

Roadway, Street & Area Lighting Upgrade Feasibility Study

Collegeville Borough
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In Partnership with:

**Delaware Valley Regional Planning Commission's
Regional Streetlight Procurement Program**

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Executive Summary

RSLPP Overview

The Delaware Valley Regional Planning Commission's Regional Streetlight Procurement Program (RSLPP) allows regional municipalities to improve the performance of municipal street lighting, and specifically to design, procure, install, and finance the transition to light-emitting-diode (LED) lighting technology, and to maintain those improvements. The RSLPP is organized in four Phases: Phase 1: Feasibility; Phase 2: Project Development; Phase 3: Construction; and Phase 4: Post-Construction Operations and Maintenance. These Phases are described in greater detail in Appendix A.

Keystone Lighting Solutions (KLS) was competitively selected by the RSLPP to serve as the Design Services Professional for all four Phases of the program. In Phase 1, KLS is contracted with DVRPC to provide Feasibility Studies for all participating municipalities. By using existing available information and with financial support from DVRPC and the PA Department of Environmental Protection, the RSLPP is able to offer this study at no-cost to the municipality.

Feasibility Study Overview & Approach

This report has been prepared by KLS. The purpose of this Feasibility Study is to provide an assessment of the opportunity associated with the upgrade of a municipalities existing roadway, street and area lighting systems to LED, which may also include traffic signals. This study will act as a decision-making tool for your municipality to decide whether to proceed to Phase 2 of the RSLPP, Project Development. Project Development Phase will include comprehensive audits, design and analysis resulting in a final project design proposal.

Phase 1, Feasibility, is a "data-driven" effort that uses existing available information to assess the opportunity associated with an upgrade to your existing lighting system. No field work has been conducted for the development of this Feasibility Study. General design principals have been used by KLS to identify LED upgrade opportunities, described in the Design Approach and Photometric Analysis section. Project costs from Round 1 of the RSLPP (2015-2018) have been used to develop this financial assessment of the municipalities upgrade opportunity.

Project Goals and Special Applications

The following list of project goals and special applications was developed during discussions between municipality staff/management and KLS as preparation for this initial study.

- **Project Goals**
 - Reduce Energy Costs
 - Reduce Maintenance Costs
 - Meet or Exceed Existing Lighting System Performance
- **Special Applications**
 - Main Street from 4th to 5th is dark compared to LED upgrades

Project Scope of Work

The following is a list of all possible energy conservation measures (ECMs) presented for the lighting upgrade project. The “In Scope” column indicates which ECMs the municipality has chosen to include in the scope of work for this Feasibility Study:

Upgrade Category	In Scope
PECO Buyback	No
Cobrahead Lighting	Yes
Decorative Lighting	Yes
Area Lighting	No
Traffic Signals	No
Control Alternates*	In Scope
Manual Fixture Controls	Yes
Local Connected Controls	Yes
Networked Control System	Yes

Executive Financial Summary

Below is an Executive Financial Summary. This summary table provides Total Annual Operating Cost Savings (includes energy and maintenance cost savings), Total Project Costs, and Payback for each Energy Conservation Measure (ECM).

ECM	Total Annual Operating Savings	Total Project Costs	Payback (Years)	GHG Reduction (MT/Year)
PECO Buyback	\$0	\$0		
Cobrahead	\$9,760	\$151,074	15.5	41.0
Decorative	\$4,069	\$121,768	29.9	11.7
Area Lighting	\$0	\$0		
Traffic Signals	\$0	\$0		
Totals	\$13,829	\$272,842	19.7	52.7

Existing Lighting System

Unmetered Streetlight Baseline

The table below represents the current lighting inventory for Unmetered Streetlights. This baseline represented in the table below was developed using information from the municipality's unmetered PECO streetlight bill(s). Though the quantities, types, and wattages of fixtures reflected on the PECO bill(s) may vary from what is actually installed in the municipality, this project's energy baseline for unmetered service will be tied to the inventory of equipment on your unmetered PECO streetlight bill. Any energy cost savings realized from upgrades to the unmetered fixtures installed in your community will be realized through changes to this PECO bill(s). If known by the municipality, this table may indicate whether a baseline fixture is style other than a cobrahead, though this classification has no impact on baseline energy use or cost.

PECO Unmetered Streetlight Baseline <i>(Consolidated Summary of all PECO Streetlight Bills)</i>								
Fixture Type Code	Fixture Type Description	Location Count	Fixture Quantity	Fixture Watts	Total kW	Annual Operating Hours	Total kWh/Year	Total Annual Electric Costs
04000M	Cobrahead, 100W MV		235	115	27.0	4,092	110,586	\$6,080
05800S	Cobrahead, 70W HPS		4	94	0.4	4,092	1,539	\$85
08000M	Cobrahead, 175W MV		8	191	1.5	4,092	6,253	\$344
09500S	Cobrahead, 100W HPS		10	131	1.3	4,092	5,361	\$295
12000M	Cobrahead, 250W MV		5	275	1.4	4,092	5,627	\$309
16000S	Cobrahead, 150W HPS		4	192	0.8	4,092	3,143	\$173
25000S	Cobrahead, 250W HPS		38	294	11.2	4,092	45,716	\$2,513
50000S	Cobrahead, 400W HPS		1	450	0.5	4,092	1,841	\$101
07800H	Cobrahead, 100W MH		3	131	0.4	4,092	1,608	\$88
Energy Usage Sub-Total			308		44		181,673	\$9,988
Locations	Service Locations	308						\$24,763
Total Electric Bill Costs		308						\$34,751

Municipality Identified Fixture Type Adjustments								
04000M	Cobrahead, 100W MV		(11)					
CHM-160W48LED-4K	Cobrahead, 161W, LED		11					
Net Adds (Deducts)			0					

*Service Location Distribution Charge, also known as the "Tap Fee" is based on \$6.70 per location, per month. This is a fixed charge on your bill, and it is not impacted by the wattage of the fixture at each location. The costs associated with SLDC are expected to stay the same unless the quantity of service locations changes as a result of your RSLPP project. Estimates for any expected changes in SLDC as a result of the project will be modeled if the municipality proceeds to Phase 2, Project Development.

