Susan Combs
Texas Comptroller of Public Accounts

Facility Preliminary Energy Assessments and Recommendations

Lake Travis ISD

3322 Ranch Road 620 South
Austin, Texas 78738

Prepared by:

Texas Energy Engineering Services, Inc.
1301 S. Capital of Texas Highway
Capital View Center – Suite B-325
Austin, Texas 78746
(512) 328-2533
TBPE# F-3502

JUNE 2010

M. Saleem Khan, P.E.
Texas Registration #98125

SECO
State Energy Conservation Office

TABLE OF CONTENTS

CONTENTS **Page No.**

TABLE OF CONTENTS i
1.0 EXECUTIVE SUMMARY 1
2.0 FACILITY DESCRIPTIONS 2
3.0 ENERGY CONSUMPTION AND PERFORMANCE 5
4.0 ENERGY ACCOUNTING 9
5.0 ENERGY LEGISLATION OVERVIEW 11
6.0 SAMPLE SNAP SHOTS AND INDOOR CONDITIONS 12
7.0 RECOMMENDED MAINTENANCE & OPERATION PROCEDURES 15
8.0 ENERGYSTAR PORTFOLIO MANAGER 21
9.0 RETROFIT OPPORTUNITIES 24
10.0 FACILITY IMPROVEMENT PROJECTS 31
11.0 NEW CONSTRUCTION COMMISSIONING 33
12.0 ENERGY MANAGEMENT POLICY 34
13.0 FUNDING OPTIONS FOR CAPITAL ENERGY PROJECTS 37

APPENDICES

APPENDIX A, ENERGY LEGISLATION (SB12, HB3693, AND SB300) ..... Page A-1
APPENDIX B, SAMPLE UTILITY DATA REPORTING FORM ..... Page B-1
APPENDIX C, BASE YEAR CONSUMPTION HISTORY ..... Page C-1
APPENDIX D, ENERGY PERFORMANCE COMPARISON CHARTS ..... Page D-1
APPENDIX E, TYPICAL EQUIPMENT MAINTENANCE CHECKLISTS ..... Page E-1
APPENDIX F, LOANSTAR INFORMATION ..... Page F-1
APPENDIX G, DATALOGGER CHARTS ..... Page G-1
APPENDIX H, BUILDING COMMISSIONING INFORMATION ..... Page H-1
APPENDIX I, REQUEST FOR ENERGY ASSISTANCE ..... Page I-1

Schools & Hospitals Energy Management Program
Lake Travis ISD
3322 Ranch Road 620 South
Austin, TX 78738
Contact Person: Jack Stevens, P.E., Facility Resources Manager
Phone: 512-533-5963

1.0 EXECUTIVE SUMMARY

Lake Travis Independent School District, now referred to as the District, requested that Texas Energy Engineering Services, Inc. (TEESI) perform a Preliminary Energy Assessment (PEA) of their facilities. This report documents that analysis.

This service is provided at no cost to the District through the Schools Energy Management and Technical Assistance Program as administered by the Texas Comptroller of Public Accounts, State Energy Conservation Office (SECO). This program promotes and encourages an active partnership between SECO and Texas schools for the purpose of planning, funding, and implementing energy saving measures, which will ultimately reduce the District's annual energy costs.

The annual cost savings, implementation cost estimate and simple payback for all building energy retrofit projects identified in this preliminary analysis are summarized below. Individual building projects are summarized in Section 9.0 of this report.

Implementation Cost Estimate:	$1,006,650
Annual Energy Cost Savings:	$172,990
Simple Payback:	5.8

Recommendations and information of interest to the District are provided in this report regarding Energy Consumption and Performance (Section 3.0), Energy Accounting (Section 4.0), Energy Legislation Overview (Section 5.0), Sample Snap Shots and Indoor Conditions (Section 6.0), Recommended Maintenance & Operation Procedures (Section 7.0), Energy Star Portfolio Manager (Section 8.0), Retrofit Opportunities (Section 9.0), Facility Improvement Projects (Section 10.0), New Construction Commissioning (Section 11.0), Energy Management Policy (Section 12.0), and Funding Options for Capital Energy Projects (Section 13.0). A follow-up visit to the District will be scheduled to address any questions pertaining to this report, or any other aspect of this program.

SECO is committed to providing whatever assistance the District may require in planning, funding and implementing the recommendations of this report. The District is encouraged to direct any questions or concerns to either of the following contact persons:

SECO / Ms. Juline Ferris	TEESI / Saleem Khan
(512) 936-9283	(512) 328-2533

2.0 FACILITY DESCRIPTIONS

This section provides a brief description of the facilities surveyed. The purpose of the onsite survey was to evaluate the major energy consuming equipment in each facility (i.e. Lighting, HVAC, and Controls Equipment). A description of each facility is provided below.

Administration Building

Stories:	Two-story
Area (estimated):	14,486 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts
HVAC:	Air cooled chiller with VAV boxes
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Bee Cave Elementary School

Stories:	Single story
Area (estimated):	86,875 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Air or Air DX heat pumps, DX outside air units
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Educational Development Center

Stories:	Single story
Area (estimated):	20,400 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts
HVAC:	Air or Air DX heat pumps, DX outside air units
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Hudson Bend Middle School

Stories:	Two-story
Area (estimated):	129,499 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Air or Air DX heat pumps, DX outside air units
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Lake Pointe Elementary School

Stories:	Single story
Area (estimated):	88,613 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Air or Air DX heat pumps, DX outside air units
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Lake Travis Elementary School

Stories:	Two-story
Area (estimated):	104,866 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Geothermal Heat Pumps. Air cooled chiller for outside air
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Serene Hills Elementary School

Stories:	Single story
Area (estimated):	94,000 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Geothermal Heat Pumps. Air cooled chiller for outside air
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Lake Travis Middle School

Stories:	Single story
Area (estimated):	129,597 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Air or Air DX heat pumps, DX outside air units
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Lakeway Elementary School

Stories:	Single story
Area (estimated):	87,999 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Air or Air DX heat pumps, DX outside air units
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Lake Travis High School (D-Wing, Library, L-Wing, and PAC)

Stories:	Two-story
Area (estimated):	308,279 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts
HVAC:	Air or Air DX heat pumps, DX outside air units, Air cooled chiller for fan coil units and outside air
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Cavalier Activity Center

Stories:	Single story
Area (estimated):	44,371 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Air or Air DX heat pumps, DX outside air units
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Lake Travis High School Main/Round Gymnasium

Stories:	Single story
Area (estimated):	23,742 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Air or Air DX heat pumps, DX outside air units
Controls:	Energy Management System (EMS) – Manufacturer Siemens

Lake Travis Auxiliary Gymnasium

Stories:	Single story
Area (estimated):	17,816 SF
Bldg. Components:	Concrete masonry exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Air or Air DX heat pumps, DX outside air units
Controls:	Energy Management System (EMS) – Manufacturer Siemens

3.0 ENERGY CONSUMPTION AND PERFORMANCE

A site survey was conducted at several of the District's facilities. The facilities surveyed comprised a total gross area of approximately 1,150,903 square feet.

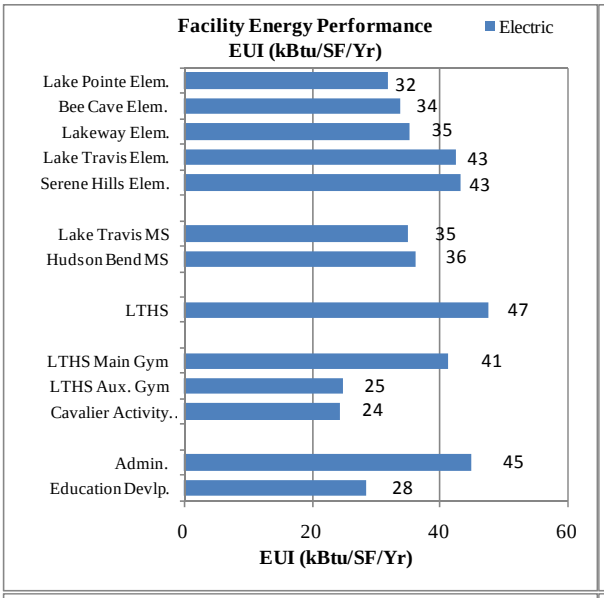
Annual electric invoices for the buildings surveyed were $1,254,152 for the 12-month period ending December 2009. A summary of annual utility costs is provided in **Appendix C**, Base Year Consumption History.

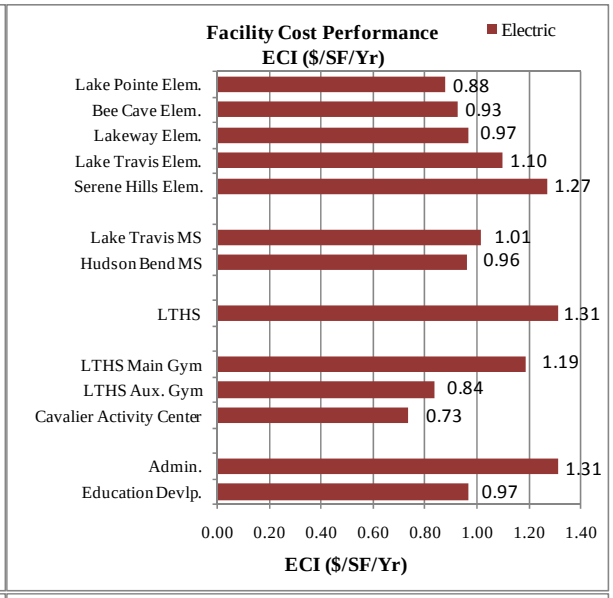
To help the District evaluate the overall energy performance of its facilities TEESI has calculated their Energy Utilization Index (EUI) and Energy Cost Index (ECI). The EUI represents a facility's annual energy usage per square foot; it is measured as thousand BTU's per square foot per year (kBTU/SF/Year). Similarly, ECI is measured as cost per square foot per year ($/SF/Year). The EUI and ECI performance for selected facilities are listed below:

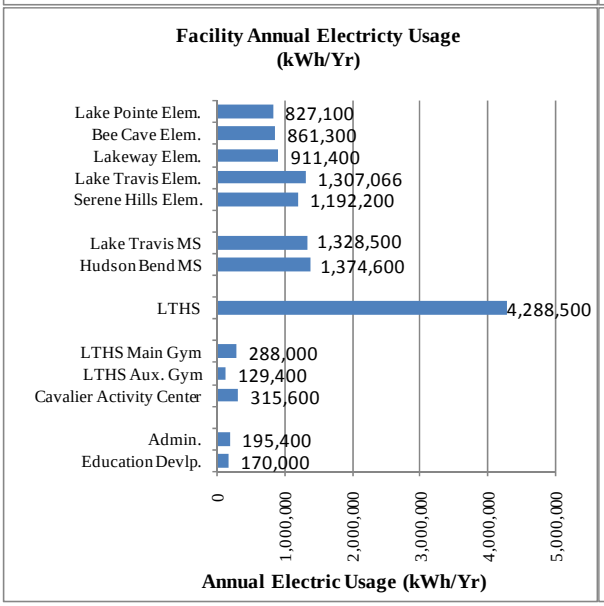
Energy Cost and Consumption Benchmarks								
		Electric			Total	EUI	ECI	
	Building	KWH/Yr	MMBTU/Yr	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
1	Lake Pointe Elem.	827,100	2,823	77,776	2,823	32	0.88	88,613
2	Bee Cave Elem.	861,300	2,940	80,443	2,940	34	0.93	86,875
3	Lakeway Elem.	911,400	3,111	85,140	3,111	35	0.97	87,999
4	Lake Travis Elem.	1,307,066	4,461	115,459	4,461	43	1.10	104,866
5	Serene Hills Elem.	1,192,200	4,069	119,279	4,069	43	1.27	94,000
6	Lake Travis MS	1,328,500	4,534	131,336	4,534	35	1.01	129,597
7	Hudson Bend MS	1,374,600	4,692	124,895	4,692	36	0.96	129,499
8	LTHS	4,288,500	14,637	404,796	14,637	47	1.31	308,279
9	LTHS Main Gym	288,000	983	28,217	983	41	1.19	23,742
10	LTHS Aux. Gym	129,400	442	14,957	442	25	0.84	17,816
11	Cavalier Activity Center	315,600	1,077	32,603	1,077	24	0.73	44,371
12	Admin.	195,400	667	19,502	667	45	1.31	14,846
13	Education Devlp.	170,000	580	19,748	580	28	0.97	20,400
		KWH/Yr	MMBTU/Yr	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
		13,189,066	45,014	1,254,152	45,014	39	1.09	1,150,903

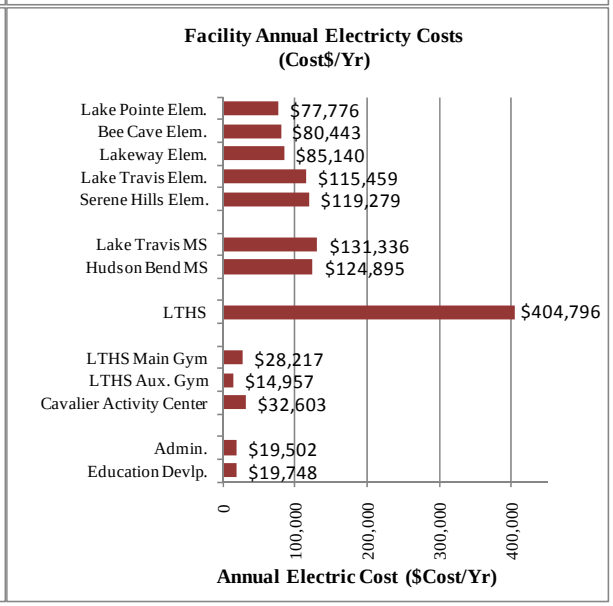
Knowing the EUI and ECI of each facility is useful to help determine the District's overall energy performance. In addition, the District's EUI was compared to TEESI's database of Texas schools. See **Appendix D** to determine how these facilities' EUI compared to other schools in Texas.

The following charts summarize the data presented in the previous table. See **Appendix C** for further detail.

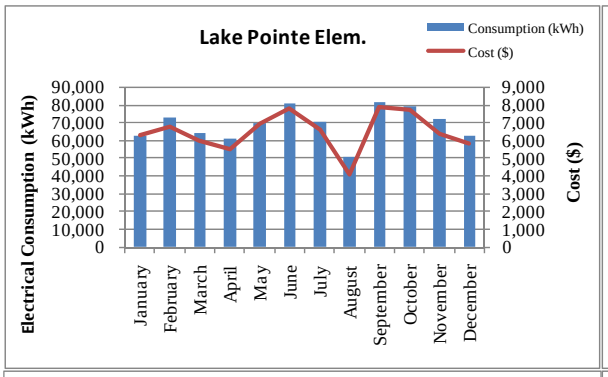


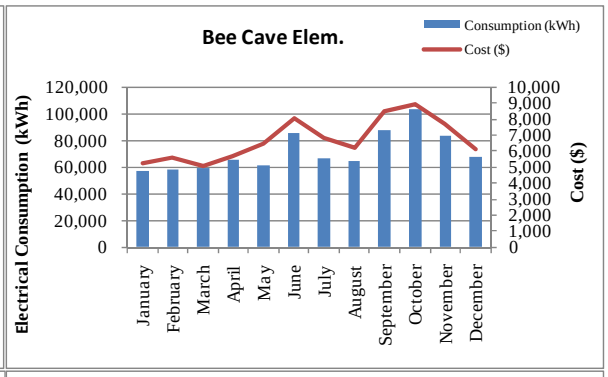


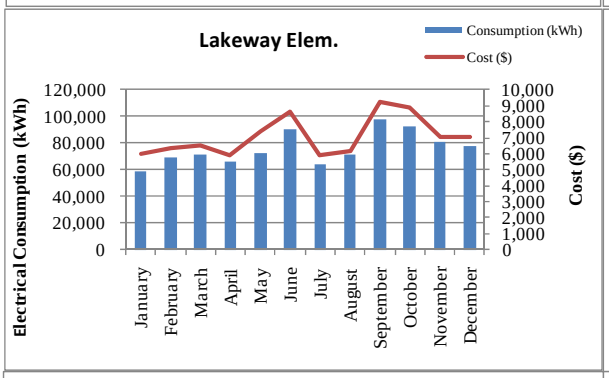


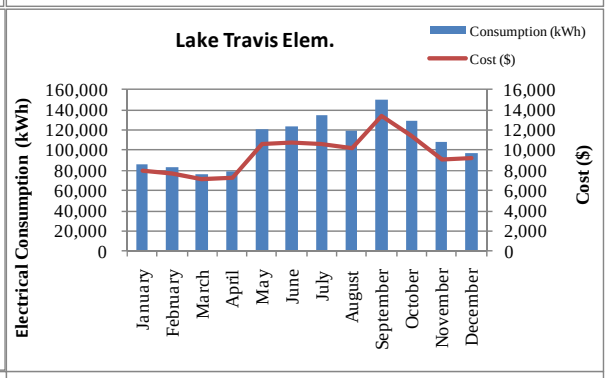


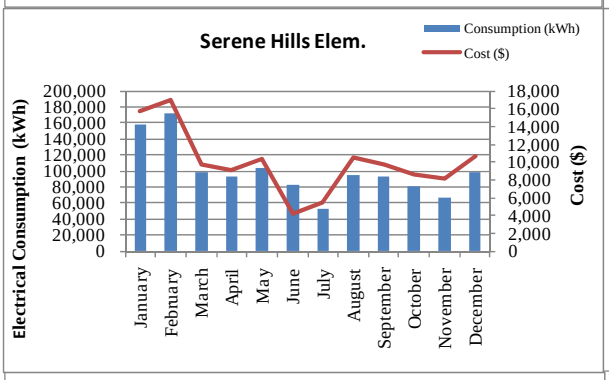
The following charts summarize the each campus monthly utility data. See **Appendix C** for further detail.

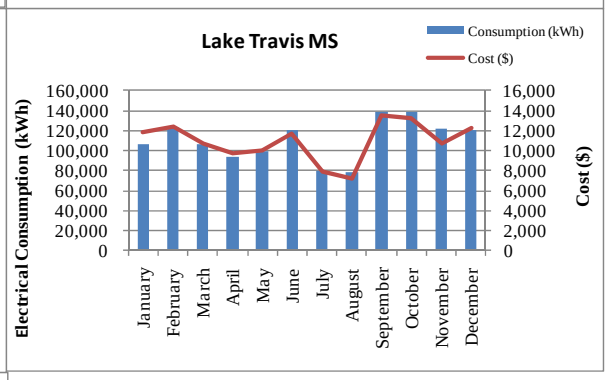


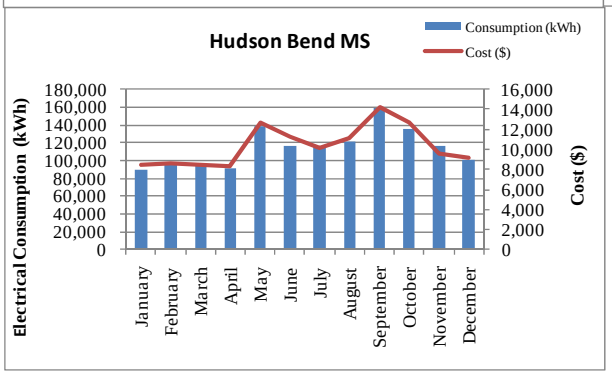


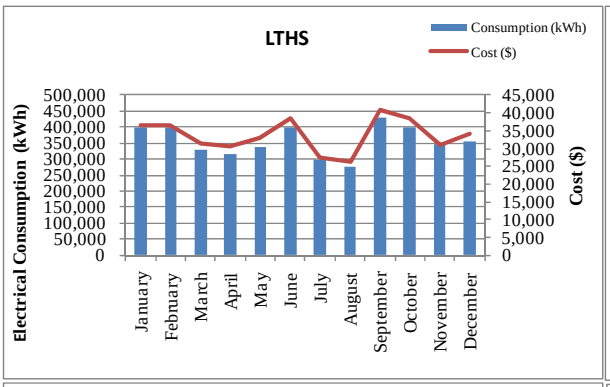


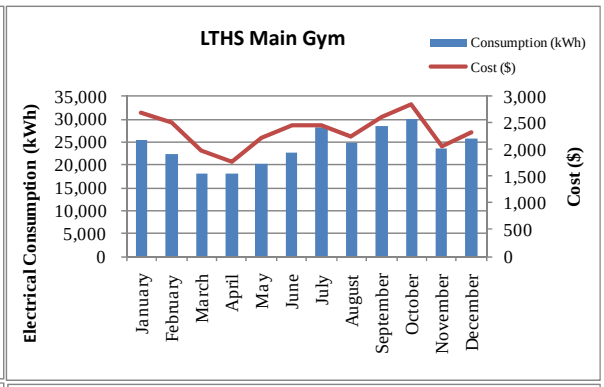


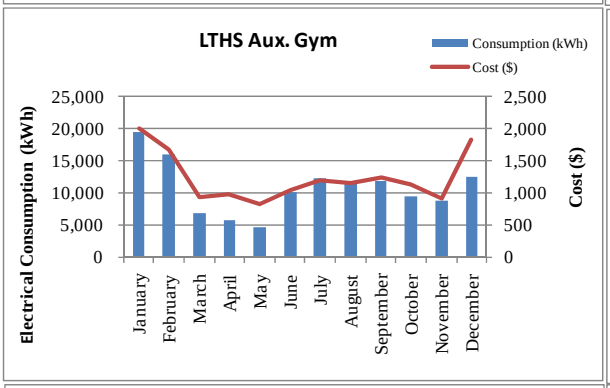


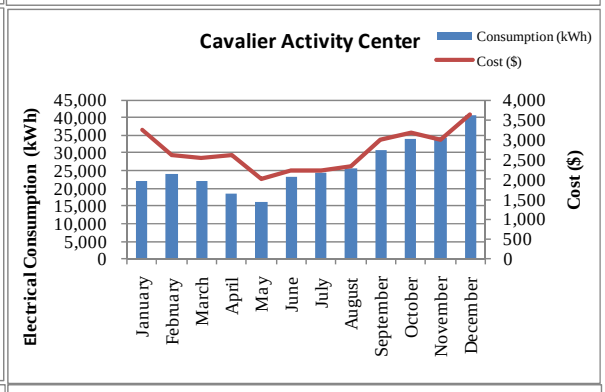


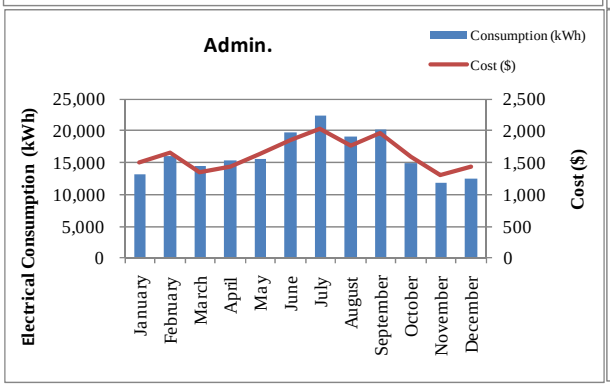


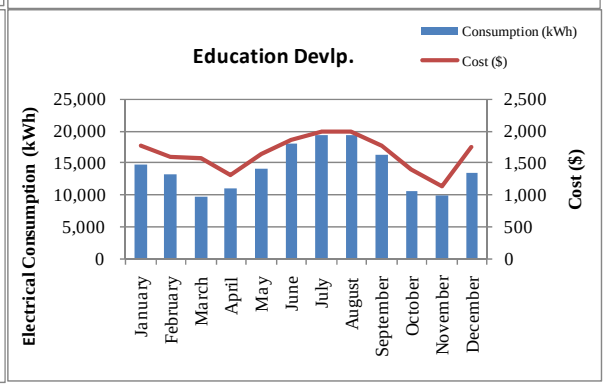

LTHS
Consumption (kWh)
Cost ($)
Electrical Consumption (kWh)
Cost ($)
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
January
February
March
April
May
June
July
August
September
October
November
December


LTHS Main Gym
Consumption (kWh)
Cost ($)
Electrical Consumption (kWh)
Cost ($)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
3,000
2,500
2,000
1,500
1,000
500
0
January
February
March
April
May
June
July
August
September
October
November
December


LTHS Aux. Gym
Consumption (kWh)
Cost ($)
Electrical Consumption (kWh)
Cost ($)
25,000
20,000
15,000
10,000
5,000
0
2,500
2,000
1,500
1,000
500
0
January
February
March
April
May
June
July
August
September
October
November
December


Cavalier Activity Center
Consumption (kWh)
Cost ($)
Electrical Consumption (kWh)
Cost ($)
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
January
February
March
April
May
June
July
August
September
October
November
December


Admin.
Consumption (kWh)
Cost ($)
Electrical Consumption (kWh)
Cost ($)
25,000
20,000
15,000
10,000
5,000
0
2,500
2,000
1,500
1,000
500
0
January
February
March
April
May
June
July
August
September
October
November
December


Education Devlp.
Consumption (kWh)
Cost ($)
Electrical Consumption (kWh)
Cost ($)
25,000
20,000
15,000
10,000
5,000
0
2,500
2,000
1,500
1,000
500
0
January
February
March
April
May
June
July
August
September
October
November
December

4.0 ENERGY ACCOUNTING

UTILITY PROVIDERS

Austin Energy and Pedernales Electric provide electric service to the District.

