Detailed Energy Audit for

City of Newton - Phase 3

May 28, 2010

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SECTION A
FACILITY PROFILE

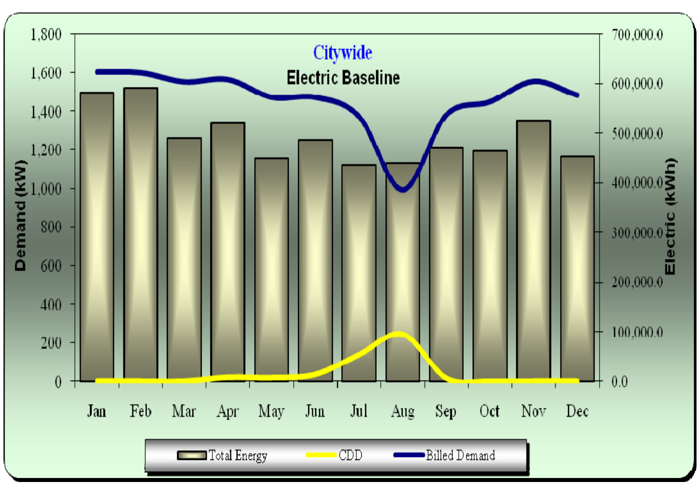
A.1 BASELINE ENERGY USE

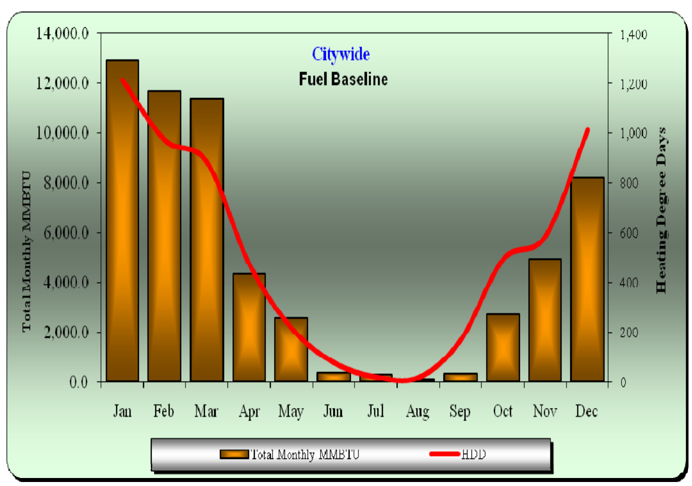
NORESCO obtained three years of electric and fuel utility data for the buildings included in Phase 3. We analyzed energy use for all buildings and compared energy use to heating and cooling degree day data. Baseline energy profiles are based on the twelve month period from January 2009 to December 2009. We use this recent period because the data included most accurately reflects energy savings activities that the City has implemented on their own. Therefore, savings calculations for the energy conservation measures are based on the most accurate baseline energy profiles for each building.

Citywide Facility Baseline

Square Footage: **983,194** ft²

BASELINE:	**Jan-09**	**TO**	**Jan-10**					
Month	HDD	CDD	Billed Demand kW	Total Energy kWh	#2 Fuel Oil Gallons	Natural Gas Therms	Total Monthly MMBTU (Gas & Oil)	Water/ Sewer HCF
Jan	1,212	0	1,600.3	582,090	37,847	76,208	12,900	1,451
Feb	972	0	1,596.5	590,201	49,244	48,201	11,692	1,231
Mar	883	0	1,550.2	490,017	52,827	40,151	11,388	376
Apr	474	20	1,561.9	519,346	10,421	29,077	4,360	1,050
May	217	18	1,470.9	448,996	1,420	23,665	2,565	1,053
Jun	79	35	1,471.1	485,668	0	3,728	373	467
Jul	21	138	1,372.1	436,512	379	2,381	291	1,357
Aug	19	244	993.5	439,905	0	1,287	129	1,040
Sep	170	15	1,380.2	470,849	1,176	1,889	352	427
Oct	493	0	1,447.7	463,823	10,555	12,432	2,715	1,476
Nov	586	0	1,552.8	526,378	13,112	31,017	4,929	1,150
Dec	1,011	0	1,482.3	451,872	26,582	44,757	8,185	406
	6,137	**470**	**17,479.5**	**5,905,657**	**203,562**	**314,792**	**59,878**	**11,484**
				6.01			**60.9**	
				kWh/Sqft			Mbtu/Sqft	
							9.9	
							Btu/Sqft/HDD	



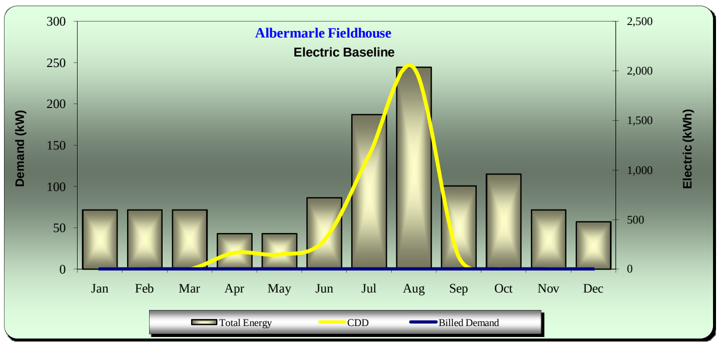


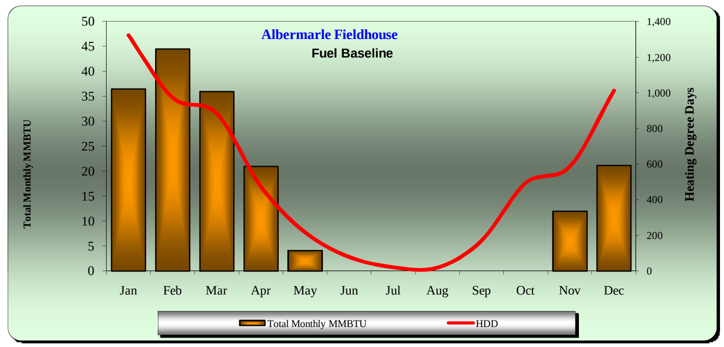
Albermarle Fieldhouse

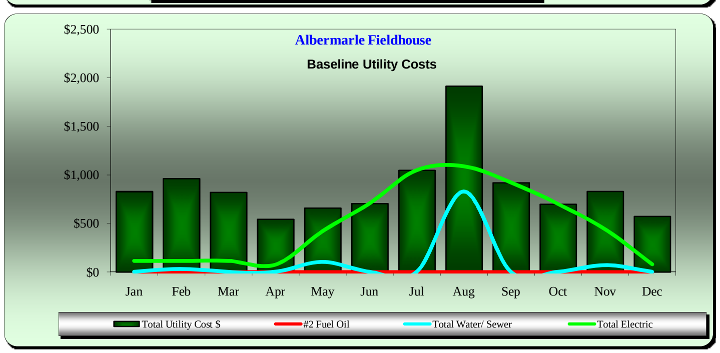
Square Footage: 2,072 ft²

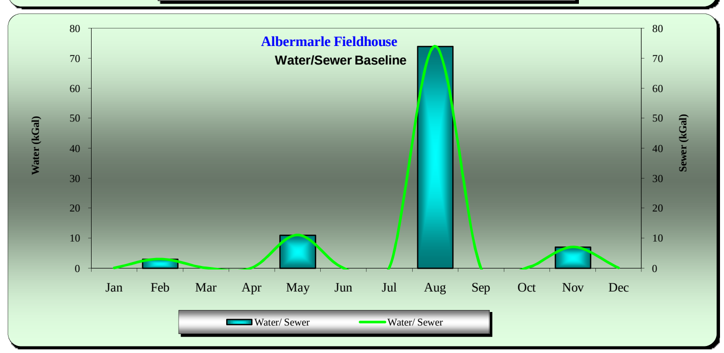
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

BASELINE: Jan-09 TO Dec-09																			
Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	600	$115	$0.1919	0	$0	$0.00	365	$714	$1.96	37	$714	$19.55	0	$0	$0.00	$829
Feb	972	0	0.0	600	$115	$0.1910	0	$0	$0.00	445	$818	$1.84	45	$818	$18.39	3	$30	$9.96	$963
Mar	883	0	0.0	600	$115	$0.1910	0	$0	$0.00	360	$706	$1.96	36	$706	$19.60	0	$0	$0.00	$820
Apr	474	20	0.0	360	$76	$0.2113	0	$0	$0.00	210	$467	$2.22	21	$467	$22.23	0	$0	$0.00	$543
May	217	18	0.0	360	$420	$1.1653	0	$0	$0.00	42	$137	$3.30	4	$137	$32.96	11	$103	$9.32	$659
Jun	79	35	0.0	720	$706	$0.9801	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$706
Jul	21	138	0.0	1,560	$1,047	$0.6714	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,047
Aug	19	244	0.0	2,040	$1,087	$0.5327	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	74	$828	$11.18	$1,914
Sep	170	15	0.0	840	$921	$1.0963	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$921
Oct	493	0	0.0	960	$700	$0.7288	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$700
Nov	586	0	0.0	600	$439	$0.7314	0	$0	$0.00	120	$322	$2.69	12	$322	$26.85	7	$70	$9.96	$831
Dec	1,011	0	0.0	480	$80	$0.1666	0	$0	$0.00	212	$493	$2.33	21	$493	$23.26	0	$0	$0.00	$573
	6,247	470	0.0	9,720	$5,819	$0.5987	0	$0	$0.00	1,754	$3,657	$2.09	175	$3,657	$20.85	95	$1,030	$10.84	$10,505
				4.69									84.6						$5.07
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													13.5						
													Btu/Sqft/HDD						









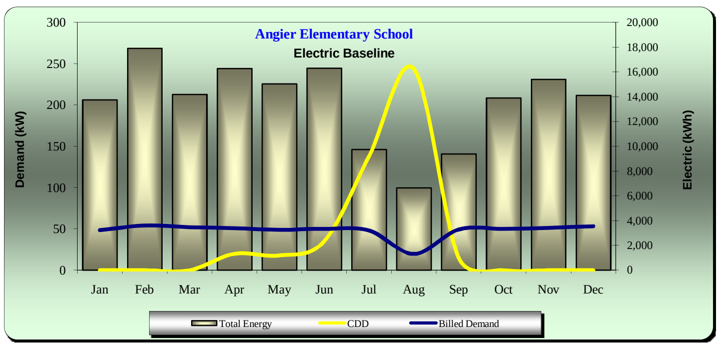
Angier Elementary School

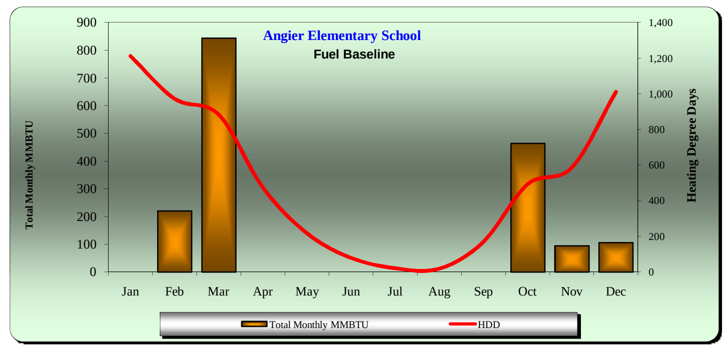
Square Footage: 51,300 ft²

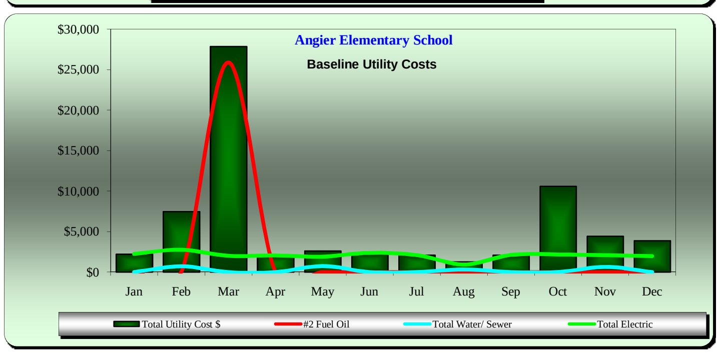
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

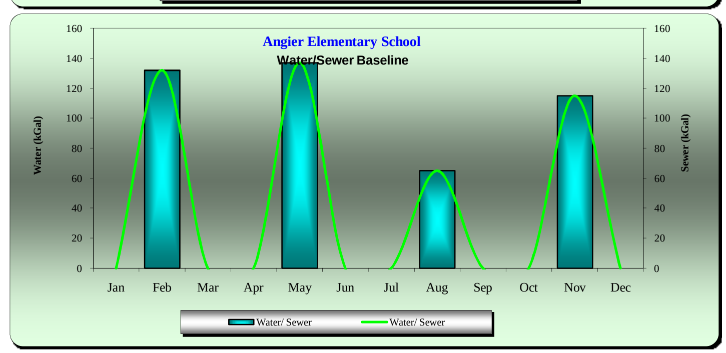
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	48.4	13,760	$2,219	$0.1613	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,219
Feb	972	0	54.0	17,920	$2,735	$0.1526	0	$0	$0.00	2,212	$4,022	$1.82	221	$4,022	$18.18	132	$703	$5.32	$7,460
Mar	883	0	52.0	14,200	$1,995	$0.1405	6,049	$25,899	$4.28	0	$0	$0.00	844	$25,899	$30.67	0	$0	$0.00	$27,894
Apr	474	20	50.8	16,280	$2,038	$0.1252	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,038
May	217	18	48.8	15,040	$1,889	$0.1256	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	137	$733	$5.35	$2,622
Jun	79	35	50.0	16,320	$2,359	$0.1446	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,359
Jul	21	138	48.0	9,760	$2,086	$0.2137	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,086
Aug	19	244	19.6	6,640	$943	$0.1420	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	65	$315	$4.85	$1,258
Sep	170	15	49.2	9,400	$2,096	$0.2229	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,096
Oct	493	0	50.0	13,920	$2,165	$0.1556	0	$0	$0.00	4,638	$8,433	$1.82	464	$8,433	$18.18	0	$0	$0.00	$10,599
Nov	586	0	51.2	15,400	$2,068	$0.1343	0	$0	$0.00	955	$1,736	$1.82	96	$1,736	$18.18	115	$630	$5.48	$4,434
Dec	1,011	0	53.2	14,120	$1,953	$0.1383	0	$0	$0.00	1,067	$1,940	$1.82	107	$1,940	$18.18	0	$0	$0.00	$3,893
	6,137	**470**	**575.2**	**162,760**	**$24,546**	**$0.1508**	**6,049**	**$25,899**	**$4.28**	**8,872**	**$16,132**	**$1.82**	**1,732**	**$42,031**	**$24.27**	**449**	**$2,381**	**$5.30**	**$68,958**
				3.17 kWh/Sqft									**33.8** Mbtu/Sqft						**$1.34** $/Sqft
													5.5 Btu/Sqft/HDD						









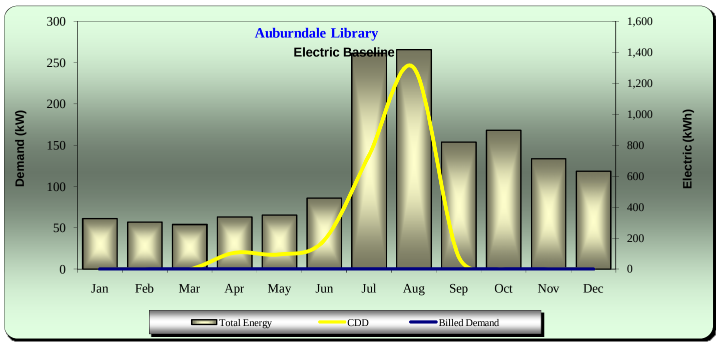
Auburndale Library

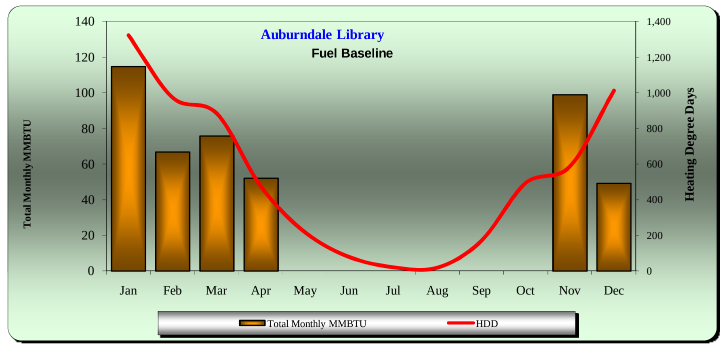
Square Footage: 4,830 ft²

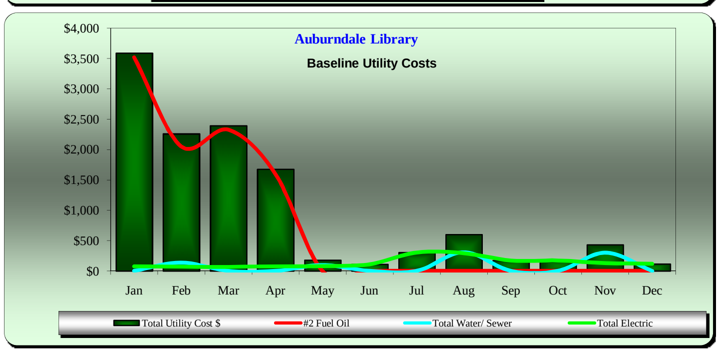
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

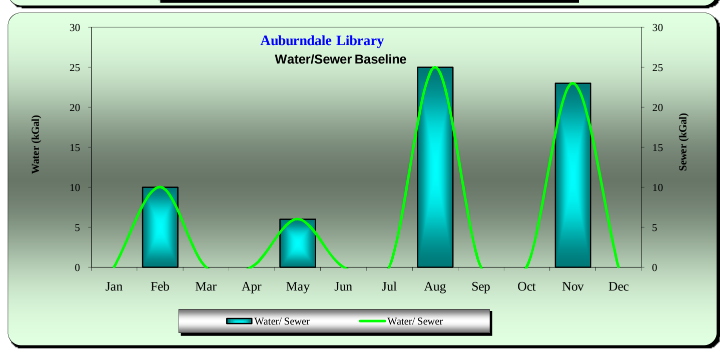
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	328	$75	$0.2274	822	$3,518	$4.28	0	$0	$0.00	115	$3,518	$30.67	0	$0	$0.00	$3,592
Feb	972	0	0.0	305	$71	$0.2313	479	$2,052	$4.28	0	$0	$0.00	67	$2,052	$30.67	10	$137	$13.71	$2,259
Mar	883	0	0.0	289	$67	$0.2327	543	$2,325	$4.28	0	$0	$0.00	76	$2,325	$30.67	0	$0	$0.00	$2,393
Apr	474	20	0.0	338	$77	$0.2287	373	$1,599	$4.28	0	$0	$0.00	52	$1,599	$30.67	0	$0	$0.00	$1,676
May	217	18	0.0	350	$80	$0.2279	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	6	$97	$16.21	$177
Jun	79	35	0.0	460	$110	$0.2397	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$110
Jul	21	138	0.0	1,396	$304	$0.2181	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$304
Aug	19	244	0.0	1,419	$293	$0.2063	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	25	$309	$12.34	$601
Sep	170	15	0.0	822	$173	$0.2105	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$173
Oct	493	0	0.0	897	$173	$0.1930	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$173
Nov	586	0	0.0	713	$131	$0.1840	709	$0	$0.00	0	$0	$0.00	99	$0	$0.00	23	$301	$13.08	$432
Dec	1,011	0	0.0	634	$118	$0.1854	353	$0	$0.00	0	$0	$0.00	49	$0	$0.00	0	$0	$0.00	$118
	6,247	**470**	**0.0**	**7,951**	**$1,672**	**$0.2103**	**3,279**	**$9,494**	**$2.90**	**0**	**$0**	**$0.00**	**458**	**$9,494**	**$20.74**	**64**	**$844**	**$13.18**	**$12,009**
				1.65 kWh/Sqft									**94.8** Mbtu/Sqft						**$2.49** $/Sqft
													15.2 Btu/Sqft/HDD						









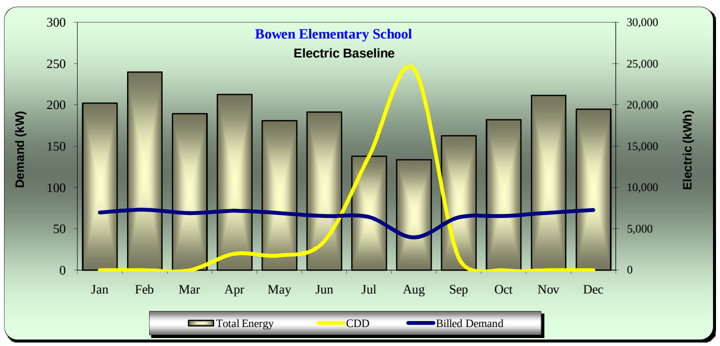
Bowen Elementary School

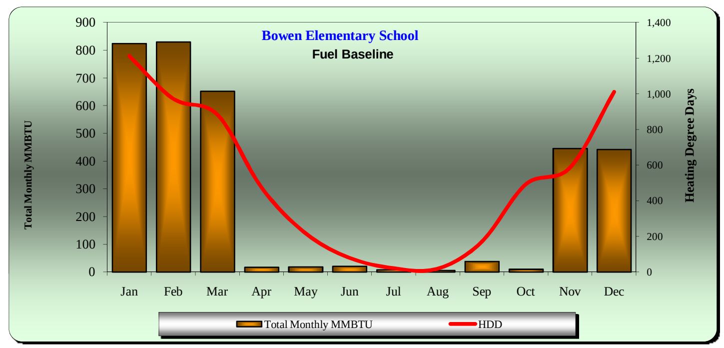
Square Footage: 63,915 ft²

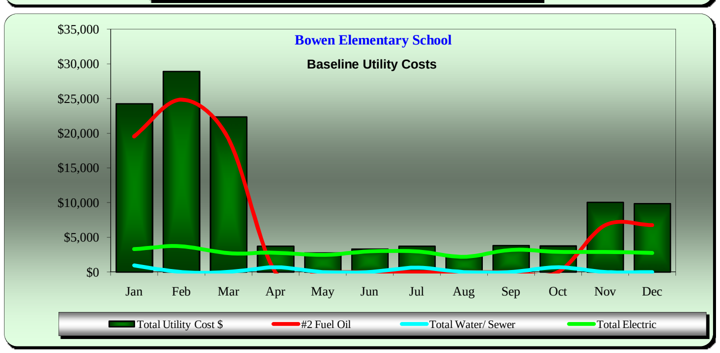
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

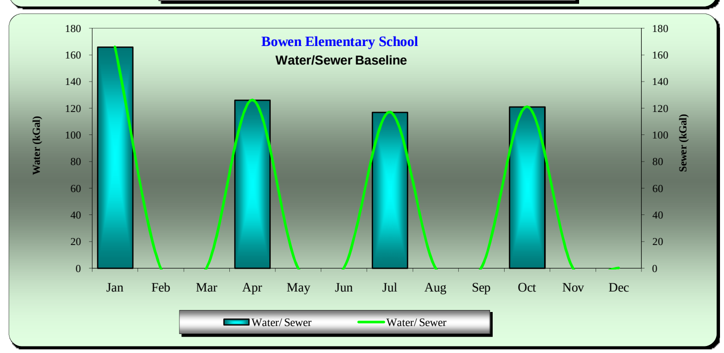
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	70.0	20,240	$3,297	$0.1629	5,727	$19,562	$3.42	253	$450	$1.78	825	$20,012	$24.26	166	$939	$5.66	$24,248
Feb	972	0	73.2	24,000	$3,709	$0.1545	5,807	$24,862	$4.28	194	$342	$1.76	830	$25,204	$30.37	0	$0	$0.00	$28,913
Mar	883	0	69.2	18,960	$2,694	$0.1421	4,500	$19,267	$4.28	242	$429	$1.77	652	$19,696	$30.19	0	$0	$0.00	$22,390
Apr	474	20	72.0	21,280	$2,770	$0.1302	0	$0	$0.00	174	$313	$1.80	17	$313	$17.98	126	$667	$5.29	$3,750
May	217	18	69.2	18,120	$2,437	$0.1345	0	$0	$0.00	185	$327	$1.77	19	$327	$17.70	0	$0	$0.00	$2,764
Jun	79	35	65.6	19,160	$2,946	$0.1538	0	$0	$0.00	208	$366	$1.76	21	$366	$17.61	0	$0	$0.00	$3,312
Jul	21	138	64.4	13,800	$2,947	$0.2136	0	$0	$0.00	87	$173	$1.99	9	$173	$19.88	117	$620	$5.30	$3,740
Aug	19	244	39.6	13,400	$2,160	$0.1612	0	$0	$0.00	59	$122	$2.07	6	$122	$20.73	0	$0	$0.00	$2,282
Sep	170	15	64.0	16,280	$3,162	$0.1942	0	$0	$0.00	389	$650	$1.67	39	$650	$16.72	0	$0	$0.00	$3,813
Oct	493	0	65.6	18,240	$2,896	$0.1588	0	$0	$0.00	102	$196	$1.92	10	$196	$19.23	121	$667	$5.51	$3,759
Nov	586	0	69.6	21,160	$2,868	$0.1356	3,014	$6,756	$2.24	255	$435	$1.71	446	$7,191	$16.11	0	$0	$0.00	$10,059
Dec	1,011	0	72.8	19,520	$2,728	$0.1398	3,018	$6,765	$2.24	211	$386	$1.83	442	$7,151	$16.16	0	$0	$0.00	$9,879
	6,137	470	795.2	224,160	$34,613	$0.1544	22,065	$77,212	$3.50	2,359	$4,190	$1.78	3,316	$81,402	$24.55	530	$2,893	$5.46	$118,908
				3.51 kWh/Sqft									51.9 Mbtu/Sqft						$1.86 $/Sqft
													8.5 Btu/Sqft/HDD						









Burr Elementary School

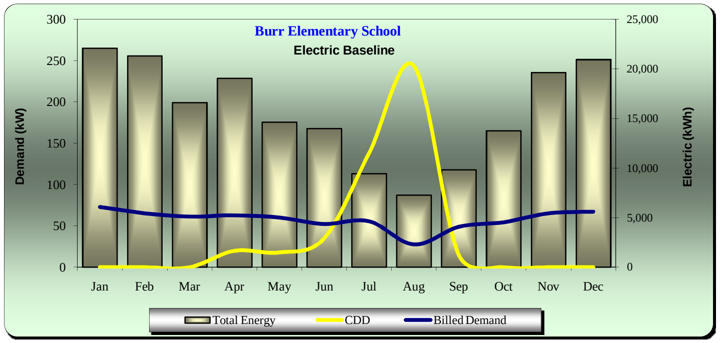
Square Footage: 53,000 ft²

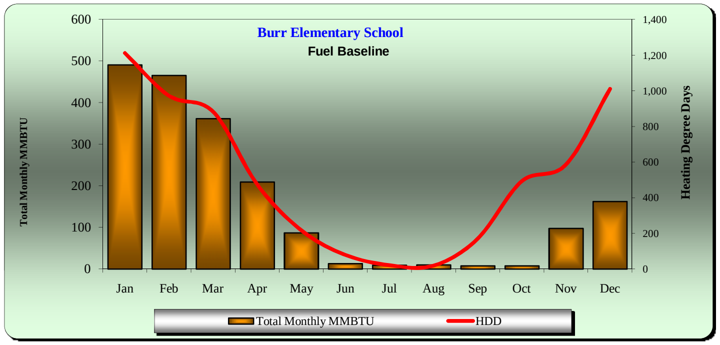
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

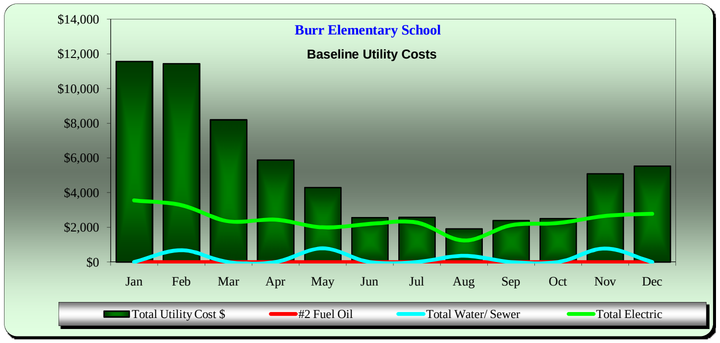
BASELINE: Jan-09 TO Jan-10

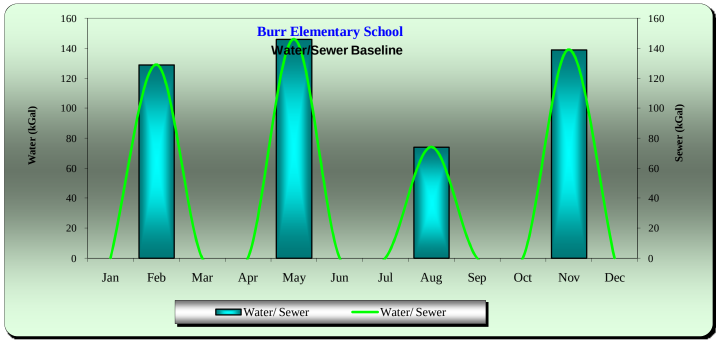
Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal
Jan	1,212	0	72.8	22,120	$3,561	$0.1610	0	$0	$0.00
Feb	972	0	65.2	21,320	$3,286	$0.1541	0	$0	$0.00
Mar	883	0	61.2	16,600	$2,354	$0.1418	0	$0	$0.00
Apr	474	20	62.8	19,080	$2,450	$0.1284	0	$0	$0.00
May	217	18	60.0	14,640	$2,005	$0.1369	0	$0	$0.00
Jun	79	35	52.4	14,000	$2,202	$0.1573	0	$0	$0.00
Jul	21	138	55.6	9,440	$2,288	$0.2423	0	$0	$0.00
Aug	19	244	27.6	7,280	$1,245	$0.1711	0	$0	$0.00
Sep	170	15	48.8	9,840	$2,123	$0.2157	0	$0	$0.00
Oct	493	0	54.4	13,760	$2,252	$0.1636	0	$0	$0.00
Nov	586	0	65.2	19,640	$2,663	$0.1356	0	$0	$0.00
Dec	1,011	0	67.2	20,960	$2,789	$0.1331	0	$0	$0.00
	6,137	**470**	**693.2**	**188,680**	**$29,217**	**$0.1548**	**0**	**$0**	**$0.00**
				3.56					
				kWh/Sqft					

Month	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	4,913	$8,018	$1.63	491	$8,018	$16.32	0	$0	$0.00	$11,580
Feb	4,655	$7,472	$1.61	466	$7,472	$16.05	129	$685	$5.31	$11,443
Mar	3,621	$5,849	$1.62	362	$5,849	$16.15	0	$0	$0.00	$8,203
Apr	2,097	$3,436	$1.64	210	$3,436	$16.38	0	$0	$0.00	$5,885
May	871	$1,509	$1.73	87	$1,509	$17.33	146	$786	$5.39	$4,301
Jun	131	$361	$2.76	13	$361	$27.57	0	$0	$0.00	$2,563
Jul	95	$296	$3.12	10	$296	$31.15	0	$0	$0.00	$2,584
Aug	103	$308	$2.99	10	$308	$29.93	74	$366	$4.94	$1,919
Sep	82	$271	$3.31	8	$271	$33.05	0	$0	$0.00	$2,394
Oct	77	$258	$3.36	8	$258	$33.57	0	$0	$0.00	$2,510
Nov	976	$1,653	$1.69	98	$1,653	$16.93	139	$780	$5.61	$5,096
Dec	1,623	$2,756	$1.70	162	$2,756	$16.98	0	$0	$0.00	$5,544
	19,244	**$32,187**	**$1.67**	**1,924**	**$32,187**	**$16.73**	**488**	**$2,617**	**$5.36**	**$64,021**
				36.3						**$1.21**
				Mbtu/Sqft						$/Sqft
				5.9						
				Btu/Sqft/HDD						









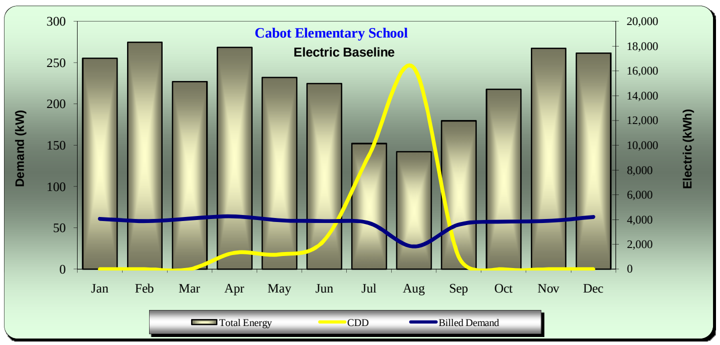
Cabot Elementary School

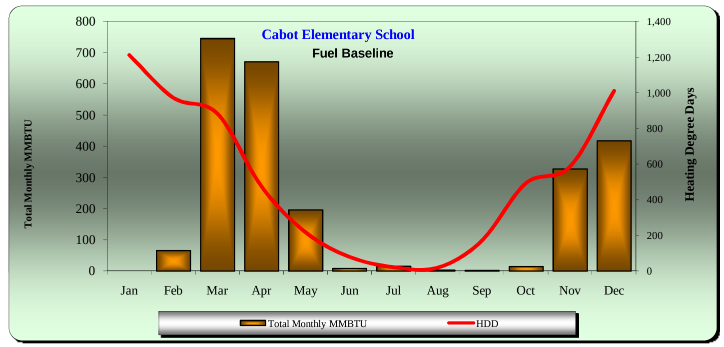
Square Footage: 35,000 ft²

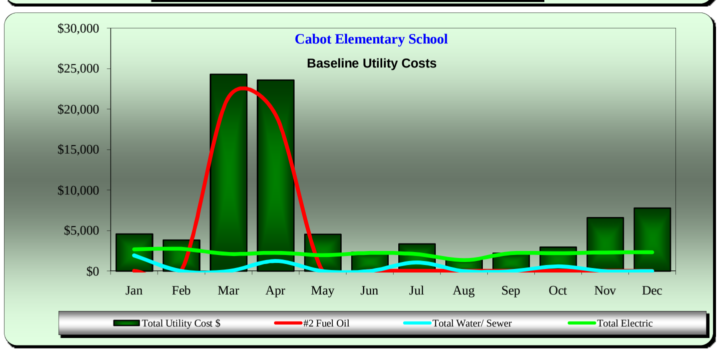
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

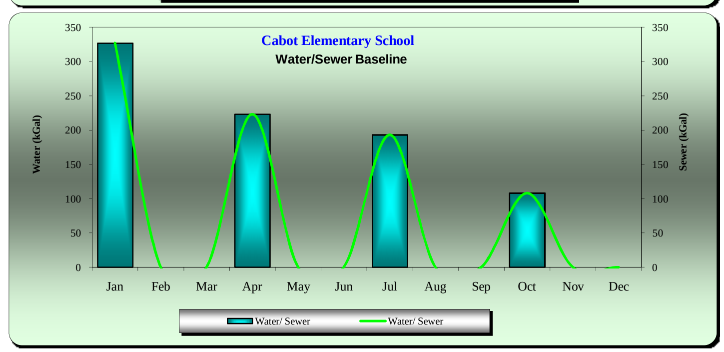
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	60.8	17,030	$2,664	$0.1565	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	327	$1,933	$5.91	$4,598
Feb	972	0	58.0	18,340	$2,725	$0.1486	0	$0	$0.00	658	$1,095	$1.66	66	$1,095	$16.63	0	$0	$0.00	$3,819
Mar	883	0	61.1	15,143	$2,095	$0.1383	5,002	$21,416	$4.28	473	$798	$1.69	746	$22,214	$29.80	0	$0	$0.00	$24,309
Apr	474	20	63.8	17,911	$2,244	$0.1253	4,519	$19,346	$4.28	403	$774	$1.92	671	$20,120	$29.98	223	$1,247	$5.59	$23,612
May	217	18	59.0	15,496	$1,952	$0.1260	0	$0	$0.00	1,965	$2,590	$1.32	197	$2,590	$13.18	0	$0	$0.00	$4,543
Jun	79	35	57.9	14,998	$2,218	$0.1479	0	$0	$0.00	88	$116	$1.32	9	$116	$13.18	0	$0	$0.00	$2,334
Jul	21	138	55.7	10,152	$2,072	$0.2041	0	$0	$0.00	155	$204	$1.32	16	$204	$13.18	193	$1,077	$5.58	$3,353
Aug	19	244	27.3	9,493	$1,331	$0.1402	0	$0	$0.00	36	$47	$1.32	4	$47	$13.18	0	$0	$0.00	$1,378
Sep	170	15	53.7	11,986	$2,179	$0.1818	0	$0	$0.00	25	$33	$1.32	3	$33	$13.18	0	$0	$0.00	$2,212
Oct	493	0	57.3	14,531	$2,179	$0.1500	0	$0	$0.00	150	$198	$1.32	15	$198	$13.18	108	$586	$5.42	$2,963
Nov	586	0	58.2	17,846	$2,282	$0.1279	0	$0	$0.00	3,280	$4,324	$1.32	328	$4,324	$13.18	0	$0	$0.00	$6,606
Dec	1,011	0	63.1	17,462	$2,288	$0.1310	0	$0	$0.00	4,180	$5,510	$1.32	418	$5,510	$13.18	0	$0	$0.00	$7,798
	6,137	470	675.9	180,388	$26,230	$0.1454	9,520	$40,762	$4.28	11,413	$15,690	$1.37	2,470	$56,452	$22.85	851	$4,843	$5.69	$87,524
				5.15 kWh/Sqft									70.6 Mbtu/Sqft						$2.50 $/Sqft
													11.5 Btu/Sqft/HDD						









