Prepared for
City of Smithville

Measurement and Verification Cost Savings Report Year 4

September 1, 2019 through August 31, 2020

Delivered: April 8, 2021

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City of Smithville

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Section 1.0: Executive Summary

1.1 Overview

Energy Cost savings & Revenue increases have exceeded the projected amount by $28,974 (18%). However, at the City's request, Meter Reader O&M savings have been excluded from the savings, resulting in Year 4 Actual Savings at 95% of the projection.

1.1 Report Period

This Measurement & Verification (M&V) Report includes energy and cost saving information for the period from September 1, 2018 through August 31, 2019, corresponding to Year 4 of the 15-year performance period.

1.3 Report Summary

The City of Smithville contracted with Ameresco to replace inefficient energy infrastructure and to improve the efficiency of specific systems throughout the City. The Performance Contract (PC) for this work was executed on July 30, 2015. The construction phase of this project achieved Final Customer Acceptance on August 19, 2016. The actual start date of the performance guarantee period was September 1, 2016.

This Post Construction Measurement & Verification report summarizes the projected energy savings for each of the Energy Conservation Measures (ECMs) for the third year following the acceptance of the project. The intent is to demonstrate that the ECMs are capable of generating the energy cost savings that were projected in the Investment Grade Audit (IGA), dated June 3, 2015, and the PC. This report was developed using the savings calculations, formulas, and explanations defined by the PC and the IGA, as well as the actual post-construction measurements that were taken during the commissioning of certain ECMs.

The ECMs that comprise this project include:

- Retrofit 1 Water and Electric Meter AMI Upgrade
- Retrofit 2 Facility Lighting Retrofits
- Retrofit 3 Street Lighting Retrofits
- Retrofit 4 Gym RTUs Replacement

1.4 Summary of Facility Changes

Rate increases, effective October 2017 & January 2019, increased revenue from the meter systems.

Electric & The meter system continuously experienced a significant number of monthly read failure errors. This resulted in City personnel performing the meter reads manually. To reflect this, the Operations & Maintenance Savings have been reduced by the estimated cost of labor.

1.5 Summary of Project Savings

Table 1.0 summarizes the projected annual Energy Cost Savings, as determined by the calculation methodology presented in the IGA, and reported in the Proforma.

Table 1.0. Year 4 Projected Energy Cost Savings

Guaranteed Savings		*Electricity (kWh)*	*Gas (Therm)*		*Dollar ($)*
• Retrofit 2	Facility Lighting Retrofits	231,690	-710	$	24,208
• Retrofit 3	Street Lighting Retrofits	254,679	0	$	20,424
	Total Guaranteed Savings, Year 4	**486,369**	**-710**	**$**	**44,632**
Additional Savings/Revenue		***Electricity (kWh)***	***Gas (Therm)***		***Dollar ($)***
• Retrofit 1	Water and Electric Meter AMI Upgrade	N/A	N/A	$	118,551
• Retrofit 4	Gym RTUs Replacement	12,791	92	$	1,424
• O&M Savings		N/A	N/A	$	78,320
	Total Additional Savings/Revenue, Year 4	**12,791**	**92**	**$**	**198,296**
Projected Total Savings/Revenue		***Electricity (kWh)***	***Gas (Therm)***		***Dollar ($)***
Project Total Savings		**499,160**	**-618**	**$**	**242,928**

Table 1.1 summarizes the Year 4 Energy Cost Savings, as determined by the calculation methodology presented in the IGA, and measurements taking during the ECM commissioning.

Table 1.1. Year 4 Measured Cost Savings

Measured Savings		*Electricity (kWh)*	*Gas (Therm)*		*Dollar ($)*
• Retrofit 2	Facility Lighting Retrofits	285,037	-710	$	30,328
• Retrofit 3	Street Lighting Retrofits	431,288	0	$	34,587
	Total Measured Guarantee Savings, Year 4	**716,325**	**-710**	**$**	**64,915**
Additional Savings/Revenue		***Electricity (kWh)***	***Gas (Therm)***		***Dollar ($)***
• Retrofit 1	Water and Electric Meter AMI Upgrade	N/A	N/A	$	127,243
• Retrofit 4	Gym RTUs Replacement	12,791	92	$	1,424
• O&M Savings		N/A	N/A	$	38,370
	Total Additional Savings/Revenue, Year 4	**12,791**	**92**	**$**	**167,037**
Year 4 Total Savings/Revenue		***Electricity (kWh)***	***Gas (Therm)***		***Dollar ($)***
Project Total Savings		**729,116**	**-618**	**$**	**231,952**
Percentage of Projected Savings		**146%**	**100%**		**95%**

Energy cost savings projections for Year 4 are recorded in Tables 1.2 and 1.3; energy consumption savings appear in table 1.4.

Table 1.2. Monthly Energy Cost Savings by Retrofit

City of Smithville - Energy Services Agreement
Monthly Savings Summary
Year 4

Utility Savings

	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Total Savings ($)
Refrofit 1: Water and Electric Meter AMI Upgrade	$ 10,604	$ 10,604	$ 10,604	$ 10,604	$ 10,604	$ 10,604	$ 10,604	$ 10,604	$ 10,604	$ 10,604	$ 10,604	$ 10,604	$ 127,243
Refrofit 2: Facility Lighting Retrofits	$ 2,527	$ 2,527	$ 2,527	$ 2,527	$ 2,527	$ 2,527	$ 2,527	$ 2,527	$ 2,527	$ 2,527	$ 2,527	$ 2,527	$ 30,328
Refrofit 3: Street Lighting Retrofits	$ 2,845	$ 3,064	$ 3,253	$ 3,347	$ 3,295	$ 3,130	$ 2,916	$ 2,696	$ 2,512	$ 2,423	$ 2,472	$ 2,635	$ 34,587
Refrofit 4: Gym RTUs Replacement	$ 197	$ 176	$ 9	$ 17	$ 20	$ 15	$ 7	$ 171	$ 188	$ 203	$ 211	$ 211	$ 1,424
Monthly ECM Savings	**$ 16,173**	**$ 16,371**	**$ 16,393**	**$ 16,495**	**$ 16,446**	**$ 16,276**	**$ 16,054**	**$ 15,998**	**$ 15,831**	**$ 15,757**	**$ 15,813**	**$ 15,976**	**$ 193,582**

Operational Savings

	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Total Savings ($)
Refrofit 1: Water and Electric Meter AMI Upgrade	$ 2,706	$ 2,706	$ 2,706	$ 2,706	$ 2,706	$ 2,706	$ 2,706	$ 2,706	$ 2,706	$ 2,706	$ 2,706	$ 2,706	$ 32,473
Refrofit 2: Facility Lighting Retrofits	$ 255	$ 255	$ 255	$ 255	$ 255	$ 255	$ 255	$ 255	$ 255	$ 255	$ 255	$ 255	$ 3,060
Refrofit 3: Street Lighting Retrofits	$ 236	$ 236	$ 236	$ 236	$ 236	$ 236	$ 236	$ 236	$ 236	$ 236	$ 236	$ 236	$ 2,837
TOTAL OPERATIONAL SAVINGS	**$ 3,198**	**$ 3,198**	**$ 3,198**	**$ 3,198**	**$ 3,198**	**$ 3,198**	**$ 3,198**	**$ 3,198**	**$ 3,198**	**$ 3,198**	**$ 3,198**	**$ 3,198**	**$ 38,370**

TOTAL SAVINGS

	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Total Savings ($)
Year 4 Cumulative Total ECM Savings	**$ 19,370**	**$ 38,939**	**$ 58,529**	**$ 78,221**	**$ 97,865**	**$ 117,338**	**$ 136,589**	**$ 155,785**	**$ 174,813**	**$ 193,768**	**$ 212,778**	**$ 231,952**	**$ 231,952**
Year 4 Cumulative Projected Savings	**$ 20,244**	**$ 40,488**	**$ 60,732**	**$ 80,976**	**$ 101,220**	**$ 121,464**	**$ 141,708**	**$ 161,952**	**$ 182,196**	**$ 202,440**	**$ 222,684**	**$ 242,928**	**$ 242,928**
Deviation	**$ (874)**	**$ (1,549)**	**$ (2,203)**	**$ (2,755)**	**$ (3,355)**	**$ (4,126)**	**$ (5,119)**	**$ (6,168)**	**$ (7,383)**	**$ (8,673)**	**$ (9,906)**	**$ (10,976)**	**$ (10,976)**
Percent of Plan	**96%**	**96%**	**96%**	**97%**	**97%**	**97%**	**96%**	**96%**	**96%**	**96%**	**96%**	**95%**	**95%**

Table 1.3. Annual Energy Cost Savings by Utility Type

City of Smithville - Energy Services Agreement Year 4 Cost Savings Summary															
ECM Description	Projected Savings						Actual Savings						Difference	
	Annual Demand ($)	Electricity ($)	Gas ($)	Water / Sewer ($)	Operational Savings	Total ($)	Annual Demand ($)	Electricity ($)	Gas ($)	Water / Sewer ($)	Operational Savings	Total ($)	Over / Under	% of Projection
Refrofit 1: Water and Electric Meter AMI Upgrade	$ 876	$ 49,340	$ -	$ 68,336	$ 72,423	$ 190,975	$ 876	$ 53,275	$ -	$ 73,092	$ 32,473	$ 159,716	$ (31,259)	84%
Refrofit 2: Facility Lighting Retrofits	$ -	$ 24,739	$ (530)	$ -	$ 3,060	$ 27,268	$ -	$ 30,858	$ (530)	$ -	$ 3,060	$ 33,388	$ 6,120	122%
Refrofit 3: Street Lighting Retrofits	$ -	$ 20,424	$ -	$ -	$ 2,837	$ 23,261	$ -	$ 34,587	$ -	$ -	$ 2,837	$ 37,424	$ 14,163	161%
Refrofit 4: Gym RTUs Replacement	$ -	$ 1,356	$ 68	$ -	$ -	$ 1,424	$ -	$ 1,356	$ 68	$ -	$ -	$ 1,424	$ -	100%
Total ALL Proposed	**$ 876**	**$ 95,858**	**$ (462)**	**$ 68,336**	**$ 78,320**	**$ 242,928**	**$ 876**	**$ 120,076**	**$ (462)**	**$ 73,092**	**$ 38,370**	**$ 231,952**	**$ (10,976)**	**95%**

Table 1.4. Annual Energy Consumption Savings by Utility Type

City of Smithville - Energy Services Agreement Year 4 Energy/Resource Savings Summary															
ECM Description	Projected Savings					Actual Savings					Difference				
	Annual Demand (kW)	Electricity (kWh)	Gas (Therms)	Water / Sewer (Kgal)	Total (MMBTU)	Annual Demand (kW)	Electricity (kWh)	Gas (Therms)	Water / Sewer (Kgal)	Total (MMBTU)	Annual Demand (kW)	Electricity (kWh)	Gas (Therms)	Water / Sewer (Kgal)	Total (MMBTU)
Refrofit 1: Water and Electric Meter AMI Upgrade	120	417,999	0	20,959	1,427	120	420,513	0	21,108	1,435	0	2,514	0	149	9
Refrofit 2: Facility Lighting Retrofits	0	231,690	-710	0	720	602	285,037	-710	0	902	602	53,347	0	0	182
Refrofit 3: Street Lighting Retrofits	0	254,679	0	0	869	114	431,288	0	0	1,472	114	176,609	0	0	603
Refrofit 4: Gym RTUs Replacement	0	12,791	92	0	53	0	12,791	92	0	53	0	0	0	0	0
Total ALL Proposed	**120**	**917,159**	**-619**	**20,959**	**3,068**	**837**	**1,149,628**	**-619**	**21,108**	**3,862**	**716**	**232,470**	**0**	**149**	**793**

Section 2.0: Energy Conservation Measure M&V Plans

Ameresco partnered with the City of Smithville, TX to develop a comprehensive Measurement and Verification (M&V) plan to verify continued savings. This is an important part of the performance contract as it provides the basis for the energy savings guarantee and debt-service payment. M&V involves verifying the competence of the project to generate the projected and/or guaranteed savings. The plan also includes measuring the actual periodic performance of the project against the established energy consumption baselines.

Baselines are an essential prerequisite of the M&V plan and are developed from a methodically derived end-use analysis of historical energy consumption data. The analysis includes various techniques from stipulating all factors affecting ECM performance to installing highly accurate metering equipment to monitor facility systems. When selecting the appropriate level of sophistication for a particular plan, considerations such as complexity of the ECM, expected magnitude of savings from the measure, and the risk aversion of customer all influence the final M&V strategy.

In an effort to standardize M&V procedures across the energy industry, the International Performance Measurement and Verification Protocol (IPMVP) was developed in 1994 by a coalition of international organizations led by the United States Department of Energy. Ameresco establishes all M&V strategies and plans referencing these conventions. The approach in determining energy savings involves comparing the energy consumption associated with a facility (or certain energy consuming systems within a facility) before (baseline) and after (post-retrofit) the implementation of the ECM.

The IPMVP defines four M&V options (A, B, C, and D) addressing the requirements of a wide range of energy conservation measures. They provide industry-approved procedures for baseline energy consumption development and post-construction M&V processes. These options are flexible and reflect the considerations mentioned above.

Table 2.0 provides a summary of the M&V options available to measure the savings of applied ECMs.

Table 2.0. IPMVP Measurement and Verification Options

M&V Option	How Savings Are Calculated	Typical Applications
Option A: Partially Measured Retrofit Isolation		
Savings are determined by partial field measurement of the energy use of the system(s) to which an ECM was applied, separate from the energy use of the rest of the facility. Measurements may be either short-term or continuous. Partial measurement means that some but not all parameter(s) may be stipulated, if the total impact of possible stipulation error(s) is not significant to the resultant savings. Careful review of ECM design and installation will ensure that stipulated values fairly represent the probable actual value. Stipulations should be shown in the M&V plan along with analysis of the significance of the error they may introduce.	Engineering calculations using short-term or continuous post-retrofit measurements and stipulations.	Lighting retrofit where power draw is measured periodically. Operating hours of the lights are assumed to be one half hour per day longer than store open hours.
Option B: Retrofit Isolation		
Savings are determined by field measurement of the energy use of the systems to which the ECM was applied, separate from the energy use of the rest of the facility. Short-term or continuous measurements are taken throughout the post-retrofit period.	Engineering calculations using short-term or continuous measurements	Application of controls to vary the load on a constant speed pump using a variable speed drive. Electricity use is measured by a kWh meter installed on the electrical supply to the pump motor. In the base year this meter is in place for a week to verify constant loading. The meter is in place throughout the post-retrofit period to track variations in energy use.
Option C: Whole Facility (Bill Comparison)		
Savings are determined by measuring energy use at the whole facility level. Short-term or continuous measurements are taken throughout the post-retrofit period.	Analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis.	Multifaceted energy management program affecting many systems in a building. Energy use is measured by the gas and electric utility meters for a 12-month base year period and throughout the post-retrofit period.
Option D: Calibrated Simulation (Calibrated Building Modeling)		
Savings are determined through simulation of the energy use of components or the whole facility. Simulation routines must be demonstrated to adequately model actual energy performance measured in the facility. This option usually requires considerable skill in calibrated simulation.	Energy use simulation, calibrated with hourly or monthly utility billing data and/or end- use metering.	Multifaceted energy management program affecting many systems in a building but where no base year data are available. Post-retrofit period energy use is measured by the gas and electric utility meters. Base year energy use is determined by simulation using a model calibrated by the post-retrofit period utility data.

Table 2.1 summarizes the installed ECMs by location and IPMVP Option.

Table 2.1. ECM Matrix

Facility	ECM			
	Water and Electric Meter AMI Upgrade	Facility Lighting Retrofits	Street Lighting Retrofits	Gym RTUs Replacement
City Hall		A		
Police Station		A		
Library		A		
Fire Station 1		A		
Recreation Center		A		S
Fire Station 2		A		
Warehouse		A		
Gazley Sewer Plant		A		
Water Plant		A		
Airport Lounge and Garage		A		
City Wide - Streetlights			A	
City Wide - Meters	A			

Notes:

A = IPMVP Option A

B = IPMVP Option B

C = IPMVP Option C

D = IPMVP Option D

S = Stipulated

Retrofit 1: Water and Electric Meter AMI Upgrade

Energy Conservation Measure Overview

Ameresco installed a fixed-based Advanced Metering Infrastructure (AMI) system, and replaced 1,807 water meters and 2,132 electric meters throughout the city. The new meters have increased accuracy compared to the previous systems, which allows the city to more accurately measure and bill end user consumption. The AMI system will provide automation in the billing system, reduce billing errors, and greatly lower City staff's work load.

Previously, each of the water and electric meters in the City was read manually; the City contracted a meter reader to physically go to each meter, at least once per month, to read the registers, then manually input the readings into their billing system. Monthly bills for water, sewer, and electricity services were then generated accordingly. In the event the meters could not be read for a particular billing cycle, the consumption was estimated.

The AMI system allows for wireless reading of the water and electric meters data, eliminating the need for manual reading and consumption estimation. Combined with billing software, the AMI system also eliminates manual data input by City personnel.

Installing the new AMI system required the City to replace the water and electric meters, as the old water and electric meters could not be retrofitted with radio transmitters. Replacing the water and electric meters also brought the benefit of increased measurement accuracy. This increase, in turn, will allow the City to capture more utility consumption, by the end-user, that otherwise will be unmetered.

