

5.3 | Implications for policy

Compared to past years, it would seem that an even stronger case can be made today for street lighting interventions to be part of crime-prevention policy. A larger body of high-quality evaluation research, implemented in a range of high-crime public places, some evidence of value for

money, and a continued desirable impact on crime, especially property crime, all point to the policy relevance of street lighting interventions.

Based on the new meta-analysis, there is a slight decrease in the measured effectiveness of street lighting interventions. In our previous review, street lighting interventions were associated with a 20% reduction in total crimes. In our current review, based on 17 studies included in the meta-analysis, the reduction in total crimes is now 14%. This suggests that the new studies have weaker effects. This is largely accounted for by two key factors. One has to do with our use of a more conservative meta-analytic approach in the current review. While this seemingly has more to do with the refinement and improvement of research methodology over time, this can also have important implications for the soundness of policy decision making—specifically, using the best available scientific evidence that is based on the highest quality evaluation research and the most rigorous review methods.

The other key factor has to do with variability in street lighting interventions. Improved street lighting was the focus of all 13 studies in the prior review, but accounted for only one of the eight new studies in the current review. Of the four new studies that could be included in the meta-analysis, three focused on new lighting technologies and applications (e.g., LEDs, smart lights, temporary or permanent switching off). This represents an important new development for street lighting for crime prevention. However, with this newness in street lighting interventions it may be that associated reductions in crime have yet to be fully realized. Replications of these studies will help address this question.

In consideration of the magnitude of the overall impact of street lighting on crime, it is important to note that this is based on street lighting as a stand-alone intervention. In the current review, only two of the 21 studies involved secondary interventions. Other research demonstrates the effectiveness of street lighting as a secondary intervention (e.g., combined with video surveillance cameras) (Piza et al., 2019) or as part of a larger package of situational crime-prevention measures (Eck & Guerette, 2014). Writing more than 20 years ago, Pease (1999, p. 72) recommended that the debate on street lighting's impact on crime should be squarely focused on "how can I flexibly and imaginatively incorporate lighting in crime reduction strategy and tactics?" This is not to suggest that alternative situational crime-prevention measures (e.g., defensible space, place managers) should be overlooked in place of street lighting interventions, but rather the focus should be on how street lighting (where feasible) can be incorporated as part of a comprehensive package of situational interventions.

It is also important to make clear that it is not enough to only consider the research evidence on the effects of street lighting on crime in policy decisions about its role in preventing crime. Local governments wanting to lower costs by eliminating (e.g., permanently switching off) or reducing (e.g., part-night lighting, dimming) the use of street lights should take account of other budgetary needs and priorities, public support for street lighting (especially as it pertains to personal safety and fear of crime), monetary costs and benefits, and street lighting's impact on traffic and pedestrian safety. Benefit-cost analyses that consider a wider range of potential benefits (beyond crime reduction) can be especially informative in policy decisions, as well as in public discussions about how to payback or cover the capital and operating costs associated with street lights, whether it be for new installations or modifications for new technologies.

Another key factor that needs to be weighed in policy decisions about the use of street lighting for crime prevention is concerns about social costs. Research on the social costs of the different types of situational crime prevention that perform a surveillance function (e.g., cameras, defensible space, place managers, street lighting) identifies street lighting as the least intrusive and exclusionary (Welsh et al., 2015; see also Clarke, 2008). Street lighting does not violate anyone's privacy,

infringe on civil liberties, or contribute to the social exclusion of groups. Yet, it can contribute to light pollution, which has costs to the environment and the public's enjoyment of nighttime viewing of the skies (Pease, 1999). Certain modern types of lighting are designed to shine downward rather than upward, thus minimizing light pollution. Other lighting technologies, some tied to energy conservation (e.g., smart lights, LEDs), may also mitigate light pollution. All things considered, it would seem that street lighting for crime prevention has much to offer to law-abiding citizens and policymakers.

ACKNOWLEDGEMENTS

Funding for this research was provided by a grant from the Swedish National Council for Crime Prevention. We thank Erik Grevholm. We also thank the journal editors and the three anonymous reviewers for helpful comments, as well as all of the study authors who responded to our endless questions and requests for data.

CONFLICT OF INTEREST

The authors confirm that they have no conflict of interest to declare.

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ENDNOTES

[1] Recently, Wilson (2021) put forth the relative incident rate ratio (RIRR) effect size for use in meta-analyses of area-based studies with count-level data. The RIRR has been applied in a couple of meta-analyses so far, including hot spots policing and problem-oriented policing (Braga & Weisburd, 2020; Hinkle et al., 2020). It is important to note that the RIRR is identical to the RES when the before and after time periods are equal (which they usually are in area-based studies). It is also the case that our approach of dealing with over-dispersion (as discussed in detail here) can be more straightforward than the approach outlined in Wilson (2021).