Metered Area Lighting Baseline

The table below represents the current lighting inventory and baseline for all metered outdoor lighting, which may include decorative, area lighting, and in some cases cobrahead lighting as well. The inventory of fixture quantities, type, wattages, and operating hours was estimated using information provided by the municipality. The energy use and cost baselines associated with this equipment were estimated according your municipality’s PECO rates for metered service. Because this is a metered service, this baseline may be adjusted in Phase 2, Project Development, to reflect the actual inventory of installed equipment identified in your field audit.

Metered Area Lighting Baseline							
<i>(Municipality provided information)</i>							
Fixture Type Code	Fixture Type Description	Fixture Quantity	Fixture Watts	Total kW	Annual Operating Hours	Total kWh/Year	Total Annual Electric Costs
6SL-150W-MHPS-SHERWOOD	6-Sided Lantern, 150W MHPS	75	175	13.1	4,092	53,708	\$4,934
Total Electric Bill Costs		75		13.1		53,708	\$4,934

Design Approach and Standardized Upgrade Plan

Design Approach

The following section explains the design approach for standardized upgrade recommendations.

KLS has conducted a photometric analysis for 5 typical lighting applications in order to compare the lighting performance of a “traditional” fixture type and technology (e.g. high-pressure sodium, metal halide, mercury vapor, incandescent) with that of a new fixture using LED technology. When keeping all application details the same (e.g. road width, pole spacing, fixture mounting height, etc.) this analysis identifies LED fixtures that perform equal or better than existing older technology fixtures. An example of this photometric analysis comparison can be seen in Appendix D.

For each typical application analysis KLS evaluates illumination levels and uniformity ratios against IES RP-8 standards. Actual municipality applications will likely not match typical applications (i.e. pole spacing, fixture mounting height) and therefore will not meet IES RP-8 standards. The design goal and strategy for the RSLPP is to “meet or exceed” existing lighting performance. Performance is not solely based on illumination levels (quantity of light) but is heavily impacted by light distribution, uniformity, glare, cut-off, source-brightness and color temperature. Many of these factors impact a human’s perceived visibility of a lit environment.

Upgrade recommendations will also be advised by a less technical, but equally relevant approach, which is to utilize the general knowledge of what upgrades have worked well on previous rounds of the RSLPP and other KLS projects. This secondary assessment is to be used as a sanity check to the previous analysis driven approach discussed above.

Typical Applications include:

- **Cobrahead Roadway Applications**
 - Arterial > Roadways
 - Collector > Roadways
 - Local Residential Street
- **Decorative Street Applications**
 - Commercial District
 - Local Residential Street

***Note:** The above list of Typical Applications will be expanded during Phase II, Project Development. Intersection typical designs will be considered in Phase II, when fixture location information is available. Typical designs will be provided for high and low volume Local Residential Streets in Phase II, when roadway volume information is available.*

Standardized Upgrade Plan

Based on the general design approach discussed above, the following standardized upgrade plan has been developed for this Feasibility Study.

Cobrahead Roadway & Street Applications			
Arterial Roadway			
Existing Lamp & Wattage	Proposed LED Fixture & Wattage	Distribution Type	Color Temp
400W High-Pressure Sodium	215W LED Cobrahead	Defined in Phase II	Defined in Phase II
250W High-Pressure Sodium	160W LED Cobrahead		
400W Metal Halide	108W LED Cobrahead		
Collector Roadway			
Existing Lamp & Wattage	Proposed LED Wattage	Distribution Type	Color Temp
150W High-Pressure Sodium	72W LED Cobrahead	Defined in Phase II	Defined in Phase II
175-250W Metal Halide	72W LED Cobrahead		
175-400W Mercury Vapor	72W LED Cobrahead		
Local Residential Street			
Existing Lamp & Wattage	Proposed LED Wattage	Distribution Type	Color Temp
100W or Less High-Pressure Sodium	35W LED Cobrahead	Defined in Phase II	Defined in Phase II
175W or Less High-Pressure Sodium	35W LED Cobrahead		
175W or Less High-Pressure Sodium	35W LED Cobrahead		
Decorative Street Applications			
Commercial District Street (Premium Decorative)			
Existing Lamp & Wattage	Proposed LED Wattage	Distribution Type	Color Temp
150W or Less High-Pressure Sodium	63W LED Retrofit Kit	Defined in Phase II	Defined in Phase II
175W or Less Metal Halide Sodium	63W LED Retrofit Kit		
Local - High Volume Street (Standard Decorative)			
Existing Lamp & Wattage	Proposed LED Wattage	Distribution Type	Color Temp
150W High-Pressure Sodium	52W LED Decorative (i.e. 4SC)	Defined in Phase II	Defined in Phase II
100W High-Pressure Sodium	38W LED Decorative (i.e. 4SC)		
70W or Less High-Pressure Sodium	25W LED Decorative (i.e. 4SC)		
100W or Less Metal Halide Sodium	25W LED Decorative (i.e. 4SC)		
100W or Less Mercury Vapor Sodium	25W LED Decorative (i.e. 4SC)		

Control Upgrade Options

All upgrade solutions represented in the feasibility study include either basic photocell or existing timeclock control. This feasibility study does not include the costs or benefits of more advanced lighting control options. In Phase II, Project Development, we will further define what control options to include in the final project design. There are no additional design costs associated with the specification of controls, but depending on the type of controls specified, there will be additional project costs. Below is a brief description of advanced control options that could be added to your project in Phase II, Project Development.

Manual Fixture Controls

Most roadway fixture manufacturers offer a manual dimming control option. This manual control is located in the fixture housing, not visible to the public, and allows for light levels to be adjusted up or down. When this control option is requested, the next higher fixture lumen package is specified and during installation the control is “dialed-down” to the desired lumen output. This option is not typically used to save energy but rather to provide future flexibility to increase or decrease illumination levels based on application needs. In Round I of the RSLPP more than 30% of municipalities choose this option.