This retrofit is also expected to greatly reduce the Operations and Maintenance (O&M) costs the City previously paid to replace and maintain the old meters.

Measurement and Verification Overview

The M&V protocol for Retrofit 1 was established using the guidelines of the IPMVP Option A. This option allows for the measurement of at least one variable, while permitting others to be stipulated constant.

For this retrofit, the average existing meter accuracy was measured from a random, statistical sample of existing meters. Ameresco performed accuracy tests on the existing water meters in two categories: (1) residential 5/8-inch x3/4-inch water meter bench tests, and (2) large 2-inch, 3-inch, and 4-inch water meter field tests. All tests were performed following the AWWA guidelines. Average accuracy for the low flow, mid flow, and high flow was aggregated assuming a 15 percentage / 70 percent / 15 percent usage in each range.

For the small meter bench tests, Ameresco pulled a sample of 68 residential meters (5/8"x3/4" size) and sent them to a testing facility for measurement. The sample size of 68 meters was selected from a sampling design of 10 percent precision with 90 percent confidence interval. For the large meter

field tests, Ameresco performed field tests on 7 (out of 26) 2-inch meters, 2 (out of 4) 3-inch meters, and 1 (out of 1) 4-inch meter.

Table 2.2 summarizes the results of the existing meter accuracy tests.

Table 2.2. Summary of Existing Meter Accuracy Tests

Flow Range	Residential Meter Average Accuracy	2" Meter Average Accuracy	3" Meter Accuracy (High School)	3" Meter Accuracy (Housing Authority)	4" Meter Accuracy
Low flow	74.80%	81.48%	0.00%	50.00%	87.03%
Mid flow	92.18%	99.62%	0.00%	108.99%	79.00%
High flow	97.90%	92.61%	64.64%	110.84%	100.00%
Weighted average	90.43%	95.85%	9.70%	100.42%	83.35%

No testing was performed on the existing electricity meters, nor will testing be done on the newly installed meters. Projected revenue increase from replacing the electric meters is stipulated to be 1 percent of the total billed electricity to the retail customers. This stipulation includes expected meter accuracy increases, billing error reductions, etc.

Measured Variables:

- Average accuracy of existing water meters
- Average accuracy of new water meters

Stipulated Variables:

- Accuracy of the 1" and 1.5" water meters are equal to the accuracy of the 5/8"x3/4" meters
- Water and sewer revenue increase from meter replacement
- Electric revenue increase from meter replacement
- Meter reader salary cost savings
- Meter annual O&M replacement cost savings

Accuracy tests to determine average new meter accuracy will be performed in Year 5, after construction, in similar conditions to the existing meter accuracy tests.

For the residential water meters, in Year 5, Ameresco will pull a sample of 68 meters and install the same replacement meters in their place. The collected meter samples will then be sent to a test facility to measure their average accuracy following the AWWA guidelines. Average accuracy for the low flow, mid flow, and high flow will be aggregated assuming a 15 percentage / 70 percent / 15 percent usage in each range. The verification will be deemed satisfied if the aggregate average accuracy of the sample meters is at least 98.5 percentage.

For the large 2-inch, 3-inch, and 4-inch water meters, in Year 5, Ameresco will perform field tests to determine their average accuracy. All new 2-inch, 3-inch, and 4-inch that will be installed will have test ports to allow for field tests without having to remove the meters from the line. The field tests will be performed according to AWWA guidelines. As in the residential meters, the low flow, mid flow, and high flow accuracies will be aggregated assuming a 15 percent / 70 percent / 15 percent usage pattern. The verification will be deemed satisfied if the aggregate average accuracy of the meters is at least 98.5 percent.

Energy Savings Calculation Methodology

Savings Algorithm:

$$Savings = Water\ \text{Re}venue + Sewer\ \text{Re}venue + Demand\ \text{Re}venue + Energy\ \text{Re}venue + SalarySavings + \text{Re}placementSavings$$

$$Water\ \text{Re}venue = AdditionalMeteredWater \times {}^{\$}/_{kgal}$$

$$AdditionalMeteredWater = MeteredWater \times \left(\frac{PostMeterEff}{BaseMeterEff} - 1 \right)$$

$$Sewer\ \text{Re}venue = AdditionalMeteredSewer \times {}^{\$}/_{kgal}$$

$$AdditionalMeteredSewer = MeteredSewer \times \left(\frac{PostMeterEff}{BaseMeterEff} - 1 \right)$$

$$Demand\ \text{Re}venue = AdditionalMeteredDemand \times {}^{\$}/_{kW}$$

$$AdditionalMeteredDemand = \frac{MeteredDemand}{99\%}$$

$$Energy\ \text{Re}venue = AdditionalMeteredEnergy \times {}^{\$}/_{kWh}$$

$$AdditionalMeteredEnergy = \frac{MeteredEnergy}{99\%}$$

Where:

MeteredWater	=	Baseline metered water amount
MeteredSewer	=	Baseline metered sewer amount
MeteredDemand	=	Baseline metered peak demand usage
MeteredEnergy	=	Baseline metered energy usage
PostMeterEff	=	Retrofit meter efficiency
BaseMeterEff	=	Baseline meter efficiency
SalarySavings	=	Labor costs saved by AMI system; assumed to be $36,908
ReplacementSavings	=	Avoided labor & material costs for meter replacement; stipulated at 30,000

Metering Plan

No physical metering of equipment energy will be provided for this measure. The high level of confidence in the engineering of the ECM and calculation of the associated savings allows the M&V plan to eliminate the cost of a metering strategy and not adversely impact the economics of the program.

Annual Inspection Plan

No annual inspection will be performed on the equipment associated with this retrofit.

Details of any Baseline or Savings Adjustments Made

No baseline or savings adjustments have been made.

Measured Savings for this ECM

Table 2.3. Retrofit 1 Savings Summary

Electricity Revenue	$	53,275
Water Revenue	$	73,092
TOTAL	**$**	**127,243**

Table 2.4. Saving Details - Retrofit 1: Water and Electric Meter AMI Upgrade

City of Smithville - Energy Services Agreement Annual Energy and Demand Savings Summary Measure Name: Refrofit 1: Water and Electric Meter AMI Upgrade Date Inspection Completed: 10/20/20 - 10/21/20			
	Facility Name:	**City Wide - Meters**	**Summary**
Resource Savings	Units	Savings	
Electricity			
Energy	kWh	420,513	420,513
On-Peak Demand	kW	120	120
Fossil Fuel			
Natural Gas	Therms	0	0
Water			
Water	kGallons	21,108	21,108

	Facility Name:	**City Wide - Meters**	**Summary**
Resource Cost Savings	Units	Savings	
Electricity			
Energy	$	$ 53,275	$ 53,275
On-Peak Demand	$	$ 876	$ 876
Fossil Fuel			
Natural Gas	$	$ -	$ -
Water			
Water	$	$ 73,092	$ 73,092
TOTAL COST SAVINGS	$	**$ 127,243**	**$ 127,243**

Retrofit 2: Facility Lighting Retrofits

Energy Conservation Measure Overview

Ameresco retrofitted over 1,200 existing light fixtures, lamps, and controls at the City facilities with new and more efficient lighting technology. These retrofits will significantly reduce electricity consumption at the facilities.

The previous lighting systems at the City's facilities were a mixture of different types. The majority of the facilities had recessed fluorescent light fixtures with 34W T12 lamps and magnetic ballasts. Some facilities had 32W T8 lamps and electronic ballasts. Small quantities of incandescent lamps were also present. The garage spaces at the fire stations and warehouse had high bay light fixtures with 400W metal halide lamps. Exterior lighting at the facilities was typically wall-mounted fixtures with incandescent or metal halide lamps. Some facilities had arm-mounted cobrahead or barn-yard area light fixtures for exterior illumination.

Ameresco's lighting strategy standardized the lighting system as much as was practical. Fixtures throughout the city containing standard efficiency 4-foot T12 and T8 lamps were replaced or retrofitted with premium efficiency T8 lamps and high-quality electronic ballasts. Ballast output was tailored to each specific location to obtain desired light levels without sacrificing energy savings. In fixtures deemed unsuitable for the T8 lamps, premium efficiency LED lamps were installed. Ameresco also installed occupancy sensors in offices, restrooms, and other areas with intermittent occupancy. Lighting controls realize savings by turning lighting off when the rooms are unoccupied, and lighting is not needed, thereby reducing the number of operating hours. Most exterior lights at the facilities had existing photo sensors for controls, and were undisturbed.

The new lighting systems utilize use extended-life lamps, which will increase the time between burnouts. This, along with the standardized lamp types, will reduce maintenance costs associated with purchasing, storing, and replacing lamps.

Measurement and Verification Overview

The M&V protocol for Retrofit 2 was established using the guidelines of the IPMVP Option A. This option allows for the measurement of at least one variable, while permitting others to be stipulated constant.

For this retrofit, the power consumption (wattage) was measured from a random, statistical sample of each type of existing and project installed lighting fixture. The sample types included individual fixtures or specific lighting circuits with the same lamp/ballast combination operating at full output. The sample quantities were determined in reference to the Federal Energy Management Program (FEMP) protocol, using a sampling plan with a confidence level of 80% and ±20% uncertainty. The pre- and post- retrofit power measurements occurred at the time of installation.

Measured Variables:

- Baseline power consumption of select light fixtures
- Post retrofit power consumption of select light fixtures

Stipulated Variables:

- Run hours of light fixtures
- Heating system efficiency
- Number of heating months
- Cooling system efficiency
- Number of cooling months
- Energy rates

The measurements determined that the savings total was within ± 10% of the projections, verifying that this ECM is saving energy as designed.

Energy Savings Calculation Methodology

Savings Algorithm:

$$Savings = Light\$Savings - Heat + Cool$$

$$Light\$Savings = LightkWhSavings \times {}^{\$}/_{kWh}$$

$$LightkWhSavings = BasekWh - PostkWh$$

$$BasekWh = \sum_{fixtures} \left(kW_{Base} \times hrs_{Base} \right)$$

$$PostkWh = \sum_{fixtures} \left(kW_{Post} \times hrs_{Post} \right)$$

$$Heat = \frac{(BasekWh - PostkWh) \times \%Vent \times \frac{Mths_{Heat}}{12 months} \times 3.413 \, {}^{kBTU}/_{kWh}}{HeatEff \times 100 \, {}^{kBTU}/_{Therm}} \times {}^{\$}/_{Therm}$$

$$Cool = \frac{(BasekWh - PostkWh) \times (1 - \%Vent) \times \frac{Mths_{Cool}}{12 months} \times 3.413 \, {}^{kBTU}/_{kWh}}{12 \, {}^{kBTU}/_{ton \cdot hr} / _{CoolEff}} \times {}^{\$}/_{kWh}$$

Where:

kW_{Base}	=	Base fixture kW
kW_{Post}	=	Retrofit fixture kW
Hrs_{Base}	=	Base fixture operating hours
hrs_{Post}	=	Retrofit fixture hours, including reductions by sensors
MthsHeat	=	Number of months heating penalty will occur; assumed to be 3 months
MthsCool	=	Number of months the cooling benefit will occur; assumed to be 8 months
HeatEff	=	Heating system efficiency; assumed to be 80%
CoolEff	=	Cooling system efficiency; assumed to be 1.0 kW/ton
$/kWh	=	Unit cost of electrical energy as per Unit Prices section
$/therm	=	Unit cost of electrical demand as per Unit Prices section

Metering Plan

No physical metering of equipment energy will be provided for this measure. The high level of confidence in the engineering of the ECM and calculation of the associated savings allows the M&V plan to eliminate the cost of a metering strategy and not adversely impact the economics of the program.

Annual Inspection Plan

As part of the services provided under the measurement and verification agreement, Ameresco will visually inspect a sample of fixtures to verify the lamp types are as efficient as those proposed in the IGA. The observations recorded during this inspection will be included in Section 3.0 of this report, and inspection documentation will be included in Section 4.0.

Details of any Baseline or Savings Adjustments

No baseline or savings adjustments have been made.

Measured Savings for this ECM

Table 2.5. Retrofit 2 Savings Summary

Electricity Cost Savings	$	30,858
Fossil Fuel Cost Savings	$	(530)
TOTAL	**$**	**30,328**

Table 2.6. Saving Details – Retrofit 2: Facility Lighting Retrofits

City of Smithville - Energy Services Agreement
Annual Energy and Demand Savings Summary
Measure Name: **Refrofit 2: Facility Lighting Retrofits**
Date Inspection Completed: **10/20/20 - 10/21/20**

	Facility Name:	City Hall	Police Station	Library	Fire Station 1	Recreation Center	Fire Station 2	Warehouse	Gazley Sewer Plant	Water Plant	Airport Lounge and Garage	Summary
Resource Savings	Units	Savings	Savings	Savings	Savings	Savings	Savings	Savings	Savings	Savings	Savings	
Electricity												
Energy	kWh	27,058	20,777	17,746	21,377	112,349	7,788	41,535	7,204	6,374	22,829	285,037
On-Peak Demand	kW	70	54	64	43	235	13	51	4	7	61	602
Fossil Fuel												
Natural Gas	Therms	0	0	0	-167	-483	-61	0	0	0	0	-710
Water												
Water	kGallons	0	0	0	0	0	0	0	0	0	0	0

	Facility Name:	City Hall	Police Station	Library	Fire Station 1	Recreation Center	Fire Station 2	Warehouse	Gazley Sewer Plant	Water Plant	Airport Lounge and Garage	Summary
Resource Cost Savings	Units	Savings	Savings	Savings	Savings	Savings	Savings	Savings	Savings	Savings	Savings	
Electricity												
Energy	$	$ 2,868	$ 2,203	$ 1,881	$ 2,266	$ 11,910	$ 826	$ 4,403	$ 764	$ 676	$ 3,062	$ 30,858
On-Peak Demand	$	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fossil Fuel												
Natural Gas	$	$ -	$ -	$ -	$ (125)	$ (360)	$ (45)	$ -	$ -	$ -	$ -	$ (530)
Water												
Water	$	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL COST SAVINGS	$	**$ 2,868**	**$ 2,203**	**$ 1,881**	**$ 2,142**	**$ 11,550**	**$ 780**	**$ 4,403**	**$ 764**	**$ 676**	**$ 3,062**	**$ 30,328**

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Retrofit 3: Street Lighting Retrofits

Energy Conservation Measure Overview

The majority of streetlights at the City were barn-yard area light fixtures mounted on electrical poles, with 175W metal halide lamps. Some streetlights were cobrahead style light fixtures, also mounted on electrical poles, with 100W High Pressure Sodium lamps. The historic downtown area in the City had exterior decorative pole-mounted globe lights with incandescent or compact fluorescent lamps. A few of these decorative globe lights were also found at the RVIC's village at the southeast of the City.

Ameresco replaced 571 existing streetlights at the City with new and more efficient lighting technology. The 175W barn-yard area style streetlights were replaced with 48W Cooper LED area light fixtures. The 100W cobrahead style streetlights were replaced with 53W CREE LED cobrahead light fixtures. The incandescent and compact fluorescent lamps within the exterior decorative pole streetlights were replaced with 19W screw in LED lamps.

The new lighting systems utilize use extended-life lamps, which will increase the time between burnouts. This, along with the standardized lamp types, will reduce maintenance costs associated with purchasing, storing, and replacing lamps.

Measurement and Verification Overview

The M&V protocol for Retrofit 3 was established using the guidelines of the IPMVP Option A. This option allows for the measurement of at least one variable, while permitting others to be stipulated constant.

For this retrofit, the power consumption (wattage) was measured from a random, statistical sample of each type of existing and project installed lighting fixture. The sample types included individual fixtures or specific lighting circuits with the same lamp/ballast combination operating at full output. The sample quantities were determined in reference to the Federal Energy Management Program (FEMP) protocol, using a sampling plan with a confidence level of 80% and ±20% uncertainty. The pre- and post- retrofit power measurements occurred at the time of installation.

Measured Variables:

- Baseline power consumption of select light fixtures
- Post retrofit power consumption of select light fixtures

Stipulated Variables:

- Run hours of light fixtures
- Energy rates

The measurements determined that the savings total was within ± 10% of the projections, verifying that this ECM is saving energy as designed.

Energy Savings Calculation Methodology

Savings Algorithm:

$$Savings = Light\$Savings$$

$$Light\$Savings = LightkWhSavings \times {}^{\$}/_{kWh}$$

$$LightkWhSavings = BasekWh - PostkWh$$

$$BasekWh = \sum_{fixtures} \left(kW_{Base} \times hrs \right)$$

$$PostkWh = \sum_{fixtures} \left(kW_{Post} \times hrs \right)$$

Where:

kW_{Base}	=	Base fixture kW
kW_{Post}	=	Retrofit fixture kW
hrs	=	Fixture operating hours; assumed to be dusk to dawn.
$/kWh	=	Unit cost of electrical energy as per Unit Prices section

Metering Plan

No physical metering of equipment energy will be provided for this measure. The high level of confidence in the engineering of the ECM and calculation of the associated savings allow the M&V plan to eliminate the cost of a metering strategy and not adversely impact the economics of the measure.

Annual Inspection Plan

As part of the services provided under the measurement and verification agreement, Ameresco will visually inspect a sample of fixtures to verify the lamp types are as efficient as those proposed in the IGA. The observations recorded during this inspection will be included in Section 3.0 of this report, and inspection documentation will be included in Section 4.0.

Details of any Baseline or Savings Adjustments

No baseline or savings adjustments have been made.

