



Year 2 – 2018

# *Measurement and Verification Report*



**Kings Local School District**  
1797 King Avenue  
Kings Mills, OH 45034

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## Table of Contents

Executive Summary .....	2
Project at a Glance .....	4
Measurement & Verification Details .....	7
Energy Savings Summary Table .....	8
Option C ECM Verification .....	9
Mutually Agreed Upon ECM Verification .....	11
Water Conservation.....	11
Building Envelope.....	12
Building Operation .....	13
Base Utility Rates and Meter Details .....	19
Baseline Adjustments.....	22
Measurement & Verification Glossary .....	24
Appendix.....	26

## Executive Summary

The following measurement and verification (M&V) report details the findings resulting from Trane's installation of new energy efficient equipment and services at the Kings Local School District. The project goal was to decrease electric, natural gas and water consumption over a 15 year term. The following pages include a detailed report of the financial and energy savings as a result of the successful installation of numerous energy conservation measures (ECMs) throughout the district.

To summarize our findings, Trane concluded the total cost savings for year 2 of the performance agreement, June, 2017 – May, 2018, was \$196,604, which is \$19,468 over the guaranteed savings of \$177,136. As a result, **the guarantee year 2 has been exceeded.**

### Measurement Methodology

The majority of the energy savings for this project are measured using International Performance Measurement and Verification Protocol (IPMVP) Option C, whole facility measurement. This methodology involves collecting monthly utility bills throughout the year, and comparing them to baseline utility bills.

Mutually agreed savings are based on engineering calculations or building modeling and will not be measured, monitored, or adjusted for the duration of the contract.

Building	Natural Gas Savings	Electric Savings	Water Savings
Kings HS	Option C	Option C	Mutually Agreed
Kings JHS	Option C	Option C	Mutually Agreed
Columbia IS	Option C	Option C	Mutually Agreed
JF Burns ES	Option C	Option C	Mutually Agreed
Kings Mills ES	Option C	Option C	Mutually Agreed
South Lebanon ES	Option C	Option C	Mutually Agreed
Kings Ed Center	Option C	Option C	Mutually Agreed
Transport. Bldg.	Mutually Agreed		

The table above depicts the methodology used to verify each utility type. This data collection makes it possible to calculate and provide the savings shown in the following pages.

### Changes since the Last Report

Energy and cost savings have improved over the year 1 results:

- 19% increase in electricity savings
- 6% increase in electric demand savings
- 22% increase in natural gas savings
- 11% increase in cost savings

During the course of the year 2 performance period, Trane undertook the following actions to improve the energy savings of the project:

- Checked/adjusted building schedules
- Lowered/raised duct static pressure setpoints
- Verified/adjusted fan status to be consistent with what is being commanded
- Reduced PID loop gains to reduce setpoint oscillation
- Reviewed OA dampers allowing a certain amount of OA flow
- Reviewed heating/HW valve operation
- Addressed sensors that didn't show air flows

- Reduced space sub cooling incidents
- Raised the range on the mixed air sensors to get them reading
- Implemented discharge air reset
- Disabled reheat
- Reduced space overheating instances
- Fixed communication issues
- Released overrides
- Fixed control program code to prevent heating valve from opening when active economizing is occurring
- Verified temperature reading and relocated or replaced sensors
- Revised the program code to better constrain the active discharge air temperature setpoint based on heating or cooling mode
- Added control points to monitor more equipment

### Outlook

We expect to continue on the same path of energy savings and look forward to reporting next year's accomplishments. Since the guarantee performance period began, Kings Local School District has saved over \$475,000 in energy and operational savings.

## Project at a Glance

This project primarily consisted of the following Energy Conservation Measures

- Lighting upgrades
- Building controls
- Variable frequency drives (VFDs) on hot and chilled water pumps and air handling units
- Building envelope improvements
- Water conservation

### General Benefits from these ECMs

In addition to reducing energy use and cost, these ECMs also provide the following benefits:

#### Lighting

- Improved lighting quality
- Improved reliability, reduced maintenance costs
- Improved environmental impact

#### Building Controls

- Air and temperature quality/control
- Better control of equipment
- Optimal start/stop
- Demand management (reduced electrical costs)
- Remote access & control

#### VFDs

- Demand management

#### Building Envelope

- Improved building comfort

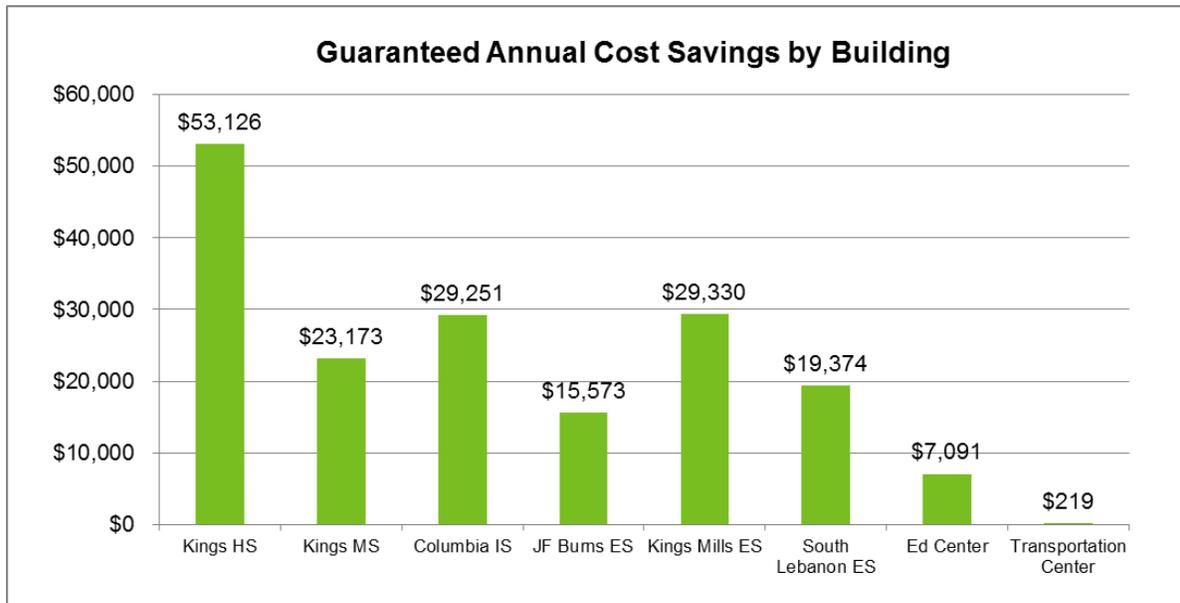
### Environmental Impact from the Project

This project has a favorable environmental impact by reducing CO<sub>2</sub> emissions by 1,478 metric tons per year in each year of the guarantee.