[2] It is important to note that, as with all systematic reviews, the initial number of references is highly inflated. There are several main reasons for this, including that only a small proportion are research studies, a substantial number are duplicates, and many more are completely unrelated to the topic (the latter is a result of poor search algorithms in some of the databases). For these reasons, we present this number as an estimate in Figure 1.

[3] The four studies that could not be included were Perkins et al. (2015), Arvate et al. (2018), Chalfin, Hansen et al. (2021), and Chalfin, Kaplan et al. (2021). Email correspondence with the primary author of two of the studies yielded an explanation for the unavailability of the raw numbers of crimes (the requisite data) for one of the studies and some data for the other study, which ultimately did not allow for the calculation of raw numbers of crimes.

[4] Part I Index crimes include murder and nonnegligent manslaughter, robbery, felony assault, burglary, grand larceny, and motor vehicle theft.

[5] The benefit-cost analysis of the New York City study is reported in a working paper by Chalfin et al. (2019).

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How to cite this article: Welsh, B. C., Farrington, D. P., & Douglas, S. (2022). The impact and policy relevance of street lighting for crime prevention: A Systematic review based on a half-century of evaluation research. *Criminology & Public Policy*, 1–27. https://doi.org/10.1111/1745-9133.12585

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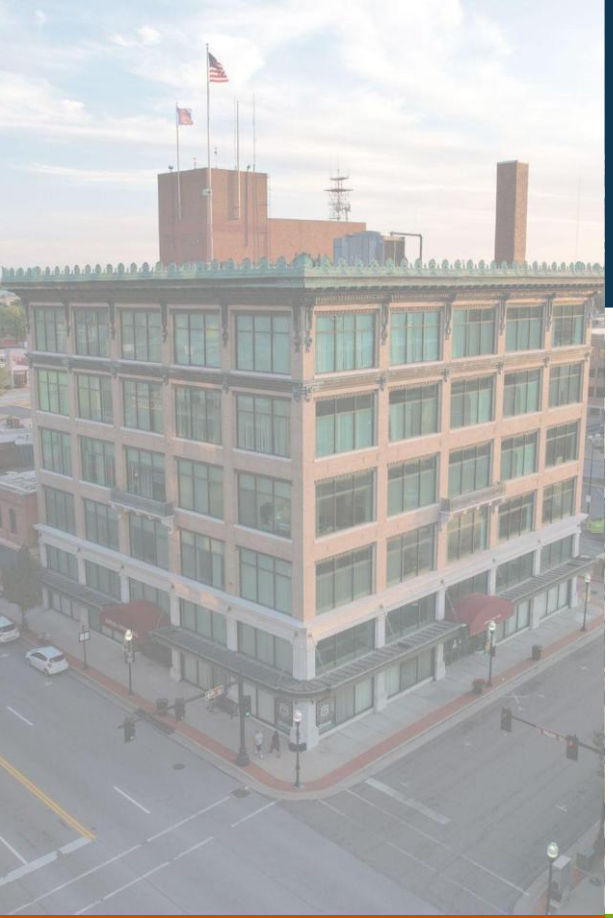
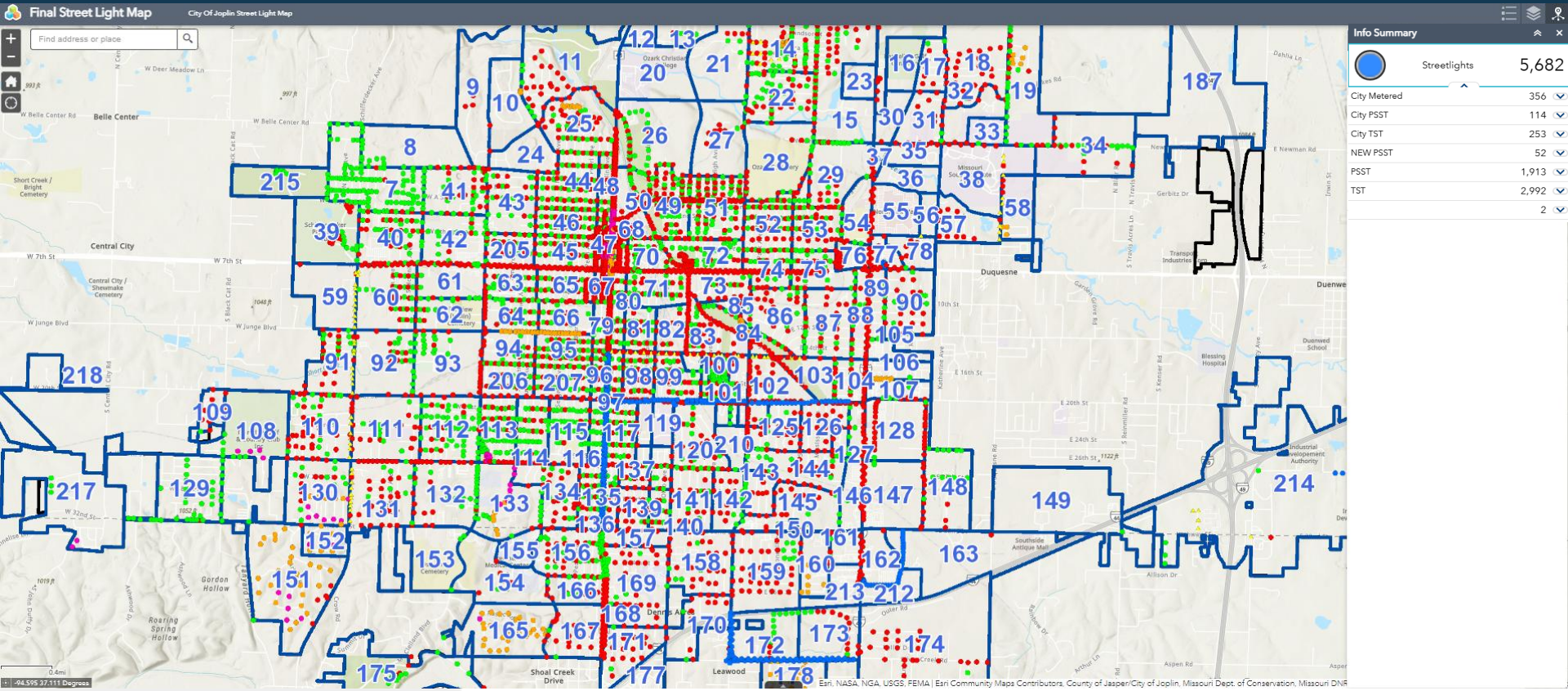