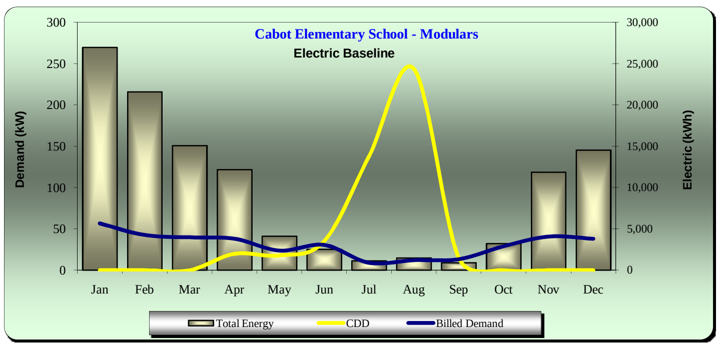
Cabot Elementary School - Modulars

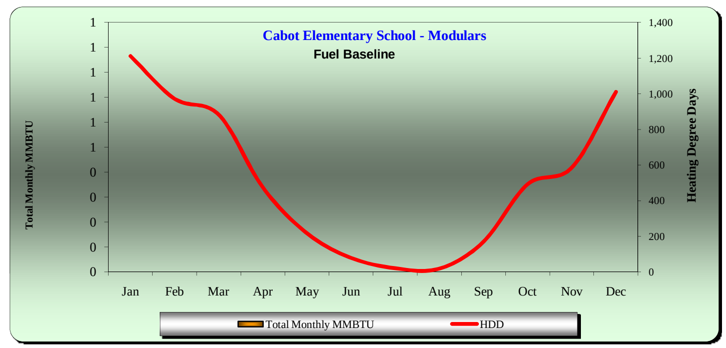
Square Footage: 6,000 ft²

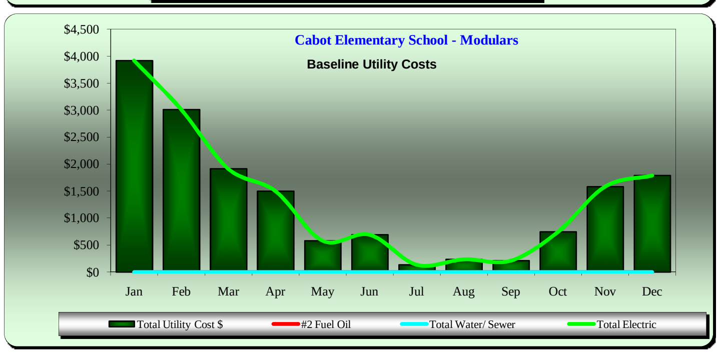
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

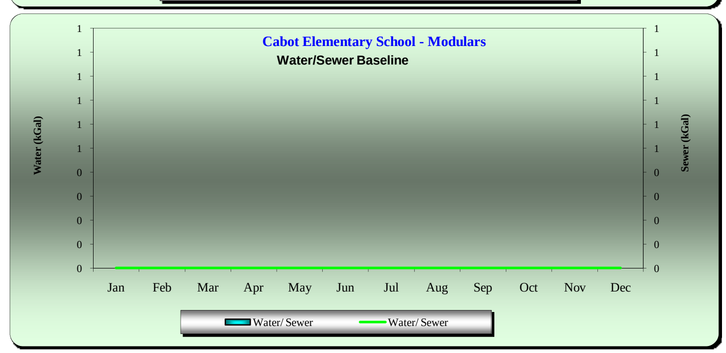
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	56.4	27,000	$3,919	$0.1451	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$3,919
Feb	972	0	42.4	21,600	$3,011	$0.1394	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$3,011
Mar	883	0	39.6	15,080	$1,913	$0.1269	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,913
Apr	474	20	38.0	12,200	$1,501	$0.1231	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,501
May	217	18	23.6	4,120	$580	$0.1408	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$580
Jun	79	35	30.4	2,520	$694	$0.2753	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$694
Jul	21	138	8.8	1,120	$136	$0.1211	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$136
Aug	19	244	12.0	1,480	$235	$0.1587	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$235
Sep	170	15	13.2	920	$212	$0.2303	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$212
Oct	493	0	28.8	3,240	$747	$0.2304	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$747
Nov	586	0	40.4	11,880	$1,584	$0.1334	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,584
Dec	1,011	0	38.0	14,560	$1,790	$0.1229	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,790
	6,137	470	371.6	115,720	$16,322	$0.1410	0	$0	$0.00	0	$0	$0.00	-	$0	#DIV/0!	0	$0	$0.00	$16,322
				19.29									0.0						$2.72
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													0.0						
													Btu/Sqft/HDD						









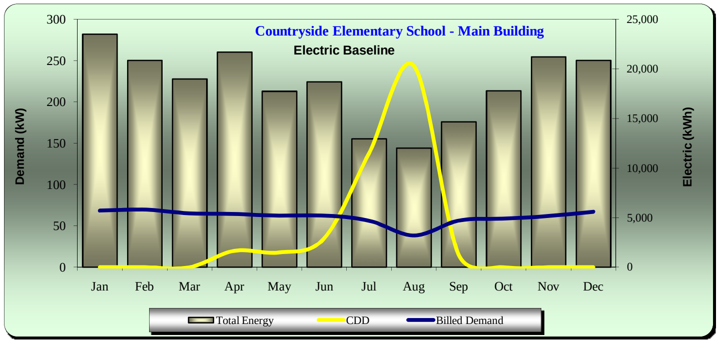
Countryside Elementary School - Main Building

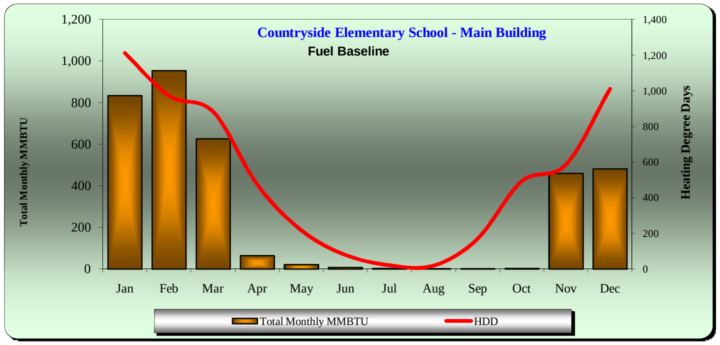
Square Footage: 56,700 ft²

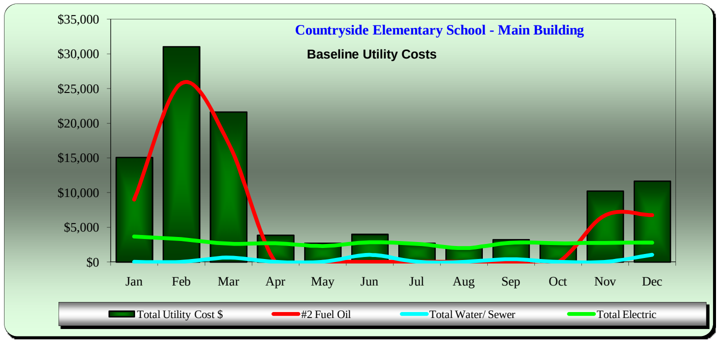
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

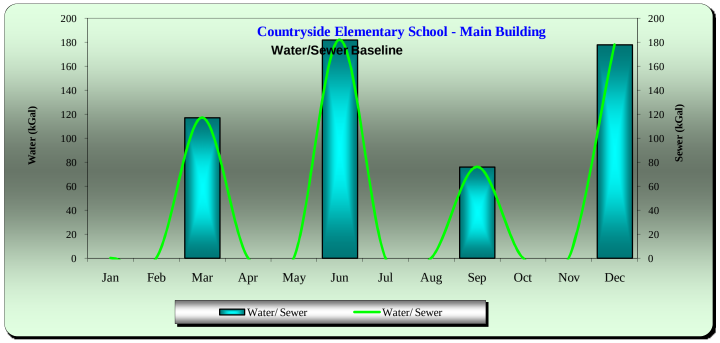
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	68.4	23,520	$3,668	$0.1560	5,002	$8,971	$1.79	1,363	$2,429	$1.78	835	$11,400	$13.66	0	$0	$0.00	$15,068
Feb	972	0	69.6	20,880	$3,294	$0.1577	6,009	$25,728	$4.28	1,154	$2,025	$1.75	954	$27,752	$29.08	0	$0	$0.00	$31,046
Mar	883	0	65.2	19,000	$2,643	$0.1391	4,017	$17,197	$4.28	660	$1,168	$1.77	627	$18,366	$29.30	117	$613	$5.24	$21,622
Apr	474	20	64.4	21,720	$2,707	$0.1246	0	$0	$0.00	649	$1,152	$1.78	65	$1,152	$17.75	0	$0	$0.00	$3,859
May	217	18	62.4	17,760	$2,313	$0.1303	0	$0	$0.00	222	$405	$1.82	22	$405	$18.23	0	$0	$0.00	$2,718
Jun	79	35	62.4	18,720	$2,839	$0.1516	0	$0	$0.00	75	$150	$2.00	8	$150	$19.96	182	$1,002	$5.50	$3,990
Jul	21	138	56.4	12,960	$2,627	$0.2027	0	$0	$0.00	30	$82	$2.72	3	$82	$27.24	0	$0	$0.00	$2,709
Aug	19	244	38.4	12,040	$2,002	$0.1662	0	$0	$0.00	19	$61	$3.22	2	$61	$32.16	0	$0	$0.00	$2,063
Sep	170	15	56.4	14,680	$2,787	$0.1898	0	$0	$0.00	16	$51	$3.22	2	$51	$32.18	76	$384	$5.05	$3,222
Oct	493	0	58.8	17,800	$2,703	$0.1518	0	$0	$0.00	40	$92	$2.30	4	$92	$23.04	0	$0	$0.00	$2,795
Nov	586	0	62.0	21,240	$2,773	$0.1306	2,997	$6,717	$2.24	423	$735	$1.74	461	$7,452	$16.18	0	$0	$0.00	$10,225
Dec	1,011	0	67.2	20,880	$2,781	$0.1332	3,010	$6,748	$2.24	625	$1,127	$1.80	483	$7,875	$16.31	178	$1,024	$5.75	$11,680
	6,137	**470**	**731.6**	**221,200**	**$33,137**	**$0.1498**	**21,034**	**$65,361**	**$3.11**	**5,276**	**$9,477**	**$1.80**	**3,464**	**$74,837**	**$21.60**	**553**	**$3,023**	**$5.47**	**$110,997**
				3.90									**61.1**						**$1.96**
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													10.0						
													Btu/Sqft/HDD						









Countryside Elementary School - Modular 1

Square Footage: 2,000 ft²

Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	42.4	16,320	$2,443	$0.1497	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,443
Feb	972	0	43.6	16,480	$2,425	$0.1472	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,425
Mar	883	0	44.0	12,280	$1,698	$0.1383	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,698
Apr	474	20	40.4	8,440	$1,198	$0.1419	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,198
May	217	18	37.2	2,800	$641	$0.2288	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$641
Jun	79	35	37.2	2,480	$832	$0.3356	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$832
Jul	21	138	15.6	1,440	$339	$0.2351	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$339
Aug	19	244	32.0	4,000	$1,079	$0.2698	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,079
Sep	170	15	30.0	4,680	$1,080	$0.2309	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,080
Oct	493	0	32.0	2,440	$746	$0.3056	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$746
Nov	586	0	39.6	8,320	$1,232	$0.1481	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,232
Dec	1,011	0	38.8	9,480	$1,320	$0.1392	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,320
	6,137	**470**	**432.8**	**89,160**	**$15,033**	**$0.1686**	**0**	**$0**	**$0.00**	**0**	**$0**	**$0.00**	**-**	**$0**	**#DIV/0!**	**0**	**$0**	**$0.00**	**$15,033**
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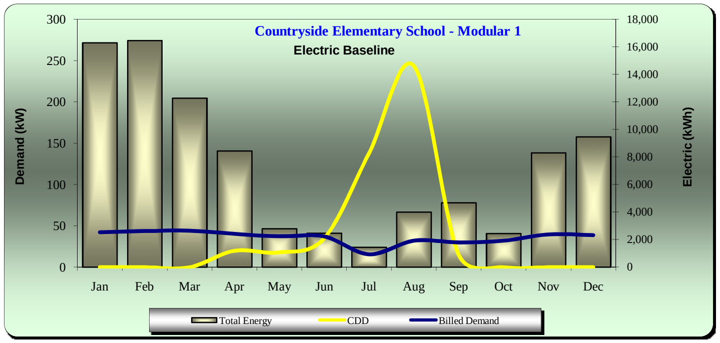
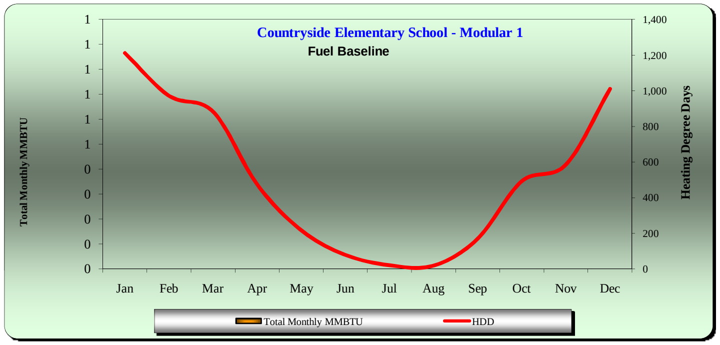
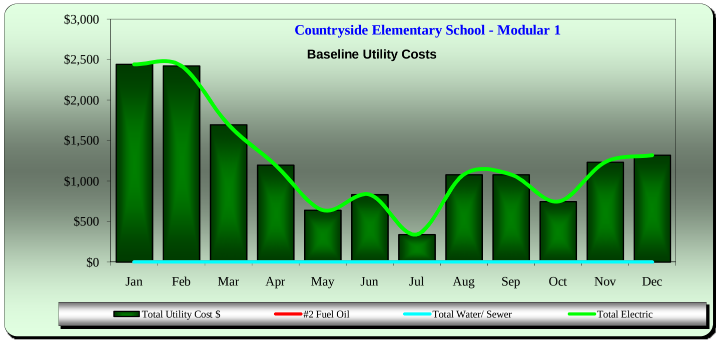
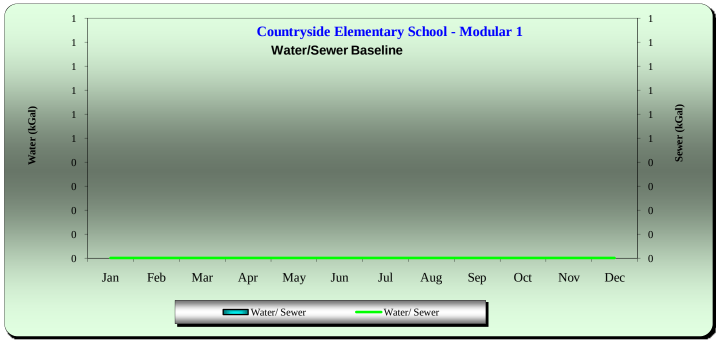
													0.0 Btu/Sqft/HDD						









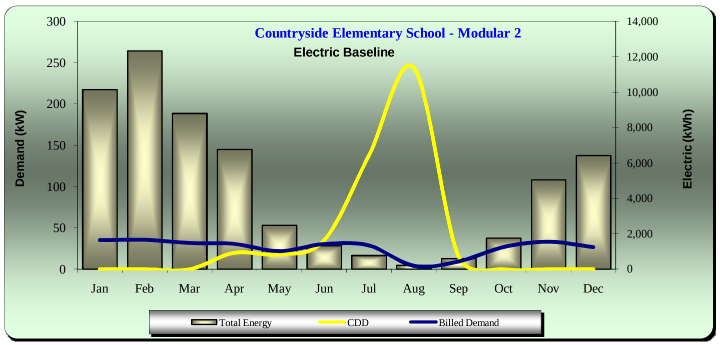
Countryside Elementary School - Modular 2

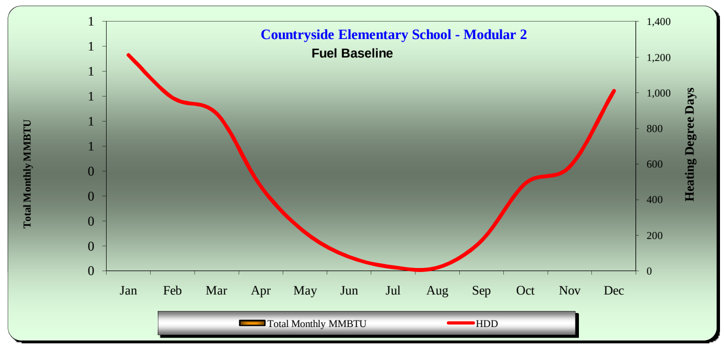
Square Footage: 2,000 ft²

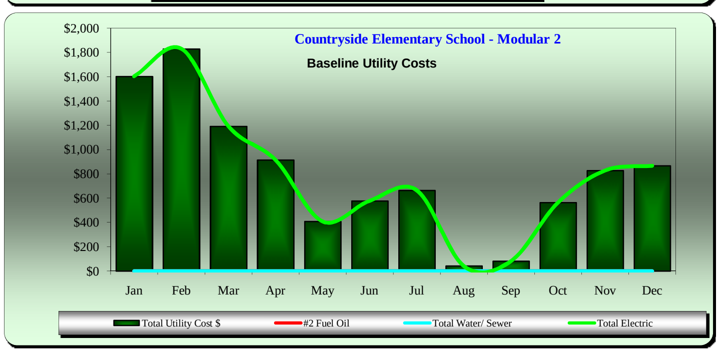
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

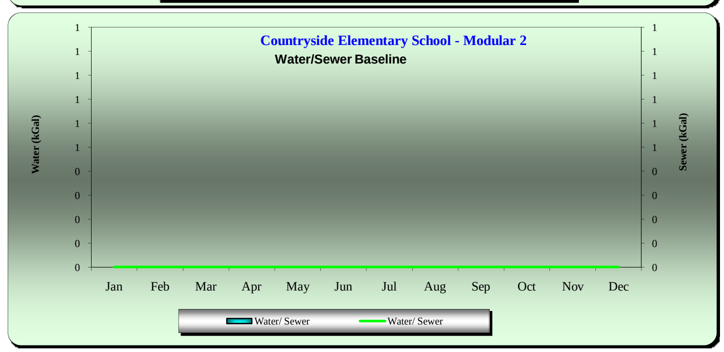
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	35.2	10,152	$1,603	$0.1579	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,603
Feb	972	0	35.5	12,348	$1,831	$0.1482	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,831
Mar	883	0	31.8	8,806	$1,193	$0.1354	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,193
Apr	474	20	30.5	6,767	$915	$0.1352	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$915
May	217	18	21.8	2,478	$408	$0.1647	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$408
Jun	79	35	30.4	1,328	$578	$0.4354	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$578
Jul	21	138	28.7	774	$665	$0.8590	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$665
Aug	19	244	3.8	218	$41	$0.1890	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$41
Sep	170	15	9.2	599	$81	$0.1357	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$81
Oct	493	0	26.7	1,754	$564	$0.3215	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$564
Nov	586	0	33.2	5,047	$828	$0.1641	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$828
Dec	1,011	0	26.6	6,435	$867	$0.1348	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$867
	6,137	470	313.4	56,706	$9,575	$0.1688	0	$0	$0.00	0	$0	$0.00	-	$0	#DIV/0!	0	$0	$0.00	$9,575
				28.35 kWh/Sqft									0.0 Mbtu/Sqft						$4.79 $/Sqft
													0.0 Btu/Sqft/HDD						









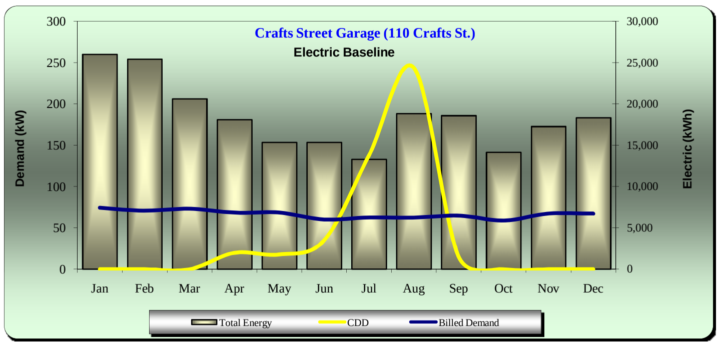
Crafts Street Garage (110 Crafts St.)

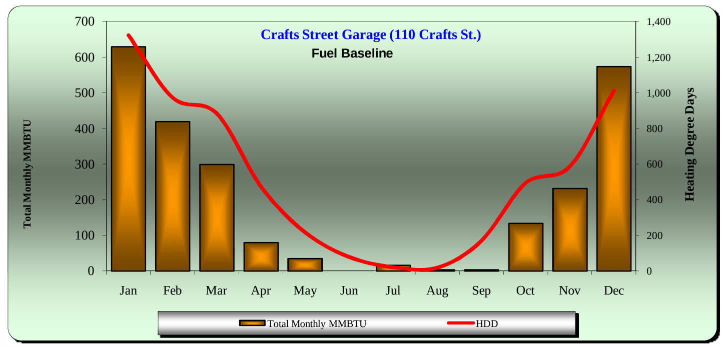
Square Footage: 23,474 ft²

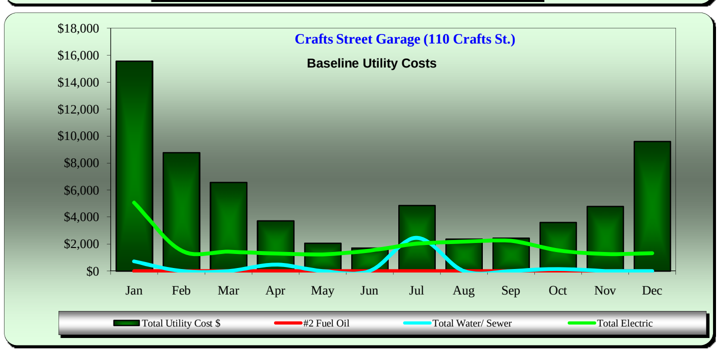
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

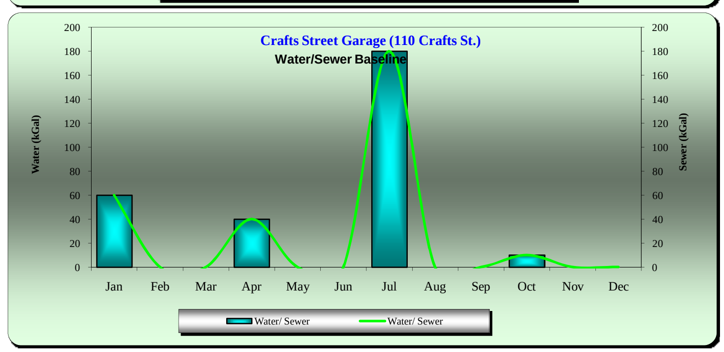
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	74.4	26,040	$5,064	$0.1945	0	$0	$0.00	6,295	$9,785	$1.55	629	$9,785	$15.54	60	$715	$11.91	$15,563
Feb	972	0	70.8	25,440	$1,514	$0.0595	0	$0	$0.00	4,192	$7,256	$1.73	419	$7,256	$17.31	0	$0	$0.00	$8,770
Mar	883	0	73.2	20,640	$1,422	$0.0689	0	$0	$0.00	2,994	$5,151	$1.72	299	$5,151	$17.20	0	$0	$0.00	$6,573
Apr	474	20	68.4	18,120	$1,292	$0.0713	0	$0	$0.00	800	$1,955	$2.44	80	$1,955	$24.44	40	$476	$11.89	$3,723
May	217	18	68.4	15,360	$1,221	$0.0795	0	$0	$0.00	349	$835	$2.39	35	$835	$23.91	0	$0	$0.00	$2,056
Jun	79	35	60.0	15,360	$1,509	$0.0982	0	$0	$0.00	0	$209	$0.00	0	$209	$0.00	0	$0	$0.00	$1,717
Jul	21	138	62.4	13,320	$2,016	$0.1514	0	$0	$0.00	167	$402	$2.41	17	$402	$24.06	180	$2,449	$13.61	$4,867
Aug	19	244	62.4	18,840	$2,162	$0.1147	0	$0	$0.00	42	$213	$5.14	4	$213	$51.37	0	$0	$0.00	$2,375
Sep	170	15	64.8	18,600	$2,229	$0.1198	0	$0	$0.00	41	$207	$5.10	4	$207	$50.97	0	$0	$0.00	$2,436
Oct	493	0	58.8	14,160	$1,523	$0.1075	0	$0	$0.00	1,339	$1,925	$1.44	134	$1,925	$14.38	10	$149	$14.91	$3,597
Nov	586	0	67.2	17,280	$1,254	$0.0726	0	$0	$0.00	2,316	$3,534	$1.53	232	$3,534	$15.26	0	$0	$0.00	$4,788
Dec	1,011	0	67.2	18,360	$1,307	$0.0712	0	$0	$0.00	5,739	$8,302	$1.45	574	$8,302	$14.47	0	$0	$0.00	$9,609
	6,247	470	798.0	221,520	$22,512	$0.1016	0	$0	$0.00	24,273	$39,775	$1.64	2,427	$39,775	$16.39	290	$3,789	$13.06	$66,075
				9.44 kWh/Sqft									103.4 Mbtu/Sqft						$2.81 $/Sqft
													16.6 Btu/Sqft/HDD						









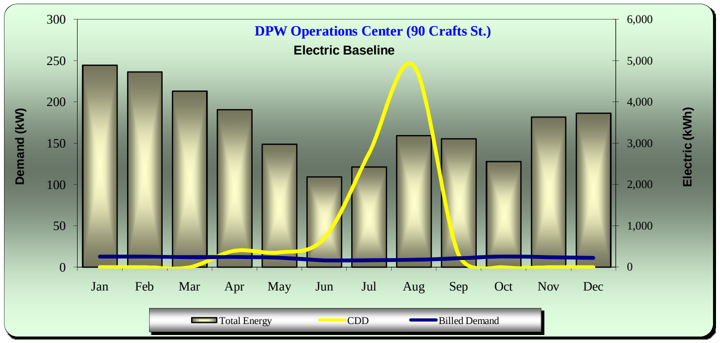
DPW Operations Center (90 Crafts St.)

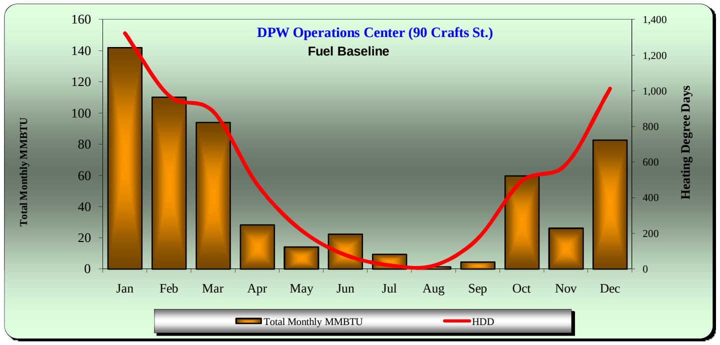
Square Footage: 19,553 ft²

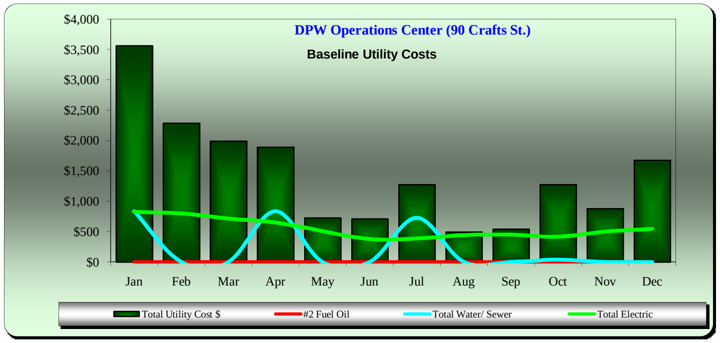
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

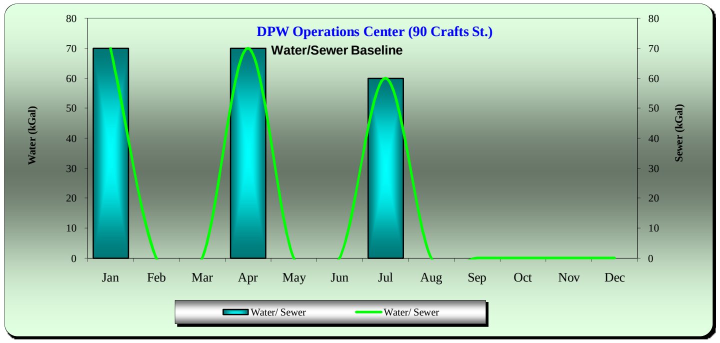
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	12.6	4,898	$825	$0.1684	0	$0	$0.00	1,420	$1,906	$1.34	142	$1,906	$13.42	70	$834	$11.92	$3,565
Feb	972	0	12.8	4,730	$800	$0.1692	0	$0	$0.00	1,103	$1,488	$1.35	110	$1,488	$13.49	0	$0	$0.00	$2,288
Mar	883	0	11.9	4,266	$717	$0.1680	0	$0	$0.00	940	$1,274	$1.36	94	$1,274	$13.56	0	$0	$0.00	$1,991
Apr	474	20	12.1	3,817	$650	$0.1703	0	$0	$0.00	284	$410	$1.44	28	$410	$14.45	70	$834	$11.92	$1,894
May	217	18	11.3	2,983	$510	$0.1709	0	$0	$0.00	142	$219	$1.54	14	$219	$15.43	0	$0	$0.00	$729
Jun	79	35	8.2	2,189	$378	$0.1728	0	$0	$0.00	224	$333	$1.49	22	$333	$14.87	0	$0	$0.00	$711
Jul	21	138	8.4	2,429	$391	$0.1608	0	$0	$0.00	95	$159	$1.67	10	$159	$16.72	60	$725	$12.09	$1,275
Aug	19	244	9.0	3,189	$444	$0.1394	0	$0	$0.00	14	$51	$3.59	1	$51	$35.94	0	$0	$0.00	$496
Sep	170	15	10.6	3,109	$453	$0.1456	0	$0	$0.00	46	$91	$2.00	5	$91	$20.00	0	$0	$0.00	$544
Oct	493	0	12.8	2,560	$418	$0.1634	0	$0	$0.00	597	$819	$1.37	60	$819	$13.71	0	$38	$0.00	$1,275
Nov	586	0	11.8	3,641	$502	$0.1379	0	$0	$0.00	262	$378	$1.44	26	$378	$14.41	0	$0	$0.00	$880
Dec	1,011	0	11.2	3,732	$549	$0.1472	0	$0	$0.00	828	$1,129	$1.36	83	$1,129	$13.63	0	$0	$0.00	$1,679
	6,247	**470**	**132.7**	**41,543**	**$6,638**	**$0.1598**	**0**	**$0**	**$0.00**	**5,954**	**$8,257**	**$1.39**	**595**	**$8,257**	**$13.87**	**200**	**$2,431**	**$12.16**	**$17,326**
				2.12 kWh/Sqft									**30.5** Mbtu/Sqft						**$0.89** $/Sqft
													4.9 Btu/Sqft/HDD						









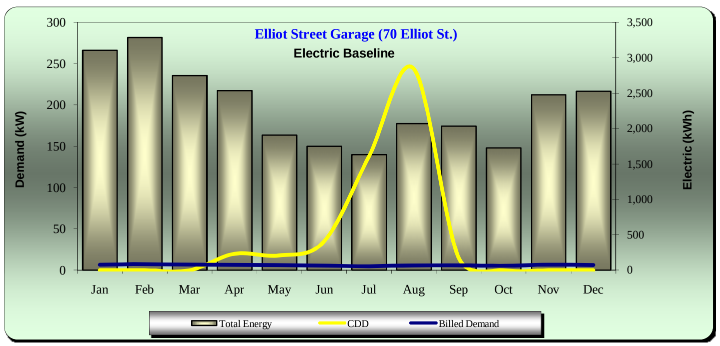
Elliot Street Garage (70 Elliot St.)