Local Connected Controls

A new control option to be offered in the RSLPP are local connected controls. These controls can be integrated into a photocell or as a separate module wired as an additional fixture component. These local connected controls allow for “pre-set” dimming schedules to be defined for each fixture. For example, if it is desired for a set of fixtures (e.g. parking lot) to illuminate at dusk, dim down to 30% at 2am and turn off at dawn, the local connected control can be set for this specific dimming strategy. Often these controls can be connected to a local networking technology (e.g. Bluetooth) and re-programmed on-site. This option is typically useful for area lighting fixtures where automatic dimming is desired during the fixture “on” period or where a timeclock is not available to turn lights off during the typical photocell fixture “on” period.

Network Control System

If a municipality wants complete control of a lighting system with remote networked access, then a network control system can be specified and designed. These control systems allow a municipality to manage and remotely modify master dimming schedules for all connected fixtures. A network control system also monitors the operations of all connected fixtures. Outages or under-performing fixtures can be quickly identified and, in most cases, be included in a proactive reporting to the municipality. This option can be used to save energy but is typically specified for the asset management benefits. In Round I of the RSLPP one municipality choose this option.

Upgrade Details & Savings

Annual Energy Savings

The following table shows the annual energy savings for each existing fixture type and the upgrade recommendation.

Unmetered Streetlight Energy Savings

Existing							Upgrade							Savings
Fixture Type Code	Fixture Type Description	Watts/ Fixture	Fixture Quantity	Total kW	Total kWh/ Year	Annual Electric Costs	Fixture Type Code	Fixture Type Description	Watts/ Fixture	Fixture Quantity	Total kW	Total kWh/ Year	Annual Electric Costs	Annual Energy Cost Savings
Unmetered Streetlight														
Cobrahead														
Baseline														
04000M	Cobrahead, 100W MV	115	235	27.0	110,586	\$6,080	CHS-35W16LED-4K	Cobrahead, 38W, LED	38	235	9	36,542	\$2,009	\$4,071
05800S	Cobrahead, 70W HPS	94	4	0.4	1,539	\$85	CHS-35W16LED-4K	Cobrahead, 38W, LED	38	4	0	622	\$34	\$50
08000M	Cobrahead, 175W MV	191	8	1.5	6,253	\$344	CHM-72W32LED-4K	Cobrahead, 73W, LED	73	8	1	2,390	\$131	\$212
09500S	Cobrahead, 100W HPS	131	10	1.3	5,361	\$295	CHS-54W16LED-4K	Cobrahead, 53W, LED	53	10	1	2,169	\$119	\$175
12000M	Cobrahead, 250W MV	275	5	1.4	5,627	\$309	CHM-108W48LED-4K	Cobrahead, 106W, LED	106	5	1	2,169	\$119	\$190
16000S	Cobrahead, 150W HPS	192	4	0.8	3,143	\$173	CHM-72W32LED-4K	Cobrahead, 73W, LED	73	4	0	1,195	\$66	\$107
25000S	Cobrahead, 250W HPS	294	38	11.2	45,716	\$2,513	CHM-108W48LED-4K	Cobrahead, 106W, LED	106	38	4	16,483	\$906	\$1,607
50000S	Cobrahead, 400W HPS	450	1	0.5	1,841	\$101	CHL-215W96LED-4K	Cobrahead, 207W, LED	207	1	0	847	\$47	\$55
07800H	Cobrahead, 100W MH	131	3	0.4	1,608	\$88	CHS-35W16LED-4K	Cobrahead, 38W, LED	38	3	0	466	\$26	\$63
Baseline Sub-Total			308	44.4	181,673	\$9,988			308	15.4	62,882	\$3,457	\$6,531	
Adjustments														
04000M	Cobrahead, 100W MV		(11)				CHS-35W16LED-4K	Cobrahead, 38W, LED	38	(11)	(0)	(1,710)	(\$94)	\$94
CHM-160W48LED-4K	Cobrahead, 161W, LED		11				CHM-160W48LED-4K	Cobrahead, 161W, LED	161	11	2	7,247	\$398	(\$398)
Adjustment Sub-Total			0						0	1.4	5,536	\$304	(\$304)	
Cobrahead Total			308	44.4	181,673	\$9,988			308	16.7	68,418	\$3,762	\$6,227	

Metered Area Lighting Energy Savings

Existing							Upgrade							Savings
Fixture Type Code	Fixture Type Description	Watts/ Fixture	Fixture Quantity	Total kW	Total kWh/ Year	Annual Electric Costs	Fixture Type Code	Fixture Type Description	Watts/ Fixture	Fixture Quantity	Total kW	Total kWh/ Year	Annual Electric Costs	Annual Energy Cost Savings
Metered Area Lighting														
Decorative														
6SL-150W-MHPS-SHERWOOD	6-Sided Lantern, 150W MHPS	175	75	13	53,707.5	\$4,934	RTK-70W-4K-SHERWOOD	Decorative Retrofit Kit, 70W, LED	70	75	5.3	21,483	\$1,974	\$2,960
Decorative Total			75	13.1	53,708	\$4,934			75	5.3	21,483	\$1,974	\$2,960	

Annual Maintenance Savings

The following table shows the annual maintenance savings for each existing fixture type and the upgrade recommendation. Average annual maintenance expenses were modeled for both the existing and proposed fixture types. Average annual maintenance expenses for proposed fixtures were further reduced to reflect a 1-year labor warranty and a 10-year parts warranty. The assumptions used to estimate Annual Maintenance savings are provided in Appendix B, Project Assumptions.

