

2019

Energy Savings Project
Year 1 Performance Period
Savings Report
for Town of Bel Air



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Section 1: Overview

Introduction

In April, 2017 Johnson Controls, under an agreement with Town of Bel Air, began installation of various energy conservation measures (ECMs) in order to provide energy savings to the Township. Added benefits of the energy savings project include infrastructure improvements.

This report contains savings realized during Year 1 of the annual guarantee which is the period from May 2018 through April 2019.

Section 2: Executive Summary

Annual Savings

Cumulative savings for the Installation Period and Year 1 of the guarantee are shown in the chart below.

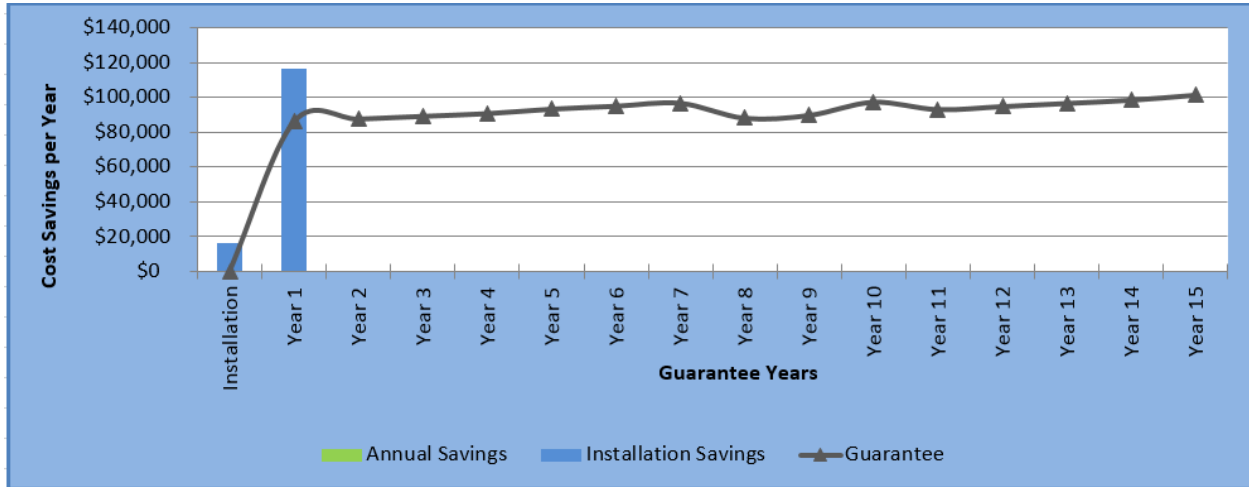
Table 1: Cumulative Annual Savings by Energy Conservation Measure

Facility Improvement Measure	Installation Period Savings	Year 1 Savings	Cumulative savings
Street Lighting Upgrades	\$4,321	\$52,577	\$56,898
Interior Lighting and Occupancy Sensors	\$2,872	\$10,659	\$13,532
Exterior Lighting	\$5,376	\$20,294	\$25,670
Domestic Water Conservation	\$537	\$1,225	\$1,762
Building Envelope Improvements	\$1,446	\$3,170	\$4,615
Destratification Fans	\$340	\$762	\$1,101
Solar Photovoltaic System	\$177	\$1,463	\$1,640
Operation and Maintenance Savings	\$1,246	\$4,549	\$5,795
Energy Rebates		\$21,895	\$21,895
Total Benefits	\$16,315	\$116,593	\$132,908
Guarantee	\$0	\$86,156	\$86,156
Over/(Under) Performance	\$16,315	\$30,437	\$46,752

Year 1 Report

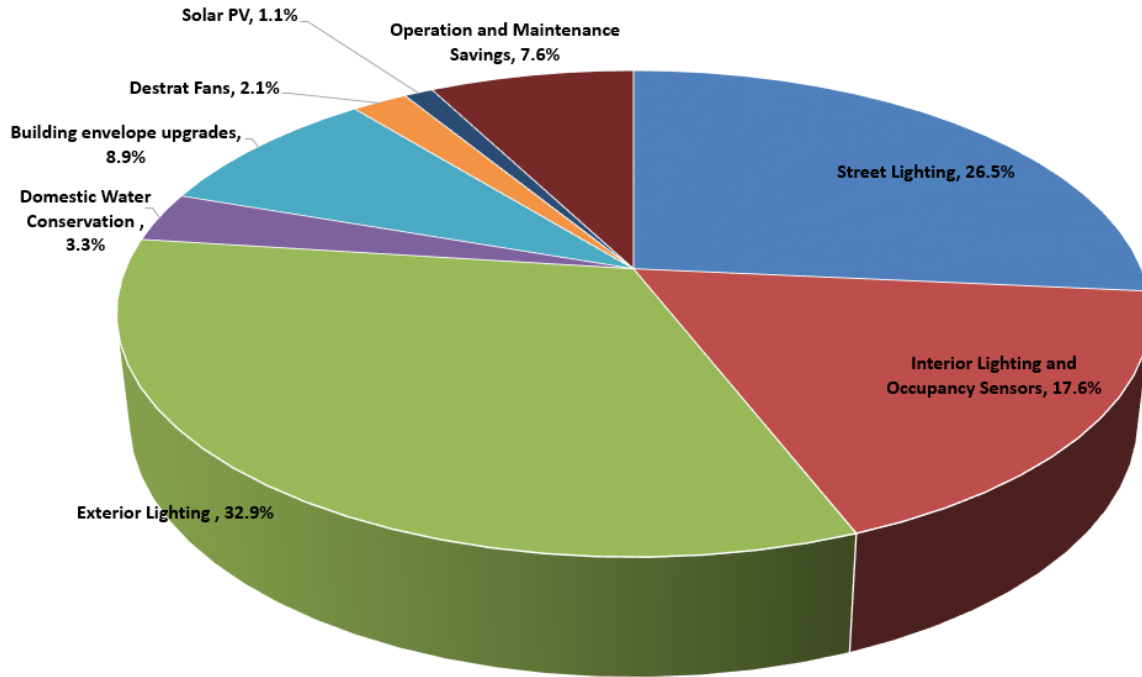
The savings beginning with the installation period through Year 1 are shown in the graph below along with the annual savings guarantees.