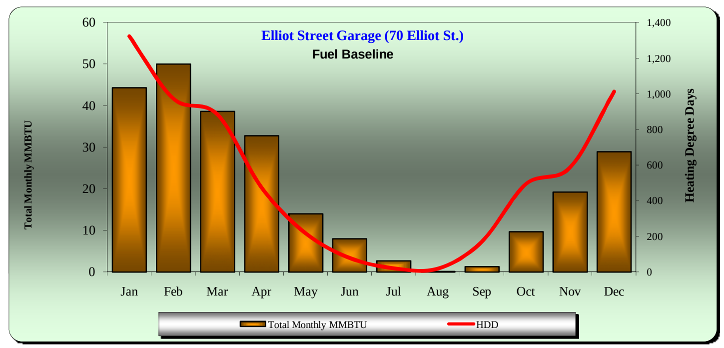
Square Footage: 9,000 ft²

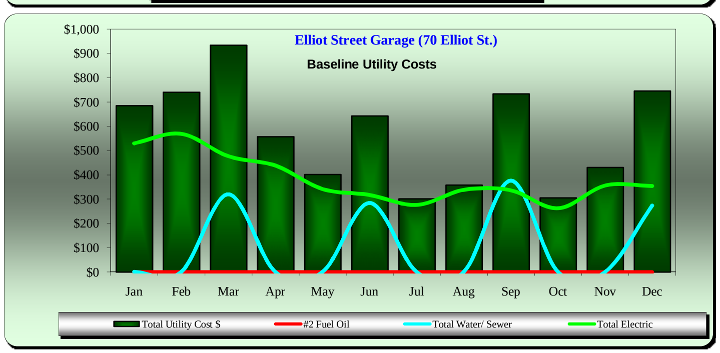
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

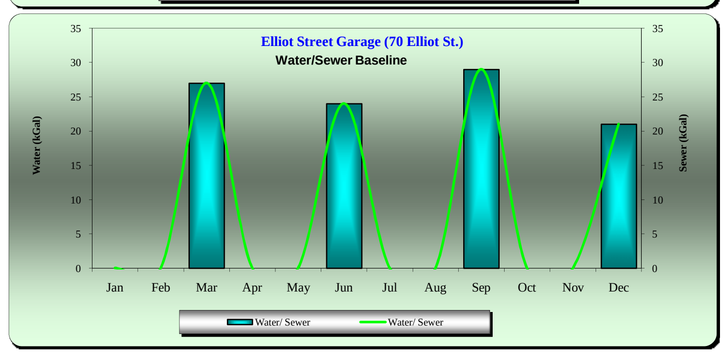
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	6.5	3,108	$530	$0.1704	0	$0	$0.00	444	$155	$0.35	44	$155	$3.50	0	$0	$0.00	$685
Feb	972	0	7.4	3,289	$569	$0.1731	0	$0	$0.00	500	$172	$0.34	50	$172	$3.44	0	$0	$0.00	$741
Mar	883	0	6.7	2,751	$477	$0.1733	0	$0	$0.00	387	$137	$0.35	39	$137	$3.55	27	$320	$11.86	$934
Apr	474	20	6.2	2,541	$438	$0.1724	0	$0	$0.00	328	$120	$0.37	33	$120	$3.67	0	$0	$0.00	$558
May	217	18	6.2	1,910	$342	$0.1788	0	$0	$0.00	140	$60	$0.43	14	$60	$4.30	0	$0	$0.00	$402
Jun	79	35	5.1	1,752	$317	$0.1807	0	$0	$0.00	80	$42	$0.53	8	$42	$5.27	24	$285	$11.85	$643
Jul	21	138	4.5	1,635	$276	$0.1687	0	$0	$0.00	28	$27	$0.97	3	$27	$9.68	0	$0	$0.00	$302
Aug	19	244	5.7	2,072	$338	$0.1631	0	$0	$0.00	1	$21	$14.36	0	$21	$143.55	0	$0	$0.00	$359
Sep	170	15	5.8	2,037	$336	$0.1649	0	$0	$0.00	13	$22	$1.69	1	$22	$16.94	29	$377	$12.99	$735
Oct	493	0	5.1	1,728	$262	$0.1516	0	$0	$0.00	97	$44	$0.46	10	$44	$4.56	0	$0	$0.00	$306
Nov	586	0	6.7	2,480	$356	$0.1434	0	$0	$0.00	193	$75	$0.39	19	$75	$3.91	0	$0	$0.00	$431
Dec	1,011	0	6.3	2,530	$354	$0.1400	0	$0	$0.00	289	$117	$0.41	29	$117	$4.06	21	$274	$13.05	$746
	6,247	**470**	**72.2**	**27,834**	**$4,593**	**$0.1650**	**0**	**$0**	**$0.00**	**2,499**	**$994**	**$0.40**	**250**	**$994**	**$3.98**	**101**	**$1,256**	**$12.43**	**$6,843**
				3.09									**27.8**						**$0.76**
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													4.4						
													Btu/Sqft/HDD						









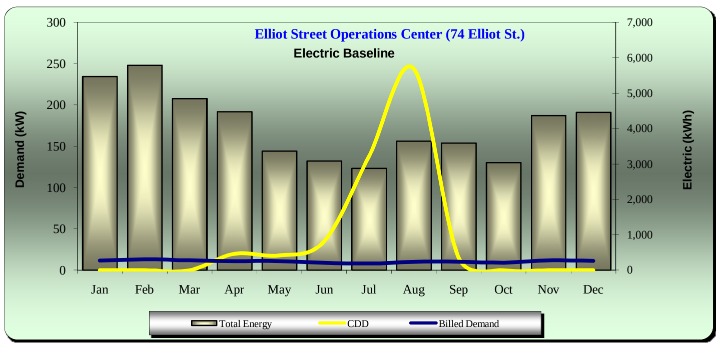
Elliot Street Operations Center (74 Elliot St.)

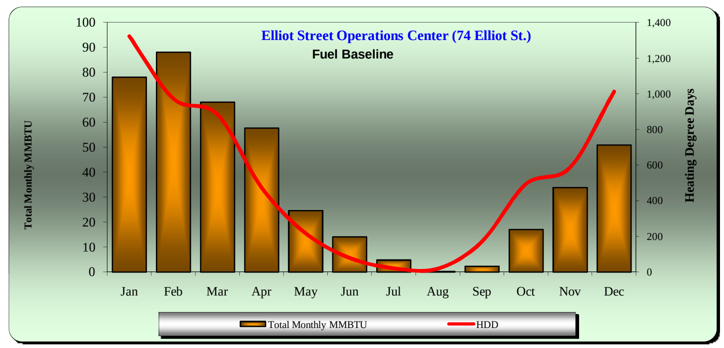
Square Footage: 15,858 ft²

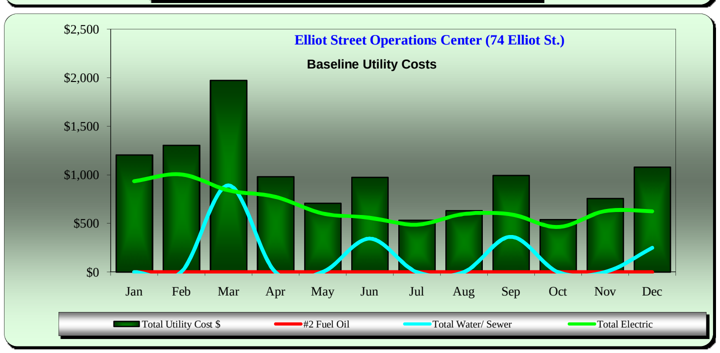
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

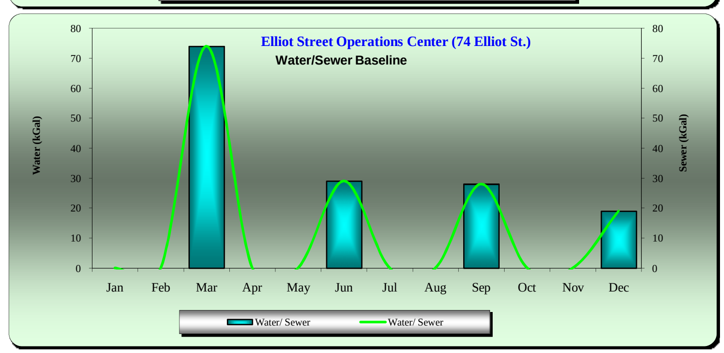
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	11.5	5,477	$933	$0.1704	0	$0	$0.00	781	$274	$0.35	78	$274	$3.50	0	$0	$0.00	$1,207
Feb	972	0	13.0	5,796	$1,003	$0.1731	0	$0	$0.00	881	$303	$0.34	88	$303	$3.44	0	$0	$0.00	$1,306
Mar	883	0	11.7	4,847	$840	$0.1733	0	$0	$0.00	681	$242	$0.35	68	$242	$3.55	74	$892	$12.05	$1,973
Apr	474	20	10.9	4,476	$772	$0.1724	0	$0	$0.00	577	$212	$0.37	58	$212	$3.67	0	$0	$0.00	$984
May	217	18	11.0	3,365	$602	$0.1788	0	$0	$0.00	247	$106	$0.43	25	$106	$4.30	0	$0	$0.00	$708
Jun	79	35	8.9	3,088	$558	$0.1807	0	$0	$0.00	141	$74	$0.53	14	$74	$5.27	29	$344	$11.87	$977
Jul	21	138	8.0	2,880	$486	$0.1687	0	$0	$0.00	48	$47	$0.97	5	$47	$9.68	0	$0	$0.00	$533
Aug	19	244	10.1	3,652	$596	$0.1631	0	$0	$0.00	3	$37	$14.36	0	$37	$143.55	0	$0	$0.00	$632
Sep	170	15	10.2	3,590	$592	$0.1649	0	$0	$0.00	23	$39	$1.69	2	$39	$16.94	28	$363	$12.97	$994
Oct	493	0	9.1	3,044	$462	$0.1516	0	$0	$0.00	171	$78	$0.46	17	$78	$4.56	0	$0	$0.00	$540
Nov	586	0	11.7	4,370	$627	$0.1434	0	$0	$0.00	339	$133	$0.39	34	$133	$3.91	0	$0	$0.00	$759
Dec	1,011	0	11.2	4,459	$624	$0.1400	0	$0	$0.00	510	$207	$0.41	51	$207	$4.06	19	$250	$13.13	$1,081
	6,247	470	127.3	49,043	$8,094	$0.1650	0	$0	$0.00	4,403	$1,751	$0.40	440	$1,751	$3.98	150	$1,849	$12.32	$11,693
				3.09 kWh/Sqft									27.8 Mbtu/Sqft						$0.74 $/Sqft
													4.4 Btu/Sqft/HDD						









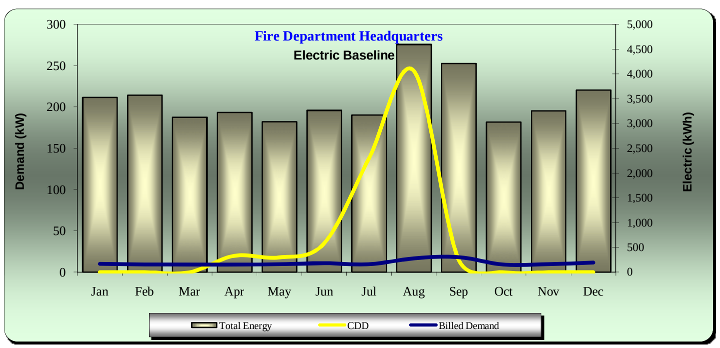
Fire Department Headquarters

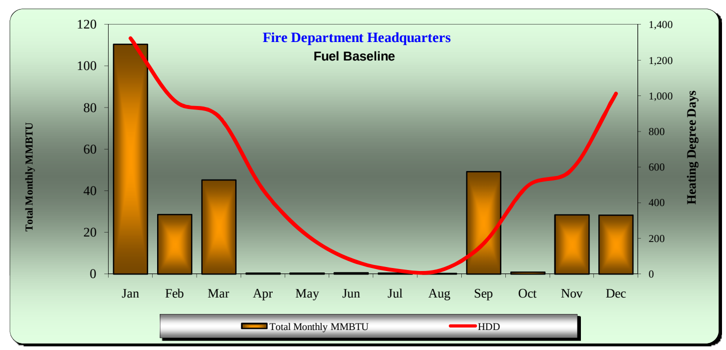
Square Footage: 6,541 ft²

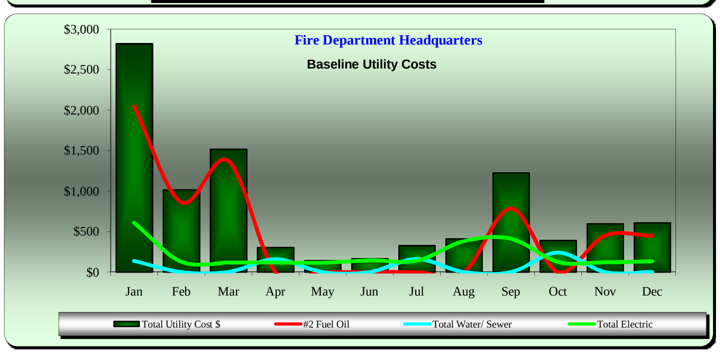
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

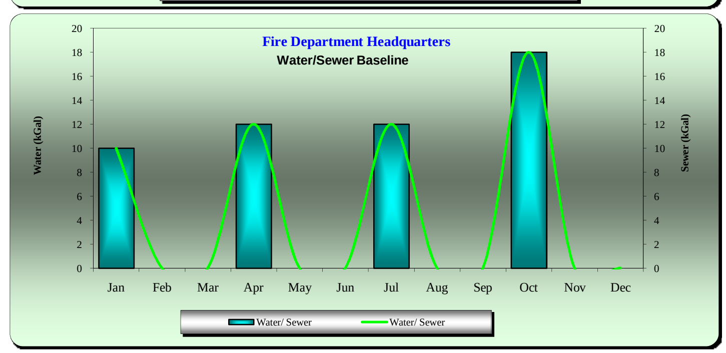
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	9.9	3,531	$606	$0.1717	788	$2,047	$2.60	5	$31	$6.22	110	$2,078	$18.81	10	$137	$13.71	$2,822
Feb	972	0	9.2	3,577	$127	$0.0356	202	$863	$4.28	6	$28	$4.60	29	$890	$30.99	0	$0	$0.00	$1,018
Mar	883	0	9.1	3,127	$115	$0.0368	321	$1,373	$4.28	5	$31	$6.21	45	$1,404	$31.02	0	$0	$0.00	$1,519
Apr	474	20	8.9	3,223	$118	$0.0365	0	$0	$0.00	5	$29	$5.83	1	$29	$58.30	12	$157	$13.09	$304
May	217	18	9.4	3,040	$113	$0.0371	0	$0	$0.00	5	$30	$6.01	1	$30	$60.12	0	$0	$0.00	$143
Jun	79	35	10.7	3,268	$144	$0.0440	0	$0	$0.00	7	$23	$3.34	1	$23	$33.44	0	$0	$0.00	$167
Jul	21	138	9.4	3,172	$138	$0.0436	0	$0	$0.00	5	$32	$6.37	1	$32	$63.66	12	$160	$13.30	$330
Aug	19	244	16.6	4,599	$380	$0.0825	0	$0	$0.00	4	$32	$7.89	0	$32	$78.85	0	$0	$0.00	$411
Sep	170	15	18.0	4,217	$411	$0.0975	351	$786	$2.24	4	$29	$7.17	49	$814	$16.51	0	$0	$0.00	$1,225
Oct	493	0	9.0	3,033	$124	$0.0409	0	$0	$0.00	10	$30	$3.04	1	$30	$30.42	18	$238	$13.24	$393
Nov	586	0	9.5	3,259	$119	$0.0364	201	$450	$2.24	5	$28	$5.64	29	$478	$16.76	0	$0	$0.00	$597
Dec	1,011	0	11.3	3,678	$131	$0.0356	200	$448	$2.24	5	$31	$6.29	28	$480	$16.88	0	$0	$0.00	$611
	6,247	**470**	**131.0**	**41,724**	**$2,526**	**$0.0605**	**2,061**	**$5,967**	**$2.89**	**66**	**$354**	**$5.37**	**294**	**$6,321**	**$21.48**	**52**	**$692**	**$13.31**	**$9,539**
				6.38									**45.0**						**$1.46**
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													7.2						
													Btu/Sqft/HDD						









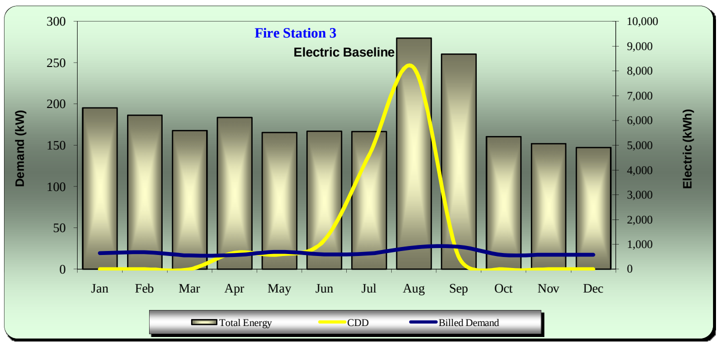
Fire Station 3

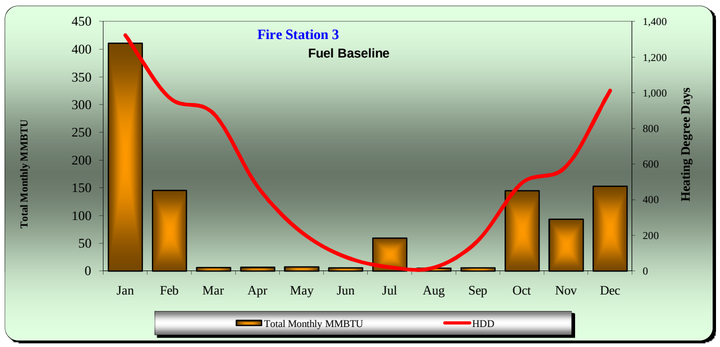
Square Footage: 16,215 ft²

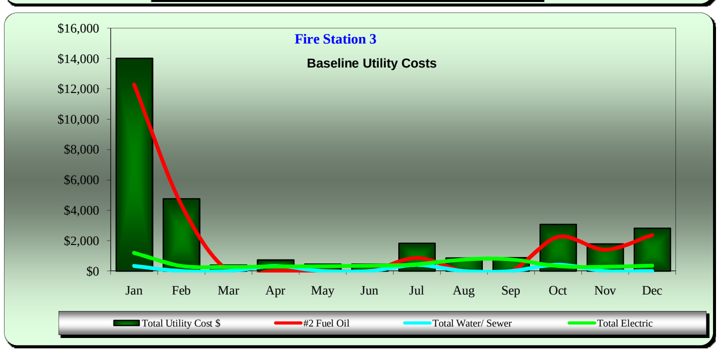
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

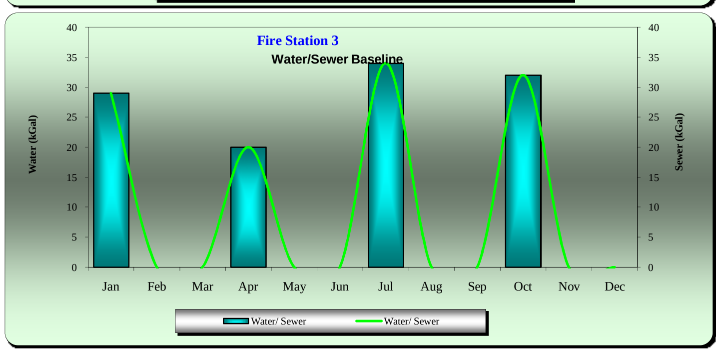
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	19.3	6,520	$1,193	$0.1829	2,870	$12,286	$4.28	106	$206	$1.94	411	$12,492	$30.38	29	$344	$11.87	$14,029
Feb	972	0	20.4	6,224	$327	$0.0526	1,023	$4,378	$4.28	26	$68	$2.61	145	$4,446	$30.59	0	$0	$0.00	$4,773
Mar	883	0	16.4	5,596	$261	$0.0467	0	$0	$0.00	66	$137	$2.07	7	$137	$20.73	0	$0	$0.00	$398
Apr	474	20	17.0	6,125	$275	$0.0450	0	$0	$0.00	68	$119	$1.75	7	$119	$17.54	20	$332	$16.62	$727
May	217	18	20.8	5,521	$314	$0.0568	0	$0	$0.00	76	$156	$2.05	8	$156	$20.46	0	$0	$0.00	$469
Jun	79	35	17.8	5,575	$334	$0.0600	0	$0	$0.00	58	$123	$2.12	6	$123	$21.16	0	$0	$0.00	$457
Jul	21	138	18.8	5,558	$431	$0.0775	379	$850	$2.24	67	$140	$2.09	60	$990	$16.60	34	$412	$12.12	$1,833
Aug	19	244	26.1	9,332	$752	$0.0806	0	$0	$0.00	53	$113	$2.12	5	$113	$21.25	0	$0	$0.00	$865
Sep	170	15	27.0	8,691	$760	$0.0875	0	$0	$0.00	62	$128	$2.07	6	$128	$20.67	0	$0	$0.00	$888
Oct	493	0	17.0	5,359	$313	$0.0585	1,000	$2,240	$2.24	55	$103	$1.88	145	$2,343	$16.14	32	$421	$13.17	$3,078
Nov	586	0	17.5	5,074	$258	$0.0509	626	$1,401	$2.24	63	$137	$2.18	94	$1,538	$16.42	0	$0	$0.00	$1,797
Dec	1,011	0	17.3	4,909	$339	$0.0691	1,052	$2,359	$2.24	62	$135	$2.17	153	$2,494	$16.29	0	$0	$0.00	$2,833
	6,247	470	235.4	74,484	$5,559	$0.0746	6,950	$23,514	$3.38	762	$1,564	$2.05	1,046	$25,078	$23.97	115	$1,510	$13.13	$32,147
				4.59 kWh/Sqft									64.5 Mbtu/Sqft						$1.98 $/Sqft
													10.3 Btu/Sqft/HDD						









Franklin Elementary School

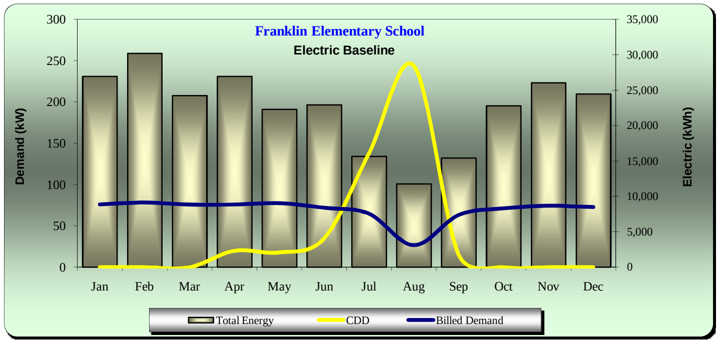
Square Footage: 56,764 ft²

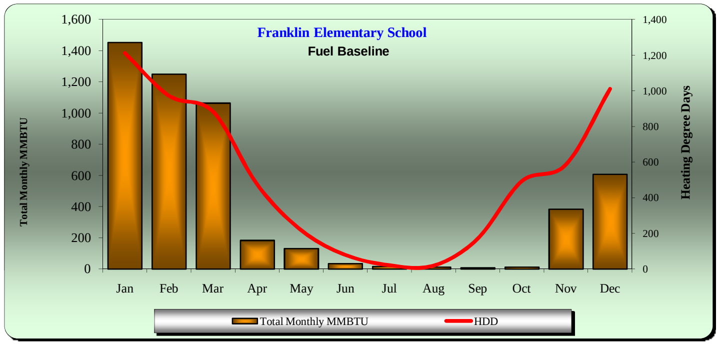
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

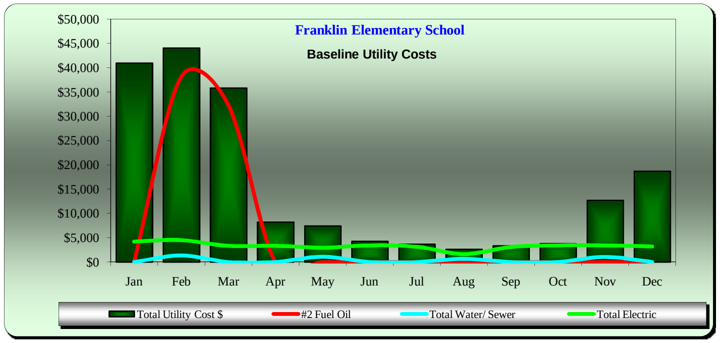
BASELINE: Jan-09 TO Jan-10

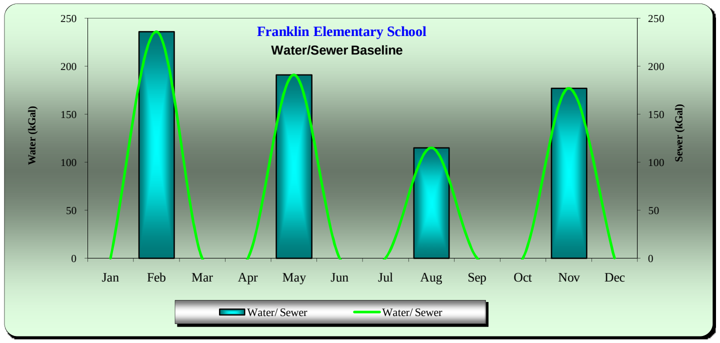
Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal
Jan	1,212	0	76.0	26,960	$4,186	$0.1553	0	$0	$0.00
Feb	972	0	78.4	30,240	$4,513	$0.1492	8,890	$38,062	$4.28
Mar	883	0	76.0	24,240	$3,303	$0.1363	7,563	$32,380	$4.28
Apr	474	20	76.0	26,960	$3,331	$0.1235	0	$0	$0.00
May	217	18	77.6	22,320	$2,922	$0.1309	0	$0	$0.00
Jun	79	35	72.0	22,960	$3,423	$0.1491	0	$0	$0.00
Jul	21	138	64.8	15,680	$3,126	$0.1994	0	$0	$0.00
Aug	19	244	26.4	11,760	$1,608	$0.1367	0	$0	$0.00
Sep	170	15	63.2	15,440	$3,063	$0.1984	0	$0	$0.00
Oct	493	0	71.2	22,800	$3,420	$0.1500	0	$0	$0.00
Nov	586	0	74.4	26,080	$3,405	$0.1306	0	$0	$0.00
Dec	1,011	0	72.8	24,480	$3,197	$0.1306	0	$0	$0.00
	6,137	**470**	**828.8**	**269,920**	**$39,497**	**$0.1463**	**16,453**	**$70,443**	**$4.28**
				4.76 kWh/Sqft					

Month	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	14,533	$36,809	$2.53	1,453	$36,809	$25.33	0	$0	$0.00	$40,995
Feb	94	$183	$1.94	1,250	$38,245	$30.59	236	$1,325	$5.61	$44,082
Mar	86	$170	$1.97	1,064	$32,550	$30.58	0	$0	$0.00	$35,853
Apr	1,842	$4,922	$2.67	184	$4,922	$26.72	0	$0	$0.00	$8,253
May	1,318	$3,495	$2.65	132	$3,495	$26.51	191	$1,056	$5.53	$7,472
Jun	349	$882	$2.53	35	$882	$25.26	0	$0	$0.00	$4,305
Jul	168	$584	$3.48	17	$584	$34.77	0	$0	$0.00	$3,710
Aug	137	$431	$3.15	14	$431	$31.46	115	$617	$5.37	$2,657
Sep	84	$317	$3.78	8	$317	$37.76	0	$0	$0.00	$3,380
Oct	131	$409	$3.12	13	$409	$31.23	0	$0	$0.00	$3,829
Nov	3,838	$8,326	$2.17	384	$8,326	$21.69	177	$1,018	$5.75	$12,748
Dec	6,080	$15,493	$2.55	608	$15,493	$25.48	0	$0	$0.00	$18,690
	28,660	**$72,019**	**$2.51**	**5,163**	**$142,462**	**$27.59**	**719**	**$4,015**	**$5.58**	**$185,974**
				91.0 Mbtu/Sqft						**$3.28** $/Sqft
				14.8 Btu/Sqft/HDD						









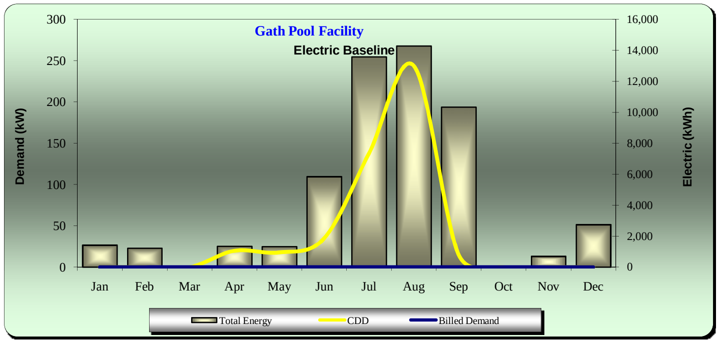
Gath Pool Facility

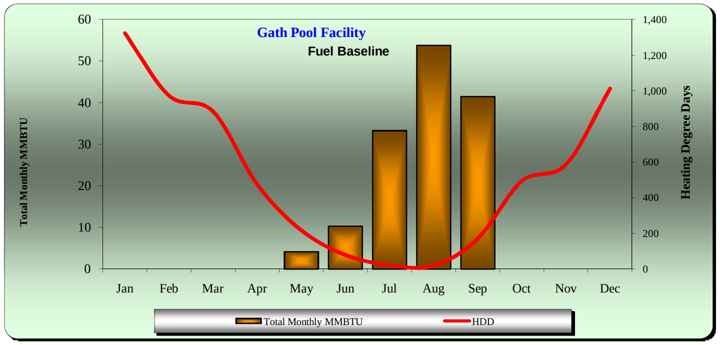
Square Footage: 4,600 ft²

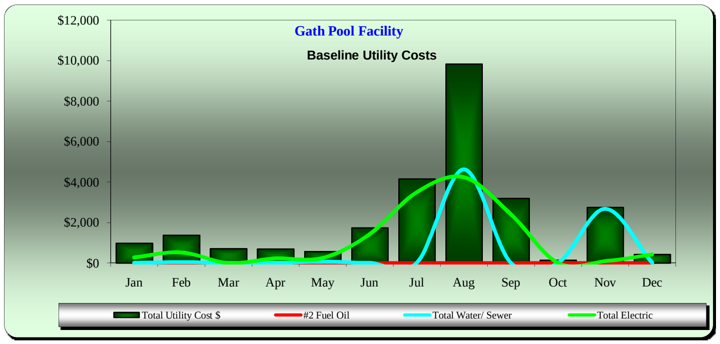
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

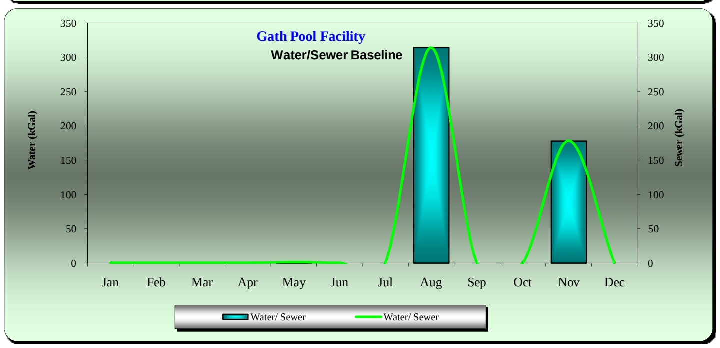
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	1,423	$273	$0.1918	0	$0	$0.00	0	$714	$0.00	0	$714	$0.00	0	$0	$0.00	$987
Feb	972	0	0.0	1,230	$520	$0.4228	0	$0	$0.00	0	$818	$0.00	0	$818	$0.00	0	$44	$0.00	$1,382
Mar	883	0	0.0	0	$0	$0.0000	0	$0	$0.00	0	$706	$0.00	0	$706	$0.00	0	$0	$0.00	$706
Apr	474	20	0.0	1,341	$224	$0.1672	0	$0	$0.00	0	$467	$0.00	0	$467	$0.00	0	$0	$0.00	$691
May	217	18	0.0	1,331	$243	$0.1828	0	$0	$0.00	42	$274	$6.59	4	$274	$65.92	1	$54	$53.71	$571
Jun	79	35	0.0	5,847	$1,422	$0.2432	0	$0	$0.00	103	$319	$3.09	10	$319	$30.93	0	$0	$0.00	$1,741
Jul	21	138	0.0	13,584	$3,493	$0.2571	0	$0	$0.00	333	$666	$2.00	33	$666	$19.99	0	$0	$0.00	$4,158
Aug	19	244	0.0	14,285	$4,238	$0.2967	0	$0	$0.00	538	$984	$1.83	54	$984	$18.28	314	$4,622	$14.72	$9,843
Sep	170	15	0.0	10,346	$2,404	$0.2324	0	$0	$0.00	415	$788	$1.90	42	$788	$18.99	0	$0	$0.00	$3,192
Oct	493	0	0.0	0	$0	$0.0000	0	$0	$0.00	0	$140	$0.00	0	$140	$0.00	0	$0	$0.00	$140
Nov	586	0	0.0	698	$82	$0.1179	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	178	$2,671	$15.01	$2,753
Dec	1,011	0	0.0	2,746	$424	$0.1542	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$424
	6,247	**470**	**0.0**	**52,831**	**$13,324**	**$0.2522**	**0**	**$0**	**$0.00**	**1,431**	**$5,873**	**$4.11**	**143**	**$5,873**	**$41.06**	**493**	**$7,390**	**$14.99**	**$26,587**
				11.49 kWh/Sqft									**31.1** Mbtu/Sqft						**$5.78** $/Sqft
													5.0 Btu/Sqft/HDD						









Hawthorne Fieldhouse

Square Footage: 5,608 ft²

Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

BASELINE: Jan-09 TO Dec-09

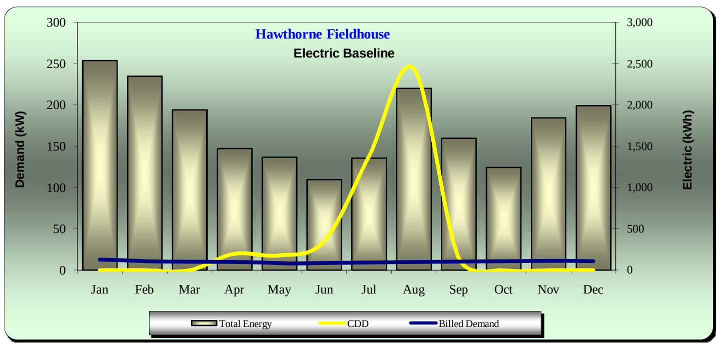
Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	12.8	2,539	$534	$0.2104	1,014	$4,341	$4.28	0	$0	$0.00	142	$4,341	$30.67	20	$237	$11.84	$5,111
Feb	972	0	10.9	2,352	$173	$0.0737	341	$1,462	$4.28	0	$0	$0.00	48	$1,462	$30.67	0	$0	$0.00	$1,635
Mar	883	0	10.0	1,943	$140	$0.0723	704	$3,015	$4.28	0	$0	$0.00	98	$3,015	$30.67	0	$0	$0.00	$3,156
Apr	474	20	10.0	1,474	$109	$0.0743	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	10	$137	$13.71	$247
May	217	18	8.2	1,369	$103	$0.0749	300	$1,284	$4.28	0	$0	$0.00	42	$1,284	$30.67	0	$0	$0.00	$1,387
Jun	79	35	8.3	1,099	$97	$0.0886	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$97
Jul	21	138	9.0	1,358	$136	$0.1005	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	20	$239	$11.97	$376
Aug	19	244	9.8	2,203	$208	$0.0946	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$208
Sep	170	15	10.4	1,598	$169	$0.1057	248	$556	$2.24	0	$0	$0.00	35	$556	$16.06	0	$0	$0.00	$725
Oct	493	0	10.6	1,247	$122	$0.0980	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	30	$395	$13.15	$517
Nov	586	0	11.0	1,846	$143	$0.0772	225	$505	$2.24	0	$0	$0.00	31	$505	$16.06	0	$0	$0.00	$648
Dec	1,011	0	10.9	1,994	$134	$0.0673	201	$451	$2.24	0	$0	$0.00	28	$451	$16.06	0	$0	$0.00	$585
	6,247	**470**	**121.9**	**21,022**	**$2,070**	**$0.0985**	**3,034**	**$11,614**	**$3.83**	**0**	**$0**	**$0.00**	**424**	**$11,614**	**$27.42**	**80**	**$1,008**	**$12.60**	**$14,692**