Environmental Impact based on Guaranteed Savings		
<b>Reduced CO<sub>2</sub> emissions</b> 	<b>Miles driven by average passenger vehicle</b> 	<b>Carbon sequestered by acres of forest for one year</b> 
1,478 metric tons	3,621,217 miles	1,741 acres
<small>CO<sub>2</sub> emissions reduction based on project energy savings converted utilizing <a href="https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator">https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator</a></small>		
Guaranteed Energy Savings Totals for Project		
<b>Electric Savings</b> 	<b>Natural Gas Savings</b> 	<b>Water Savings</b> 
1,874,068 kWh	15,606 therms	1,806,000 gal

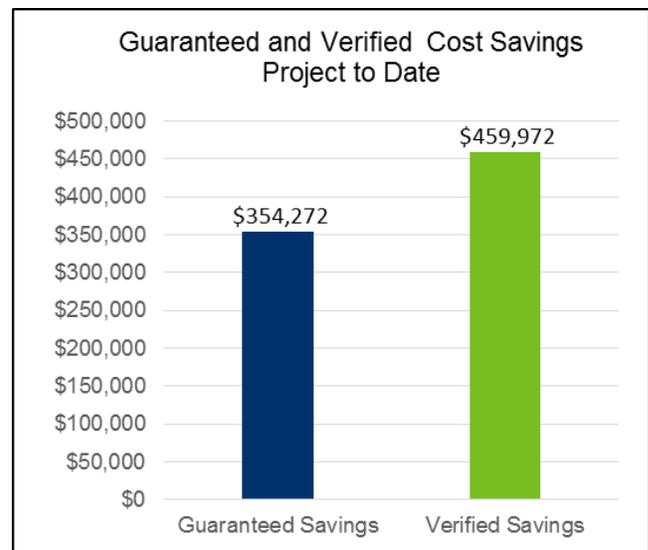
### Guaranteed Savings by Building

The annual guaranteed savings for this project is \$177,136 and is shown by building below:



### \$196,604 Savings in Year 2

During the year 2 performance period of June 1, 2017 – May 31, 2018, the Trane and Kings Local School District energy services project saved \$196,604. This is 11% greater than the guaranteed savings for this period, bringing the total verified energy savings-to-date, including construction period savings, to \$459,972.



### Recommendations based on what happened this year

Working together, Trane and Kings Schools could also increase savings by pursuing the following recommendations:

- Optimize the building-by-building occupancy and holiday schedules in the BAS.
- Check for HVAC systems in override or units placed in manual or the on/off position.
- Optimize resets (CHW, HW, SA, etc.) and space temperature set point dead bands.
- Maintain temperature set points and schedules within tolerances specified in the agreement
- Routinely inspect weather stripping, door seals and look for cracks or gaps that could compromise building envelope savings.
- Perform scheduled equipment inspections such as coils surfaces and duct leaks.
- Perform scheduled maintenance such as filter changes to ensure optimal equipment efficiency and performance.

### Recommendations for Behavioral Changes and Associated Potential Benefits

- Engage school staff and students in your energy-saving initiatives. They have the power to greatly enhance savings.
- Encourage building occupants to turn off lights when leaving a room and in areas that are unoccupied.
- Use partial lighting when using only a portion of the room.
- Raise blinds or shades during the day to allow in natural light.
- Close blinds or shades at the end of the day to reduce overnight air temperature loss or gain.
- Dress appropriately for the season to avoid adjusting temperature set points.
- Turn off PC's, monitors, electronics and personal appliances when not in use, when leaving the room, or at the end of the day, and unplug these items during extended periods of non-use.
- Consider performing a plug-load audit to identify energy-consuming equipment that can be eliminated from classrooms.
- Work with your IT department to deploy computer power management features across the district.

## Measurement & Verification Details

### Background

This document is in reference to the PACT™ Agreement (hereinafter the "agreement") made and entered into as of February 5, 2015, by and between Trane and Kings Local School District, for the purpose of furnishing services designed to reduce energy consumption and operational costs at the premises, to guarantee a specified minimum level of energy savings.

### Savings Guarantee

The guarantee phase of the project began on June 1, 2016. The second year guarantee period, therefore, was from June 1, 2017 to May 31, 2018. The project has a guarantee term of 15 years.

As a result of the services furnished, Trane guarantees that the Kings Local School District will realize total energy saving of:

- 1,874,068 kWh of electrical consumption
- 4,497 kW of electric demand
- 15,606 therms of natural gas
- 1,806,000 gallons of water

Kings School has also realized operational savings of \$7,800 as further detailed in the agreement. This savings is due to plumbing and lighting material deferment.

### Savings Calculation Methods

Two (2) different methods were utilized to measure and calculate energy savings, based on International Performance Measurement and Verification Protocol (IPMVP): 1) Whole Facility IPMVP Option C, and 2) Mutually agreed upon (stipulated) savings, which is data that will not be measured, monitored or adjusted. The type and location of each energy conservation measure (ECM) were factors in determining which method was used.

### Year 2 Total Savings

The total year 2 savings shown in the table below is the sum of the Option C verified savings and the mutually agreed upon savings. Cost savings have been calculated using the base utility rates as described on page 19 of this report. Descriptions of how the energy savings were calculated are included in pages 9 through 12 of this report. An energy savings summary is provided in the next section of this report.

Energy Type	Guaranteed Savings	Verified + Mutually Agreed Savings	Excess/Shortfall
Electric Energy (kWh)	1,874,068	1,385,567	-488,502
Electric Demand (kW)	4,497	5,698	1,201
Natural Gas (therms)	15,606	30,667	15,061
Water (gallons)	1,806,000	1,806,000	0
<b>Cost Savings</b>	<b>\$177,136</b>	<b>\$196,604</b>	<b>\$19,468</b>

## Energy Savings Summary Table

### Kings Local School District ENERGY SAVINGS SUMMARY June 2017 - May 2018

**Guaranteed Savings**

kWh 1,874,068  
kW 4,497  
Therms 15,606  
Gallons 1,806,000

**Year 2 Guarantee Information**

**Guaranteed Savings** \$177,136  
**Annual Escalation %** 0%  
**Excess/Shortfall** \$19,468  
**Operational Savings** \$7,800

Year	Verified Energy Savings				Deviation from Guarantee				Cost Savings	
	Electrical Energy (kWh)	Electrical Demand (kW)	Natural Gas (therms)	Water (gallons)	Electrical Energy (kWh)	Electrical Demand (kW)	Natural Gas (therms)	Water (gallons)	Cost Savings	Excess/Shortfall
<b>Constr.<sup>(1)</sup></b>	718,271	2,006	13,088	1,207,299	n/a	n/a	n/a		\$88,243	\$88,243
<b>Year 1</b>	1,167,420	5,382	25,154	1,806,000	-706,648	885	9,548	0	\$175,124	-\$2,012
<b>Year 2</b>	1,385,567	5,698	30,667	1,806,000	-488,502	1,201	15,061	0	\$196,604	\$19,468
<b>Year 3</b>										
<b>Year 4</b>										
<b>Year 5</b>										
<b>Year 6</b>										
<b>Year 7</b>										
<b>Year 8</b>										
<b>Year 9</b>										
<b>Year 10</b>										
<b>Year 11</b>										
<b>Year 12</b>										
<b>Year 13</b>										
<b>Year 14</b>										
<b>Year 15</b>										
<b>Total</b>	<b>3,271,258</b>	<b>13,086</b>	<b>68,909</b>	<b>4,819,299</b>	<b>-1,195,150</b>	<b>2,085</b>	<b>24,609</b>	<b>0</b>	<b>\$459,972</b>	<b>\$105,700</b>

(1) There are no guaranteed savings during the construction period.