Unmetered Streetlight Maintenance Savings

Existing				Upgrade				Savings
Fixture Type Code	Fixture Type Description	Fixture Quantity	Annual Maintenance Costs	Fixture Type Code	Fixture Type Description	Fixture Quantity	Annual Maintenance Costs	Annual Maintenance Savings
Unmetered Streetlight								
Cobrahead								
Baseline								
04000M	Cobrahead, 100W MV	235	\$4,060	CHS-35W16LED-4K	Cobrahead, 38W, LED	235	\$1,193	\$2,867
05800S	Cobrahead, 70W HPS	4	\$69	CHS-35W16LED-4K	Cobrahead, 38W, LED	4	\$20	\$49
08000M	Cobrahead, 175W MV	8	\$138	CHM-72W32LED-4K	Cobrahead, 73W, LED	8	\$49	\$89
09500S	Cobrahead, 100W HPS	10	\$173	CHS-54W16LED-4K	Cobrahead, 53W, LED	10	\$55	\$117
12000M	Cobrahead, 250W MV	5	\$86	CHM-108W48LED-4K	Cobrahead, 106W, LED	5	\$33	\$53
16000S	Cobrahead, 150W HPS	4	\$69	CHM-72W32LED-4K	Cobrahead, 73W, LED	4	\$25	\$44
25000S	Cobrahead, 250W HPS	38	\$656	CHM-108W48LED-4K	Cobrahead, 106W, LED	38	\$253	\$403
50000S	Cobrahead, 400W HPS	1	\$17	CHL-215W96LED-4K	Cobrahead, 207W, LED	1	\$10	\$8
07800H	Cobrahead, 100W MH	3	\$52	CHS-35W16LED-4K	Cobrahead, 38W, LED	3	\$15	\$37
Baseline Sub-Total		308	\$5,321			308	\$1,653	\$3,668
Adjustments								
04000M	Cobrahead, 100W MV	(11)	(\$190)	CHS-35W16LED-4K	Cobrahead, 38W, LED	(11)	(\$56)	(\$134)
CHM-160W48LED-4K	Cobrahead, 161W, LED	11	\$77	CHM-160W48LED-4K	Cobrahead, 161W, LED	11	\$77	\$0
Adjustment Sub-Total		0	(\$113)			0	\$21	(\$134)
Cobrahead Total		308	\$5,208			308	\$1,674	\$3,533

Metered Area Lighting Maintenance Savings

Existing				Upgrade				Savings
Fixture Type Code	Fixture Type Description	Fixture Quantity	Annual Maintenance Costs	Fixture Type Code	Fixture Type Description	Fixture Quantity	Annual Maintenance Costs	Annual Maintenance Savings
Metered Area Lighting								
Decorative								
6SL-150W-MHPS-SHERWOOD	6-Sided Lantern, 150W MHPS	75	\$1,296	RTK-70W-4K-SHERWOOD	Decorative Retrofit Kit, 70W, LED	75	\$188	\$1,108
Decorative Total		75	\$1,296			75	\$188	\$1,108

Bill of Material and Project Costs

The following table shows the bill of material (BOM) for proposed upgrade scope of work. In addition to material and installation costs, a summary of DSP Fees and Program Fees are included – all per unit costs associated with, material, installation, DSP fees, and Program fees are further defined in Appendix C. Rebates from PECO and PJM (regional transmission organization) are also included in this table and further defined in Appendix B.

Fixture Type Code	Fixture Type Description	Fixture Quantity	Material Costs	Install Costs	Rebates	KLS Fees	Program Fees	Contingency	Interest Costs	Total Project Costs
Cobrahead										
CHL-215W96LED-4K	Cobrahead, 207W, LED	1	\$364	\$110	(\$90)	\$34	\$16	\$47	\$293	\$864
CHM-160W48LED-4K	Cobrahead, 161W, LED	11	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
CHM-72W32LED-4K	Cobrahead, 73W, LED	12	\$2,244	\$1,320	(\$485)	\$408	\$127	\$356	\$2,283	\$6,739
CHS-35W16LED-4K	Cobrahead, 38W, LED	231	\$32,933	\$25,410	(\$7,166)	\$7,854	\$2,143	\$5,834	\$38,000	\$112,174
CHS-54W16LED-4K	Cobrahead, 53W, LED	10	\$1,661	\$1,100	(\$547)	\$340	\$100	\$276	\$1,781	\$5,259
CHM-108W48LED-4K	Cobrahead, 106W, LED	43	\$9,148	\$4,730	(\$3,704)	\$1,462	\$489	\$1,388	\$8,821	\$26,038
Cobrahead Total		308	\$46,350	\$32,670	(\$11,992)	\$10,098	\$2,876	\$7,902	\$51,178	\$151,074
Decorative										
RTK-70W-4K-SHERWOOD	Decorative Retrofit Kit, 70W, LED	75	\$56,885	\$12,000	(\$4,223)	\$2,550	\$2,194	\$6,889	\$41,250	\$121,768
Decorative Total		75	\$56,885	\$12,000	(\$4,223)	\$2,550	\$2,194	\$6,889	\$41,250	\$121,768
BOM		383	\$103,236	\$44,670	(\$16,214)	\$12,648	\$5,070	\$14,791	\$92,428	\$272,842

Financial Analysis & Summary

Payback Analysis Matrix

The payback analysis matrix is provided as a decision-making tool to assess the opportunity of ECMs available and to define a project scope that best meets the needs of the municipality. If a PECO buyback is planned prior to this project being implemented, we show the payback associated with that activity. A separate payback calculation is made for each ECM as well as for common control alternates to be considered. This section also shows typical combinations of upgrade solutions to aid with the project scoping decision.

ECM	Energy Savings	Maintenance Savings	Total Operating Savings	Material Costs	Install Costs	KLS Fees	Program Costs	Cost Contingency	Interest Costs	Rebates	Total Project Costs	Payback w/ Financing (Years)	Payback w/o Financing (Years)
PECO Buyback													
Cobrahead	\$6,227	\$3,533	\$9,760	\$46,350	\$32,670	\$10,098	\$2,876	\$7,902	\$51,178	(\$11,992)	\$151,074	15.5	10.2
Decorative	\$2,960	\$1,108	\$4,069	\$56,885	\$12,000	\$2,550	\$2,194	\$6,889	\$41,250	(\$4,223)	\$121,768	29.9	19.8
Area Lighting													
Traffic Signals													
Totals	\$9,187	\$4,642	\$13,829	\$103,236	\$44,670	\$12,648	\$5,070	\$14,791	\$92,428	(\$16,214)	\$272,842	19.7	13.0

Cash Flow Analysis

The cash flow analysis shows how the project savings offset project costs, resulting in little to no capital outlay for this project.