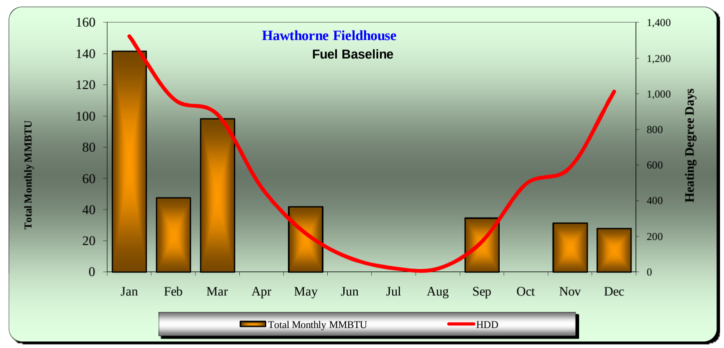
3.75 kWh/Sqft

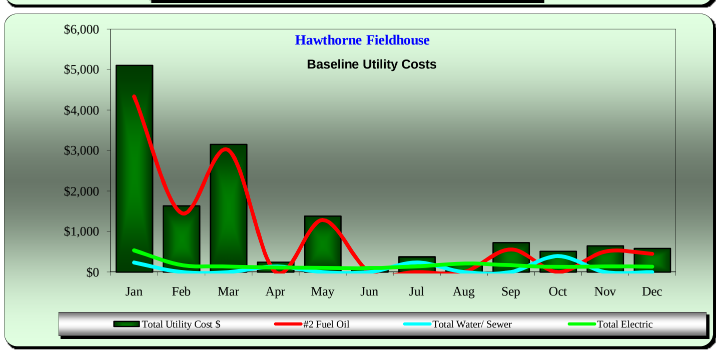
75.5 Mbtu/Sqft

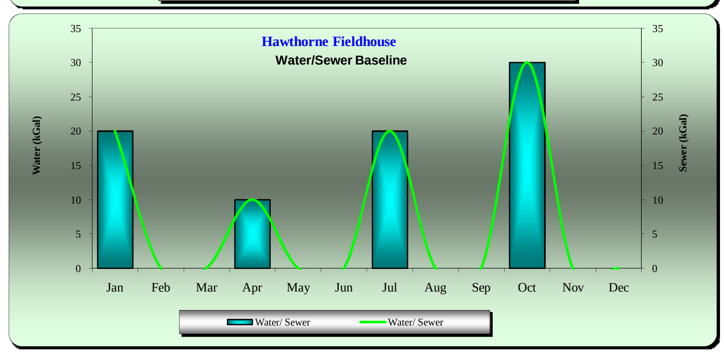
12.1 Btu/Sqft/HDD

$2.62 $/Sqft









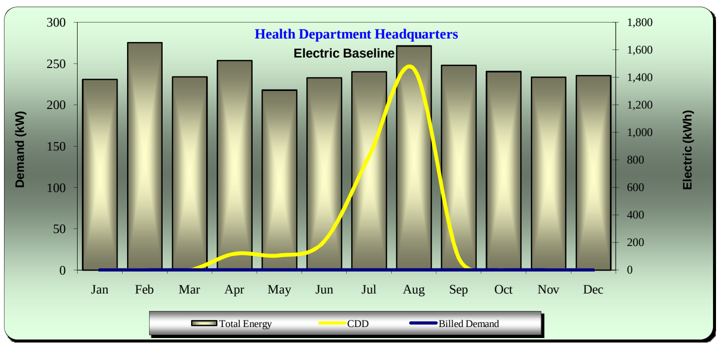
Health Department Headquarters

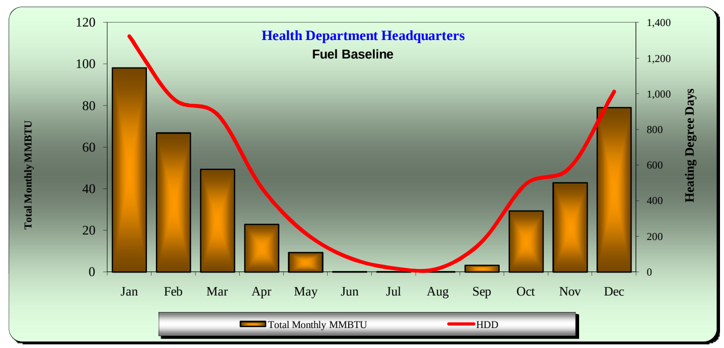
Square Footage: 4,581 ft²

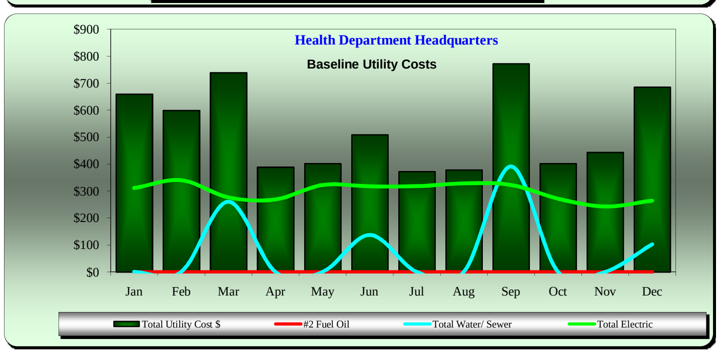
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

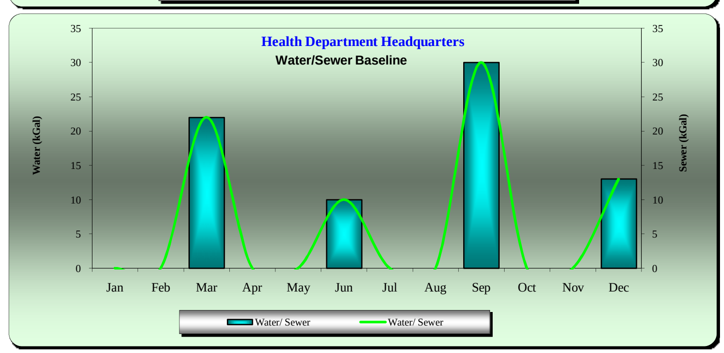
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	1,386	$311	$0.2242	0	$0	$0.00	982	$349	$0.36	98	$349	$3.55	0	$0	$0.00	$660
Feb	972	0	0.0	1,654	$340	$0.2056	0	$0	$0.00	669	$259	$0.39	67	$259	$3.87	0	$0	$0.00	$599
Mar	883	0	0.0	1,406	$276	$0.1964	0	$0	$0.00	494	$202	$0.41	49	$202	$4.09	22	$261	$11.85	$739
Apr	474	20	0.0	1,524	$268	$0.1761	0	$0	$0.00	230	$120	$0.52	23	$120	$5.22	0	$0	$0.00	$389
May	217	18	0.0	1,309	$322	$0.2462	0	$0	$0.00	94	$80	$0.85	9	$80	$8.53	0	$0	$0.00	$402
Jun	79	35	0.0	1,399	$317	$0.2268	0	$0	$0.00	1	$55	$54.89	0	$55	$548.90	10	$137	$13.71	$509
Jul	21	138	0.0	1,442	$318	$0.2204	0	$0	$0.00	2	$55	$27.59	0	$55	$275.85	0	$0	$0.00	$373
Aug	19	244	0.0	1,630	$328	$0.2014	0	$0	$0.00	1	$50	$49.77	0	$50	$497.70	0	$0	$0.00	$378
Sep	170	15	0.0	1,489	$322	$0.2165	0	$0	$0.00	33	$58	$1.77	3	$58	$17.72	30	$391	$13.04	$772
Oct	493	0	0.0	1,444	$271	$0.1879	0	$0	$0.00	294	$131	$0.45	29	$131	$4.46	0	$0	$0.00	$403
Nov	586	0	0.0	1,404	$242	$0.1725	0	$0	$0.00	430	$202	$0.47	43	$202	$4.70	0	$0	$0.00	$444
Dec	1,011	0	0.0	1,414	$264	$0.1865	0	$0	$0.00	791	$320	$0.40	79	$320	$4.04	13	$103	$7.88	$686
	6,247	470	0.0	17,501	$3,581	$0.2046	0	$0	$0.00	4,021	$1,881	$0.47	402	$1,881	$4.68	75	$891	$11.89	$6,353
				3.82									87.8						$1.39
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													14.1						
													Btu/Sqft/HDD						







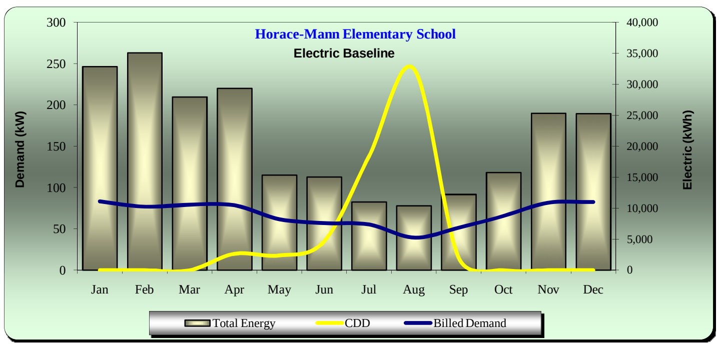


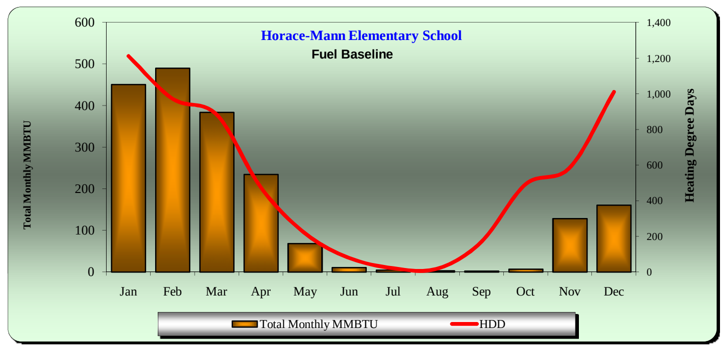
Horace-Mann Elementary School

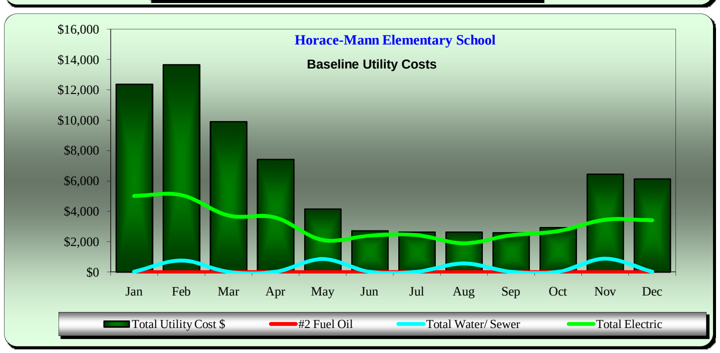
Square Footage: 35,000 ft²

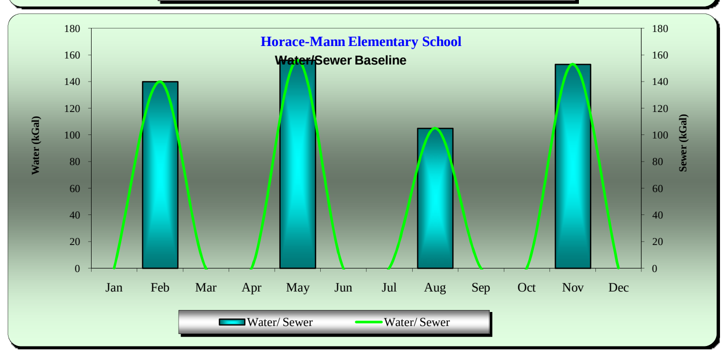
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

BASELINE:	Jan-09	TO	Jan-10																
Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	83.2	32,880	$4,997	$0.1520	0	$0	$0.00	4,512	$7,376	$1.63	451	$7,376	$16.35	0	$0	$0.00	$12,373
Feb	972	0	76.8	35,120	$5,065	$0.1442	0	$0	$0.00	4,901	$7,859	$1.60	490	$7,859	$16.04	140	$751	$5.36	$13,675
Mar	883	0	79.2	28,000	$3,715	$0.1327	0	$0	$0.00	3,841	$6,191	$1.61	384	$6,191	$16.12	0	$0	$0.00	$9,906
Apr	474	20	78.4	29,360	$3,577	$0.1218	0	$0	$0.00	2,350	$3,839	$1.63	235	$3,839	$16.33	0	$0	$0.00	$7,416
May	217	18	61.6	15,360	$2,090	$0.1361	0	$0	$0.00	687	$1,223	$1.78	69	$1,223	$17.80	156	$846	$5.42	$4,159
Jun	79	35	56.8	15,040	$2,389	$0.1588	0	$0	$0.00	113	$333	$2.95	11	$333	$29.50	0	$0	$0.00	$2,722
Jul	21	138	55.2	11,040	$2,420	$0.2192	0	$0	$0.00	49	$225	$4.59	5	$225	$45.89	0	$0	$0.00	$2,645
Aug	19	244	39.2	10,400	$1,880	$0.1808	0	$0	$0.00	30	$196	$6.52	3	$196	$65.18	105	$556	$5.30	$2,631
Sep	170	15	51.2	12,240	$2,410	$0.1969	0	$0	$0.00	27	$186	$6.89	3	$186	$68.92	0	$0	$0.00	$2,596
Oct	493	0	65.6	15,760	$2,680	$0.1700	0	$0	$0.00	69	$246	$3.57	7	$246	$35.67	0	$0	$0.00	$2,926
Nov	586	0	81.6	25,360	$3,433	$0.1354	0	$0	$0.00	1,290	$2,155	$1.67	129	$2,155	$16.71	153	$868	$5.67	$6,456
Dec	1,011	0	82.4	25,280	$3,402	$0.1346	0	$0	$0.00	1,613	$2,730	$1.69	161	$2,730	$16.92	0	$0	$0.00	$6,132
	6,137	**470**	**811.2**	**255,840**	**$38,058**	**$0.1488**	**0**	**$0**	**$0.00**	**19,482**	**$32,558**	**$1.67**	**1,948**	**$32,558**	**$16.71**	**554**	**$3,020**	**$5.45**	**$73,637**
				7.31									**55.7**						**$2.10**
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													9.1						
													Btu/Sqft/HDD						









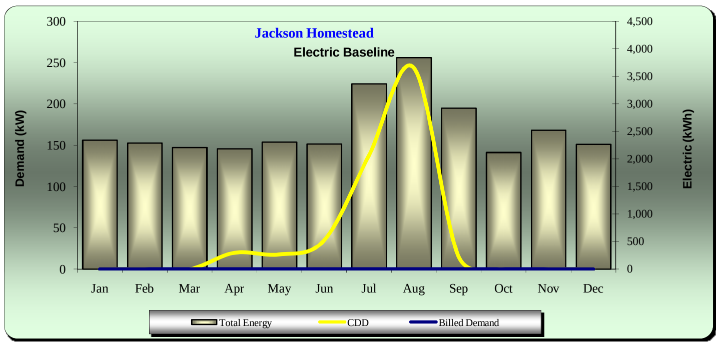
Jackson Homestead

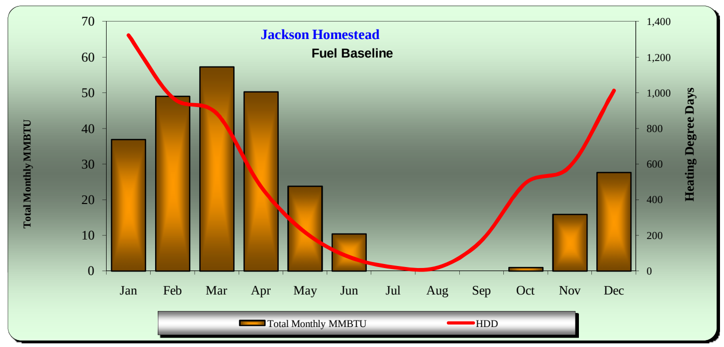
Square Footage: 7,000 ft²

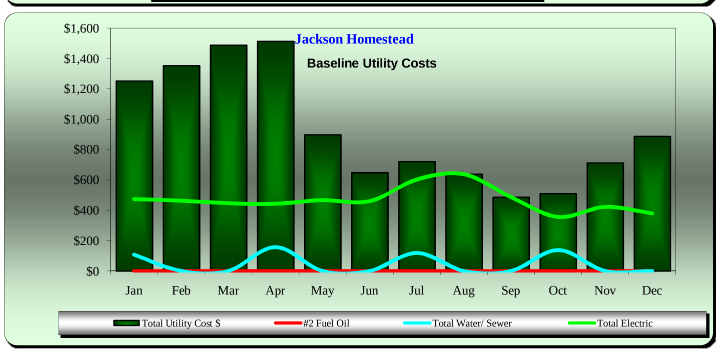
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

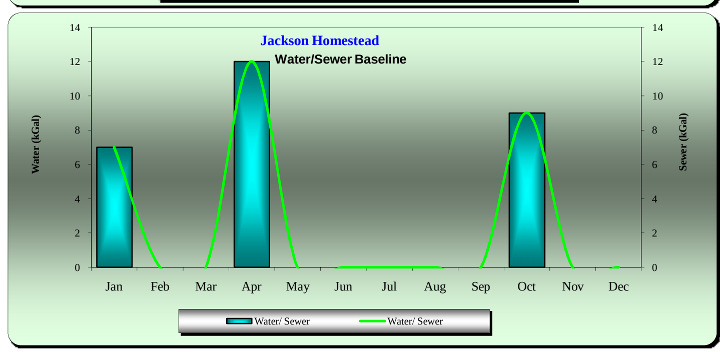
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	2,347	$474	$0.2019	0	$0	$0.00	369	$671	$1.82	37	$671	$18.18	7	$107	$15.32	$1,252
Feb	972	0	0.0	2,294	$463	$0.2019	0	$0	$0.00	490	$891	$1.82	49	$891	$18.18	0	$0	$0.00	$1,354
Mar	883	0	0.0	2,210	$447	$0.2020	0	$0	$0.00	573	$1,042	$1.82	57	$1,042	$18.18	0	$0	$0.00	$1,488
Apr	474	20	0.0	2,189	$442	$0.2021	0	$0	$0.00	503	$915	$1.82	50	$915	$18.18	12	$157	$13.09	$1,514
May	217	18	0.0	2,308	$466	$0.2019	0	$0	$0.00	238	$433	$1.82	24	$433	$18.18	0	$0	$0.00	$899
Jun	79	35	0.0	2,275	$459	$0.2020	0	$0	$0.00	104	$189	$1.82	10	$189	$18.18	0	$0	$0.00	$649
Jul	21	138	0.0	3,367	$602	$0.1788	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$118	$0.00	$721
Aug	19	244	0.0	3,847	$638	$0.1659	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$638
Sep	170	15	0.0	2,924	$487	$0.1664	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$487
Oct	493	0	0.0	2,121	$355	$0.1673	0	$0	$0.00	10	$18	$1.83	1	$18	$18.31	9	$138	$15.33	$511
Nov	586	0	0.0	2,526	$421	$0.1668	0	$0	$0.00	159	$292	$1.83	16	$292	$18.35	0	$0	$0.00	$713
Dec	1,011	0	0.0	2,268	$379	$0.1671	0	$0	$0.00	277	$508	$1.83	28	$508	$18.35	0	$0	$0.00	$887
	6,247	470	0.0	30,676	$5,634	$0.1836	0	$0	$0.00	2,723	$4,959	$1.82	272	$4,959	$18.21	28	$521	$18.59	$11,113
				4.38 kWh/Sqft									38.9 Mbtu/Sqft						$1.59 $/Sqft
													6.2 Btu/Sqft/HDD						









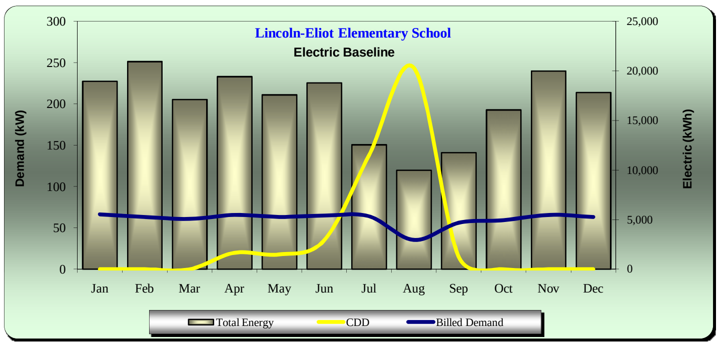
Lincoln-Eliot Elementary School

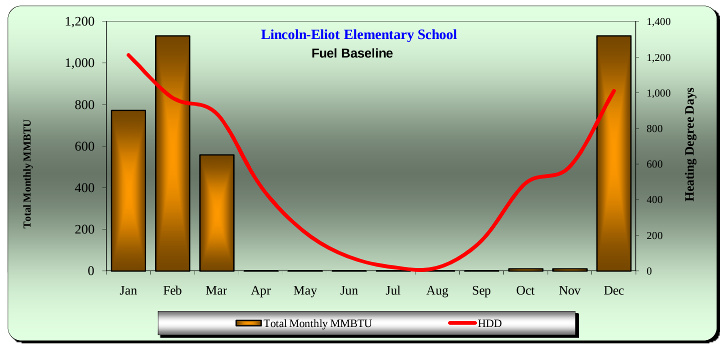
Square Footage: 51,074 ft²

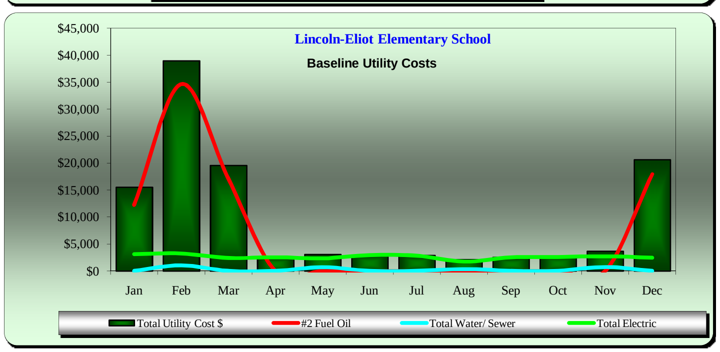
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

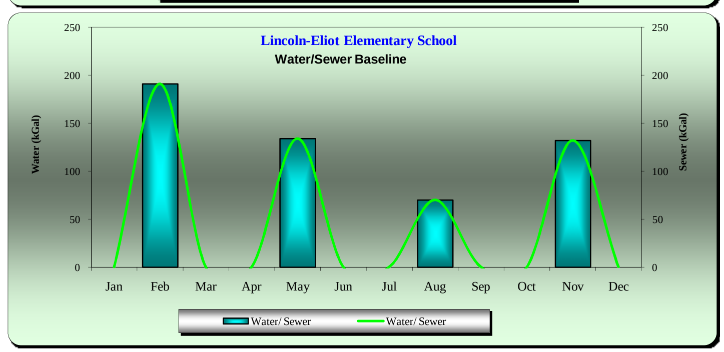
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	66.4	18,960	$3,093	$0.1631	5,468	$12,257	$2.24	96	$209	$2.17	773	$12,466	$16.13	0	$0	$0.00	$15,559
Feb	972	0	63.2	20,960	$3,217	$0.1535	8,094	$34,656	$4.28	8	$62	$7.77	1,131	$34,719	$30.70	191	$1,056	$5.53	$38,991
Mar	883	0	60.8	17,120	$2,400	$0.1402	4,003	$17,139	$4.28	4	$58	$14.39	559	$17,196	$30.75	0	$0	$0.00	$19,596
Apr	474	20	65.6	19,440	$2,519	$0.1296	0	$0	$0.00	3	$56	$18.65	0	$56	$186.52	0	$0	$0.00	$2,575
May	217	18	63.2	17,600	$2,310	$0.1313	0	$0	$0.00	5	$57	$11.48	1	$57	$114.78	134	$715	$5.33	$3,082
Jun	79	35	64.8	18,800	$2,897	$0.1541	0	$0	$0.00	5	$66	$13.17	1	$66	$131.70	0	$0	$0.00	$2,962
Jul	21	138	64.0	12,560	$2,825	$0.2249	0	$0	$0.00	4	$57	$14.37	0	$57	$143.66	0	$0	$0.00	$2,883
Aug	19	244	35.2	10,000	$1,721	$0.1721	0	$0	$0.00	8	$65	$8.18	1	$65	$81.78	70	$341	$4.87	$2,127
Sep	170	15	56.0	11,760	$2,514	$0.2138	0	$0	$0.00	7	$62	$8.88	1	$62	$88.78	0	$0	$0.00	$2,577
Oct	493	0	59.2	16,080	$2,562	$0.1593	0	$0	$0.00	108	$218	$2.02	11	$218	$20.21	0	$0	$0.00	$2,781
Nov	586	0	65.6	20,000	$2,703	$0.1352	0	$0	$0.00	107	$216	$2.02	11	$216	$20.19	132	$736	$5.58	$3,655
Dec	1,011	0	63.2	17,840	$2,440	$0.1368	8,005	$17,944	$2.24	137	$276	$2.02	1,131	$18,221	$16.11	0	$0	$0.00	$20,660
	6,137	470	727.2	201,120	$31,202	$0.1551	25,571	$81,997	$3.21	492	$1,403	$2.85	3,619	$83,400	$23.05	527	$2,847	$5.40	$117,449
				3.94 kWh/Sqft									70.9 Mbtu/Sqft						$2.30 $/Sqft
													11.5 Btu/Sqft/HDD						







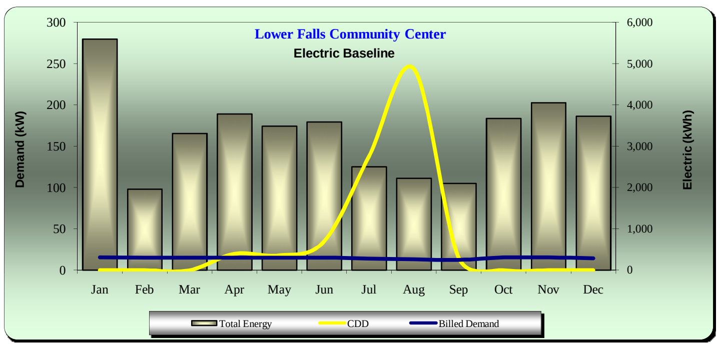


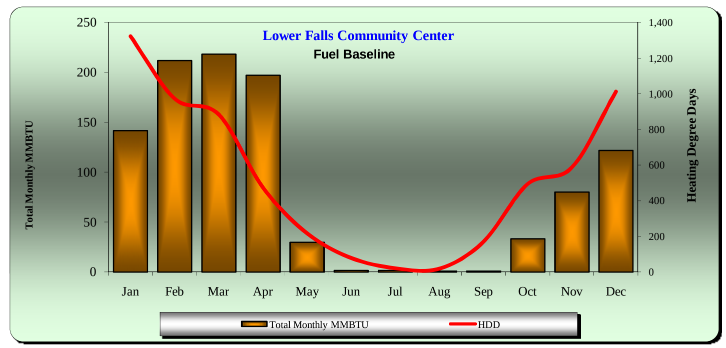
Lower Falls Community Center

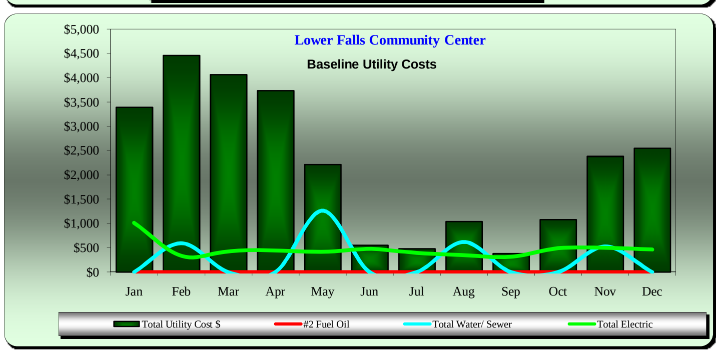
Square Footage: 10,519 ft²

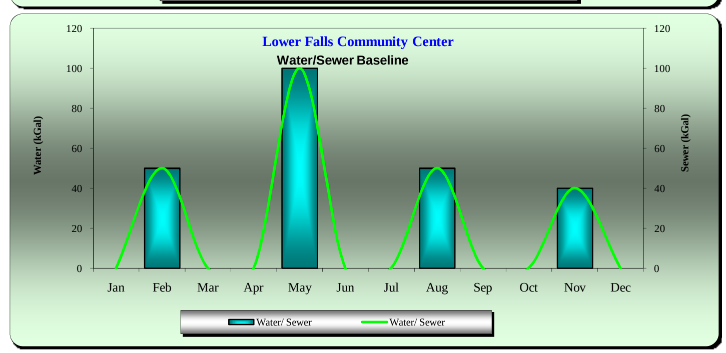
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

BASELINE:	Jan-09	TO	Dec-09																
Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	15.5	5,602	$1,011	$0.1805	0	$0	$0.00	1,419	$2,383	$1.68	142	$2,383	$16.79	0	$0	$0.00	$3,394
Feb	972	0	15.3	1,965	$333	$0.1694	0	$0	$0.00	2,121	$3,535	$1.67	212	$3,535	$16.67	50	$595	$11.90	$4,463
Mar	883	0	15.0	3,316	$426	$0.1284	0	$0	$0.00	2,184	$3,638	$1.67	218	$3,638	$16.66	0	$0	$0.00	$4,064
Apr	474	20	15.2	3,784	$444	$0.1174	0	$0	$0.00	1,971	$3,293	$1.67	197	$3,293	$16.71	0	$0	$0.00	$3,738
May	217	18	15.3	3,493	$414	$0.1185	0	$0	$0.00	300	$539	$1.80	30	$539	$17.96	100	$1,264	$12.64	$2,217
Jun	79	35	15.2	3,590	$475	$0.1324	0	$0	$0.00	17	$76	$4.50	2	$76	$44.99	0	$0	$0.00	$552
Jul	21	138	14.0	2,503	$395	$0.1578	0	$0	$0.00	17	$85	$5.02	2	$85	$50.19	0	$0	$0.00	$480
Aug	19	244	13.1	2,226	$347	$0.1560	0	$0	$0.00	12	$72	$6.02	1	$72	$60.22	50	$621	$12.43	$1,041
Sep	170	15	12.5	2,105	$314	$0.1492	0	$0	$0.00	12	$71	$5.88	1	$71	$58.79	0	$0	$0.00	$385
Oct	493	0	15.4	3,678	$489	$0.1331	0	$0	$0.00	334	$589	$1.76	33	$589	$17.65	0	$0	$0.00	$1,079
Nov	586	0	15.5	4,058	$500	$0.1231	0	$0	$0.00	803	$1,355	$1.69	80	$1,355	$16.87	40	$529	$13.21	$2,383
Dec	1,011	0	14.4	3,729	$462	$0.1240	0	$0	$0.00	1,219	$2,089	$1.71	122	$2,089	$17.14	0	$0	$0.00	$2,552
	6,247	470	176.4	40,049	$5,611	$0.1401	0	$0	$0.00	10,409	$17,727	$1.70	1,041	$17,727	$17.03	240	$3,009	$12.54	$26,347
				3.81 kWh/Sqft									99.0 Mbtu/Sqft						$2.50 $/Sqft
													15.8 Btu/Sqft/HDD						









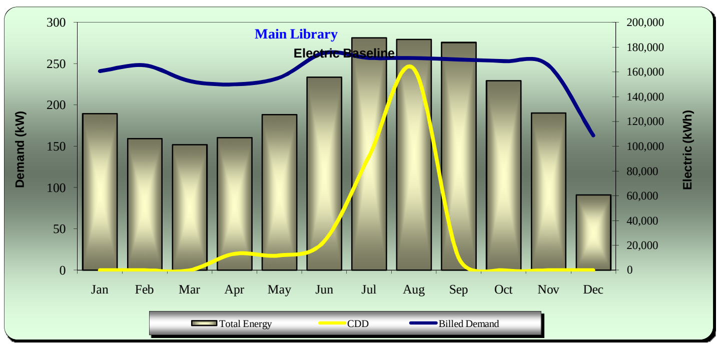
Main Library

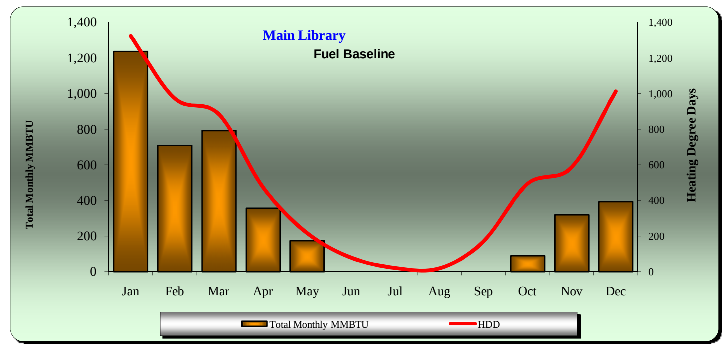
Square Footage: 93,000 ft²

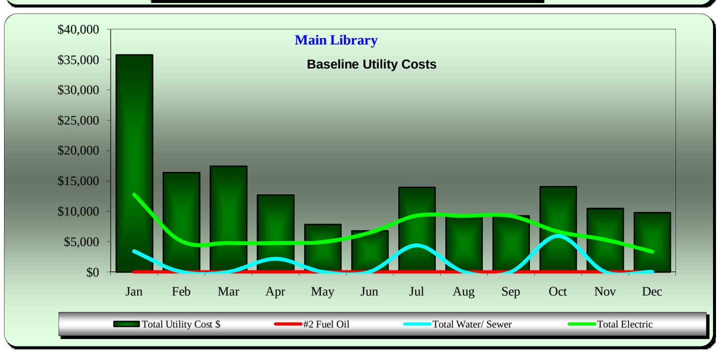
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

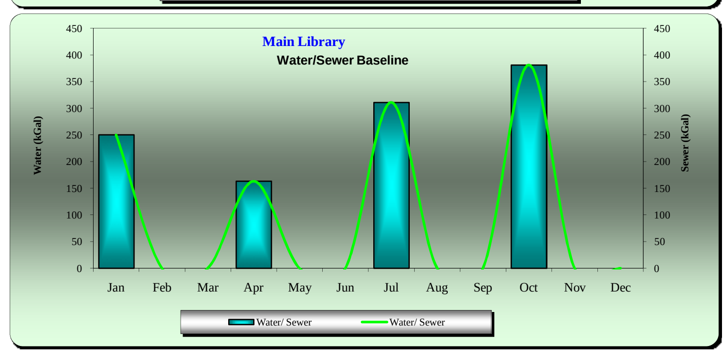
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	241.0	126,340	$12,758	$0.1010	0	$0	$0.00	12,368	$19,642	$1.59	1,237	$19,642	$15.88	250	$3,415	$13.66	$35,815
Feb	972	0	248.0	106,220	$5,110	$0.0481	0	$0	$0.00	7,104	$11,308	$1.59	710	$11,308	$15.92	0	$0	$0.00	$16,417
Mar	883	0	229.0	101,360	$4,777	$0.0471	0	$0	$0.00	7,931	$12,657	$1.60	793	$12,657	$15.96	0	$0	$0.00	$17,435
Apr	474	20	225.0	107,180	$4,790	$0.0447	0	$0	$0.00	3,578	$5,738	$1.60	358	$5,738	$16.04	163	$2,168	$13.30	$12,696
May	217	18	233.0	125,700	$4,945	$0.0393	0	$0	$0.00	1,746	$2,919	$1.67	175	$2,919	$16.72	0	$0	$0.00	$7,864
Jun	79	35	263.0	155,880	$6,477	$0.0416	0	$0	$0.00	0	$303	$0.00	0	$303	$0.00	0	$0	$0.00	$6,780
Jul	21	138	257.0	187,600	$9,305	$0.0496	0	$0	$0.00	0	$308	$0.00	0	$308	$0.00	311	$4,371	$14.05	$13,983
Aug	19	244	257.0	186,480	$9,271	$0.0497	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$9,271
Sep	170	15	255.0	183,960	$9,255	$0.0503	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$9,255
Oct	493	0	253.0	153,060	$6,657	$0.0435	0	$0	$0.00	908	$1,499	$1.65	91	$1,499	$16.50	381	$5,924	$15.55	$14,080
Nov	586	0	248.0	126,940	$5,332	$0.0420	0	$0	$0.00	3,195	$5,134	$1.61	320	$5,134	$16.07	0	$0	$0.00	$10,466
Dec	1,011	0	163.0	60,800	$3,362	$0.0553	0	$0	$0.00	3,930	$6,440	$1.64	393	$6,440	$16.39	0	$0	$0.00	$9,801
	6,247	**470**	**2,872.0**	**1,621,520**	**$82,038**	**$0.0506**	**0**	**$0**	**$0.00**	**40,760**	**$65,947**	**$1.62**	**4,076**	**$65,947**	**$16.18**	**1,105**	**$15,878**	**$14.37**	**$163,864**
				17.44									**43.8**						**$1.76**
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													7.0						
													Btu/Sqft/HDD						









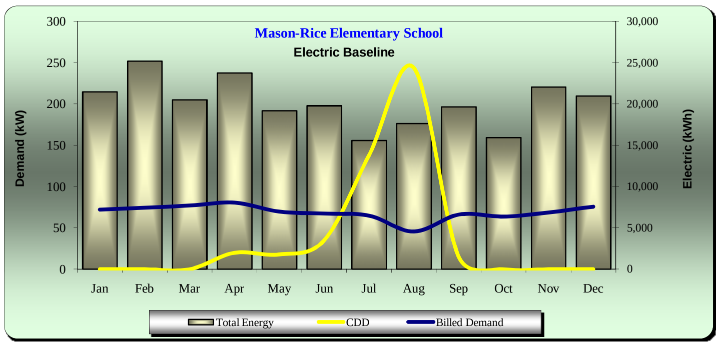
Mason-Rice Elementary School

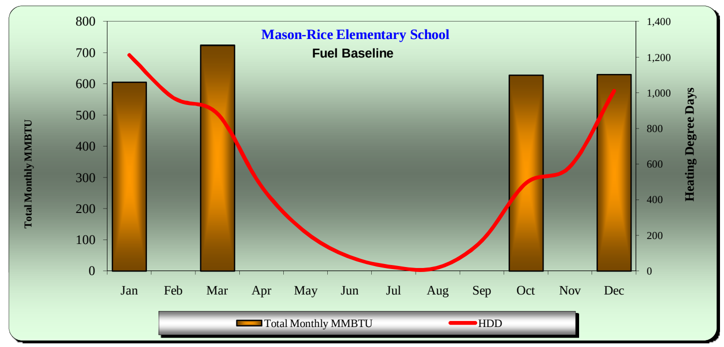
Square Footage: 39,000 ft²

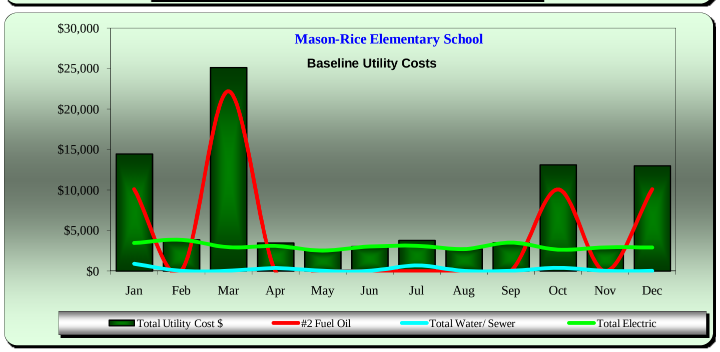
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