MONITORING AND TRACKING

Currently, the District has an energy tracking spreadsheet in place. An effective energy tracking system is an essential tool by which an energy management program's activities are monitored. The system should be centralized and available for all engaged staff members to use in verifying progress toward established targets and milestones.

The District should continue consolidating the tracking and recording of all the Districts utility accounts (i.e., Electricity, Water, etc.) into an electronic format. The District can use this data to track utility consumption patterns and budget utility expenses. **Having this historical data improves the District's awareness of their energy performance and will help in tracking their energy reduction goals.**

The steps below are essential for an effective energy management tracking system:

1. Perform regular updates. An effective system requires current and comprehensive data. Monthly updates should be strongly encouraged.

2. Conduct periodic reviews. Such reviews should focus on progress made, problems encountered, and potential rewards.

3. Identify necessary corrective actions. This step is essential for identifying if a specific activity is not meeting its expected performance and is in need of review.

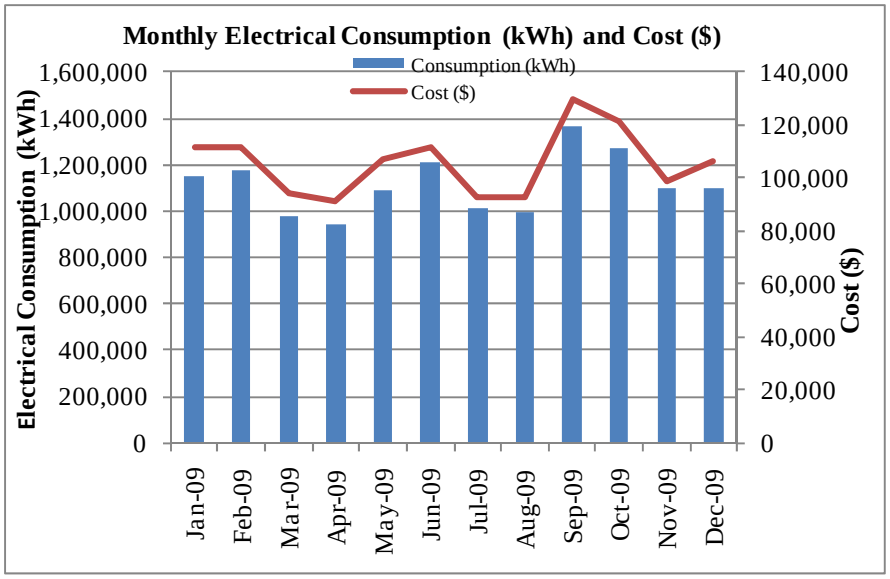
In addition, having this historical utility data would facilitate **HB 3693** and **Senate Bill 12** reporting requirements. Please see Section 5.0 for additional information regarding these requirements.

The data presented below is a summation of the data provided by the District. This data below includes only selected utility accounts and is for reference purposes only and does not represent the District's total utility data. See **Appendix C** for further detail regarding each utility account represented in the table below.

Lake Travis ISD - Sample Utility Input Form

MONTH	ELECTRICITY		
	KWH	COST $	Avg. Rate $/KWH
Jan-09	1,151,250	111,698	$0.0970
Feb-09	1,177,809	111,979	$0.0951
Mar-09	975,682	94,232	$0.0966
Apr-09	944,267	91,064	$0.0964
May-09	1,086,964	107,048	$0.0985
Jun-09	1,211,418	111,896	$0.0924
Jul-09	1,010,990	92,967	$0.0920
Aug-09	996,810	93,074	$0.0934
Sep-09	1,365,402	129,912	$0.0951
Oct-09	1,271,584	121,398	$0.0955
Nov-09	1,096,151	98,918	$0.0902
Dec-09	1,096,433	106,514	$0.0971
Total	13,384,760	$1,270,700	$0.0949

Gross Building Area:	1,163,073	SF



5.0 ENERGY LEGISLATION OVERVIEW

In 2007, the 80th Texas Legislature passed Senate Bill 12 (**SB12**) which among other things extended the timeline set by Senate Bill 5 (**SB5**). SB5, commonly referred to as the Texas Emissions Reduction Plan, was adopted in 2001 by the 77th Texas Legislature to comply with the federal Clean Air Act standards. Also in 2007, the 80th Texas Legislature passed House Bill 3693 (**HB3693**) which amended provisions of several codes relating primarily to energy efficiency.

In 2009, the 81st Texas Legislature passed Senate Bill 300 (**SB300**). This bill specifically addressed the requirement for Texas Schools. This bill repealed the requirement in HB3693 that school districts must establish a goal of reducing electric consumption by 5% each year for six years starting Fiscal Year (FY) 2007. SB300 instead requires that school districts establish a **long-range energy plan** to reduce the overall electricity use by 5% beginning FY 2008. Besides this change, other requirements set forth in SB12 and HB3693 applicable to schools still apply.

Following are key requirements established by the above energy legislation:

Per SB300 a district should establish a Long-Range Energy Plan to reduce the District's electric consumption by five percent (5%) beginning with the 2008 state fiscal year and to consume electricity in subsequent fiscal years in accordance with the plan. The Long-Range Energy Plan should include strategies in the plan for achieving energy efficiency that result in net savings or that can be achieved without financial cost to the district. The Plan should account for the initial, short-term capital costs and lifetime costs and savings that may occur from implementation of the strategy. Each strategy should be evaluated based on the total net costs and savings that may occur over a seven-year period following implementation of the strategy.

Record electric, water, and natural gas utility services (consumption and cost) in an electronic repository. The recorded information shall be on a publicly accessible Internet Web site with an interface designed for ease of navigation if available, or at another publicly accessible location. To help with the utility reporting process a sample input form can be found in **Appendix B** of this report.

Energy-efficient light bulbs for buildings, requires an institution to purchase commercially available light bulbs using the lowest wattages for the required illumination levels.

Installation of energy saving devices in Vending Machines with non-perishable food products. **Not required by School Districts but highly recommended.**

A summary description of SB12, HB3693, and SB300 are available in **Appendix A.**

6.0 SAMPLE SNAP SHOTS AND INDOOR CONDITIONS

During the preliminary walk-through, data-logging equipment was deployed throughout Lake Travis High School, to take snapshot readings of the indoor conditions. The data-logging equipment recorded the room's indoor temperature, indoor relative humidity and outdoor temperature conditions at fifteen-minute intervals for a short duration (one week). In addition, several screenshots of the facility's Energy Management System (EMS) frontend were taken during the walkthrough. The EMS screenshots help provide a snapshot of the HVAC equipment settings (Temperature Setpoints, Equipment On/Off Status, etc.). Below are example charts illustrating the results of screen shots and logging data. See **Appendix G** for the source data charts and data-logger placement locations.

While this information only provides a brief sample of the indoor conditions, this information is helpful in providing a general understanding of a facility's HVAC system operations. Since HVAC is the major energy using systems in a facility, investigating these systems will help identify energy reduction opportunities. Below are some examples of the information obtained using the data-logging equipment and EMS screenshots. Please note the following images and data was obtained during the month of May 2010, and front-end EMS access was not available.

EMS Screenshot
Lake Travis High School

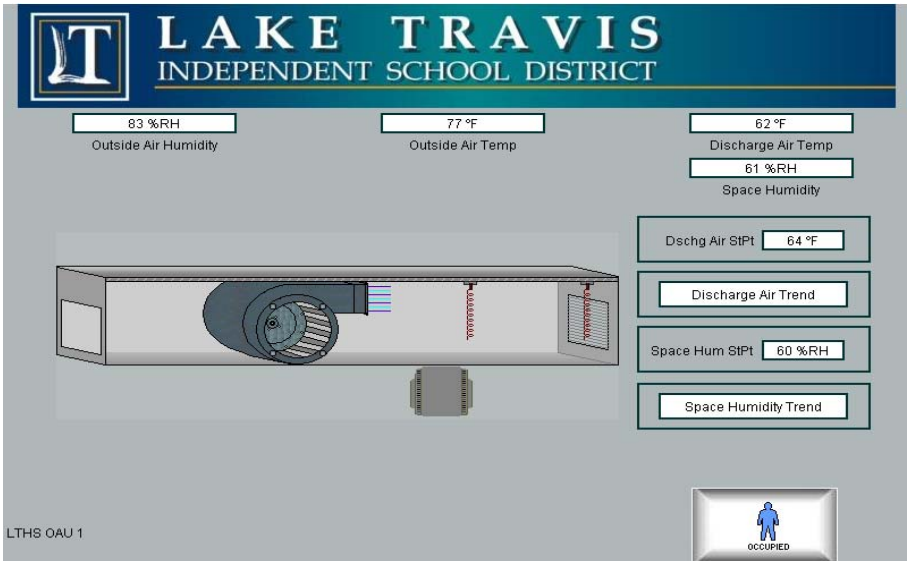


Figure 1. EMS Screenshot of Outside air AHU-1. Possible incomplete EMS graphic (Missing cooling coil).

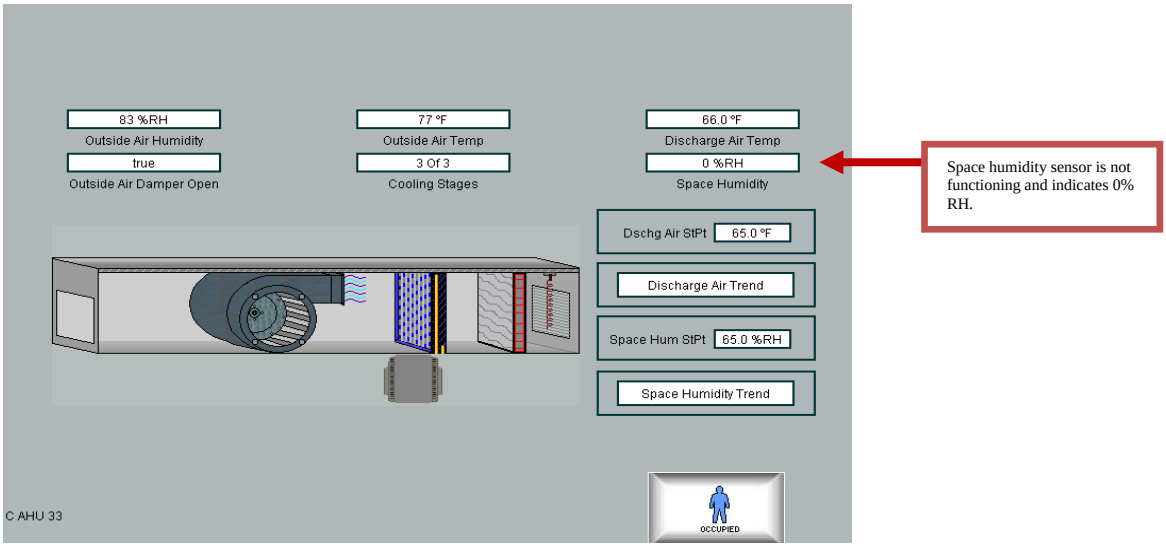


Figure 2. EMS screenshot of AHU-33

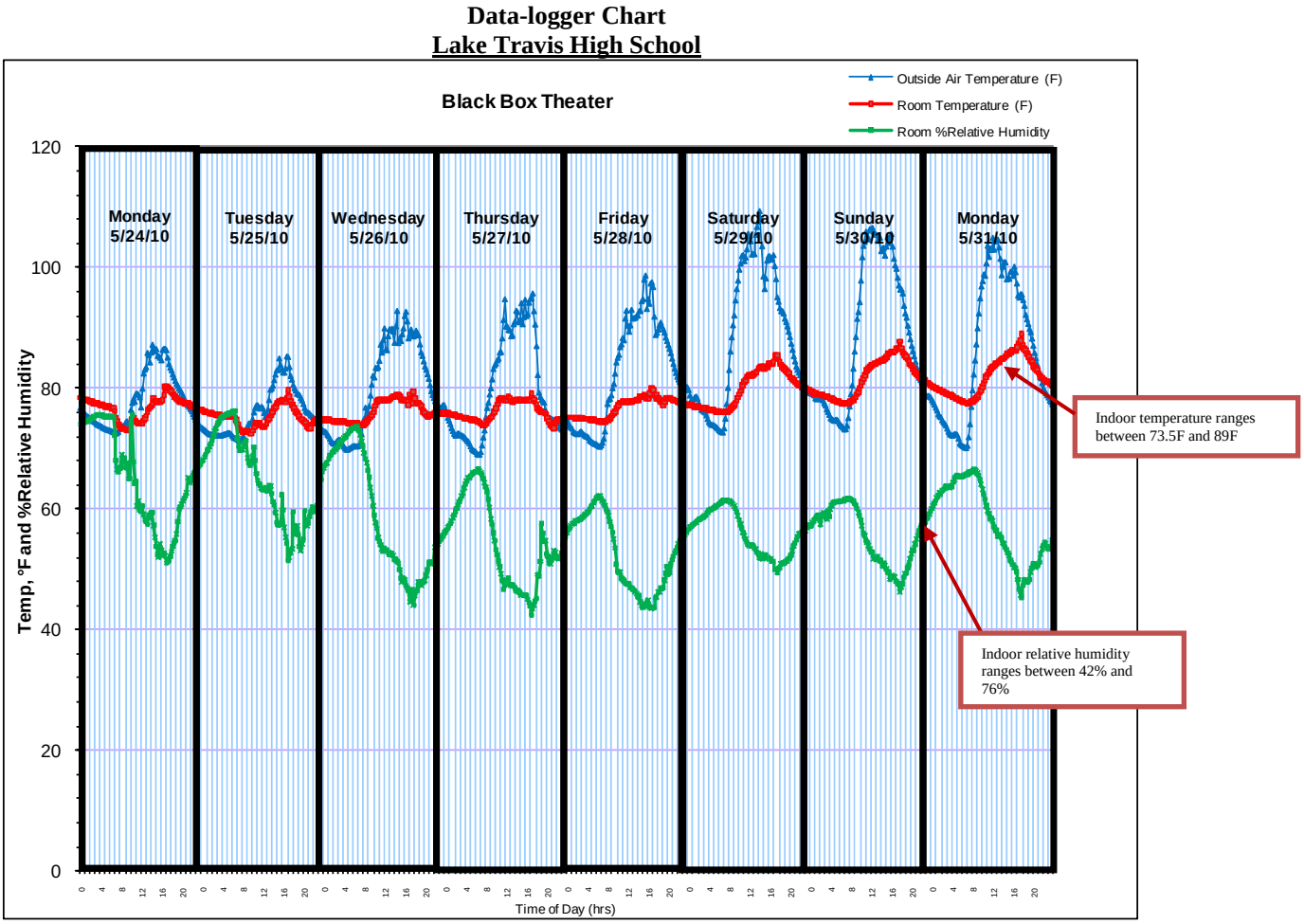


Figure 3. Data-logging chart of Black Box Theater. Temperatures vary from 73.5°F to 89°F, and relative humidity varies from 42% to 76%.

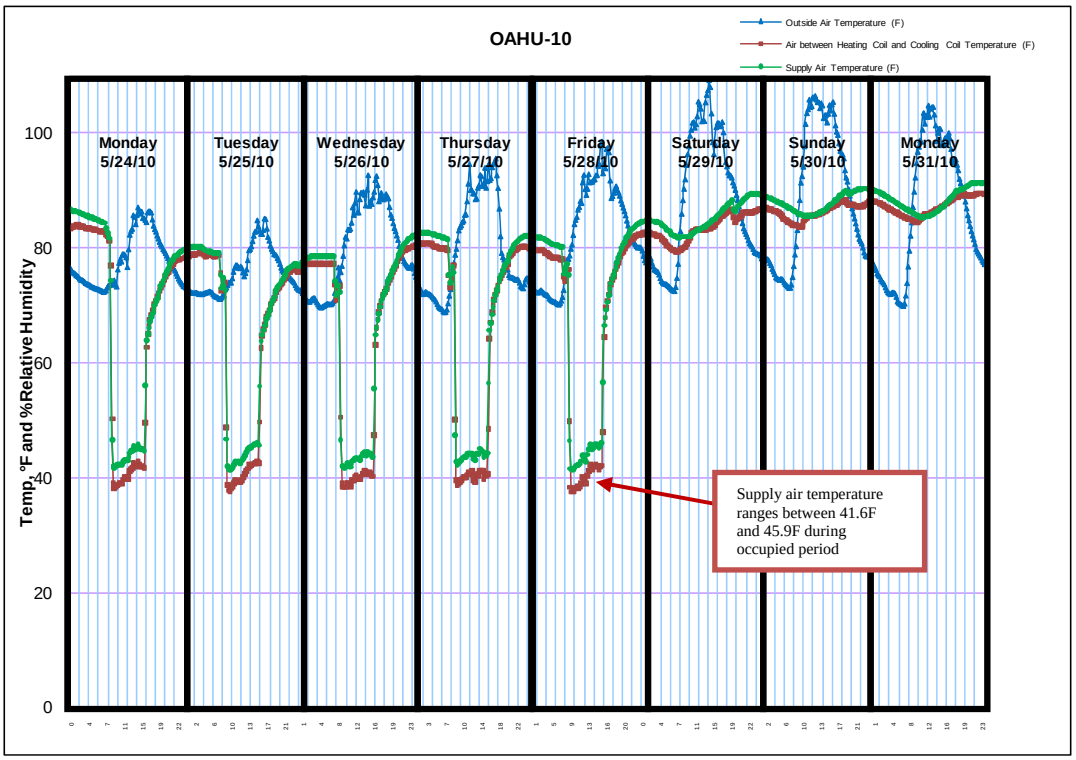


Figure 4. Data-logging chart of outside air unit 10 (OAU-10) serving classroom F205. The supply/discharge air temperature varies between 41.6°F to 45.9°F during occupied mode and is slightly heated.

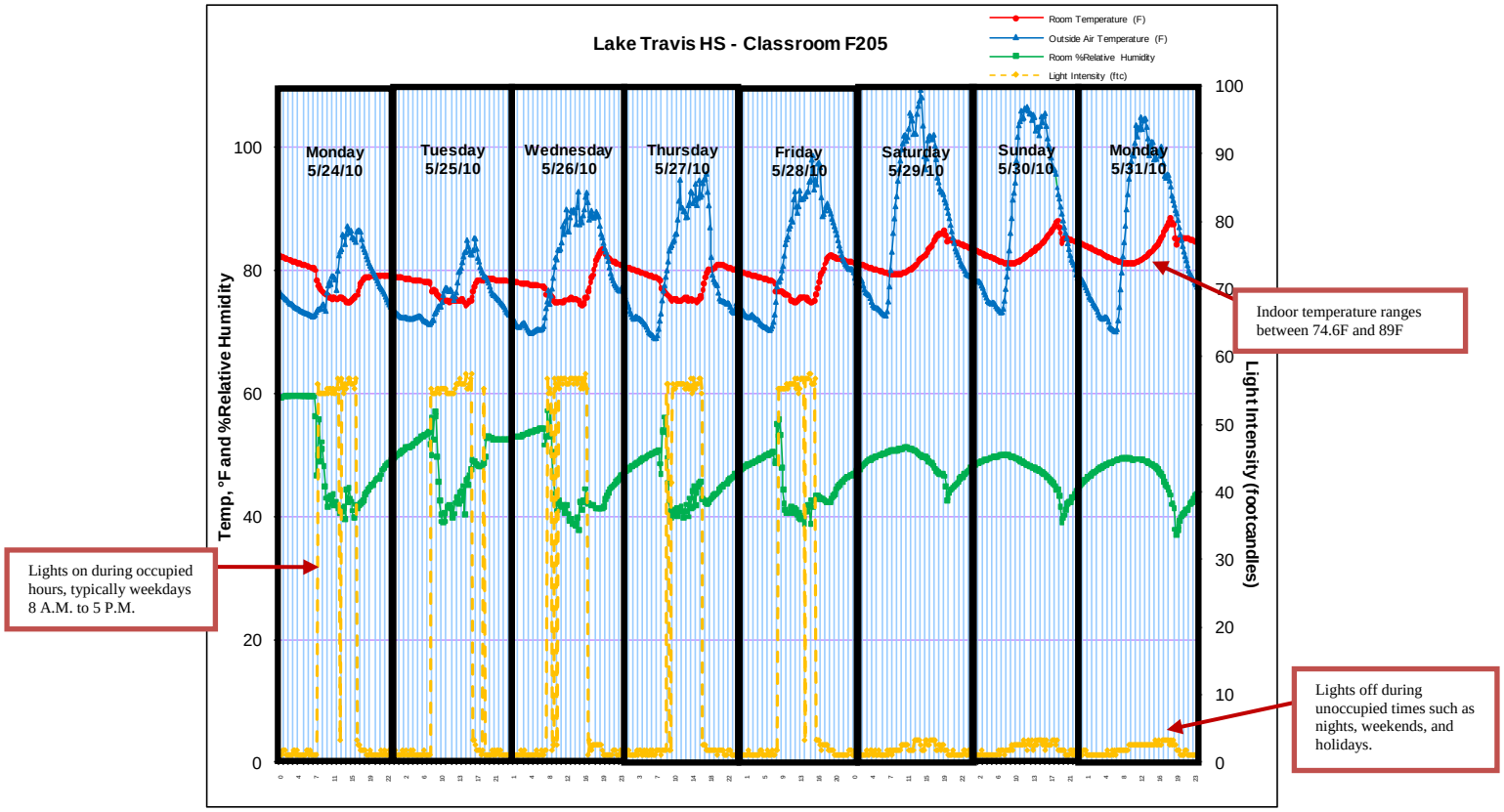


Figure 6. Data-logging chart of Classroom F205, served by outdoor air unit 10 on previous page. Indoor room temperatures vary from 75°F to 89°F.