Measured Savings for this ECM

Table 2.7. Retrofit 3 Savings Summary

Electricity Cost Savings	$	34,587
Fossil Fuel Cost Savings	$	0
TOTAL	**$**	**34,587**

Table 2.8. Saving Details – Retrofit 3: Street Lighting Retrofits

City of Smithville - Energy Services Agreement Annual Energy and Demand Savings Summary Measure Name: Refrofit 3: Street Lighting Retrofits Date Inspection Completed: 10/20/20 - 10/21/20			
	Facility Name:	**City Wide - Streetlights**	**Summary**
Resource Savings	Units	Savings	
Electricity			
Energy	kWh	431,288	431,288
On-Peak Demand	kW	114	114
Fossil Fuel			
Natural Gas	Therms	0	0
Water			
Water	kGallons	0	0

	Facility Name:	**City Wide - Streetlights**	**Summary**
Resource Cost Savings	Units	Savings	
Electricity			
Energy	$	$ 34,587	$ 34,587
On-Peak Demand	$	$ -	$ -
Fossil Fuel			
Natural Gas	$	$ -	$ -
Water			
Water	$	$ -	$ -
TOTAL COST SAVINGS	$	**$ 34,587**	**$ 34,587**

Retrofit 4: Gym RTUs Replacement

Energy Conservation Measure Overview

The City recently replaced the two roof top units (RTUs) serving the gym at the Recreation Center in March 2015. The two RTUs are packaged DX units with natural gas burners. Because of the increased efficiency of the new units compared to the old, there will be energy and cost savings from this replacement. Ameresco estimated this cost savings, and the City agreed to include it in the project cash flow as a stipulated amount.

Measurement and Verification Overview

This Retrofit was purchased and installed by the District; no M&V services will be provided.

Energy Savings Calculation Methodology

Savings Algorithm:

$$Savings = Light\$Savings - Heat + Cool$$

$$Light\$Savings = LightkWhSavings \times {}^{\$}/_{kWh}$$

$$kWhSavings = BasekWh - PostkWh$$

$$ThermSavings = BaseTherm - PostTherm$$

$$EnvelopeHeatTransfer = Ufactor \times Area \times (T_{outside} - T_{inside})$$

$$VentilationHeatTransfer = 1.08 \times CFM_{OutsideAir} \times (T_{outside} - T_{inside})$$

$$SolarHeatGain = ShadingCoeff \times SolarRadiation \times WindowSF$$

$$InternalHeatGain = OccupantHeat \times LightingHeat \times PlugEquipmentHeat$$

$$TotalHeatGain = EnvelopeHeatTransfer + VentilationHeatTransfer + SolarHeatGain + InternalHeatGain$$

$$TotalHeatLoss = EnvelopeHeatTransfer + VentilationHeatTransfer + SolarHeatGain + InternalHeatGain$$

$$Heat = \frac{(BasekWh - PostkWh) \times \%Vent \times \frac{Mths_{Heat}}{12months} \times 3.413\,{}^{kBTU}/_{kWh}}{HeatEff \times 100\,{}^{kBTU}/_{Therm}} \times {}^{\$}/_{Therm}$$

$$Cool = \frac{(BasekWh - PostkWh) \times (1 - \%Vent) \times \frac{Mths_{Cool}}{12months} \times 3.413\,{}^{kBTU}/_{kWh}}{12\,{}^{kBTU}/_{ton \cdot hr}/_{CoolEff}} \times {}^{\$}/_{kWh}$$

Where:

kW_{Base}	=	Base fixture kW
kW_{Post}	=	Retrofit fixture kW
Hrs_{Base}	=	Base fixture operating hours
hrs_{Post}	=	Retrofit fixture hours, including reductions by sensors
MthsHeat	=	Number of months heating penalty will occur; assumed to be 3 months
MthsCool	=	Number of months the cooling benefit will occur; assumed to be 8 months
HeatEff	=	Heating system efficiency; assumed to be 80%
CoolEff	=	Cooling system efficiency; assumed to be 1.0 kW/ton
$/kWh	=	Unit cost of electrical energy as per Unit Prices section
$/therm	=	Unit cost of electrical demand as per Unit Prices section

Metering Plan

No physical metering of equipment energy will be provided for this measure. The high level of confidence in the engineering of the ECM and calculation of the associated savings allow the M&V plan to eliminate the cost of a metering strategy and not adversely impact the economics of the measure.

Annual Inspection Plan

No annual inspection will be performed on the equipment associated with this retrofit.

Details of any Baseline or Savings Adjustments

No baseline or savings adjustments have been made.

Measured Savings for this ECM

Table 2.9. Retrofit 4 Savings Summary

Electricity Cost Savings	$	1,356
Fossil Fuel Cost Savings	$	68
TOTAL	**$**	**1,424**

Table 2.10. Saving Details – Retrofit 4: Gym RTUs Replacement

City of Smithville - Energy Services Agreement Annual Energy and Demand Savings Summary Measure Name: Refrofit 4: Gym RTUs Replacement Date Inspection Completed: 10/20/20 - 10/21/20			
	Facility Name:	**Recreation Center**	**Summary**
Resource Savings	Units	Savings	
Electricity			
Energy	kWh	12,791	12,791
On-Peak Demand	kW	0	0
Fossil Fuel			
Natural Gas	Therms	92	92
Water			
Water	kGallons	0	0

	Facility Name:	**Recreation Center**	**Summary**
Resource Cost Savings	Units	Savings	
Electricity			
Energy	$	$ 1,356	$ 1,356
On-Peak Demand	$	$ -	$ -
Fossil Fuel			
Natural Gas	$	$ 68	$ 68
Water			
Water	$	$ -	$ -
TOTAL COST SAVINGS	$	**$ 1,424**	**$ 1,424**

Section 3.0: Performance Period M&V Activities

The Year 3 inspection Was performed on October 20 & 21, 2020. Measurement and verification activities performed during the contract period coincide with annual on-site inspection and vary by measure. In general, the activities included interviews with on-site maintenance and facility personnel responsible for the equipment, reviews of maintenance records, and a visual inspection of the equipment. Variations in equipment and/or operation that are, or potentially could be, adversely affecting system performance are documented in this section.

Inspection documentation can be found in Section 4.0.

Retrofit 1: Water and Electric Meter AMI Upgrade

Annual Inspection Results

Annual inspection of associated equipment will not be performed for this measure. Meter accuracy tests will be performed in Year 5.

The AMI collectors had been moved off of the water towers to allow for water tower refurbishments.

Retrofit 2: Facility Lighting Retrofits

Annual Inspection Results

The majority of the inspected lighting fixtures and lamps were found to be properly installed, in excellent condition, and were observed and/or reported by facility staff to be operating normally. The following exceptions were noted:

- 1 T8 Lamp out in City Hall Open Office.
- A few lamps were removed due to a roof leak at the Library.
- 2 Wallpack fixtures were out at the Rec Center

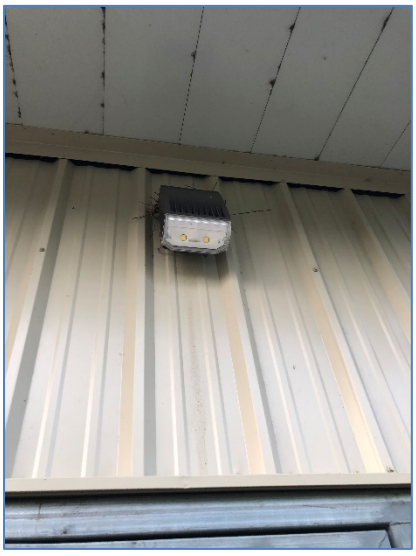

Image 3.0. Inoperable Wallpack Fixture.

Retrofit 3: Street Lighting Retrofits

Annual Inspection Results

The majority of the inspected lighting fixtures and lamps were found to be properly installed, in excellent condition, and were observed and/or reported by facility staff to be operating normally. The following exceptions were noted:

- 1 Barnyard fixture out on NE 8th st, East of Charleston Blvd.
- 1 Barnyard fixture out near intersection of SE 5th st. & Yeager st.
- 1 Barnyard fixture out near intersection of N 3rd st.. & Turney st.
- 1 Barnyard fixture out near intersection of N 3rd st.. & Bishop st.

Retrofit 4: Gym RTUs Replacement

Annual Inspection Results

Annual inspection of associated equipment will not be performed for this measure.

Section 4.0: Inspection Documentation

Measurement & Verification Inspection Activities

Project Name: City of Smithville, TX
Project Number: 05382

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for City of Smithville, TX

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Site Specific M&V Inspection Instructions
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ECM 2: Facility Lighting Retrofits
ECM 3: Street Lighting Retrofits
ECM 4: Gym RTUs Replacement

City of Smithville, TX
317 Main Street, Smithville, TX 78957

GENERAL PROJECT MEASUREMENT & VERIFICATION INSTRUCTIONS

The Measurement and Verification (M&V) Plan requires specific activities be performed on the Energy Conservation Measures (ECMs) associated with this project. This document contains the worksheets to record the observations of the assessment for eight of nine ECMs and must be completed to satisfy part of the inspection requirements. The table on the following page provides a summary of the measures selected for the inspection with a brief explanation of the M&V activities required for each.

The Ameresco representative will obtain the information for the designated measures during each Performance Period Year; an owner representative has the option to observe the collection of the M&V information. Each of the worksheets provided in this document will be signed by the Ameresco representative performing the inspection.

MEASUREMENT & VERIFICATION INSPECTION FORMS

Project Name:	City of Smithville, TX
Project Number:	05382
Location:	317 Main Street, Smithville, TX 78957
Date of Inspection:	10/20/2020 - 10/21/2020
M&V Project Contact:	Travis Prill
Phone #:	(480) 499-9158
Email:	tprill@ameresco.com

ECM #	ECM Description	Performance Period Activities	Sample Qty.	Location	Notes
1	Water and Electric Meter AMI Upgrade	No Inspections will be performed on this ECM.	83		
2	Facility Lighting Retrofits	Visual inspection of a statistically relevant sample of equipment to verify proper installation, operation and maintenance.			
3	Street Lighting Retrofits	Visual inspection of a statistically relevant sample of lamps to verify proper equipment installation, operation and maintenance.			
4	Gym RTUs Replacement	No Inspections will be performed on this ECM.			

City of Smithville, TX

ECM 2: Facility Lighting Retrofits & ECM 3: Street Lighting Retrofits

M&V Instructions

Visual inspection of a statistically relevant sample of equipment to verify proper installation, operation and maintenance.

Statistical Sampling Criteria	
Precision	20%
Confidence	80%
Population Size N	**Sample Size n**
1	1
2	2
4	3
6	4
9	5
14	6
22	7
36	8
73	9
426	10
> 426	11

Inspection Groups			
Lamp Types			
Group	**Identifier**	**Population Size N**	**Sample Size n**
L1	T8	535	11
L2	Barnyard	344	10
L3	SI	342	10
L4	Cobra	49	9
L5	Lowbay	43	9
L6	Shoebox	16	7
L7	WPK	13	6
L8	Drum	8	5
S1	WIR	73	9
S2	CDT	22	7
	Lamp Total	**1350**	**67**
	Sensor Total	**95**	**16**
ECM 1	**Equipment Total**	**1445**	**83**

ECM 2: Facility Lighting Retrofits & ECM 3: Street Lighting Retrofits

Project Name: City of Smithville, TX
Project Number: 05382
No Inspections will be performed on this ECM.

Item #	Group Type	Facility	Location	Area Type	Unit Code	Qty in Area	Unit in Place? [Y or N]	Unit Operational? [Y or N]	Comments / Notes
1	T8	City Hall	Office Open Secretary	office open	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	6	Y	Y	1 T8 lamp out
2	T8	City Hall	Office Open Secretary	office open	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	6	Y	Y	
3	T8	Library	Library Children	library	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	6	Y	Y	Some lamps removed due to roof leak.
4	T8	Fire Station 1	Lounge Staff	lounge	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	10	Y	Y	
5	T8	Fire Station 1	Lounge Staff	lounge	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	10	Y	Y	
6	T8	Recreation Center	Hall Off Lobby (2)	hall	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	9	Y	Y	
7	T8	Recreation Center	Hall Off Lobby (2)	hall	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	9	Y	Y	
8	T8	Fire Station 2	Hall To Staff	hall	FLU-F32T8/25W-80(2): B-T8-2-32-PS-LP(1)	1	Y	Y	
9	T8	Warehouse	Repair Garage Min	repair garage	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	15	Y	Y	
10	T8	Warehouse	Repair Garage Min	repair garage	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	15	Y	Y	
11	T8	Warehouse	Repair Garage Min	repair garage	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	15	Y	Y	

The above equipment was inspected on the signature date below; all information is affirmed to be true and correct.

Ameresco Representative: Travis Prill **Signature:** Travis Prill **Date:** 10/20/2020 - 10/21/2020

ECM 2: Facility Lighting Retrofits & ECM 3: Street Lighting Retrofits

Project Name: City of Smithville, TX
Project Number: 05382
No Inspections will be performed on this ECM.

Item #	Group Type	Facility	Location	Area Type	Unit Code	Qty in Area	Unit in Place? [Y or N]	Unit Operational? [Y or N]	Comments / Notes
1	Barnyard	Fire Station 1	Bldg Mt Total	bldg mt	LED-48W-BARNYARD(1): NA(0)	1	Y	Y	
2	Barnyard	Fire Station 1	Bldg Mt Total	bldg mt	LED-39W-BARNYARD(1): NA(0)	1	Y	Y	
3	Barnyard	Fire Station 2	Bldg Mt Total	bldg mt	LED-39W-BARNYARD(1): NA(0)	3	Y	Y	
4	Barnyard	Fire Station 2	Bldg Mt Total	bldg mt	LED-39W-BARNYARD(1): NA(0)	3	Y	Y	
5	Barnyard	Fire Station 2	Bldg Mt Total	bldg mt	LED-39W-BARNYARD(1): NA(0)	3	Y	Y	
6	Barnyard	Warehouse	Bldg Mt Total	bldg mt	LED-39W-BARNYARD(1): NA(0)	5	Y	Y	
7	Barnyard	Warehouse	Bldg Mt Total	bldg mt	LED-39W-BARNYARD(1): NA(0)	5	Y	Y	
8	Barnyard	Warehouse	Bldg Mt Total	bldg mt	LED-39W-BARNYARD(1): NA(0)	5	Y	Y	
9	Barnyard	Warehouse	Bldg Mt Total	bldg mt	LED-39W-BARNYARD(1): NA(0)	5	Y	Y	
10	Barnyard	Warehouse	Bldg Mt Total	bldg mt	LED-39W-BARNYARD(1): NA(0)	5	Y	Y	
11									

The above equipment was inspected on the signature date below; all information is affirmed to be true and correct.

Ameresco Representative: Travis Prill **Signature:** Travis Prill **Date:** 10/20/2020 - 10/21/2020

ECM 2: Facility Lighting Retrofits & ECM 3: Street Lighting Retrofits

Project Name: City of Smithville, TX
Project Number: 05382
No Inspections will be performed on this ECM.

Item #	Group Type	Facility	Location	Area Type	Unit Code	Qty in Area	Unit in Place? [Y or N]	Unit Operational? [Y or N]	Comments / Notes
1	SI	City Hall	Kitchen 34	kitchen	LED-9.5W-A-SI(1): NA(0)	3	Y	Y	
2	SI	Police Station	Bldg Mt Total	bldg mt	LED-9.5W-A-SI(1): NA(0)	2	Y	Y	
3	SI	Library	Bldg Mt Total	bldg mt	LED-9.5W-A-SI(1): NA(0)	11	Y	Y	
4	SI	Library	Bldg Mt Total	bldg mt	LED-9.5W-A-SI(1): NA(0)	11	Y	Y	
5	SI	Library	Bldg Mt Total	bldg mt	LED-9.5W-A-SI(1): NA(0)	11	Y	Y	
6	SI	Library	Bldg Mt Total	bldg mt	LED-9.5W-A-SI(1): NA(0)	11	Y	Y	
7	SI	Library	Bldg Mt Total	bldg mt	LED-9.5W-A-SI(1): NA(0)	11	Y	Y	
8	SI	Fire Station 1	Stair Main	stair	LED-9.5W-A-SI(1): NA(0)	2	Y	Y	
9	SI	Fire Station 2	Lounge Staff	lounge	LED-9.5W-A-SI(1): NA(0)	3	Y	Y	
10	SI	Fire Station 2	Lounge Staff	lounge	LED-9.5W-A-SI(1): NA(0)	3	Y	Y	
11									

The above equipment was inspected on the signature date below; all information is affirmed to be true and correct.

Ameresco Representative: **Travis Prill** Signature: Travis Prill Date: **10/20/2020 - 10/21/2020**

ECM 2: Facility Lighting Retrofits & ECM 3: Street Lighting Retrofits

Project Name: City of Smithville, TX
Project Number: 05382
No Inspections will be performed on this ECM.