Figure 1: Annual Savings and Guarantees



The following graphic shows the savings contribution per ECM during guarantee Year 1.

Figure 2: Savings Contribution per Energy Conservation Measure



Section 3: Energy Savings Calculations

Street Lighting Upgrades

In a partnership with Baltimore Gas and Electric (BGE), Johnson Controls provided material and BGE provided labor and associated equipment for the replacement of existing street lighting fixtures with LED models on existing utility poles. The scope of work included the replacement of 362 lighting fixtures.

The town of Bel Air is billed by BGE based on street lighting fixture type and count. This schedule was updated based on the upgrades, providing economic savings to the Town. Johnson Controls has verified that the project changes were incorporated in the bill of April 2018 (see Appendix B) and quantified the savings as follows:

Table 2: Baseline and Updated Monthly Bill Comparison

Month	Start	End	LW	kWh	Cable ft	underground cable	Rental	Lamp Insp, Clean, Removal
Base			146,426	48,760	43,746	\$2,261.67	\$4,917.20	\$1,620.82
Apr-18	3/31/2018	4/30/2018	67,346	22,426	43,751	\$2,261.93	\$3,499.09	\$ 700.39
Savings (Base – April bill)			79,080	26,334	-5	\$ (0.26)	\$1,418.11	\$ 920.43

Table 3: Street Lighting Savings

Building	Monthly LW Savings	Monthly kWh Savings	\$/LW	\$/kWh	Monthly cable, rental, & inspection/cleaning savings	Monthly Savings	Annual Savings
Street Lights	79,080	26,334	\$0.02558	\$0.00077	\$2,338.28	\$4,381	\$52,577

Cost savings for LW and kWh are based on contract \$/LW and \$/kWh rates. Cable, rental, and inspection/cleaning savings are from bill comparison to baseline shown in Table 2.

Interior Lighting Upgrades

- Amphitheater
- Armory
- Department of Public Works
- Rockfield Manor
- Parks and Recreation
- Park Comfort Center
- Police Department / Town Hall

Interior lighting was upgraded where old technology fixtures were identified in the buildings listed above. These upgrades replaced existing lighting ballasts and lamps with new higher efficiency components resulting in energy savings without the need to reduce lighting levels. In addition, occupancy controls were installed in selected rooms to reduce lighting burn hours when the rooms were vacant.

Lighting upgrade savings are based on a reduction in wattage. Fixtures or lamps power draw were determined from measurements (see Appendix C) and typical wattages as published by ANSI (American National Standards Institute). Measurements are taken once for the life of the contract.

Control savings is based on the locations of sensors installed and the measured or published wattages of lights affected. Lighting burn hour reductions is based on lighting loggers' deployment from August to September 2016. The difference between logged lighting hours and occupancy hours per space type, extrapolated to annual hours, is the key parameter for the calculation of lighting controls savings. Both Burn Hours and Occupancy Hours are listed in the contract.

The following equations were used to determine energy savings.

Lighting replacements:

$$\text{Demand Savings} = \sum (\text{Old Fixture kWatts} \times \text{No of Fixtures} - \text{New Fixture kWatts} \times \text{No of Fixtures}) \Big|_{\text{fixture type}}$$

$$\text{kWh Savings} = \sum \text{Demand Savings} \times \text{Annual Hours of Operation} \Big|_{\text{fixture type}}$$

Lighting Controls:

$$\text{kWh Savings} = \sum \text{New Fixture Watts} \times (\text{Hours of operation w/o controls} - \text{Hours of operation w/ controls}) \Big|_{\text{fixture type}}$$

$$\text{Cost Savings} = \text{kWh Savings} \times \text{Electric energy rate.}$$

The following table shows the verified benefits from Interior Lighting:

Table 4: Interior Lighting Energy Savings

Building	Annual Electric Savings (kWh)	\$/kWh	Annual Savings
Armory	17,503	\$0.134	\$2,341
Armory Garage	385	\$0.113	\$44
Band Shell	224	\$0.113	\$25
DPW	24,444	\$0.113	\$2,766
Rockfield Manor	22,143	\$0.117	\$2,592
Parks and Recreation	1,703	\$0.113	\$193
Park Comfort Center	218	\$0.113	\$25
Police Dept./ Town Hall	23,634	\$0.113	\$2,674
Total	90,254		\$10,659

Exterior Lighting Upgrades

- Amphitheater
- Armory
- Band Shell
- Department of Public Works
- Parks and Recreation
- Park Comfort Center
- Parking Garage
- Police Dept./ Town Hall
- Rockfield Manor

Existing exterior metal halide, high pressure sodium, CFL, and incandescent fixtures were replaced with new LED fixtures resulting in energy savings without the need to reduce lighting levels.

Lighting upgrade savings are based on a reduction in wattage. Fixtures or lamps power draw were determined from measurements (see Appendix C) and typical wattages as published by ANSI (American National Standards Institute). Measurements were taken once for the life of the contract. Hours of operation of exterior fixtures were assumed to be 4,380 hours per year for most fixtures. The value is based on 12 burn hours per day, 365 days per year.

For the parking garage, savings is based on a comparison of bills from January to December 2015 vs. the Year 1 Performance Period (see Appendix G). This was done to provide a more conservative estimate of savings due to discrepancies between measured and billed savings.