## Option C ECM Verification

### ECM Description

This performance guarantee applies to the Option C ECMs described in the agreement. The table below lists the ECMs and the buildings in which the work was performed.

ECM	Kings HS	Kings JHS	Columbia IS	JF Burns ES	Kings Mills ES	South Lebanon ES	Kings Ed Center	Transportation
Lighting	x	x	x	x	x	x	x	
Controls	x	x	x	x	x	x		
VFDs	x	x	x	x				
Convert MZ AHU to VAV		x						
Gym Dampers		x						
Eliminate HRUs					x	x		
Boiler Replacement							x	
Building Envelope	x	x	x	x	x	x	x	x
Kitchen Hood	x	x						
Pipe Insulation		x		x				
Water Conservation	x	x	x	x	x	x	x	

### Year 2 Savings

The tables below compares the Option C guaranteed and verified energy savings for year 2. The methodology and calculations used to verify these savings are included in the section following the table.

#### Option C Savings – Year 2

Energy Type	Guaranteed Savings	Verified Energy Savings	Excess/Shortfall
Electric Energy (kWh)	1,873,895	1,385,394	-488,502
Electric Demand (kW)	4,497	5,698	1,201
Natural Gas (therms)	15,377	30,438	15,061
Water (gallons)	0	0	0
<b>Cost Savings</b>	<b>\$163,129</b>	<b>\$182,597</b>	<b>\$19,468</b>

### Measurement Methodology & Computation of Energy Savings

Energy savings from a total of seven electric and seven natural gas meters were measured and calculated using IPMVP Option C (Whole Facility). This method involves continuous measurements of the Option C sites by collecting utility bills throughout the year and comparing them to baseline utility bills.

This project calculates Option C savings by utilizing the Metrix Utility Accounting System software, copyrighted by Abraxas Energy Consulting. Energy savings are calculated as follows:

**Baseline energy use (adjusted) – current period energy use from bills = energy saved**

Baseline energy use is routinely adjusted to account for changes in weather and the number of days in the utility billing cycle. All other non-routine baseline adjustments are detailed in the Baseline Adjustment section of this report.

Cost savings are computed by multiplying the energy savings by the applicable base utility rate, as detailed in this report.

Detailed performance graphs for this project, by building and by meter, are included in the appendix of this report.

## Mutually Agreed Upon ECM Verification

Mutually agreed upon savings are savings that have been agreed upon and will not be measured, monitored, or adjusted for the duration of the contract. These savings are based on engineering calculations or building modeling, and are used for relatively low cost saving ECMs, where the cost to calculate actual savings is not cost effective. In this project, mutually agreed to saving were used for the water conservation ECMs and the building envelope ECM at the Transportation Building. The table below shows the mutually agreed upon savings for year 2. Cost savings are calculated using the base utility rates in the agreement.

### Year 2 – Total Mutually Agreed Savings

Energy Type	Mutually Agreed Savings
Electric Energy (kWh)	173
Electric Demand (kW)	0
Natural Gas (therms)	229
Water (gallons)	1,806,000
<b>Cost Savings</b>	<b>\$14,007</b>

### Water Conservation

This performance guarantee applies to the energy conservation measure involving the retrofits of urinals, sinks, showers, and toilets located in the following buildings:

- Kings High School
- Kings Junior High
- Columbia Intermediate School
- JF Burns Elementary School
- Kings Mills Elementary School
- South Lebanon Elementary School
- Kings Education Center

### Year 2 Savings

The table below identifies the guaranteed energy savings for year 2. These savings have been mutually agreed upon and will not be measured or monitored.

### Water Conservation – Year 2

Energy Type	Mutually Agreed Savings
Water (gallons)	1,806,000
<b>Cost Savings</b>	<b>\$13,788</b>

### Measurement Methodology

The urinals, sinks, toilets, showers, and cooling towers of Kings Local Schools were surveyed and water flow rates analyzed. For the purposes of the agreement, the number of urinals, sinks, toilets and usage characteristics are stipulated.

### Computation of Savings

The following describes the methodology for computing savings based on the agreed to water flow rates, usage rates, and flush data.

Water Savings Calculation for Toilets:

$$\text{Annual Water Savings (gallons)} = [(\text{EXISTWTR} - \text{NEWWTR}) * \text{FLUSH\#} * \text{TOILET\#} * \text{DAYS\#}]$$

$$\text{Annual Cost Savings} = [\text{Annual Water Savings} / 11,000] * \text{WTRCOST}$$

Water Savings Calculation for Urinals:

$$\text{Annual Water Savings (gallons)} = [(\text{EXISTWTR} - \text{NEWWTR}) * \text{FLUSH\#} * \text{URINAL\#} * \text{DAYS\#}]$$

$$\text{Annual Cost Savings} = [\text{Annual Water Savings} / 11,000] * \text{WTRCOST}$$

Water Savings Calculation for Sinks:

$$\text{Annual Water Savings (gallons)} = [(\text{EXISTWTR} - \text{NEWWTR}) * \text{USE\#} * \text{SINK\#} * \text{DAYS\#}]$$

$$\text{Annual Cost Savings} = [\text{Annual Water Savings} / 1,000] * \text{WTRCOST}$$

Water Savings Calculation for Showers:

$$\text{Annual Water Savings (gallons)} = [(\text{EXISTWTR} - \text{NEWWTR}) * \text{USE\#} * \text{SHOWER\#} * \text{DAYS\#}]$$

$$\text{Annual Cost Savings} = [\text{Annual Water Savings} / 11,000] * \text{WTRCOST}$$

Water Savings Calculation for Leaks:

$$\text{Annual Water Savings (gallons)} = [(\text{EXISTLEAK} - \text{FIXLEAK}) * \text{MINUTE\#} * \text{DAYS\#}]$$

$$\text{Annual Cost Savings} = [\text{Annual Water Savings} / 1,000] * \text{WTRCOST}$$

### Building Envelope

This performance guarantee applies to the energy conservation measure involving building envelope improvements in the Transportation Building.

#### Year 2 Savings

The table below identifies the guaranteed energy savings for year 2. These savings have been mutually agreed upon and will not be measured or monitored.

#### Building Envelope – Year 2

Energy Type	Mutually Agreed Savings
Electric Energy (kWh)	173
Natural Gas (therms)	229
<b>Cost Savings</b>	<b>\$219</b>

#### Computation of Savings:

The following describes the agreed to methodology for calculating building envelope leaks:

$$(\text{bldg. leakage} * \text{bldg. "k"}) * (\text{wind P factor}) * (\text{HDD} * 24 * 60) * (.075) * (.243) / 100,000 * \text{systems Efficiency \%}$$

## Building Operation

The following operational parameters were collaboratively agreed upon by the customer and Trane, and are mutually agreed to for the purposes of the agreement. The parameters were used in the detailed energy analysis process to determine energy use savings and the customer bears the risk of decreased energy savings if the facilities are operated outside of these parameters. Variation from these parameters will permit Trane to make an adjustment to the baseline.