STREETLIGHT INSTALL PROGRESS UPDATE

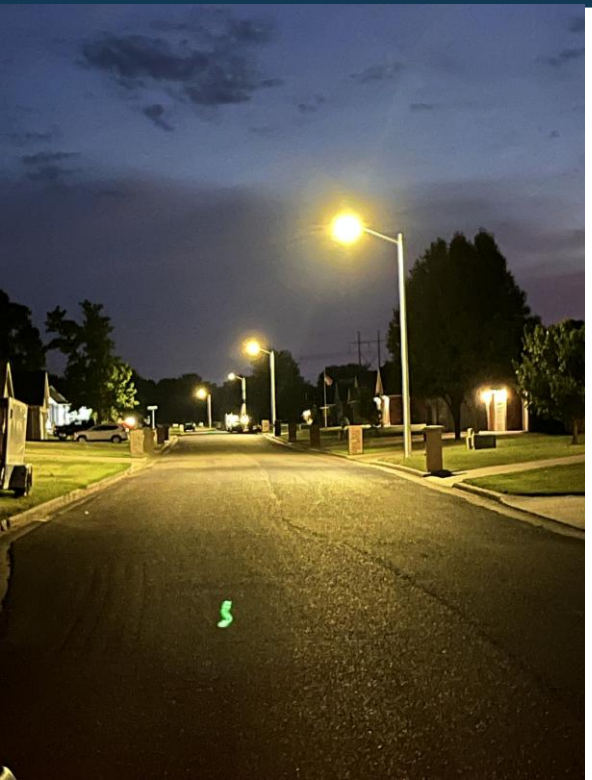
City Council Presentation

Public Works | April 7, 2024

TOTAL EXISTING STREETLIGHTS



Streetlight Update



The following is a semi-annual update of the Public Safety Sales Tax Streetlight Program areas and remaining installations.

City and Liberty meet monthly to coordinate and answer questions.

Streetlight Update

Since Fall 2024 update:

- Area 97-104 15th Street completed
- Area 214 Prigmore completed
- Area 58-38 Duquesne completed
- New large projects continue – Eagles Edge (Wildwood) Emerald Glades (St. Louis/Mount Hope)
- New ARPA projects –
  - Zora roundabout complete
  - Zora Duquesne to 249 underway
  - 20th Street planning underway

Streetlight Update

- Nearing completion of original installation plan
  - Remaining areas: 181 Hidden Hills and Silver Creek
- The following progress list and maps show the original streetlight installation areas by showing the “before” and “after” maps for each.