7.0 RECOMMENDED MAINTENANCE & OPERATION PROCEDURES

Sound Maintenance and Operation procedures significantly improve annual utility costs, equipment life, and occupant comfort. Generally, maintenance and operation procedural improvements can be made with existing staff and budgetary levels. Below are typical maintenance and operations procedures that have energy savings benefits. Please note that some of the recommendations noted below are currently being practiced by the District. With this in mind, the following maintenance and operation procedures should be encouraged / continued to ensure sustainable energy savings.

PUBLICIZE ENERGY CONSERVATION

Promote energy awareness at regular staff meetings, on bulletin boards, and through organizational publications. Publicize energy cost reports showing uptrends and downtrends.

MANAGE SMALL ELECTRICAL EQUIPMENT LOADS

Small electrical equipment loads consists of small appliances / devices such as portable heaters, microwaves, small refrigerators, coffee makers, stereos, cell phone chargers, desk lamps, etc. The District should establish a goal to reduce the number of small appliances and to limit their usage. For example, the use small space heaters should be discouraged; hence, all space heating should be accomplished by the District's main heating system. In addition, many small devices such as radios, printers, and phone chargers can consume energy while not in use. To limit this "stand-by" power usage these devices should be unplugged or plugged into a power strip that can act as a central "turn off" point while not in use. With an effective energy awareness campaign to encourage participation, managing small electrical loads can achieve considerable energy savings.

ESTABLISH HVAC UNIT SERVICE SCHEDULES

Document schedules and review requirements for replacing filters, cleaning condensers, and cleaning evaporators. Include particulars such as filter sizes, crew scheduling, contract availability if needed, etc. Replace filters with standard efficiency pleated units. Generally, appropriate service frequencies are as follows -- filters: monthly; condensers: annually; evaporators: 5 years.

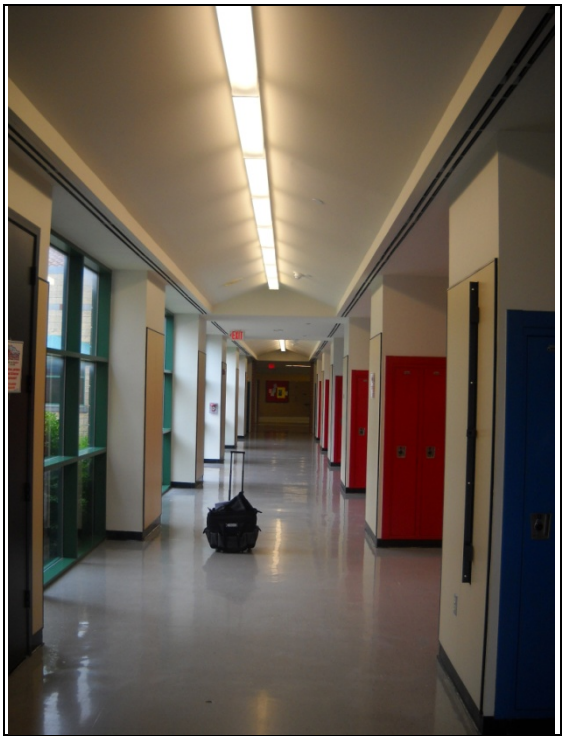
PRE-IDENTIFY PREMIUM EFFICIENCY MOTOR (PEM) REPLACEMENTS

Pre-identify supply sources and PEM stock numbers for all HVAC fan and pump motors so that as failures occur, replacement with PEM units can take place on a routine basis. As funding allows, pre-stock PEM replacements according to anticipated demand, i.e., motors in service more than 10 years, motors in stressful service, and particular motor types that are in service at several locations.

IMPROVE CONTROL OF INTERIOR & EXTERIOR LIGHTING

Establish procedures to monitor use of lighting at times and places of possible/probable unnecessary use: Offices and classes at lunchtime, maintenance shops, closets, exterior and parking lots during daylight hours, etc. Encouraging staff (i.e. Teacher, Custodial, maintenance, and students) to participate in the District's efforts to limit unnecessary lighting use would help improve this effort.

Example – Daylighting Opportunity: The pictures below are a good example of a day-lighting opportunity. The building's windows placed along the main corridor help bring in sufficient natural light to illuminate the space during school hours. The District should consider reducing the amount of artificial lighting in areas where sufficient natural light is available.



HS hall lights on: 60 – 100 foot-candles

HS hall lights off: 35 – 50 foot-candles

TYPICAL EQUIPMENT MAINTENANCE CHECKLISTS

Effective operation and maintenance of equipment is one of the most cost effective ways to achieve reliability, safety, and efficiency. Failing to maintain equipment can cause significant energy waste and severely decrease the life of equipment. Substantial savings can result from good operation and maintenance procedures. In addition, such procedures require little time and cost to implement. Examples of typical maintenance checklists for common equipment including are provided in **Appendix E**. These checklists from the Federal Energy Management Program (FEMP), a branch of the Department of Energy (DOE), are based on industry standards and should supplement, not replace those provided by the manufacturer.

In addition, periodic inspection of the general conditions of equipment is considered a good risk management practice. For example the picture below depicts an electrical service cabinet serving the High School. It is recommended the doors on the cabinet be locked in order to restrict the use and limit access of the panels to authorized personnel. Limiting access can help reduce the risk of unauthorized use.

Unlocked High School
electrical service cabinets

CONTROL OUTSIDE AIR INFILTRATION

Conduct periodic inspections of door and window weather-stripping, and schedule repairs when needed. Additionally, make sure doors and windows are closed during operation of HVAC systems (heating or cooling). Unintended outside air contributes to higher energy consumption and increases occupant discomfort.

REPLACE INCANDESCENT LAMPS WITH COMPACT FLUORESCENTS

Replace existing incandescent lamps with compact fluorescent lamps as they burn out. Compact fluorescents use 50 to 75 percent less wattage for the same light output, with ten times the operating life of incandescents.

ENERGY STAR POWER MANAGEMENT

ENERGY STAR Power Management Program promotes placing monitors and computers (CPU, hard drive, etc.) into a low-power “sleep mode” after a period of inactivity. The estimated annual savings can range from $25 to $75 per computer. ENERGY STAR recommends setting computers to enter system standby or hibernate after 30 to 60 minutes of inactivity. Simply touching the mouse or keyboard “wakes” the computer and monitor in seconds. Activating sleep features saves energy, money, and helps protect the environment.

INSTALL ENERGY SAVING DEVICES ON VENDING MACHINE

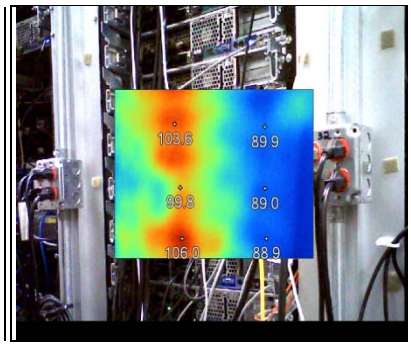
Install energy saving devices on vending machines with non-perishable food items to reduce the equipment power usage. These devices shut the vending machines down during unoccupied periods. There are several commercially available devices that can be easily installed on existing vending machines. These devices typical have a motion sensor which powers down the equipment after periods of inactivity. For example if the motion sensor does not sense activity within 15 minutes the device will shutdown the vending machine and turn on once motion is sensed. These devices range in price from $100 to $250 and have a typical annual savings of $20 to $150 per vending machine.

HAIL GUARDS ON CONDENSING AND PACKAGED ROOFTOP UNITS

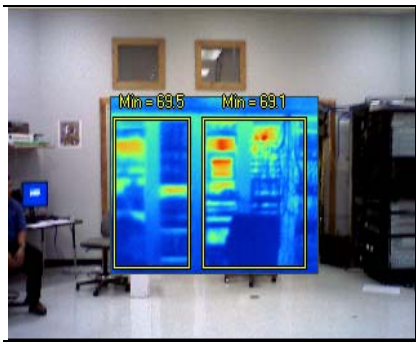
When an HVAC unit is replaced the District should ensure the new unit be specified with hail guards. The hail guards protect the condensing unit's heat exchanger coils from hail damage. Damage to the condensing unit heat exchangers reduces the efficiency of the units. It is recommended if any existing unit(s) have damaged condensing coil fins the condensing fins should be straightened using a fin comb.

DATACENTER EFFICIENCY MEASURES

Datacenters can consume 25% to 50% more electricity than standard office spaces. Below are a few recommendations that could help improve the efficiency of an existing datacenter. Datacenter equipment can produce very concentrated heat loads. Proper air management to minimize or eliminate mixing between the cooling air supplied to equipment and the hot air rejected from the equipment can reduce operating costs, increase the data center's watt density (W/SF) capacity, and reduce heat related processing interruptions or failures. Proper placement of server equipment, location of supply and returns, and the configuration of the equipment's air intake and heat exhaust ports all influence air flow patterns in the room. The placement and orientation of server equipment should create distinct Hot/Cold aisle to prevent mixing of the hot air exhausted by the racks and the cool air supplied to the racks. The images below were taken at the High School Server Room using a thermal imaging camera. These images help visualize the temperature variations and heat rejected from server equipment.



Thermal Image of heat rejected from server equipment



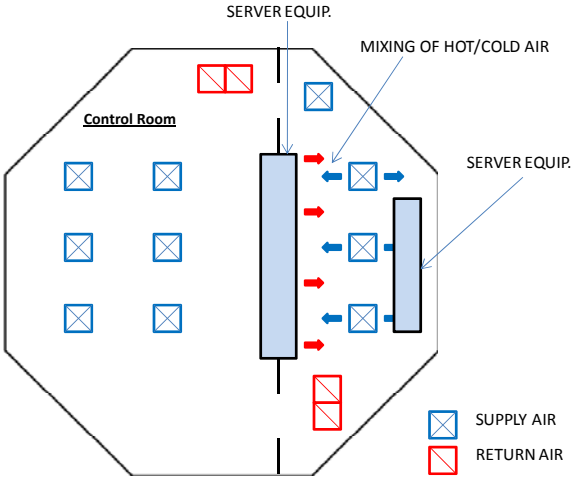
Cold Aisle: Server Rack Inlet Temperatures

Image of Cold Supply Air Diffuser inside Server Rack Room

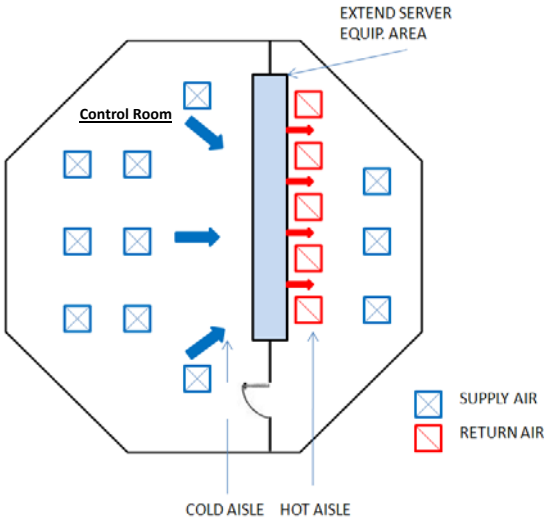
Server equipment heat rejection mixing with cold aisle

Other energy efficiency measures that may be applicable to datacenters are: increasing the temperature difference between the return and supply air temperature; increase allowable humidity range (30%-70%); utilize high efficiency power supplies in Information Technology (IT) computing equipment that meet the Server System Infrastructure (SSI) minimum recommended efficiency. For further information regarding these topics please visit the following resources: Server System Infrastructure (www.ssiforums.org), High-Performance Buildings for High Tech Industries (http://hightech.lbl.gov/datacenters.html). Based on our preliminary observation of Lake Travis High School's Server Room it appears the Server Room's existing air distribution configuration could be modified to ensure proper air flow management suitable for a Server Room. Modification of the Server Room air conditioning layout will help improve air management, cooling efficiency, and equipment reliability. The sketches below provide a schematic/rough layout of the server Room's configuration. The following are some suggestions that may improve the Server Room's distribution of air and increase system efficiency:

PRESENT CONFIGURATION



MODIFIED CONFIGURATION



Items causing improper Air management

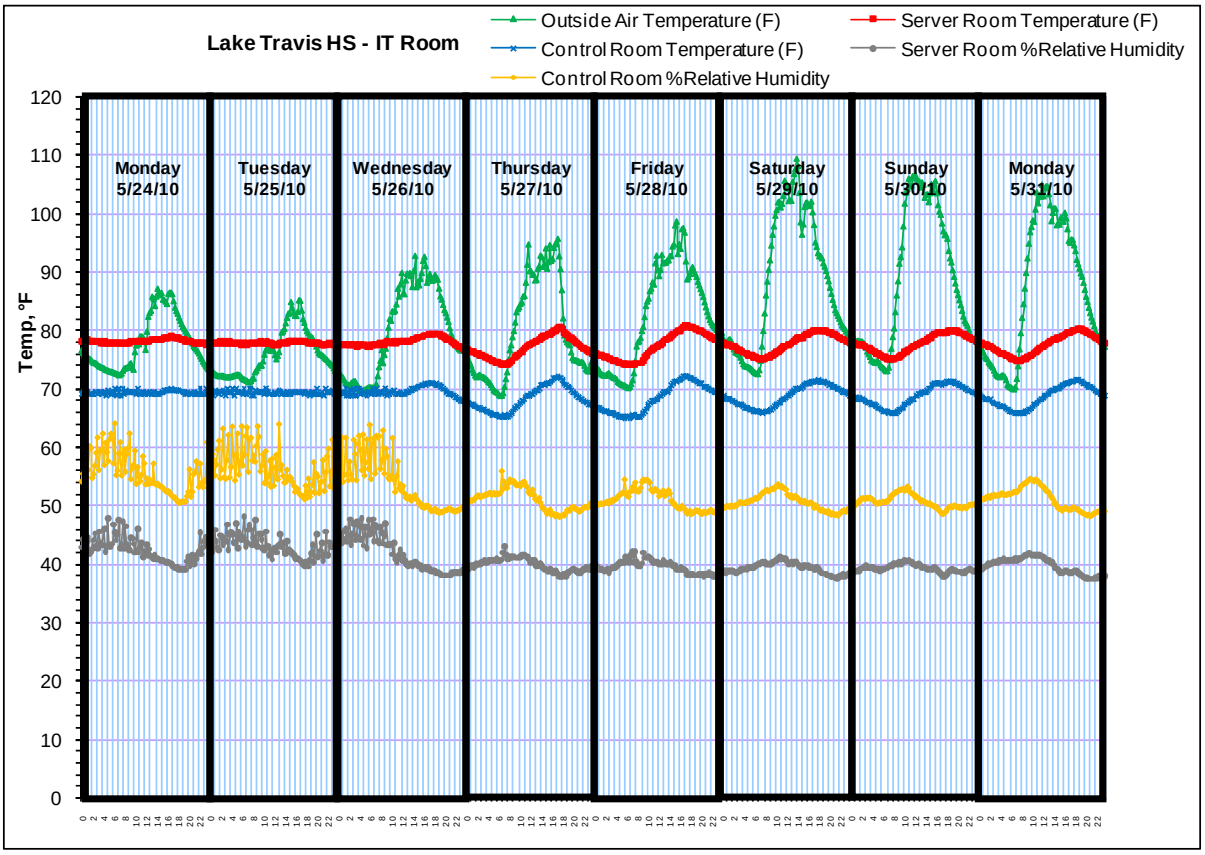
- Server equipment's inlet/outlet air ports are not uniformly positioned.
- Supply air (SA) diffusers locations are causing mixing cold and hot air.
- Server equipment inside hot aisle.

Modifications to create distinct hot/cold aisles.

- Re-position server equipment's inlet/outlet to create distinct Hot/Cold aisles.
- Re-position supply air diffusers to deliver air to the cold aisle of Server Rack. Preferably, perforated supply air diffusers would be used as opposed to standard office/classroom diffusers.
- Extend the Server Rack area to accommodate future expansion.

Important: The above is a schematic layout only and not intended to be a design guide for the application. Detailed analysis and design for modifications and future expansion (s) must be done by professional engineer experienced with data center layouts and design.

Below is a snapshot of the indoor temperature and relative humidity readings inside the Server Room. Two data-loggers were deployed in this location. One was placed inside the server rack room titled "Server Room" and the other was placed in general office area titled "Control Room".



8.0 ENERGYSTAR PORTFOLIO MANAGER

ENERGY STAR is a joint program of the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE). ENERGY STAR has developed Portfolio Manager, an innovative online energy management tool, designed to help organizations track and assess energy and water consumption of their facilities. Portfolio Manager helps organizations set investment priorities, identify under-performing buildings, verify efficiency improvements, and receive EPA recognition for superior energy performance.

Portfolio Manger is also an energy performance benchmarking tool. Portfolio Manager rates a building's energy performance on a scale of 1–100 relative to similar buildings nationwide. The rating system is based on a statistically representative model utilizing a national survey conducted by the Department of Energy's Energy Information Administration. This national survey, known as the Commercial Building Energy Consumption Survey (CBECS), is conducted every four years, and gathers data on building characteristics and energy use from thousands of buildings across the United States. A rating of 50 indicates that the building, from an energy consumption standpoint, performs better than 50% of all similar buildings nationwide, while a rating of 75 indicates that the building performs better than 75% of all similar buildings nationwide.

In addition, Portfolio Manager is used to generate a Statement of Energy Performance (SEP) for each building, summarizing key energy information such as site and source energy intensity, greenhouse gas emission, energy reduction targets and energy cost. The Statement of Energy Performance can help in applying for an ENERGY STAR Building label or satisfying LEED for Existing Buildings (LEED-EB) requirements. For example, one of the requirements to receive an ENERGY STAR Building Label is to achieve a minimum rating of **75**. The District's energy baseline can be developed in EnergySTAR's Portfolio Manager. One of the key reasons for using EnergySTAR Portfolio Manager is its ability to normalize the District's baseline according to several key factors (i.e. Weather, Square Feet, Hours of Operation, Number of Computers, etc.). It is also a free online resource available to all registered users, and is a user-friendly web-based tool.

To develop the District's baseline, 12 months of utility data and Building Space Use information will be required. The table below is a sample of the Building Space Use data required by Portfolio Manager to generate the Energy Performance Rating. These inputs are critical and can significantly influence how Portfolio Manager computes the ENERGY STAR Rating. Many of these key inputs may vary over-time and could influence the rating. If an ENERGY STAR Label is pursued these key inputs will need to be verified and certified by a Professional Engineer. Verification of this information is required when submitting the Statement of Energy Performance for ENERGY STAR's review.

EnergySTAR Portfolio Manager Example Space Use Data

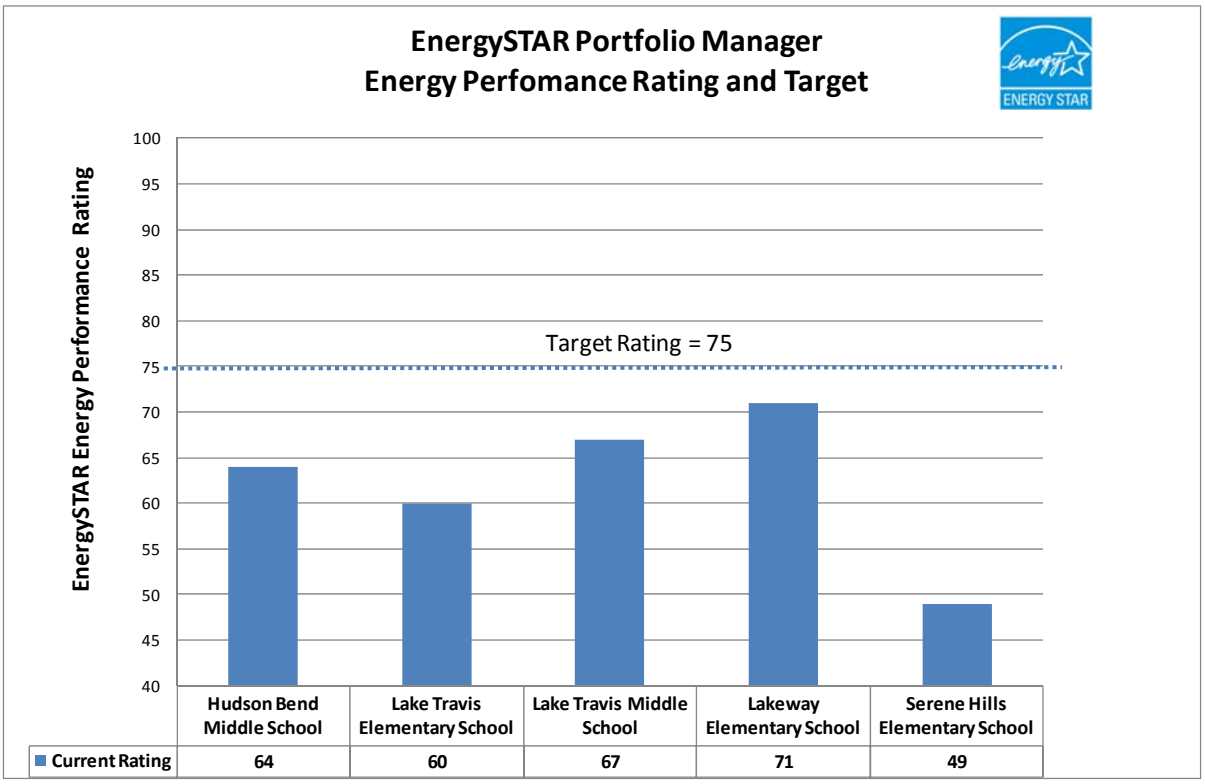
Facility Type: K-12 School	
• 12 Months of Electric	• Presence of cooking facilities
• Gross Floor Area	• Percent Cooled
• Open Weekends (Y/N)	• Percent Heated
• # of PCs	• Months Open per Year
• # of Walk in refrigerators/freezers units	• High School (Y/N)

Each facility at the District was analyzed through the EnergySTAR Portfolio Manager. **Default** values were used for the data in the table above except for utility bills and gross floor areas. It is recommended the District update these to correct values for each facility in order to achieve appropriate EnergySTAR rating. The table below summarizes the preliminary results based on default values.