The following equations were used to determine energy savings.

$$\text{Demand Savings} = \sum (\text{Old Fixture kWatts} - \text{New Fixture kWatts}) \times \text{No of Fixtures} \Big|_{\text{fixture type}}$$

$$\text{kWh Savings} = \sum (\text{Demand Savings} \times \text{Hours of Operation}) \Big|_{\text{fixture type}}$$

$$\text{Cost Savings} = \text{kWh Savings} \times \text{Electric energy rate}$$

The following table shows the verified benefits from Exterior Lighting:

Table 5: Exterior Lighting Energy Savings

Building	Annual Electric Savings (kWh)	\$/kWh	Annual Savings
Amphitheater	4,022	\$0.113	\$455
Armory	795	\$0.134	\$106
Band Shell	337	\$0.113	\$38
DPW	19,050	\$0.113	\$2,156
Rockfield Manor	15,349	\$0.117	\$1,797
Park and Rec	382	\$0.113	\$43
Park Comfort Center	2,677	\$0.113	\$303
Parking Garage	118,044*	\$0.113	\$13,802
Police Town Hall	14,083	\$0.113	\$1,594
Total	174,739		\$20,294

*based on bill comparison

Domestic Water Conservation

- Amphitheater
- Armory
- Department of Public Works
- Parks and Recreation
- Park Comfort Center
- Police Dept./Town Hall
- Rockfield Manor

High flow domestic fixtures were replaced with new low-flow fixtures, including toilets, urinals and faucets in lavatories and kitchen areas. Water and sewer savings are achieved through a reduction in water use at the fixture. Energy savings are also achieved by the reduction in hot water use.

Domestic water conservation savings are based on a reduction in either gallons per flush (GPF) or gallons per minute (GPM) registered at the fixture. Flow measurements were sampled for fixture types which contributed the most savings and were used in savings calculations. These measurements were taken once for the life of the contract and are shown in Appendix D. For fixtures types which were not measured, nominal data was used. Other key parameters, such as building population and male/ female distribution is listed in the contract.

The following equations were used to determined energy savings.

$$\text{Water Savings (kGal)} = \sum (Usage\ rate_{baseline} - Usage\ rate_{post}) \times People \times Days \times ADUF_{type} \times Usage\ factor / 1,000 \quad |_{fixture\ type}$$

Where:

Usage rate_{baseline} = baseline fixture use rate (GPM or GPF)

Usage rate_{post} = Post-retrofit fixture use rate (GPM or GPF)

People = number of people using the fixture

Days = number of days per year fixture is used, 226 days/yr.

ADUF = average daily use per fixture (flushes or minutes)

Usage factor = daily frequency of fixture use

Natural gas savings will be determined using the following equations:

$$\text{Nat Gas Savings} = \text{Water Savings} \times 1,000 \times Usage\ Factor \times (\text{Water temp}_{hot} - \text{Water temp}_{cold}) \times \text{Specific heat} / \text{Efficiency}_{DWH}$$

Where:

Water savings = water savings for faucets and showers in kGal

Usage factor = % hot water used on sinks (54%)

Water temp_{hot} = average hot water temperature (agreed to be 120°F)

Water temp_{cold} = average tap water temperature (agreed to be 60°F)

Specific heat = 8.34 Btu/Gal x °F for water

Efficiency_{DWH} = domestic water heater efficiency (agreed to be 80%)

$$\text{Cost Savings} = \text{Water Savings} \times (\text{Water} + \text{Sewer rate}) \times \text{Therms Savings} \times \text{Nat Gas energy rate}$$

The following table shows the water conservation benefits:

Table 6: Domestic Water Conservation Savings

Building	Annual Water Sewer Savings (kGal)	Annual Electric Savings (kWh)	Annual Nat Gas Savings (Therms)	\$/kGal	\$/kWh	\$/Therm	Annual Savings
Amphitheater	5.4	-	5	\$13.39	\$0.113	\$0.898	\$77
Armory	0.5	-	-	\$15.12	\$0.134	\$0.898	\$8
Dept. of Public Works	28.8	1,483	-	\$13.39	\$0.113	\$0.898	\$553
Parks and Recreation	9.6	-	-	\$13.39	\$0.117	\$0.898	\$52
Park Comfort Center	3.0	-	2	\$13.39	\$0.113	\$0.898	\$129
Police Dept./ Town Hall	16.5	1,455	-	\$13.39	\$0.113	\$0.898	\$42
Rockfield Manor	2.2	194	-	\$12.03	\$0.113	\$0.919	\$364
Totals	66.1	3,132	7				\$1,225

Building Envelope

- Armory
- Band Shell
- Dept. Public Works
- Rockfield Manor
- Parks and Recreation
- Police Dept./ Town Hall

Johnson Controls identified and repaired several building envelope flaws including weather strip and astragals on exterior doors, sealing roof wall intersections, etc. Energy savings are realized by minimizing the infiltration of outdoor (not conditioned) air into the building. Refer to Appendix E for a summary of envelope improvements in each building.

Savings were calculated per the contract by updating the calculations of expected savings with as-built sizes and quantities of building envelope improvements. Baseline conditions used in the calculations are shown in the contract.

The following table shows the verified benefits from Building Envelope Improvements:

Table 7: Building Envelope Energy Savings

Building	Annual Electric Savings (kWh)	Annual Nat Gas Savings (Therms)	Annual Fuel Oil Savings (Gal)	\$/kWh	\$/Therm	\$/Gal	Annual Savings
Armory	-	44	-		\$0.898		\$39
Band Shell	3,800	-	-	\$0.113			\$430
Dept of Public Works	-	-	1,262			\$1.750*	\$2,209
Rockfield Manor	-	108	-		\$0.898		\$97
Parks and Recreation	321	-	-	\$0.113			\$36
Police Dept./ Town Hall	-	390	-		\$0.919		\$358
Totals	4,120	542	1,262				\$3,170

* rate from 2016 average

Destratification Fans

- Armory

Stratification is the build-up of zone temperatures within a room, usually in high ceiling areas due to poor air distribution. As the air in the room is not properly mixed, hot air moves and stays up close to the ceiling, creating occupant discomfort and increased load in the systems. The installation of destratification fans promotes the mixing of the air, preventing stratification. Energy savings are achieved by improving the air distribution in the zone.