### Operational Parameters from Contract

#### King High School

Kings High School HVAC Schedules and Setpoints									
Type	Day	Start	Stop	Days	Weekly Hours	Heating Setpoint		Cooling Setpoint	
						Occupied	Unoccupied	Occupied	Unoccupied
AHU1 Multi/Nurse	M-F	6.05	21.00	5	74.75	70	55	74	85
AHU2 Classroom	M-F	6.12	15.30	5	45.9	70	55	74	85
AHU2R Counselors	M-F	6.11	17.00	5	54.45	70	55	74	85
AHU3 Auditorium	M-F	7.00	17.28	5	51.4	70	55	74	85
AHU4 Gym	M-F	6.25	21.30	2	30.1	70	55	74	85
AHU6 Vocal/Art	M-F	6.07	15.30	5	46.15	70	55	74	85
AHU7 Locker Room	M-F	7.02	15.30	5	41.4	70	55	74	85
AHU8 Kitchen	M-F	6.06	17.30	5	56.2	70	55	74	85
AHU9 Cafeteria	M-F	6.06	17.30	5	56.2	70	55	74	85
AHU B1 Media	M-F	6.09	16.00	5	49.55	70	55	74	85
AHU B2 Media	M-F	6.09	15.30	5	46.05	70	55	74	85
AHU B3 Media	M-F	6.00	15.30	5	46.5	70	55	74	85
AHU D1 Band	M-F	6.00	16.00	5	50	70	55	74	85
RTU1 East Commons	M-F	6.08	16.00	5	49.6	70	55	74	85
RTU2 West Commons	M-F	6.08	16.00	5	49.6	70	55	74	85
RTU3 Offices	M-F	6.00	17.00	5	55	70	55	74	85
RTU4 Band Room	M-F	6.31	15.30	5	44.95	70	55	74	85
RTU5 Band Room	M-F	6.38	15.30	5	44.6	70	55	74	85
RTU7 New Kitchen	M-F	6.01	19.00	5	64.95	70	55	74	85
FCUs Classrooms	M-F	6.10	15.30	5	46	70	55	74	85
Building	S-S	0.00	24.00	2	48	55	55	85	85
Event Mode Specific to Zone	Programed and Scheduled as needed								
Boiler Plant		0.00	24.00	Enable at OA < 55°F					
Chiller Ice Build		21.00	6.00	Chiller enable at OA > 45°F, Chiller off at RWT = 22°F					
Chiller + Ice Melt		6.00	21.00	Chiller enable at OA > 60°F, Ice melt, enable chiller at RWT = 50°F					
Ice Mely Only		6.00	Varies	Chiller enable at RWT = 45°F, next chiller staged on at ice depletion					
Chiller Only		Varies	Varies	Chiller enable at OA > 60°F					

### Kings Junior High

Kings Junior High School HVAC Schedules and Setpoints									
Type	Day	Start	Stop	Days	Weekly Hours	Heating Setpoint		Cooling Setpoint	
						Occupied	Unoccupied	Occupied	Unoccupied
AHU1 Band Room	M-F	6.30	15.30	5	45	70	55	74	85
AHU2 Cafeteria	M-F	6.30	14.00	5	38.5	70	55	74	85
AHU3 Kitchen	M-F	6.00	15.00	5	45	70	55	74	85
AHU4 Locker Room	M-F	6.30	16.00	5	48.5	70	55	74	85
AHU5&6 Gym	M-F	6.30	20.00	2	27.4	70	55	74	85
AHU10 Clinic	M-F	6.30	15.30	5	45	70	55	74	85
RTU6 Admin Offices	M-F	6.30	15.30	5	45	70	55	74	85
RTU8&9 Weight Room	M-F	5.30	14.30	5	45	70	55	74	85
RTU10 Multipurpose	M-F	6.30	20.00	5	68.5	70	55	74	85
UVs Classrooms	M-F	6.30	15.00	5	43.5	70	55	74	85
Building	S-S	0.00	24.00	2	48	55	55	85	85
Event Mode Specific to Zone		Programed and Scheduled as needed							
Boiler Plant	M-S	0.00	24.00	Boiler enable at OA < 55°F					
Chiller Plant	M-S	0.00	24.00	Chiller enable at OA > 60°F					

### Columbia Intermediate School

Columbia Intermediate School HVAC Schedules and Setpoints									
Type	Day	Start	Stop	Days	Weekly Hours	Heating Setpoint		Cooling Setpoint	
						Occupied	Unoccupied	Occupied	Unoccupied
AHU1 Building	M-F	6.30	15.30	5	45	70	55	74	85
AHU2 Office, DX Cooling	M-F	6.30	16.00	5	48.5	70	55	74	85
Building	S-S	0.00	24.00	2	48	55	55	85	85
Event Mode Specific to Zone		Programed and Scheduled as needed							
Boiler Plant		0.00	24.00	Enable at OA < 55°F					
Chiller Ice Build		-	-	Ice disabled					
Chiller + Ice Melt		-	-	Ice disabled					
Ice Mely Only		-	-	Ice disabled					
Chiller Only		0.00	24.00	Chiller enable at OA > 60°F					

### JF Burns Elementary School

JF Burns Elementary School HVAC Schedules and Setpoints									
Type	Day	Start	Stop	Days	Weekly Hours	Heating Setpoint		Cooling Setpoint	
						Occupied	Unoccupied	Occupied	Unoccupied
AHU Office	M-F	6.00	16.00	5	50	70	55	74	85
AHUGym	M-F	6.00	16.00	5	50	70	55	74	85
AHU Old Gym	M-F	6.00	16.00	5	50	70	55	74	85
AHU Café/Kitchen	M-F	6.00	16.00	5	50	70	55	74	85
RTU DX Cooling only	M-F	6.00	16.00	5	50	-	-	74	85
UVs Classrooms	M-F	6.00	16.00	5	50	70	55	74	85
Building	S-S	0.00	24.00	2	48	55	55	85	85
Event Mode Specific to Zone		Programed and Scheduled as needed							
Boiler Plant		0.00	24.00	Enable at OA < 55°F					
Chiller Ice Build		21.00	6.00	Chiller enable at OA > 45°F, Chiller off at RWT = 22°F					
Chiller + Ice Melt		6.00	17.00	Chiller enable at OA > 60°F, Ice melt, enable chiller at RWT = 50°F					
Ice Mely Only		8.00	21.00	Chiller enable at RWT = 45°F					
Chiller Only		6.00	8.00	Chiller enable at OA > 60°F					

### Kings Mills Elementary School

Kings Mills Elementary School HVAC Schedules and Setpoints									
Type	Day	Start	Stop	Days	Weekly Hours	Heating Setpoint		Cooling Setpoint	
						Occupied	Unoccupied	Occupied	Unoccupied
AHU-D101	M-F	6.30	16.00	5	48.5	70	55	74	85
AHU-D103	M-F	6.30	16.00	5	48.5	70	55	74	85
AHU-D103	M-F	6.30	16.00	5	48.5	70	55	74	85
HRU-D101	Disabled								
HRU-D102	Disabled								
Building	S-S	0.00	24.00	2	48	55	55	85	85
Event Mode Specific to Zone	Programed and Scheduled as needed								
Boiler Plant		0.00	24.00	Enable at OA < 55°F					
Chiller Ice Build		21.00	6.00	Chiller enable at OA > 45°F, Chiller off at RWT = 22°F					
Chiller + Ice Melt		6.00	21.00	Chiller enable at OA > 60°F, Ice melt, enable chiller at RWT = 50°F					
Ice Mely Only		8.00	Varies	Chiller enable at RWT = 45°F					
Chiller Only		6.00	8.00	Chiller enable at OA > 60°F					