Item #	Group Type	Facility	Location	Area Type	Unit Code	Qty in Area	Unit in Place? [Y or N]	Unit Operational? [Y or N]	Comments / Notes
1	Cobra	Streetlighting	Street Totals	street	LED-53W-COBRA(1): NA(0)	48	Y	Y	
2	Cobra	Streetlighting	Street Totals	street	LED-53W-COBRA(1): NA(0)	48	Y	Y	
3	Cobra	Streetlighting	Street Totals	street	LED-53W-COBRA(1): NA(0)	48	Y	Y	
4	Cobra	Streetlighting	Street Totals	street	LED-53W-COBRA(1): NA(0)	48	Y	Y	
5	Cobra	Streetlighting	Street Totals	street	LED-53W-COBRA(1): NA(0)	48	Y	Y	
6	Cobra	Streetlighting	Street Totals	street	LED-53W-COBRA(1): NA(0)	48	Y	Y	
7	Cobra	Streetlighting	Street Totals	street	LED-53W-COBRA(1): NA(0)	48	Y	Y	
8	Cobra	Streetlighting	Street Totals	street	LED-53W-COBRA(1): NA(0)	48	Y	Y	
9	Cobra	Streetlighting	Street Totals	street	LED-53W-COBRA(1): NA(0)	48	Y	Y	
10									
11									

The above equipment was inspected on the signature date below; all information is affirmed to be true and correct.

Ameresco Representative: **Travis Prill** Signature: Travis Prill Date: **10/20/2020 - 10/21/2020**

ECM 2: Facility Lighting Retrofits & ECM 3: Street Lighting Retrofits

Project Name: City of Smithville, TX
Project Number: 05382
No Inspections will be performed on this ECM.

Item #	Group Type	Facility	Location	Area Type	Unit Code	Qty in Area	Unit in Place? [Y or N]	Unit Operational? [Y or N]	Comments / Notes
1	Lowbay	Fire Station 1	Repair Garage Main Trucks	repair garage	LED-100W-LOWBAY(1): NA(0)	5	Y	Y	
2	Lowbay	Recreation Center	Gym Main	gym	LED-100W-LOWBAY(1): NA(0)	20	Y	Y	
3	Lowbay	Recreation Center	Gym Main	gym	LED-100W-LOWBAY(1): NA(0)	20	Y	Y	
4	Lowbay	Recreation Center	Gym Main	gym	LED-100W-LOWBAY(1): NA(0)	20	Y	Y	
5	Lowbay	Recreation Center	Gym Main	gym	LED-100W-LOWBAY(1): NA(0)	20	Y	Y	
6	Lowbay	Warehouse	Repair Garage Min	repair garage	LED-100W-LOWBAY(1): NA(0)	6	Y	Y	
7	Lowbay	Airport	Repair Garage Hanger	repair garage	LED-100W-LOWBAY(1): NA(0)	2	Y	Y	
8	Lowbay	Airport	Repair Garage Hanger	repair garage	LED-100W-LOWBAY(1): NA(0)	10	Y	Y	
9	Lowbay	Airport	Repair Garage Hanger	repair garage	LED-100W-LOWBAY(1): NA(0)	10	Y	Y	
10									
11									

The above equipment was inspected on the signature date below; all information is affirmed to be true and correct.

Ameresco Representative: Travis Prill **Signature:** Travis Prill **Date:** 10/20/2020 - 10/21/2020

ECM 2: Facility Lighting Retrofits & ECM 3: Street Lighting Retrofits

Project Name: City of Smithville, TX
Project Number: 05382
No Inspections will be performed on this ECM.

Item #	Group Type	Facility	Location	Area Type	Unit Code	Qty in Area	Unit in Place? [Y or N]	Unit Operational? [Y or N]	Comments / Notes
1	Shoebox	City Hall	Walkway Dropbox	walkway	LED-93W-SHOEBOX(1): NA(0)	1	Y	Y	
2	Shoebox	Recreation Center	Bldg Mt Total	bldg mt	LED-93W-SHOEBOX(1): NA(0)	15	Y	Y	
3	Shoebox	Recreation Center	Bldg Mt Total	bldg mt	LED-93W-SHOEBOX(1): NA(0)	15	Y	Y	
4	Shoebox	Recreation Center	Bldg Mt Total	bldg mt	LED-93W-SHOEBOX(1): NA(0)	15	Y	Y	
5	Shoebox	Recreation Center	Bldg Mt Total	bldg mt	LED-93W-SHOEBOX(1): NA(0)	15	Y	Y	
6	Shoebox	Recreation Center	Bldg Mt Total	bldg mt	LED-93W-SHOEBOX(1): NA(0)	15	Y	Y	
7	Shoebox	Recreation Center	Bldg Mt Total	bldg mt	LED-93W-SHOEBOX(1): NA(0)	15	Y	Y	
8									
9									
10									
11									

The above equipment was inspected on the signature date below; all information is affirmed to be true and correct.

Ameresco Representative: **Travis Prill** Signature: Travis Prill Date: **10/20/2020 - 10/21/2020**

ECM 2: Facility Lighting Retrofits & ECM 3: Street Lighting Retrofits

Project Name: City of Smithville, TX
Project Number: 05382
No Inspections will be performed on this ECM.

Item #	Group Type	Facility	Location	Area Type	Unit Code	Qty in Area	Unit in Place? [Y or N]	Unit Operational? [Y or N]	Comments / Notes
1	WPK	Library	Bldg Mt Total	bldg mt	LED-20W-WPK(1): NA(0)	2	Y	Y	
2	WPK	Recreation Center	Bldg Mt Total	bldg mt	LED-30W-WPK(1): NA(0)	8	Y	Y	
3	WPK	Recreation Center	Bldg Mt Total	bldg mt	LED-30W-WPK(1): NA(0)	8	Y	Y	
4	WPK	Recreation Center	Bldg Mt Total	bldg mt	LED-30W-WPK(1): NA(0)	8	Y	Y	
5	WPK	Recreation Center	Bldg Mt Total	bldg mt	LED-30W-WPK(1): NA(0)	8	Y	Y	
6	WPK	Warehouse	Bldg Mt Total	bldg mt	LED-20W-WPK(1): NA(0)	1	Y	Y	
7									
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The above equipment was inspected on the signature date below; all information is affirmed to be true and correct.

Ameresco Representative: **Travis Prill** Signature: Travis Prill Date: **10/20/2020 - 10/21/2020**

ECM 2: Facility Lighting Retrofits & ECM 3: Street Lighting Retrofits

Project Name: City of Smithville, TX
Project Number: 05382
No Inspections will be performed on this ECM.

AMERESCO Green • Clean • Sustainable

Item #	Group Type	Facility	Location	Area Type	Unit Code	Qty in Area	Unit in Place? [Y or N]	Unit Operational? [Y or N]	Comments / Notes
1	WIR	City Hall	Office Director	office	NA(0): NA(0)	1	Y	Y	
2	WIR	City Hall	Bath M/W (2)	bath	NA(0): NA(0)	2	Y	Y	
3	WIR	City Hall	Bath M/W (2)	bath	NA(0): NA(0)	2	Y	Y	
4	WIR	City Hall	Hall Waiting Back	hall	NA(0): NA(0)	1	Y	Y	
5	WIR	Library	Bath Staff	bath	NA(0): NA(0)	1	Y	Y	
6	WIR	Recreation Center	Office Admin	office	NA(0): NA(0)	1	Y	Y	
7	WIR	Recreation Center	Storage Custodian	storage	NA(0): NA(0)	1	Y	Y	
8	WIR	Recreation Center	Storage Senior (2)	storage	NA(0): NA(0)	2	Y	Y	
9	WIR	Warehouse	Office Open Jack	office open	NA(0): NA(0)	1			
10									
11									

The above equipment was inspected on the signature date below; all information is affirmed to be true and correct.

Ameresco Representative: **Travis Prill** **Signature:** Travis Prill **Date:** **10/20/2020 - 10/21/2020**

ECM 2: Facility Lighting Retrofits & ECM 3: Street Lighting Retrofits

Project Name: City of Smithville, TX
Project Number: 05382
No Inspections will be performed on this ECM.

Item #	Group Type	Facility	Location	Area Type	Unit Code	Qty in Area	Unit in Place? [Y or N]	Unit Operational? [Y or N]	Comments / Notes
1	CDT	City Hall	Courtroom Council	courtroom	NA(0): NA(0)	1			
2	CDT	Library	Office Open Front	office open	NA(0): NA(0)	1	Y	Y	
3	CDT	Library	Conference Meeting	conference	NA(0): NA(0)	1	Y	Y	
4	CDT	Recreation Center	Office Back	office	NA(0): NA(0)	1	Y	Y	
5	CDT	Recreation Center	Exercise Weight Green	exercise	NA(0): NA(0)	1	Y	Y	
6	CDT	Recreation Center	Classroom Arts/Crafts	classroom	NA(0): NA(0)	1	Y	Y	
7	CDT	Recreation Center	Office Arts/Crafts	Office	NA(0): NA(0)	1	Y	Y	
8									
9									
10									
11									

The above equipment was inspected on the signature date below; all information is affirmed to be true and correct.

Ameresco Representative: Travis Prill **Signature:** Travis Prill **Date:** 10/20/2020 - 10/21/2020

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Appendix A: Savings Calculations – Contract Rates

Table A.0 summarizes the projected annual Energy Cost Savings, as determined by the calculation methodology presented in the IGA, and reported in the Proforma.

Table 1.0. Year 4 Projected Energy Cost Savings

Guaranteed Savings		*Electricity (kWh)*	*Gas (Therm)*		*Dollar ($)*
• Retrofit 2	Facility Lighting Retrofits	231,690	-710	$	24,208
• Retrofit 3	Street Lighting Retrofits	254,679	0	$	20,424
	Total Guaranteed Savings, Year 4	**486,369**	**-710**	**$**	**44,632**
Additional Savings/Revenue		***Electricity (kWh)***	***Gas (Therm)***		***Dollar ($)***
• Retrofit 1	Water and Electric Meter AMI Upgrade	N/A	N/A	$	118,551
• Retrofit 4	Gym RTUs Replacement	12,791	92	$	1,356
• O&M Savings		N/A	N/A	$	78,320
	Total Additional Savings/Revenue, Year 4	**12,791**	**92**	**$**	**192,577**
Projected Total Savings/Revenue		***Electricity (kWh)***	***Gas (Therm)***		***Dollar ($)***
Project Total Savings		**499,160**	**-618**	**$**	**242,928**

Table 1.1 summarizes the Year 4 Energy Cost Savings, as determined by the calculation methodology presented in the IGA, and measurements taking during the ECM commissioning.

Table 1.1. Year 4 Measured Cost Savings – Contract Rates

Measured Savings		*Electricity (kWh)*	*Gas (Therm)*		*Dollar ($)*
• Retrofit 2	Facility Lighting Retrofits	285,037	-710	$	30,328
• Retrofit 3	Street Lighting Retrofits	431,288	0	$	34,587
	Total Measured Guarantee Savings, Year 4	**716,325**	**-710**	**$**	**64,915**
Additional Savings/Revenue		***Electricity (kWh)***	***Gas (Therm)***		***Dollar ($)***
• Retrofit 1	Water and Electric Meter AMI Upgrade	N/A	N/A	$	119,847
• Retrofit 4	Gym RTUs Replacement	12,791	92	$	1,424
• O&M Savings		N/A	N/A	$	78,320
	Total Additional Savings/Revenue, Year 4	**12,791**	**92**	**$**	**200,238**
Year 4 Total Savings/Revenue		***Electricity (kWh)***	***Gas (Therm)***		***Dollar ($)***
Project Total Savings		**729,116**	**-618**	**$**	**264,506**
Percentage of Projected Savings		**146%**	**100%**		**109%**

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Appendix B: Water and Electric Meter Data

SMALL METER WATER REVENUE INCREASE

Accounts	Rate Code	FY11-12 kGal	FY12-13 kGal	FY13-14 kGal	Baseline kGal
Residential 5/8" inside	2001	109,435	110,249	93,040	104,241
Commercial 5/8" inside	2002	10,303	10,358	9,056	9,906
Municipal 5/8" inside	2003	793	658	132	528
Residential 1" inside	2011	10,152	9,888	7,998	9,346
Commercial 1" inside	2012	951	759	772	827
Municipal 1" inside	2013	368	356	348	357
Residential 1.5" inside	2021	1,285	1,349	1,083	1,239
Commercial 1.5" inside	2022	4,325	3,521	3,973	3,940
Municipal 1.5" inside	2023	392	525	360	426
Residential 5/8" outside	2101	3,436	3,289	2,975	3,233
Commercial 5/8" outside	2102	622	438	194	418
Residential 1" outside	2111	43	123	107	91
Commercial 1.5" outside	2122	20	10	4	11
TOTAL		**142,125**	**141,523**	**120,042**	**134,563**

Accounts	Rate Code	Qty	Baseline kGal	Included base water (2 kGal/mo)	Consumption above base water kGal
Residential 5/8" inside	2001	1,394	104,241	33,456	70,785
Commercial 5/8" inside	2002	148	9,906	3,552	6,354
Municipal 5/8" inside	2003	6	528	144	384
Residential 1" inside	2011	62	9,346	1,488	7,858
Commercial 1" inside	2012	12	827	288	539
Municipal 1" inside	2013	6	357	144	213
Residential 1.5" inside	2021	5	1,239	120	1,119
Commercial 1.5" inside	2022	11	3,940	264	3,676
Municipal 1.5" inside	2023	3	426	72	354
Residential 5/8" outside	2101	61	3,233	1,464	1,769
Commercial 5/8" outside	2102	3	418	72	346
Residential 1" outside	2111	1	91	24	67
Commercial 1.5" outside	2122	1	11	24	-
TOTAL		**1,713**	**134,563**	**41,112**	**93,464**

Account	Adjusted Baseline kGal	Combined accuracy
Commercial 5/8" inside	6,354	90.4%
Commercial 1" inside	539	90.4%
Commerical 1.5" inside	3,676	90.4%
Commerical 2" inside	11,866	95.8%
Commercial 3" inside	5,766	99.2%
Commercial 4" inside	158	83.4%
Weighted Avg Commercial Inside		**94.4%**
Commercial 5/8" outside	346	90.4%
Municipal 5/8" inside	384	90.4%
Municipal 1" inside	213	90.4%
Municipal 1.5" inside	354	90.4%
Municipal 2" inside	15,335	95.8%
Weighted Avg Municipal Inside		**95.5%**

Accounts	Rate Code	Consumption above base water kGal	Baseline accuracy (from tests)			Consumption %			Combined accuracy
			Low flow	Mid flow	High flow	Low flow	Mid flow	High flow	
Residential 5/8" inside	2001	70,785	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Commercial 5/8" inside	2002	6,354	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Municipal 5/8" inside	2003	384	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Residential 1" inside	2011	7,858	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Commercial 1" inside	2012	539	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Municipal 1" inside	2013	213	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Residential 1.5" inside	2021	1,119	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Commercial 1.5" inside	2022	3,676	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Municipal 1.5" inside	2023	354	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Residential 5/8" outside	2101	1,769	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Commercial 5/8" outside	2102	346	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Residential 1" outside	2111	67	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
Commercial 1.5" outside	2122	-	74.8%	92.2%	97.9%	15%	70%	15%	90.4%
TOTAL		**93,464**							

Accounts	Rate Code	Consumption above base water kGal	Baseline combined accuracy	Guaranteed combined accuracy	Metered water gain (kGal)
Residential 5/8" inside	2001	70,785	90.4%	98.5%	6,316
Commercial 5/8" inside	2002	6,354	90.4%	98.5%	567
Municipal 5/8" inside	2003	384	90.4%	98.5%	34
Residential 1" inside	2011	7,858	90.4%	98.5%	701
Commercial 1" inside	2012	539	90.4%	98.5%	48
Municipal 1" inside	2013	213	90.4%	98.5%	19
Residential 1.5" inside	2021	1,119	90.4%	98.5%	100
Commercial 1.5" inside	2022	3,676	90.4%	98.5%	328
Municipal 1.5" inside	2023	354	90.4%	98.5%	32
Residential 5/8" outside	2101	1,769	90.4%	98.5%	158
Commercial 5/8" outside	2102	346	90.4%	98.5%	31
Residential 1" outside	2111	67	90.4%	98.5%	6
Commercial 1.5" outside	2122	-	90.4%	98.5%	-
TOTAL		**93,464**			**8,340**

Accounts	Rate Code	Metered Water Gain (kGal)	Water Rate $/kGal	Water Revenue Increase $
Residential 5/8" inside	2001	6,316	$ 2.80	$ 17,685
Commercial 5/8" inside	2002	567	$ 2.80	$ 1,587
Municipal 5/8" inside	2003	34	$ 2.80	$ 96
Residential 1" inside	2011	701	$ 2.80	$ 1,963
Commercial 1" inside	2012	48	$ 2.80	$ 135
Municipal 1" inside	2013	19	$ 2.80	$ 53
Residential 1.5" inside	2021	100	$ 2.80	$ 280
Commercial 1.5" inside	2022	328	$ 2.80	$ 918
Municipal 1.5" inside	2023	32	$ 2.80	$ 88
Residential 5/8" outside	2101	158	$ 4.06	$ 641
Commercial 5/8" outside	2102	31	$ 4.06	$ 125
Residential 1" outside	2111	6	$ 4.06	$ 24
Commercial 1.5" outside	2122	-	$ 4.06	$ -
TOTAL		**8,340**		**$ 23,596**