Facility Name	Current Rating (1-100)	Total Floor Space (Sq. Ft.)
Bee Cave Elementary	75*	86,875
Hudson Bend Middle School	64*	129,499
Lake Pointe Elementary School	80*	88,613
Lake Travis Elementary School	60*	104,866
Lake Travis High School	75*	769,426
Lake Travis Middle School	67*	129,597
Lakeway Elementary School	71*	87,999
Serene Hills Elementary School	49*	94,000

*Ratings based on default values

The following indicates the school's current energy performance ratings that were not eligible ending in December 2009. The target for each of these schools is a rating of 75 to qualify for Energy Star.



A benefit of using Energy Star's Portfolio Manager is its ability to set goals for energy performance. It allows an energy performance target to be set and calculates the estimated savings per year to reach the goal. With a performance target of 75 set, the estimated yearly savings for each of the schools is indicated below.

Facility	Current Utility Cost $/yr	Target Utility Cost $/yr	Target Savings $/yr
Hudson Bend Middle School	$124,895	$111,157	$13,738
Lake Travis Elementary School	$115,459	$100,884	$14,575
Lake Travis Middle School	$131,336	$122,142	$9,194
Lakeway Elementary School	$85,140	$81,739	$3,401
Serene Hills Elementary School	$119,279	$93,038	$26,241

Note: *These target utility costs are based on the default values used in Energy Star and based on January through December 2009 consumption data. In order for a facility to be eligible, it is recommended these values be updated for each facility. Utility data for Serene Hills Elementary indicate a consumption reduction trend starting March 2009.*

9.0 RETROFIT OPPORTUNITIES

Energy retrofit projects identified during the preliminary analysis are detailed below. Project cost estimates include labor, material, engineering and construction management services.

REPLACE EXISTING T8 FLUORESCENT LAMPS WITH LOWER WATTAGE LAMPS

Low-wattage T8 fluorescent lamps are available in 30, 28 and 25-watt versions. It is recommended replacing existing 32-watt T8 Fluorescent lamps with lower wattage lamps (where applicable). Changing to a lower wattage T8 Lamp is a relatively straightforward process however, lower wattage T8 lamps do have limitations and are only suitable for certain applications. Lower wattage T8 lamps have reduced lighting levels therefore, it is important to ensure recommended lighting levels are maintained. Lighting levels should be verified prior to and after lamp replacement. In addition, compatibility with existing ballasts, local codes and other requirements must be verified prior to retrofitting. Nevertheless, if suitable for the application, switching to lower wattage T8 lamps will have sustainable energy savings with minimal impact. For example, replacing a 32-watt T8 lamp with a 28-watt T8 lamp will approximately have a 12% lighting energy reduction with only a lighting level drop near 4%.

The estimated costs and savings noted below are based on replacement of existing 32-watt T8 lamps and does not account for ballast replacements (if existing are incompatible) or reduced lamps (if existing lighting levels are above recommended levels). Estimates are based on a preliminary walkthrough of the facilities. A detailed lighting analysis will be required to determine exact cost, quantities and configuration to maximize the energy savings and lighting performance.

LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT			
Building	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Simple Payback (years)**
Admin.	$3,000	$860	3.5
Bee Cave Elem.	$17,400	$4,350	4.0
Education Devlp.	$4,100	$1,030	4.0
Hudson Bend MS	$25,900	$6,820	3.8
Lake Pointe Elem.	$17,700	$4,430	4.0
Lake Travis Elem.	$21,000	$5,250	4.0
Lake Travis MS	$25,900	$6,820	3.8
Lakeway Elem.	$17,600	$4,400	4.0
Cavalier Activity Center	$2,700	$680	4.0
LTHS	$61,700	$17,630	3.5
Serene Hills Elem.	$18,800	$4,700	4.0
TOTAL	**$215,800**	**$56,970**	**3.8**

GYMNASIUM HID TO FLUORESCENT FIXTURE LIGHTING RETROFIT

All of the District's gymnasiums utilize High Intensity Discharge (HID) fixtures to light the Gym. It is recommended that the District replace the existing HID fixtures with fluorescent fixtures suitable for gym applications. Fluorescent fixtures offer improved control, reduce energy consumption and improve lighting levels. In addition, due to the long re-strike times associated with HID fixtures, they cannot be effectively switched on/off during unoccupied periods. This causes the HID lamps to operate longer, which both consumes more energy and affects lamp life. The cost and savings estimates below are based on preliminary observations and analysis.

GYM HID TO FLUORESCENT LIGHTING RETROFIT			
Building	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Simple Payback (years)**
Bee Cave Elem.	$5,600	$660	8.5
Hudson Bend MS Gymnasiums	$18,900	$2,520	7.5
Lake Pointe Elem.	$5,600	$660	8.5
Lake Travis Elem.	$5,600	$660	8.5
Lake Travis MS Gymnasiums	$14,000	$1,750	8.0
Lakeway Elem.	$5,600	$660	8.5
Cavalier Activity Center	$33,400	$5,140	6.5
Serene Hills Elem.	$5,600	$660	8.5
TOTAL	**$94,300**	**$12,710**	**7.4**

INSTALLATION OF OCCUPANCY SENSORS FOR INDOOR LIGHTING CONTROL

It is recommended the District consider installing occupancy sensors primarily in the original construction portions of the facilities to improve control of interior lighting. Occupancy sensors will help ensure lights are only on when the space is occupied. The following table below provides an estimated cost and energy savings for the installation of these types of sensors. Please note this estimation is based on a preliminary assessment. Exact sensor location, technology (Infrared, Ultrasonic, and Dual Technology) and quantity can be determined during a detailed energy assessment or design phase. In general, enclosed areas with intermittent use are typically good candidates for occupancy sensors (i.e. hallways, specific classrooms, administration office, break rooms, etc.).

MOTION SENSOR INSTALLATION			
Building	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Simple Payback (years)**
Admin.	$7,200	$1,110	6.5
Bee Cave Elem.	$14,000	$1,750	8.0
Education Devlp.*	$4,800	$740	6.5
Hudson Bend MS	$19,200	$2,310	8.3
Lake Pointe Elem.	$14,600	$1,850	7.9
Lake Travis Elem.	$15,800	$2,000	7.9
Lake Travis MS	$15,800	$1,880	8.4
Lakeway Elem.	$14,800	$1,870	7.9
Cavalier Activity Center	$4,000	$620	6.5
LTHS	$22,000	$2,750	8.0
Serene Hills Elem.	$15,000	$1,900	7.9
TOTAL	**$147,200**	**$18,780**	**7.8**

*Pertains to building half with no motion sensors

INSTALL VARIABLE FREQUENCY DRIVES ON CHILLED WATER PUMPS

Install Variable Frequency Drives (VFDs) on the Chilled Water Pumps at each of Schools Central Plant listed below. The VFDs will allow for improved control of the chilled water loop by varying the chilled water flow to match the building's cooling load. Provisions to ensure minimum flow across the chiller will need to be incorporated. The application of VFDs will improve system operation and reduce energy consumption.

INSTALL VFDs ON CHILLED WATER PUMPS			
Building	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Simple Payback (years)**
Lake Travis Elem. (2-10HP Pumps)	$12,000	$1,200	10.0
LTHS Central Plant (2-10 HP & 1-15HP Pumps)	$28,000	$3,290	8.5
Serene Hills Elem. (2-10HP Pumps)	$12,000	$1,200	10.0
TOTAL	**$52,000**	**$5,690**	**9.1**

INSTALL VARIABLE FREQUENCY DRIVES ON AIR HANDLING UNITS

Install Variable Frequency Drives (VFDs) on selected Air-Handling Units (AHUs) serving the facilities listed below. The VFDs will allow the AHU's fan speed to modulate according to system demand. The application of VFDs will improve system operation and reduce energy consumption, and enhance comfort control. The estimated cost below includes the installation of VFDs and controls integration.

INSTALL VFDs ON AHUs			
Building	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Simple Payback (years)**
Bee Cave Elem. (2 GYM AHUs)	$6,000	$750	8.0
Lake Pointe Elem. (2 GYM AHUs)	$6,000	$750	8.0
Lakeway Elem. (Gym AHUs)	$6,000	$750	8.0
LTHS (Auditorium, Black Box Theatre, Library)	$33,000	$4,400	7.5
TOTAL	**$51,000**	**$6,650**	**7.7**

(Note: AHUs with DX coil require minimum airflow and must have equipment manufacturer's approval)

INTEGRATED HVAC COMMISSIONING (Cx) & TRAINING PROGRAM

Detailed HVAC & Controls systems commissioning in an existing building involves analysis of existing systems to ensure compliance with original set-up/design conditions and where feasible conduct basic research to adjust operating parameters to enhance comfort and reduce energy consumption. For more information regarding building commissioning, the different forms of commissioning, list of certification bodies, typical costs and benefits see **Appendix H**.

Overall, the goal of commissioning is to deliver a facility that operates as it was intended, meets the needs of the building owner and occupants, and provides training of facility operators. To reach this goal it is necessary for the commissioning process to provide documentation and verification of the performance of all building equipment and systems. For the process to work successfully it is equally important to have good communications between all participants (owners, operators and the commissioning agent) and to keep all parties involved and informed of all pertinent decisions.

HVAC Retro-commissioning (RCx) involves the optimization of an existing building's energy usage through testing and documentation. Typically, this procedure will review and improve a building's energy consumption levels by documenting staff and occupant observations as well as improving the building systems to meet the original design intent. This process is ideal for buildings that have not been commissioned previously. While most commissioning programs focus on bringing building the original design intent, Continuous Commissioning® focuses on optimizing the HVAC system operation to the existing building conditions. This type of commissioning process is ideal for existing buildings with relatively complex HVAC systems.

Preliminary examination (utility data review, discussion with staff, EMS data review, data-logging and walkthrough) of the District indicate potential for energy cost savings primarily in the HVAC systems operations and controls. During the walkthrough the preliminary energy assessment team could not find good records related to EMS point list, sequences of operations and as-built conditions records related to controls systems. The District would greatly benefit by implementing a comprehensive building Commissioning (Cx) program that ensures the optimization of HVAC systems for the building's existing conditions, works to improve the building air quality, increase comfort levels, resolve any operating problems and in process provide site specific training to District maintenance staff. Any Commissioning program chosen by the District should require collaborative efforts between the commissioning engineer(s) and the maintenance staff. The Cx program should be an ongoing process for the duration of the project that continues to both commission the building as well as train the facility staff. Cx is typically characterized as fast payback, usually 12 - 48 months. However, at LTISD, due to types of HVAC systems and operating parameters projected payback periods are higher than typical.

At the building level, typical commissioning measures will look into opportunities to verify and optimize the operations of HVAC equipment. Detailed commissioning measures at the building level may include the following:

1. Central Plant Optimization.
   - Select enabled chiller set (and speed, if variable) for best chiller efficiency.
   - Optimize Chilled Water (CHW) flows between chillers for peak combined efficiency.
   - Select each hydronic loop pump set to match the head/flow^2 ratio of that loop.
   - Control each hydronic loop pump relative speed from most open valve and/or highest relative pump speed of downstream tier.

2. Optimize AHU operations.
   - Develop base schedule of occupancy (expressed as people count) for each AHU.
   - Develop base optimal start schedule (or optimized start routine, if supported by EMS) for each AHU.
   - Develop means of easily accommodating after-hours use.
   - Develop optimal discharge temperature setpoint routine for each AHU heating and cooling coil.
   - Add or expand economizer cycle use where feasible.
   - Develop minimum ventilation assurance routine. Use CO_2, moisture, or heat to detect occupant count in assembly areas. Use heat/person ratio to set fresh air fraction limits in low-occupant-density areas with little shell load. Use fresh air measurement to control to scheduled occupancy in predictable occupancy areas.
   - Optimize air distribution where necessary.

3. Recalibrate sensors.
   - Temperature: occupied spaces, return air, discharge air, cold and hot deck, outdoor
   - Differential Pressure: primary supply duct – space, space – outdoors, ChWS – ChWR, HWS – HWR.
   - Humidity: occupied spaces, return air, humidifier discharge, outdoor
   - Airflow Measurement: Outdoor intake, supply air, return, relief and exhaust where applicable, zone terminal unit (hot, cold and/or mixed, as applicable).

4. Set up trends for major parameters.
   - Air Temperatures: discharge (cold and hot deck, as applicable), return, zone supply, occupied spaces, outdoor.
   - Duct static pressures.
   - Run status (and speed if variable) for each chiller, AHU and pump
   - kW, Tons, SST & SCT for each chiller
   - Run status and capacity fraction for each boiler.
   - AHU airflows, where available; supply (hot & cold), outdoor intake
   - Hydronic valve opening fractions.
   - Hydronic loop differential pressures, and pump differential pressures where available.
   - Hydronic system flows (as available) directly read or by equipment pressure drop or pump head and speed.
   - Hydronic system supply and return temperatures
   - Chiller plant load, tons
   - Heating plant load, MBH.

5. Identify malfunctioning devices.
   - Failed or disconnected valve and damper actuators.
   - Valves and dampers that do not travel through full range
   - Leaky valves and dampers
   - Disconnected damper linkages.

6. Reprogram control sequences where required
   - Air Handling Systems
   - Terminal Boxes
   - Central Plant (Chillers, Boilers, Cooling Towers, Pumps etc.)

The project implementation duration may vary from a 10 to 12 months period. The following estimates are based on a preliminary walkthrough, available utility data analysis, and discussion with staff. Project (detailed assessment plan, analysis and implementation), if authorized, would normally be accomplished by an organization/firm specializing in particular Cx techniques and project implementation. The following table summarizes the implementation costs, annual savings and payback for the above project.

COMMISSIONING (Cx)				
Building	**Cx Type**	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Simple Payback (years)**
Bee Cave Elem.	Retro Cx	$27,500	$3,670	7.5
Hudson Bend MS	Retro Cx	$39,750	$5,680	7.0
Lake Pointe Elem.	Retro Cx	$28,000	$4,000	7.0
Lake Travis MS	Retro Cx	$39,500	$5,640	7.0
Lakeway Elem.	Retro Cx	$27,500	$3,930	7.0
Lake Travis Elem.	Retro Cx	$41,900	$6,450	6.5
Serene Hills Elem.	Retro Cx	$41,900	$6,400	6.5
LTHS	Continuous Cx	$200,300	$36,420	5.5
TOTAL		**$446,350**	**$72,190**	**6.2**

The following table summarizes the implementation costs, annual savings and simple payback for the above projects:

SUMMARY OF ENERGY COST REDUCTION MEASURES			
Project Description	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Simple Payback (years)**
LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT	$215,800	$56,970	3.8
MOTION SENSOR INSTALLATION	$147,200	$18,780	7.8
GYM HID TO FLUORESCENT LIGHTING RETROFIT	$94,300	$12,710	7.4
INSTALL VFDs ON CHILLED WATER PUMPS	$52,000	$5,690	9.1
INSTALL VFDs ON AHUs	$51,000	$6,650	7.7
COMMISSIONING (Cx)	$446,350	$72,190	6.2
TOTAL:	**$1,006,650**	**$172,990**	**5.8**

The above projects implementation costs and annual savings are estimated based on a preliminary examination of the facilities. Furthermore, maintenance cost savings are not included in this preliminary energy assessment. Final costs will be determined from detailed building assessments, engineering calculations, and contractor estimates. Project acquisition for the next step(s) should be in accordance with District requirements.

10.0 FACILITY IMPROVEMENT PROJECTS

This section is intended to describe capital improvement projects that have energy savings opportunities but cannot be justified solely based on the potential energy savings. However, these projects may be considered essential to ensure optimum system performance, enhance occupant comfort and to improve overall building efficiency. Capital Facility Improvement Projects identified during the preliminary analysis are detailed below.

HIGH SCHOOL AUDITORIUM - VESTIBULE EXTENSION

During the preliminary assessment, the District staff indicated the lobby near the High School Black Box Theater's main entrance was experiencing high temperatures and undesirable thermal comfort especially during peak occupancy hours. Typically, high temperature problems can be attributed to facility layout and/or high infiltration of unconditioned humid air and/or underperforming of HVAC system. One possible source of air infiltration is the Black Box Lobby entrance doors. During hours of high usage, such as prior to a theatre performance event, many occupants are in the lobby, and the doors are consistently being opened. Because of this situation, conditioned air is lost through the door opening (loss of building pressurization) and unconditioned humid outside air infiltrates into the building. A possible solution to limit the infiltration would be to create a vestibule, which would create an additional set of double doors, and deliver an airlock-type effect to the lobby. As the first set of double doors is opened, occupants walk into the vestibule, and the doors close behind them. They would then proceed into the next set of double doors leading into the lobby. The addition of this vestibule serves to reduce the amount of air infiltration into the auditorium lobby, and therefore reduce the additional air conditioning load on the system. The vestibule effectiveness will be dependent upon prevailing wind direction with respect to vestibule axis, time between door release and closure with respect to time for the person to cross vestibule and rate of traffic through the vestibule. Anticipated cost may range from $20,000 - $25,000. However, it is recommended that feasibility and associated cost of the vestibule should be evaluated by the District Architect.

Black Box Theatre Lobby
Proposed Vestibule Extension

UTILIZE ROLLER SHADES ON WINDOWS WITH HIGH SOLAR HEAT GAIN

During the preliminary assessment, it was observed that some areas have high indoor temperature levels due to solar heat gain through windows. One such room is the High School Black Box Theatre Lobby, which contains windows on the south and west walls. These windows reach the ceiling of the lobby, and allow heat to enter the room, which increases the cooling load on the room. It is recommended the District utilize roller shades that can be drawn or lifted to help lower the solar heat entering the building. Anticipated cost to install motorized solar shades on the upper section of southern and western facing windows in the Black Box Theatre Lobby is from $10,000 to $12,000.

Black Box Theatre Lobby
Proposed Solar Shades

ADMINISTRATION BUILDING HVAC SYSTEM

Administration Building's primary HVAC (chiller, boiler, air handlers etc.) system is nearing the end of its useful life. It is recommended the air handling units, boiler and air-cooled chiller be replaced with a new high efficiency system. In addition, slight modifications to existing VAV system and upgrade of Controls may be required to improve comfort conditions. The option may include change out of primary HVAC systems with similar (chiller, boiler and air handlers) but latest equipment or go with option to replace existing system with packaged DX system and install new fan powered boxes with electric heat instead of hot water coils thereby eliminating the need for electric boiler. Anticipated construction cost assuming existing duct system to remain may range from $375,000 - $425,000. A more detailed feasibility study may be required to determine more precise costs for various feasible options.

CONTROLS UPGRADES & REPAIR

During the commissioning assessment phase, deferred maintenance items or necessary upgrades will be identified that the District will need to address. Example of deferred maintenance items may include: sensor and actuator replacement or recalibration, chilled water valve repair, additional control point integration such as demand control ventilation, and software upgrades. The estimated deferred maintenance and minor upgrades costs district wide may range from $110,000 - $125,000.

11.0 NEW CONSTRUCTION COMMISSIONING

Commissioning (Cx), in general, is a process ensuring that all of the systems of a building perform according to their unique design, as well as meets the needs of both the owner and the occupants. Commissioning for new construction is a method of assuring the building systems will function as intended. It is important to involve commissioning agent as early as possible, such as in the planning/pre-design phase of the project. This allows the commissioning provider to become familiar with the building's design and expected operating parameters, which is anticipated to minimize and/or avoid problems later on. The commissioning service provider selected would preferably be independent of design and construction teams, reporting directly to the Owner.

Typically, the initial cost of commissioning will be recovered quickly by avoiding construction problems and improving building performance. The lack of new construction commissioning can lead to problems further into the building's operation, including increased time for construction, uncomfortable building occupants, and inadequate building maintenance. The costs incurred from these problems come from increase manual labor to fix them, equipment charges, and increased energy consumption. While these problems can be fixed in the future, commissioning objective from the beginning is to either minimize or avoid them entirely. In addition, if the District elects to pursue LEED or any other Green Building rating system, commissioning is prerequisite.

It is recommended the District evaluate and incorporate commissioning in any plans for new construction or major renovation projects. For more information regarding building commissioning processes, various forms of commissioning, typical costs and benefits see Appendix H.

12.0 ENERGY MANAGEMENT POLICY

By requesting this study, the District has demonstrated interest in taking a more aggressive approach to energy management. In order to establish an effective Energy Management Program it should have support from top management. An Energy Management Policy adopted by the school board sends a strong signal that energy management is an institutional priority. A formal Energy Management Policy can be as simple as a two-page document that clearly states the District's energy management objectives.

Along with a clear energy **POLICY** an energy management **PLAN** should be developed to ensure sustained energy savings. The energy management plan is a document that details roles, responsibilities, and objectives. Following are key items that should be included in an energy management plan:

1. ESTABLISH ROUTINE ENERGY TRACKING AND REPORTING PROCEDURES Establishing a procedure to monitor energy usage and cost will help identify energy use patterns. The data will also help determine the effectiveness of the Energy Management Program.

2. ESTABLISH AN ENERGY MANAGEMENT STEERING COMMITTEE The Energy Management Steering Committee will include representatives from a cross section of the District. The steering committee will serve as a review board to evaluate all energy management recommendations before adoption and implementation. The steering committee will meet **quarterly or semiannually** to review the District's energy cost and consumption. Regular meetings will ensure the District's goals are being met prior to the end of the year.

3. PROMOTE ENERGY AWARENESS The energy management steering committee members shall establish a program to publicize the District's energy goals and progress on a **quarterly or semiannually** basis. For example, student drawn posters of the District's energy savings can be placed in hallways. This will encourage student involvement and act as an educational tool. Continuous promotion of the District's goals will ensure the sustainability of the energy management program and help achieve further energy savings.

4. ESTABLISH ACCEPTABLE OPERATING PARAMETERS Establish a District-wide uniform temperature set point for all HVAC units. Having a standard setpoint will help keep HVAC runtimes to a minimum. The following are some suggested temperature settings, however, the district will need to monitor and ensure that other building parameters (**humidity levels etc.**) are within acceptable limits. Also, areas with special equipment (MDF/IDF, server rooms, etc.) or materials (wood flooring, paper storage, etc.) shall be maintained at the equipment supplier's recommended settings and settings appropriate to the material.

   Occupied Cooling Temperature Setpoints:

Instructional Areas	73 F – 76 F
Admin Areas	72 F – 74 F

Unoccupied Cooling Temperature Setpoints:
Instructional Areas 85 F
Admin Areas 85 F

Occupied Heating Temperature Setpoints:
Instructional Areas 67 F – 69 F
Admin Areas 67 F – 69 F

Unoccupied Heating Temperature Setpoints:
Instructional Areas 55 F
Admin Areas 55 F

5. STAFF INCENTIVES AND RECOGNITION PROGRAM Establishing a student, staff, and campus incentive and recognition program would help promote and encourage support from staff and custodial members. The District may consider implementing a staff incentive and recognition program. Following are some program examples.

- The energy accounting system can be used to monitor cost savings and compare it to the base year consumption. An energy incentive plan consisting of a 50-50 sharing with the school campus and the Energy Management Program could be employed. The school would get 50% of the savings resulting from energy cost reduction. The school would be free to use the money for educational programs such as materials, supplies, etc. The other 50% would be used for continuing energy management efforts. The following is an example of the Building savings summary report.