This energy conservation measure installed three destratification fans in high ceiling areas in the Armory building. The following conditions were used in the calculation of the benefits from this improvement:

Building	Ceiling Height	Room Length	Room Width	Roof U-Value	Temp Set point	Interior Roof Temp	Avg. Exterior Temp
Armory	40 ft	50 ft	50 ft	0.68	68 F	105 F	34.8 F

The following equations were used to determine energy savings:

$$\text{Heating Energy Savings (Therms)} = \text{Roof U Factor} \times \text{Room Area} \times [\text{Average (Interior roof temp \& Temp set point)} - \text{Average exterior temp}] / 1,000.$$

As outlined in the contract agreement, no measurements were taken for this ECM. The following table shows the verified benefits:

Table 8: Destratification Fans Energy Savings

Building	Annual Nat Gas Savings (Therms)	\$/Therms	Annual Savings
Armory	848	\$0.898	\$762
Totals	848		\$762

Solar PV System

- Police Dept./ Town Hall

Johnson Controls installed a Photovoltaic system on the roof of the Police Department / Town Hall building in order to generate electricity, offsetting building consumption and thereby producing savings. The system utilizes a rooftop array with a total of 36 panels, each capable of producing 285 watts, for a total system power of 10.260 kW. The system utilizes a 9,000 watt Solar Edge inverter coupled with Solar Edge P600 optimizers paired with every two panels in the system, decreasing the negative impact of shading and increasing overall system efficiency versus traditional string inverters, as well as panel-level monitoring.

The expected annual energy production was calculated according to the contract using PVWatts calculator of the National Renewable Energy Laboratory. The expected annual energy production of 12,926 kWh exceeds the design minimum of 12,564 kWh. Appendix F shows the output of the PVWatts calculator.

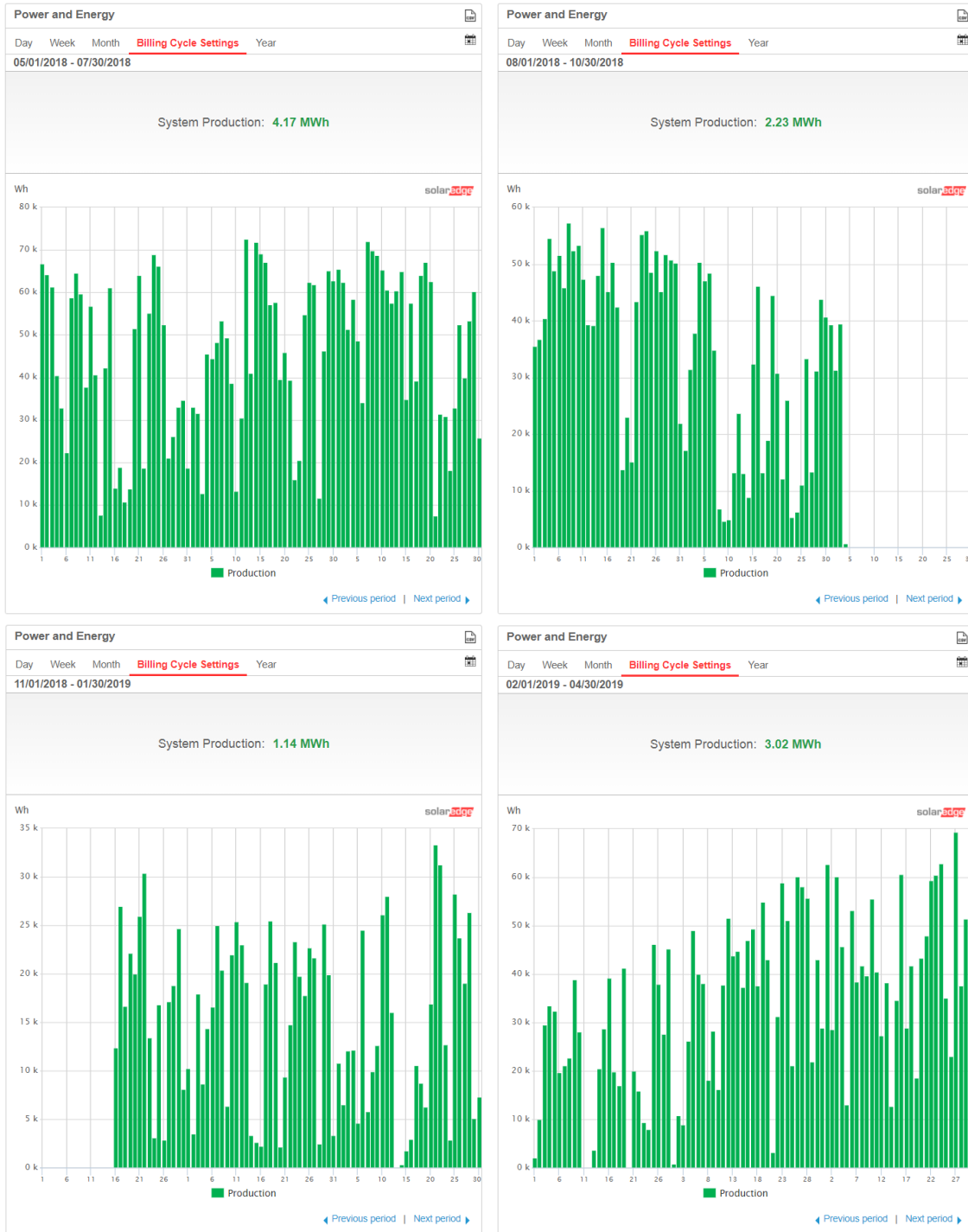
Year 1 energy savings is the system kWh as modeled using the PVWatts web site. The actual energy produced as read from the SolarEdge website which is connected to the on-site meter was 10,608 kWh. Due to the system being offline due to roof work, the annual savings was calculated using the expected annual energy production instead of the actual Year 1 energy production.

Alerts reported on the SolarEdge website indicate that energy production data was not received from the Solar PV system from 10/05/2018 to 11/15/2018 during the roof work. The 42 days gap in data can be seen in figure 3. This data gap may also be reflected in the difference between the Expected Annual Energy Production and the actual Year 1 Energy Production. Figure 4 shows the alerts captured on the SolarEdge website.