LARGE METER WATER REVENUE INCREASE

Account No	Last Name	Meter size	FY11-12 kGal	FY12-13 kGal	FY13-14 kGal	Baseline kGal	Included Base Water (2 kGal/Mo)	Consumption above base water kGal
330055000	JR HIGH SCHOOL- GYM	4 inch	201	218	126	182	24	158
40043100	SMITHVILLE HIGH SCHOOL	3 inch	5,139	3,503	721	3,121	24	3,097
80055002	HOUSING AUTHORITY	3 inch	3,125	1,706	1,463	2,098	24	2,074
70190000	SETON S.REGION HOSP SETON1501	3 inch	1,057	463	336	619	24	595
10031500	SMITHVILLE REC CENTR	3 inch	76	67	75	73	24	49
10002000	GAZLEY SEWER PLANT	2 inch	9,210	9,296	9,235	9,247	24	9,223
30124000	TOWERS NURSING HM SETON 1507	2 inch	-	2,339	2,458	1,599	24	1,575
330057300	SISD FOOTBALL FIELD	2 inch	1,237	1,857	1,442	1,512	24	1,488
70097000	WILLOWS APTS	2 inch	1,132	886	1,032	1,017	24	993
10027000	SPARKLING CLEAN CAR WASH	2 inch	929	867	867	888	24	864
80053000	URBAN HOUSING AUTHORITY	2 inch	745	850	955	850	24	826
70192003	AMERICAS BEST VALUE INN	2 inch	1,077	642	652	790	24	766
70096000	WILLOWS APTS	2 inch	789	619	598	669	24	645
10012000	BROOKSHIRE BROTHERS	2 inch	653	482	475	537	24	513
70190300	SETON S.REGION HOSP SETON 1501	2 inch	948	376	255	526	24	502
30123000	SETON RURAL H CLINIC SET 1504	2 inch	470	438	653	520	24	496
80054000	URBAN HOUSING AUTHORITY	2 inch	533	423	576	511	24	487
40055400	BROWN PRIMARY SCHOOL	2 inch	417	665	415	499	24	475
10006001	SMITHVILLE FOOD LOCKER DBA	2 inch	406	429	398	411	24	387
330050000	ELEMENTARY SCHOOL	2 inch	388	337	357	361	24	337
40055200	BROWN PRIMARY SCHOOL	2 inch	342	353	366	354	24	330
20007000	AUTUMN SPRINGS OFFICE	2 inch	347	279	235	287	24	263
30003000	TOWERS NURSING HM SETON 1507	2 inch	326	253	278	286	24	262
30245302	BONE SPIRITS LLC	2 inch	302	329	213	281	24	257
10035000	FIRE STATION	2 inch	56	47	473	192	24	168
330052300	JR HIGH SCHOOL-ANNEX	2 inch	123	142	291	185	24	161
330054000	JR HIGH SCHOOL	2 inch	185	172	148	168	24	144
10031800	VETERANS MEMORIAL PARK	2 inch	-	169	212	127	24	103
330039000	ELEMENTARY SCHOOL	2 inch	122	109	129	120	24	96
10173000	POLICE DEPT	2 inch	40	72	41	51	24	27
10122200	SMI RR MUSEUM SPRINKLERS	2 inch	132	-	-	44	24	20
70197000	WILLOW CREEK SE PLANT	1.5 inch	4,746	4,430	8,133	5,770	24	5,746
TOTAL			**35,253**	**32,818**	**33,608**	**33,893**		**33,125**

Field Accuracy Test Results (highlighted in yellow are estimates from sample mean)

Account No	Last Name	Meter size	Meter Type	Low flow	Mid Flow	High Flow	Combined Accuracy
330055000	JR HIGH SCHOOL- GYM	4 inch	Hersey Turbo	87.03%	79.00%	100.00%	83.35%
40043100	SMITHVILLE HIGH SCHOOL	3 inch	Sensus Compound	0.00%	0.00%	64.64%	9.70%
80055002	HOUSING AUTHORITY	3 inch	Precision Turbo	50.00%	108.99%	110.84%	100.42%
70190000	SETON S.REGION HOSP SETON1501	3 inch	Rockwell Compound	94.09%	100.00%	100.56%	99.20%
10031500	SMITHVILLE REC CENTR	3 inch	Sensus Compound	94.09%	100.00%	100.56%	99.20%
10002000	GAZLEY SEWER PLANT	2 inch	Sensus PD	81.48%	99.62%	92.61%	95.85%
30124000	TOWERS NURSING HM SETON 1507	2 inch	Precision Jet	81.48%	99.62%	92.61%	95.85%
330057300	SISD FOOTBALL FIELD	2 inch	Elster Jet	99.01%	100.00%	96.90%	99.39%
70097000	WILLOWS APTS	2 inch	Precision Jet	81.48%	99.62%	92.61%	95.85%
10027000	SPARKLING CLEAN CAR WASH	2 inch	Rockwell PD	81.48%	99.62%	92.61%	95.85%
80053000	URBAN HOUSING AUTHORITY	2 inch	Rockwell PD	81.48%	99.62%	92.61%	95.85%
70192003	AMERICAS BEST VALUE INN	2 inch	Elster PD	81.48%	99.62%	92.61%	95.85%
70096000	WILLOWS APTS	2 inch	Precision Jet	81.48%	99.62%	92.61%	95.85%
10012000	BROOKSHIRE BROTHERS	2 inch	Precision Jet	81.48%	99.62%	92.61%	95.85%
70190300	SETON S.REGION HOSP SETON 1501	2 inch	Precision Jet	81.48%	99.62%	92.61%	95.85%
30123000	SETON RURAL H CLINIC SET 1504	2 inch	Rockwell PD	83.00%	98.93%	73.93%	92.79%
80054000	URBAN HOUSING AUTHORITY	2 inch	Precision Jet	81.48%	99.62%	92.61%	95.85%
40055400	BROWN PRIMARY SCHOOL	2 inch	Neptune PD	81.48%	99.62%	92.61%	95.85%
10006001	SMITHVILLE FOOD LOCKER DBA	2 inch	Rockwell PD	81.48%	99.62%	92.61%	95.85%
330050000	ELEMENTARY SCHOOL	2 inch	Rockwell PD	81.48%	99.62%	92.61%	95.85%
40055200	BROWN PRIMARY SCHOOL	2 inch	n/a	81.48%	99.62%	92.61%	95.85%
20007000	AUTUMN SPRINGS OFFICE	2 inch	Precision Jet	81.48%	99.62%	92.61%	95.85%
30003000	TOWERS NURSING HM SETON 1507	2 inch	Elster Jet	81.48%	99.62%	92.61%	95.85%
30245302	BONE SPIRITS LLC	2 inch	Sensus Compound	94.09%	100.00%	100.56%	99.20%
10035000	FIRE STATION	2 inch	Precision Jet	102.60%	100.87%	101.50%	101.22%
330052300	JR HIGH SCHOOL-ANNEX	2 inch	Rockwell PD	81.48%	99.62%	92.61%	95.85%
330054000	JR HIGH SCHOOL	2 inch	Precision Jet	81.48%	99.62%	92.61%	95.85%
10031800	VETERANS MEMORIAL PARK	2 inch	Elster Jet	93.19%	96.96%	88.99%	95.20%
330039000	ELEMENTARY SCHOOL	2 inch	Precision Jet	17.00%	100.97%	93.80%	87.30%
10173000	POLICE DEPT	2 inch	Rockwell PD	81.48%	99.62%	92.61%	95.85%
10122200	SMI RR MUSEUM SPRINKLERS	2 inch	Precision Jet	0.00%	0.00%	0.00%	0.00%
70197000	WILLOW CREEK SE PLANT	1.5 inch	Neptune PD	81.48%	99.62%	92.61%	95.85%
TOTAL			Sample Average (2 inch)	81.48%	99.62%	92.61%	95.85%
			Sample St Dev (2 inch)	29.47%	1.37%	9.35%	
			Std error of mean (2 inch)	12.03%	0.56%	3.82%	1.93%
			Margin of error (2 inch)				2.48%

Account No	Last Name	Meter size	Consumption Above Base Water kGal	Baseline Combined Accuracy	Guaranteed Combined Accuracy	Metered Water Gain (kGal)
330055000	JR HIGH SCHOOL- GYM	4 inch	158	83.35%	98.50%	29
40043100	SMITHVILLE HIGH SCHOOL	3 inch	3,097	9.70%	98.50%	2,782
80055002	HOUSING AUTHORITY	3 inch	2,074	100.42%	100.00%	(9)
70190000	SETON S.REGION HOSP SETON1501	3 inch	595	99.20%	98.50%	-
10031500	SMITHVILLE REC CENTR	3 inch	49	99.20%	98.50%	-
10002000	GAZLEY SEWER PLANT	2 inch	9,223	95.85%	98.50%	255
30124000	TOWERS NURSING HM SETON 1507	2 inch	1,575	95.85%	98.50%	44
330057300	SISD FOOTBALL FIELD	2 inch	1,488	99.39%	98.50%	-
70097000	WILLOWS APTS	2 inch	993	95.85%	98.50%	27
10027000	SPARKLING CLEAN CAR WASH	2 inch	864	95.85%	98.50%	24
80053000	URBAN HOUSING AUTHORITY	2 inch	826	95.85%	98.50%	23
70192003	AMERICAS BEST VALUE INN	2 inch	766	95.85%	98.50%	21
70096000	WILLOWS APTS	2 inch	645	95.85%	98.50%	18
10012000	BROOKSHIRE BROTHERS	2 inch	513	95.85%	98.50%	14
70190300	SETON S.REGION HOSP SETON 1501	2 inch	502	95.85%	98.50%	14
30123000	SETON RURAL H CLINIC SET 1504	2 inch	496	92.79%	98.50%	31
80054000	URBAN HOUSING AUTHORITY	2 inch	487	95.85%	98.50%	13
40055400	BROWN PRIMARY SCHOOL	2 inch	475	95.85%	98.50%	13
10006001	SMITHVILLE FOOD LOCKER DBA	2 inch	387	95.85%	98.50%	11
330050000	ELEMENTARY SCHOOL	2 inch	337	95.85%	98.50%	9
40055200	BROWN PRIMARY SCHOOL	2 inch	330	95.85%	98.50%	9
20007000	AUTUMN SPRINGS OFFICE	2 inch	263	95.85%	98.50%	7
30003000	TOWERS NURSING HM SETON 1507	2 inch	262	95.85%	98.50%	7
30245302	BONE SPIRITS LLC	2 inch	257	99.20%	98.50%	-
10035000	FIRE STATION	2 inch	168	101.22%	100.00%	(2)
330052300	JR HIGH SCHOOL-ANNEX	2 inch	161	95.85%	98.50%	4
330054000	JR HIGH SCHOOL	2 inch	144	95.85%	98.50%	4
10031800	VETERANS MEMORIAL PARK	2 inch	103	95.20%	98.50%	4
330039000	ELEMENTARY SCHOOL	2 inch	96	87.30%	98.50%	12
10173000	POLICE DEPT	2 inch	27	95.85%	98.50%	1
10122200	SMI RR MUSEUM SPRINKLERS	2 inch	20	0.00%	98.50%	-
70197000	WILLOW CREEK SE PLANT	1.5 inch	5,746	95.85%	98.50%	159
TOTAL			**33,125**			**3,525**

Account No	Last Name	Meter size	Rate Code	Description	Water Rate $/kGal	Increased kGal	Water Revenue Increase $
330055000	JR HIGH SCHOOL- GYM	4 inch	2062	Com 4" Inside	$2.80	29	$ 80.21
40043100	SMITHVILLE HIGH SCHOOL	3 inch	2052	Com 3" Inside	$2.80	2,782	$ 7,789.60
80055002	HOUSING AUTHORITY	3 inch	2052	Com 3" Inside	$2.80	(9)	$ (24.23)
70190000	SETON S.REGION HOSP SETON1501	3 inch	2052	Com 3" Inside	$2.80	-	$ -
10031500	SMITHVILLE REC CENTR	3 inch	2033	Mun 2"	$2.80	-	$ -
10002000	GAZLEY SEWER PLANT	2 inch	2033	Mun 2"	$2.80	255	$ 714.14
30124000	TOWERS NURSING HM SETON 1507	2 inch	2032	Com 2" Inside	$2.80	44	$ 121.95
330057300	SISD FOOTBALL FIELD	2 inch	2032	Com 2" Inside	$2.80	-	$ -
70097000	WILLOWS APTS	2 inch	2032	Com 2" Inside	$2.80	27	$ 76.86
10027000	SPARKLING CLEAN CAR WASH	2 inch	2032	Com 2" Inside	$2.80	24	$ 66.87
80053000	URBAN HOUSING AUTHORITY	2 inch	2032	Com 2" Inside	$2.80	23	$ 63.96
70192003	AMERICAS BEST VALUE INN	2 inch	2032	Com 2" Inside	$2.80	21	$ 59.34
70096000	WILLOWS APTS	2 inch	2032	Com 2" Inside	$2.80	18	$ 49.92
10012000	BROOKSHIRE BROTHERS	2 inch	2032	Com 2" Inside	$2.80	14	$ 39.70
70190300	SETON S.REGION HOSP SETON 1501	2 inch	2032	Com 2" Inside	$2.80	14	$ 38.90
30123000	SETON RURAL H CLINIC SET 1504	2 inch	2032	Com 2" Inside	$2.80	31	$ 85.51
80054000	URBAN HOUSING AUTHORITY	2 inch	2032	Com 2" Inside	$2.80	13	$ 37.68
40055400	BROWN PRIMARY SCHOOL	2 inch	2032	Com 2" Inside	$2.80	13	$ 36.78
10006001	SMITHVILLE FOOD LOCKER DBA	2 inch	2032	Com 2" Inside	$2.80	11	$ 29.97
330050000	ELEMENTARY SCHOOL	2 inch	2032	Com 2" Inside	$2.80	9	$ 26.07
40055200	BROWN PRIMARY SCHOOL	2 inch	2032	Com 2" Inside	$2.80	9	$ 25.53
20007000	AUTUMN SPRINGS OFFICE	2 inch	2032	Com 2" Inside	$2.80	7	$ 20.36
30003000	TOWERS NURSING HM SETON 1507	2 inch	2032	Com 2" Inside	$2.80	7	$ 20.26
30245302	BONE SPIRITS LLC	2 inch	2032	Com 2" Inside	$2.80	-	$ -
10035000	FIRE STATION	2 inch	2033	Mun 2"	$2.80	(2)	$ (5.69)
330052300	JR HIGH SCHOOL-ANNEX	2 inch	2032	Com 2" Inside	$2.80	4	$ 12.49
330054000	JR HIGH SCHOOL	2 inch	2032	Com 2" Inside	$2.80	4	$ 11.18
10031800	VETERANS MEMORIAL PARK	2 inch	2033	Mun 2"	$2.80	4	$ 10.00
330039000	ELEMENTARY SCHOOL	2 inch	2032	Com 2" Inside	$2.80	12	$ 34.49
10173000	POLICE DEPT	2 inch	2033	Mun 2"	$2.80	1	$ 2.09
10122200	SMI RR MUSEUM SPRINKLERS	2 inch	2033	Mun 2"	$2.80	-	$ -
70197000	WILLOW CREEK SE PLANT	1.5 inch	2033	Mun 2"	$2.80	159	$ 444.89
					TOTAL	**3,525**	**$ 9,869**

SEWER REVENUE INCREASE

Accounts	Rate Code	FY11-12 kGal	FY12-13 kGal	FY13-14 kGal	Baseline kGal
Residential inside	3001	90,243	88,957	88,954	89,385
Commercial inside	3002	32,223	22,354	18,764	24,447
Municipal	3003	609	586	570	588
Residential outside	3101	333	384	294	337
Commercial outside	3102	329	-	-	110
TOTAL		**123,737**	**112,281**	**108,582**	**114,867**

Accounts	Rate Code	Baseline kGal	Baseline Accuracy	Guaranteed Accuracy	Metered Sewer Gain (kGal)
Residential inside	3001	89,385	90.4%	98.5%	7,976
Commercial inside	3002	24,447	94.4%	98.5%	1,051
Municipal	3003	588	95.5%	98.5%	18
Residential outside	3101	337	90.4%	98.5%	30
Commercial outside	3102	110	90.4%	98.5%	10
TOTAL		**114,867**			**9,084**

Accounts	Rate Code	Increased Sewer kGal	Sewer Rate	Sewer Revenue Increase
Residential inside	3001	7,976	$ 3.50	$ 27,915
Commercial inside	3002	1,051	$ 3.50	$ 3,677
Municipal	3003	18	$ 3.50	$ 64
Residential outside	3101	30	$ 3.50	$ 105
Commercial outside	3102	10	$ 3.50	$ 34
TOTAL		**9,084**		**$ 31,795**

ELECTRIC REVENUE INCREASE

Revenue from kWh gain	$	47,190
Revenue from demand gain	$	838
Total revenue gain	**$**	**48,027**

ENERGY REVENUE

Account	Rate Code	FY11-12 kWh	FY12-13 kWh	FY13-14 kWh	Baseline kWh
Residential	1001	21,850,398	20,987,995	24,522,287	22,453,560
Small Commercial	1002	3,170,741	2,928,617	3,455,798	3,185,052
Municipal	1003	1,327,703	1,849,152	2,283,651	1,820,169
Demand Commercial	1012	18,096,500	11,201,866	12,470,698	13,923,021
Large Demand C3	1023	-	-	-	-
TOTAL		**44,445,342**	**36,967,630**	**42,732,434**	**41,381,802**

Account	Accuracy (stipulated)	Baseline kWh increase	Rate $/kWh	Revenue increase $
Residential	99.00%	226,804	$ 0.1155	$ 26,196
Small Commercial	99.00%	32,172	$ 0.1295	$ 4,166
Municipal	99.00%	18,386	$ 0.1014	$ 1,864
Demand Commercial	99.00%	140,637	$ 0.1064	$ 14,964
Large Demand C3	99.00%	-	$ 0.1064	$ -
TOTAL		**417,998**		**$ 47,190**