  EXAMPLE:

  High School - Annual Total Electric Cost

Baseline (2006 - 07)	Current (2007 - 08)	Savings	50% Savings
$248,483	$240,483	$8,000	$4,000

  In this example, the High School saved $8,000 where 50% ($4,000) would be assigned to the school. This money would be paid in October of the following fiscal year.

- An energy flag program should be implemented. There would be three energy flags, one flag per each grade level. An energy flag would be awarded to the schools exhibiting the greatest percentage reduction in energy costs. Energy flags would be awarded on a rotating basis each summer. In order to provide motivation, maintain enthusiasm, and recognize individuals doing their part to save the District taxpayers money through the Energy Management Program, the local media (including district newsletters) should be informed of the energy flag results. The energy flags would be awarded in January and August of each year based on the energy consumption of the previous four months.

- ❖ The successes of the program should also be communicated to the public through the media to show what the District is doing to reduce costs to taxpayers.

6. NEW BUILDING AND CONSTRUCTION Ensure proper maintenance and operation of energy using equipment in new buildings by required adequate documentation of all systems and control strategies, specifying minimum content of M&O manuals; specifying contractor requirements for cleaning and adjusting equipment prior to occupancy; specifying on-site vendor training for M&O staff; and requiring as-built drawings.

7. DEVELOP CRITERIA FOR EQUIPMENT UPGRADES AND ENERGY MANAGEMENT INVESTMENT Outline purchasing requirement for primary energy consumption equipment and develop an acceptable payback criteria for investment in energy projects.

8. STAFFING & TRAINING REQUIREMENTS Outline various activities required for an active energy program and then adequately address staffing requirements for energy management and operations related activities. Staff training should also be addressed to ensure program success.

9. ESTABLISH A WATER MANAGEMENT PROGRAM Along with saving energy the District should establish a program to reduce water consumption. The following conservation measures should be employed.

   a. Investigate the use of water conserving faucets, showerheads, and toilets in all new and existing facilities.
   b. Utilize water-pervious materials such as gravel, crushed stone, open paving blocks or previous paving blocks for walkways and patios to minimize runoff and increase infiltration.
   c. Employ Xeriscaping, using native plants that are well suited to the local climate, that are drought-tolerant and do not require supplemental irrigation.
   d. Utilize drip irrigation systems for watering plants in beds and gardens.
   e. Install controls to prevent irrigation when the soil is wet from rainfall.
   f. Establish a routine check of water consuming equipment for leaks and repair equipment immediately.

13.0 FUNDING OPTIONS FOR CAPITAL ENERGY PROJECTS

Institutional organizations have traditionally tapped bond money, maintenance dollars, or federal grants to fund energy-efficient equipment change outs or additions such as energy-efficient lighting systems, high efficiency air conditioning units, and computerized energy management control systems. Today, a broader range of funding options are available. A number of these are listed below.

Texas LoanSTAR Program

The LoanSTAR (Saving Taxes and Resources) Program, which is administered by the State Energy Conservation Office, finances energy-efficient building retrofits at a low interest rate (typically 3 percent). The program's revolving loan mechanism allows borrowers to repay loans through the stream of cost savings realized from the projects. Projects financed by LoanSTAR must have an average simple payback of ten years or less and must be analyzed in an Energy Assessment Report by a Professional Engineer. Upon final loan execution, the School District proceeds to implement funded projects through the traditional bid/specification process. Contact: Eddy Trevino (512/463-1080).

Internal Financing

Improvements can be paid for by direct allocations of revenues from an organization's currently available operating or capital funds (bond programs). The use of internal financing normally requires the inclusion and approval of energy-efficiency projects within an organization's annual operating and capital budget-setting process. Often, small projects with high rate of return can be scheduled for implementation during the budget year for which they are approved. Large projects can be scheduled for implementation over the full time period during which the capital budget is in place. Budget constraints, competition among alternative investments, and the need for higher rates of return can significantly limit the number of internally financed energy-efficiency improvements.

Private Lending Institutions or Leasing Corporations

Banks, leasing corporations, and other private lenders have become increasingly interested in the energy efficiency market. The financing vehicle frequently used by these entities is a municipal lease. Structured like a simple loan, a municipal leasing agreement is usually a lease-purchase arrangement. Ownership of the financed equipment passes to the School District at the beginning of the lease, and the lessor retains a security interest in the purchase until the loan is paid off. A typical lease covers the total cost of the equipment and may include installation costs. At the end of the contract period the lessee pays a nominal amount, usually a dollar, for title to the equipment.

Performance Contracting with an Energy Service Company

Through this arrangement, an energy service company (ESCO) uses third party financing to implement a comprehensive package of energy management retrofits for a facility. This turnkey service includes an initial assessment by the contractor to determine the energy-saving potential for a facility, design work for identified projects, purchase and installation of equipment, and overall project management. The ESCO guarantees that the cost savings generated by the projects will, at a minimum, cover the annual payment due to the ESCO over the term of the contract.

Utility Sponsored Energy Efficiency Incentive Programs

Many of the State's utilities offer energy efficiency incentive programs to offset a portion of the upfront cost associated with energy efficiency measures. The program requirements and incentives range from utility to utility. For example, CenterPoint Energy provides incentives for efficiency measures such as installation of high efficiency equipment, lighting upgrades, and building commissioning. These energy efficiency programs' incentives typically cover $0.06/kWh and $175/kW of verifiable energy and demand reductions, respectively. For further information, contact your utility provider to determine what programs are available in your area.

APPENDICES

APPENDIX A

ENERGY LEGISLATION
(SB12, HB3693 AND SB300)

How to comply with SB12 & HB 3693

What you need to know about Texas Senate Bill 12

The passage of Senate Bill 12 (SB12) by the 80th Texas Legislature signified the continuance of Senate Bill 5 (SB5), the 77th Texas Legislature's sweeping approach in 2001 to clean air and encourage energy efficiency in Texas. SB12 was enacted on September 1, 2007 and was crafted to continue to assist the state and its political jurisdictions to conform to the standards set forth in the Federal Clean Air Act. The bill contains energy-efficiency strategies intended to decrease energy consumption while improving air quality.

All political subdivisions in the 41 non-attainment or near non-attainment counties in Texas are required to:

*1) Adopt a goal to reduce electric consumption by 5 percent each year for six years, beginning September 1, 2007**

2) Implement all cost-effective energy-efficiency measures to reduce electric consumption by existing facilities. (Cost effectiveness is interpreted by this legislation to provide a 20 year return on investment.)

3) Report annually to the State Energy Conservation Office (SECO) on the entity's progress, efforts and consumption data.

*Note: The recommended baseline data for those reporting entities will consist of the jurisdiction's 2006 energy consumption for its facilities and based on the State Fiscal Year (September 1, 2006 to August 31, 2007).

What you need to know about Texas House Bill 3693

The passage of House Bill 3693 (HB3693) by the 80th Texas Legislature is intended to provide additional provisions for energy-efficiency in Texas. Adopted with an effective date of September 1, 2007, HB 3693 is an additional mechanism by which the state can encourage energy-efficiency through various means for School Districts, State Facilities and Political Jurisdictions in Texas.

HB 3693 includes the following state-wide mandates that apply differently according to the nature and origin of the entity:

Record, Report and Display Consumption Data
All Political Subdivisions, School Districts and State-Funded Institutes of Higher Education, are mandated to record and report the entity's metered resource consumption usage data for electricity, natural gas and water on a publically accessible internet page.
Note: The format, content and display of this information are determined by the entity or subdivision providing this information.

Energy Efficient Light Bulbs
All School Districts and State-Funded Institutes of Higher Education shall purchase and use energy-efficient light bulbs in education and housing facilities.

Who must comply?
The provisions in this bill will apply to entities including: Cities and Counties; School Districts; Institutes of Higher Education; State Facilities and Buildings.

How do you define energy-efficiency measures?

Energy-efficiency measures are defined as any facility modifications or changes in operations that reduce energy consumption. Energy-efficiency is a strategy that has the potential to conserve resources, save money** and better the quality of our air. They provide immediate savings and add minimal costs to your project budget.

Examples of energy-efficiency measures include:

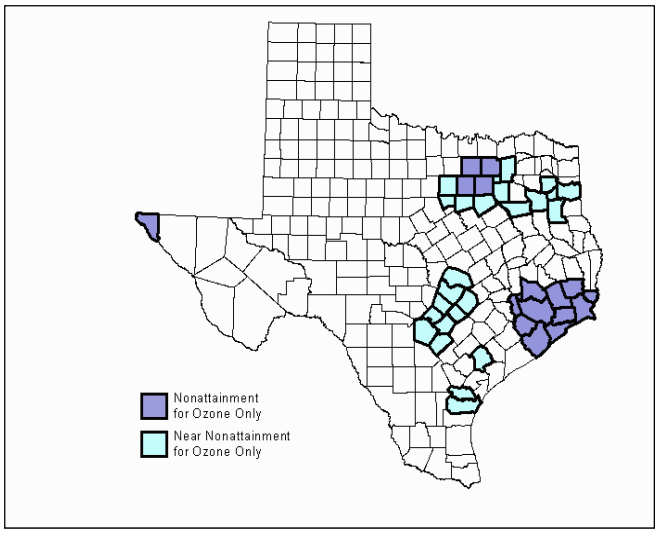
• installation of insulation and high-efficiency windows and doors • modifications or replacement of HVAC systems, lighting fixtures and electrical systems • installation of automatic energy control systems • installation of energy recovery systems or renewable energy generation equipment • building commissioning • development of energy efficient procurement specifications • employee awareness campaigns

***SECO's Preliminary Energy Assessment (PEA) program is an excellent resource for uncovering those energy-efficiency measures that can benefit your organization.*

What counties are affected?

All political jurisdictions located in the following Non-attainment and affected counties:

Bastrop Bexar Brazoria Caldwell Chambers Collin
Comal Dallas Denton El Paso Ellis Fort Bend
Galveston Gregg Guadalupe Hardin Harris Harrison
Hays Henderson Hood Hunt Jefferson Johnson
Kaufman Liberty Montgomery Nueces Orange Parker
Rockwall Rusk San Patricio Smith Tarrant Travis
Upshur Victoria Waller Williamson Wilson



What assistance is available for affected areas?

The Texas Energy Partnership is a partner with Energy Star©, who partners across the nation with the goal of improving building performance, reducing air emissions through reduced energy demand, and enhancing the quality of life through energy-efficiency and renewable energy technologies.

To assist jurisdictions, the Texas Energy Partnership will:

- Present workshops and training seminars in partnership with private industry on a range of topics that include energy services, financing, building technologies and energy performance rating and benchmarking

- Prepare information packages – containing flyers, documents and national lab reports about energy services, management tools and national, state and industry resources that will help communities throughout the region

- Launch an electronic newsletter to provide continuous updates and develop additional information packages as needed

Please contact Stephen Ross at 512-463-1770 for more information.

SECO Program Contact Information

LoanSTAR;
Preliminary Energy Assessments:
Theresa Sifuentes - 512-463-1896
Theresa.Sifuentes@cpa.state.tx.us

Schools Partnership Program:
Glenda Baldwin - 512-463-1731
Glenda.Baldwin@cpa.state.tx.us

Engineering (Codes / Standards):
Felix Lopez - 512-463-1080
Felix.Lopez@cpa.state.tx.us

Innovative / Renewable Energy:
Pamela Groce - 512-463-1889
pam.groce@cpa.state.tx.us

Energy / Housing
Partnership Programs:
Stephen Ross - 512-463-1770
Stephen.Ross@cpa.state.tx.us

Alternate Fuels / Transportation:
Mary-Jo Rowan - 512-463-2637
Mary-Jo.Rowan@cpa.state.tx.us

BILL ANALYSIS

Senate Research Center

S.B. 300
By: Patrick, Dan
Education
7/1/2009
Enrolled

AUTHOR'S / SPONSOR'S STATEMENT OF INTENT

Many independent school districts across Texas are reporting severe financial difficulties due to several factors, including the requirement to fulfill unfunded mandates. These mandates are particularly burdensome to fast-growth school districts. In a difficult economic climate and with dwindling resources, districts are forced to fulfill unnecessary mandates rather than focus on their basic mission, which is to educate students.

S.B. 300 amends current law relating to eliminating or modifying certain mandates on school districts.

RULEMAKING AUTHORITY

This bill does not expressly grant any additional rulemaking authority to a state officer, institution, or agency.

SECTION BY SECTION ANALYSIS

SECTION 1. Amends Section 11.1513(d), Education Code, as follows:

(d) Requires that the employment policy provide that not later than the 10th school day before the date on which a district fills a vacant position for which a certificate or license is required as provided by Section 21.003, other than a position that affects the safety and security of students as determined by the board of trustees, the district is required to provide to each current district employee notice of the position by posting the position on a bulletin board at certain locations or, rather than and, the district's Internet website, if the district has a website, and a reasonable opportunity to apply for the position.

SECTION 2. Amends Section 25.112, Education Code, by amending Subsection (d) and adding Subsections (e)-(g), as follows:

(d) Authorizes the commissioner of education (commissioner), on application of a school district (district), to except the district from the limit in Subsection (a) (relating to the prohibition of more than 22 students enrolled in an elementary school class) if the commissioner finds the limit works an undue hardship on the district. Provides that an exception expires at the end of the school year for which it is granted. Deletes existing text providing that an exception expires at the end of the semester for which it is granted, and prohibiting the commissioner from granting an exception for more than one semester at a time.

(e) Requires a district seeking an exception under Subsection (d) to notify the commissioner and apply for the exception not later than the later of October 1 or the 30th day after the first school day the district exceeds the limit in Subsection (a).

(f) Authorizes the commissioner, if a district repeatedly fails to comply with this section, to take any appropriate action authorized to be taken by the commissioner under Section 39.131 (Sanctions for Districts).

(g) Requires the Texas Education Agency, not later than January 1, 2011, to report to the legislature the number of applications for exceptions under Subsection (d) submitted by

each district and for each application indicate whether the application was granted or denied. Provides that this subsection expires February 1, 2011.

SECTION 3. Amends Section 34.0021, Education Code, by amending Subsections (a) and (b) and adding Subsection (c-1), as follows:

(a) Authorizes, rather than requires, each school district, pursuant to the safety standards established by the Department of Public Safety under Section 34.002, to conduct a training session for students and teachers concerning procedures for evacuating a school bus during an emergency.

(b) Provides that a school district that chooses to conduct a training session under Subsection (a) is encouraged to conduct the school bus emergency evacuation training session in the fall of the school year. Provides that the school district is also encouraged to structure the training session so that the session applies to school bus passengers, a portion of the session occurs on a school bus, and the session lasts for at least one hour. Deletes existing text requiring a school district to conduct the school bus emergency evacuation training at least twice each school year, with one training session occurring in the fall and one training session occurring in the spring. Deletes existing text requiring that a portion of the training session occur on a school bus and requiring the training session to last for at least one hour.

(c-1) Provides that a school district, immediately before each field trip involving transportation by school bus, is encouraged to review school bus emergency evacuation procedures with the school bus passengers, including a demonstration of the school bus emergency exits and the safe manner to exit.

SECTION 4. Amends Section 44.902, Education Code, as follows:

Sec. 44.902. New heading: LONG-RANGE ENERGY PLAN TO REDUCE CONSUMPTION OF ELECTRIC ENERGY. (a) Creates this subsection from existing text. Requires the board of trustees of a district to establish a long-range energy plan to reduce the district's annual electric consumption by five percent beginning with the 2008 state fiscal year and consume electricity in subsequent fiscal years in accordance with the district's energy plan. Deletes existing text requiring the board of trustees of a district to establish a goal to reduce the school district's annual electric consumption by five percent each state fiscal year for six years beginning September 1, 2007.

(b) Requires that the plan required under Subsection (a) include strategies for achieving energy efficiency that result in net savings for the district or can be achieved without financial cost to the district and for each strategy identified under Subdivision (1), the initial, short-term capital costs and lifetime costs and savings that may result from implementation of the strategy.

(c) Requires the board of trustees, in determining under Subsection (b) whether a strategy may result in financial cost to the district, to consider the total net costs and savings that may occur over the seven-year period following implementation of the strategy.

(d) Authorizes the board of trustees to submit the plan required under Subsection (a) to the State Energy Conservation Office for the purposes of determining whether funds available through loan programs administered by the office are available to the district.

SECTION 5. Repealer: Section 44.901(b) (regarding the requirement that the board of trustees establish a goal to reduce electric consumption by five percent each year for six years), Education Code.

SECTION 6. Provides that this Act applies beginning with the 2009-2010 school year.

SECTION 7. Effective date: upon passage or September 1, 2009.

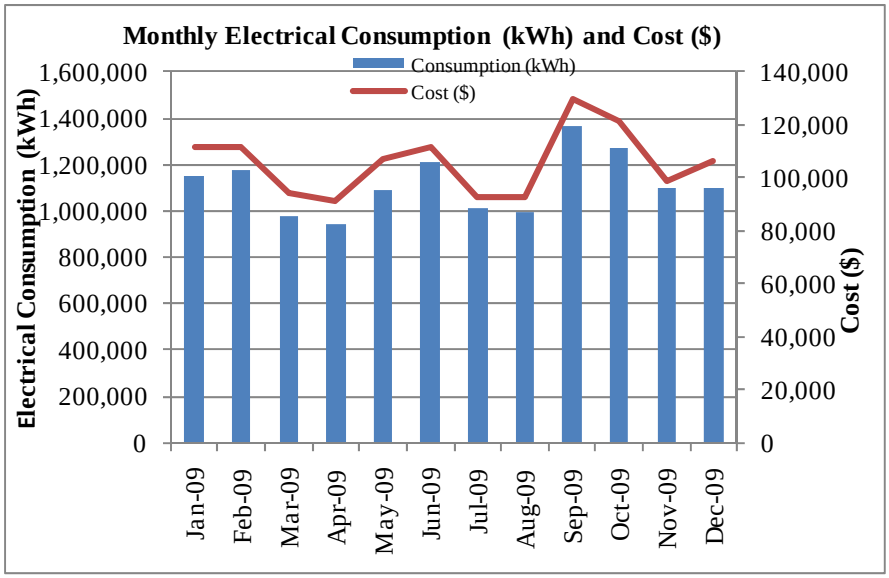
APPENDIX B

SAMPLE UTILITY DATA REPORTING FORM

Lake Travis ISD - Sample Utility Input Form

MONTH	ELECTRICITY		
	KWH	COST $	Avg. Rate $/KWH
Jan-09	1,151,250	111,698	$0.0970
Feb-09	1,177,809	111,979	$0.0951
Mar-09	975,682	94,232	$0.0966
Apr-09	944,267	91,064	$0.0964
May-09	1,086,964	107,048	$0.0985
Jun-09	1,211,418	111,896	$0.0924
Jul-09	1,010,990	92,967	$0.0920
Aug-09	996,810	93,074	$0.0934
Sep-09	1,365,402	129,912	$0.0951
Oct-09	1,271,584	121,398	$0.0955
Nov-09	1,096,151	98,918	$0.0902
Dec-09	1,096,433	106,514	$0.0971
Total	13,384,760	$1,270,700	$0.0949

Gross Building Area:	1,163,073	SF



APPENDIX C

BASE YEAR CONSUMPTION HISTORY

Energy Cost and Consumption Benchmarks								
		Electric			Total	EUI	ECI	
	Building	KWH/Yr	MMBTU/Yr	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
1	Lake Pointe Elem.	827,100	2,823	77,776	2,823	32	0.88	88,613
2	Bee Cave Elem.	861,300	2,940	80,443	2,940	34	0.93	86,875
3	Lakeway Elem.	911,400	3,111	85,140	3,111	35	0.97	87,999
4	Lake Travis Elem.	1,307,066	4,461	115,459	4,461	43	1.10	104,866
5	Serene Hills Elem.	1,192,200	4,069	119,279	4,069	43	1.27	94,000
6	Lake Travis MS	1,328,500	4,534	131,336	4,534	35	1.01	129,597
7	Hudson Bend MS	1,374,600	4,692	124,895	4,692	36	0.96	129,499
8	LTHS	4,288,500	14,637	404,796	14,637	47	1.31	308,279
9	LTHS Main Gym	288,000	983	28,217	983	41	1.19	23,742
10	LTHS Aux. Gym	129,400	442	14,957	442	25	0.84	17,816
11	Cavalier Activity Center	315,600	1,077	32,603	1,077	24	0.73	44,371
12	Admin.	195,400	667	19,502	667	45	1.31	14,846
13	Education Devlp.	170,000	580	19,748	580	28	0.97	20,400
		KWH/Yr	MMBTU/Yr	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
		13,189,066	45,014	1,254,152	45,014	39	1.09	1,150,903

Version 1

District: Lake Travis ISD

ACCOUNT# 610539 Electric

Gas

BUILDING: Admin.

FLOOR AREA: 14,846 estimated

		Electrical				NATURAL GAS / FUEL		
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	13,200		94		1,512	0	0
February	2009	16,000		100		1,654	0	0
March	2009	14,400		62		1,346	0	0
April	2009	15,400		66		1,427	0	0
May	2009	15,600		68		1,629	0	0
June	2009	19,800		70		1,859	0	0
July	2009	22,400		72		2,024	0	0
August	2009	19,200		62		1,760	0	0
September	2009	20,200		80		1,971	0	0
October	2009	15,000		70		1,583	0	0
November	2009	11,800		84		1,303	0	0
December	2009	12,400		98		1,433	0	0
TOTAL		195,400				19,502	0.0	0

Annual Total Energy Cost = 19,502 $/year

Total KWH/yr x 0.003413 = 666.90 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 667 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 45 kBTU/SF/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 1.31 $/SF/year

Electric Utility: Austin Energy

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# 292957 Electric

Gas

BUILDING: Bee Cave Elem.

FLOOR AREA: 86,875 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	57,300		318		5,243	0	0
February	2009	57,900		369		5,568	0	0
March	2009	59,400		270		5,103	0	0
April	2009	66,000		285		5,721	0	0
May	2009	61,800		327		6,441	0	0
June	2009	85,500		375		8,045	0	0
July	2009	66,600		369		6,869	0	0
August	2009	64,500		297		6,184	0	0
September	2009	87,600		417		8,534	0	0
October	2009	103,800		345		8,923	0	0
November	2009	83,100		402		7,721	0	0
December	2009	67,800		354		6,091	0	0
TOTAL		861,300				80,443	0.0	0

* Natural Gas service not included in this summary.

Annual Total Energy Cost = 80,443 $/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 34 kBTU/SF/year

Total KWH/yr x 0.003413 = 2,939.62 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 2,940 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 0.93 $/SF/year

Electric Utility: Austin Energy

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# 378948 Electric

Gas

BUILDING: Education Devlp.