Project Cash Flow (Requested ECM Scope)

Project Summary	
Construction Cost	\$147,906
DSP Fees	\$12,648
Program Fees	\$5,070
Contingency	\$14,791
Total Project Cost	\$180,414
Capital Contribution	\$0
Financed Amount	\$180,414
Loan Rate	4.31%
Loan Term (Years)	20
Loan Payment	\$13,642
Interest Paid	\$92,428

ECM	In Scope
PECO Buyback	No
Cobrahead Lighting	Yes
Decorative Lighting	Yes
Area Lighting	No
Traffic Signals	No

Period	Energy Cost Savings	Maintenance Cost Savings	Rebates	Total Savings	DSP & Program Fees	Loan Payment	Balance
Design				\$0	\$7,239		(\$7,239)
Construction				\$0	(\$7,239)		\$7,239
1	\$9,187	\$4,642	\$16,214	\$30,043		\$13,642	\$16,401
2	\$9,187	\$4,642		\$13,829		\$13,642	\$186
3	\$9,187	\$4,642		\$13,829		\$13,642	\$186
4	\$9,187	\$4,642		\$13,829		\$13,642	\$186
5	\$9,187	\$4,642		\$13,829		\$13,642	\$186
6	\$9,187	\$4,642		\$13,829		\$13,642	\$186
7	\$9,187	\$4,642		\$13,829		\$13,642	\$186
8	\$9,187	\$4,642		\$13,829		\$13,642	\$186
9	\$9,187	\$4,642		\$13,829		\$13,642	\$186
10	\$9,187	\$4,642		\$13,829		\$13,642	\$186
11	\$9,187	\$4,642		\$13,829		\$13,642	\$186
12	\$9,187	\$4,642		\$13,829		\$13,642	\$186
13	\$9,187	\$4,642		\$13,829		\$13,642	\$186
14	\$9,187	\$4,642		\$13,829		\$13,642	\$186
15	\$9,187	\$4,642		\$13,829		\$13,642	\$186
16	\$9,187	\$4,642		\$13,829		\$13,642	\$186
17	\$9,187	\$4,642		\$13,829		\$13,642	\$186
18	\$9,187	\$4,642		\$13,829		\$13,642	\$186
19	\$9,187	\$4,642		\$13,829		\$13,642	\$186
20	\$9,187	\$4,642		\$13,829		\$13,642	\$186
Total	\$183,739	\$92,831	\$16,214	\$292,784		\$272,842	\$19,942

Project Cash Flow (Cobrahead Only)

Project Summary	
Construction Cost	\$79,020
DSP Fees	\$10,098
Program Fees	\$2,876
Contingency	\$7,902
Total Project Cost	\$99,896
Capital Contribution	\$0
Financed Amount	\$99,896
Loan Rate	4.31%
Loan Term (Years)	14
Loan Payment	\$9,652
Interest Paid	\$35,226

ECM	In Scope
PECO Buyback	No
Cobrahead Lighting	Yes
Decorative Lighting	No
Area Lighting	No
Traffic Signals	No

Period	Energy Cost Savings	Maintenance Cost Savings	Rebates	Total Savings	DSP & Program Fees	Loan Payment	Balance
Design				\$0	\$7,239		(\$7,239)
Construction				\$0	(\$7,239)		\$7,239
1	\$6,227	\$3,533	\$11,992	\$21,752		\$9,652	\$12,100
2	\$6,227	\$3,533		\$9,760		\$9,652	\$108
3	\$6,227	\$3,533		\$9,760		\$9,652	\$108
4	\$6,227	\$3,533		\$9,760		\$9,652	\$108
5	\$6,227	\$3,533		\$9,760		\$9,652	\$108
6	\$6,227	\$3,533		\$9,760		\$9,652	\$108
7	\$6,227	\$3,533		\$9,760		\$9,652	\$108
8	\$6,227	\$3,533		\$9,760		\$9,652	\$108
9	\$6,227	\$3,533		\$9,760		\$9,652	\$108
10	\$6,227	\$3,533		\$9,760		\$9,652	\$108
11	\$6,227	\$3,533		\$9,760		\$9,652	\$108
12	\$6,227	\$3,533		\$9,760		\$9,652	\$108
13	\$6,227	\$3,533		\$9,760		\$9,652	\$108
14	\$6,227	\$3,533		\$9,760		\$9,652	\$108
15	\$6,227	\$3,533		\$9,760		\$0	\$9,760
16	\$6,227	\$3,533		\$9,760		\$0	\$9,760
17	\$6,227	\$3,533		\$9,760		\$0	\$9,760
18	\$6,227	\$3,533		\$9,760		\$0	\$9,760
19	\$6,227	\$3,533		\$9,760		\$0	\$9,760
20	\$6,227	\$3,533		\$9,760		\$0	\$9,760
Total	\$124,531	\$70,667	\$11,992	\$207,189		\$135,122	\$72,067

Phase 1 Action Items

The purpose of this Feasibility Study is to provide an assessment of the opportunity associated with the upgrade of a municipalities existing outdoor lighting system to LED, which may include roadway and area lighting fixtures as well as traffic signals. This study will act as a decision-making tool for your municipality to decide whether to proceed to Phase 2 of the RSLPP, Project Development. Project Development Phase will include comprehensive audits, design and analysis resulting in a final project design proposal.

The following is a list of action items for municipality staff, management and council members to aid finalizing the Feasibility Study and presenting the opportunity for council consideration and a decision on whether to continue to Phase 2, Project Development.

Staff/Management Action Items

- Municipal Staff/Management - provide additional data to improve or clarify the Feasibility Study
- KLS - make final modifications to the Feasibility Study
- Municipal Staff/Management – final approval of Feasibility Study
- Municipal Staff/Management – establish position on agenda for relevant committee or council meetings
- Municipal Staff/Management – prepare packet information with Feasibility Study for relevant committee or council meetings
- Municipal Staff/Management – continue to build awareness and provide preliminary updates to other municipality staff and management as well as council members

Council Action Items

- KLS – present summary of Feasibility Study to relevant committee or council meetings
- Municipality Solicitor – Review resolutions and contracts required to proceed to the Project Development Phase
- Council – Review, analyze and discuss Feasibility Study with municipality staff and management and KLS
- Council – Take action to approve or reject decision to continue to the Project Development Phase and authorize municipality management to sign Project Development Phase contract with KLS.