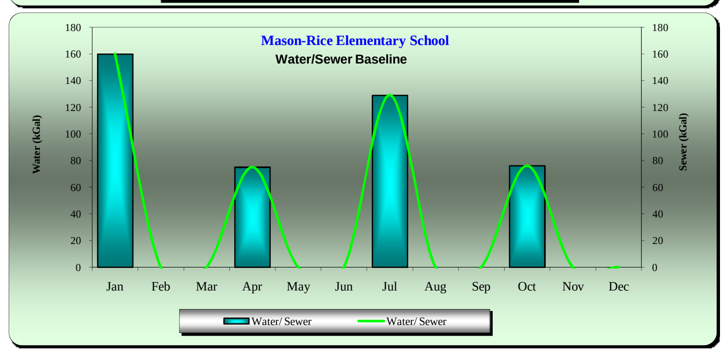
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	72.0	21,480	$3,474	$0.1617	4,338	$10,112	$2.33	0	$0	$0.00	606	$10,112	$16.70	160	$902	$5.63	$14,487
Feb	972	0	74.4	25,200	$3,866	$0.1534	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$3,866
Mar	883	0	76.8	20,520	$2,949	$0.1437	5,186	$22,206	$4.28	0	$0	$0.00	724	$22,206	$30.67	0	$0	$0.00	$25,155
Apr	474	20	80.4	23,760	$3,104	$0.1307	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	75	$362	$4.83	$3,466
May	217	18	69.6	19,200	$2,538	$0.1322	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,538
Jun	79	35	67.2	19,800	$3,037	$0.1534	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$3,037
Jul	21	138	64.8	15,600	$3,119	$0.1999	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	129	$690	$5.35	$3,809
Aug	19	244	45.6	17,640	$2,722	$0.1543	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,722
Sep	170	15	66.0	19,680	$3,526	$0.1792	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$3,526
Oct	493	0	63.6	15,960	$2,652	$0.1661	4,500	$10,087	$2.24	0	$0	$0.00	628	$10,087	$16.06	76	$386	$5.07	$13,124
Nov	586	0	68.4	22,080	$2,940	$0.1332	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,940
Dec	1,011	0	75.6	21,000	$2,906	$0.1384	4,511	$10,112	$2.24	0	$0	$0.00	630	$10,112	$16.06	0	$0	$0.00	$13,018
	6,137	470	824.4	241,920	$36,833	$0.1523	18,536	$52,517	$2.83	0	$0	$0.00	2,588	$52,517	$20.30	440	$2,339	$5.32	$91,690
				6.20 kWh/Sqft									66.3 Mbtu/Sqft						$2.35 $/Sqft
													10.8 Btu/Sqft/HDD						







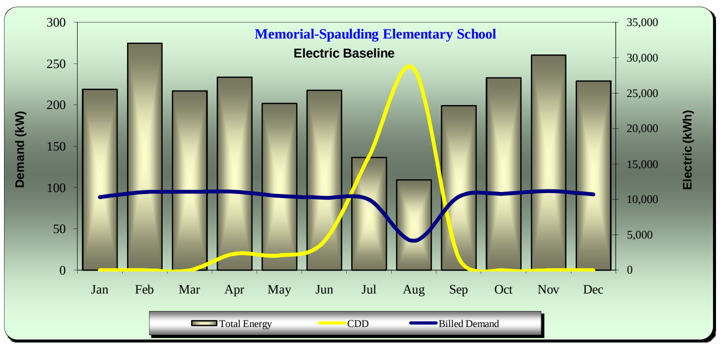


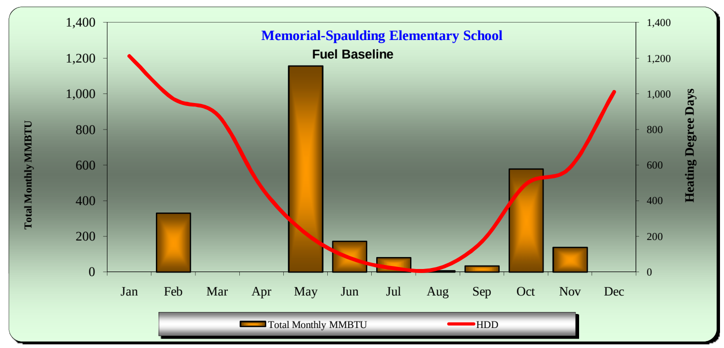
Memorial-Spaulding Elementary School

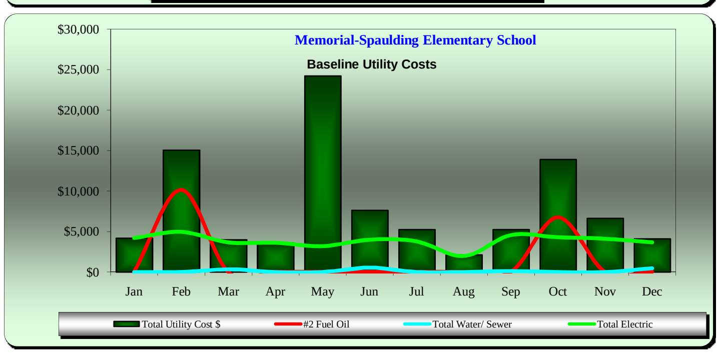
Square Footage: 68,775 ft²

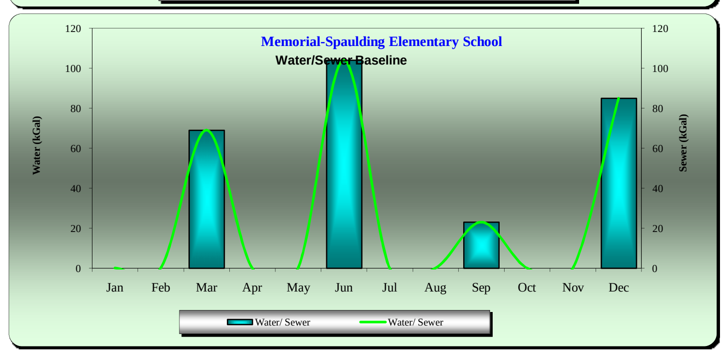
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

BASELINE:	Jan-09	TO	Jan-10																
Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	88.4	25,560	$4,191	$0.1640	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$4,191
Feb	972	0	94.4	32,080	$4,945	$0.1541	2,368	$10,140	$4.28	0	$0	$0.00	331	$10,140	$30.67	0	$0	$0.00	$15,085
Mar	883	0	94.8	25,320	$3,663	$0.1447	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	69	$327	$4.74	$3,990
Apr	474	20	94.8	27,280	$3,613	$0.1324	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$3,613
May	217	18	89.6	23,560	$3,194	$0.1356	0	$0	$0.00	11,568	$21,034	$1.82	1,157	$21,034	$18.18	0	$0	$0.00	$24,228
Jun	79	35	87.6	25,440	$3,977	$0.1563	0	$0	$0.00	1,723	$3,133	$1.82	172	$3,133	$18.18	104	$535	$5.15	$7,646
Jul	21	138	85.2	15,920	$3,773	$0.2370	0	$0	$0.00	820	$1,491	$1.82	82	$1,491	$18.18	0	$0	$0.00	$5,264
Aug	19	244	35.6	12,760	$1,980	$0.1552	0	$0	$0.00	77	$140	$1.82	8	$140	$18.18	0	$0	$0.00	$2,120
Sep	170	15	88.8	23,240	$4,543	$0.1955	0	$0	$0.00	342	$622	$1.82	34	$622	$18.18	23	$102	$4.45	$5,267
Oct	493	0	92.4	27,200	$4,284	$0.1575	3,010	$6,747	$2.24	1,585	$2,882	$1.82	579	$9,629	$16.64	0	$0	$0.00	$13,913
Nov	586	0	95.6	30,400	$4,105	$0.1350	0	$0	$0.00	1,391	$2,529	$1.82	139	$2,529	$18.18	0	$0	$0.00	$6,634
Dec	1,011	0	91.6	26,760	$3,666	$0.1370	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	85	$442	$5.20	$4,108
	6,137	470	1,038.8	295,520	$45,934	$0.1554	5,378	$16,887	$3.14	17,506	$31,831	$1.82	2,501	$48,718	$19.48	281	$1,406	$5.01	$96,059
				4.30									36.4						$1.40
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													5.9						
													Btu/Sqft/HDD						







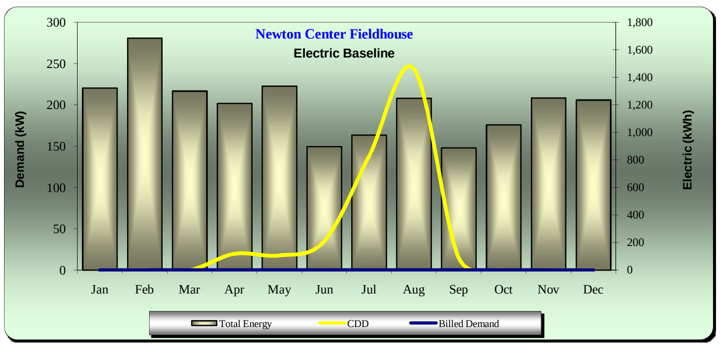


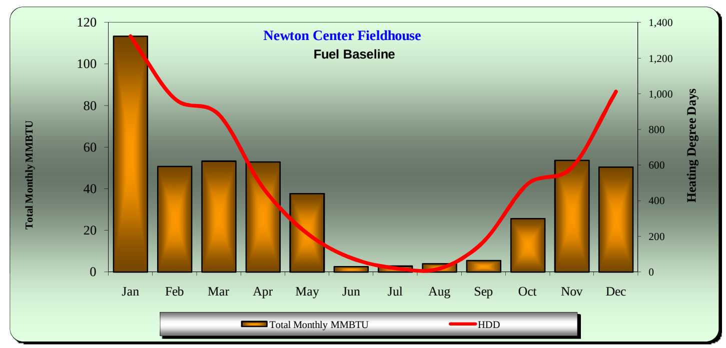
Newton Center Fieldhouse

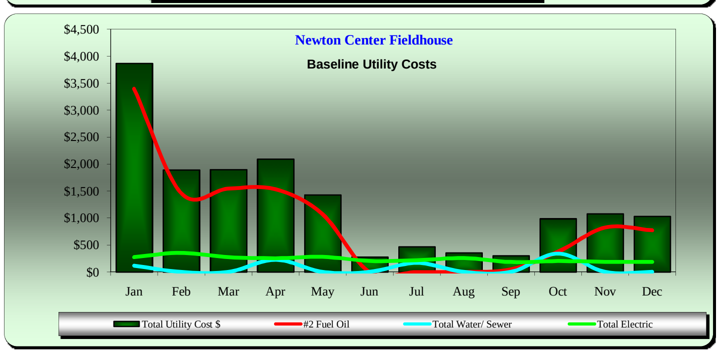
Square Footage: 4,352 ft²

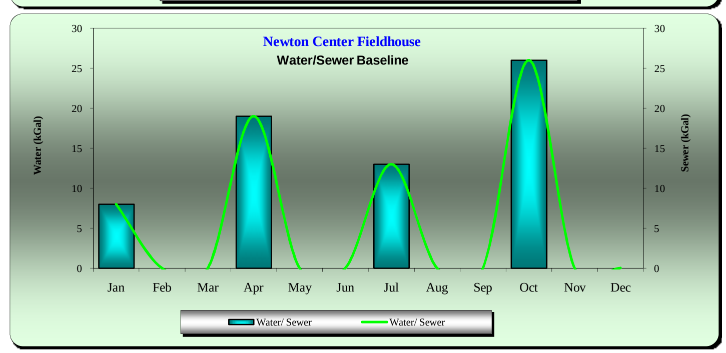
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

BASELINE:	Jan-09	TO	Dec-09																
Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	1,324	$276	$0.2083	794	$3,399	$4.28	27	$76	$2.82	114	$3,475	$30.61	8	$117	$14.65	$3,868
Feb	972	0	0.0	1,687	$353	$0.2094	341	$1,462	$4.28	31	$75	$2.42	51	$1,537	$30.28	0	$0	$0.00	$1,890
Mar	883	0	0.0	1,302	$276	$0.2116	362	$1,548	$4.28	29	$77	$2.67	53	$1,625	$30.45	0	$0	$0.00	$1,901
Apr	474	20	0.0	1,213	$256	$0.2113	359	$1,536	$4.28	29	$76	$2.61	53	$1,611	$30.42	19	$227	$11.93	$2,095
May	217	18	0.0	1,339	$282	$0.2107	251	$1,074	$4.28	28	$75	$2.67	38	$1,149	$30.38	0	$0	$0.00	$1,431
Jun	79	35	0.0	899	$206	$0.2296	0	$0	$0.00	26	$73	$2.79	3	$73	$27.90	0	$0	$0.00	$279
Jul	21	138	0.0	983	$219	$0.2227	0	$0	$0.00	29	$77	$2.67	3	$77	$26.72	13	$170	$13.04	$466
Aug	19	244	0.0	1,250	$259	$0.2072	0	$0	$0.00	40	$96	$2.41	4	$96	$24.06	0	$0	$0.00	$355
Sep	170	15	0.0	889	$186	$0.2097	23	$50	$2.24	24	$66	$2.73	6	$116	$20.93	0	$0	$0.00	$302
Oct	493	0	0.0	1,056	$204	$0.1934	168	$376	$2.24	24	$66	$2.77	26	$442	$17.14	26	$341	$13.12	$988
Nov	586	0	0.0	1,251	$190	$0.1517	369	$827	$2.24	22	$63	$2.85	54	$889	$16.57	0	$0	$0.00	$1,079
Dec	1,011	0	0.0	1,237	$188	$0.1517	345	$774	$2.24	24	$71	$2.98	51	$846	$16.72	0	$0	$0.00	$1,033
	6,247	470	0.0	14,430	$2,895	$0.2007	3,010	$11,045	$3.67	333	$891	$2.68	454	$11,936	$26.32	66	$855	$12.95	$15,686
				3.32									104.2						$3.60
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													16.7						
													Btu/Sqft/HDD						









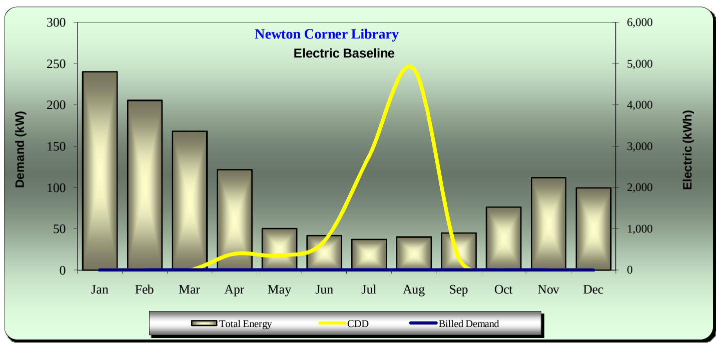
Newton Corner Library

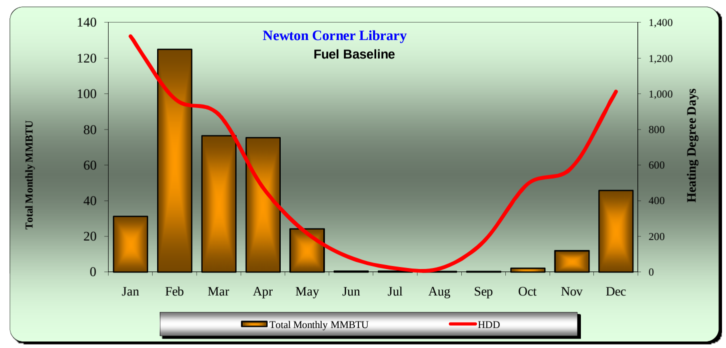
Square Footage: 6,138 ft²

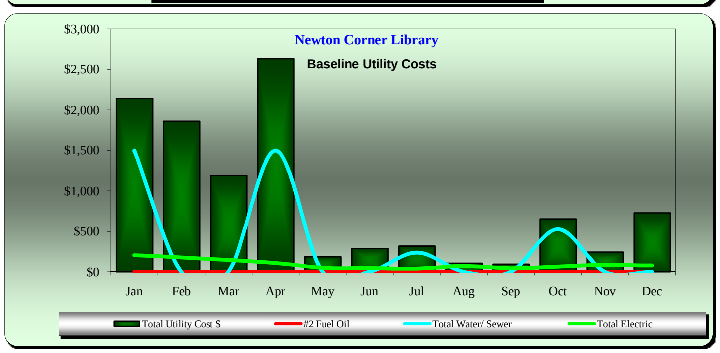
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

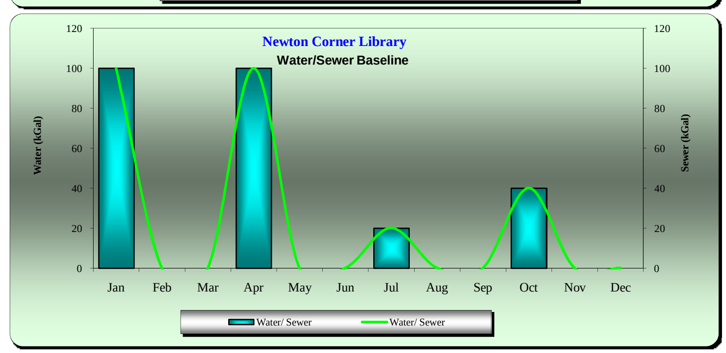
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	4,810	$203	$0.0422	0	$0	$0.00	313	$442	$1.41	31	$442	$14.14	100	$1,499	$14.99	$2,144
Feb	972	0	0.0	4,115	$177	$0.0429	0	$0	$0.00	1,250	$1,686	$1.35	125	$1,686	$13.49	0	$0	$0.00	$1,863
Mar	883	0	0.0	3,370	$146	$0.0433	0	$0	$0.00	765	$1,043	$1.36	77	$1,043	$13.64	0	$0	$0.00	$1,189
Apr	474	20	0.0	2,435	$108	$0.0443	0	$0	$0.00	755	$1,026	$1.36	76	$1,026	$13.59	100	$1,499	$14.99	$2,633
May	217	18	0.0	1,010	$49	$0.0490	0	$0	$0.00	243	$137	$0.57	24	$137	$5.66	0	$0	$0.00	$187
Jun	79	35	0.0	840	$45	$0.0542	0	$0	$0.00	6	$243	$38.84	1	$243	$388.42	0	$0	$0.00	$288
Jul	21	138	0.0	750	$40	$0.0532	0	$0	$0.00	5	$40	$8.01	1	$40	$80.06	20	$239	$11.93	$318
Aug	19	244	0.0	805	$71	$0.0884	0	$0	$0.00	4	$37	$9.97	0	$37	$99.73	0	$0	$0.00	$109
Sep	170	15	0.0	905	$44	$0.0491	0	$0	$0.00	4	$52	$13.75	0	$52	$137.55	0	$0	$0.00	$96
Oct	493	0	0.0	1,530	$65	$0.0422	0	$0	$0.00	23	$59	$2.62	2	$59	$26.21	40	$529	$13.21	$652
Nov	586	0	0.0	2,240	$85	$0.0381	0	$0	$0.00	120	$158	$1.32	12	$158	$13.20	0	$0	$0.00	$244
Dec	1,011	0	0.0	1,995	$77	$0.0386	0	$0	$0.00	458	$649	$1.42	46	$649	$14.19	0	$0	$0.00	$726
	6,247	**470**	**0.0**	**24,805**	**$1,111**	**$0.0448**	**0**	**$0**	**$0.00**	**3,944**	**$5,574**	**$1.41**	**394**	**$5,574**	**$14.13**	**260**	**$3,764**	**$14.48**	**$10,449**
				4.04 kWh/Sqft									**64.3** Mbtu/Sqft						**$1.70** $/Sqft
													10.3 Btu/Sqft/HDD						









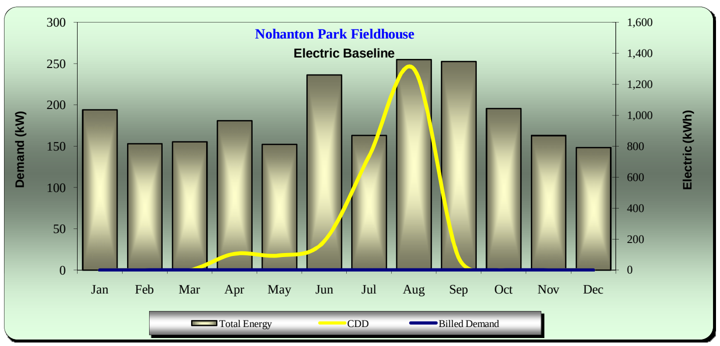
Nohanton Park Fieldhouse

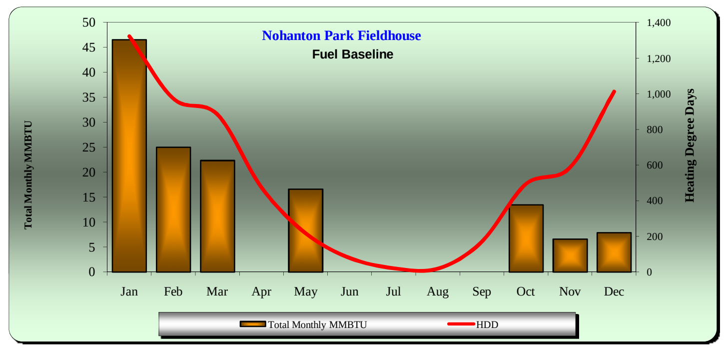
Square Footage: 1,440 ft²

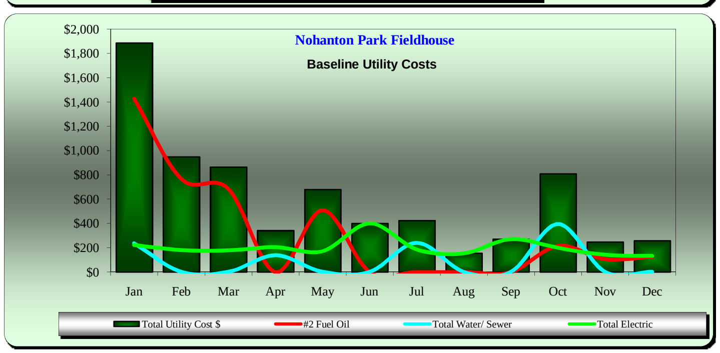
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

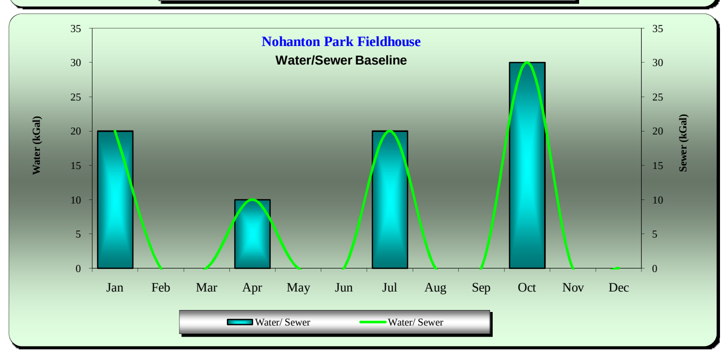
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	1,036	$222	$0.2147	334	$1,429	$4.28	0	$0	$0.00	47	$1,429	$30.67	20	$237	$11.84	$1,888
Feb	972	0	0.0	817	$181	$0.2212	179	$768	$4.28	0	$0	$0.00	25	$768	$30.67	0	$0	$0.00	$948
Mar	883	0	0.0	829	$178	$0.2152	160	$686	$4.28	0	$0	$0.00	22	$686	$30.67	0	$0	$0.00	$864
Apr	474	20	0.0	966	$204	$0.2115	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	10	$137	$13.71	$341
May	217	18	0.0	813	$172	$0.2113	119	$510	$4.28	0	$0	$0.00	17	$510	$30.67	0	$0	$0.00	$681
Jun	79	35	0.0	1,262	$400	$0.3173	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$400
Jul	21	138	0.0	871	$186	$0.2135	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	20	$240	$11.98	$426
Aug	19	244	0.0	1,361	$155	$0.1138	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$155
Sep	170	15	0.0	1,348	$271	$0.2009	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$271
Oct	493	0	0.0	1,044	$199	$0.1906	97	$216	$2.24	0	$0	$0.00	13	$216	$16.06	30	$395	$13.15	$810
Nov	586	0	0.0	870	$142	$0.1633	47	$106	$2.24	0	$0	$0.00	7	$106	$16.06	0	$0	$0.00	$248
Dec	1,011	0	0.0	793	$132	$0.1670	57	$127	$2.24	0	$0	$0.00	8	$127	$16.06	0	$0	$0.00	$259
	6,247	470	0.0	12,010	$2,443	$0.2034	993	$3,841	$3.87	0	$0	$0.00	139	$3,841	$27.72	80	$1,008	$12.60	$7,292
				8.34									96.2						$5.06
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													15.4						
													Btu/Sqft/HDD						









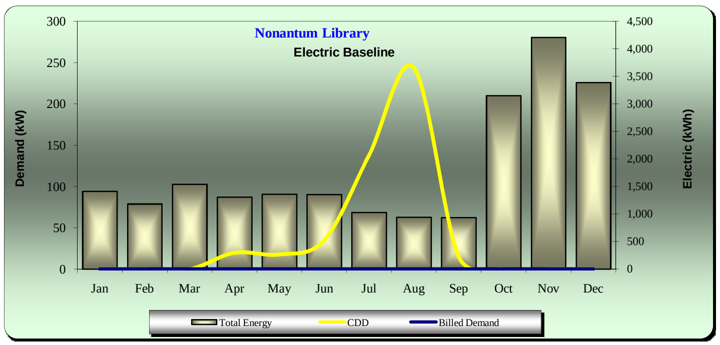
Nonantum Library

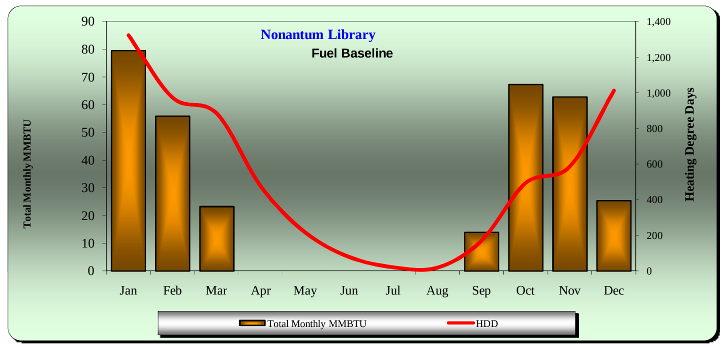
Square Footage: 5,137 ft²

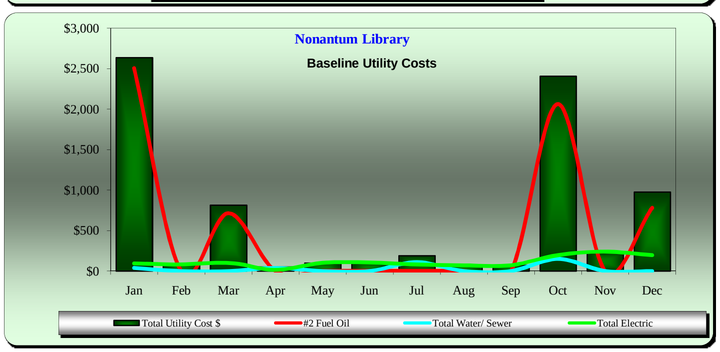
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

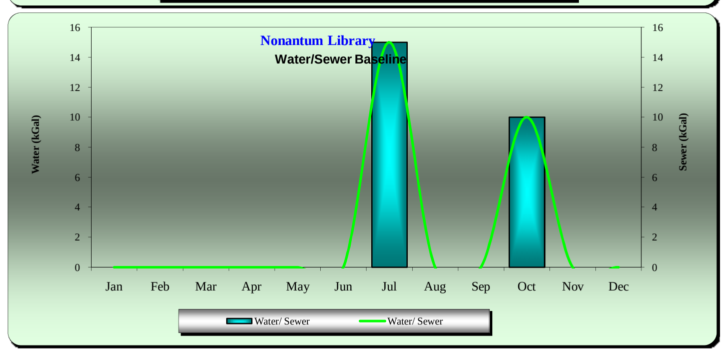
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	1,413	$94	$0.0667	570	$2,507	$4.40	0	$0	$0.00	80	$2,507	$31.53	0	$38	$0.00	$2,639
Feb	972	0	0.0	1,185	$82	$0.0689	400	$0	$0.00	0	$0	$0.00	56	$0	$0.00	0	$0	$0.00	$82
Mar	883	0	0.0	1,545	$101	$0.0654	167	$714	$4.28	0	$0	$0.00	23	$714	$30.67	0	$0	$0.00	$815
Apr	474	20	0.0	1,308	$15	$0.0114	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$38	$0.00	$52
May	217	18	0.0	1,365	$100	$0.0735	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$100
Jun	79	35	0.0	1,356	$105	$0.0774	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$105
Jul	21	138	0.0	1,029	$82	$0.0799	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	15	$109	$7.28	$191
Aug	19	244	0.0	945	$71	$0.0753	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$71
Sep	170	15	0.0	936	$71	$0.0754	100	$0	$0.00	0	$0	$0.00	14	$0	$0.00	0	$0	$0.00	$71
Oct	493	0	0.0	3,153	$197	$0.0623	482	$2,064	$4.28	0	$0	$0.00	67	$2,064	$30.67	10	$149	$14.91	$2,409
Nov	586	0	0.0	4,209	$239	$0.0568	450	$0	$0.00	0	$0	$0.00	63	$0	$0.00	0	$0	$0.00	$239
Dec	1,011	0	0.0	3,393	$195	$0.0575	182	$781	$4.28	0	$0	$0.00	25	$781	$30.67	0	$0	$0.00	$976
	6,247	**470**	**0.0**	**21,837**	**$1,352**	**$0.0619**	**2,351**	**$6,066**	**$2.58**	**0**	**$0**	**$0.00**	**328**	**$6,066**	**$18.48**	**25**	**$333**	**$13.33**	**$7,751**
				4.25 kWh/Sqft									**63.9** Mbtu/Sqft						**$1.51** $/Sqft
													10.2 Btu/Sqft/HDD						









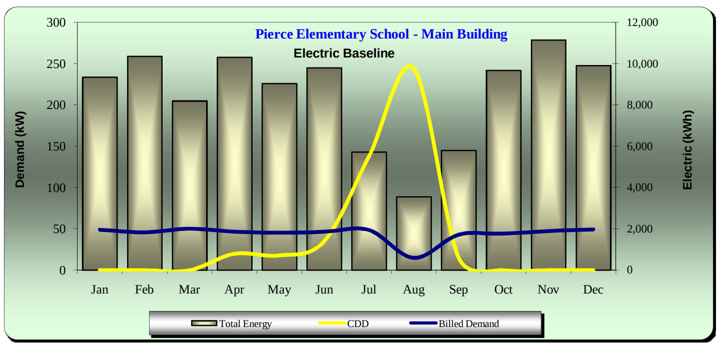
Pierce Elementary School - Main Building

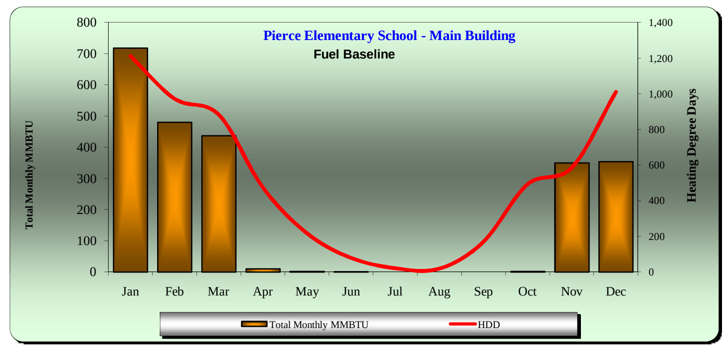
Square Footage: 31,800 ft²

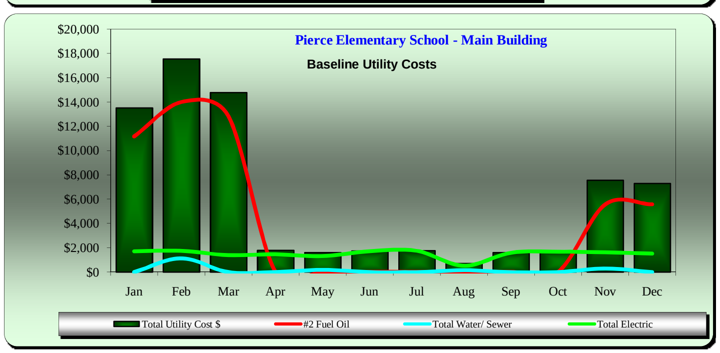
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

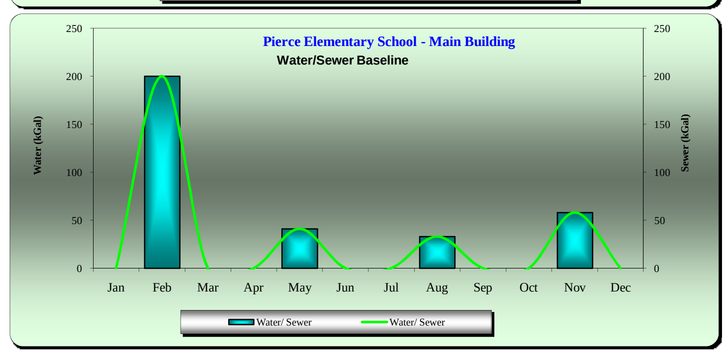
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	48.8	9,360	$1,696	$0.1812	4,977	$11,155	$2.24	232	$677	$2.92	718	$11,832	$16.48	0	$0	$0.00	$13,528
Feb	972	0	45.6	10,360	$1,733	$0.1673	3,267	$13,990	$4.28	240	$736	$3.07	480	$14,726	$30.67	200	$1,109	$5.55	$17,568
Mar	883	0	50.0	8,200	$1,376	$0.1679	3,000	$12,846	$4.28	185	$559	$3.02	437	$13,405	$30.65	0	$0	$0.00	$14,781
Apr	474	20	46.4	10,320	$1,447	$0.1402	0	$0	$0.00	108	$341	$3.16	11	$341	$31.61	0	$0	$0.00	$1,788
May	217	18	45.2	9,040	$1,310	$0.1449	0	$0	$0.00	27	$100	$3.69	3	$100	$36.89	41	$188	$4.58	$1,597
Jun	79	35	46.4	9,800	$1,698	$0.1732	0	$0	$0.00	9	$49	$5.49	1	$49	$54.94	0	$0	$0.00	$1,747
Jul	21	138	48.4	5,720	$1,730	$0.3024	0	$0	$0.00	0	$35	$0.00	0	$35	$0.00	0	$0	$0.00	$1,765
Aug	19	244	14.8	3,560	$518	$0.1456	0	$0	$0.00	0	$30	$0.00	0	$30	$0.00	33	$152	$4.59	$700
Sep	170	15	42.8	5,800	$1,571	$0.2708	0	$0	$0.00	0	$30	$0.00	0	$30	$0.00	0	$0	$0.00	$1,601
Oct	493	0	44.0	9,680	$1,660	$0.1715	0	$0	$0.00	20	$75	$3.74	2	$75	$37.43	0	$0	$0.00	$1,735
Nov	586	0	47.2	11,160	$1,607	$0.1440	2,474	$5,546	$2.24	46	$137	$2.98	350	$5,683	$16.24	58	$285	$4.92	$7,575
Dec	1,011	0	49.2	9,920	$1,502	$0.1514	2,482	$5,562	$2.24	77	$244	$3.17	354	$5,806	$16.40	0	$0	$0.00	$7,308
	6,137	470	528.8	102,920	$17,848	$0.1734	16,200	$49,099	$3.03	944	$3,013	$3.19	2,356	$52,112	$22.12	332	$1,734	$5.22	$71,693
				3.24									74.1						$2.25
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													12.1						
													Btu/Sqft/HDD						









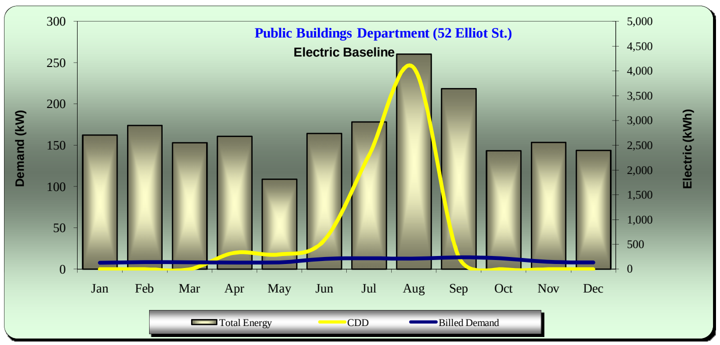
Public Buildings Department (52 Elliot St.)