DEMAND REVENUE

Account	Rate Code	FY11-12 kW	FY12-13 kW	FY13-14 kW	Baseline kW
Residential	1001				
Small Commercial	1002				
Municipal	1003				
Demand Commercial	1012				
Large Demand C3	1023	11,933	11,716	12,101	11,917
TOTAL		**11,933**	**11,716**	**12,101**	**11,917**

Account	Accuracy (stipulated)	Baseline kW increase	Rate $/kW	Revenue increase $
Residential	99.00%			
Small Commercial	99.00%			
Municipal	99.00%			
Demand Commercial	99.00%			
Large Demand C3	99.00%	120.37	$ 6.96	$ 838
TOTAL		**120**		**$ 838**

METER READER SALARY & BENEFITS SAVINGS

Annual Salary	$ 33,431.33
SS and Medicare	$ 3,476.58
TOTAL	**$ 36,908**

Appendix C: Lighting Measurements

PRE-RETROFIT MEASUREMENTS

Project Name:	**City of Smithville,Tx**
Date(s):	**42346**
Name:	**Fernando Jimenez**
Witness:	**Antonio Hunter, Mike Frejnik**
RTS Meter Kit #:	**#006**

																			AUTOMATIC: DO NOT ENTER DATA		
Measurement ID #	Scope ID#	Lamp and Ballast Group Code	Manufact.- Proposed Watts (W)	Facility Name or Code	Location in Facility	Room Type and Number	RTS Map ID# (RTS Operations)	Lamp Manufacturer (From Measure	Lamp Catalog # (From Measured Lamp)	Ballast Manufacturer (From Measured Ballast Label)	Ballast Catalog # (From Measured Ballast Label)	Comments / Notes	Measured Light Level (FC) Location A (Directly Under Fixture)	Measured Light Level (FC) Location B (In Between Fixtures) FEMP V 3.0, 2008,	Number of Fixtures in Space	Quantity of Fixtures Measured	Measured Volts (V)	Measured Amps (A)	Measured Power Factor (PF)	Measured Total WATTS (W)	Measured Watts per Fixture (W)	Calculated Total Watts (W)	Calculated Watts per Fixture (W)
1	160	FLU-F34T12(4): B-T12-2-40-MAG(2)	144	Recreation Center	Lobby Main	lobby	Floor 1	GE	F40CX50ECO	Advance	R-2S40-1-TP	2 ballast ea.	80	64	14	1	120.5	1.265	0.96	146	146.00	146.34	146.34
2	160	FLU-F34T12(4): B-T12-2-40-MAG(2)	144	Recreation Center	Lobby Main	lobby	Floor 1	GE	F40CX50ECO	MagneTek	446-L-SLH-TC-P	2 ballast ea.	88	63	14	1	121.5	1.206	0.99	145	145.00	145.06	145.06
3	160	FLU-F34T12(4): B-T12-2-40-MAG(2)	144	Recreation Center	Lobby Main	lobby	Floor 1	GE	F40CX50ECO	Advance	R-2S40-1-TP	2 ballast ea.	48	51	14	1	119.8	1.246	0.97	145	145.00	144.79	144.79
4	160	FLU-F34T12(4): B-T12-2-40-MAG(2)	144	Recreation Center	Lobby Main	lobby	Floor 1	GE	F40CX50ECO	Advance	R-2S40-1-TP	2 ballast ea.	68	64	14	1	120.1	1.236	0.96	142	142.00	142.51	142.51
5	160	FLU-F34T12(4): B-T12-2-40-MAG(2)	144	Recreation Center	Lobby Main	lobby	Floor 1	GE	F40CX50ECO	Advance	R-2S40-1-TP	2 ballast ea.	55	45	14	1	119.7	1.260	0.97	146	146.00	146.30	146.30
6	160	FLU-F34T12(4): B-T12-2-40-MAG(2)	144	Recreation Center	Lobby Main	lobby	Floor 1	GE	F40CX50ECO	Advance	R-2S40-1-TP	2 ballast ea.	61	7	14	1	119.8	1.232	0.97	143	143.00	143.17	143.17
7	160	FLU-F34T12(4): B-T12-2-40-MAG(2)	144	Recreation Center	Lobby Main	lobby	Floor 1	GE	F40CX50ECO	Advance	R-2S40-1-TP	2 ballast ea.	36	9	14	1	119.7	1.157	0.98	135	135.00	135.72	135.72
8	160	FLU-F34T12(4): B-T12-2-40-MAG(2)	144	Recreation Center	Lobby Main	lobby	Floor 1	GE	F40CX50ECO	Advance	R-2S40-1-TP	2 ballast ea.	35	19	14	1	119.8	1.194	0.97	138	138.00	138.75	138.75
9	160	FLU-F34T12(4): B-T12-2-40-MAG(2)	144	Recreation Center	Lobby Main	lobby	Floor 1	GE	F40CX50ECO	Advance	R-2S40-1-TP	2 ballast ea.	47	40	14	1	121.7	1.201	0.97	142	142.00	141.78	141.78
10	160	FLU-F34T12(4): B-T12-2-40-MAG(2)	144	Recreation Center	Lobby Main	lobby	Floor 1	GE	F40CX50ECO	Advance	R-2S40-1-TP	2 ballast ea.	55	40	14	1	121.8	1.189	0.97	140	140.00	140.48	140.48
11	160	FLU-F34T12(4): B-T12-2-40-MAG(2)	144	Recreation Center	Lobby Main	lobby	Floor 1	GE	F40CX50ECO	Advance	R-2S40-1-TP	2 ballast ea.	54	40	14	1	121.5	1.190	0.97	142	142.00	140.25	140.25
12	215	MH-400W-ED37-SIM(1): B-MH-1-400-MAG(1)	460	Recreation Center	Gym Main	gym	Floor 1	Sylvania	MR400	Advance			16	19	20	1	122.8	3.950	0.95	461	461.00	460.81	460.81
13	215	MH-400W-ED37-SIM(1): B-MH-1-400-MAG(1)	460	Recreation Center	Gym Main	gym	Floor 1	Sylvania	MR400	Advance			19	22	20	1	122.7	3.983	0.94	460	460.00	459.39	459.39
14	215	MH-400W-ED37-SIM(1): B-MH-1-400-MAG(1)	460	Recreation Center	Gym Main	gym	Floor 1	Sylvania	MR400	Advance			18	23	20	1	122.0	3.897	0.96	456	456.00	456.42	456.42
15	215	MH-400W-ED37-SIM(1): B-MH-1-400-MAG(1)	460	Recreation Center	Gym Main	gym	Floor 1	Sylvania	MR400	Advance			21	24	20	1	122.4	3.991	0.93	454	454.00	454.30	454.30
16	215	MH-400W-ED37-SIM(1): B-MH-1-400-MAG(1)	460	Recreation Center	Gym Main	gym	Floor 1	Sylvania	MR400	Advance			21	25	20	1	121.9	3.982	0.95	462	462.00	461.14	461.14
17	215	MH-400W-ED37-SIM(1): B-MH-1-400-MAG(1)	460	Recreation Center	Gym Main	gym	Floor 1	Sylvania	MR400	Advance			20	24	20	1	121.8	3.899	0.96	456	456.00	455.90	455.90
18	215	MH-400W-ED37-SIM(1): B-MH-1-400-MAG(1)	460	Recreation Center	Gym Main	gym	Floor 1	Sylvania	MR400	Advance			22	27	20	1	122.3	3.876	0.97	460	460.00	459.81	459.81
19	215	MH-400W-ED37-SIM(1): B-MH-1-400-MAG(1)	460	Recreation Center	Gym Main	gym	Floor 1	Sylvania	MR400	Advance			18	24	20	1	122.1	3.954	0.95	459	459.00	458.64	458.64
20	215	MH-400W-ED37-SIM(1): B-MH-1-400-MAG(1)	460	Recreation Center	Gym Main	gym	Floor 1	Sylvania	MR400	Advance			18	20	20	1	121.8	3.992	0.96	467	467.00	466.78	466.78
21	215	MH-400W-ED37-SIM(1): B-MH-1-400-MAG(1)	460	Recreation Center	Gym Main	gym	Floor 1	Sylvania	MR400	Advance			16	16	20	1	122.0	3.990	0.95	463	463.00	462.44	462.44
22	295	MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	210	Streetlighting	Street Totals	street	Exterior					5TH & TURNE	separate grid measurements		332	1	123.4	3.010	0.57	212	212.00	211.72	211.72
23	295	MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	210	Streetlighting	Street Totals	street	Exterior					5TH & BURLES	separate grid measurements		332	1	123.3	2.840	0.60	210	210.00	210.10	210.10
24	295	MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	210	Streetlighting	Street Totals	street	Exterior					5TH & MILLS	separate grid measurements		332	1	122.8	2.844	0.60	209	209.00	209.55	209.55
25	295	MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	210	Streetlighting	Street Totals	street	Exterior					5TH & RAMON	separate grid measurements		332	1	124.3	3.257	0.51	207	207.00	206.47	206.47
26	295	MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	210	Streetlighting	Street Totals	street	Exterior					5TH & HUDG	separate grid measurements		332	1	117.6	3.022	0.57	202	202.00	202.57	202.57
27	295	MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	210	Streetlighting	Street Totals	street	Exterior					6TH & GRESH	separate grid measurements		332	1	122.1	2.640	0.67	216	216.00	215.97	215.97
28	295	MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	210	Streetlighting	Street Totals	street	Exterior					5TH & SHORT	separate grid measurements		332	1	123.0	2.896	0.58	207	207.00	206.60	206.60
29	295	MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	210	Streetlighting	Street Totals	street	Exterior					6TH & GARW	separate grid measurements		332	1	122.6	2.420	0.71	211	211.00	210.65	210.65
30	295	MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	210	Streetlighting	Street Totals	street	Exterior					6TH & BYRNE	separate grid measurements		332	1	122.3	2.954	0.58	210	210.00	209.54	209.54
31	295	MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	210	Streetlighting	Street Totals	street	Exterior					6TH & WHITE	separate grid measurements		332	1	121.7	2.912	0.57	202	202.00	202.00	202.00
32	295	MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	210	Streetlighting	Street Totals	street	Exterior					6TH &WILKES	separate grid measurements		332	1	122.6	3.005	0.58	214	214.00	213.68	213.68

Pre Lamp and Ballast Group	# Measurements	# Fixtures Measured (n#)	Avg Measured W	Avg Calc W	Proposed W	StdDev	Measured Coefficient of Variation (Cv)	Precision Achieved
FLU-F34T12(4): B-T12-2-40-MAG(2)	11	11	142.18	142.28	144	3.459	0.024	0.336%
MH-175W-ED28-SIM(1): B-MH-1-175-MAG(1)	11	11	209.09	208.99	210	4.415	0.021	0.240%
MH-400W-ED37-SIM(1): B-MH-1-400-MAG(1)	10	10	459.80	459.56	460	3.824	0.008	0.064%
Grand Total	**32**	**32**	**264.44**	**264.36**	**265**	**136.809**	0.517	5.234%

Confidence Required By Plan 90%
Precision Required by Plan: 10%

Using the actual Cv, calculated using Equation 1 (M&V Plan tab), the resultant precision can be calculated from the previous equations after some simple algebraic manipulation. The measurement precision can be calculated as follows:

Equation 4:

$$p = \frac{ZC_v}{\sqrt{n\#}}$$

where: n# = the actual quantity measured

POST-RETROFIT MEASUREMENTS

Project Name:	**City of Smithville**
Date(s):	**2/3/16, 1/8/16-1/12/16**
Name:	**Joaquin Cedillo**
Witness:	**Fernando Jimenez, Mike Frejnik, Antonio Hunter**
RTS Meter Kit #:	**#006**

																				AUTOMATIC: DO NOT ENTER DATA			
Measurement ID #	Scope ID#	Lamp and Ballast Group Code	Manufact.- Proposed Watts (W)	Facility Name or Code	Location in Facility	Room Type and Number	RTS Map ID# (RTS Operations)	Lamp Manufacturer (From Measure	Lamp Catalog # (From Measured Lamp)	Ballast Manufacturer (From Measured Ballast Label)	Ballast Catalog # (From Measured Ballast Label)	Comments / Notes	Measured Light Level (FC) Location A (Directly Under Fixture)	Measured Light Level (FC) Location B (In Between Fixtures) FEMP V 3.0, 2008,	Number of Fixtures in Space	Quantity of Fixtures Measured	Measured Volts (V)	Measured Amps (A)	Measured Power Factor (PF)	Measured Total WATTS (W)	Measured Watts per Fixture (W)	Calculated Total Watts (W)	Calculated Watts per Fixture (W)	Good (X)
1	160	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	59	Recreation Center	Lobby Main	lobby	Floor 1	Phillips	F32T8ADV841XE	Advance	IOP.2PSP32HLN		50	11	14	1	122.0	0.490	0.99	59	59.00	59.18	59.18	X
2	160	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	59	Recreation Center	Lobby Main	lobby	Floor 1	Phillips	F32T8ADV841XE	Advance	IOP.2PSP32HLN		48	7	14	1	122.0	0.484	1.00	59	58.60	59.05	59.05	X
3	160	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	59	Recreation Center	Lobby Main	lobby	Floor 1	Phillips	F32T8ADV841XE	Advance	IOP.2PSP32HLN		51	28	14	1	122.0	0.491	0.99	59	59.00	59.30	59.30	X
4	160	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	59	Recreation Center	Lobby Main	lobby	Floor 1	Phillips	F32T8ADV841XE	Advance	IOP.2PSP32HLN		64	63	14	1	121.0	0.480	1.00	58	58.00	58.08	58.08	X
5	160	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	59	Recreation Center	Lobby Main	lobby	Floor 1	Phillips	F32T8ADV841XE	Advance	IOP.2PSP32HLN		72	69	14	1	121.7	0.491	0.99	59	59.00	59.16	59.16	X
6	160	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	59	Recreation Center	Lobby Main	lobby	Floor 1	Phillips	F32T8ADV841XE	Advance	IOP.2PSP32HLN		80	60	14	1	121.3	0.489	1.00	59	58.70	59.32	59.32	X
7	160	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	59	Recreation Center	Lobby Main	lobby	Floor 1	Phillips	F32T8ADV841XE	Advance	IOP.2PSP32HLN		80	50	14	1	121.7	0.493	1.00	60	60.10	60.00	60.00	X
8	160	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	59	Recreation Center	Lobby Main	lobby	Floor 1	Phillips	F32T8ADV841XE	Advance	IOP.2PSP32HLN		81	75	14	1	122.3	0.494	0.99	60	59.60	59.81	59.81	X
9	160	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	59	Recreation Center	Lobby Main	lobby	Floor 1	Phillips	F32T8ADV841XE	Advance	IOP.2PSP32HLN		73	71	14	1	121.6	0.499	0.99	60	60.00	60.07	60.07	X
10	160	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	59	Recreation Center	Lobby Main	lobby	Floor 1	Phillips	F32T8ADV841XE	Advance	IOP.2PSP32HLN		79	71	14	1	121.6	0.490	1.00	60	60.10	59.58	59.58	X
11	160	FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	59	Recreation Center	Lobby Main	lobby	Floor 1	Phillips	F32T8ADV841XE	Advance	IOP.2PSP32HLN		58	49	14	1	121.9	0.478	1.00	58	58.00	58.27	58.27	X
12	215	LED-100W-LOWBAY(1): NA(0)	100	Recreation Center	Gym Main	gym	Floor 1	Neptun	LED-17-100-PC-U	Neptun	LED-17-100-PC-UNV-841-MD-PC3		14	20	20	1	122.9	0.780	0.99	95	95.00	94.90	94.90	X
13	215	LED-100W-LOWBAY(1): NA(0)	100	Recreation Center	Gym Main	gym	Floor 1	Neptun	LED-17-100-PC-U	Neptun	LED-17-100-PC-UNV-841-MD-PC3		23	20	20	1	123.1	0.783	1.00	96	96.00	96.39	96.39	X
14	215	LED-100W-LOWBAY(1): NA(0)	100	Recreation Center	Gym Main	gym	Floor 1	Neptun	LED-17-100-PC-U	Neptun	LED-17-100-PC-UNV-841-MD-PC3		22	21	20	1	123.0	0.791	0.99	96	96.00	96.32	96.32	X
15	215	LED-100W-LOWBAY(1): NA(0)	100	Recreation Center	Gym Main	gym	Floor 1	Neptun	LED-17-100-PC-U	Neptun	LED-17-100-PC-UNV-841-MD-PC3		16	18	20	1	122.8	0.781	0.99	95	95.00	94.95	94.95	X
16	215	LED-100W-LOWBAY(1): NA(0)	100	Recreation Center	Gym Main	gym	Floor 1	Neptun	LED-17-100-PC-U	Neptun	LED-17-100-PC-UNV-841-MD-PC3		17	23	20	1	122.2	0.786	0.99	95	95.00	95.09	95.09	X
17	215	LED-100W-LOWBAY(1): NA(0)	100	Recreation Center	Gym Main	gym	Floor 1	Neptun	LED-17-100-PC-U	Neptun	LED-17-100-PC-UNV-841-MD-PC3		25	27	20	1	122.6	0.779	0.99	94	94.00	94.55	94.55	X
18	215	LED-100W-LOWBAY(1): NA(0)	100	Recreation Center	Gym Main	gym	Floor 1	Neptun	LED-17-100-PC-U	Neptun	LED-17-100-PC-UNV-841-MD-PC3		25	23	20	1	122.8	0.783	1.00	96	96.00	96.15	96.15	X
19	215	LED-100W-LOWBAY(1): NA(0)	100	Recreation Center	Gym Main	gym	Floor 1	Neptun	LED-17-100-PC-U	Neptun	LED-17-100-PC-UNV-841-MD-PC3		18	21	20	1	122.7	0.781	0.99	95	95.00	94.87	94.87	X
20	215	LED-100W-LOWBAY(1): NA(0)	100	Recreation Center	Gym Main	gym	Floor 1	Neptun	LED-17-100-PC-U	Neptun	LED-17-100-PC-UNV-841-MD-PC3		17	23	20	1	123.1	0.779	0.99	94	94.00	94.94	94.94	X
21	215	LED-100W-LOWBAY(1): NA(0)	100	Recreation Center	Gym Main	gym	Floor 1	Neptun	LED-17-100-PC-U	Neptun	LED-17-100-PC-UNV-841-MD-PC3		21	20	20	1	122.4	0.787	0.99	95	95.00	95.37	95.37	X
22	295	LED-39W-BARNYARD(1): NA(0)	39	Streetlighting	Street Totals	street	Exterior	ACUITY	LNH2 LU4 MVOLT	ACUITY	LNH2 LU4 MVOLT	8TH & MILLS	brate grid measurements		332	1	122.8	0.319	1.00	39	39.00	39.17	39.17	X
23	295	LED-39W-BARNYARD(1): NA(0)	39	Streetlighting	Street Totals	street	Exterior	ACUITY	LNH2 LU4 MVOLT	ACUITY	LNH2 LU4 MVOLT	8TH & HUDGE	brate grid measurements		332	1	124.2	0.336	0.98	41	41.00	40.90	40.90	X
24	295	LED-39W-BARNYARD(1): NA(0)	39	Streetlighting	Street Totals	street	Exterior	ACUITY	LNH2 LU4 MVOLT	ACUITY	LNH2 LU4 MVOLT	8TH & BURLES	brate grid measurements		332	1	123.1	0.334	0.99	40	40.00	40.70	40.70	X
25	295	LED-39W-BARNYARD(1): NA(0)	39	Streetlighting	Street Totals	street	Exterior	ACUITY	LNH2 LU4 MVOLT	ACUITY	LNH2 LU4 MVOLT	9TH & BURLES	brate grid measurements		332	1	123.8	0.332	0.99	41	41.00	40.69	40.69	X
26	295	LED-39W-BARNYARD(1): NA(0)	39	Streetlighting	Street Totals	street	Exterior	ACUITY	LNH2 LU4 MVOLT	ACUITY	LNH2 LU4 MVOLT	9th & HUDGE	brate grid measurements		332	1	123.4	0.328	0.98	40	40.00	39.67	39.67	X
27	295	LED-39W-BARNYARD(1): NA(0)	39	Streetlighting	Street Totals	street	Exterior	ACUITY	LNH2 LU4 MVOLT	ACUITY	LNH2 LU4 MVOLT	9TH & 601	brate grid measurements		332	1	122.6	0.329	0.99	39	39.00	39.93	39.93	X
28	295	LED-39W-BARNYARD(1): NA(0)	39	Streetlighting	Street Totals	street	Exterior	ACUITY	LNH2 LU4 MVOLT	ACUITY	LNH2 LU4 MVOLT	9TH & 802	brate grid measurements		332	1	123.1	0.326	0.99	39	39.00	39.73	39.73	X
29	295	LED-39W-BARNYARD(1): NA(0)	39	Streetlighting	Street Totals	street	Exterior	ACUITY	LNH2 LU4 MVOLT	ACUITY	LNH2 LU4 MVOLT	PECAN SHORE	brate grid measurements		332	1	123.1	0.321	0.98	38	38.00	38.72	38.72	X
30	295	LED-39W-BARNYARD(1): NA(0)	39	Streetlighting	Street Totals	street	Exterior	ACUITY	LNH2 LU4 MVOLT	ACUITY	LNH2 LU4 MVOLT	PECAN SHORE	brate grid measurements		332	1	122.6	0.323	1.00	40	40.00	39.60	39.60	X
31	295	LED-39W-BARNYARD(1): NA(0)	39	Streetlighting	Street Totals	street	Exterior	ACUITY	LNH2 LU4 MVOLT	ACUITY	LNH2 LU4 MVOLT	1400 PECAN S	brate grid measurements		332	1	122.8	0.318	1.00	39	39.00	39.05	39.05	X
32	295	LED-39W-BARNYARD(1): NA(0)	39	Streetlighting	Street Totals	street	Exterior	ACUITY	LNH2 LU4 MVOLT	ACUITY	LNH2 LU4 MVOLT	1402 PECAN S	brate grid measurements		332	1	123.2	0.315	0.99	38	38.00	38.42	38.42	X