Appendix A:

RSLPP Phase Overview

Phase 1: Feasibility: Data-driven analysis of upgrade opportunities resulting in a no-cost Feasibility Study.

- Municipalities receive a data-driven, no-cost Feasibility Study showing estimated savings, project costs, rebates and financial payback. This study is developed by KLS using data, information, and input provided by the municipality.
- **Municipalities use the Feasibility Study as a tool to decide whether to proceed to Phase 2 and contract with KLS for Project Development Services.**
- The RSLPP Project Team provides a contract form and resolution for municipalities to proceed to Phase 2.

Phase 2: Project Development: Field audits, design and analysis resulting in a final design project proposal.

- KLS conducts field audits of the municipality's existing lighting system showing GPS location and attributes of each fixture. KLS also conducts a comprehensive and standardized design of upgraded lighting system.
- KLS develops and DVRPC issues solicitations and contracts for materials, distributor, and installation contractor for the purpose of arranging cooperative purchasing agreements that municipalities are able to piggyback off of.
- The RSLPP Project Team organizes a pool of financing for municipalities who wish to finance their projects.
- KLS prepares final design proposal showing forecasted savings, final project costs, rebates, and financial payback.
- **Municipalities use the Final Design Proposal as a tool to decide whether to proceed to Phase 3, Construction.**
- The RSLPP Project Team provides a contract form and resolution for contracting between municipality and installation contractor for construction (the construction contract). Municipalities piggyback off of DVRPC's installation contract for construction.
- Municipalities that finance participate in the pool of financing arranged by the RSLPP.

Phase 3: Construction: Comprehensive Installation Services and Project Management of Installation including reporting and issue resolution during construction.

- Construction, including the procurement of all equipment, is provided by the RSLPP selected installation contractor according to the municipality's construction contract.
- KLS provides robust project management services ensuring consistent communication of progress and issue resolution.
- KLS manages the municipality's PECO Bill Updates and the applicable rebate application processes.

Phase 4: Post Construction Operations and Maintenance Confirmation of project savings and strategies for on-going maintenance.

- KLS provides the municipalities strategies for maintaining new system and on-going standardization, verification of project savings, and (if desired) prepare and/or update municipality lighting ordinances.
-

Appendix B:

Project Assumptions

The following assumptions were used in the development of this Feasibility Study:

1) Energy use

a. Un-metered:

i. **Streetlights:** Energy use for un-metered streetlight service is calculated by PECO using the following algorithm:

1. $\text{kWh} = \text{Billed Wattage of fixture} \times \text{quantity of fixture} \times 4092 \text{ (annual operating hours)}/1000$

ii. **Traffic Signals:** Energy use for un-metered traffic signal service is calculated by PECO using the following algorithm:

1. $\text{kWh} = \text{Billed Wattage of fixture} \times \text{quantity of fixture} \times \text{annual operating hours (yellow} = 175.2 \text{ hours; green} = 3766.8 \text{ hours; red} = 4819 \text{ hours)}/1000$.

b. **Metered:** Energy use for metered fixtures is calculated using the estimated wattage of each fixture X annual operating hours (4092 hours assumed for all metered streetlight fixtures and area lighting, while a lower number of hours may be used for other outdoor lighting types if provided or indicated by the municipality)/1000.

2) Energy Costs:

a. Across the entire RSLPP, energy costs were estimated according to the following PECO rates included in PECO's Proposed Tariff Electric Pa. P.U.C. No. 6, filed as a 2018 Electric Distribution Rate Case with the Pennsylvania Public Utility Commission.

i. SL-E, SL-S, SL-C, TSLs, and GS.

b. KLS used the generation supply rate listed for each PECO account on the utility bills supplied by the municipality.

3) Maintenance cost savings

a. Average annual maintenance expenses were modeled for both the existing and proposed fixture types.

i. Maintenance expenses are based on the probability a component (e.g. lamp, ballast/driver, fixture, photocell) will fail multiplied by the material and labor replacement cost. Failure probability is based on the annual operating hours of a component divided by its published rated or expected life.

b. Use of average annual maintenance expenses assumes that both the existing and new lighting systems have a standard distribution fixture and component ages. Average annual maintenance expenses for proposed LED fixtures were further reduced by 50% to reflect a 1-year labor warranty, a 10-year parts warranty and the expected life of a new fixture and its components.

4) Project rebates: There are two rebate types available to municipalities in the RSLPP:

a. **PECO Smart Ideas:** Through Phase 3 of Act 129, PECO's offers lighting rebates to municipal customers. These rebates vary from \$25 - \$75 per streetlight and vary from \$10 - \$60 for metered area lighting depending on the watts reduced by each fixture conversion. Rebates have been estimated in Phase 1 based on the scope of work included in this Feasibility Study. Municipalities that proceed to Phase 2 will have a pre-application submitted on their behalf by the KLS to PECO based on the scope of work

defined in the municipality's Final Design Proposal. Submitting a pre-application will "reserve" rebates for municipalities that proceed to Phase 3, construction.

- b. **PJM:** PJM, the Regional Transmission Operator for this region offers rebates for outdoor lighting projects through its Capacity Market. Energy efficiency projects can receive PJM Capacity Market rebates for the first four years that a project is installed based on the kW reductions of the project, and the price/kW of this rebate is determined by a "forward auction" in each utility territory within PJM. The current rate for these incentives in PECO territory ranges from \$18.70-\$28.90 per kW reduced depending on the year. The PJM Capacity Market rebate has been estimated based on the scope of work defined in this Feasibility Study, the associated kW reduction and a \$15.00 per kW rebate. Municipalities that proceed to Phase 3 (Construction) of the RSLPP will have the opportunity to have receive this rebate through a RSLPP-arranged aggregator.

5) Project Contingency

- a. For project budgeting we used a 5% contingency.

6) Material & Installation Costs

- a. RSLPP Round I costs, with some minor adjustments to reflect price increases for labor, were used for material and installation.