FLOOR AREA: 20,400 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	14,800		120		1,763	0	0
February	2009	13,200		108		1,601	0	0
March	2009	0		0		0	0	0
April	2009	22,600		138		2,864	0	0
May	2009	14,200		74		1,638	0	0
June	2009	18,000		82		1,852	0	0
July	2009	19,400		80		1,994	0	0
August	2009	19,400		78		1,981	0	0
September	2009	16,200		72		1,776	0	0
October	2009	10,600		62		1,398	0	0
November	2009	10,000		130		1,142	0	0
December	2009	13,400		138		1,739	0	0
TOTAL		171,800				19,748	0.0	0

Annual Total Energy Cost = 19,748 $/year

Total KWH/yr x 0.003413 = 586.35 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 586 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 29 kBTU/SF/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 0.97 $/SF/year

Electric Utility: Austin Energy

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# 3759431 Electric

Gas

BUILDING: Hudson Bend MS

FLOOR AREA: 129,499 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	90,000		528		8,400	0	0
February	2009	96,600		498		8,645	0	0
March	2009	93,900		381		8,511	0	0
April	2009	91,200		501		8,345	0	0
May	2009	138,300		555		12,703	0	0
June	2009	116,700		543		11,197	0	0
July	2009	114,900		423		10,110	0	0
August	2009	120,600		510		11,152	0	0
September	2009	158,400		621		14,271	0	0
October	2009	135,900		591		12,733	0	0
November	2009	116,700		471		9,613	0	0
December	2009	101,400		549		9,215	0	0
TOTAL		1,374,600		6171		124,895	0.0	0

Annual Total Energy Cost = 124,895 $/year

Total KWH/yr x 0.003413 = 4,691.51 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 4,692 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 36 kBTU/SF/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 0.96 $/SF/year

Electric Utility: Austin Energy

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# 4354794 Electric

Gas

BUILDING: Lake Pointe Elem. FLOOR AREA: 88,613 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	62,400		423		6,269	0	0
February	2009	72,600		429		6,784	0	0
March	2009	63,900		375		5,962	0	0
April	2009	60,900		324		5,487	0	0
May	2009	69,600		339		6,971	0	0
June	2009	81,000		387		7,821	0	0
July	2009	70,500		318		6,658	0	0
August	2009	50,700		138		4,076	0	0
September	2009	81,300		384		7,879	0	0
October	2009	79,500		375		7,689	0	0
November	2009	72,300		384		6,382	0	0
December	2009	62,400		360		5,798	0	0
TOTAL		827,100		4236		77,776	0.0	0

Annual Total Energy Cost = 77,776 $/year

Total KWH/yr x 0.003413 = 2,822.89 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 2,823 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 32 kBTU/SF/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 0.88 $/SF/year

Electric Utility: Austin Energy

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# 5243614 5255026 557122 Electric

Gas

BUILDING: Lake Travis Elem.

FLOOR AREA: 104,866 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	86,057		474		7,923	0	0
February	2009	83,871		450		7,695	0	0
March	2009	76,043		366		7,079	0	0
April	2009	79,329		420		7,231	0	0
May	2009	120,206		423		10,666	0	0
June	2009	123,506		420		10,731	0	0
July	2009	3,929		6		409	0	0
August	2009	250,912		756		20,532	0	0
September	2009	149,508		573		13,413	0	0
October	2009	128,525		477		11,429	0	0
November	2009	108,437		465		9,114	0	0
December	2009	143		0		18	0	0
TOTAL		1,210,466		4831		106,240	0.0	0

Annual Total Energy Cost = 106,240 $/year

Total KWH/yr x 0.003413 = 4,131.32 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 4,131 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 39 kBTU/SF/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 1.01 $/SF/year

Electric Utility: Austin Energy

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# _____ Electric

_____ Gas

BUILDING: Serene Hills Elem.

FLOOR AREA: 94,000

		ELECTRICAL					NATURAL GAS / FUEL		
			DEMAND			TOTAL ALL			
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL	
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)	
January	2009	158,400		0		15,666	0	0	0.09890
February	2009	172,200		0		17,028	0	0	0.09889
March	2009	97,800		0		9,686	0	0	0.09904
April	2009	92,400		0		9,154	0	0	0.09907
May	2009	103,800		0		10,278	0	0	0.09902
June	2009	82,800		0		4,277	0	0	0.05165
July	2009	52,200		256		5,482	0	0	0.10502
August	2009	95,400		633		10,558	0	0	0.11067
September	2009	92,400		484		9,714	0	0	0.10513
October	2009	80,400		506		8,652	0	0	0.10761
November	2009	66,600		650		8,116	0	0	0.12186
December	2009	97,800		660		10,668	0	0	0.10908
TOTAL		1,192,200		3189		119,279	0.0	0	

Annual Total Energy Cost = 119,279 $/year

Total KWH/yr x 0.003413 = 4,068.98 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 4,069 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 43 kBTU/SF/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 1.27 $/SF/year

Electric Utility: Pedernales Electric

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# 28369 Electric

Gas

BUILDING: Lake Travis MS

FLOOR AREA: 129,597 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	106,500		915		11,846	0	0
February	2009	123,500		805		12,363	0	0
March	2009	106,000		720		10,784	0	0
April	2009	93,500		675		9,775	0	0
May	2009	99,500		455		10,066	0	0
June	2009	120,000		530		11,640	0	0
July	2009	80,500		350		7,856	0	0
August	2009	78,500		290		7,269	0	0
September	2009	139,000		620		13,472	0	0
October	2009	139,500		590		13,237	0	0
November	2009	121,500		580		10,703	0	0
December	2009	120,500		840		12,325	0	0
TOTAL		1,328,500		7370		131,336	0.0	0

Annual Total Energy Cost = 131,336 $/year

Total KWH/yr x 0.003413 = 4,534.17 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 4,534 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 35 kBTU/SF/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 1.01 $/SF/year

Electric Utility: Austin Energy

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# 83512 83513 Electric

Gas

BUILDING: Lakeway Elem.

FLOOR AREA: 87,999 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	58,500		350		6,003	0	0
February	2009	69,500		390		6,383	0	0
March	2009	71,500		390		6,513	0	0
April	2009	66,000		340		5,897	0	0
May	2009	72,500		375		7,440	0	0
June	2009	90,500		410		8,592	0	0
July	2009	64,500		265		5,901	0	0
August	2009	71,000		250		6,179	0	0
September	2009	97,500		430		9,243	0	0
October	2009	92,000		425		8,856	0	0
November	2009	80,545		410		7,056	0	0
December	2009	77,355		425		7,078	0	0
TOTAL		911,400		4460		85,140	0.0	0

Annual Total Energy Cost = 85,140 $/year

Total KWH/yr x 0.003413 = 3,110.61 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 3,111 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 35 kBTU/SF/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 0.97 $/SF/year

Electric Utility: Austin Energy

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# 146208 3801090 Electric

Gas

BUILDING: LTHS

FLOOR AREA: 308,279

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	397,500		1,155		36,524	0	0
February	2009	397,500		1,125		36,404	0	0
March	2009	327,000		990		31,408	0	0
April	2009	316,500		1,020		30,510	0	0
May	2009	339,000		750		33,020	0	0
June	2009	400,500		840		38,592	0	0
July	2009	298,500		555		27,636	0	0
August	2009	277,500		435		26,201	0	0
September	2009	432,000		960		40,951	0	0
October	2009	399,000		900		38,465	0	0
November	2009	348,000		855		30,924	0	0
December	2009	355,500		1,170		34,159	0	0
TOTAL		4,288,500		10755		404,796	0.0	0

Annual Total Energy Cost = 404,796 $/year

Total KWH/yr x 0.003413 = 14,636.65 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 14,637 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 47 kBTU/SF/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 1.31 $/SF/year

Electric Utility: Austin Energy

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# 146207 Electric

Gas

BUILDING: LTHS Main Gym

FLOOR AREA: 23,742

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	25,500		207		2,703	0	0
February	2009	22,500		207		2,520	0	0
March	2009	18,000		159		1,976	0	0
April	2009	18,000		123		1,772	0	0
May	2009	20,100		126		2,232	0	0
June	2009	22,800		138		2,445	0	0
July	2009	28,200		99		2,452	0	0
August	2009	24,900		99		2,254	0	0
September	2009	28,500		117		2,627	0	0
October	2009	30,000		132		2,846	0	0
November	2009	23,700		117		2,058	0	0
December	2009	25,800		138		2,332	0	0
TOTAL		288,000		1662		28,217	0.0	0

Annual Total Energy Cost = 28,217 $/year

Total KWH/yr x 0.003413 = 982.94 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 983 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 41 kBTU/SF/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 1.19 $/SF/year

Electric Utility: Austin Energy

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# 714507 Electric

Gas

BUILDING: LTHS Aux. Gym

FLOOR AREA: 17,816

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	19,600		138		2,017	0	0
February	2009	16,000		130		1,688	0	0
March	2009	6,800		94		938	0	0
April	2009	5,800		112		985	0	0
May	2009	4,600		68		820	0	0
June	2009	10,200		56		1,050	0	0
July	2009	12,200		60		1,194	0	0
August	2009	11,600		60		1,156	0	0
September	2009	11,800		68		1,244	0	0
October	2009	9,400		72		1,132	0	0
November	2009	8,800		68		901	0	0
December	2009	12,600		190		1,832	0	0
TOTAL		129,400		1116		14,957	0.0	0

Annual Total Energy Cost = 14,957 $/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 25 kBTU/SF/year

Total KWH/yr x 0.003413 = 441.64 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 442 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 0.84 $/SF/year

Electric Utility: Austin Energy

Gas Utility: N/A

District: Lake Travis ISD

ACCOUNT# 5682901 Electric

Gas

BUILDING: Cavalier Activity Center

FLOOR AREA: 44,371

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
January	2009	21,900		339		3,238	0	0
February	2009	24,000		207		2,606	0	0
March	2009	21,900		219		2,550	0	0
April	2009	18,600		267		2,628	0	0
May	2009	16,200		126		1,996	0	0
June	2009	23,100		111		2,239	0	0
July	2009	24,300		99		2,214	0	0
August	2009	25,500		105		2,338	0	0
September	2009	30,900		147		2,991	0	0
October	2009	33,900		147		3,167	0	0
November	2009	34,500		177		3,011	0	0
December	2009	40,800		210		3,623	0	0
TOTAL		315,600		2154		32,603	0.0	0

Annual Total Energy Cost = 32,603 $/year

Total KWH/yr x 0.003413 = 1,077.14 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 1,077 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 24 kBTU/SF/year

Energy Cost Index:

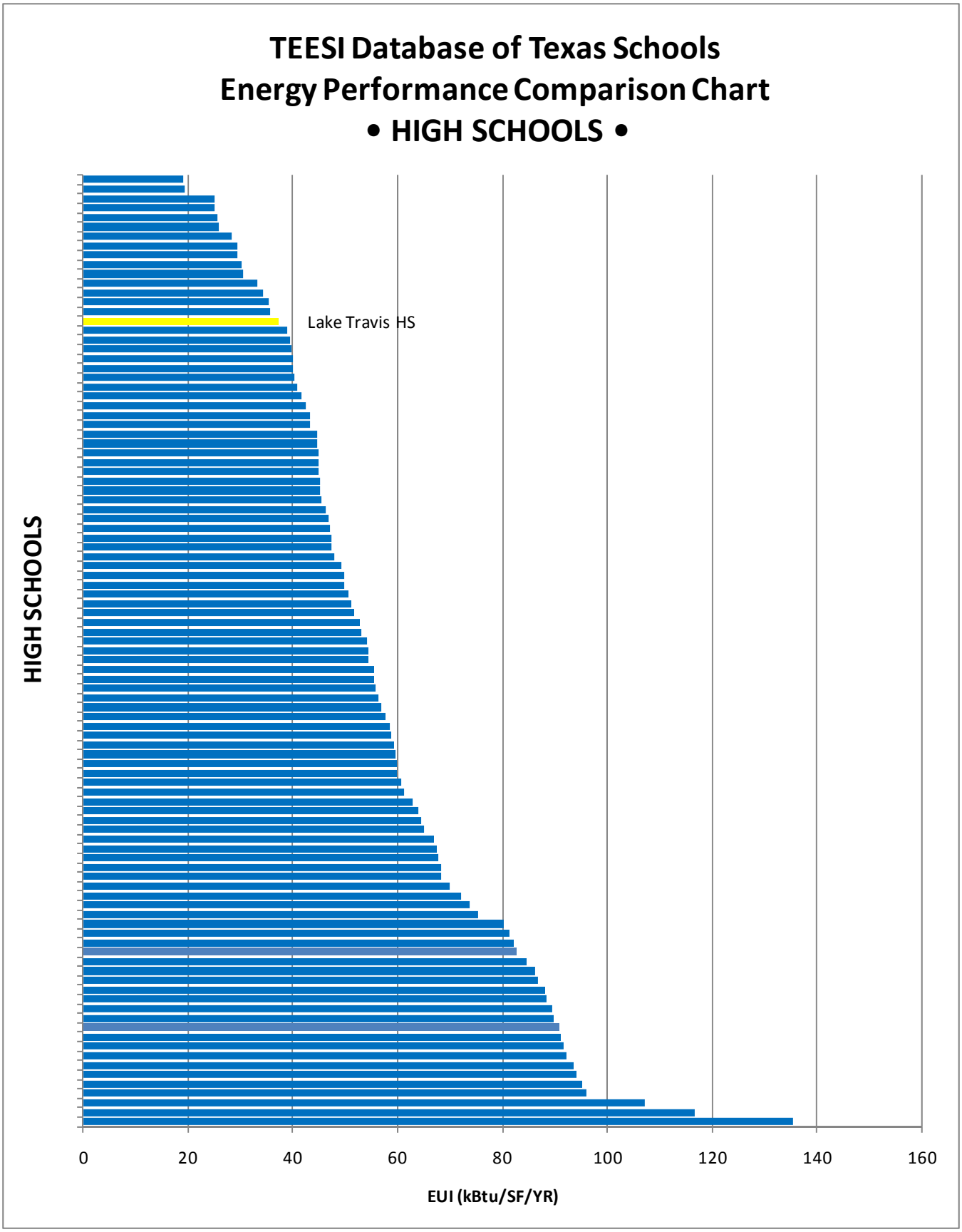
Total Energy Cost/Yr ÷ Total Area (SF) = 0.73 $/SF/year

Electric Utility: Austin Energy

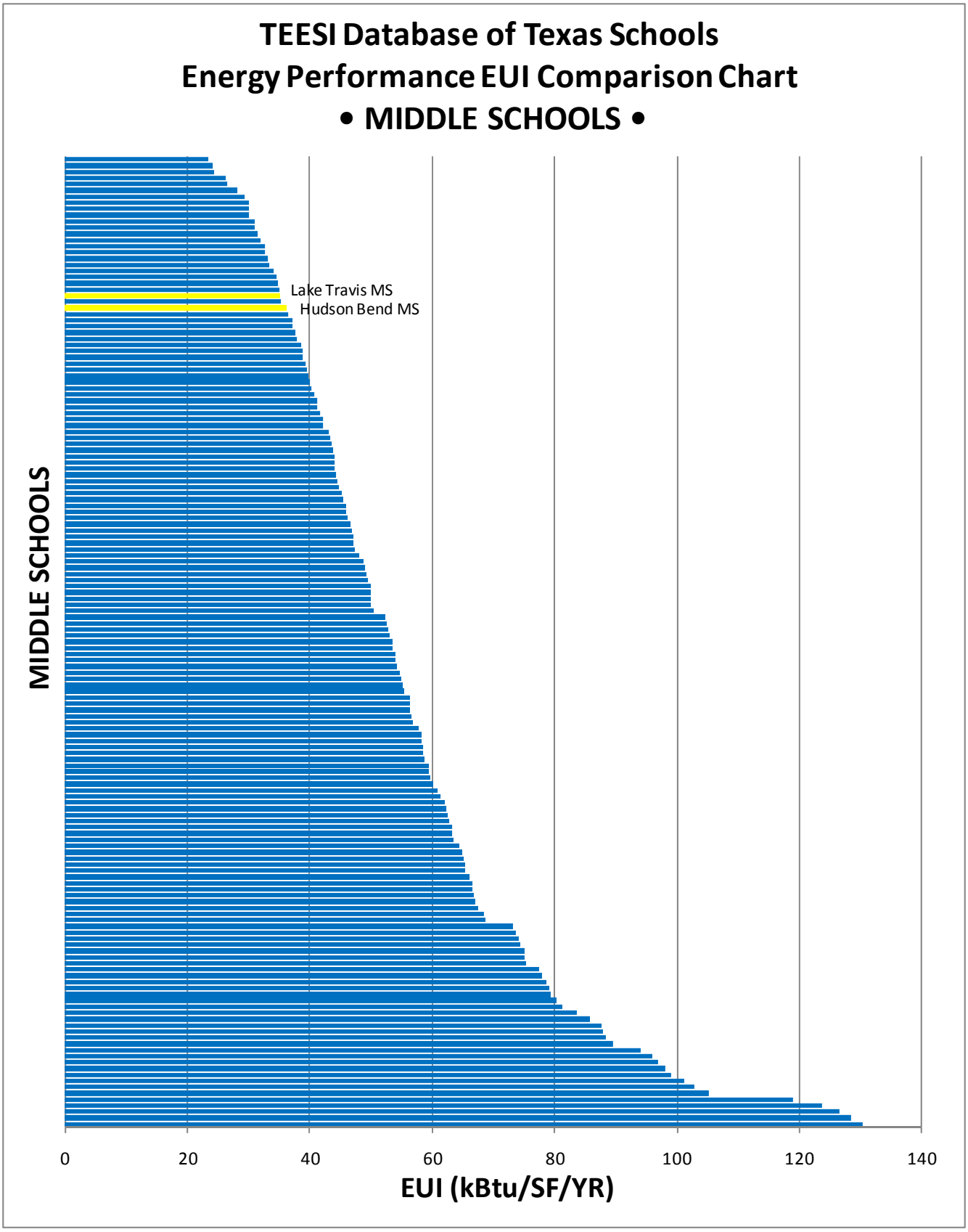
Gas Utility: N/A

APPENDIX D

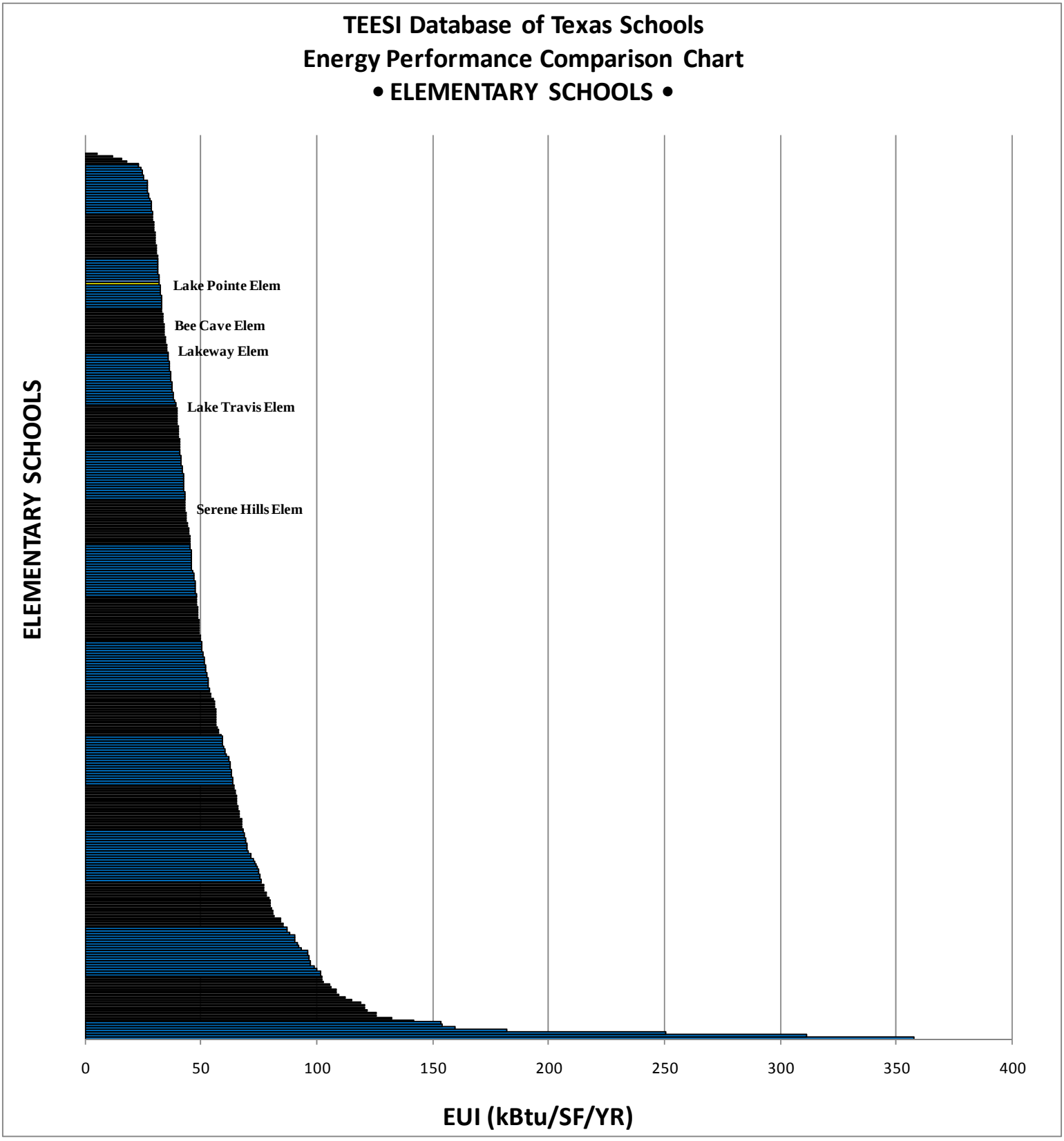
ENERGY PERFORMANCE COMPARISON CHARTS



(The chart above is a comparison of EUIs based on sample data from TEESI's database of Texas Schools)



(The chart above is a comparison of EUIs based on sample data from TEESI's database of Texas Schools)



(The chart above is a comparison of EUIs based on sample data from TEESI's database of Texas Schools)

APPENDIX E

TYPICAL EQUIPMENT MAINTENANCE CHECKLISTS

Boilers Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Boiler use/sequencing	Turn off/sequence unnecessary boilers	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Follow manufacturer's recommended procedures in lubricating all components	Compare temperatures with tests performed after annual cleaning	X			
Check steam pressure	Is variation in steam pressure as expected under different loads? Wet steam may be produced if the pressure drops too fast	X			
Check unstable water level	Unstable levels can be a sign of contaminates in feedwater, overloading of boiler, equipment malfunction	X			
Check burner	Check for proper control and cleanliness	X			
Check motor condition temperatures	Check for proper function	X			
Check air temperatures in boiler room	Temperatures should not exceed or drop below design limits	X			
Boiler blowdown	Verify the bottom, surface and water column blow downs are occurring and are effective	X			
Boiler logs	Keep daily logs on: • Type and amount of fuel used • Flue gas temperature • Makeup water volume • Steam pressure, temperature, and amount generated Look for variations as a method of fault detection	X			
Check oil filter assemblies	Check and clean/replace oil filters and strainers	X			
Inspect oil heaters	Check to ensure that oil is at proper temperature prior to burning	X			
Check boiler water treatment	Confirm water treatment system is functioning properly	X			
Check flue gas temperatures and composition	Measure flue gas composition and temperatures at selected firing positions - recommended O2% and CO2% Fuel / O2 % / CO2% Natural gas / 1.5 / 10 No. 2 fuel oil / 2.0 / 11.5 No. 6 fuel oil / 2.5 / 12.5 Note: percentages may vary due to fuel composition variations		X		