Good (X) | X

Post Lamp and Ballast Group	# Measurements	# Fixtures Measured (n#)	Measured W	Calc W	Proposed W	Std Dev	Measured Coefficient of Variation (Cv)	Precision Achieved
FLU-F32T8/25W-80(2): B-T8-2-32-PS-HP(1)	11	11	59.10	59.26	59	0.769	0.013	0.279%
LED-100W-LOWBAY(1): NA(0)	10	10	95.10	95.35	100	0.738	0.008	0.131%
LED-39W-BARNYARD(1): NA(0)	11	11	39.45	39.69	39	1.036	0.026	0.687%
Grand Total	**32**	**32**	**63.60**	**63.81**	**64.9375**	**23.126**	0.364	7.501%

Confidence Required By Plan 90%
Precision Required by Plan: 10%

Using the actual Cv, calculated using Equation 1 (M&V Plan tab), the resultant precision can be calculated from the previous equations after some simple algebraic manipulation. The measurement precision can be calculated as follows:

Equation 4:

$$p = \frac{ZC_v}{\sqrt{n\#}}$$

where: n# = the actual quantity measured

Appendix D: RTU Calculations

PRE RETROFIT CALCULATIONS

CITY OF SMITHVILLE, TX - RECREATION CENTER GYM RTU REPLACEMENT
SAVINGS CALCULATION

Electricity - HVAC only (kWh)	
Baseline	29,015
Post retrofit	14,804
Rate ($/kWh)	$ 0.10140
SAVINGS	14,212
Cost $	$ 1,441

Natural gas (Therms)	
Baseline	1,730
Post retrofit	1,628
Rate ($/Therms)	$ 0.710
SAVINGS	102
Cost $	$ 72

TOTAL SAVINGS $ 1,513

BASELINE

U factors (Btu/hr-F-SF)	
Walls	0.04
Roof	0.2
Floor	0.2
Windows	1

Total size (SF)	
Walls	4,280
Roof	8,500
Floor	8,500
Windows	0

Solar radiation		
Avg in year	350	Btu/hr-SF
Shading Coeff	0.35	

Occupants		
People	100	
People heat	280	Btu/hr-person
Ventilation	3750	cfm

Plug loads		
Interior Light	1.0	W/SF
Misc	0	W/SF
Exterior light	0	kW

Cooling COP	2.9	(Assume 10 SEER for old units)
Gas pack efficiency	80%	(Assume 80% for old units)

Units 2 x 25 ton RTUs, 7500 CFM
DX cooling with gas heat

					Bldg set point		Bldg envelope load - Occupied						Bldg internal load - Occupied					
Temp range (F)	Mid point (F)	MCWB (F)	Occupied hrs (See schedule)	Unoccupied hrs (all others)	Occupied	Unoccupied	Walls (Btu/hr)	Roof (Btu/hr)	Floor (Btu/hr)	Windows (Btu/hr)	Windows solar gain (Btu/hr)	Total envelope load (Btu/hr)	Occupants (Btu/hr)	Ventilation (Btu/hr)	Interior Lighting (Btu/hr)	Misc plug load (Btu/hr)	Total internal load (Btu/hr)	Total HVAC load (Btu/hr)
115 - 119	117	0	0	0	75	85	7,190	71,400	71,400	-	-	149,990	28,000	170,100	29,002	-	227,102	377,092
110 - 114	112	0	0	0	75	85	6,334	62,900	62,900	-	-	132,134	28,000	149,850	29,002	-	206,852	338,986
105 - 109	107	74.5	0	0	75	85	5,478	54,400	54,400	-	-	114,278	28,000	129,600	29,002	-	186,602	300,880
100 - 104	102	74.2	12	5	75	85	4,622	45,900	45,900	-	-	96,422	28,000	109,350	29,002	-	166,352	262,774
95 - 99	97	74.7	118	50	75	85	3,766	37,400	37,400	-	-	78,566	28,000	89,100	29,002	-	146,102	224,668
90 - 94	92	74.6	295	125	75	85	2,910	28,900	28,900	-	-	60,710	28,000	68,850	29,002	-	125,852	186,562
85 - 89	87	73.4	391	186	75	85	2,054	20,400	20,400	-	-	42,854	28,000	48,600	29,002	-	105,602	148,456
80 - 84	82	71.9	486	372	75	85	1,198	11,900	11,900	-	-	24,998	28,000	28,350	29,002	-	85,352	110,350
75 - 79	77	70.5	466	860	75	85	342	3,400	3,400	-	-	7,142	28,000	8,100	29,002	-	65,102	72,244
70 - 74	72	66.4	429	753	70	85	342	3,400	3,400	-	-	7,142	28,000	8,100	29,002	-	65,102	72,244
65 - 69	67	61.1	342	555	70	85	(514)	(5,100)	(5,100)	-	-	(10,714)	28,000	(12,150)	29,002	-	44,852	34,138
60 - 64	62	56.1	291	471	70	55	(1,370)	(13,600)	(13,600)	-	-	(28,570)	28,000	(32,400)	29,002	-	24,602	(3,968)
55 - 59	57	51.3	239	414	70	55	(2,226)	(22,100)	(22,100)	-	-	(46,426)	28,000	(52,650)	29,002	-	4,352	(42,074)
50 - 54	52	46.8	211	389	70	55	(3,082)	(30,600)	(30,600)	-	-	(64,282)	28,000	(72,900)	29,002	-	(15,898)	(80,180)
45 - 49	47	42.5	159	321	70	55	(3,938)	(39,100)	(39,100)	-	-	(82,138)	28,000	(93,150)	29,002	-	(36,148)	(118,286)
40 - 44	42	38.2	110	257	70	55	(4,794)	(47,600)	(47,600)	-	-	(99,994)	28,000	(113,400)	29,002	-	(56,398)	(156,392)
35 - 39	37	33.9	72	179	70	55	(5,650)	(56,100)	(56,100)	-	-	(117,850)	28,000	(133,650)	29,002	-	(76,648)	(194,498)
30 - 34	32	29	34	85	70	55	(6,506)	(64,600)	(64,600)	-	-	(135,706)	28,000	(153,900)	29,002	-	(96,898)	(232,604)
25 - 29	27	24.3	15	40	70	55	(7,362)	(73,100)	(73,100)	-	-	(153,562)	28,000	(174,150)	29,002	-	(117,148)	(270,710)
20 - 24	22	19.5	5	15	70	55	(8,218)	(81,600)	(81,600)	-	-	(171,418)	28,000	(194,400)	29,002	-	(137,398)	(308,816)
15 - 19	17	14.6	2	5	70	55	(9,074)	(90,100)	(90,100)	-	-	(189,274)	28,000	(214,650)	29,002	-	(157,648)	(346,922)
TOTAL			3,676	5,083														

Bldg envelope load - Unoccupied						Bldg internal load - Unoccupied						
Walls (Btu/hr)	Roof (Btu/hr)	Floor (Btu/hr)	Windows (Btu/hr)	Windows solar gain (Btu/hr)	Total envelope load (Btu/hr)	Occupants (Btu/hr)	Ventilation (Btu/hr)	Interior Lighting (Btu/hr)	Misc plug load (Btu/hr)	Total internal load (Btu/hr)	Total HVAC load (Btu/hr)
5,478	54,400	54,400	-	-	114,278	-	-	-	-	-	114,278
4,622	45,900	45,900	-	-	96,422	-	-	-	-	-	96,422
3,766	37,400	37,400	-	-	78,566	-	-	-	-	-	78,566
2,910	28,900	28,900	-	-	60,710	-	-	-	-	-	60,710
2,054	20,400	20,400	-	-	42,854	-	-	-	-	-	42,854
1,198	11,900	11,900	-	-	24,998	-	-	-	-	-	24,998
342	3,400	3,400	-	-	7,142	-	-	-	-	-	7,142
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
1,198	11,900	11,900	-	-	24,998	-	-	-	-	-	24,998
342	3,400	3,400	-	-	7,142	-	-	-	-	-	7,142
(514)	(5,100)	(5,100)	-	-	(10,714)	-	-	-	-	-	(10,714)
(1,370)	(13,600)	(13,600)	-	-	(28,570)	-	-	-	-	-	(28,570)
(2,226)	(22,100)	(22,100)	-	-	(46,426)	-	-	-	-	-	(46,426)
(3,082)	(30,600)	(30,600)	-	-	(64,282)	-	-	-	-	-	(64,282)
(3,938)	(39,100)	(39,100)	-	-	(82,138)	-	-	-	-	-	(82,138)
(4,794)	(47,600)	(47,600)	-	-	(99,994)	-	-	-	-	-	(99,994)
(5,650)	(56,100)	(56,100)	-	-	(117,850)	-	-	-	-	-	(117,850)
(6,506)	(64,600)	(64,600)	-	-	(135,706)	-	-	-	-	-	(135,706)

Annual electricity use						
Cooling kWh	Interior Lighting kWh	Exterior Lighting kWh	Plug load kWh	Total kWh	Heating Therms	
-	-	-	-	-	-	
-	-	-	-	-	-	
-	-	-	-	-	-	
354	106	-	-	460	-	
2,859	1,000	-	-	3,859	-	
5,811	2,505	-	-	8,316	-	
5,932	3,320	-	-	9,252	-	
5,363	4,131	-	-	9,494	-	
3,366	3,960	-	-	7,327	-	
3,100	3,648	-	-	6,748	-	
1,167	2,905	-	-	4,072	-	
1,062	2,473	-	-	3,535	-	
	2,032	-	-	2,032	89	
	1,797	-	-	1,797	264	
	1,352	-	-	1,352	350	
	934	-	-	934	364	
	610	-	-	610	319	
	287	-	-	287	186	
	128	-	-	128	101	
	43	-	-	43	41	
	14	-	-	14	16	
29,015	31,206	-	-	60,261	1,730	

POST RETROFIT CALCULATIONS

CITY OF SMITHVILLE, TX - RECREATION CENTER GYM RTU REPLACEMENT
SAVINGS CALCULATION

POST RETROFIT

U factors (Btu/hr-F-SF)	
Walls	0.04
Roof	0.2
Floor	0.2
Windows	1

Total size (SF)	
Walls	4,280
Roof	8,500
Floor	8,500
Windows	0

Solar radiation		
Avg in year	350	Btu/hr-SF
Shading Coeff	0.35	

Occupants		
People	100	
People heat	280	Btu/hr-person
Ventilation	3750	cfm

Plug loads		
Interior Ligh	1.0	W/SF
Misc	0	W/SF
Exterior ligh	0	kW

Cooling COP	4.7	(16 SEER for new units)
Gas pack efficiency	85%	(85% for new units)