### South Lebanon Elementary School

South Lebanon Elementary School HVAC Schedules and Setpoints									
Type	Day	Start	Stop	Days	Weekly Hours	Heating Setpoint		Cooling Setpoint	
						Occupied	Unoccupied	Occupied	Unoccupied
AHU-A001	M-F	6.30	16.00	5	48.5	70	55	74	85
AHU-C201	M-F	6.30	16.00	5	48.5	70	55	74	85
AHU-C202	M-F	6.30	16.00	5	48.5	70	55	74	85
HRU-D101	Disabled								
HRU-D102	Disabled								
Building	S-S	0.00	24.00	2	48	55	55	85	85
Event Mode Specific to Zone	Programed and Scheduled as needed								
Boiler Plant		0.00	24.00	Enable at OA < 55°F					
Chiller Ice Build		21.00	6.00	Chiller enable at OA > 45°F, Chiller off at RWT = 22°F					
Chiller + Ice Melt		6.00	21.00	Chiller enable at OA > 60°F, Ice melt, enable chiller at RWT = 50°F					
Ice Mely Only		8.00	Varies	Chiller enable at RWT = 45°F					
Chiller Only		6.00	8.00	Chiller enable at OA > 60°F					

### Kings Education Center

Kings Education Center HVAC Schedules and Setpoints									
Type	Day	Start	Stop	Days	Weekly Hours	Heating Setpoint		Cooling Setpoint	
						Occupied	Unoccupied	Occupied	Unoccupied
AHU1	M-F	6.30	17.00	5	53.5	70	55	74	85
AHU2	M-F	6.30	16.00	5	48.5	70	55	74	85
AHU3 Gym	M-F	6.30	16.00	5	48.5	70	55	74	85
UVs Classrooms	M-F	6.30	16.00	5	48.5	70	55	74	85
Building	S-S	0.00	24.00	2	48	55	55	85	85
Event Mode Specific to Zone	Programed and Scheduled as needed								
Boiler Plant 1		0.00	24.00	Enable at OA < 55°F					
Boiler Plant 2		0.00	24.00	Enable at OA < 55°F					
Chiller Ice Build		21.00	6.00	Chiller enable at OA > 45°F, Chiller off at RWT = 22°F					
Chiller + Ice Melt		6.00	21.00	Chiller enable at OA > 60°F, Ice melt, enable chiller at RWT = 50°F					
Ice Mely Only		8.00	Varies	Chiller enable at RWT = 45°F					
Chiller Only		6.00	8.00	Chiller enable at OA > 60°F					

## Revised Operational Parameters

Energy savings were adjusted in year 1 and continue for year 2, due to the increase in heating setpoints and the decrease in cooling setpoints in all buildings. Changes in operating hours from the original agreed to schedules were also accounted for. The revised operating schedules and setpoints are detailed below.

### Kings High School - Revised

Kings High School		Actual Setpoints and Schedules								
Type	Day	Start	Stop	Days	Exhibit E Hours	Hours 8/14/17	ECM Heating Setpoint		ECM Cooling Setpoint	
							Occupied	Unoccupied	Occupied	Unoccupied
AHU1 Multi/Nurse	M-F	6.00	16.00	5	75	50	72.5	60	72.5	80
AHU2 Classroom	M-F	6.00	16.00	5	46	50	72.5	60	72.5	80
AHU2R Counselors	M-F	6.15	17.00	5	55	54	72.5	60	72.5	80
AHU3 Auditorium	M-F	7.00	16.45	5	52	47	72.5	60	72.5	80
AHU4 Gym	M-F	6.15	21.00	5	30	74	72.5	60	72.5	80
AHU6 Vocal/Art	M-F	6.00	15.00	5	46	45	72.5	60	72.5	80
AHU7 Locker Room	M-F	6.15	21.00	5	42	74	72.5	60	72.5	80
AHU8 Kitchen	M-F	6.00	13.50	5	56	38	72.5	60	72.5	75
AHU9 Cafeteria	M-F	6.00	13.50	5	56	38	72.5	60	72.5	80
AHU B1 Media	M-F	6.00	16.00	5	50	50	72.5	60	72.5	80
AHU B2 Media	M-F	6.00	16.00	5	46	50	72.5	60	72.5	80
AHU B3 Media	M-F	6.00	16.00	5	47	50	72.5	60	72.5	80
AHU D1 Band	M-F	6.00	15.00	5	50	45	72.5	60	72.5	80
RTU1 East Commons	M-F	6.00	16.00	5	50	50	72.5	60	72.5	80
RTU2 West Commons	M-F	6.00	16.00	5	50	50	72.5	60	72.5	80
RTU3 Offices	M-F	6.00	17.00	5	55	55	72.5	60	72.5	80
RTU4 Band Room	M-F	6.00	15.00	5	45	45	72.5	60	72.5	80
RTU5 Band Room	M-F	6.00	15.00	5	45	45	72.5	60	72.5	80
RTU7 New Kitchen	M-F	6.01	13.30	5	65	36	72.5	60	72.5	75
FCUs Classrooms	M-F	6.00	16.00	5	46	50	72.5	60	72.5	80
Building	S-S	0.00	24.00	2		0	72.5	60	72.5	80
Event Mode Specific to Zone		Programmed and Scheduled as Needed								
Boiler Plant		0.00	24.00	Enable at OA < 50°F						
Chiller Ice Build		21.00	6.00	Chiller enable at OA > 45°F, Chiller off at RWT = 22°F						
Chiller + Ice Melt		0.00	0.00	Chiller enable at OA > 55°F, Ice melt, enable chiller at RWT = 50°F						
Ice Melt Only		10.00	20.00	Chiller enable at RWT = 45°F, next chiller staged on at ice depletion						
Chiller Only		6.00	10.00	Chiller enable at OA > 55°F						

### Kings Junior High – Revised

Kings Junior High		Actual Setpoints and Schedules								
Type	Day	Start	Stop	Days	Exhibit E Hours	Hours 8/14/17	ECM Heating Setpoint		ECM Cooling Setpoint	
							Occupied	Unoccupied	Occupied	Unoccupied
AHU1 Band Room	M-F	6.00	15.00	5	45	45	72.5	60	72.5	80
AHU2 Cafeteria	M-F	5.00	13.30	5	39	42	72.5	60	72.5	80
AHU3 Kitchen	M-F	5.30	13.30	5	45	40	72.5	60	72.5	80
AHU4 Locker Room	M-F	6.00	15.00	5	49	45	72.5	60	72.5	80
AHU5&6 Gym	M-F	6.00	21.00	5	27	75	72.5	60	72.5	80
AHU10 Clinic	M-F	6.00	15.00	5	45	45	72.5	60	72.5	80
RTU6 Admin Offices	M-F	6.00	16.00	5	45	50	72.5	60	72.5	80
RTU8&9 Weight Room	M-F	5.00	18.30	5	45	67	72.5	60	72.5	80
RTU10 Multipurpose	M-F	6.00	15.30	5	69	47	72.5	60	72.5	80
UVs Classrooms	M-F	7.00	16.00	5	44	45	72.5	60	72.5	80
Building	S-S	0.00	24.00	2			72.5	60	72.5	80
Event Mode Specific to Zone		Programmed and Scheduled as needed								
Boiler Plant	M-S	0.00	24.00	Boiler enable at OA < 50°F						
Chiller Plant	M-S	0.00	24.00	Chiller enable at OA > 55°F						