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Check all relief valves	Check for leaks		X		
Check water level control	Stop feedwater pump and allow control to stop fuel flow to burner. Do not allow water level to drop below recommended level.		X		
Check pilot and burner assemblies	Clean pilot and burner following manufacturer's guidelines. Examine for mineral or corrosion buildup.		X		
Check boiler operating characteristics	Stop fuel flow and observe flame failure. Start boiler and observe characteristics of flame.		X		
Inspect system for water/ steam leaks and leakage opportunities	Look for: leaks, defective valves and traps, corroded piping, condition of insulation		X		
Inspect all linkages on combustion air dampers and fuel valves	Check for proper setting and tightness		X		
Inspect boiler for air leaks	Check damper seals		X		
Check blowdown and water treatment procedures	Determine if blowdown is adequate to prevent solids buildup			X	
Flue gases	Measure and compare last month's readings flue gas composition over entire firing range			X	
Combustion air supply	Check combustion air inlet to boiler room and boiler to make sure openings are adequate and clean			X	
Check fuel system	Check pressure gauge, pumps, filters and transfer lines. Clean filters as required.			X	
Check belts and packing glands	Check belts for proper tension. Check packing glands for compression leakage.			X	
Check for air leaks	Check for air leaks around access openings and flame scanner assembly.			X	
Check all blower belts	Check for tightness and minimum slippage.			X	
Check all gaskets	Check gaskets for tight sealing, replace if do not provide tight seal			X	
Inspect boiler insulation	Inspect all boiler insulation and casings for hot spots			X	
Steam control valves	Calibrate steam control valves as specified by manufacturer			X	
Pressure reducing/regulating valves	Check for proper operation			X	

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Perform water quality test	Check water quality for proper chemical balance			X	
Clean waterside surfaces	Follow manufacturer's recommendation on cleaning and preparing waterside surfaces				X
Clean fireside	Follow manufacturer's recommendation on cleaning and preparing fireside surfaces				X
Inspect and repair refractories on fireside	Use recommended material and procedures				X
Relief valve	Remove and recondition or replace				X
Feedwater system	Clean and recondition feedwater pumps. Clean condensate receivers and deaeration system				X
Fuel system	Clean and recondition system pumps, filters, pilot, oil preheaters, oil storage tanks, etc.				X
Electrical systems	Clean all electrical terminals. Check electronic controls and replace any defective parts.				X
Hydraulic and pneumatic valves	Check operation and repair as necessary				X
Flue gases	Make adjustments to give optimal flue gas composition. Record composition, firing position, and temperature.				X
Eddy current test	As required, conduct eddy current test to assess tube wall thickness				X

Chillers Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Semi-Annually	Annually
Chiller use/sequencing	Turn off/sequence unnecessary chillers	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Check setpoints	Check all setpoints for proper setting and function	X			
Evaporator and condenser coil fouling	Assess evaporator and condenser coil fouling as required		X		
Compressor motor temperature	Check temperature per manufacturer's specifications		X		
Perform water quality test	Check water quality for proper chemical balance		X		
Leak testing	Conduct leak testing on all compressor fittings, oil pump joints and fittings, and relief valves		X		
Check all insulation	Check insulation for condition and appropriateness		X		
Control operation	Verify proper control function including: • Hot gas bypass • Liquid injection		X		
Check vane control settings	Check settings per manufacturer's specification			X	
Verify motor load limit control	Check settings per manufacturer's specification			X	
Verify load balance operation	Check settings per manufacturer's specification			X	
Check chilled water reset settings and function	Check settings per manufacturer's specification			X	
Check chiller lockout setpoint	Check settings per manufacturer's specification				X
Clean condenser tubes	Clean tubes at least annually as part of shutdown procedure				X

Building Controls Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Semi-Annually	Annually
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Verify control schedules	Verify in control software that schedules are accurate for season, occupancy, etc.	X			
Verify setpoints	Verify in control software that setpoints are accurate for season, occupancy, etc.	X			
Time clocks	Reset after every power outage	X			
Check all gauges	Check all gauges to make sure readings are as expected		X		
Control tubing (pneumatic system)	Check all control tubing for leaks		X		
Check outside air volumes	Calculated the amount of outside air introduced and compare to requirements		X		
Check setpoints	Check setpoints and review rational for setting		X		
Check schedules	Check schedules and review rational for setting		X		
Check deadbands	Assure that all deadbands are accurate and the only simultaneous heating and cooling is by design		X		
Check sensors	Conduct thorough check of all sensors - temperature, pressure, humidity, flow, etc. - for expected values			X	
Time clocks	Check for accuracy and clean			X	
Calibrate sensors	Calibrate all sensors: temperature, pressure, humidity, flow, etc.				X

Pumps Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Pump use/sequencing	Turn off/sequence unnecessary pumps	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Check lubrication	Assure that all bearings are lubricated per the manufacture's recommendation			X	
Check packing	Check packing for wear and repack as necessary. Consider replacing packing with mechanical seals.			X	
Motor/pump alignment	Aligning the pump/motor coupling allows for efficient torque transfer to the pump			X	
Check mountings	Check and secure all pump mountings			X	
Check bearings	Inspect bearings and drive belts for wear. Adjust, repair, or replace as necessary.				X
Motor condition	Checking the condition of the motor through temperature or vibration analysis assures long life				X

Fans Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
System use/sequencing	Turn off/sequence unnecessary equipment	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Observe belts	Verify proper belt tension and alignment			X	
Inspect pulley wheels	Clean and lubricate where required			X	
Inspect dampers	Confirm proper and complete closure control; outside air dampers should be airtight when closed			X	
Observe actuator/linkage control	Verify operation, clean, lubricate, adjust as needed			X	
Check fan blades	Validate proper rotation and clean when necessary			X	
Filters	Check for gaps, replace when dirty - monthly			X	
Check for air quality anomalies	Inspect for moisture/growth on walls, ceilings, carpets, and in/outside of duct-work. Check for musty smells and listen to complaints.			X	
Check wiring	Verify all electrical connections are tight				X
Inspect ductwork	Check and refasten loose connections, repair all leaks				X
Coils	Confirm that filters have kept clean, clean as necessary				X
Insulation	Inspect, repair, replace all compromised duct insulation				X

Electric Motors Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Motor use/sequencing	Turn off/sequence unnecessary motors	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Motor condition	Check the condition of the motor through temperature or vibration analysis and compare to baseline values		X		
Check lubrication	Assure that all bearings are lubricated per the manufacture's recommendation			X	
Check packing	Check packing for wear and repack as necessary. Consider replacing packing with mechanical seals.			X	
Motor alignment	Aligning the motor coupling allows for efficient torque transfer to the pump			X	
Check mountings	Check and secure all motor mountings			X	
Check terminal tightness	Tighten connection terminals as necessary			X	
Cleaning	Remove dust and dirt from motor to facilitate cooling			X	
Check bearings	Inspect bearings and drive belts for wear. Adjust, repair, or replace as necessary.				X
Motor condition	Checking the condition of the motor through temperature or vibration analysis assures long life				X
Check for balanced three-phase power	Unbalanced power can shorten the motor life through excessive heat build up				X
Check for over-voltage or under-voltage conditions	Over- or under-voltage situations can shorten the motor life through excessive heat build up				X

APPENDIX F

LOANSTAR INFORMATION

Texas LoanSTAR Program

FACTS ABOUT LoanSTAR

The State of Texas LoanSTAR (Saving Taxes and Resources) Program finances energy efficient facility up-grades for state agencies, public schools, institutions of higher education, local governments, municipalities, and hospitals. The program's revolving loan mechanism allows participants to borrow money and repay all project costs through the stream of **cost savings** produced.

ELIGIBLE PROJECTS

Up-grades financed through the program include, but are not limited to, (1) energy efficient lighting systems; (2) high efficiency heating, ventilation and air conditioning systems; (3) energy management systems; (4) boiler efficiency improvements; (5) energy recovery systems; (6) building shell improvements; and (7) load management projects. The prospective borrower hires a Professional Engineer to analyze the potential energy efficient projects that will be submitted for funding through the Loan STAR Program. All engineering costs are covered under the program.

PROGRAM REQUIREMENTS

Once the projects are analyzed and the prospective borrower agrees with the recommended projects, the engineer prepares an Energy Assessment Report (EAR) with the project descriptions and calculations. The EAR must be prepared according to the LoanSTAR Technical Guidelines. The EAR is reviewed and approved by the State Energy Conservation Office (SECO) technical staff before project financing is authorized. Projects financed by LoanSTAR must have an average simple payback of ten years or less. Borrowers do, however, have the option of buying down paybacks to meet the composite ten-year limit.

To ensure up-grade projects are designed and constructed according to the EAR, SECO performs a review of the design documents at the 50% and 100% completion phases. On-site construction monitoring is also performed at the 50% and 100% completion phases.

SAVINGS VERIFICATION

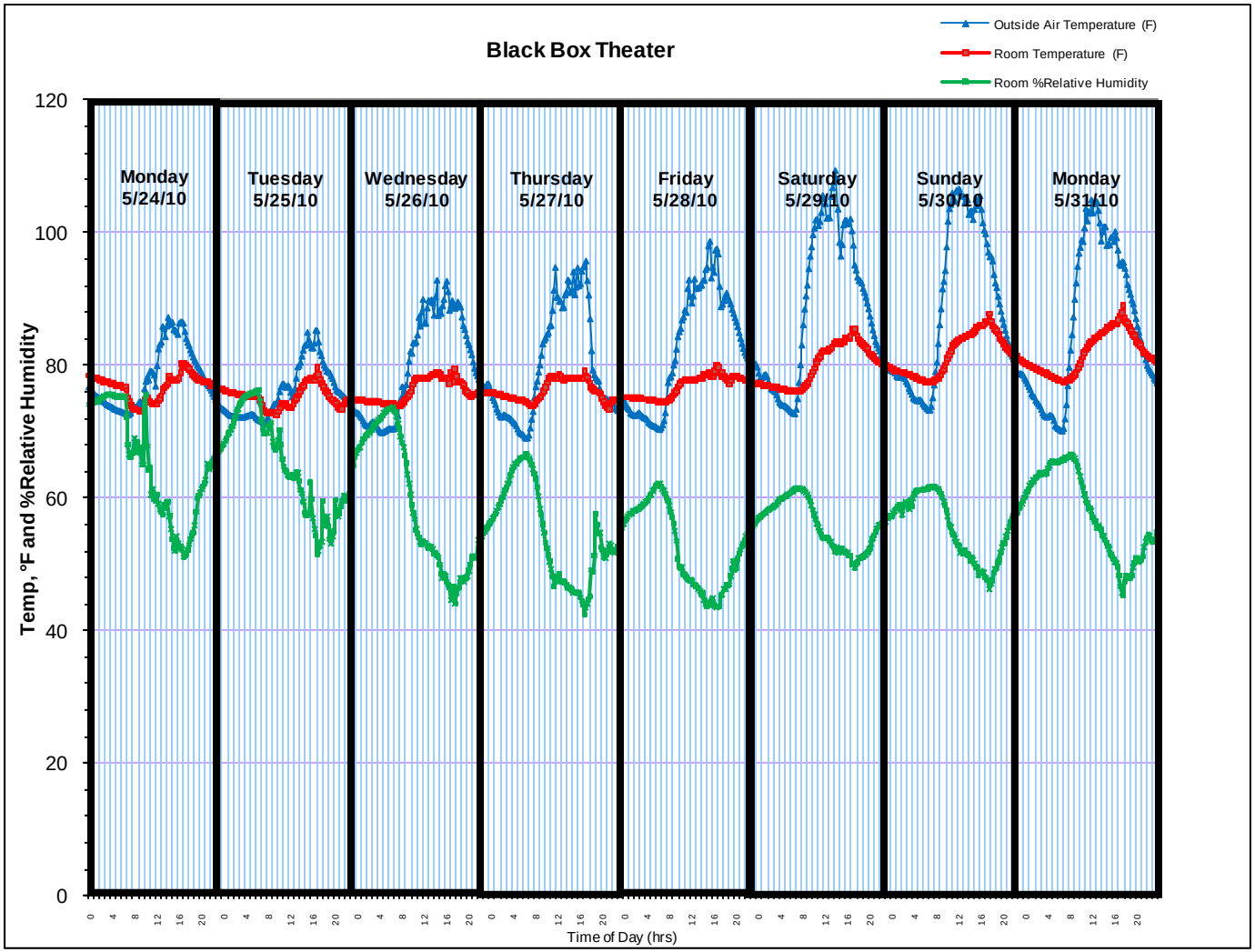
To ensure that the Borrower is achieving the estimated energy savings, monitoring and verification is required for all LoanSTAR funded projects. The level of monitoring and verifications may range from utility bill analysis to individual system or whole building metering depending on the size and type of retrofit projects. If whole building metering is required, metering and monitoring cost can be rolled into the loan.

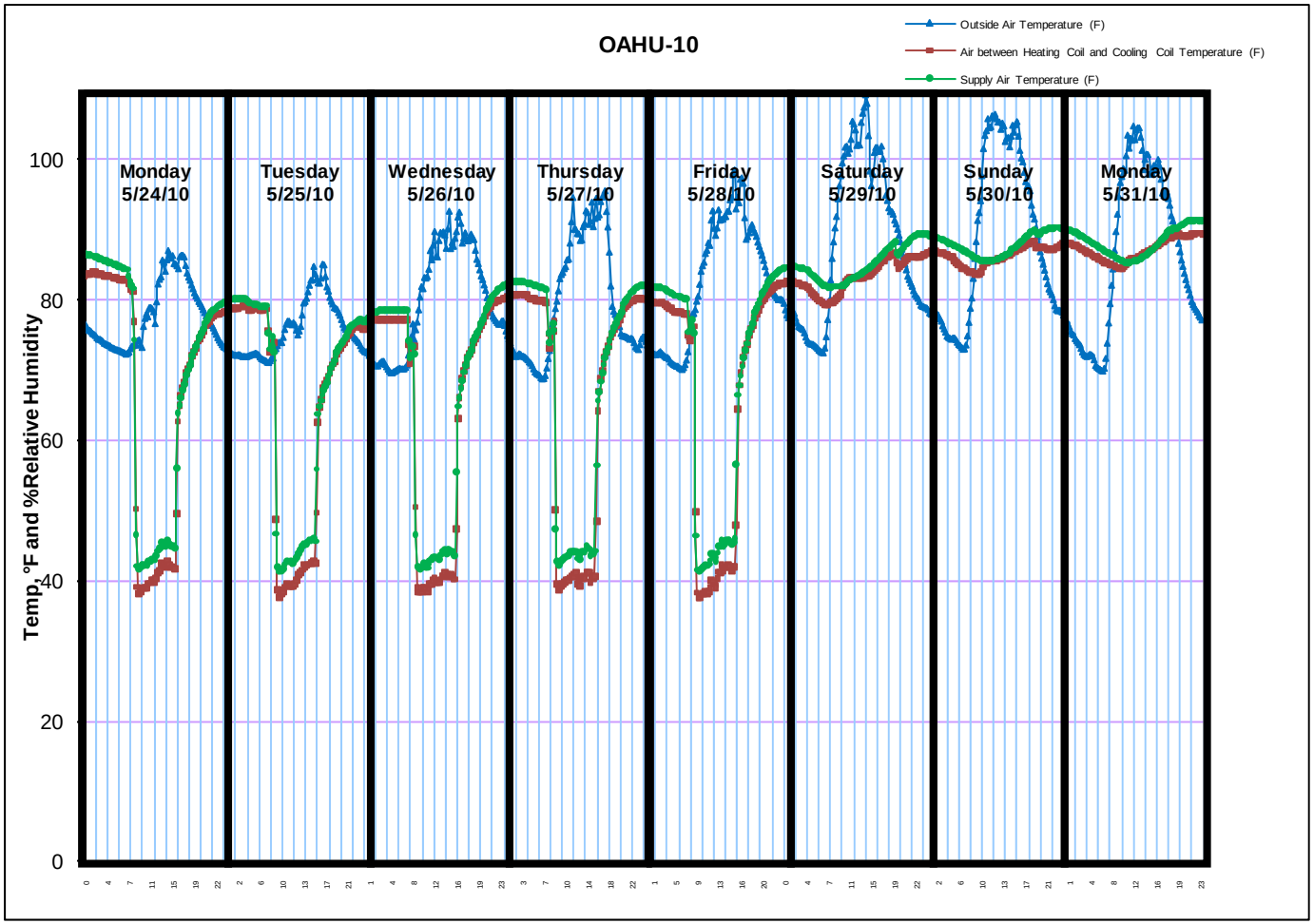
For additional information regarding the
LoanSTAR program, please contact:

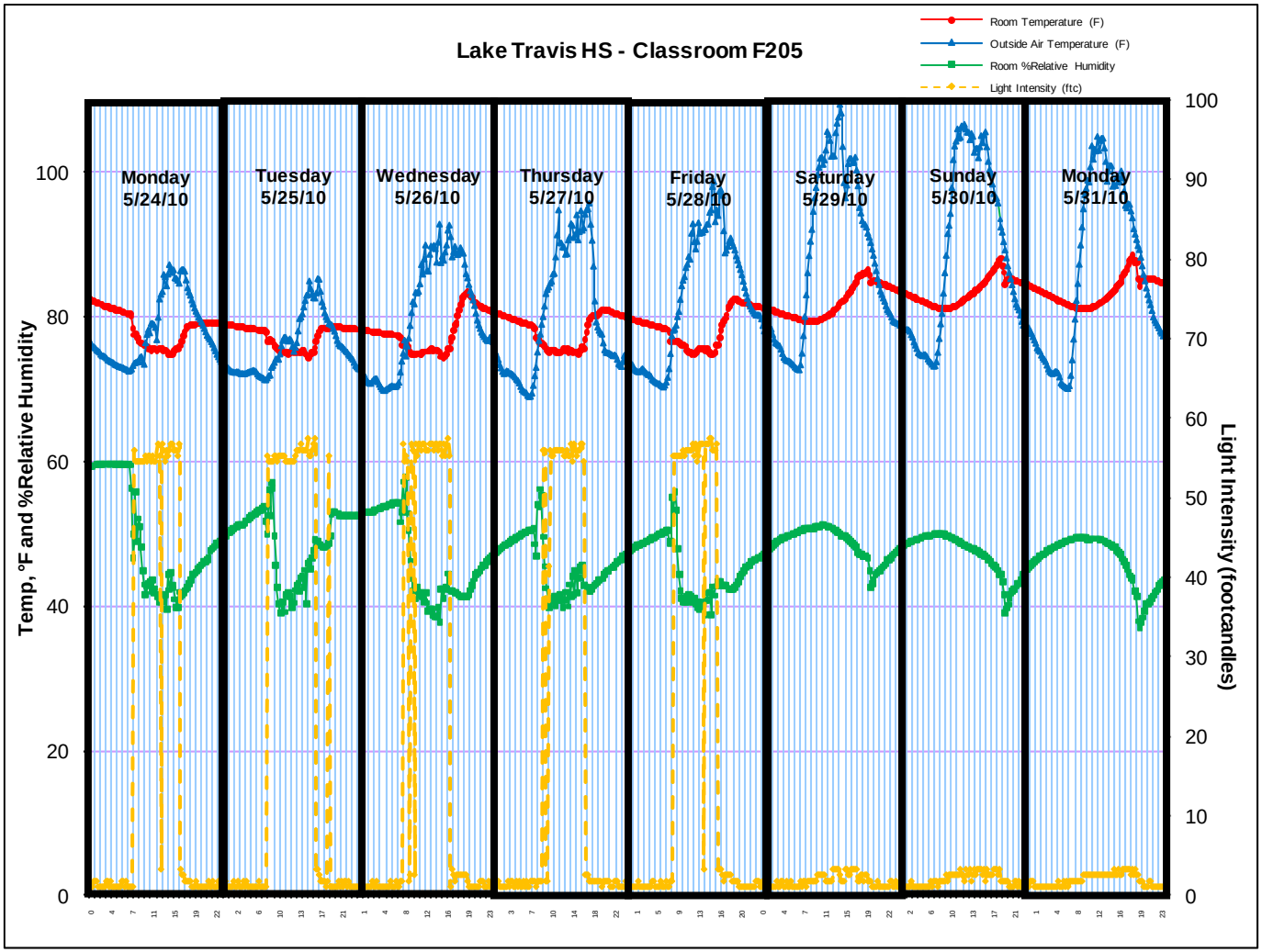
Eddy Trevino
SECO, LoanSTAR Program Manager
(512) 463-1080