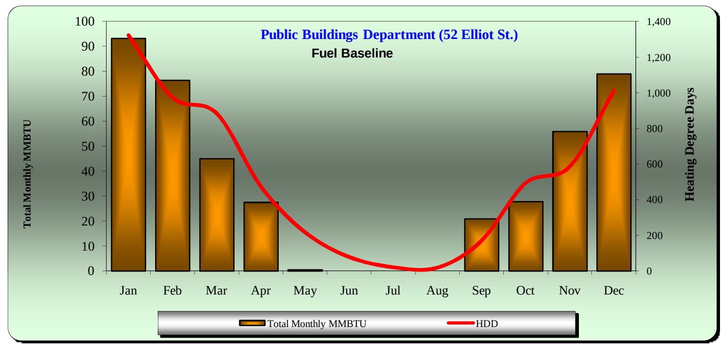
Square Footage: 7,100 ft²

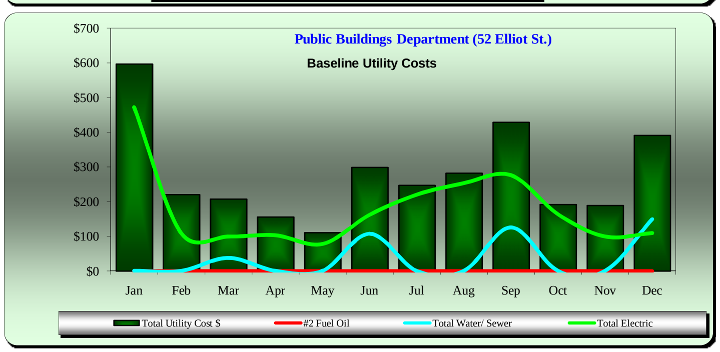
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

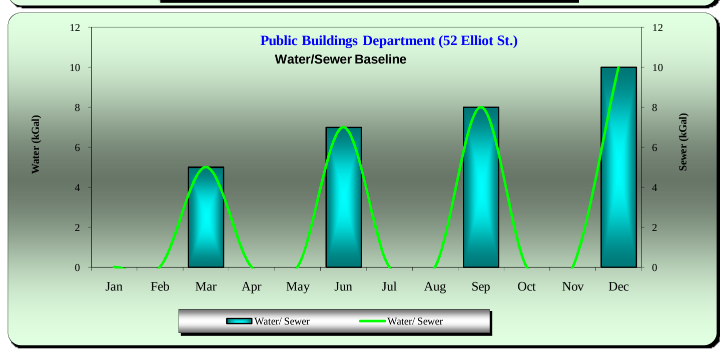
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	7.8	2,711	$472	$0.1742	500	$0	$0.00	234	$125	$0.53	93	$125	$1.34	0	$0	$0.00	$597
Feb	972	0	8.4	2,904	$109	$0.0375	400	$0	$0.00	206	$111	$0.54	76	$111	$1.46	0	$0	$0.00	$220
Mar	883	0	8.2	2,553	$99	$0.0388	250	$0	$0.00	102	$71	$0.70	45	$71	$1.58	5	$37	$7.46	$208
Apr	474	20	8.1	2,682	$103	$0.0383	150	$0	$0.00	66	$53	$0.81	28	$53	$1.94	0	$0	$0.00	$156
May	217	18	8.1	1,815	$78	$0.0428	0	$0	$0.00	5	$33	$6.57	1	$33	$65.66	0	$0	$0.00	$111
Jun	79	35	12.3	2,739	$162	$0.0591	0	$0	$0.00	0	$29	$0.00	0	$29	$0.00	7	$107	$15.32	$299
Jul	21	138	12.9	2,973	$220	$0.0740	0	$0	$0.00	0	$28	$0.00	0	$28	$0.00	0	$0	$0.00	$248
Aug	19	244	12.7	4,344	$253	$0.0583	0	$0	$0.00	0	$29	$0.00	0	$29	$0.00	0	$0	$0.00	$283
Sep	170	15	14.1	3,644	$276	$0.0758	150	$0	$0.00	0	$28	$0.00	21	$28	$1.32	8	$126	$15.70	$429
Oct	493	0	12.6	2,390	$164	$0.0684	200	$0	$0.00	0	$29	$0.00	28	$29	$1.03	0	$0	$0.00	$192
Nov	586	0	8.8	2,560	$99	$0.0388	300	$0	$0.00	141	$90	$0.64	56	$90	$1.61	0	$0	$0.00	$190
Dec	1,011	0	8.0	2,398	$109	$0.0456	400	$0	$0.00	232	$133	$0.57	79	$133	$1.69	10	$149	$14.91	$392
	6,247	**470**	**122.0**	**33,713**	**$2,145**	**$0.0636**	**2,350**	**$0**	**$0.00**	**986**	**$760**	**$0.77**	**427**	**$760**	**$1.78**	**30**	**$419**	**$13.97**	**$3,323**
				4.75 kWh/Sqft									**60.1** Mbtu/Sqft						**$0.47** $/Sqft
													9.6 Btu/Sqft/HDD						









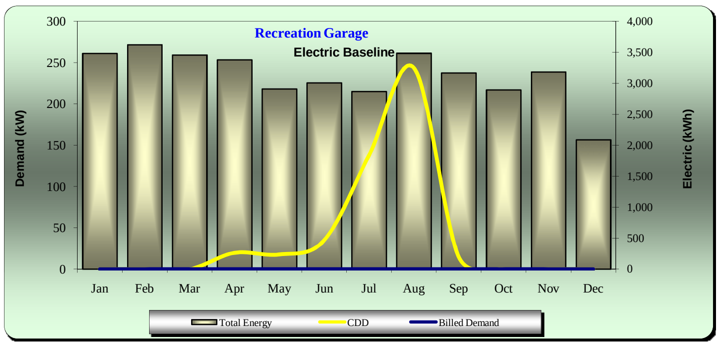
Recreation Garage

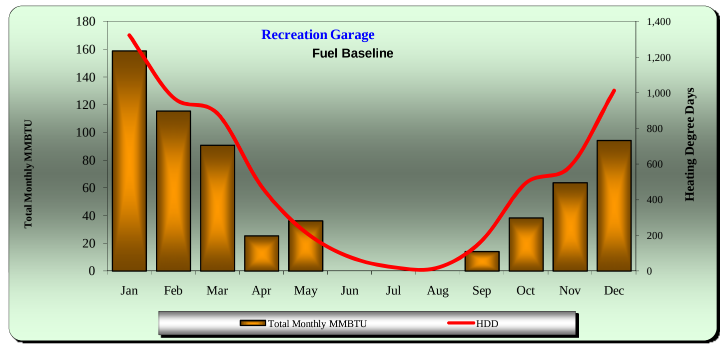
Square Footage: 4,600 ft²

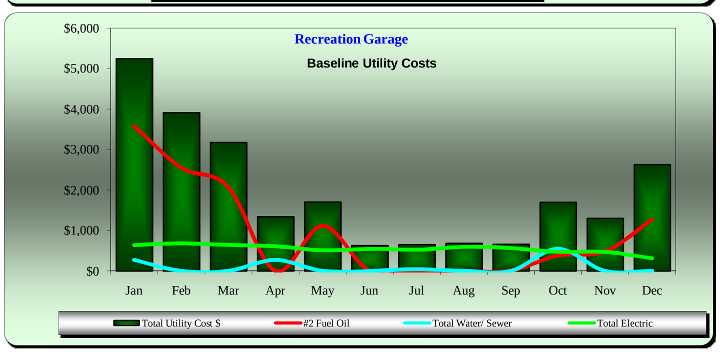
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

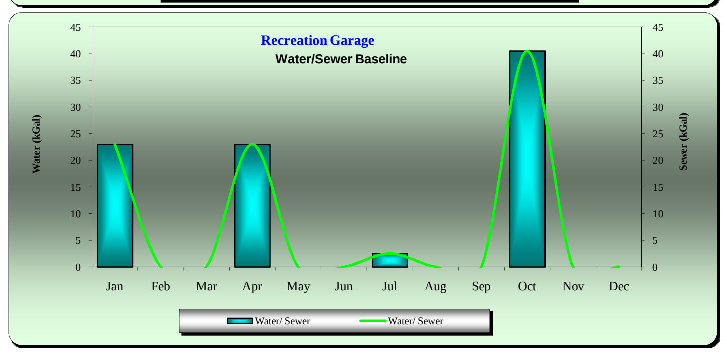
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Propane Gallons	Propane Cost $	Propane $/Gal	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	3,484	$644	$0.1847	835	$3,576	$4.28	462	$763	$1.65	159	$4,338	$27.30	23	$274	$11.90	$5,255
Feb	972	0	0.0	3,627	$688	$0.1896	596	$2,551	$4.28	353	$675	$1.91	116	$3,226	$27.93	0	$0	$0.00	$3,914
Mar	883	0	0.0	3,462	$646	$0.1866	483	$2,068	$4.28	255	$465	$1.83	91	$2,534	$27.91	0	$0	$0.00	$3,180
Apr	474	20	0.0	3,380	$614	$0.1817	0	$0	$0.00	277	$454	$1.64	25	$454	$17.87	23	$274	$11.90	$1,341
May	217	18	0.0	2,913	$512	$0.1758	260	$1,113	$4.28	0	$82	$0.00	36	$1,196	$32.94	0	$0	$0.00	$1,708
Jun	79	35	0.0	3,011	$549	$0.1824	0	$0	$0.00	0	$80	$0.00	0	$80	$0.00	0	$0	$0.00	$629
Jul	21	138	0.0	2,869	$527	$0.1836	0	$0	$0.00	0	$82	$0.00	0	$82	$0.00	3	$44	$17.79	$654
Aug	19	244	0.0	3,488	$601	$0.1722	0	$0	$0.00	0	$84	$0.00	0	$84	$0.00	0	$0	$0.00	$685
Sep	170	15	0.0	3,169	$569	$0.1795	5	$11	$2.24	147	$82	$0.56	14	$93	$6.56	0	$0	$0.00	$662
Oct	493	0	0.0	2,897	$475	$0.1639	170	$382	$2.24	160	$293	$1.83	38	$674	$17.55	41	$553	$13.66	$1,702
Nov	586	0	0.0	3,187	$473	$0.1486	215	$482	$2.24	369	$352	$0.95	64	$834	$13.07	0	$0	$0.00	$1,307
Dec	1,011	0	0.0	2,089	$315	$0.1506	568	$1,273	$2.24	164	$1,045	$6.37	94	$2,318	$24.58	0	$0	$0.00	$2,633
	6,247	**470**	**0.0**	**37,575**	**$6,611**	**$0.1760**	**3,132**	**$11,456**	**$3.66**	**2,187**	**$4,457**	**$2.04**	**638**	**$15,913**	**$24.96**	**89**	**$1,145**	**$12.86**	**$23,669**
				8.17 kWh/Sqft									**138.6** Mbtu/Sqft						**$5.15** $/Sqft
													22.2 Btu/Sqft/HDD						







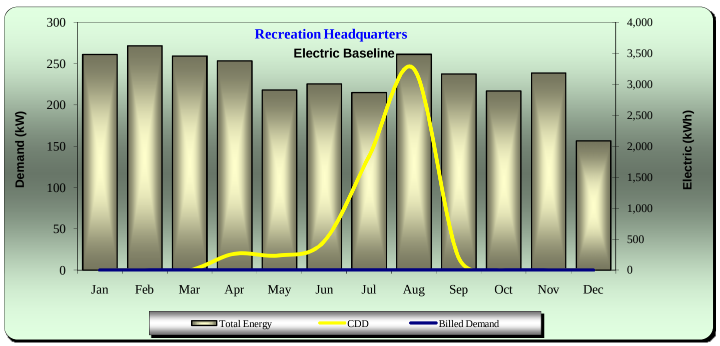


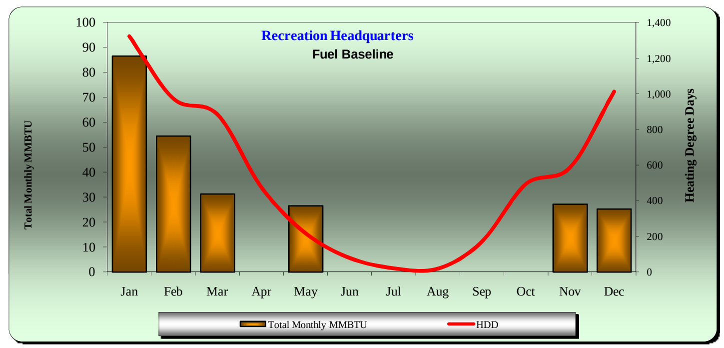
Recreation Headquarters

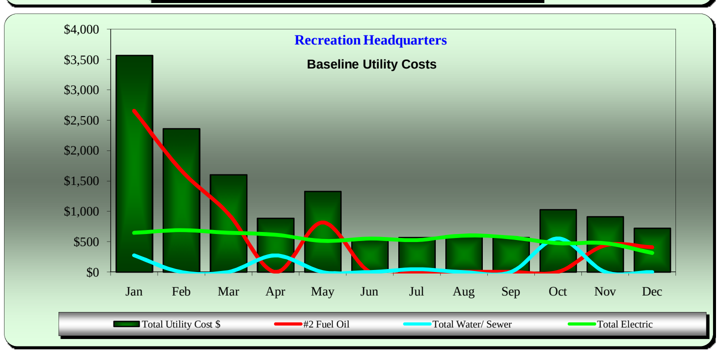
Square Footage: 3,208 ft²

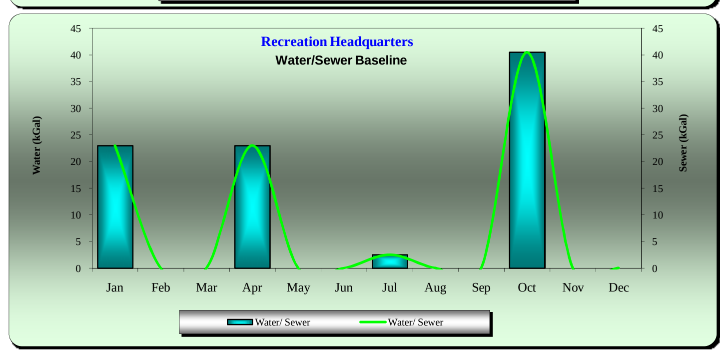
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

BASELINE: Jan-09 TO Dec-09																			
Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	3,484	$644	$0.1847	620	$2,654	$4.28	0	$0	$0.00	87	$2,654	$30.67	23	$274	$11.90	$3,571
Feb	972	0	0.0	3,627	$688	$0.1896	391	$1,673	$4.28	0	$0	$0.00	55	$1,673	$30.67	0	$0	$0.00	$2,360
Mar	883	0	0.0	3,462	$646	$0.1866	224	$959	$4.28	0	$0	$0.00	31	$959	$30.67	0	$0	$0.00	$1,605
Apr	474	20	0.0	3,380	$614	$0.1817	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	23	$274	$11.90	$888
May	217	18	0.0	2,913	$512	$0.1758	190	$814	$4.28	0	$0	$0.00	27	$814	$30.67	0	$0	$0.00	$1,327
Jun	79	35	0.0	3,011	$549	$0.1824	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$549
Jul	21	138	0.0	2,869	$527	$0.1836	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	3	$44	$17.79	$571
Aug	19	244	0.0	3,488	$601	$0.1722	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$601
Sep	170	15	0.0	3,169	$569	$0.1795	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$569
Oct	493	0	0.0	2,897	$475	$0.1639	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	41	$553	$13.66	$1,028
Nov	586	0	0.0	3,187	$473	$0.1486	195	$438	$2.24	0	$0	$0.00	27	$438	$16.06	0	$0	$0.00	$911
Dec	1,011	0	0.0	2,089	$315	$0.1506	181	$406	$2.24	0	$0	$0.00	25	$406	$16.06	0	$0	$0.00	$720
	6,247	470	0.0	37,575	$6,611	$0.1760	1,801	$6,943	$3.86	0	$0	$0.00	251	$6,943	$27.62	89	$1,145	$12.86	$14,700
				11.71 kWh/Sqft									78.4 Mbtu/Sqft						$4.58 $/Sqft
													12.5 Btu/Sqft/HDD						









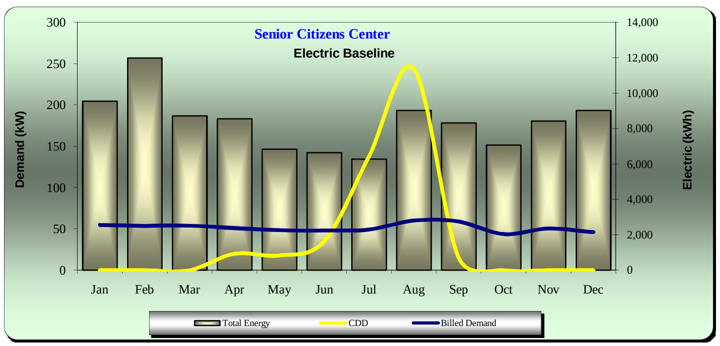
Senior Citizens Center

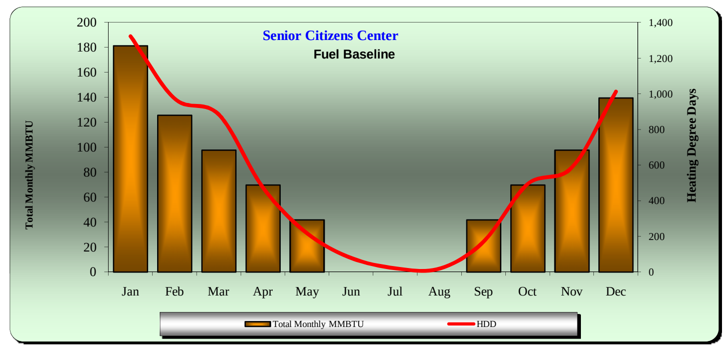
Square Footage: 11,298 ft²

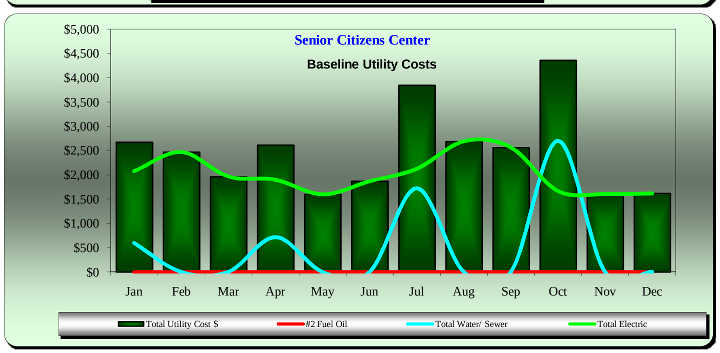
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

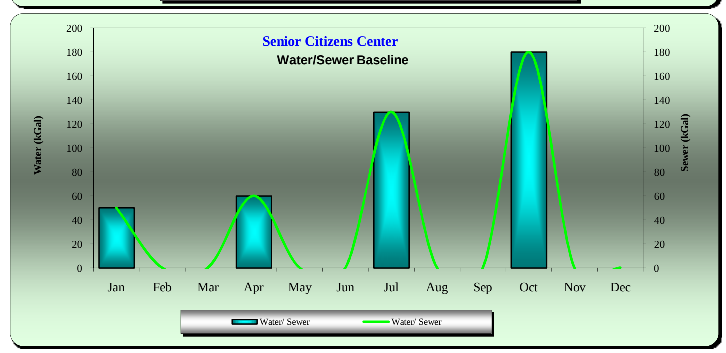
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	54.8	9,560	$2,078	$0.2173	1,300	$0	$0.00	0	$0	$0.00	181	$0	$0.00	50	$595	$11.90	$2,673
Feb	972	0	53.6	12,000	$2,469	$0.2057	900	$0	$0.00	0	$0	$0.00	126	$0	$0.00	0	$0	$0.00	$2,469
Mar	883	0	54.0	8,720	$1,967	$0.2256	700	$0	$0.00	0	$0	$0.00	98	$0	$0.00	0	$0	$0.00	$1,967
Apr	474	20	50.8	8,560	$1,900	$0.2219	500	$0	$0.00	0	$0	$0.00	70	$0	$0.00	60	$715	$11.91	$2,614
May	217	18	48.4	6,840	$1,600	$0.2340	300	$0	$0.00	0	$0	$0.00	42	$0	$0.00	0	$0	$0.00	$1,600
Jun	79	35	48.0	6,640	$1,869	$0.2814	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,869
Jul	21	138	49.2	6,280	$2,125	$0.3383	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	130	$1,721	$13.24	$3,846
Aug	19	244	60.0	9,040	$2,690	$0.2976	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,690
Sep	170	15	58.8	8,320	$2,563	$0.3081	300	$0	$0.00	0	$0	$0.00	42	$0	$0.00	0	$0	$0.00	$2,563
Oct	493	0	43.6	7,080	$1,668	$0.2356	500	$0	$0.00	0	$0	$0.00	70	$0	$0.00	180	$2,697	$14.98	$4,365
Nov	586	0	50.4	8,440	$1,605	$0.1902	700	$0	$0.00	0	$0	$0.00	98	$0	$0.00	0	$0	$0.00	$1,605
Dec	1,011	0	46.0	9,040	$1,621	$0.1793	1,000	$0	$0.00	0	$0	$0.00	140	$0	$0.00	0	$0	$0.00	$1,621
	6,247	**470**	**617.6**	**100,520**	**$24,155**	**$0.2403**	**6,200**	**$0**	**$0.00**	**0**	**$0**	**$0.00**	**866**	**$0**	**$0.00**	**420**	**$5,728**	**$13.64**	**$29,883**
				8.90 kWh/Sqft									**76.6** Mbtu/Sqft						**$2.64** $/Sqft
													12.3 Btu/Sqft/HDD						









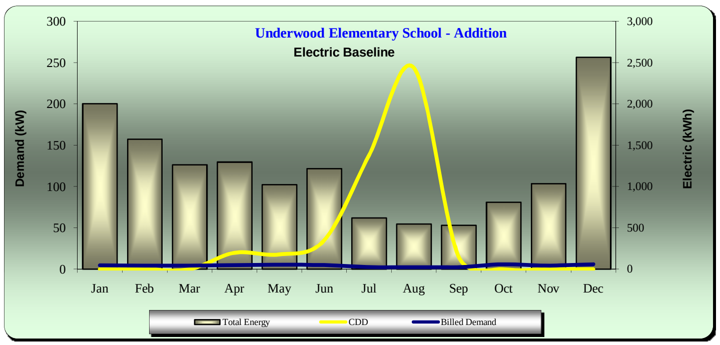
Underwood Elementary School - Addition

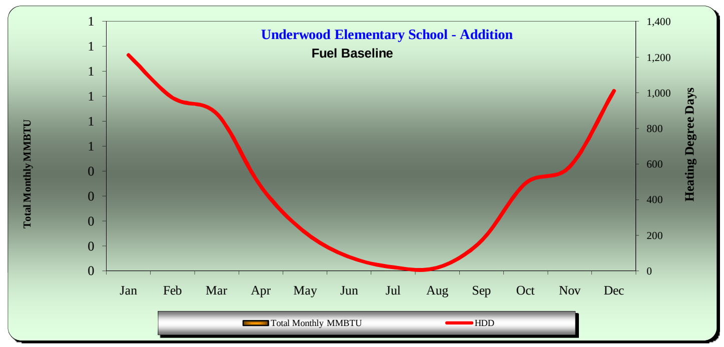
Square Footage: 2,000 ft²

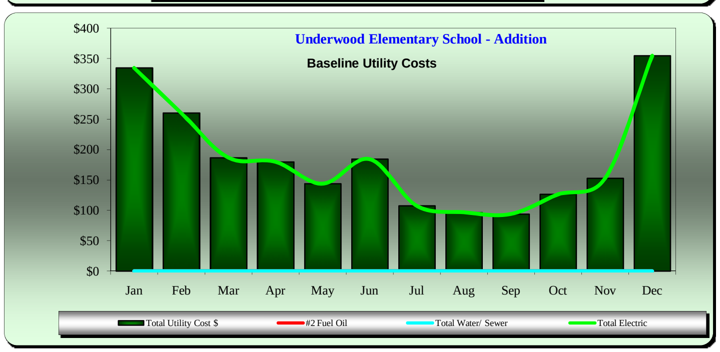
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

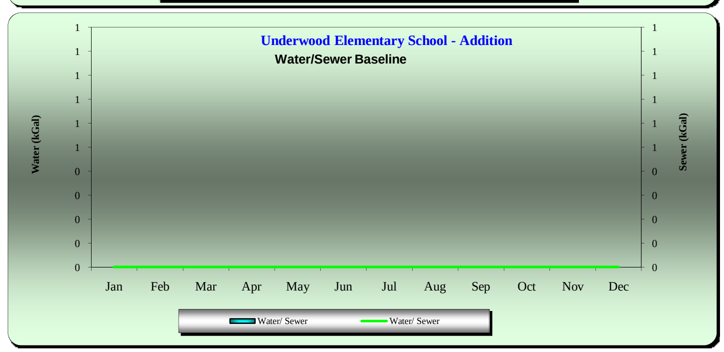
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	4.4	2,005	$335	$0.1669	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$335
Feb	972	0	4.2	1,574	$260	$0.1654	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$260
Mar	883	0	4.0	1,264	$187	$0.1478	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$187
Apr	474	20	4.8	1,298	$180	$0.1387	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$180
May	217	18	5.1	1,025	$144	$0.1404	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$144
Jun	79	35	4.7	1,220	$184	$0.1511	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$184
Jul	21	138	2.3	621	$108	$0.1732	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$108
Aug	19	244	2.2	548	$97	$0.1765	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$97
Sep	170	15	2.3	531	$94	$0.1769	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$94
Oct	493	0	5.7	813	$126	$0.1555	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$126
Nov	586	0	4.1	1,035	$153	$0.1477	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$153
Dec	1,011	0	5.8	2,566	$355	$0.1382	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$355
	6,137	470	49.6	14,500	$2,222	$0.1533	0	$0	$0.00	0	$0	$0.00	-	$0	#DIV/0!	0	$0	$0.00	$2,222
				7.25 kWh/Sqft									0.0 Mbtu/Sqft						$1.11 $/Sqft
													0.0 Btu/Sqft/HDD						









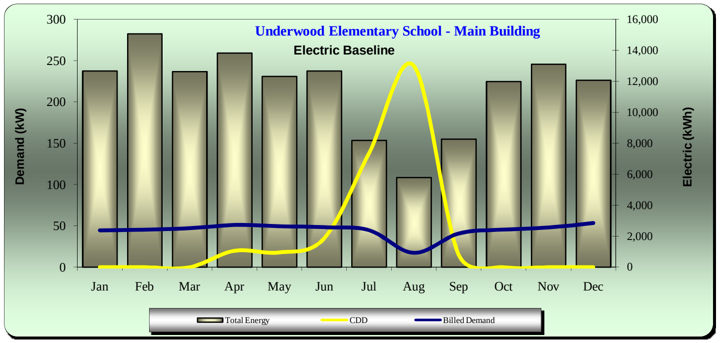
Underwood Elementary School - Main Building

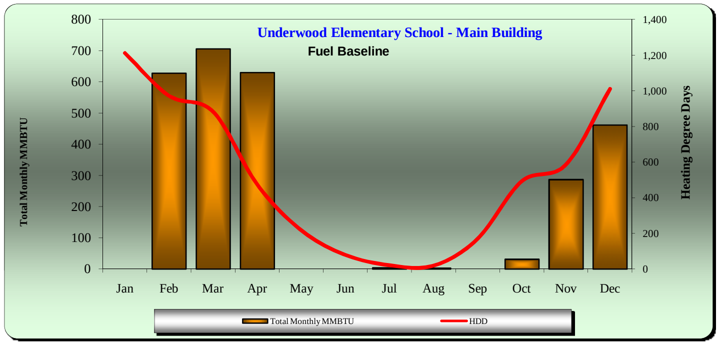
Square Footage: 41,300 ft²

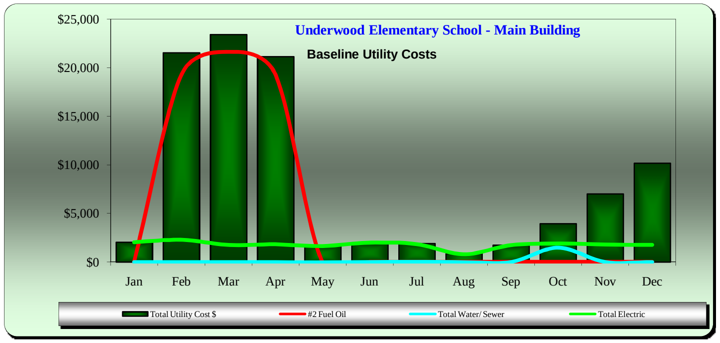
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

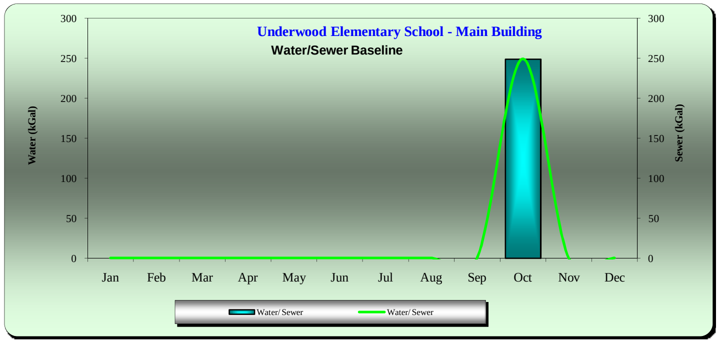
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	44.8	12,680	$2,040	$0.1609	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$2,040
Feb	972	0	45.6	15,080	$2,288	$0.1517	4,500	$19,267	$4.28	0	$0	$0.00	628	$19,267	$30.67	0	$0	$0.00	$21,555
Mar	883	0	47.2	12,640	$1,777	$0.1406	5,058	$21,658	$4.28	0	$0	$0.00	706	$21,658	$30.67	0	$0	$0.00	$23,435
Apr	474	20	51.2	13,840	$1,826	$0.1319	4,515	$19,330	$4.28	0	$0	$0.00	630	$19,330	$30.67	0	$0	$0.00	$21,155
May	217	18	49.6	12,320	$1,659	$0.1347	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,659
Jun	79	35	48.4	12,680	$1,998	$0.1576	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,998
Jul	21	138	44.8	8,200	$1,848	$0.2254	0	$0	$0.00	39	$71	$1.82	4	$71	$18.18	0	$0	$0.00	$1,919
Aug	19	244	17.2	5,800	$809	$0.1394	0	$0	$0.00	34	$62	$1.82	3	$62	$18.18	0	$0	$0.00	$870
Sep	170	15	40.8	8,280	$1,738	$0.2099	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$1,738
Oct	493	0	45.6	12,000	$1,898	$0.1582	0	$0	$0.00	316	$575	$1.82	32	$575	$18.18	249	$1,469	$5.90	$3,941
Nov	586	0	48.0	13,120	$1,806	$0.1376	0	$0	$0.00	2,870	$5,219	$1.82	287	$5,219	$18.18	0	$0	$0.00	$7,024
Dec	1,011	0	53.6	12,080	$1,778	$0.1472	0	$0	$0.00	4,618	$8,397	$1.82	462	$8,397	$18.18	0	$0	$0.00	$10,175
	6,137	**470**	**536.8**	**138,720**	**$21,464**	**$0.1547**	**14,073**	**$60,255**	**$4.28**	**7,877**	**$14,323**	**$1.82**	**2,752**	**$74,577**	**$27.10**	**249**	**$1,469**	**$5.90**	**$97,510**
				3.36									**66.6**						**$2.36**
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													10.9						
													Btu/Sqft/HDD						









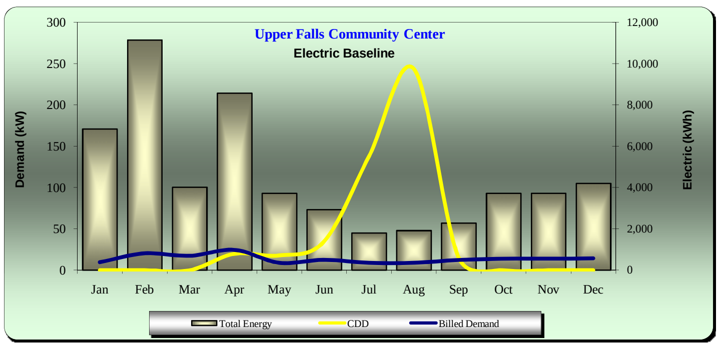
Upper Falls Community Center

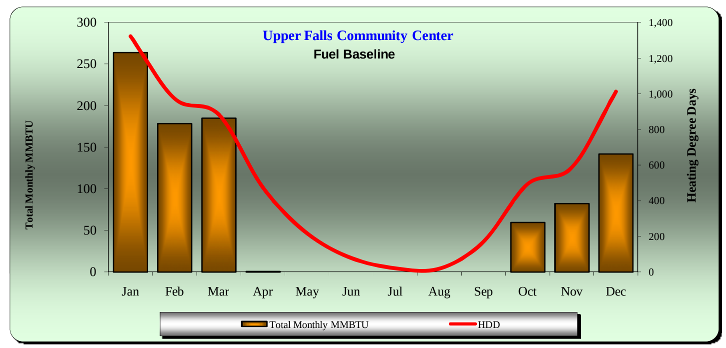
Square Footage: 13,418 ft²

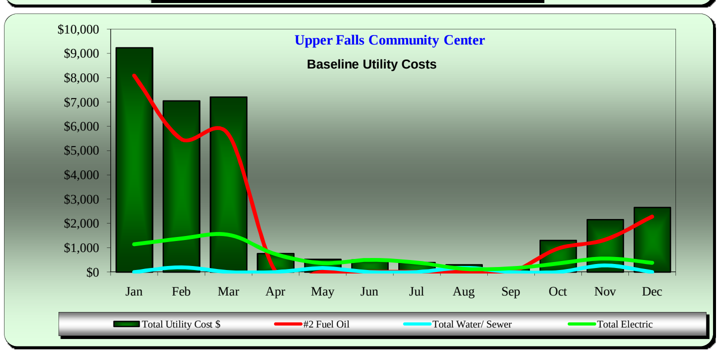
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