### Columbia Intermediate – Revised

Columbia Intermediate School		Actual Setpoints and Schedules										
Type	Day	Start	Stop	Days	Exhibit E Hours	Hours 8/14/17	ECM Heating Setpoint		ECM Cooling Setpoint			
							Occupied	Unoccupied	Occupied	Unoccupied		
AHU1 Building	M-F	6.00	15.30	5	45	47	72.5	60	72.5	80		
Gym	M-F	6.00	15.30	5	49	47	72.5	60	72.5	80		
AHU2 Office, DX Cooling	M-F	7.00	16.00	5	48	45	72.5	60	72.5	80		
Building	S-S	0.00	24.00	2			72.5	60	72.5	80		
Event Mode Specific to Zone		Programed and Scheduled as needed										
Boiler Plant		0.00	24.00	Enable at OA <50°F								
Chiller Ice Build		-	-	Ice disabled								
Chiller + Ice Melt		-	-	Ice disabled								
Ice Mely Only		-	-	Ice disabled								
Chiller Only		0.00	24.00	Chiller enable at OA >60°F								

### JF Burns Elementary – Revised

JF Burns Elementary School		Actual Setpoints and Schedules										
Type	Day	Start	Stop	Days	Exhibit E Hours	Hours 8/14/17	ECM Heating Setpoint		ECM Cooling Setpoint			
							Occupied	Unoccupied	Occupied	Unoccupied		
AHU Office	M-F	7.00	15.30	5	50	42	72.5	60	72.5	80		
AHU Gym	M-F	7.00	15.30	5	50	42	72.5	60	72.5	80		
AHU Old Gym	M-F	7.00	15.30	5	50	42	72.5	60	72.5	80		
AHU Café/Kitchen	M-F	7.00	15.30	5	50	42	72.5	60	72.5	80		
RTU DX Cooling only	M-F	7.00	15.30	5	50	42	72.5	60	72.5	80		
UVs Classrooms	M-F	7.00	15.30	5	50	42	72.5	60	72.5	80		
Building	S-S	0.00	24.00	2			72.5	60	72.5	80		
Event Mode Specific to Zone		Programed and Scheduled as needed										
Boiler Plant		0.00	24.00	Enable at OA < 50°F								
Chiller Ice Build		21.00	6.00	Chiller enable at OA > 45°F, Chiller off at RWT = 22°F								
Chiller + Ice Melt		6.00	21.00	Chiller enable at OA > 55°F, Ice melt, enable chiller at RWT = 50°F								
Ice Mely Only		6.00	Varies	Chiller enable at RWT = 45°F								
Chiller Only		Varies	Varies	Chiller enable at OA > 60°F								

### Kings Mills Elementary – Revised

Kings Mills Elementary School		Actual Setpoints and Schedules										
Type	Day	Start	Stop	Days	Exhibit E Hours	Hours 8/14/17	ECM Heating Setpoint		ECM Cooling Setpoint			
							Occupied	Unoccupied	Occupied	Unoccupied		
AHU-D101	M-F	7.00	15.30	5	48.5	42	72.5	60	72.5	80		
AHU-D102	M-F	7.00	16.30	5	48.5	47	72.5	60	72.5	80		
AHU-D103	M-F	7.00	15.30	5	48.5	42	72.5	60	72.5	80		
HRU-D101 EF	M-F	7.00	15.30	5	0	42	72.5	60	72.5	80		
HRU-D102 EF	M-F	7.00	16.30	5	0	47	72.5	60	72.5	80		
Building	S-S	0.00	24.00				72.5	60	72.5	80		
Event Mode Specific to Zone		Programed and Scheduled as needed										
Boiler Plant		0.00	24.00	Enable at OA < 50°F								
Chiller Ice Build		20.00	6.00	Chiller enable at OA > 45°F, Chiller off at RWT = 22°F								
Chiller + Ice Melt		10.45	20.00	Chiller enable at OA > 55°F, Ice melt, enable chiller at RWT = 50°F								
Ice Melt Only		6.00	10.45	Chiller enable at RWT = 45°F								
Chiller Only		Varies	Varies	Chiller enable at OA >60°F								

### South Lebanon Elementary – Revised

South Lebanon Elementary School		Actual Setpoints and Schedules								
Type	Day	Start	Stop	Days	Exhibit E Hours	Hours 8/14/17	ECM Heating Setpoint		ECM Cooling Setpoint	
							Occupied	Unoccupied	Occupied	Unoccupied
AHU-A001	M-F	7.00	15.30	5	48.5	42	72.5	60	72.5	80
AHU-C201	M-F	7.00	18.00	5	48.5	55	72.5	60	72.5	80
AHU-C202	M-F	7.00	15.30	5	48.5	42	72.5	60	72.5	80
HRU-D101 EF	M-F	7.00	18.00	5	48.5	55	72.5	60	72.5	80
HRU-D102 EF	M-F	7.00	15.30	5	48.5	42	72.5	60	72.5	80
Building	S-S	0.00	24.00				72.5	60	72.5	80
Event Mode Specific to Zone		Programed and Scheduled as needed								
Boiler Plant		0.00	24.00	Enable at OA < 50°F						
Chiller Ice Build		20.30	6.00	Chiller enable at OA > 45°F, Chiller off at RWT = 22°F						
Chiller + Ice Melt		10.45	20.30	Chiller enable at OA > 55°F, Ice melt, enable chiller at RWT = 50°F						
Ice Melt Only		6.00	10.45	Chiller enable at RWT = 45°F						
Chiller Only		Varies	Varies	Chiller enable at OA > 60°F						

### Kings Education Center – Revised

Kings Education Center		Actual Setpoints and Schedules								
Type	Start	Stop	Days	Exhibit E Hours	Hours 8/14/17	ECM Heating		ECM Cooling Setpoint		
						Occupied	Unoccupied	Occupied	Unoccupied	
AHU1	6.30	17.00	5	53.5	54	72.5	60	72.5	80	
AHU2	6.30	16.00	5	48.5	49	72.5	60	72.5	80	
AHU3 Gym	6.30	16.00	5	48.5	49	72.5	60	72.5	80	
UVs Classrooms	6.30	16.00	5	48.5	49	72.5	60	72.5	80	
Building	0.00	24.00	2			72.5	60	72.5	80	
Event Mode Specific to Zone		Programed and Scheduled as needed								
Boiler Plant 1	0.00	24.00	Enable at OA < 50°F							
Boiler Plant 2	0.00	24.00	Enable at OA < 50°F							
Chiller Ice Build	21.00	6.00	Chiller enable at OA > 45°F, Chiller off at RWT = 22°F							
Chiller + Ice Melt	14.00	21.00	Chiller enable at OA > 55°F, Ice melt, enable chiller at RWT = 50°F							
Ice Melt Only	6.00	14.00	Chiller enable at RWT = 45°F							
Chiller Only	Varies	Varies	Chiller enable at OA > 60°F							

Kings Schools is responsible to perform the updates to the control system to conform to the above tables, and should limit access to thermostats to its maintenance staff.