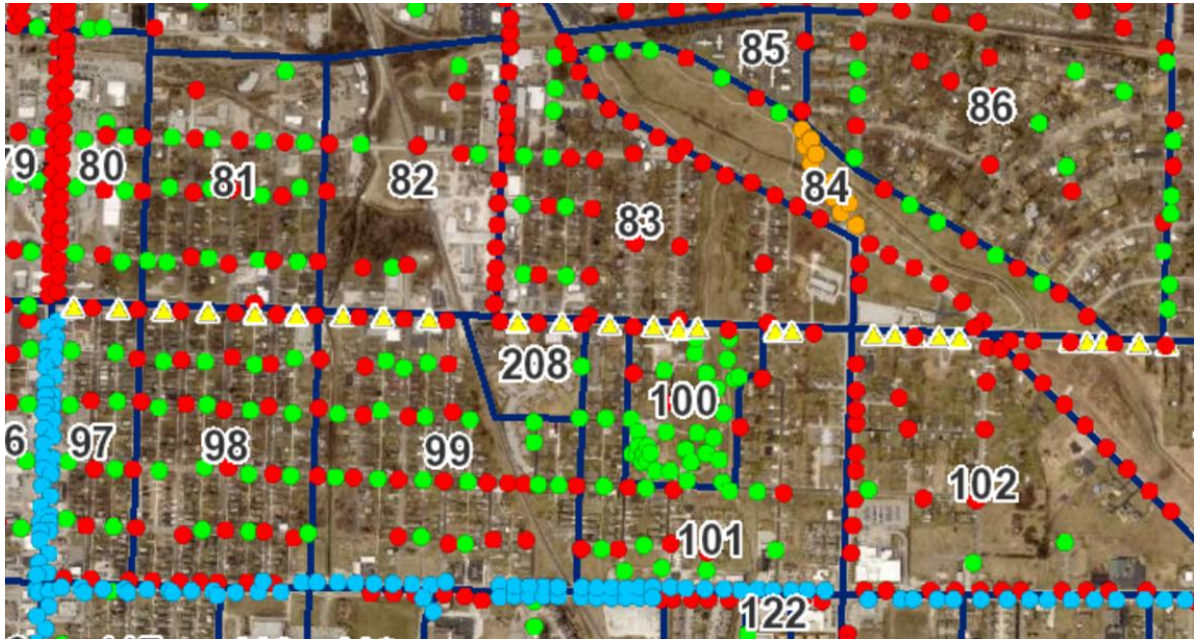
Streetlight Update

Updated installations by Area as of March 31, 2025.

Area #	*Counts*	*Explanation*	*Progress Report*
9/10	0 installs	No lights to be installed	N/A
11	19 installs	14 TT – 5 PSST	All Complete in field
24	1 install	1 TT	All Complete in field
25	25 installs	17 TT – 8 PSST	All Complete in field
31	8 installs	6 TT – 2 PSST	All Complete in field
32	3 installs	2 TT - 1 PSST	All Complete in field
19	5 installs	4 TT – 1 PSST	All Complete in field
90	7 installs	4 TT – 3 PSST	All Complete in field
18	16 installs	15 TT – 1 PSST	All Complete in field
6	13 installs	10 TT – 3 PSST	All Complete in field
17	7 installs	7 TT	All Complete in field
162	2 installs	2 TT	All Complete in field
78	7 installs	5 TT – 2 PSST	All Complete in field
14 /22	43 installs	16 TT – 27 PSST	All Complete in field
57	4 installs	4 TT	All Complete in field
34	3 installs	3 TT	All Complete in field
187	0 installs	No lights to be installed	N/A
175	10 installs	6 PSST – 4 TST	All Complete in field
4	32 installs	25 PSST – 7 TST	All Complete in field
214	5 installs	Prigmore/Fire Station 7/Jaguar Road	All Complete in field
58/38	5 installs	4 TST/1PSST Duquesne Road	All Complete in Field
97-104	23 installs	6 PSST + TBD 15th St.	6 Complete in field
59-131	15 installs	4 PSST/10 TST S. Schifferdecker	12 Complete/2 pending
181	TBD	Hidden Hills	Underway
174	TBD	Silver Creek	Underway
217	TBD +3	Eagles Edge/Wildwood	Underway

15th Street

"*Before*"
97-104
15th St/Main
to Range Line



LEGEND:
Green-PSST
Red-TST
Blue-City Metered
Orange-City-Owned TST
Pink-City-Owned PSST

15th Street

"After"
97-104
15th St/Main to Range Line

LEGEND:
Green-PSST
Red-TST
Blue-City Metered
Orange-City-Owned TST
Pink-City-Owned PSST