Table 9: Solar PV Energy Savings

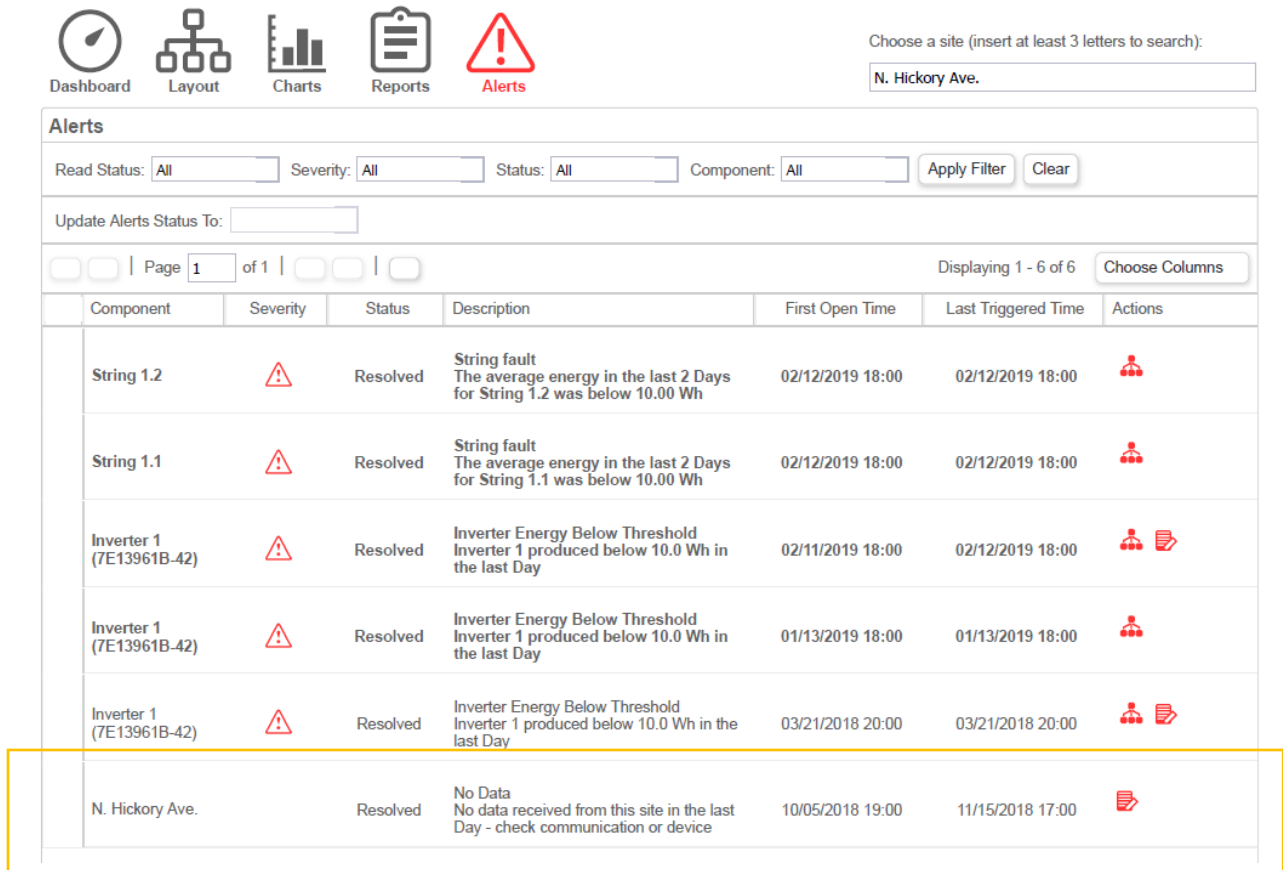
Building	Expected Annual Energy Production (kWh)	Year 1 Energy Production (kWh)	\$/kWh	Annual Savings
Police Dept./ Town Hall	12,926	10,608	\$0.113	\$1,463
Totals	12,926	10,608		\$1,463

Figure 3: SolarEdge Display from May 2018 to April 2019 by Quarter



Year 1 Report

Figure 4 SolarEdge Alerts



Highlighted in yellow is the outage corresponding to the roof work done in October to November 2018.

Operation and Maintenance Savings

As described in the contract this project includes lighting material as operation and maintenance cost avoidance. By installing new lighting components with longer rated life, the Town of Bel Air will reduce the cost of replacing lighting system components. The savings were calculated by taking the rated life of pre-retrofit and post-retrofit system components, and averaging the annualized cost based on the operating hours of each item. The difference in the annualized cost of the pre-retrofit and post-retrofit system is realized material savings per year. The following table shows the Operational and Maintenance savings:

Table 10: Operation and Maintenance Savings

ECM	Annual Savings
Interior, exterior and parking garage lighting	\$4,549

Energy Rebates

Johnson Controls supported Town of Bel Air, compiling and submitting on their behalf, all applicable documentation to support rebate applications through Baltimore Gas and Electric (BGE). The benefits realized through rebates were not guaranteed, but are an additional benefit provided by the project. Rebate benefits have been included in Year 1 of the guarantee reconciliation.

Table 11: Utility Rebate Benefits

ECM	Building	Application Number	Received (\$)	Date	check no.
Lighting	Amphitheater	BGPLPS1535460986	\$7,495	5/15/2018	0001409726
Lighting	Armory	BGPLPS1535458919	included above	"	"
Lighting	DPW	BGPLPS1535458780	included above	"	"
Lighting	Parking Garage	BGPLPS1535459694	\$12,300	5/10/2018	0001408548
Lighting	Police Station	BGPLPS1535458824	\$2,100	5/30/2018	0001415771
Total			\$21,895		

Recommendations

In order to realize the benefits of this energy conservation program, the energy conservation measures must remain in use as intended. The ECM's may be checked periodically by the Performance Engineer throughout the Performance Period, but it is imperative that the operators of the systems are attentive to the systems' performance on a daily basis. Modifications to the installed ECMs may have a negative impact on energy savings and must be considered carefully when changes are made. Regular maintenance of equipment is also necessary to continue to realize energy savings.

Appendices

Appendix A: Energy Rates

The energy rates used for calculation in this report are taken from the higher of the escalated contract base rate and the actual rate for the Performance Period. These are presented below.