7) Financing

- a. For financing forecasts, a 4.31% interest rate was used. This rate is published by PennSEF, a joint partnership between the Foundation for Renewable Energy and Environment (FREE) and the Pennsylvania Department of Treasury. The rate above is based on a BBB rating, tax-exempt status and a 15-year financing term. The published values are derived from recent actual bond rates that correspond to each credit rating and term. However, the values shown have been adjusted to reflect that financing lease obligations be made "subject to appropriation." The "subject to appropriation" requirement can protect the participant in certain circumstances, but it results in rates that are slightly higher than rates for General Obligation bonds.
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Appendix C:

DSP & Program Fees Breakdown

Design Service Professional (KLS) Unit Pricing

DVRPC conducted a comprehensive RFP process to identify and select a design services professional to support all four Phases of the RSLPP. Municipalities are able to “piggy-back” off the DVRPC’s cooperative purchasing agreement for DSP services. The table below not only defines the final DSP unit priced fee structure but also shows the assumed volume for your project and the total associated fees. The finance resolution provided for RSLPP municipalities who wish to proceed to Phase 2, Project Development, includes provisions for reimbursement of Project Development Phase fees with a financing package put in place for the Construction Phase.

DSP Unit Price Schedule and Payment Milestones					
DSP Service Item	KLS Unit Price (Fee) Schedule	KLS Billing Milestones	Fixture & Signal Quantity	DSP Fees	DVRPC Program Fees
Project Development (Phase II)					
Field Audit	\$9/Fixture	100% at Completion of audit (if less than 1 month); Otherwise on monthly auditing progress	383	\$3,447	\$172
Field Audit (Traffic Signals)	\$8/Signal (not lamp)		0	\$0	\$0
Mapping	\$1/Fixture or Signal		383	\$383	\$19
Design	\$7/Fixture or Signal	50% at Preliminary Design Review; 50% at Final Design Review	383	\$2,681	\$134
Design (Traffic Signals)	\$6/Signal (not lamp)		0	\$0	\$0
Utility bill update & rebate processes	\$1/Fixture or Signal	50% at Final Utility Bill Update; 50% at Final Rebate Submittal	383	\$383	\$19
Project Development Sub-Total				\$6,894	\$345
Construction Project Management (Phase III)					
Project Management Services	\$10/Fixture or Signal	20% at Pre-Construction Meeting; Remainder on Monthly Installation Progress Billing	383	\$3,830	
PECO Buyback	\$5/Fixture (with max fee of \$5,000 and min fee of \$1,000)	At Buyback Completion		\$0	
Field deployable installation data capture	\$3/Fixture or Signal	Monthly Installation Progress Billing	383	\$1,149	
Project Management Sub-Total				\$4,979	\$4,437
Post-Construction Services (Phase IV)					
Project annual Energy and Operational Savings Report	\$1/Fixture or Signal	100% at Report Delivery	383	\$383	
Operations and Maintenance Plan for a municipality's new LED system.	\$1/Fixture or Signal	100% at Plan Delivery	383	\$383	
Development of Operation and Maintenance Manual	\$1/Fixture or Signal	100% at Manual Delivery	383	\$383	
Development or update of a lighting ordinance	\$1,000/municipality (minimum)	Estimated Cost Between \$1,000 - \$10,000	0	\$0	
Project Management Sub-Total				\$1,149	
Total				\$13,022	\$4,782

Notes:

- 1) All unit prices above are "not to exceed" as defined in the municipalities DSP contract.
- 2) DVRPC program fees are based on the RSLPP LOI signed by each participating municipality.

DVRPC Program Fees

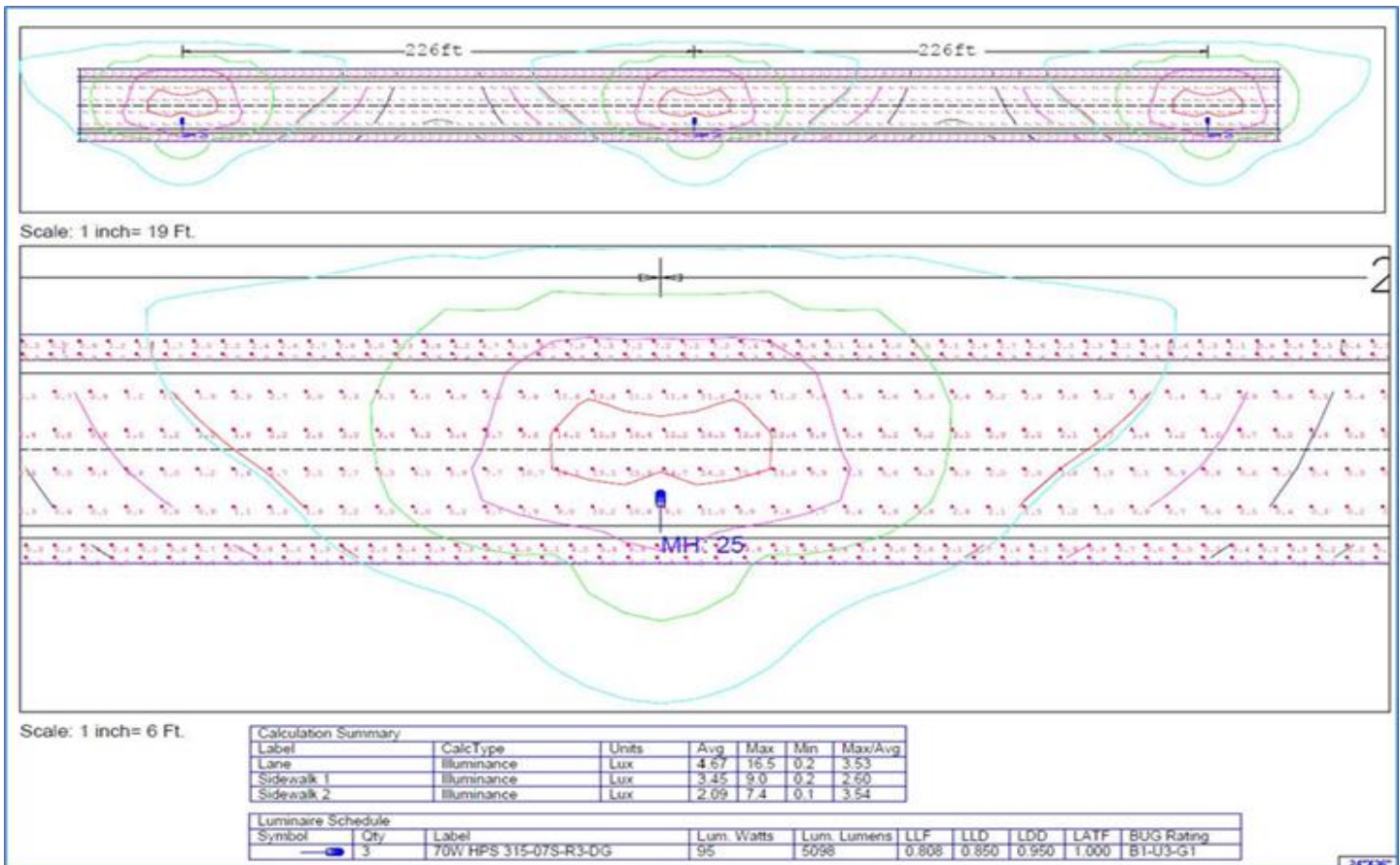
The following Program Fees have been established by DVRPC to allow DVRPC to recoup the upfront costs DVRPC has incurred for program development, program management, and for the development and issuance of contracts and solicitations associated with material, distributor, installation contractor, and finance. These fees are reflected throughout this Feasibility Study as “Program Fees”:

- 5% of DSP Total Fees
 - Up to 3% of Construction Costs (Material & Installation costs only).
 - 3% has been used as a conservative estimate for this Feasibility Study.
-

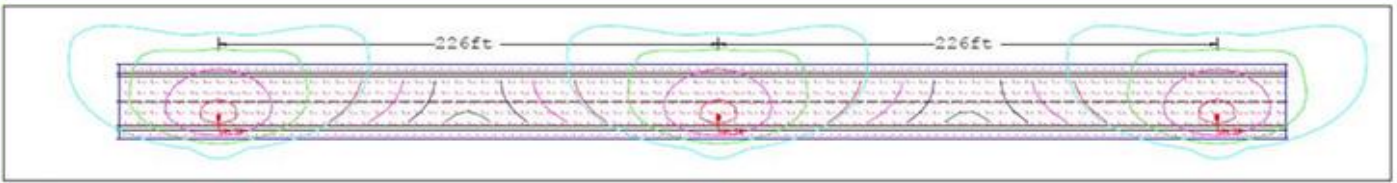
Appendix D: Photometric Analysis Example

The photometric comparison below shows how a traditional fixture and technology compares to a similar style fixture using LED technology. With all application specifications the same for both it allows for a fair comparison between the existing and new lighting solutions.

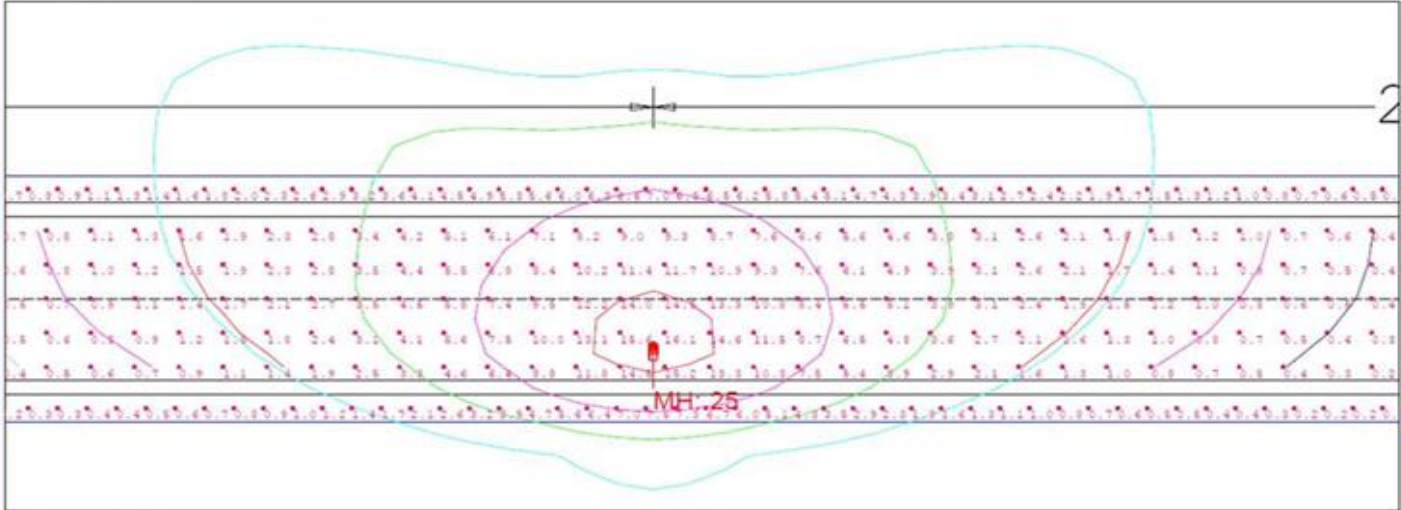
Traditional 70W High-Pressure Sodium Cobrahead on a Local Street



New 35W LED Cobrahead on a Local Street



Scale: 1 inch= 20 Ft.



Scale: 1 inch= 6 Ft.

Calculation Summary						
Label	CalcType	Units	Avg	Max	Min	Max/Avg
Lane	Illuminance	Lux	4.24	16.3	0.2	3.33
Sidewalk 1	Illuminance	Lux	3.09	7.0	0.2	1.86
Sidewalk 2	Illuminance	Lux	2.22	7.5	0.1	3.03

Luminaire Schedule									
Symbol	Qty	Label	Lum. Watts	Lum. Lumens	LLF	LLD	LDD	LATF	BUG Rating
	3	RFS-35W16LED4K-T-R3M	38	4030	0.903	0.950	0.950	1.000	B1-U0-G1