Indoor temperature boundaries should be maintained at no warmer than 72.5° F for heating and no cooler than 72.5° F for cooling (within +/- 2 degrees).

It should also be noted that additional savings can be achieved by maintaining a lower temperature during the heating season and a higher temperature during the cooling season.

## Base Utility Rates and Meter Details

The base utility rates are those utility rates that are used to calculate the monetary value of the cost savings and are the rates set forth below in the tables. Trane will use the greater of the then current applicable utility rate unit cost or the base utility rates as adjusted (the “Adjusted Base Utility Rates”). Adjusted base utility rates are the base utility rates adjusted upward for inflation by zero percent (0%) per year, compounded annually. The parties agree that the 0% adjustment rate is a reasonable projection of inflation based on past inflation experience and Customer’s budgetary practices. However, in the event verified energy savings are less than the Guarantee, the lesser of the then current applicable utility rate unit cost or the base utility rates will be used to determine the monetary value of the shortfall in verified energy savings.

The following are the Base Utility Rates:

### Cost of Electricity

#### Duke Energy Electric Rate DS01 and Duke Retail Rate DE87

Duke Energy DS01 Rate, Duke Retail Rate DE87				
<b>Retail Rate DE87</b>		All kWh	\$0.0521	kWh
<b>Duke Energy Rate DS01</b>				
Customer Charge			\$45.95	per bill
Rate	Minimum Bill		5	kW
	All kW		\$5.3815	kW
85% Demand Ratchet	85% of highest 15 minute monthly demand set May-Sep, for the next 11 months			per bill
90% Power Factor Adjustment	if PF < 90%, billing demand = kVA * .090			per bill
Rider	DR-IKE	Storm Recovery Rider	\$0.00	per bill
	EER	Energy Efficiency Recovery Rider	\$0.09	per bill
	OET	Ohio Excise Tax Rider		
		First 2,000 kWh	\$0.00465	kWh
		Next 13,000 kWh	\$0.00419	kWh
		Additional kWh	\$0.00363	kWh
	USR	Universal Service Fund Rider		
		Up to 833,000 kWh	\$0.0010791	kWh
		Over 833,000 kWh	\$0.000469	kWh
	UE-GEN	Uncollectible Expense-Electric Generation	\$0.07	per bill
	BTR	Base Transmission Rider		
		BTR Charge	\$1.3216	kWh/kW
		RTEP Credit	\$0.000655	kWh
	RTO	Regional Transmission Organization	\$0.00	kWh
	DR-IM	Infrastructure Modernization	\$7.17	per bill
	DR-ECF	Economic Competiveness Fund	\$0.000312	kWh
	DR-SAWR	Energy Efficient Recovery	\$0.00	kWh
	UE-ED	Uncollectible Expense-Electric Distribution	\$0.18	per bill
	AER-R	Alternative Energy Recovery	\$0.000364	kWh
	RC	Retail Capacity		
		First 1,000 kW	\$2.5065	kWh/kW
		Additional kW	\$1.9828	kWh/kW
		Billing Demand Times 300	\$0.005727	kWh/kW
		Additional kWh	\$0.001733	kWh/kW
	RE	Retail Energy	\$0.046167	kWh
	ESSC	Electric Security Stabilization Charge		
		First 1,000 kW	\$1.335983	kWh/kW
		Additional kW	\$1.053909	kWh/kW
		Billing Demand Times 300	\$0.003444	kWh/kW
		Additional kWh	\$0.001297	kWh/kW
	LFA	Load Factor Adjustment		
		Charge	\$8.00	kW/kVA
		Credit	\$0.019510	kWh
	SCR	Supplier Cost Reconciliation	\$0.001846	kWh
	EE-PDRR	Energy Efficiency & Peak Demand Response Recovery	\$0.00167	kWh

## Cost of Fuel(s)

### Gas Rate Structure Duke Energy Rate FTL1

<b>Duke Energy Firm Transportation Service-Large, Rate FTL1</b>					
Fixed Delivery Service Charge				\$226.64	per bill
Usage-Based Transportation Charge				\$0.10483	CCF
Rider	AMRP	Accelerated Main Replacement Program		\$21.32	per bill
	AU	Advanced Utility		\$1.40	per bill
	PIPP	Percentage of Income Payment Plan		\$0.021642	CCF
	GSR	Gas Surcredit	Credit	\$0.0012479	CCF
	UE-G	Uncollectible Expense		\$0.009802	CCF
	MGP	Manufactured Gas Plant		\$0.00	per bill
	STR	State Tax Rider	First 1,000 CCF	\$0.01593	CCF
			Next 19,000 CCF	\$0.00877	CCF
			Additional CCF	\$0.00411	CCF
	CCCR	Contract Commitment Cost Recovery		\$0.00	CCF
<b>Constellation Natural Gas Forward Pricing</b>					
		Winter Rate November-March		\$4.073	MMBtu
		Summer Rate April-October		\$3.850	MMBtu

Due to the complexity and variability of the electric and natural gas rate schedule structures, an average cost per kWh, an average cost per kW and an average cost per therm was calculated for each meter from the baseline utility costs. These average units were used to calculate project energy cost savings.

## Cost of Water/Sewer

Cost	Water Charge	Sewer Charge	Fire Charge
Cost per gallon \$/gal	\$0.00345		
Cost per gallon \$/gal		\$0.00427	
Cost per quarter \$/3 months ES			\$5.00
Cost per quarter \$/3 months HS			\$80.00

## Meter Details

Option C verification requires metered energy and/or water usage data to be collected. The data collected was based on the meters and utility accounts listed below.

Facility	Utility Type	Account #	Meter #	Rate Schedule
Kings High School	Electricity	1590-0782-01-1	108012741	DS01, DE87
	Natural Gas	6870-0790-20-0	518495	FTL1
Kings Junior High	Electricity	9240-2052-01-7	108023827	DS01, DE87
	Natural Gas	8420-3556-01-1	683036	FTL1
Columbia Intermediate	Electricity	7940-2095-01-1	106179899	DS01, DE87
	Natural Gas	64702097-01-9	477410	FTL1
JF Burns Elementary	Electricity	2820-2190-02-4	108197886	DS01, DE87
	Natural Gas	9660-3557-01-5	681665	FTL1
Kings Mills Elementary	Electricity	8680-2196-01-8	106179845	DS01, DE87
	Natural Gas	3520-3556-01-0	681695	FTL1
South Lebanon Elementary	Electricity	4090-2213-04-1	108048156	DS01, DE87
	Natural Gas	9840-2217-01-4	680690	FTL1
Kings Education Center	Electricity	4440-2052-01-2	106165256	DS01, DE87
	Natural Gas	7340-2052-01-2	471439	FTL1

## Baseline Adjustments

Trane reserves the right to make baseline adjustments during the guarantee term in response to changes to the facilities or deviations in the operating parameters per the agreement.