Units 2 x 25 ton RTUs, 7500 CFM
DX cooling with gas heat, full economizer

					Bldg set point		Bldg envelope load - Occupied						Bldg internal load - Occupied						
Temp range (F)	Mid point (F)	MCWB (F)	Occupied hrs (See schedule)	Unoccupied hrs (all others)	Occupied	Unoccupied	Walls (Btu/hr)	Roof (Btu/hr)	Floor (Btu/hr)	Windows (Btu/hr)	Windows solar gain (Btu/hr)	Total envelope load (Btu/hr)	Occupants (Btu/hr)	Ventilation (Btu/hr)	Interior Lighting (Btu/hr)	Misc plug load (Btu/hr)	Total internal load (Btu/hr)	Total HVAC load (Btu/hr)
115 - 119	117	0	0	0	75	85	7,190	71,400	71,400	-	-	149,990	28,000	170,100	29,002	-	227,102	377,092
110 - 114	112	0	0	0	75	85	6,334	62,900	62,900	-	-	132,134	28,000	149,850	29,002	-	206,852	338,986
105 - 109	107	74.5	0	0	75	85	5,478	54,400	54,400	-	-	114,278	28,000	129,600	29,002	-	186,602	300,880
100 - 104	102	74.2	12	5	75	85	4,622	45,900	45,900	-	-	96,422	28,000	109,350	29,002	-	166,352	262,774
95 - 99	97	74.7	118	50	75	85	3,766	37,400	37,400	-	-	78,566	28,000	89,100	29,002	-	146,102	224,668
90 - 94	92	74.6	295	125	75	85	2,910	28,900	28,900	-	-	60,710	28,000	68,850	29,002	-	125,852	186,562
85 - 89	87	73.4	391	186	75	85	2,054	20,400	20,400	-	-	42,854	28,000	48,600	29,002	-	105,602	148,456
80 - 84	82	71.9	486	372	75	85	1,198	11,900	11,900	-	-	24,998	28,000	28,350	29,002	-	85,352	110,350
75 - 79	77	70.5	466	860	75	85	342	3,400	3,400	-	-	7,142	28,000	8,100	29,002	-	65,102	72,244
70 - 74	72	66.4	429	753	70	85	342	3,400	3,400	-	-	7,142	28,000	8,100	29,002	-	65,102	72,244
65 - 69	67	61.1	342	555	70	85	(514)	(5,100)	(5,100)	-	-	(10,714)	28,000	(12,150)	29,002	-	44,852	34,138
60 - 64	62	56.1	291	471	70	55	(1,370)	(13,600)	(13,600)	-	-	(28,570)	28,000	(32,400)	29,002	-	24,602	(3,968)
55 - 59	57	51.3	239	414	70	55	(2,226)	(22,100)	(22,100)	-	-	(46,426)	28,000	(52,650)	29,002	-	4,352	(42,074)
50 - 54	52	46.8	211	389	70	55	(3,082)	(30,600)	(30,600)	-	-	(64,282)	28,000	(72,900)	29,002	-	(15,898)	(80,180)
45 - 49	47	42.5	159	321	70	55	(3,938)	(39,100)	(39,100)	-	-	(82,138)	28,000	(93,150)	29,002	-	(36,148)	(118,286)
40 - 44	42	38.2	110	257	70	55	(4,794)	(47,600)	(47,600)	-	-	(99,994)	28,000	(113,400)	29,002	-	(56,398)	(156,392)
35 - 39	37	33.9	72	179	70	55	(5,650)	(56,100)	(56,100)	-	-	(117,850)	28,000	(133,650)	29,002	-	(76,648)	(194,498)
30 - 34	32	29	34	85	70	55	(6,506)	(64,600)	(64,600)	-	-	(135,706)	28,000	(153,900)	29,002	-	(96,898)	(232,604)
25 - 29	27	24.3	15	40	70	55	(7,362)	(73,100)	(73,100)	-	-	(153,562)	28,000	(174,150)	29,002	-	(117,148)	(270,710)
20 - 24	22	19.5	5	15	70	55	(8,218)	(81,600)	(81,600)	-	-	(171,418)	28,000	(194,400)	29,002	-	(137,398)	(308,816)
15 - 19	17	14.6	2	5	70	55	(9,074)	(90,100)	(90,100)	-	-	(189,274)	28,000	(214,650)	29,002	-	(157,648)	(346,922)
TOTAL			3,676	5,083														

	Bldg envelope load - Unoccupied						Bldg internal load - Unoccupied					
	Walls (Btu/hr)	Roof (Btu/hr)	Floor (Btu/hr)	Windows (Btu/hr)	Windows solar gain (Btu/hr)	Total envelope load (Btu/hr)	Occupants (Btu/hr)	Ventilation (Btu/hr)	Interior Lighting (Btu/hr)	Misc plug load (Btu/hr)	Total internal load (Btu/hr)	Total HVAC load (Btu/hr)
	5,478	54,400	54,400	-	-	114,278	-	-	-	-	-	114,278
	4,622	45,900	45,900	-	-	96,422	-	-	-	-	-	96,422
	3,766	37,400	37,400	-	-	78,566	-	-	-	-	-	78,566
	2,910	28,900	28,900	-	-	60,710	-	-	-	-	-	60,710
	2,054	20,400	20,400	-	-	42,854	-	-	-	-	-	42,854
	1,198	11,900	11,900	-	-	24,998	-	-	-	-	-	24,998
	342	3,400	3,400	-	-	7,142	-	-	-	-	-	7,142
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	1,198	11,900	11,900	-	-	24,998	-	-	-	-	-	24,998
	342	3,400	3,400	-	-	7,142	-	-	-	-	-	7,142
	(514)	(5,100)	(5,100)	-	-	(10,714)	-	-	-	-	-	(10,714)
	(1,370)	(13,600)	(13,600)	-	-	(28,570)	-	-	-	-	-	(28,570)
	(2,226)	(22,100)	(22,100)	-	-	(46,426)	-	-	-	-	-	(46,426)
	(3,082)	(30,600)	(30,600)	-	-	(64,282)	-	-	-	-	-	(64,282)
	(3,938)	(39,100)	(39,100)	-	-	(82,138)	-	-	-	-	-	(82,138)
	(4,794)	(47,600)	(47,600)	-	-	(99,994)	-	-	-	-	-	(99,994)
	(5,650)	(56,100)	(56,100)	-	-	(117,850)	-	-	-	-	-	(117,850)
	(6,506)	(64,600)	(64,600)	-	-	(135,706)	-	-	-	-	-	(135,706)

Annual electricity use					
Cooling kWh	Interior Lighting kWh	Exterior Lighting kWh	Plug load kWh	Total kWh	Heating Therms
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	
221	106	-	-	327	
1,787	1,000	-	-	2,787	
3,632	2,505	-	-	6,137	
3,707	3,320	-	-	7,027	
3,352	4,131	-	-	7,483	
2,104	3,960	-	-	6,064	
-	3,648	-	-	3,648	
-	2,905	-	-	2,905	
-	2,473	-	-	2,473	
	2,032	-	-	2,032	84
	1,797	-	-	1,797	248
	1,352	-	-	1,352	329
	934	-	-	934	343
	610	-	-	610	300
	287	-	-	287	175
	128	-	-	128	95
	43	-	-	43	39
	14	-	-	14	15
14,804	31,246	-	-	46,050	1,628

Appendix E: Utility Rates

ECM Category	Location	Year 4 Contract Rates		Base Rates		
		Outside City Limits [$/kgal]	Sewer [$/kgal]	Inside City Limits [$/kgal]	Outside City Limits [$/kgal]	Sewer [$/kgal]
Refrofit 1: Water and Electric Meter AMI Upgrade	City Wide - Meters	$ 4.28372	$ 3.63203	$ 2.80000	$ 4.06000	$ 3.50000
	Escalation Rates	1.35%	0.93%			

ECM Category	Location	Year 4 Contract Rates				Base Rates			
		Electrical Energy [$/kWh]	Electrical Demand [$/kW]	Natural Gas Energy [$/therm]	O&M [Annual $]	Electrical Energy [$/kWh]	Electrical Demand [$/kW]	Natural Gas Energy [$/therm]	O&M [Annual $]
Refrofit 2: Facility Lighting Retrofits	City Hall	$ 0.10601	$ -	$ -	$ -	$ 0.10139	$ -	$ -	$ -
	Police Station	$ 0.10601	$ -	$ -	$ -	$ 0.10139	$ -	$ -	$ -
	Library	$ 0.10601	$ -	$ -	$ -	$ 0.10139	$ -	$ -	$ -
	Fire Station 1	$ 0.10601	$ -	$ 0.74681	$ -	$ 0.10139	$ -	$ 0.71033	$ -
	Recreation Center	$ 0.10601	$ -	$ 0.74681	$ -	$ 0.10139	$ -	$ 0.71033	$ -
	Fire Station 2	$ 0.10601	$ -	$ 0.74681	$ -	$ 0.10139	$ -	$ 0.71033	$ -
	Warehouse	$ 0.10601	$ -	$ -	$ -	$ 0.10139	$ -	$ -	$ -
	Gazley Sewer Plant	$ 0.10601	$ -	$ -	$ -	$ 0.10139	$ -	$ -	$ -
	Water Plant	$ 0.10601	$ -	$ -	$ -	$ 0.10139	$ -	$ -	$ -
	Airport Lounge and Garage	$ 0.13413	$ -	$ -	$ -	$ 0.12829	$ -	$ -	$ -
	City Wide - Streetlights	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	City Wide - Meters	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Refrofit 3: Street Lighting Retrofits	City Hall	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Police Station	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Library	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Fire Station 1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Recreation Center	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Fire Station 2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Warehouse	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Gazley Sewer Plant	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Water Plant	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Airport Lounge and Garage	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	City Wide - Streetlights	$ 0.08019	$ -	$ -	$ -	$ 0.07670	$ -	$ -	$ -
	City Wide - Meters	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Refrofit 4: Gym RTUs Replacement	City Hall	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Police Station	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Library	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Fire Station 1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Recreation Center	$ 0.10602	$ -	$ 0.74647	$ -	$ 0.10140	$ -	$ 0.71000	$ -
	Fire Station 2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Warehouse	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Gazley Sewer Plant	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Water Plant	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Airport Lounge and Garage	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	City Wide - Streetlights	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	City Wide - Meters	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Escalation Rates	1.12%	1.12%	1.26%	2.00%				

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Appendix F: Project Proforma

Final Project Proforma -- 7/14/2016
City of Smithville, TX

Detailed Energy Audit:	$ 45,000	***Financial Assumptions***					
Facility ECMs Costs:	$ 551,129						
Water & Electric Meter AMI Costs:	$ 1,827,950	Project Term:	15	Water Revenue Escalation Rate:	1.35%		
Performance and Payment Bond:	$ 28,125	Financing Term:	15	Sewer Revenue Escalation Rate:	0.93%		
Financing Origination Costs:	$ 34,868	Financing Rate:	0.47%	Leak Detection Savings Escalation Rate:	1.35%		
STW Billing System Costs:	$ 100,628	Payments Per Year:	12	Hardware Maintenance Savings Escalation Rate:	2.00%		
		Discount Rate:	0.47%	Labor Savings Escalation Rate:	2.00%		
Capitalized Interest	$ 73,448			Electric Energy Savings Escalation Rate:	1.12%		
		M&V Cost Escalation Rate:	2.00%	Natural Gas Savings Escalation Rate:	1.26%		
Total Amount Financed:	**$ 2,661,148**	AMI Annual Maintenance Escalation Rate:	2.00%	Facility O&M Savings Escalation Rate:	2.00%		

Year	Water Revenue	Sewer Revenue	Electricity Revenue	Meter Reader Labor Savings	Meter Replacement Materials Savings	Electric Energy Savings	Natural Gas Savings	Facility O&M Materials Savings	Total Revenues and Savings	Payments for Financing Equipment	Measurement and Verification	Mueller Annual Maintenance Cost	Net Annual Benefit	Cumulative Cash Flow	Projected Savings from Scope Added During Construction	Cumulative Cash Flow with Additional Savings
0	$ 33,465	$ 31,795	$ 48,028	$ 36,908	$ 30,000	$ 44,491	$ (439)	$ 5,448	$ 229,697							
1	$ 33,915	$ 32,091	$ 48,565	$ 37,646	$ 30,600	$ 44,989	$ (445)	$ 5,557	$ 232,918	$ 143,303	$ 9,141	$ 28,320	$ 52,154	$ 52,154	$ 8,798	$ 60,952
2	$ 34,371	$ 32,390	$ 49,108	$ 38,399	$ 31,212	$ 45,492	$ (451)	$ 5,668	$ 236,189	$ 170,331	$ 9,324	$ 28,886	$ 27,648	$ 79,802	$ 8,897	$ 97,497
3	$ 34,833	$ 32,691	$ 49,657	$ 39,167	$ 31,836	$ 46,001	$ (457)	$ 5,781	$ 239,509	$ 172,986	$ 9,510	$ 29,464	$ 27,549	$ 107,351	$ 8,996	$ 134,042
4	$ 35,302	$ 32,995	$ 50,212	$ 39,950	$ 32,473	$ 46,515	$ (463)	$ 5,897	$ 242,881	$ 175,825	$ 9,700	$ 30,053	$ 27,303	$ 134,655	$ 9,097	$ 170,442
5	$ 35,777	$ 33,302	$ 50,773	$ 40,749	$ 33,122	$ 47,035	$ (469)	$ 6,015	$ 246,304	$ 151,878	$ 36,730	$ 30,654	$ 27,042	$ 161,697	$ 9,198	$ 206,683
6	$ 36,258	$ 33,612	$ 51,341	$ 41,564	$ 33,784	$ 47,561	$ (475)	$ 6,135	$ 249,780	$ 181,577	$ 10,092	$ 31,267	$ 26,844	$ 188,541	$ 9,301	$ 242,828
7	$ 36,746	$ 33,925	$ 51,915	$ 42,395	$ 34,460	$ 48,093	$ (481)	$ 6,258	$ 253,311	$ 184,565	$ 10,294	$ 31,892	$ 26,560	$ 215,101	$ 9,405	$ 278,793
8	$ 37,240	$ 34,241	$ 52,495	$ 43,243	$ 35,149	$ 48,631	$ (487)	$ 6,383	$ 256,895	$ 187,535	$ 10,500	$ 32,530	$ 26,330	$ 241,431	$ 9,510	$ 314,633
9	$ 37,741	$ 34,560	$ 53,082	$ 44,108	$ 35,852	$ 49,175	$ (493)	$ 6,511	$ 260,536	$ 190,488	$ 10,710	$ 33,181	$ 26,157	$ 267,588	$ 9,617	$ 350,407
10	$ 38,249	$ 34,882	$ 53,675	$ 44,990	$ 36,569	$ 49,725	$ (499)	$ 6,641	$ 264,232	$ 193,623	$ 10,924	$ 33,845	$ 25,840	$ 293,428	$ 9,724	$ 385,971
11	$ 38,763	$ 35,207	$ 54,275	$ 45,890	$ 37,300	$ 50,281	$ (505)	$ 6,774	$ 267,985	$ 196,739	$ 11,142	$ 34,522	$ 25,582	$ 319,011	$ 9,833	$ 421,387
12	$ 39,284	$ 35,535	$ 54,882	$ 46,808	$ 38,046	$ 50,843	$ (511)	$ 6,909	$ 271,796	$ 199,936	$ 11,365	$ 35,212	$ 25,283	$ 344,294	$ 9,943	$ 456,613
13	$ 39,812	$ 35,866	$ 55,496	$ 47,744	$ 38,807	$ 51,411	$ (517)	$ 7,047	$ 275,666	$ 203,114	$ 11,592	$ 35,916	$ 25,044	$ 369,338	$ 10,054	$ 491,711
14	$ 40,347	$ 36,200	$ 56,116	$ 48,699	$ 39,583	$ 51,986	$ (524)	$ 7,188	$ 279,595	$ 206,473	$ 11,824	$ 36,634	$ 24,664	$ 394,002	$ 10,166	$ 526,542
15	$ 40,890	$ 36,537	$ 56,743	$ 49,673	$ 40,375	$ 52,567	$ (531)	$ 7,332	$ 283,586	$ 205,159	$ 12,060	$ 37,367	$ 29,000	$ 423,002	$ 10,280	$ 565,822
	$ 592,993	$ 545,829	$ 836,363	$ 687,933	$ 559,168	$ 774,796	$ (7,747)	$ 101,544	$ 4,090,880	$ 2,763,530	$ 184,908	$ 489,743	$ 423,002		$142,819	

Notes:

1 This cash flow reflects a QECB financing rate of 0.47%.

2 Revenues are based on current utility rate structures and usage information provided for purposes of this project.

3 The performance and payment bonds apply only to the installation portion of the contract and do not apply in any way to energy savings guarantees, payments or maintenance provisions, except that the performance bond shall guarantee that the installation will be free of defective materials and workmanship for a period of 12 months following completion and acceptance of the work

4 The STW Billing System Costs represent the installation cost for the billing system. The City will purchase this system directly from the supplier, not through Ameresco.

5 Projected savings from the work that was added during construction is not guaranteed.

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Appendix G: Additional Work Savings Calculations

	Additional water meter installation				
Size		Net Qty	AVG water gain (kGal) per meter	Total water+sewer rate ($/kGal)	Additional revenue
5/8"x3/4"	Residential	18	4.41	$6.30	$500
1"	Residential	19	0.48	$6.30	$57
2" PD	Commercial	4	12	$6.30	$302
2" MVR	Commercial	1	12	$6.30	$76
	TOTAL				$936
	Additional electric meter installation				
Size		Net Qty	AVG kWh gain per meter	$/kWh	Additional revenue
2S	Residential	22	114.3	$ 0.1155	$ 290

Additional interior lighting installation	ADDITIONAL SAVINGS FROM ADDITIONAL RETROFITS INSTALLED DURING CONSTRUCTION							
Facility	Location	Qty	Pre-Fixture	Pre-Watt	Pre-Hrs	Pre kWh		
City Warehouse	Warehouse	2	HPS	1,100	2,600	2,860		
			Post-Fixture	Post-Watt	Post-Hrs	Post kWh	kWh savings	$ savings
			RAB FXLED	300	2,600	780	4,160	$ 422

Additional exterior lighting installation	ADDITIONAL SAVINGS FROM ADDITIONAL RETROFITS INSTALLED DURING CONSTRUCTION													
Facility	Location	Qty	Pre-Fixture	Pre-Watt	Pre-Hrs	Pre kWh	Post-Fixture	Post-Watt	Post-Hrs	Post kWh	kWh savings		$/kWh	$ savings
Streetlight	Globe post tops	58	Incandescent	100	4,368	437	LED screw in	19	4,368	83	20,521	4.70	$0.0767	$ 1,574
Riverbend Park	Low bay fixtures	19	HPS	277	4,368	1,210	NEPTUNE LED	100	4,368	437	14,690	3.36	$0.0767	$ 1,127
Riverbend Park	Cobraheads	39	HPS	277	4,368	1,210	ATBS R3	49	4,368	214	38,840	8.89	$0.0767	$ 2,979
Veterans Memorial Park	Flood light	3	HPS	1,667	4,368	7,280	RAB FXLED300SF	300	4,368	1,310	17,909	4.10	$0.0767	$ 1,374
	TOTAL	119		2,321		10,137		468		2,044	91,960	21	$0.0767	$ 7,053

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