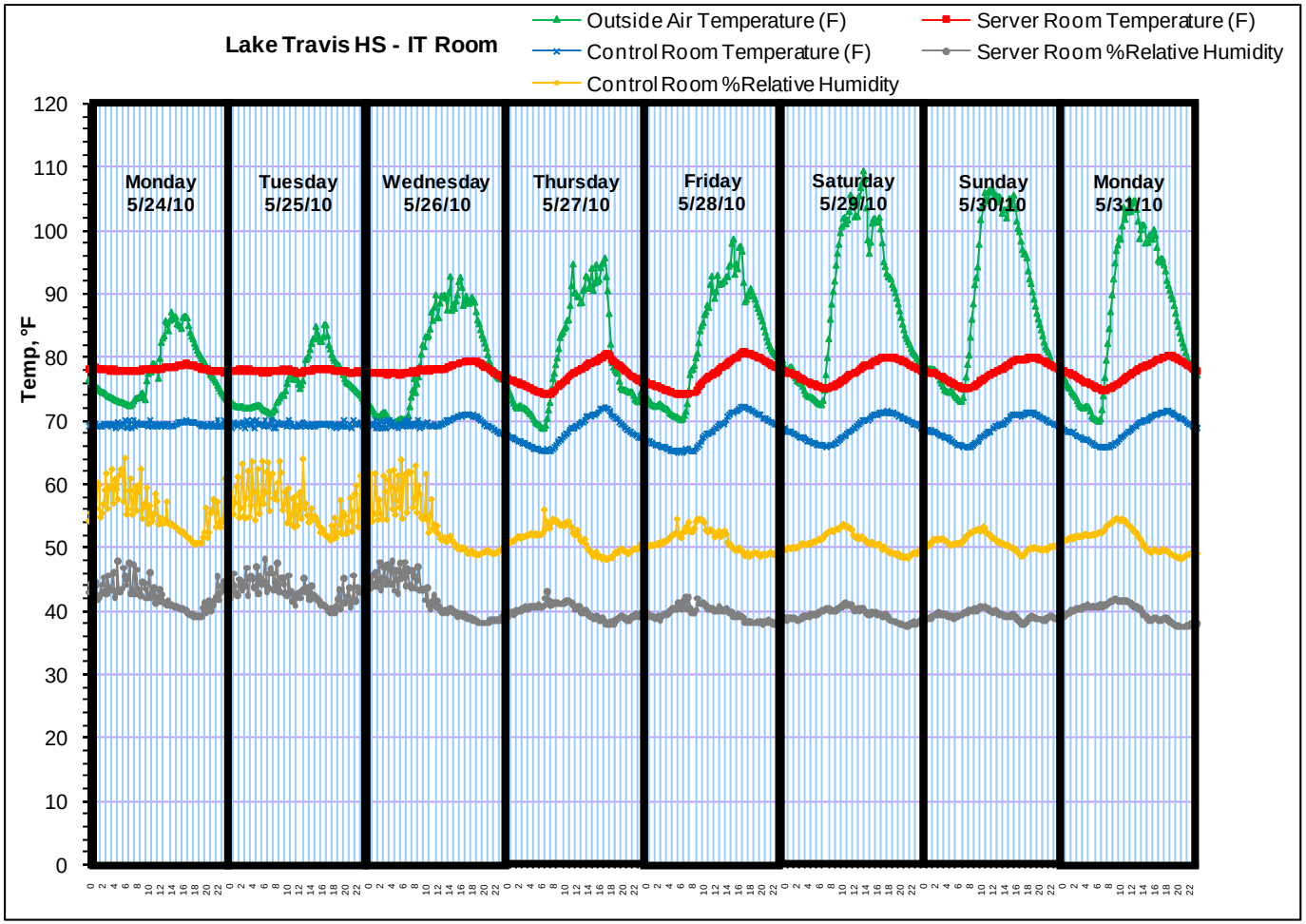
APPENDIX G

DATALOGGER CHARTS

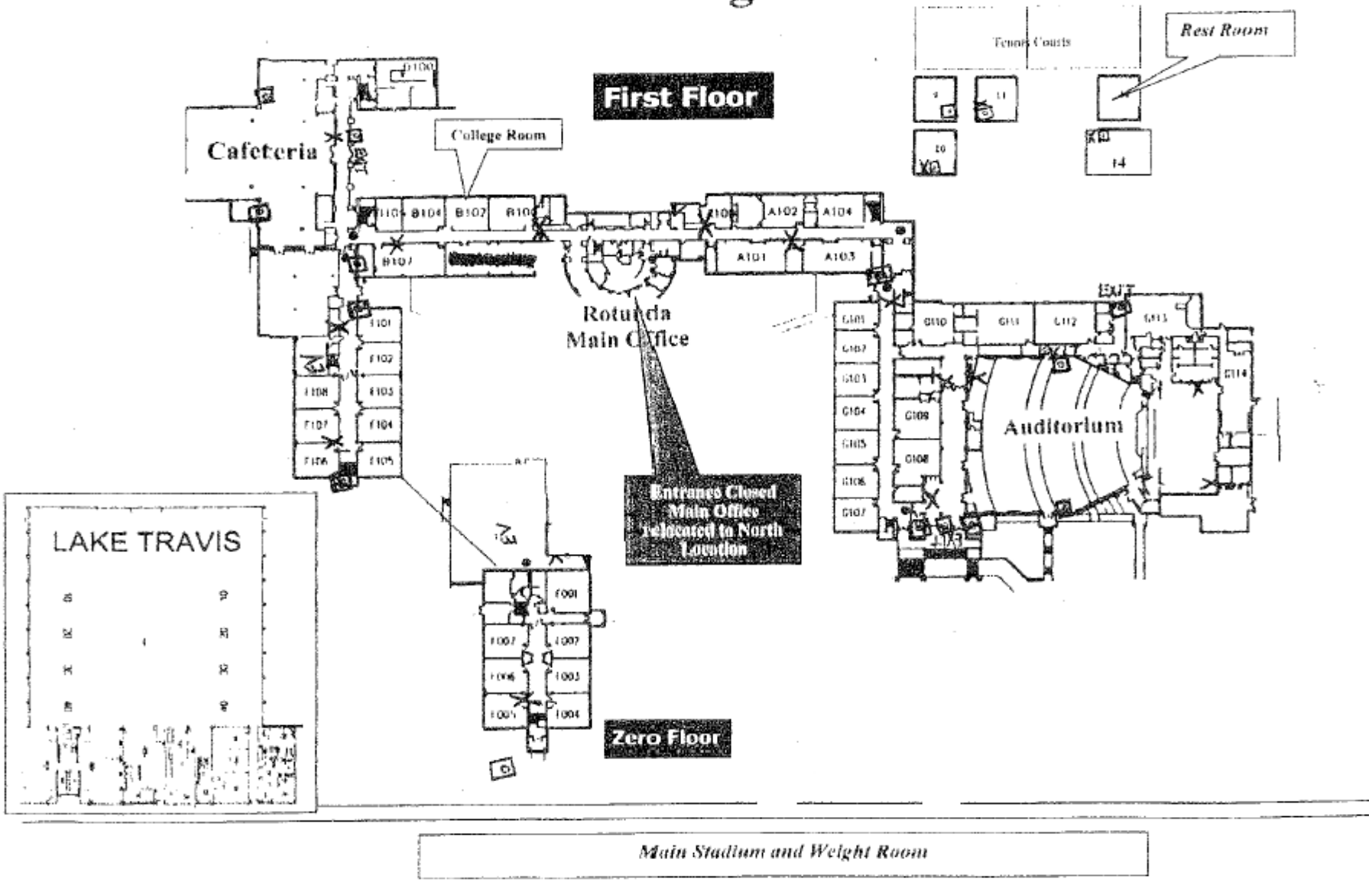

Black Box Theater
Outside Air Temperature (F)
Room Temperature (F)
Room %Relative Humidity
Temp, °F and %Relative Humidity
Time of Day (hrs)
Monday 5/24/10
Tuesday 5/25/10
Wednesday 5/26/10
Thursday 5/27/10
Friday 5/28/10
Saturday 5/29/10
Sunday 5/30/10
Monday 5/31/10


OAHU-10
Outside Air Temperature (F)
Air between Heating Coil and Cooling Coil Temperature (F)
Supply Air Temperature (F)
Temp, °F and %Relative Humidity
0
20
40
60
80
100
Monday 5/24/10
Tuesday 5/25/10
Wednesday 5/26/10
Thursday 5/27/10
Friday 5/28/10
Saturday 5/29/10
Sunday 5/30/10
Monday 5/31/10


Lake Travis HS - Classroom F205
Room Temperature (F)
Outside Air Temperature (F)
Room %Relative Humidity
Light Intensity (ftc)
Monday 5/24/10
Tuesday 5/25/10
Wednesday 5/26/10
Thursday 5/27/10
Friday 5/28/10
Saturday 5/29/10
Sunday 5/30/10
Monday 5/31/10
Temp, °F and %Relative Humidity
Light Intensity (footcandles)
0
20
40
60
80
100
0
10
20
30
40
50
60
70
80
90
100

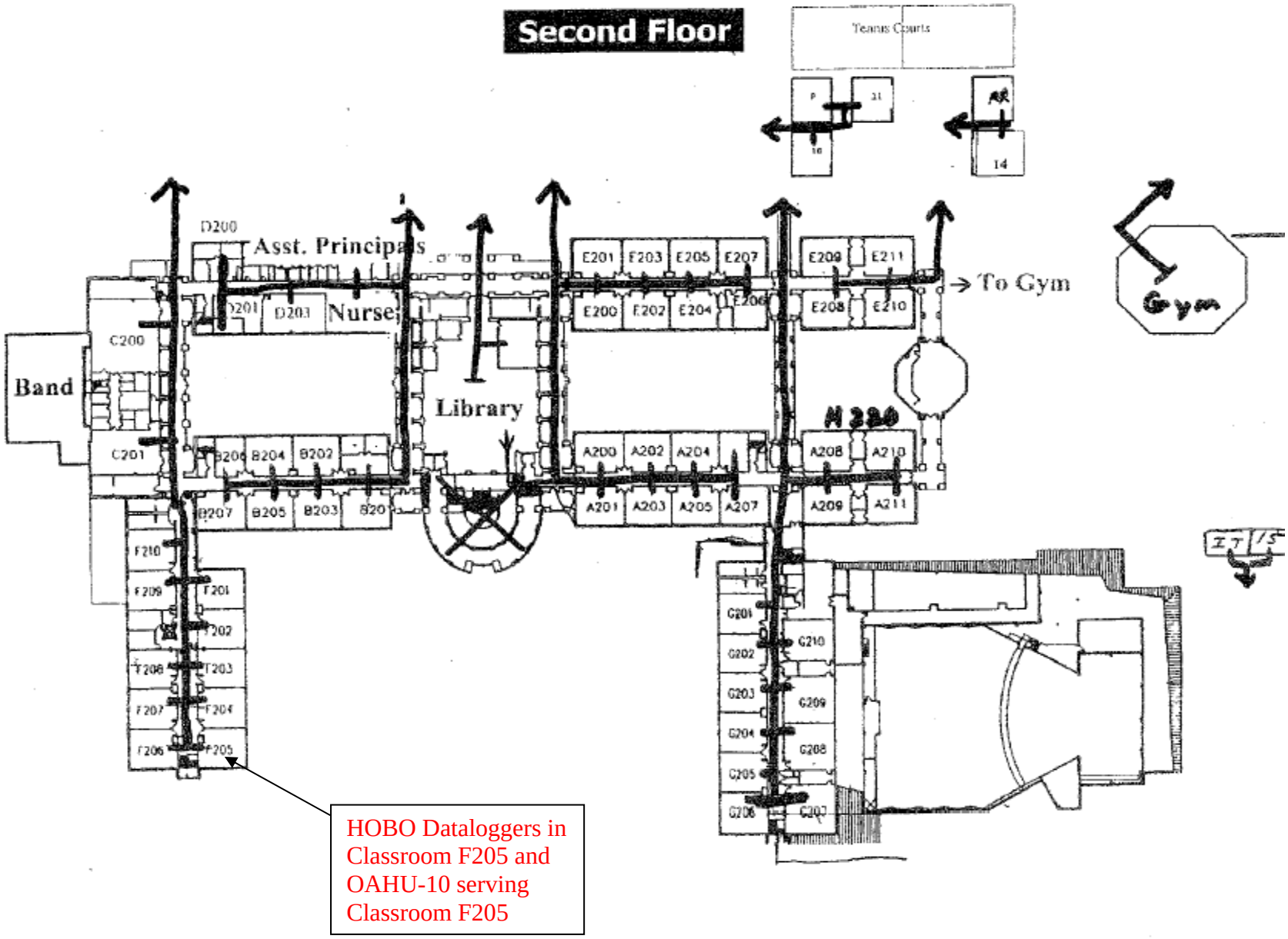

Lake Travis HS - IT Room
Outside Air Temperature (F)
Server Room Temperature (F)
Control Room Temperature (F)
Server Room %Relative Humidity
Control Room %Relative Humidity
Temp, °F
Monday 5/24/10
Tuesday 5/25/10
Wednesday 5/26/10
Thursday 5/27/10
Friday 5/28/10
Saturday 5/29/10
Sunday 5/30/10
Monday 5/31/10

Lake Travis High School



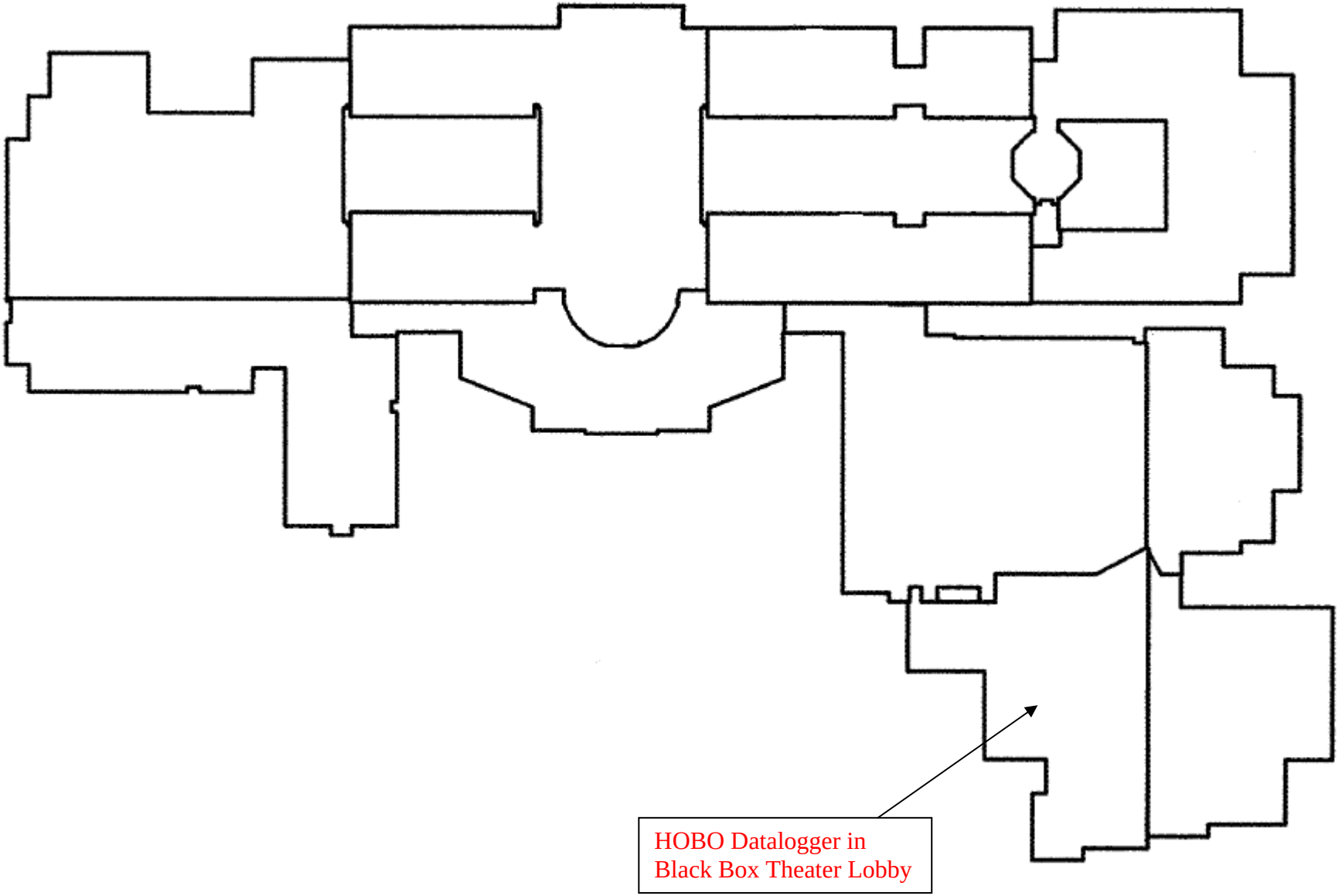
Appendix G-5

Lake Trav.. High School



HOBO Dataloggers in Classroom F205 and OAHU-10 serving Classroom F205

Lake Travis High School



APPENDIX H

BUILDING COMMISSIONG INFORMATON

BUILDING COMMISSIONING GENERAL INFORMATION

Commissioning is common in all types of building systems, including heating, ventilating, and air-conditioning (HVAC), lighting, electric, and safety controls such as fire protection and security.

Commissioning is available in many forms, the first of which is new construction commissioning. This type aims to construct a facility that obtains the performance and operation requirements of its occupants and owner, and begins during the pre-design portion of the project. If it is comprehensive commissioning, the process starts with the criteria for the facility's functionality, and constantly verifies this in all parts of the facility's creation, including design, construction, and building operation. Construction phase commissioning occurs when the Owner does not include commissioning requirements in the original design, and begins when construction is already underway.

The second form is existing building commissioning, which is identified by two types. Retro-commissioning involves buildings that have never before been commissioned, and involves documenting methods to improve the building's systems and reach the original design intentions. It is an involved process starting with obtaining utility bills, talking to the building's occupants, performing diagnostic tests on the building, and preparing the information for the owner. The second type is re-commissioning, which is different from retro-commissioning in that the building's systems have previously had commissioning performed at some point, whether in the design or construction phases. However, it is similar to retro-commissioning because it arises from system performance problems or inadequacies.

A more specific form of HVAC systems commissioning for existing building is Continuous Commissioning® (CC®). Unlike the other forms, Continuous Commissioning ensures the optimization of HVAC systems for the building's existing conditions. It also works to improve the building air quality, increase comfort levels, and resolve any operating problems. When implemented, Continuous Commissioning can decrease energy usage by 20% on average[1]. It is a joint effort between the commissioning engineers and the facility staff, and is an ongoing process that continues to both commission the building as well as train the facility staff.

All of these forms of commissioning can be used to meet several of the requirements under the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) rating system. The LEED rating system considers building commissioning to be an essential step towards sustainability. This is evident by the fact that many of the LEED rating systems (LEED-EB, LEED-NC, etc) require building commissioning as a pre-requisite.

The scope of commissioning can involve a wide range of building systems, selectable by the building owner. Mechanical systems including HVAC systems, plumbing, piping, boilers, heaters, and valves can be commissioned. Electrical systems such as lighting, transformers, and lighting control is often included, as well as other systems like fire safety, security, and standby power systems.

[1] *Continuous Commissioning Guidebook for Federal Energy Managers* (Energy Systems Laboratory at Texas A&M University)

The costs of commissioning for the owner vary from each form, as well as from building to building. The cost per square foot (SF) of the facility to be commissioned may vary from $.40/SF to $2.00/SF. However, there are general estimates in place. The following lists the percentages of the commissioning costs for each system.

- 2% to 3% of mechanical cost for Mechanical Systems (HVAC and controls)[2]
- 1% to 2% of electrical cost for Electrical Systems[3]
- 0.5% to 1.5% of construction cost for HVAC, controls, and light electrical

There are many benefits to commissioning for the designer, the building's owner, and its occupants.

- HVAC systems simultaneously operate adequately, resulting in less expense during construction and after occupancy. Satisfied occupants also lead to increased productivity.
- Commissioning reviews decrease errors in the design phase, which ultimately reduces callbacks for the engineer.
- More efficient scheduling and design coordination reduce construction errors for the contractor, and thus reduces cost and keeps the project on schedule.
- Documentation helps prevent assumptions made during design, which reduces unnecessary expenditures.

Selecting a commissioning service provider is a vital step in the process. First, the provider should be a certified commissioning professional by an industry accepted certification body (see sample certification bodies below). Next, the owner makes a formal request of the provider's qualifications in commissioning. An independent, third party commissioning provider is mostly recommended because they can objectively perform the work using practical experience. Other requirements for the provider include documentation, communication, and organization skills. This ensures the commissioning process is performed effectively. In addition, the earlier the commissioning authority can be implemented into the facility's construction or design, the more effective the process will be.

[2] Wilkison, R. (2000) Establishing Commissioning Fees, ASHRAE Journal 42 (4): 41-47
[3] PECI, 2000. The National Conference of Building Commissioning Proceedings, Portland Energy Conservation Inc. OR.

Sample list of Building Commissioning Certifications and Organizations:

AABC Commissioning Group (ACG) - "Certified Commissioning Authority (CxA)"
www.commissioning.org

Building Commissioning Association (BCA) - "Certified Cx Professional (CxP)"
www.bcxa.org

Association of Energy Engineers (AEE) - "Certified Building Cx Professional"
www.aeecenter.org

National Environmental Balancing Bureau (NEBB) - "Systems Cx Administrator"
www.nebb.org

Testing Adjusting and Balancing Bureau - "Certified Commissioning Contractor"
www.tabbcertified.org

For more information on building commissioning, you may contact any of the above. Below is contact info for two of organizations listed above:

Building Commissioning Association
1400 SW 5th Ave, Suite 700
Portland, OR 97201
Phone: (877) 666-2292
Fax: (503) 227-8954
info@bcxa.org

AABC Commissioning Group
1518 K Street KW
Washing, DC 20005
Phone: (202) 737-7775
Fax: (202) 638-4833
info@commissioning.org

For more information on Continuous Commissioning, you may contact:

Energy Systems Laboratory
Texas A&M University
3581 TAMU
214 Wisenbaker Engineering Research Center
Bizzel Street
College Station, Texas 77943
Phone: (979) 845-9213
Fax: (979) 862-8687

Additional Reference:

"Building Commissioning - A Golden Opportunity for Reducing Energy Costs and Greenhouse-Gas Emissions" by Even Mills, Ph.D., Lawrence Berkeley National Laboratory, July 21, 2009, http://cx.lbl.gov/2009-assessment.html

APPENDIX I

REQUEST FOR ENERGY ASSISTANCE

State Energy Conservation Office

Public Schools, Colleges and Non-Profit Hospitals

Preliminary Energy Assessment Service Agreement

Investing in our public schools, colleges and non-profit hospitals through improved energy efficiency in public buildings is a win-win opportunity for our communities and the state. Energy-efficient buildings reduce energy costs, increase available capital, spur economic growth, and improve working and living environments. The Preliminary Energy Assessment Service provides a viable strategy to achieve these goals.

Description of the Service

The State Energy Conservation Office (SECO) will analyze electric, gas and other utility data and work with LAKE TRAVIS ISD, hereinafter referred to as Partner, to identify energy cost-savings potential. To achieve this potential, SECO and Partner have agreed to work together to complete an energy assessment of mutually selected facilities.

SECO agrees to provide this service at no cost to the Partner with the understanding that the Partner is ready and willing to consider implementing the energy savings recommendations.

Principles of the Agreement

Specific responsibilities of the Partner and SECO in this agreement are listed below.

- ✓ Partner will select a contact person to work with SECO and its designated contractor to establish an Energy Policy and set realistic energy efficiency goals.
- ✓ SECO's contractor will go on site to provide walk through assessments of selected facilities. SECO will provide a report which identifies no cost/low cost recommendations, Capital Retrofit Projects, and potential sources of funding. Portions of this report may be posted on the SECO website.
- ✓ Partner will schedule a time for SECO's contractor to make a presentation of the assessment findings key decision makers.

Acceptance of Agreement

This agreement should be signed by your organization's chief executive officer or other upper management staff.

Signature: _____ Date: 3/15/10

Name (Mr./Ms./Dr.) JIM RATCLIFF Title: SR DIRECTOR FACILITIES CONSTRUCTION & SUPPORT SERVICES

Organization: LAKE TRAVIS ISD Phone: 512 533 6026

Street Address: 3322 RR 620 SOUTH Fax: 512 533 6002

Mailing Address: PB 338 AUSTIN TX E-Mail: RATCLIFFJ@LTISDSCHOOLS.ORG

County: TRAVIS

Contact Information:

Name (Mr./Ms./Dr.): JACK STEVENS Title: FACILITY RESOURCES MANAGER

Phone: 512 533 5963 Fax: SAME

E-Mail: STEVENSJ@LTISDSCHOOLS.ORG County: SAME

Please sign and mail or fax to: Juline Ferris, **Schools and Education** Program Administrator, State Energy Conservation Office, 111 E. 17th Street, Austin, Texas 78774. Phone: 512-936-9283. **Fax 512-475-2569.**