It should also be noted that baselines are routinely adjusted for the number of days in the utility billing periods, and for changes in weather. These changes occur within the Metrix utility tacking software, used to calculate Option C savings.

### Year 1 Baseline Adjustments

#### Ice Tank failure - JF Burns Elementary: Effective 6/1/2016 – 10/31/2017

The JF Burns ice tanks failed at the startup of the cooling season in year 1 of the guarantee. The baseline adjustment below was taken to account for two chillers running continuously during the cooling season with no ice storage available for load shifting.

JF Burns - Ice Tank Failure Baseline Adjustment	kWh	kW	Therms
<b>Total</b>	<b>-27,692</b>	<b>436</b>	<b>0</b>

Note: Positive numbers indicate an increase in the baseline, negative numbers indicated a decrease.

#### Ice Tank Failure – Kings Education Center: Effective: 6/1/2016 – 7/31/2017

The Ed Center ice tank failed in the summer of 2016 and was valved off. The chiller carried the building, and temporary air conditioning units were used to supplement the cooling needs. The following baseline adjustment was taken to account for this change.

Kings Ed Center - Ice Tank Failure Baseline Adjustment	kWh	kW	Therms
<b>Total</b>	<b>-7,303</b>	<b>422</b>	<b>0</b>

Note: Positive numbers indicate an increase in the baseline, negative numbers indicated a decrease.

#### LED Lighting Baseline Adjustment: Effective 10/1/2016 to current

After the completion of Trane’s lighting retrofit project, the district undertook an LED lighting retrofit project, separate from the Trane guarantee. A lamp count was obtained from TMI, the district’s contractor, and was used to calculate the baseline adjustment as follows:

$$\# \text{ of LED lamps installed} \times 10 \text{ watts (wattage difference between 28w lamp and 18 watt LED)} \times 1850 \text{ burn hours (based on 185 school days per year} \times 10 \text{ hours/day)}$$

Additionally, natural gas usage will increase due to the reduced heat gain from the new LED lamps. The calculation used for this adjustment is:

$$\text{kWh adjustment from LED install} \times 3.142 \text{ (convert to Btus)} \times .01$$

The baseline adjustments by building are shown in the table below.

Baseline Adjustment for LED Retrofit Project

Building	kWh	kW	therms
Kings High School	-53,484	-29	1,680
Kings Junior High	-30,803	-17	968
Columbia Intermediate	-41,699	-23	1,310
Kings Mills Elementary	-40,497	-22	1,272
South Lebanon Elementary	-24,420	-13	767
Kings Education Center	-15,984	-9	502
<b>Total</b>	<b>-206,886</b>	<b>-112</b>	<b>6,500</b>

The kWh and kW will be subtracted and the therms will be added to the original baseline to create the adjusted baseline.

### Year 2 Baseline Adjustments

#### New Ice Tank and Chiller – Kings Education Center: Effective: 8/1/2017 to current

A new chiller and ice tank were installed at the Ed Center. In addition, cooling was added to the gymnasium. The following baseline adjustment was taken to account for this change.

Kings Ed Center - Ice Tank Replacement and New Chiller - Baseline Adjustment	kWh	kW	Therms
<b>Total</b>	<b>3,378</b>	<b>-30</b>	<b>0</b>

Note: Positive numbers indicate an increase in the baseline, negative numbers indicated a decrease.

## Measurement & Verification Glossary

**Baseline Energy Usage:** Energy consumption and demand occurring during the Baseline Period.

**Baseline Period:** The period of time that represents operation of the facility or system before implementation of an ECM.

**Baseline Adjustment (BLA):** The adjustments made during the reporting period due to changes in any energy governing characteristic of the facility within the measurement boundary.

**Calibration:** The process of checking simulated energy and demand against actual measured energy and demand. Once the mean difference between simulated and measured quantities is within acceptable tolerance, the simulation is called “calibrated”. See Option D.

**Construction Period Savings:** Savings realized after an ECM has been implemented but before the entire project has been completed. This is also referred to as Installation Period Savings and Interim Period Savings.

**Consumption:** Energy consumed as rate over time (kWh, Therm, kGal)

**Cost savings:** Monetary savings from the implementation of ECM(s).

**Demand:** The highest rate of power or gas use, measured by a utility between meter readings.

**Energy Conservation Measure (ECM):** An activity or set of activities designed to increase the energy efficiency of a facility, system, or piece of equipment.

**Guaranteed Energy Savings:** The amount of energy guaranteed to be saved resulting from the implementation of ECMs.

**Guarantee Year:** 12-month period starting from 1st day of the calendar month following customer’s execution of the Certificate of Final Completion, unless the Certification of Final Completion is signed on the first day of the calendar month- in which case the Guarantee Year would start on that day.

**IPMVP:** International Performance Measurement and Verification Protocol

**Metrix:** Third party energy software program used to normalize energy usage for weather and other variables and present true energy savings. In addition to normalizing for variables, Metrix also sets benchmarking, performs load factor analysis and rate analysis, helps determine changes in energy usage patterns, and offers performance reporting.

**Measurement & Verification (M&V):** The process of using measurements to reliably determine savings created within an individual facility by an energy management program. Savings cannot be directly measured, because they represent the absence of energy use. Instead, savings are determined by comparing measured use before and after implementation of one or more ECMs, making appropriate adjustments for changes in conditions.

**Metering:** Collection of energy data over time at a facility through the use of measurement devices.

**Mutually Agreed to Savings:** Methodology used with energy retrofits where M&V costs would have a significant negative impact on the savings. The savings are verified mutually by Trane and Customer after installation or commissioning.

**Normalized Savings:** The reduction in energy use or cost that occurred in the reporting period relative to what would have occurred if the facility had been equipped and operated as if it was in the baseline period using the previously agreed upon conditions.

**Option A:** Methodology specified in IPMVP. Retrofit Isolation: Key parameter measurements. Energy savings are determined by measuring the agreed upon parameter before and after a retrofit, and multiplying the difference by an agreed-upon factor.

**Option B:** Methodology specified in IPMVP. Retrofit Isolation: All parameter measurements. Individual loads are continuously monitored to determine performance, and this measured performance is compared with a baseline to determine savings.

**Option C:** Methodology specified in IPMVP. Whole Facility. Savings are determined by measuring and analyzing overall energy use in a facility and identifying the effects of energy projects from changes in overall energy use patterns.

**Option D:** Methodology specified in IPMVP. Calibrated simulation. Savings are determined when calibrated simulation of baseline energy use is compared to calibrated simulation of post-installation energy consumption.

**Performance Period:** The defined period of time chosen for the purposes of verifying savings after implementation of ECMs. This is also referred to as the reporting period.

**Scenario:** A certain instance that happens within a project that could vary from project to project.

**Sample Measurement:** Measurements are performed on a subset of all units to determine average energy consumption per unit. Energy consumption is applied to entire population. This method is typically used in lighting, water, and Building Automation System ECMs.

**Trends:** Sampling of data over time such as space temperature, occupancy, set points, kW, kWh. It is used to verify savings. It is also referred to as data logging.

**Verified Energy Savings:** The substantiated reduction in energy use measured during the performance period.

## Appendix



Option C - district, site, and meter-level detailed graphs