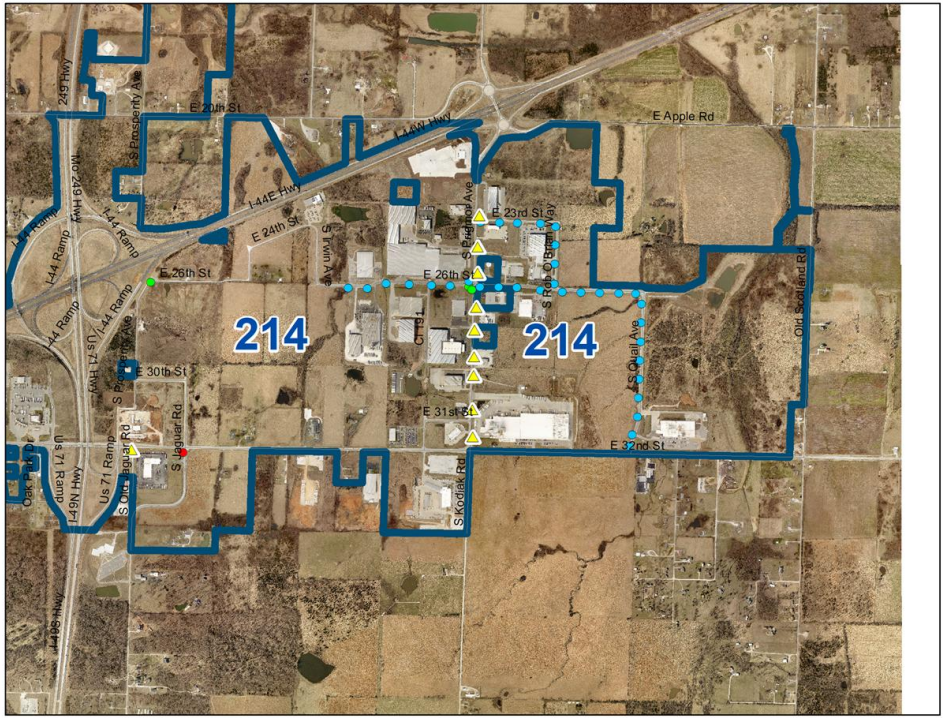


Crossroads Industrial Park

"Before"

Area 214 Crossroads/ Prigmore

LEGEND:
Green-PSST
Red-TST
Blue-City Metered
Orange-City-Owned TST
Pink-City-Owned PSST

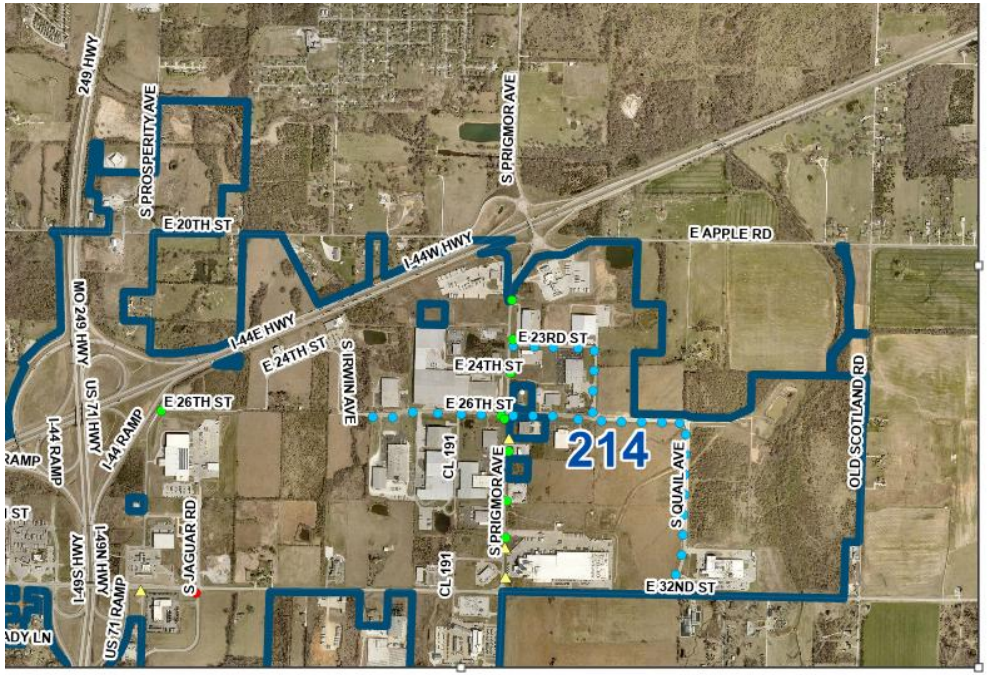


Crossroads Industrial Park

"After"

Area 214 Crossroads/ Prigmore

LEGEND:
Green-PSST
Red-TST
Blue-City Metered
Orange-City-Owned TST
Pink-City-Owned PSST