Table 12: Energy Rates for Year 1 Period

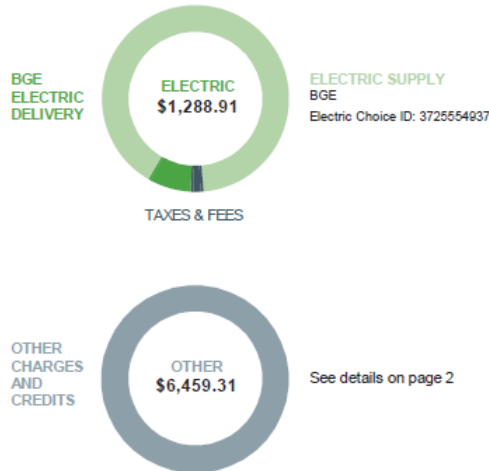
Building	Electric Energy \$/kWh	Natural Gas \$/therm	Water \$/kGal
Amphitheater	\$0.113	\$0.898	\$13.39
Armory	\$0.134	\$0.898	\$15.12
Armory Garage	\$0.113	-	-
Band Shell	\$0.113	\$0.898	-
DPW	\$0.113	\$0.898	\$13.39
Manor House	\$0.117	\$0.898	\$13.39
Park and Rec	\$0.113	\$0.898	\$13.39
Park Comfort Center	\$0.113	\$0.898	\$13.39
Parking Garage	\$0.113	-	-
Police/Town Hall	\$0.113	\$0.919	\$12.03

Appendix B: Street Light Bill

The updated PECO street light bill for March 2019 is shown below. There is a reduction lamp count by two for the cost of Lamp Inspection, Cleaning and Removal versus the prior year's bill.

Figure 5 Street Light Bill post-upgrade

 An Exelon Company	CONTACT US	BGE.COM
	Customer Service:	800.685.0123
		800.735.2258 (TTY-TTD)
	Correspondence:	P.O. Box 1475 Baltimore, MD 21203



Bill Summary

Page 1 of 3

Town Of Bel Air
39 N Hickory Ave
Bel Air, MD 21014
Account # 3725531000
Issued Date: April 1, 2019

Previous Balance	\$7,865.05
Payments Received March 20, 2019	-\$7,865.05
BGE Outstanding Balance	\$0.00
Electric	\$1,288.91
Other charges and credits (See details)	\$6,459.31
Total amount due by April 18, 2019	\$7,748.22

Payment received after April 18, 2019 will incur a late charge.
A late payment charge is applied to the unpaid balance of your BGE charges. The charge is up to 1.5% for the first month; additional charges will be assessed on unpaid balances past the first month, not to exceed 5%.
The amounts shown in the circles reflect charges from this bill period.



Return only this portion with your check made payable to BGE. Please write your account number on your check.

Pay your bill online, by phone or by mail.


See reverse side for more info ▶

Account # 3725531000	
Total amount due by Apr 18, 2019	\$7,748.22
Payment Amount \$	

Town Of Bel Air
Attn: Rachel Deaner
Deputy Director of Finance
39 N Hickory Avenue
Bel Air, MD 21014-3256

BGE
P.O. Box 13070
Philadelphia, PA 19101-3070

21372553100070007748229108100078641900

 Electric details				
Schedule SL - POLR Type I				
Billing Period: February 28, 2019 - March 31, 2019				Days Billed: 31
ELECTRIC SUPPLY				\$1,179.90
BGE	67,078 LW	x	.01759	1,179.90
BGE ELECTRIC DELIVERY				\$91.90
Distribution Chg	67,078 LW	x	.00137	91.90
TAXES & FEES				\$17.11
Envir Srchg	22,337 kWh	x	.000146	3.26
Franchise Tax	22,337 kWh	x	.00062	13.85
TOTAL				\$1,288.91


Other charges and credits				
UNDERGROUND STREET LIGHT CABLE				\$2,261.93
Cable Install After Aug 31, 1980 (Incl Replace)	43,751 Feet	x	.0517	2,261.93
RENTAL				\$3,499.09
Arm-Longer than 4' OH	51	x	2.83	144.33
100-150w SV Pendant/Flood OH	1	x	11.55	11.55
OH Fed Wood Light Pole	39	x	3.07	119.73
UG Fed Wood Light Pole	2	x	6.47	12.94
12-14' Fiberglass Pole UG	22	x	4.84	106.48
12-14' Fluted Fiberglass Pole UG	3	x	25.63	76.89
100 LED Pendant OH/UG	109	x	7.10	773.90
150 LED Pendant OH/UG	188	x	7.38	1,372.68
250 LED Pendant OH/UG	3	x	10.03	30.09
400 LED Pendant OH/UG	63	x	13.50	850.50
LAMP INSPECTION, CLEANING & REMOVAL				\$698.29
70-400w Sodium Vapor	1	x	3.19	3.19
100-1000w LED	662	x	1.05	695.10
TOTAL				\$6,459.31

Federal Tax Identification # 52-0280210

Other ways to pay

 **Online**
BGE.COM



 **In-person**
America's Cash Express**
877.223.2274

Western Union©**
800.225.5227

 **Pay-by-phone**
Western Union Speed Pay**
888.232.0088

**Fee applies.

Appendix C: Lighting Measurement Results

Wattage of a sample of lighting fixtures was measured on Feb 23, 2018. Averages of these measurements were used to calculate lighting savings.