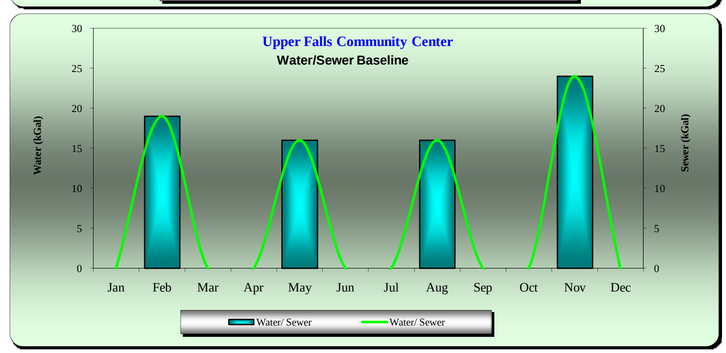
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	9.6	6,840	$1,146	$0.1675	1,890	$8,092	$4.28	0	$0	$0.00	264	$8,092	$30.67	0	$0	$0.00	$9,238
Feb	972	0	20.4	11,160	$1,376	$0.1233	1,279	$5,477	$4.28	0	$0	$0.00	179	$5,477	$30.67	19	$195	$10.29	$7,048
Mar	883	0	17.4	4,020	$1,540	$0.3830	1,326	$5,677	$4.28	0	$0	$0.00	185	$5,677	$30.67	0	$0	$0.00	$7,216
Apr	474	20	24.6	8,580	$735	$0.0856	6	$24	$4.28	0	$0	$0.00	1	$24	$30.66	0	$0	$0.00	$759
May	217	18	9.0	3,720	$366	$0.0984	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	16	$166	$10.35	$532
Jun	79	35	12.6	2,940	$498	$0.1694	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$498
Jul	21	138	9.0	1,800	$389	$0.2162	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$389
Aug	19	244	9.0	1,920	$124	$0.0644	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	16	$175	$10.92	$298
Sep	170	15	12.4	2,280	$142	$0.0624	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	0	$0	$0.00	$142
Oct	493	0	13.8	3,720	$351	$0.0943	428	$959	$2.24	0	$0	$0.00	60	$959	$16.06	0	$0	$0.00	$1,310
Nov	586	0	13.8	3,720	$556	$0.1494	591	$1,324	$2.24	0	$0	$0.00	82	$1,324	$16.06	24	$276	$11.50	$2,156
Dec	1,011	0	14.4	4,200	$380	$0.0906	1,017	$2,280	$2.24	0	$0	$0.00	142	$2,280	$16.06	0	$0	$0.00	$2,661
	6,247	470	166.0	54,900	$7,602	$0.1385	6,536	$23,833	$3.65	0	$0	$0.00	912	$23,833	$26.12	75	$812	$10.82	$32,246
				4.09 kWh/Sqft									68.0 Mbtu/Sqft						$2.40 $/Sqft
													10.9 Btu/Sqft/HDD						









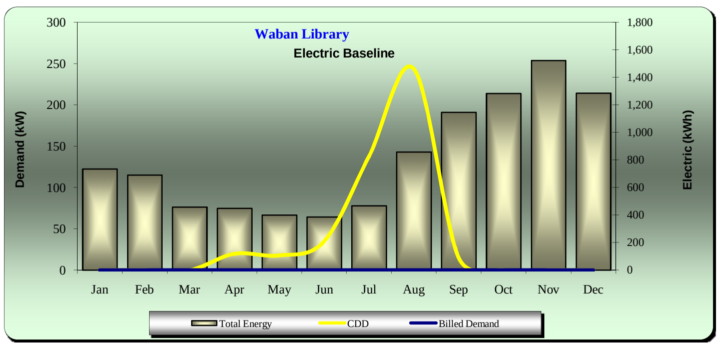
Waban Library

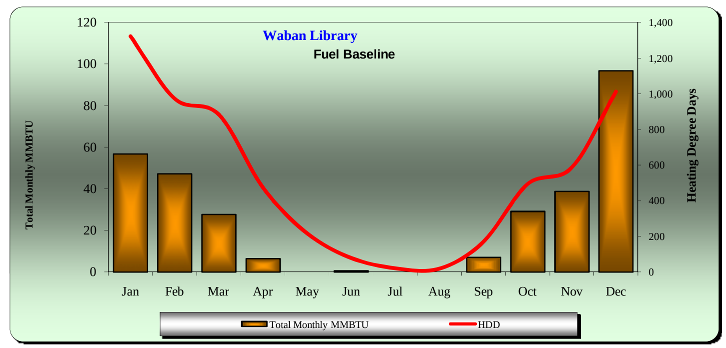
Square Footage: 6,378 ft²

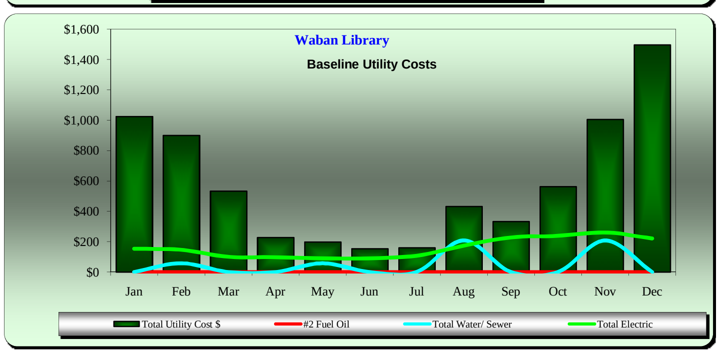
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

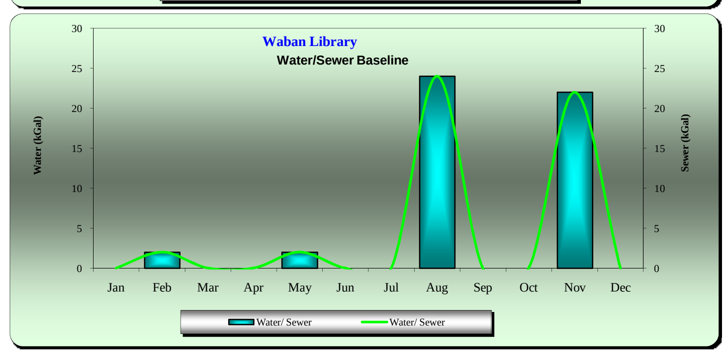
BASELINE: Jan-09 TO Dec-09

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,322	0	0.0	736	$153	$0.2085	0	$0	$0.00	568	$872	$1.54	57	$872	$15.36	0	$0	$0.00	$1,026
Feb	972	0	0.0	691	$146	$0.2115	0	$0	$0.00	473	$697	$1.47	47	$697	$14.75	2	$57	$28.71	$901
Mar	883	0	0.0	458	$101	$0.2204	0	$0	$0.00	277	$432	$1.56	28	$432	$15.61	0	$0	$0.00	$533
Apr	474	20	0.0	450	$99	$0.2208	0	$0	$0.00	65	$128	$1.97	7	$128	$19.71	0	$0	$0.00	$228
May	217	18	0.0	401	$90	$0.2241	0	$0	$0.00	0	$51	$0.00	0	$51	$0.00	2	$57	$28.71	$198
Jun	79	35	0.0	387	$92	$0.2367	0	$0	$0.00	6	$63	$10.46	1	$63	$104.60	0	$0	$0.00	$154
Jul	21	138	0.0	469	$108	$0.2303	0	$0	$0.00	0	$53	$0.00	0	$53	$0.00	0	$0	$0.00	$161
Aug	19	244	0.0	858	$173	$0.2016	0	$0	$0.00	0	$51	$0.00	0	$51	$0.00	24	$208	$8.66	$432
Sep	170	15	0.0	1,148	$227	$0.1980	0	$0	$0.00	71	$105	$1.48	7	$105	$14.82	0	$0	$0.00	$333
Oct	493	0	0.0	1,284	$237	$0.1850	0	$0	$0.00	292	$326	$1.12	29	$326	$11.16	0	$0	$0.00	$563
Nov	586	0	0.0	1,524	$259	$0.1699	0	$0	$0.00	388	$540	$1.39	39	$540	$13.92	22	$207	$9.43	$1,006
Dec	1,011	0	0.0	1,287	$220	$0.1713	0	$0	$0.00	968	$1,276	$1.32	97	$1,276	$13.18	0	$0	$0.00	$1,497
	6,247	**470**	**0.0**	**9,693**	**$1,906**	**$0.1967**	**0**	**$0**	**$0.00**	**3,108**	**$4,596**	**$1.48**	**311**	**$4,596**	**$14.79**	**50**	**$530**	**$10.60**	**$7,032**
				1.52 kWh/Sqft									**48.7** Mbtu/Sqft						**$1.10** $/Sqft
													7.8 Btu/Sqft/HDD						









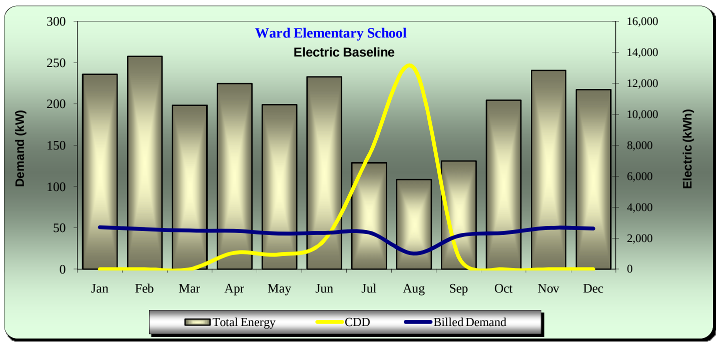
Ward Elementary School

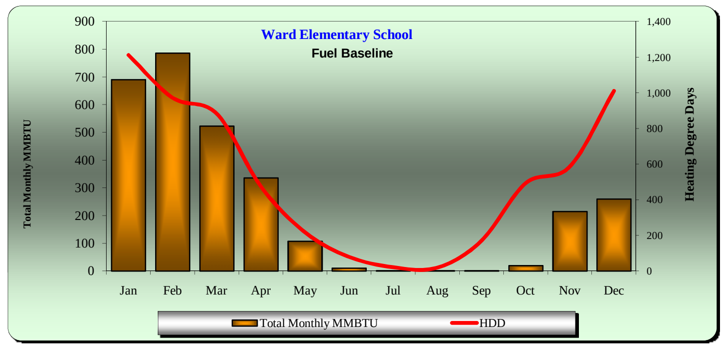
Square Footage: 38,000 ft²

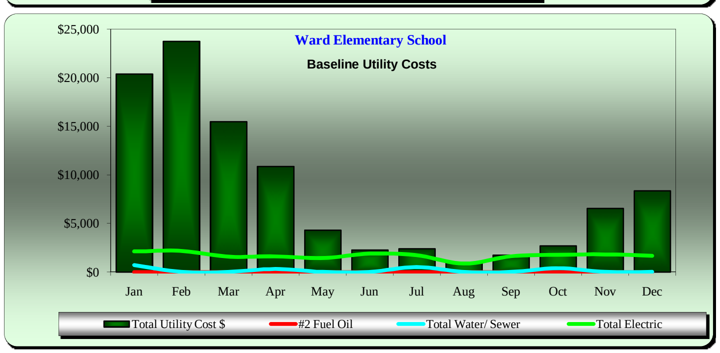
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

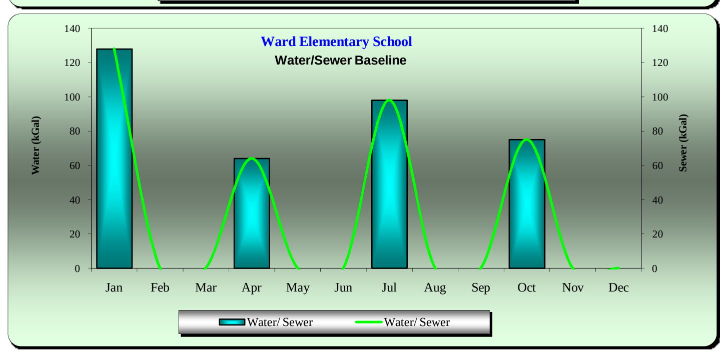
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	50.8	12,600	$2,113	$0.1677	0	$0	$0.00	6,909	$17,579	$2.54	691	$17,579	$25.44	128	$702	$5.48	$20,394
Feb	972	0	48.4	13,760	$2,171	$0.1578	0	$0	$0.00	7,863	$21,602	$2.75	786	$21,602	$27.47	0	$0	$0.00	$23,773
Mar	883	0	46.8	10,600	$1,571	$0.1482	0	$0	$0.00	5,226	$13,914	$2.66	523	$13,914	$26.62	0	$0	$0.00	$15,485
Apr	474	20	46.4	12,000	$1,597	$0.1330	0	$0	$0.00	3,358	$8,990	$2.68	336	$8,990	$26.77	64	$302	$4.72	$10,889
May	217	18	43.2	10,640	$1,424	$0.1339	0	$0	$0.00	1,081	$2,880	$2.66	108	$2,880	$26.64	0	$0	$0.00	$4,304
Jun	79	35	44.0	12,440	$1,883	$0.1514	0	$0	$0.00	112	$389	$3.48	11	$389	$34.75	0	$0	$0.00	$2,273
Jul	21	138	44.4	6,880	$1,715	$0.2493	0	$0	$0.00	19	$198	$10.42	2	$198	$104.17	98	$505	$5.15	$2,418
Aug	19	244	18.8	5,800	$843	$0.1454	0	$0	$0.00	7	$154	$22.00	1	$154	$219.95	0	$0	$0.00	$997
Sep	170	15	40.4	7,000	$1,609	$0.2298	0	$0	$0.00	2	$144	$71.84	0	$144	$718.43	0	$0	$0.00	$1,752
Oct	493	0	44.0	10,920	$1,768	$0.1619	0	$0	$0.00	195	$546	$2.80	20	$546	$27.98	75	$379	$5.06	$2,693
Nov	586	0	50.0	12,840	$1,806	$0.1406	0	$0	$0.00	2,146	$4,752	$2.21	215	$4,752	$22.14	0	$0	$0.00	$6,558
Dec	1,011	0	49.2	11,600	$1,661	$0.1432	0	$0	$0.00	2,598	$6,710	$2.58	260	$6,710	$25.83	0	$0	$0.00	$8,371
	6,137	470	526.4	127,080	$20,161	$0.1587	0	$0	$0.00	29,516	$77,857	$2.64	2,952	$77,857	$26.38	365	$1,888	$5.17	$99,906
				3.34 kWh/Sqft									77.7 Mbtu/Sqft						$2.63 $/Sqft
													12.7 Btu/Sqft/HDD						









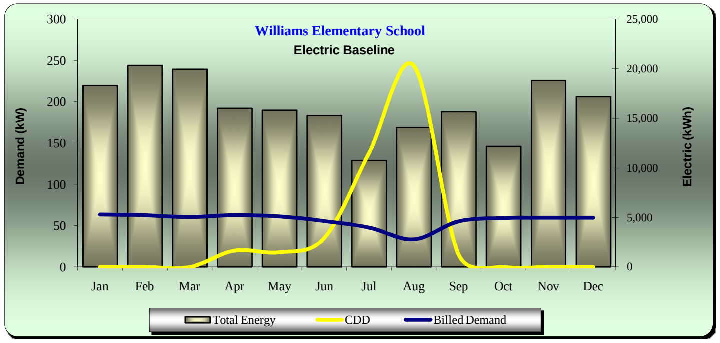
Williams Elementary School

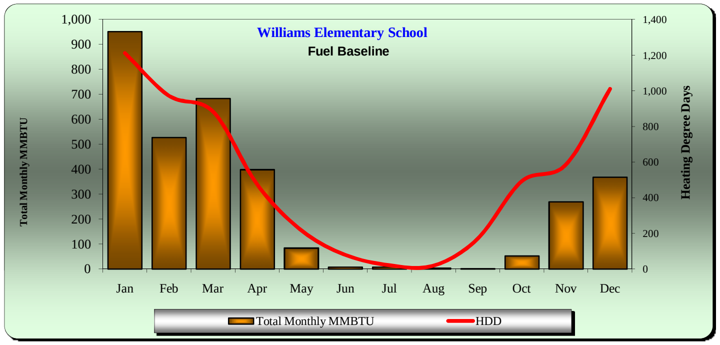
Square Footage: 31,000 ft²

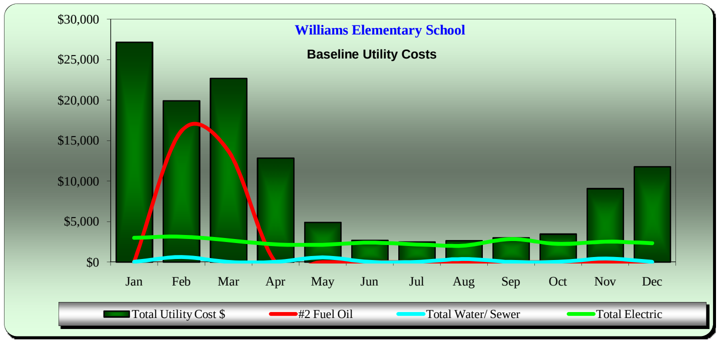
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

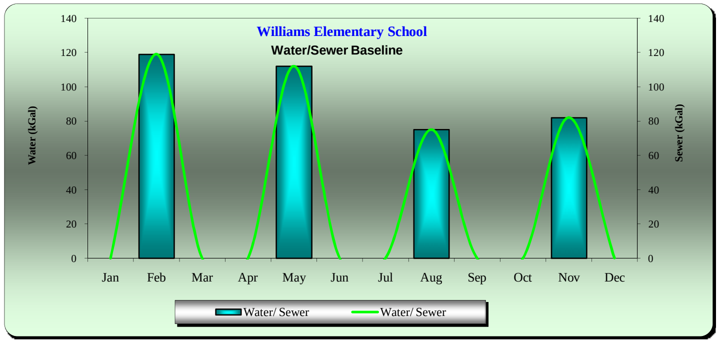
BASELINE: Jan-09 TO Jan-10

Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	63.6	18,320	$2,977	$0.1625	0	$0	$0.00	9,522	$24,184	$2.54	952	$24,184	$25.40	0	$0	$0.00	$27,161
Feb	972	0	62.8	20,360	$3,141	$0.1543	3,777	$16,172	$4.28	0	$0	$0.00	527	$16,172	$30.67	119	$625	$5.25	$19,938
Mar	883	0	60.4	19,960	$2,673	$0.1339	3,209	$13,740	$4.28	2,362	$6,298	$2.67	684	$20,038	$29.29	0	$0	$0.00	$22,711
Apr	474	20	62.8	16,040	$2,178	$0.1358	0	$0	$0.00	3,985	$10,657	$2.67	399	$10,657	$26.74	0	$0	$0.00	$12,835
May	217	18	61.2	15,840	$2,127	$0.1343	0	$0	$0.00	844	$2,209	$2.62	84	$2,209	$26.18	112	$583	$5.21	$4,920
Jun	79	35	55.6	15,280	$2,385	$0.1561	0	$0	$0.00	77	$303	$3.93	8	$303	$39.32	0	$0	$0.00	$2,688
Jul	21	138	47.6	10,760	$2,162	$0.2010	0	$0	$0.00	76	$320	$4.21	8	$320	$42.11	0	$0	$0.00	$2,482
Aug	19	244	33.2	14,080	$2,024	$0.1437	0	$0	$0.00	47	$246	$5.23	5	$246	$52.32	75	$371	$4.95	$2,641
Sep	170	15	55.2	15,680	$2,839	$0.1810	0	$0	$0.00	7	$159	$22.68	1	$159	$226.84	0	$0	$0.00	$2,997
Oct	493	0	59.2	12,200	$2,224	$0.1823	0	$0	$0.00	528	$1,236	$2.34	53	$1,236	$23.40	0	$0	$0.00	$3,460
Nov	586	0	59.6	18,840	$2,511	$0.1333	0	$0	$0.00	2,692	$6,143	$2.28	269	$6,143	$22.82	82	$423	$5.16	$9,077
Dec	1,011	0	59.6	17,200	$2,331	$0.1355	0	$0	$0.00	3,687	$9,447	$2.56	369	$9,447	$25.62	0	$0	$0.00	$11,778
	6,137	**470**	**680.8**	**194,560**	**$29,572**	**$0.1520**	**6,986**	**$29,912**	**$4.28**	**23,827**	**$61,201**	**$2.57**	**3,358**	**$91,114**	**$27.13**	**388**	**$2,003**	**$5.16**	**$122,689**
				6.28 kWh/Sqft									**108.3** Mbtu/Sqft **17.7** Btu/Sqft/HDD						**$3.96** $/Sqft







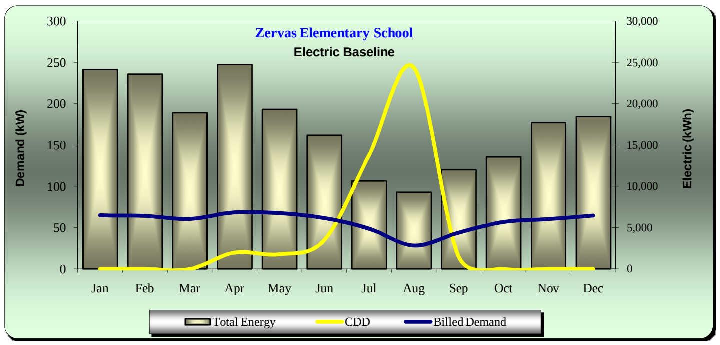


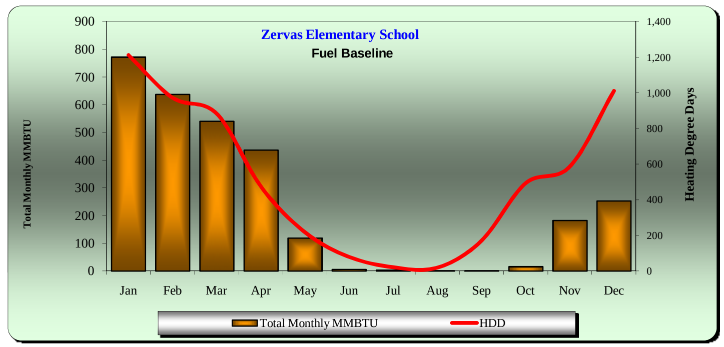
Zervas Elementary School

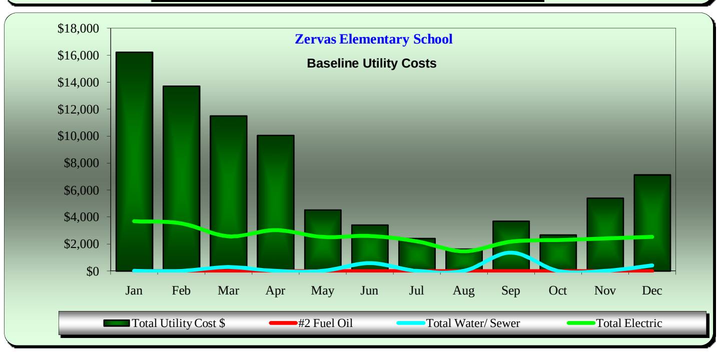
Square Footage: 30,646 ft²

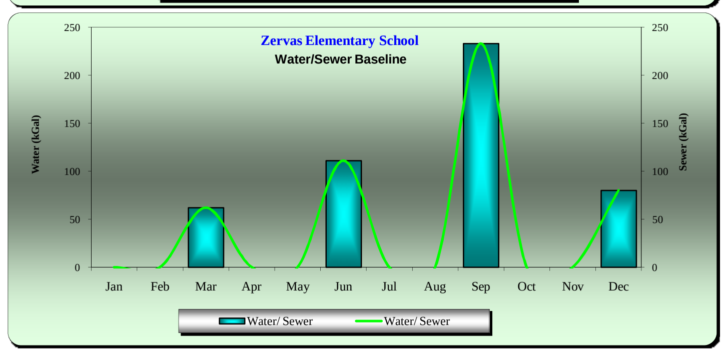
Select a start date for the Baseline Analysis Jan-09
Select the number of years to average 1

BASELINE: Jan-09 TO Jan-10																			
Month	HDD	CDD	Billed Demand kW	Total Energy kWh	Total Electric Cost $	Blended Unit Cost $/kWh	#2 Fuel Oil Gallons	#2 Fuel Oil Cost $	#2 Fuel Oil $/Gal	Natural Gas Therms	Natural Gas Cost $	Natural Gas $/Therm	Total Monthly MMBTU (Gas & Oil)	Total Fuel Cost ($) (Gas & Oil)	Fuel Unit Cost $/MMBTU	Water/ Sewer HCF	Total Water/ Sewer Cost $	Annual Water Unit Cost HCF	Total Utility Cost $
Jan	1,212	0	64.8	24,160	$3,695	$0.1529	0	$0	$0.00	7,718	$12,524	$1.62	772	$12,524	$16.23	0	$0	$0.00	$16,219
Feb	972	0	64.0	23,600	$3,538	$0.1499	0	$0	$0.00	6,372	$10,170	$1.60	637	$10,170	$15.96	0	$0	$0.00	$13,708
Mar	883	0	60.4	18,920	$2,571	$0.1359	0	$0	$0.00	5,408	$8,652	$1.60	541	$8,652	$16.00	62	$292	$4.71	$11,515
Apr	474	20	68.4	24,800	$3,035	$0.1224	0	$0	$0.00	4,362	$7,015	$1.61	436	$7,015	$16.08	0	$0	$0.00	$10,051
May	217	18	67.2	19,360	$2,520	$0.1302	0	$0	$0.00	1,196	$2,012	$1.68	120	$2,012	$16.83	0	$0	$0.00	$4,532
Jun	79	35	61.6	16,200	$2,595	$0.1602	0	$0	$0.00	65	$245	$3.77	7	$245	$37.66	111	$577	$5.20	$3,417
Jul	21	138	48.8	10,680	$2,192	$0.2053	0	$0	$0.00	43	$230	$5.35	4	$230	$53.50	0	$0	$0.00	$2,422
Aug	19	244	28.4	9,320	$1,452	$0.1558	0	$0	$0.00	19	$179	$9.40	2	$179	$93.97	0	$0	$0.00	$1,630
Sep	170	15	44.0	12,040	$2,171	$0.1803	0	$0	$0.00	14	$166	$11.86	1	$166	$118.58	233	$1,363	$5.85	$3,700
Oct	493	0	56.8	13,600	$2,292	$0.1685	0	$0	$0.00	159	$385	$2.42	16	$385	$24.22	0	$0	$0.00	$2,677
Nov	586	0	60.4	17,720	$2,414	$0.1362	0	$0	$0.00	1,823	$2,988	$1.64	182	$2,988	$16.39	0	$0	$0.00	$5,402
Dec	1,011	0	64.4	18,480	$2,516	$0.1362	0	$0	$0.00	2,533	$4,203	$1.66	253	$4,203	$16.59	80	$411	$5.13	$7,130
	6,137	470	689.2	208,880	$30,992	$0.1484	0	$0	$0.00	29,712	$48,769	$1.64	2,971	$48,769	$16.41	486	$2,643	$5.44	$82,404
				6.82									97.0						$2.69
				kWh/Sqft									Mbtu/Sqft						$/Sqft
													15.8						
													Btu/Sqft/HDD						









A.2 ENERGY AND WATER COSTS

The energy and water unit costs shown in the table below will be used to calculate energy and water cost savings. The rates in the table below are based on the rates in effect during the base year with upward adjustment (escalation) of 3.0% to account for expected rate increases during the construction period. The rates will be increased by 3.0% for each successive year to account for utility rate escalation.

Energy and Water Rates

Building	Electricity ($ / kWh)	No. 2 Oil ($ / Gal.)	Natural Gas ($ / Therm)	Water ($ / kGal)	Sewer ($ / kGal)
School Buildings	$0.1792	$2.9355	$1.6789	$8.2070	$16.4275
City Buildings	$0.1792	$2.9355	$1.6789	$8.2070	$16.4275

A.3 DESCRIPTION OF BUILDINGS

Introduction

During the Detailed Energy Audit (DEA) process, NORESCO not only considered the importance of technical and financial benchmarks, but also took a holistic approach in proposing specific Energy Conservation Measures (ECMs). NORESCO developed a comprehensive program for these forty-one city and school buildings that considered facility staff and occupant needs, existing systems and equipment and new system integration, current and future energy markets, as well as the technical and financial feasibility of the program in total. Because of this approach, not every individual proposed ECM in every building will have a payback that falls within the overall 15-year guideline. However, we have structured an integrated program that provides the City with ECMs that, in total, meet all engineering and financial criteria and address capital and infrastructure improvement needs.

General Observations

The City of Newton will greatly benefit from establishing a comprehensive energy management program that includes strategies for improving equipment efficiencies and strategies for optimizing the operation of its municipal and school buildings. This Phase 3 project completes providing these comprehensive upgrades in buildings not yet addressed in the earlier two projects.

Currently, based on the utility rates and energy use provided by the City, baseline utility costs total approximately $2.4 million annually for energy and water for the forty-one facilities listed in the DEA. The ages, conditions, and types of systems in each building vary greatly, which reflects the range of energy savings and energy conservation opportunities identified across the buildings. NORESCO identified significant savings potential in some facilities, and comparatively less savings potential in others that have had recent facilities improvements or less frequent use.

Based on the detailed investigations performed at the facilities, NORESCO projects an average energy savings potential of approximately 15 percent of existing utility costs. The energy saving measures we have identified in this audit will not only provide efficiency improvements, but also maintenance savings and building operational improvements as well. To sustain these savings over the coming years, facility maintenance staff will be trained to operate and maintain the new equipment. Also included is the annual performance monitoring by NORESCO to provide savings verification over the 15-year term of the agreement.

Site Conditions

The City of Newton selected forty-one buildings for inclusion in this energy project. The selected facilities are described on the following pages:

Building	Building Type	Total Sq.Ft.	Street Address	Year Built	Type of Heating System	Type of Cooling System	Type of Lighting	Typical Occupancy Schedule
School Buildings								
Angier School	Elementary School	51,300	1697 Beacon Street	1919	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Bowen School	Elementary School	63,915	280 Cypress Street	1952	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Burr School	Elementary School	53,000	171 Pine Street	1967	Hot Water Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Cabot School	Elementary School	41,000	229 Cabot Street	1929	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Countryside School	Elementary School	60,700	191 Dedham Street	1953	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Franklin School	Elementary School	56,764	125 Derby Street	1939	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Horace-Mann School	Elementary School	35,000	687 Watertown Street	1965	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Lincoln-Eliot School	Elementary School	51,074	191 Pearl Street	1939	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Mason-Rice School	Elementary School	39,000	149 Pleasant Street	1959	Hot Water Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Memorial-Spaulding School	Elementary School	68,775	250 Brookline Street	1954	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Pierce School	Elementary School	33,800	170 Temple Street	1951	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Underwood School	Elementary School	43,300	101 Vernon Street	1924	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Ward School	Elementary School	38,000	10 Dolphin Road	1928	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Williams School	Elementary School	31,000	141 Grove Street	1950	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F
Zervas School	Elementary School	30,646	30 Beethoven Avenue	1954	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	7 a – 4 p, M – F

Building	Building Type	Total Sq.Ft.	Street Address	Year Built	Type of Heating System	Type of Cooling System	Type of Lighting	Typical Occupancy Schedule
City Buildings								
Albermarle Fieldhouse	Recreation	2,072	250 Albemarle Road		Gas Furnace	None	T8 w/ some incandescent	
Auburndale Library	Library	4,830	371 Auburn Street	1934	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	10a – 3p, T, Sat 3p – 8p, Th
Crafts St. DPW	Administration	19,553	90 Crafts Street	1894	Hot Water Boiler	Some window A/C Units	T8 w/ some incandescent	6a – 3p, M - F
Crafts St. Garage	Public Works	23,474	110 Crafts Street	1919, 1936, 1988		Split System	T8 w/ some incandescent	6a – 3p, M - F
Elliot St Garage	Public Works	9,000	70 Elliot Street	1959		None	T8 w/ some incandescent	6a – 3p, M - F
Elliot St. Ops Center	Administration	15,858	74 Elliot Street	1927	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	6a – 3p, M - F
Fire Headquarters	Administration	6,541	1164 Centre Street	1928	Hot Water Boiler	Some window A/C Units	T8 w/ some incandescent	8a – 5p, M - F
Fire Station 3	Public Safety	16,215	31 Willow Street	1955	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	24 / 7, M – F
Gath Pool Facility	Recreation	4,600	256 Albemarle Road		None	None	T8 w/ some incandescent	9a – 6p, Sun - Sat
Hawthorne Fieldhouse	Recreation	5,608	71 Hawthorne Street	1950	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	
Health Department	Administration	4,581	1294 Centre Street	1934	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	8a – 5p, M - F
Jackson Homestead	Museum	7,000	527 Washington Street	1807	Gas Furnace	Split System	T8 w/ some incandescent	9a – 5p, M – F 12p – 5p, Sat, Sun
Lower Falls Comm Center	Recreation	10,519	545 Grove Street	1958	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	
Main Library	Library	93,000	330 Homer Street		Hot Water Boiler	Electric Chiller	T8 w/ some incandescent	9a – 9p, M - Th 9a – 6p, F - Sun
Newton Centre Fieldhouse	Recreation	4,352	81 Tyler Terrace	1900	Oil Furnace	None	T8 w/ some incandescent	
Newton Corner Library	Library	6,138	124 Vernon Street	1919, 1934	Gas Furnace	None	T8 w/ some incandescent	1p – 6p, M, T, Th 10a – 1p, W, F, S

Building	Building Type	Total Sq.Ft.	Street Address	Year Built	Type of Heating System	Type of Cooling System	Type of Lighting	Typical Occupancy Schedule
Nahanton Park Fieldhouse	Recreation	1,440	Nahanton Street		Gas Furnace	None	T8 w/ some incandescent	9a – 9p, M - Th 9a – 6p, F - Sun
Nonantum Library	Library	5,137	114 Bridge Street	1957	Steam Boiler	None	T8 w/ some incandescent	1p – 6p, M, T, Th 10a – 1p, W, F, S
Public Buildings Dept	Administration	7,100	52 Elliot Street	1965, 1975, 1980	Steam Boiler	Some window A/C Units	T8 w/ some incandescent	8a – 5p, M - F
Recreation Garage	Public Works	4,600	70 Crescent Street, Rear		Oil Furnace	None	T8 w/ some incandescent	6a – 3p, M - F
Recreation Headquarters	Administration	3,208	70 Crescent Street		Steam Boiler	Some window A/C Units	T8 w/ some incandescent	8a – 5p, M - F
Senior Citizens Center	Recreation	11,298	345 Walnut Street	1938	Steam Boiler	Split System	T8 w/ some incandescent	8a – 5p, M - F
Upper Falls Comm Ctr	Recreation	13,418	5 High Street	1955	Steam Boiler	None	T8 w/ some incandescent	
Waban Library	Library	6,378	1608 Beacon Street	1934	Hot Water Boiler	None	T8 w/ some incandescent	1p – 6p, M, T, Th 10a – 1p, W, F, S
TOTAL		**983,194**						

Note: Pump stations were removed from the scope of work per the City's request.

Angier School

The Angier School is the oldest school in the city, located in the City of Newton's Waban village. It is a brick building with a large gym in the basement, and auditorium / library in the center of the building, with classrooms around the perimeter of the school. As the City plans to demolish and replace this building, NORESCO investigated energy conservation measures with a simple payback of five years or less as directed by the City.

Building Envelope

The Angier School is a turn of the century school building of brick construction. The windows were replaced with double-pane windows with aluminum frames. Interior weather panel sections of the window system have lower insulation values, and could be improved.

Lighting Systems

The existing lighting systems at the Angier Elementary School primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consists of 2-lamp 2'x4' and 2'x2' recessed troffers; hallways have 2-lamp wraparounds; gymnasium has 4-lamp recessed troffers; and offices have 2-lamp 2'x4' recessed troffers.

Heating Systems

The school is heated by steam boilers located in the basement mechanical room. Boiler #1 is a Smith steam boiler with Power Flame Burner with dual-fuel capability. Boiler #2 is an oil-fired Smith unit with Industrial Combustion burner. During the audit, a new gas-fired boiler was being installed to replace Boiler #2. The boilers steam to unit ventilators, radiators, and heating & ventilating (H&V) units throughout the school. A typical classroom is heated by a combination of Nesbitt Unit ventilators and steam radiation. School hallways are heated by steam radiation and a steam H&V unit heats the gymnasium.

Cooling Systems

Angier has no central cooling system. Window air conditioning units were noted in the main office, and various classrooms. Because the audit was conducted during the heating season, the exact number of window units utilized during the cooling season is unknown.

Temperature Control Systems

An existing Johnson Controls pneumatic control system is in place with limited functionality. The Day/Night pneumatic panel runs on a 0/20 psig signal and has 5 control zones (Gym H&V, Second Floor North, Second Floor East, Second Floor West, Second Floor South). Signs of widespread oil & water infiltration in the day/night panel that has migrated into the rest of the building was observed. Becase of oil contamination in the pneumatics, the school is run in day mode 24/7, and cannot setback the pneumatic control valves. Boilers are manually controlled to maintain heating pressure.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks contain standard flow threaded aerators.

Bowen School

Bowen Elementary School is located just south of Newton Center. The school has had many renovations, including a recent replacement of many of the windows and doors. There is one modular attached to the building.

Building Envelope

The building is a brick and concrete main structure with flat rubber roof. Main exterior doors are in need of replacement, and many reveal large gaps when closed. Windows are double-pane with aluminum frames. Inadequate insulation was found in the older section of the building.