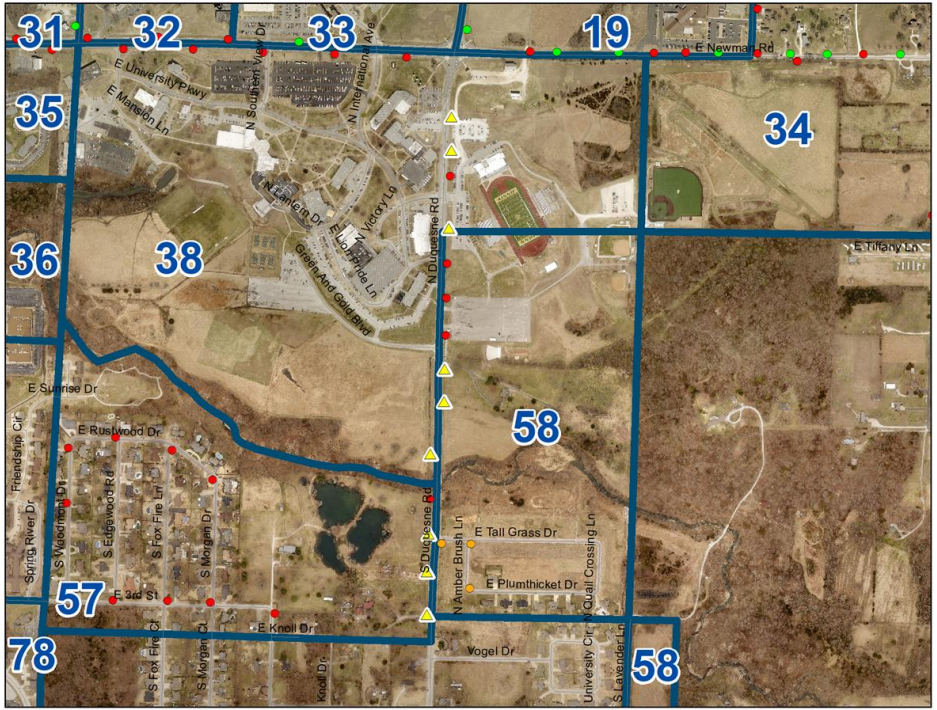
Duquesne Road

"Before"

Area 58/38

Duquesne road

LEGEND:
Green-PSST
Red-TST
Blue-City Metered
Orange-City-Owned TST
Pink-City-Owned PSST



Duquesne Road

"After"

Area 58/38

Duquesne road

LEGEND:
Green-PSST
Red-TST
Blue-City Metered
Orange-City-Owned TST
Pink-City-Owned PSST



Streetlight Update

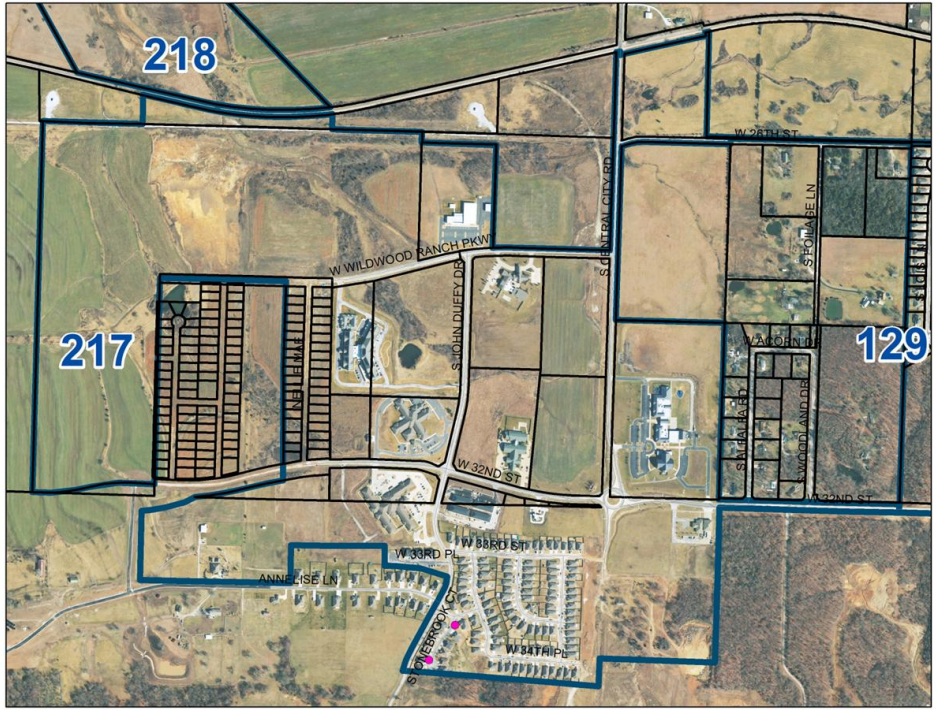
Streetlight areas under review:

- Area #217 Eagle Edge/Wildwood
- Area #37 South Schifferdecker Avenue
- Area #181 Hidden Hills
- Area #174 Silver Creek subdivision