Table 13: Lighting Wattage Measurements

Building	Room	fixture type	Fixture Qty.	Lamps out	Volts	Amps	Power Factor	Measured W	W/ fixture
Parking Garage	3rd floor	N 2VT-12.5LED-PC-1X8	1	0	123.0	0.204	0.98	24.5	24.5
Parking Garage	3rd floor	N 2VT-12.5LED-PC-1X8	1	0	122.1	0.208	0.98	24.6	24.6
Parking Garage	3rd floor	N 2VT-12.5LED-PC-1X8	1	0	122.9	0.206	0.98	24.6	24.6
Parking Garage	3rd floor	N 2VT-12.5LED-PC-1X8	1	0	123.1	0.199	0.98	24.2	24.2
Parking Garage	3rd floor	N 2VT-12.5LED-PC-1X8	1	0	122.9	0.198	0.98	24.0	24.0
Parking Garage	3rd floor	N 2VT-12.5LED-PC-1X8	1	0	122.8	0.206	0.98	25.0	25.0
Parking Garage	3rd floor	N 2VT-12.5LED-PC-1X8	1	0	123.0	0.204	0.98	24.9	24.9
Parking Garage	3rd floor	N 2VT-12.5LED-PC-1X8	1	0	122.8	0.199	0.98	24.2	24.2
Parking Garage	4th floor	N 2VT-12.5LED-PC-1X8	1	0	122.3	0.207	0.98	25.0	25.0
Parking Garage	4th floor	N 2VT-12.5LED-PC-1X8	1	0	122.4	0.214	0.98	25.4	25.4
Parking Garage	4th floor	N 2VT-12.5LED-PC-1X8	1	0	122.0	0.207	0.98	25.1	25.1
Armory	Basement Hallway	R 2L-12.5LED	1	0	119.9	0.206	0.98	24.5	24.5
Armory	Kitchen	R 4L-12.5LED	1	0	119.2	0.421	0.98	49.8	49.8
Armory	Kitchen	R 4L-12.5LED	1	0	120.1	0.416	0.98	49.5	49.5
Armory	Rm 012	R 4L-12.5LED	5	0	119.2	2.170	0.98	252.7	50.5
Armory	1st fl hallway outside restroom	R 2L-12.5LED	1	0	121.3	0.208	0.98	24.4	24.4
Armory	1st fl hallway outside restroom	R 2L-12.5LED	1	0	120.3	0.208	0.98	24.3	24.3
Armory	dish wash room	R 2L-12.5LED	1	0	120.0	0.207	0.97	24.3	24.3
DPW	conf room	R 4L-12.5LED	3	0	122.3	1.278	0.98	155.8	51.9
DPW	planning	R 4L-12.5LED	1	0	122.9	0.450	0.98	53.7	53.7
DPW	hallway	R 2L-12.5LED	1	0	119.9	0.208	0.98	24.0	24.0
DPW	hallway	R 2L-12.5LED	1	0	119.4	0.210	0.98	24.4	24.4
DPW	hallway	R 2L-12.5LED	1	0	119.7	0.206	0.98	24.5	24.5
DPW	hallway	R 2L-12.5LED	1	0	119.6	0.208	0.97	24.3	24.3
DPW	hallway	R 2L-12.5LED	1	0	118.9	0.210	0.98	24.5	24.5
DPW	hallway	R 2L-12.5LED	1	0	118.0	0.213	0.98	24.3	24.3
DPW	hallway	LED 10A	1	0	121.8	0.078	0.98	8.8	8.8

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The average fixture wattage from the above measurements was used in savings calculations. Since LED tubes are direct wired and there are no ballasts, the average watts per 4' LED tube was calculated from the measurements and was applied to additional fixture types based on the quantity of lamps in the fixture.

Table 14: Lighting Wattage Summary used for Calculations

fixture type	Watts/ fixture
N 2VT-12.5LED-PC-1X8	24.7
R 2L-12.5LED	24.4
R 4L-12.5LED	51.0
average watts per LED tube used for fixtures below	12.6
R 3L-12.5LED	37.7
R 1L-12.5LED	12.6
N 2W-12.5LED	25.2
RF 4LIR-12.5LED-1X8	50.3
R 1L-12.5LED-DA	12.6
R 4L-12.5LED-DA	50.3
N 4W-12.5LED	50.3
N 2V-12.5LED-DA	25.2

Appendix D: Water Conservation Measurement Results

Water use was measured on a sample of fixtures during installation September 19, 2017 and on March 13, 2018. Measurements were in gallons per minute (GPM) for showers and sink aerators, and gallons per flush (GPF) for toilets.

Table 15: Water Conservation Measurement Results

Building	Room	Fixture Type	Measurement	Units	Date measured
Rockfield Manor	uni	Shower	1.4	GPM	9/19/17
Parks and Rec	Uni	Gravity Toilet	1.5	GPF	9/19/17
Amphitheater	Women's	Toilet	1.25	GPF	9/19/17
Amphitheater	Women's	Toilet	1.25	GPF	9/19/17
Police	Women's staff	Shower	1.5	GPM	9/19/17
Police	Men's staff	Sink aerator	0.5	GPM	9/19/17
Police	Men's staff	Shower	1.6	GPM	9/19/17
Police	kitchenette	Kitchen aerator	1	GPM	9/19/17
Police	Women's	Sink aerator	0.5	GPM	9/19/17
Police	Men's	Sink aerator	0.5	GPM	9/19/17
Police	kitchenette	Kitchen aerator	0.9	GPM	9/19/17
DPW	Men's locker	Sink aerator	0.5	GPM	3/13/18
DPW	Men's locker	Sink aerator	0.45	GPM	3/13/18
DPW	Men's locker	Shower	1.1	GPM	3/13/18
DPW	Men's locker	Shower	1.2	GPM	3/13/18
DPW	Men	Toilet		GPF	3/13/18
DPW	Men	Sink aerator	0.45	GPM	3/13/18
DPW	Women	Sink aerator	0.5	GPM	3/13/18
Park Comfort Station	Women	Toilet	0.9	GPF	3/13/18
Park Comfort Station	Women	Toilet	0.8	GPF	3/13/18
Park Comfort Station	Women	Sink aerator	0.5	GPM	3/13/18
Park Comfort Station	Men	Sink aerator	0.5	GPM	3/13/18
DPW	Women	Toilet	1.26	GPF	3/13/18
DPW	Men	Toilet	1.18	GPF	3/13/18
DPW	Men Locker	Toilet	1.08	GPF	3/13/18

The average GPM and GPF derived from the above measurements is shown below and was used in savings calculations.

Table 16: Lighting Wattage Summary for Calculations

fixture type	average	Units
gravity toilet	1.50	GPF
kitchen aerator (police stn)	0.95	GPM
shower	1.36	GPM
sink aerator	0.49	GPM
Toilet	1.10	GPF

Appendix E: Building Envelope

Building envelope improvements are shown in detail in the as-built documentation and are summarized below.