Eagles Edge Wildwood

"*Pending*" Area 217 Eagles Edge/ Wildwood

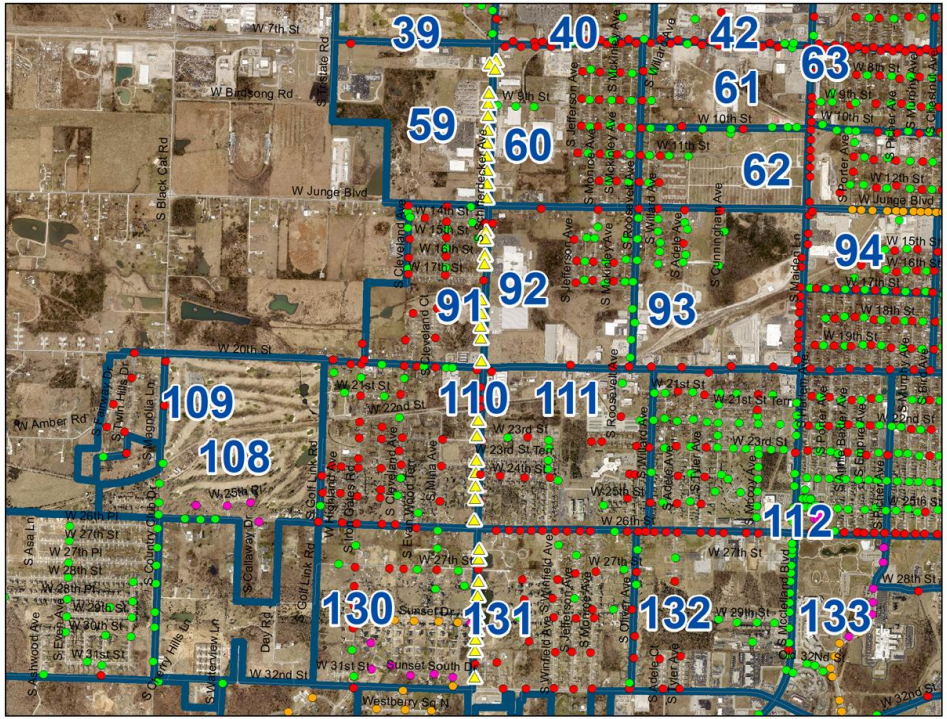
LEGEND:
Green-PSST
Red-TST
Blue-City Metered
Orange-City-Owned TST
Pink-City-Owned PSST
Yellow-To Be Installed



South Schifferdecker

"under review"
Area 59-131
South Schifferdecker

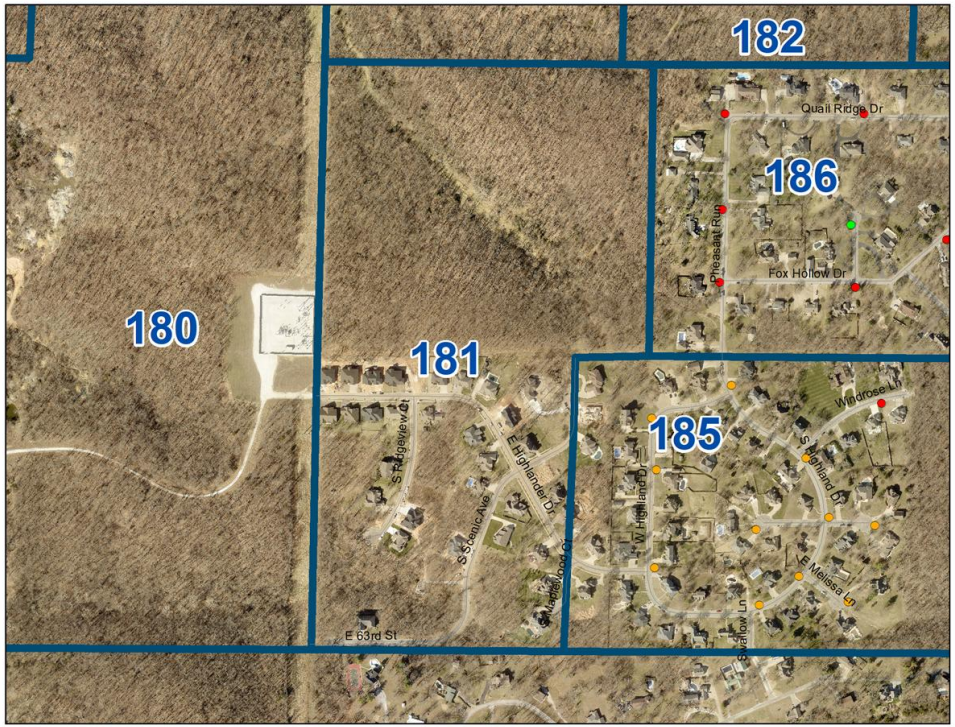
LEGEND:
Green-PSST
Red-TST
Blue-City Metered
Orange-City-Owned TST
Pink-City-Owned PSST



Hidden Hills

"under review"
Area 181
Hidden Hills

LEGEND:
Green-PSST
Red-TST
Blue-City Metered
Orange-City-Owned TST
Pink-City-Owned PSST



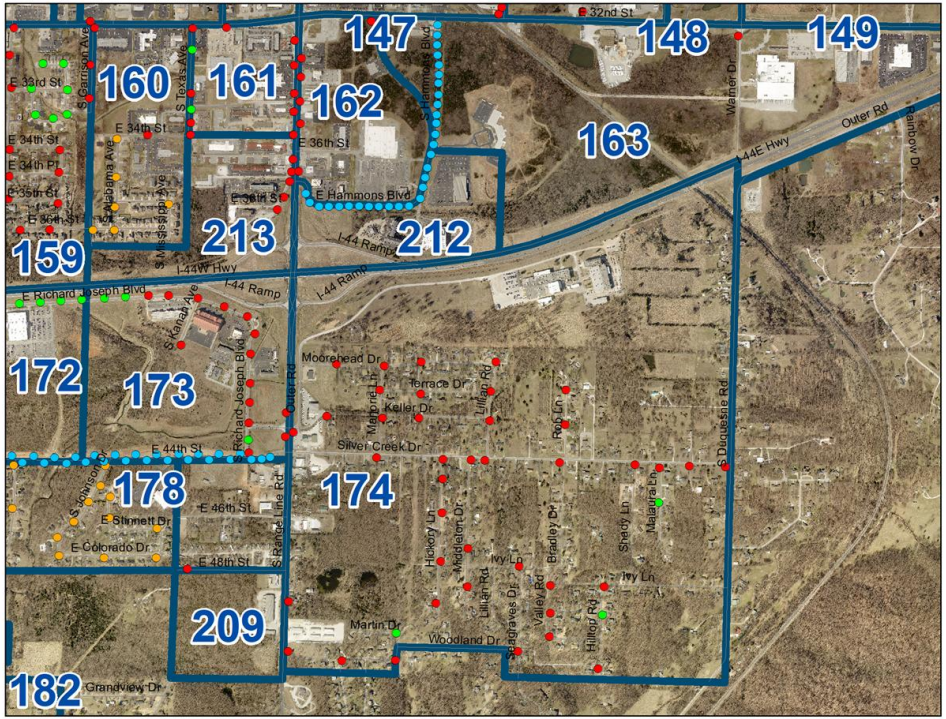
Silver Creek

"under review"

Area 174

Silver Creek

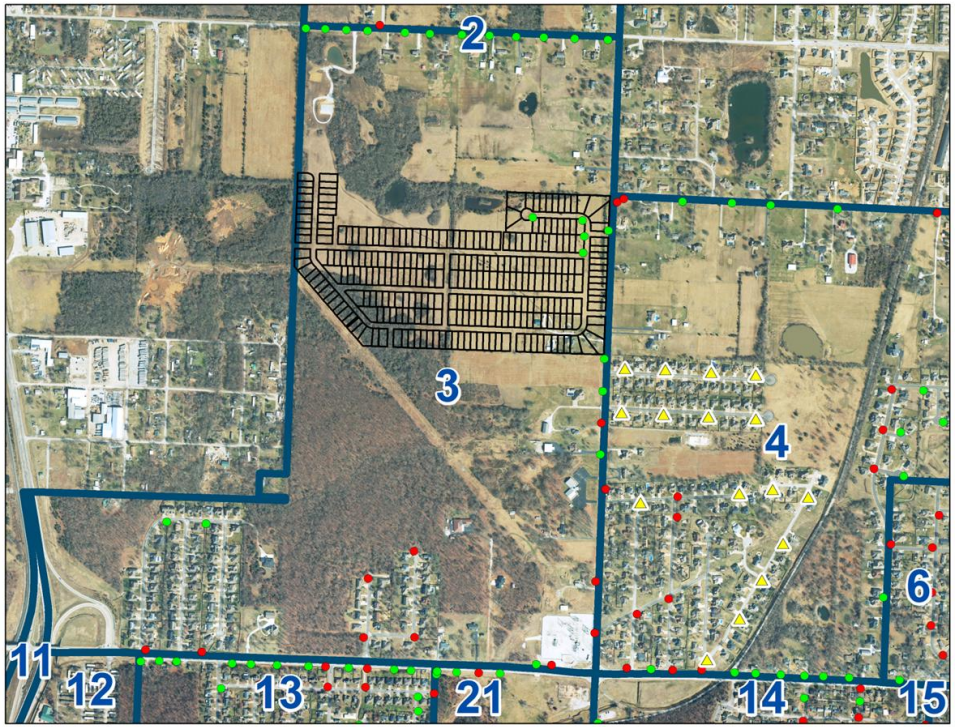
LEGEND:
Green-PSST
Red-TST
Blue-City Metered
Orange-City-Owned TST
Pink-City-Owned PSST



Emerald Glades

"*New*"
Area 3
Emerald Glades

LEGEND:
Green-PSST
Red-TST
Blue-City Metered
Orange-City-Owned TST
Pink-City-Owned PSST
Yellow-To Be Installed



Streetlight Update

- New individual streetlight requests continue to be reviewed
- Existing HPS streetlights and photocells are field-repaired if possible, prior to LED; not replaced with HPS,
- New and existing streetlights are changed or replaced with LED as supplies and resources are available

Streetlight Update

- City staff continue monthly coordination meetings with Liberty
- Nearing completion of voter approved installs, coordinating new subdivisions and developments, and continuing routine maintenance
- New install and repair requests
- Piloting a solar light install in Sunset subdivision

Streetlight Update

Online SeeClickFix light repairs:

- Since Fall 2024 Report
  - 210 reported streetlight issues
  - 177 resolved and closed
  - 5 new light install requests under review; one closed

Streetlight Next Steps

- Work will progress through the final zones and staff will continue to provide updates to City Council on new areas and developments
- Continue tracking repairs and requests
- Next semi-annual report October 2025

Questions?