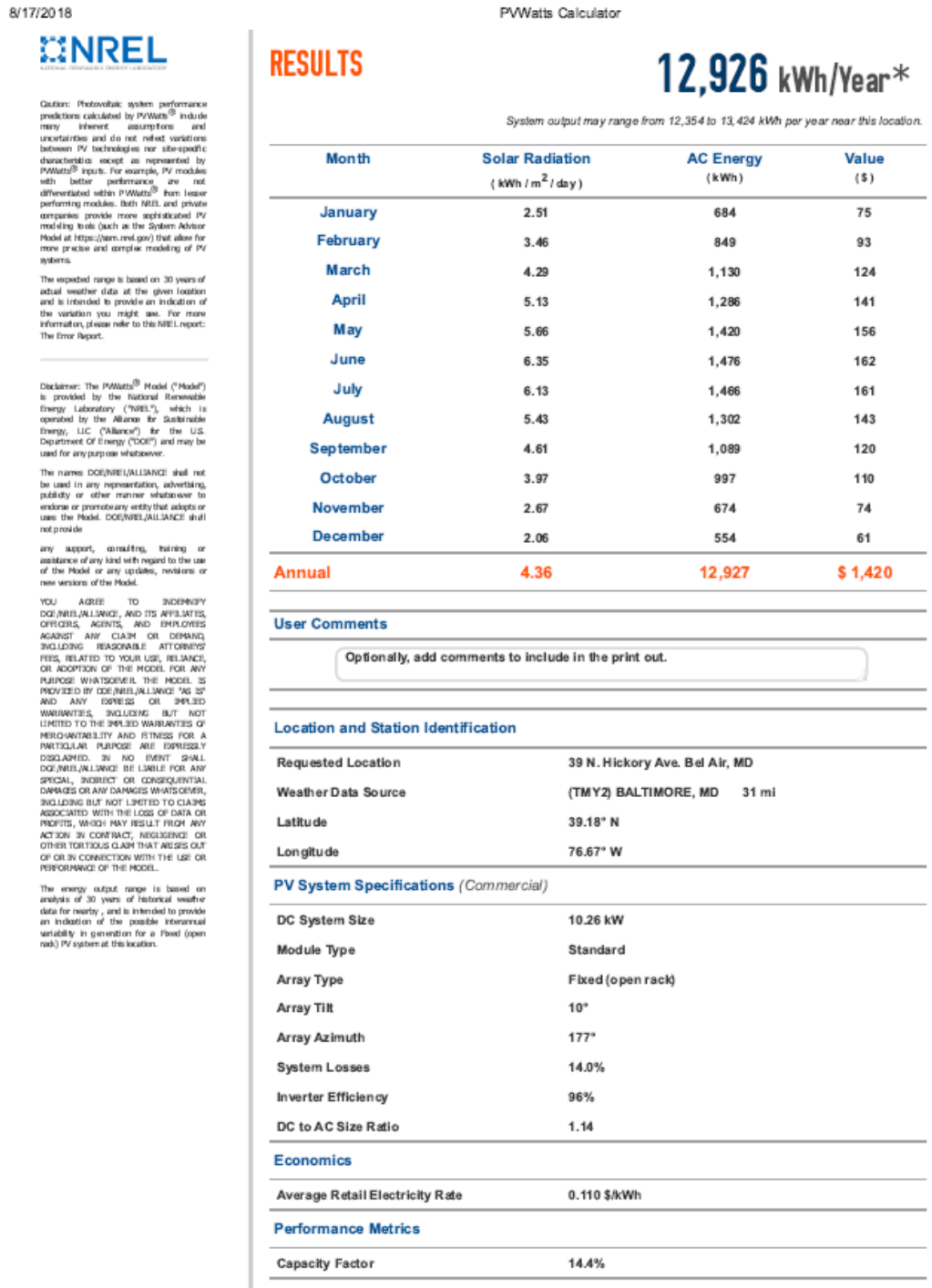
Table 17: Building Envelope SOW summary

Building	Armory	Band Shell	DPW	Parks & Recreation	Rockfield Manor & Tenant House	Town Hall & Police Dept.
Entry door maintenance	10	5	8	3	9	6
Door weather-stripping	10	5	8	3	9	6
Door sweep	10	5	8	3	9	6
Garage door weather-stripping	-	-	8	-	1	-
Worn AC sealing	3				-	
Roof Wall Gaps	-	126 ft	570 ft	-	-	416 ft

Appendix F: Solar PV Expected Annual Production

Expected solar PV performance was calculated using the PVWatts calculator with inputs from the as-built information and is shown below.

Figure 6: PVWatts Calculator Output for Police/Town Hall Solar Installation



<https://pvwatts.nrel.gov/pvwatts.php>

Appendix G: Parking Garage Bills

Parking garage bill reduction was calculated comparing to 2015 Baseline to the Year 1 Performance Period to determine annual kWh reduction.

Table 18: Parking Garage Electric Usage Summary

Month	kWh	Month	kWh	difference
Jan-15	21,700	Jan-19	14681	7,019
Feb-15	22,200	Feb-19	13261	8,939
Mar-15	21,800	Mar-19	12838	8,962
Apr-15	23,900	Apr-19	11991	11,909
May-15	23,200	May-18	12947	10,253
Jun-15	20,800	Jun-18	11588	9,212
Jul-15	25,100	Jul-18	11494	13,606
Aug-15	22,600	Aug-18	12973	9,627
Sep-15	25,900	Sep-18	12421	13,479
Oct-15	20,900	Oct-18	12560	8,340
Nov-15	22,800	Nov-18	14704	8,096
Dec-15	26,200	Dec-18	13670	12,530
Annual Total	277,100		154,264	121,972



Report Delivery Verification

Year 1 Period Performance

Town of Bel Air Guaranteed Energy Performance Project

I have received and reviewed the report for the Year 1 period of the Performance Contract from May 2018 through April 2019. The tables and figures contained in the report support the calculations used to determine the savings numbers shown. The report also contains the agreed-upon methodology used to calculate the cost avoidance for the reporting period.

This report shows a combined utility and operation cost avoidance of \$116,593 for the Year 1 period of the Performance Contract for May 2018 through April 2019.

Please sign below to indicate your receipt of the report for the time period described above.

Town of Bel Air

Signature: _____

Printed Name: _____

Title: _____

Date: _____

Johnson Controls

Signature: _____

Printed Name: _____

Title: _____

Date: _____