Lighting Systems

The existing lighting systems at the primarily consist of T8 linear fluorescent luminaires with electronic ballasts. Others include T12 lamps, compact fluorescents, and incandescent bulb fixtures. The lighting in the classrooms consists of 2-lamp 2'x4' and wraparounds; hallways have 2-lamp 2'x2' recessed; and the offices have 2-lamp 2'x4' recessed troffers.

Heating Systems

The building is heated by a single oil-fired steam boiler in the basement boiler room. Boiler #2 is currently out of service. The majority of the building is supplied with steam heat, with the exception of the 2000 addition that is supplied hot water heating via a shell & tube heat exchanger and pumps in the boiler room.

Classrooms original to the building are heated by steam unit ventilators and steam radiation. Five new classrooms are heated by hot water unit ventilators and hot water fin-tube radiation. Both the gym and Auditorium are heated by steam H&Vs. A small steam H&V in the boiler room was not running during the time of the audit, as well as approximately 50% of the classroom unit ventilators having their fans manually switched off.

Cooling Systems

Bowen has no central cooling system. Window air conditioning units were noted in the main office and various classrooms. Because the audit was conducted during the heating season, the exact number of window units operated is unknown.

Temperature Control Systems

The majority of the building, with the exception of the modular classroom, is controlled by a Johnson Controls pneumatic controls system with five control zones (Auditorium, Gym, Old Classrooms, New Wing Classrooms, and Custodian). The control system does not automatically switch from day to night mode, as the custodian manually switches the system from day to night.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks have a mixture of dual faucets without threaded aerators and standard flow threaded aerators.

Burr Elementary School

The Burr Elementary School is located in the Auburndale neighborhood, and has approximately 383 students and 55 faculty members. All of the classrooms are situated on the second floor, with the first floor being used for administrative offices as well as housing the cafetorium and gym.

Building Envelope

The building is a concrete structure with a flat rubber roof. The schools windows and doors are all original, and well beyond their useful life. The windows are operable single-pane units with poor seals between sash and jambs. Several cracks were found at the roof/wall joints.

Lighting Systems

The existing lighting systems primarily consist of T8 linear fluorescent luminaires with electronic ballasts. Others include T12 lamps, compact fluorescents, and incandescent fixtures. The lighting in the classrooms consist of 3-lamp 2'x4' recessed troffers; hallways have 4-lamp 2x2 recessed toffers; the gymnasium has 2-lamp T5 high bays; and offices have 4-lamp 2'x2' recessed troffers.

Heating Systems

The building is heated by two, new natural gas boilers providing hot water for unit ventilators and radiation. The Gym, Cafetorium, and Music Room have hot water H&V air handlers. Boilers #1 and 2 both have Power Flame Burners rated for 2,500 MBH of heating capacity. Two 7.5 HP pumps circulate the hot water throughout the building.

Boilers are set to maintain a 180°F operating temperature and operate 24/7. A 3-way mixing valve for heating hot water temperature control is receiving no signal from its oil-clogged pneumatic receiver controller, and thus is continuously open. When the pneumatic controls evaluation took place, 200°F water was being circulated to the building.

Cooling Systems

Burr has no central cooling system. Window air conditioning units were noted in the main office and various classrooms. Because the audit was conducted during the heating season, the exact number of window units operated is unknown. There are also two split air conditioning systems that cool the second floor corridors.

Temperature Control Systems

The mechanical equipment is primarily controlled by a 30-year old Honeywell pneumatic control system. Widespread oil infiltration was observed in two Honeywell control panels as well as at the thermostats. The main control air pressure reducing valves (PRVs) should operate at a 15 psig day signal. NORESCO noted the Daytime pressure has been set to 20 psig, so the system can never go into the day (or occupied) control mode.

An existing air handler day/night control panel monitors outside air temperature, AHU supply air temperature, and AHU fan status for three air handling units (labeled Gym, Cafetorium, and Day Care). The outside air damper minimum position dials for the three units do not operate. Inside the panel, the three receiver controllers for the units do not operate, and show zero pressure received.

A second controller panel for day/night control of the unit ventilators and exhaust fans does not operate. Two receiver controllers are inoperable. The receiver-controller for the hot water pumps was full of oil.

In the second floor classrooms, the unit ventilators operate in night mode. The outside (fresh) air dampers never open because of cut pneumatic lines to outside air damper actuator, and fans only cycle on when space on a call for heat. Hot water valves remain open.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; showers are standard flow; and sinks have standard flow threaded aerators.

Cabot Elementary School

As the City plans to demolish and replace this building, NORESCO investigated energy conservation measures with a simple payback of five years or less as directed by the City.

Building Envelope

The attic was lacking any significant insulation and had many gaps, allowing infiltration. Door and window weather-stripping was found to be deficient. Cracks were noted in roof/wall joint of brick structure.

Lighting Systems

The existing lighting systems at the Cabot Elementary School primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consist of 2-lamp recessed troffers and wraparounds; hallways have 3-lamp wraparounds; gymnasium has HID High Bays; and offices have 2-lamp 2'x4' recessed troffers.

Heating Systems

The boiler room houses two dual-fuel steam boilers, which the city plans to replace. Boilers are controlled via steam pressure, and the pressure-trol is set to seven psig. There are two steam zones that can be isolated with hand valves. There are no control valves for the zones.

Rooms are heated by steam unit ventilators, and hallways utilize steam radiation. Units that were opened were found to have extremely dirty filters, coils, and leaky damper seals. Outside air dampers do open on tested units, and low limit thermostats seem to operate correctly. All steam equipment had pneumatic valves with day thermostats.

Cooling Systems

Cabot has no central cooling system. Window air conditioning units were noted in the main office, and various classrooms. Because audit was completed during the heating season, the exact number of window units used is unknown.

Temperature Control Systems

The building controls are pneumatic with limited inherent functionality. There are signs of oil migration past main air coal filter and in air dryer. Air dryer is extremely dirty, and will not function properly with dirty coils. Existing Johnson Controls pneumatic day/night control panel with 15psig day, 20psig night signals has four control zones (1^{st} floor office, 1^{st} floor classrooms, 3^{rd} floor classroom 301, and Gym). There is only a single air PRV, set to 15#. Night signal PRV was removed. Since panel is only getting 15# signal, building cannot go into night mode. Oil was found inside panel.

Domestic Water System

Domestic water fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted and tank style with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks have standard flow threaded aerators.

Countryside Elementary School

The Countryside School has recently undergone a window replacement project. There are twelve year old modular buildings that utilize several heating sources. Connecting hallways are heated via electric baseboard, while the modulars themselves are conditioned via rooftop units. The boiler room has been prone to flooding, taking on almost five feet of water when a sump pump failed last November.

Building Envelope

Countryside is a brick building with rubber roof. Plaster ceilings in the original building have no existing insulation. Weather-stripping is lacking on most exterior doors.

Lighting Systems

The existing lighting systems at the Countryside Elementary School primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consist of 2-lamp and 4-lamp wraparounds; hallways have 2-lamp 2’x4’ recessed troffers and wraparounds; gymnasium has HID fixtures; and offices have 2-lamp 2’x2’ and 2’x4’ recessed troffers.

Heating Systems

Building is steam heated with pneumatic control. One boiler has been replaced and both boilers burn oil. The backup boiler is scheduled to be replaced by the City. According to the custodian, the steam unit ventilators run 27/4. There is also a steam H&Vs that serves the Cafetorium & Gym. Two small heat exchangers serve a section of the building that is heated by hot water.

Cooling Systems

Countryside has no central cooling system. Window air conditioning units were noted in the main office, and various classrooms. Because audit was completed during the heating season, the exact number of window units used is unknown.

Temperature Control Systems

Existing pneumatic controls should be abandoned. Visible oil was seen underneath a thermostat in Room 3. Boilers have no day/night control, but do have a 55°F / 45°F outdoor air lockout.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture floor mounted with exposed manual flush valves and tank style; urinals are wall mounted with exposed manual flush valves; and sinks have a mixture of dual faucets without threaded aerators and standard flow threaded aerators.

Franklin Elementary School

Franklin Elementary School was originally built in 1939 and was renovated in 1950 and 1953. The original building is brick, while the newer modular “pentagon” section in the rear is of construction that is more modern.

Building Envelope

Franklin is a brick building with rubber roof. Windows have been replaced with double-pane glass with aluminum frames. Weather-stripping is lacking on most exterior doors. Hallway and common area in pentagon modular have large single-pane glass with wood frames.

Lighting Systems

The existing lighting systems at the Franklin Elementary School primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consist of 2-lamp 1’x4’ troffers and wraparounds; hallways have 2-lamp wraparounds; gymnasium has 4-lamp troffers; and offices have 2-lamp 1’x4’ troffers.

Heating Systems

Franklin’s original section is heated by two Smith steam boilers and steam unit ventilators, along with steam radiation in common areas. Some radiation was found to have existing thermostatic radiator valves. There is one steam valve off of the boiler header that is failed in the open position. The pneumatic line attached to the valve is disconnected. In addition, the combustion air fan has not worked in quite some time.

The newer "Pentagon" area is served by a hot water heat exchanger, and has hot water unit ventilators. The common area is served by fin-tube radiation that is not in service and two hot water propeller heaters. The gym is served by radiation as well as a steam H&V unit that is in bad condition. The belt is severely slipping on the 5 HP, two-speed motor. Because of room storage, there is no access to the filters.

Cooling Systems

Franklin has no central cooling system. Window air conditioning units were noted in the main office, and various classrooms. Because audit was completed during the heating season, the exact number of window units used is unknown.

Temperature Control Systems

The school's day/night control panel controls two zones (Original steam building and newer 'pentagon' hot water area). Electric/pneumatic relays (EPs) are inoperable and the night setback mode does not function.

A second day/night control panel holds eighteen PE switches for day/night control of original building unit vent fans. The time clock for the UVs is missing "off" dogs, so it never sends the 20psig signal to shut off fans. The unit ventilator fans never shut off. The control cabinet also holds two contactors on a separate time clock for the gym AHU and school exhaust fans. This time clock also does not have any "off" dogs.

The pentagon area's day/night control panel is also missing "off" dogs, and stays in day position. This panel controls HW unit ventilators and a heat exchanger valve. The pressure switch was set to 12psig and the hot water setpoint was set to 120F.

An exhaust fan in the school penthouse was found to be disconnected from the control system, although the PE for the fan is functional. As a result, the fan runs 24/7.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; showers are standard flow; and sinks have a mixture of dual faucets without threaded aerators and standard flow threaded aerators.

Horace-Mann Elementary School

The Horace-Mann School was originally constructed in 1965 and has many additions and renovations since its first construction. There has been an addition of three modular buildings. As the City plans to demolish and replace this building, NORESCO investigated energy conservation measures with a simple payback of five years or less as directed by the City.

Building Envelope

Cracks were identified in roof/wall joint in both the boiler room and gym areas. Window weather-stripping was found to be inadequate.

Lighting Systems

The existing lighting systems at Horace-Mann primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The classroom lighting consists of 2-lamp wraparounds; hallways have 2-lamp 2'x2' and 3-lamp 2'x4' recessed troffers; gymnasium has 6-lamp high bays; and offices have 2-lamp wraparounds.

Heating Systems

The main school building is heated by a gas-fired steam boiler system. The modulars are heated by several Bard heat pumps.

Cooling Systems

Horace-Mann has no central cooling system. Window air conditioning units were noted in the main office, and various classrooms. Because audit was completed during the heating season, the exact number of window units used is unknown.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; showers are standard flow; and sinks are standard flow threaded aerators.

Lincoln-Eliot Elementary School

The Lincoln Eliot School was originally built in 1935 with additions in 1965 and 1975. The original section of the school is heated by steam and the additions by hot water. The principal noted that the school is in need of new windows with the 1965 section being in the worst shape. Last year was the first year that it was occupied year round, for day care. There are six separate hot water heaters in the building, one gas-fired unit that serves the nurses office, and five electric water heaters in various parts of the building.

Building Envelope

This building has had many additions over the years, all of brick construction. Joints at the bridge area joining the buildings have cracks that are letting a significant amount of outside air to infiltrate the building. Existing attic insulation was found to be deficient.

Lighting Systems

The existing lighting systems at the Lincoln-Elliot Elementary School primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consists of 2-lamp wraparounds; hallways have 2-lamp wraparounds and 2’x4’ recessed troffers; gymnasium has HID fixtures; and offices have 2-lamp wraparounds.

Heating Systems

The boiler room has two oil-fired boilers. Frasier Engineering had done tune-ups and efficiency testing on both boilers in August 2009. The efficiencies were noted as 79.9% and 79.5%. There are two sets of hot water convertors for the two new additions, with pumps that, due to PEs being jumped out, run 24/7

The second floor mechanical room #170 houses a Trane air handler, tagged S-1. This unit was found to be in very bad condition. There was no belt on the supply air fan motor, 1 HP. The three-way hot water valve, OA damper, and two zone dampers all are receiving zero psig from the pneumatic receiver controller. Two return air fans serve S-1, tagged RAF-1 & 2. RAF-1 was running, 2 HP motor, but RAF-2 was off at the disconnect, and needs a bearing replacement. Air Handler S-2 is housed in the #166 mechanical room. This unit was not running and was shut off at the motor control center. Writing on the unit indicated that it serves the second floor classrooms.

Cooling Systems

Lincoln-Eliot does not have a central cooling system. Window air conditioning units were noted in the main office, and various classrooms. Because audit was completed during the heating season, the exact number of window units used is unknown.

Temperature Control Systems

The building is separated into three control systems (Original building, 1965 addition, 1975 addition). All day/night pressures are set to zero psig day, 25 psig night.

The boiler is controlled by simple pressure controller to maintain pressure.

The air compressor was a new unit with working automatic blow down, air dryer, and filters.

The original 1935 section is controlled by a Honeywell Day/Night controller panel near the air compressor. A PE controls a relay to shut the steam unit vent fans on/off. The PE was found to have no air connected to it. Since this is disconnected, all Unit Vent fans run in day mode 24/7. The time clock was also found to be set to the wrong day. This panel also controls the original building exhaust fans, and seemed to operate properly. However, it was set to the wrong day. Oil migration was found inside this panel.

The first addition, 1965, is served by a hot water converter and pumpset. It is controlled by a day/night controller with outside air reset. The time clock is jumped out and does not function. 1/3 / 2/3 steam valves for the hot water converter are failed in the open position and several air lines from the receiver controller to the steam valves are not holding pressure. Steam valves need replacement.

The second addition, 1975, is also served by a hot water converter, and pumpset. An outside air reset day / night controller does not operate. All of the EPs and PEs inside the panel are disconnected. 1/3 / 2/3 steam valves are failed in the open position and should be replaced. 200F water is constantly being sent out into the building, and all unit ventilators are operating in day mode.

Unit S-1 day/night controller panel was receiving the day/night signal. However, the PEs were not working. Several Unit ventilators were tested throughout the school, and all were looked at to confirm day/night functionality. Most steam unit vent fans were not operating, and day/night functionality does not work. Hot water unit ventilators in the two additions were in better condition, and are able to change to night when manipulated.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; showers are standard flow; and sinks are standard flow threaded aerators.

Mason-Rice Elementary School

The Mason Rice School was originally built in 1959. New windows were installed in summer 2007.

Lighting Systems

The existing lighting systems at the Mason-Rice primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consists of 2-lamp wraparounds; hallways have 1-lamp wraparounds; gymnasium has 3-lamp T5 high bays; and offices have 2-lamp 2’x2’ recessed troffers and wraparounds.

Heating Systems

The building is hot water heated with a gas boiler (#and an oil-fired boiler (#2). Hot water circulation pump runs 24/7 throughout the heating season and has a 7.5HP motor. Classrooms typically have one hot water unit vent, and one hot water radiator. Library and Art Room also have ceiling mounted electric unit heaters, but were off at the disconnect.

Cooling Systems

Mason-Rice's basement after school care area is cooled by a ducted split air conditioning unit. Library and Art room also have window AC Units.

Temperature Control Systems

Existing pneumatic controls operate correctly. There are no signs of oil or water migration in the day/night control panel or at space thermostats. A simple outdoor air boiler hot water reset was found in boiler room, but has been disconnected. Existing time clock does not work, and boilers run all the time to maintain 160°F. Time clock found to have missing pin on wheel. Unit ventilators run on 5:30 – 6:30 M-F schedule.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks have a mixture of dual faucets without threaded without threaded aerators and standard flow threaded aerators.

Memorial-Spaulding Elementary School

The Memorial Spaulding School was originally built in 1956 and underwent a total renovation circa 1990. There are no modulars at this school. There are new windows.

Building Envelope

An uninsulated section of ceiling was found below the roof deck. Window and door weather-stripping was found to be inadequate, even though windows have been updated.

Lighting Systems

The existing lighting systems at the Memorial-Spaulding primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consists of 4-lamp 2'x4' and 2'x2' recessed troffers; hallways have 2-lamp wraparounds; gymnasium has HID fixtures; and offices have 2-lamp 2x4 recessed troffers and wraparounds.

Heating Systems

The building is steam heated with pneumatic control. Two years ago boiler #1 was replaced with a new gas-fired boiler. Frasier Engineering did tune-up and efficiency testing in July 2009. The gas boiler was tested at 83.1% efficiency. The school is heated by five heating zones on the control panel, but it does not operate.

Cooling Systems

Memorial-Spaulding has no central cooling system. Window air conditioning units were noted in the main office, and various classrooms. Because audit was completed during the heating season, the exact number of window units used is unknown.

Temperature Control Systems

Existing pneumatic controls should be abandoned. The air in control panel has been disconnected. Boilers have Heat-Timers that do not operate and boilers run 24/7 during heating season. The school is heated by five heating zones on the control panel, but it does not operate. Water and oil infiltration of the pneumatics have occurred

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; showers are standard flow; and sinks are standard flow threaded aerators.

Pierce Elementary School

The Pierce School was originally built in 1951 and had window replacements 3-4 years ago. There are two modular buildings that were installed 2-3 years ago. The modulars were found to have no insulation above ceiling.

Lighting Systems

The existing lighting systems at the Pierce primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consists of 2-lamp 2’x4’ and 2’x2’ recessed troffers; hallways have 2-lamp 2’x2’ recessed troffers; gymnasium has HID fixtures; and offices have 2-lamp wraparounds.

Heating Systems

The school is heated by two oil-fired steam Smith boilers. The boilers supply steam to unit ventilators and radiation throughout the school, as well as H&Vs in the gym and auditorium. Some hallway steam radiators have existing thermostatic radiation valves.

Cooling Systems

Cooling in the main office area is provided by a number of DX split systems.

Temperature Control Systems

Boilers are controlled and scheduled off of a Heat-Timer Controller. There is no pneumatic day/night control panel in use at Pierce. Existing air compressors are original to the building construction, and need replacement. School is currently run manually by custodian, who shuts of exhaust fans and unit vent fans at the motor control center.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Underwood Elementary School

The Underwood School was originally built in 1924 and was renovated last in 1978. The principal’s office and main office are overheated by steam piping in boiler room under the floor. The majority of teachers leave windows open during the heating season.

Lighting Systems

The existing lighting systems at Underwood primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consists of 2-lamp 2’x4’ recessed troffers; hallways have 2-lamp 2’x4’ recessed troffers; gymnasium has 6-lamp T5 high bays; and offices have 2-lamp 2’x4’ recessed troffers.

Heating Systems

The boiler room has two Smith gas-fired steam boilers. Some steam piping in boiler room is uncovered, causing overheating in areas above boiler room. Steam header piping is newly insulated, but other is uncovered. Air compressor is extremely old, but does have automatic blow down, new head, and newer dryer. When doing pneumatic control evaluation, Frasier Engineering was replacing unit ventilators in rooms 11 and 15.

Cooling Systems

Underwood has no central cooling system. Window air conditioning units were noted in the main office, and various classrooms. Because audit was completed during the heating season, the exact number of window units used is unknown.

Temperature Control Systems

The building controls are pneumatic with limited inherent functionality. There are three existing Honeywell zone controllers (North, South, and Auditorium) and were found in auto. These are currently running in day mode 24/7. The time clock does function, but EPs have no air connection. The day/night panel is full of oil, and no air can pass through it out to the building.

Air compressor does have an automatic blow-down, but it was not plugged in. Approximately 1 gallon of water was drained out of the tank. There is a new head on the air compressor, but there are already signs of oil in the system. The air dryer was extremely dirty and not able to dry air. The oil filter was bypassed, unknown for how long. Oil infiltration is a problem in the pneumatic system.

The boiler is controlled by a Heat-Timer automatic controller. There was a nine psig setpoint for a 45F outside temperature found that day. The scheduling is as follows: M-Th 4am – 6pm; F 4am – 5pm; Sat 6am – 10am, 7pm – 9pm; Sun 6am – 11am, 6pm – 9pm.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks have a mixture of dual faucets without threaded without threaded aerators and standard flow threaded aerators.

Ward Elementary School

The Ward School is one of the smallest in the city. The school has had a number of additions and renovations since opening in 1928. There is one modular unit in the back of the school located adjacent to the gym.

Building Envelope

Ward school is a brick constructed building and although the windows are approximately 20 years old, they are double-pane, aluminum construction. Modular insulation is inadequate, and should be improved. A number of building penetrations were found that leak air into the building.

Lighting Systems

The existing lighting systems at the Ward Elementary School primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consists of 2-lamp 1’x4’ troffers; hallways have 2-lamp 1’x4’ troffers; gymnasium has HID fixtures; and offices have 2-lamp wraparounds.

Heating Systems

Building is steam heated and has pneumatic controls. One of the two boilers was replaced approximately 4 years ago. The school burns gas 90% of the time. The boilers are on a time clock with a 5:30 to 9:00 M-F operating schedule. Steam unit ventilators typically overheat classrooms. Boiler runs to maintain 5psig, and currently cycles 9 times an hour. Gymnasium is served by a steam H&V.

Cooling Systems

Ward has no central cooling system. Window air conditioning units were noted in the main office, and various classrooms. Because audit was completed during the heating season, the exact number of window units used is unknown.

Temperature Control Systems

A Johnson pneumatic energy management system controls the mechanical equipment in the building. Day/night panel has four control zones (basement Art / Classrooms, 1st Floor, 2nd Floor, Gym). Some oil was found at air PRVs. Panel labeled as 20# day signal, and 0# night signal. Air PRVs were set to 15 & 20#. Day/night off time clock does work, and controls new boiler and UVs. However, because of wrong settings on PRVs, UVs cannot go into night mode.

A third floor unit ventilator was tested, no oil was found at thermostat. Damper will not operate as thermostat is only getting 8psig main air. An air leak on main air line to thermostat is suspected. There was no low limit thermostat found on this UV.

A library unit ventilator was also tested. Low limit thermostat inside unit was broken, and bleeding off too much air pressure. Because of this, steam valve cannot close, and damper will not open. Library is overheating. Custodian informed us that the thermostat was recently changed, and works properly.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted with exposed manual flush valves as well as tank style; urinals are wall mounted with exposed manual flush valves; and sinks have a mixture of dual faucets without threaded without threaded aerators and standard flow threaded aerators.

Williams Elementary School

Newton's Williams School is located adjacent to Lasell College in Newton Highlands. There are approximately 280 students and 20 faculty using the building.

Lighting Systems

The existing lighting systems at the Williams Elementary School primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consist of 2-lamp 1'x4' troffers; hallways have 2-lamp 1'x4' troffers; gymnasium has HID fixtures; and offices have 2-lamp 2'x4' recessed troffers.

Heating Systems

The buildings boiler room has two cast iron sectional steam boilers that are original to the building. One has had a burner upgrade, and burns natural gas. Original classrooms have steam unit ventilators with F&T traps, low limit thermostats, and direct acting valves & dampers. A new addition is heated by hot water, and two shell & tube heat exchangers are located in the boiler room.

Cooling Systems

Main office is served by 2 ton Sanyo split air conditioning unit.

Temperature Control Systems

A new Johnson Controls day/night panel was recently installed. Panel runs 15/20# day/night signal. There are four zones on this panel (Old classrooms, Gym, Auditorium, and New classrooms). Inside the panel, there are three digital time clocks. The auditorium zone is not functioning properly, and is stuck in day because of non-functioning time clock. Old Classroom zone was stuck in night mode.

The new classroom section unit ventilators do go into night mode, but HW reset panel is running "in hand" mode, pumping 180F+ water at all times. The new classroom area is hot water and is also served by a reset water panel with hot water Heat-Timer. This system as well needs to be repaired and retro commissioned, even though it is essentially brand new. Heat-Timer setpoint was 137F, but status read 182F. Steam valve actuator was found loose on top of valve body, and could not close.

Building exhaust fan has Siemens controller, but note reads, "This is jumped out. Didn't know where red white go." Suspected that exhaust fan runs 24/7.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Zervas Elementary School

Newton's Zervas School, built in 1954, is the smallest in the city. There have been many renovations and additions of modulars to Zervas. The school has three modulars and windows and doors were replaced two years ago. The library modular is approximately twenty years old, and the other modulars are two years old. As the City plans to demolish and replace this building, NORESCO investigated energy conservation measures with a simple payback of ten years or less as directed by the City.

Building Envelope

Modular ceiling is lacking insulation, and door weather-stripping was found to be inadequate.

Lighting Systems

The existing lighting systems at the Zervas Elementary School primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the classrooms consist of 2-lamp wraparounds; hallways have 2-lamp wraparounds; gymnasium has HID fixtures; and offices have 2-lamp 2'x4' recessed troffers and wraparounds.

Heating Systems

The basement boiler room houses two steam boilers. Boiler #2 is out of service as is the oil pump set. Boiler #1 has a dual-fuel burner but utilizes gas only as it has no means to switch from gas to oil. Classrooms are heated by steam unit ventilators and steam radiators that are original to the building .

Cooling Systems

Zervas has no central cooling system. Window air conditioning units were noted in the main office, and various classrooms. Because audit was completed during the heating season, the exact number of window units used is unknown.

Temperature Control Systems

There was no main air pressure found in day/night control panel. PE inside panel is clogged and not allowing pressure past it. Therefore, everything in building is running in night mode. Panel has three control zones (Classrooms, Gym, Auditorium). Overall, thermostats in the school are not functioning, from lack of main air pressure. School is subject to problematic overheating, especially in hallways with radiation.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks have a mixture of dual faucets without threaded without threaded aerators and standard flow threaded aerators.

Albermarle Fieldhouse

Newton's Albermarle Fieldhouse is located next to Horace-Mann School and Gath Pool Facility. It mainly is used for night and weekend programs, as well as daily activities during the summer.

Building Envelope

This brick structure has a flat roof and single-pane windows. Both door and window weather-stripping was found to be inadequate.

Lighting Systems

The existing lighting systems at the Albermarle Fieldhouse primarily consist of T12 linear fluorescent luminaires with magnetic ballast others include compact fluorescents and incandescent. The lighting in the bathrooms consist of 2-lamp 1'x4' troffers; dining area has 2-lamp 2'x4' recessed troffers; and concessions has 4-lamp 1'x8' chain mounted.

Heating Systems

The small building is heated by a gas furnace with local control.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks have a mixture of dual faucets without threaded aerators and standard flow threaded aerators.

Auburndale Library

The Auburndale Library is a small community library built in 1934. The single story building has a brick exterior and slate roof. According to the staff, it is open three days a week for limited hours. The attic was found to have inadequate insulation.

Lighting Systems

The existing lighting systems at the Auburndale Library primarily consist of linear fluorescent luminaires with electronic ballast others include compact fluorescents and incandescent. The lighting in the stacks consists of 2-lamp wraparounds; hallways have 2-lamp and 1-lamp incandescent; and offices have 2-lamp wraparounds.

Heating Systems

This facility is heated with steam from an oil-fired HB Smith boiler. The steam system heats the building via sixteen cast iron radiators equipped with hand valves. The basement is heated via a small steam cabinet heater. The boiler is controlled by a time clock that currently lacks the components to allow for night setback. There are separate day and night thermostats near the circulation desk, but the night thermostat does not function. A small, handwritten note near the thermostats reads, "Please turn down to 60 at night."

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks have a mixture of dual faucets without threaded without threaded aerators and standard flow threaded aerators.

Crafts Street Department of Public Works Operations Center

The Crafts Street DPW Operations Center is located in a converted horse stable originally built in 1894. The envelope is in poor condition and we noted numerous gaps around the door and window frames. Consequently, the building is extremely drafty. The attic consists of a large open space with exposed wood-frame construction and no insulation. A number of broken windows are patched over with plywood and duct tape, and all windows are single-pane. A suspended ceiling throughout much of the building provides an ineffectual thermal barrier between the uninsulated attic above and the conditioned space below.

Lighting Systems

The existing lighting systems at the Crafts Street Department of Public Works Operations Center primarily consist of T8 linear fluorescent luminaires with electronic ballast others include compact fluorescents and incandescent. The lighting in the garage consists of two-lamp strips; hallways have two-lamp 2’x4’ recessed troffers; and offices and bathrooms have two-lamp recessed troffers.

Heating Systems

The operations center is heated by an oil-fired Smith hot water boiler. The boiler feeds converted iron radiators throughout the basement and first floor of the building. The attic is unheated. Electric space heaters are utilized in offices and break rooms.

Temperature Control Systems

The hot water boiler is controlled by a single thermostat.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Crafts Street Garage

The Crafts Street Garage serves as a main garage and wash center for the Public Works Department’s vehicles and staff. The large building is mainly an open bay garage with room for parking and vehicle maintenance. The door and doorframe are in poor condition and in need of replacement.

Lighting Systems

The existing lighting systems at the Crafts Street Garage primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the shops consist of 2-lamp strips; garage areas have 2-lamp wraparounds; bathrooms have 2-lamp 2’x4’ recessed troffers; and offices have 4-lamp 2’x4’ recessed troffers.

Heating Systems

The garage is heated by a number of direct-fired gas rooftop units.

Cooling Systems

Only the administrative offices have cooling, which is provided by a packaged unit on the roof.

Temperature Control Systems

The garage is controlled by local thermostats tied into individual heaters.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are wall mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Elliot Street Garage

Elliot Street Garage is the second City garage for storage and maintenance of Public Works vehicles. The 9,000 square foot garage was built in 1959.

Lighting Systems

The existing lighting systems at the Elliot Street Garage primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the shops consists of 2-lamp industrials and wraparounds; and garage areas have 2-lamp strips and wraparounds.

Heating Systems

The garage has a simple heating system of direct fire gas heaters with local controls.

Cooling Systems

Cooling is provided by DX split systems and window air conditioning units.

Temperature Control Systems

A Johnson DDC energy management system controls the mechanical equipment in both portions of the building.

Elliot Street Operations Center

Lighting Systems

The existing lighting systems at the Elliot Street Operations Center primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the garage consist of 2-lamp strips and industrials; halls have 2-lamp wraparounds; bathrooms have 2-lamp 2’x4’ recessed troffers; and offices have 2-lamp 2’x4’ recessed troffers.

Heating Systems

This facility is heated with steam from a single boiler that supplies heat to radiation throughout the building. During NORESCO’S audit, there were also several electric heating devices found in office spaces on the first floor.

Cooling Systems

Cooling is provided by several DX split systems.

Temperature Control Systems

A Johnson DDC energy management system controls the mechanical equipment in both portions of the building.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Fire Department Headquarters

This building is located in Newton Center, and serves as the main fire dispatch and houses the administrative offices for the Newton Fire Department. Originally built in 1928, the building has been renovated to modernize the office areas and the dispatch area. The attic was lacking insulation, and should be properly insulated. Gaps around roof vents and wall penetrations allow infiltration into the building.

Lighting Systems

The existing lighting systems at the Fire Department Headquarters primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the halls consist of 2-lamp troffers; bathrooms have 2-lamp 1'x4' troffers; and offices have 2-lamp 2'x4' recessed troffers and wraparounds.

Heating Systems

This facility is heated by two hot water boilers that circulate hot water throughout the building. Cast iron radiators that remained before the installation of the hot water system remain, but there has been the addition of cabinet heaters to replace some radiators. A simple day/night thermostat controls the boiler.

Cooling Systems

Cooling is provided by a number of window AC units in the dispatch area and office spaces. Because the audit was conducted during the heating season, the exact number of units used is unknown.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Fire Station #3

This fire department building was built in 1955 and is located in Newton Centre. The first floor houses primarily the four apparatus bays and dispatch area, and the second floor houses offices and bedrooms. The building uses a number of window AC units to cool the facility, which lack weather-stripping around the enclosures. Attic insulation was found to be inadequate, and the roof hatch leaks air into the conditioned space.

Lighting Systems

The existing lighting systems at the Fire Station #3 primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the bays consist of 2-lamp industrials; halls have 1-lamp wraparounds; and offices have 2-lamp 2'x2' recessed troffers.

Heating Systems

Steam is provided to the building by an oil-fired Smith boiler. With the exceptions of the apparatus bays, the building is heated via steam radiation controlled by a non-programmable thermostat. The main apparatus bays are heated by steam unit heaters.

Cooling Systems

Cooling is provided by a number of window units. Because the audit was conducted during the heating season, the exact number of units used is unknown.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; showers are standard flow; and sinks are standard flow threaded aerators.

Gath Pool Facility

This building is located adjacent to the Horace-Mann School, and is the main outdoor pool facility operated by Newton's Park & Recreation Department. The facility is open seasonally from early June to the end of August.

Lighting Systems

The existing lighting systems at the Gath Pool Facility primarily consist of T12 linear fluorescent luminaires with electronic ballast others include compact fluorescents and incandescent. The lighting in the open areas consists of 2-lamp wraps; halls have 2-lamp wraparounds; and offices have 2-lamp wraparounds.

Heating Systems

The facility has no heating equipment.

Cooling Systems

Cooling is provided by a number of window units. Because the audit was conducted during the heating season, the exact number of units used is unknown.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; showers are standard flow; and sinks are standard flow threaded aerators.

Hawthorne Fieldhouse

The Hawthorne Fieldhouse is located in Newton's Nonantum Village, and mainly serves as a community center for the area. The building houses a few small function rooms and basketball courts, the latter of which occupy the majority of the brick structure. The gym area has single-pane glass windows with operable units. Large sections of the roof/wall joint in the gym were found to have cracks, which allow air infiltration.

Lighting Systems

The existing lighting systems at the Hawthorn Fieldhouse primarily consist of T12 linear fluorescent luminaires with electronic ballast others lamps compact fluorescents and incandescent. The lighting in the gymnasium consist of HID fixtures; bathrooms have 2-lamp 2'x2' recessed troffers; and offices have 2-lamp 2'x2' recessed troffers.

Heating Systems

This facility is heated with steam from a single oil-fired boiler feeding radiation. The boiler is controlled by a time clock that runs from 6am to 7pm.

Cooling Systems

Cooling is provided by a number of window units. Because the audit was conducted during the heating season, the exact number of units used is unknown.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; showers are standard flow; and sinks are standard flow threaded aerators.

Health Department

Newton's Health Department is located in Newton Centre, and housed in a historic 1934 brick building with slate roof. Single-pane wood frame windows are in poor condition and in need of replacement. The Health Department uses the building mainly for administrative purposes and as well for storage of the department's supplies.

Lighting Systems

The existing lighting systems at the Health Department primarily consist of T8 linear fluorescent luminaires with electronic ballast others lamps compact fluorescents and incandescent. The lighting in the halls have 2-lamp wraparounds; and offices have 2-lamp 2'x4' recessed troffers and wraparounds.

Heating Systems

This facility is heated with steam from a single steam boiler located in the basement, which supplies steam to cast iron radiators. The radiators are equipped with thermostatic radiator valves, which are old, and in poor condition.

Cooling Systems

Cooling is provided by a number of window units. Because the audit was conducted during the heating season, the exact number of units used is unknown.

Temperature Control Systems

The boiler is controlled by a simple Honeywell single zone thermostat.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Jackson Homestead

The Jackson Homestead, in Newton Corner, is an historic home in Newton that now serves as a museum and home to the Newton Historical Society. It was built in 1809, and now has two distinct sections. The main two-story structure houses the museum on the lower two floors, administrative offices on the second floor, and storage in the attic. The carriage house, which is connected to the main structure, houses administrative offices and a small retail shop. Exterior doors and hatches are in need of weather-stripping.

Lighting Systems

The existing lighting systems at the Jackson Homestead primarily consist of incandescent fixtures. The lighting throughout the buildings consists of fixtures with incandescent lamps. Fixtures included are chandeliers, Tracks, surface mount, and recessed.

Heating Systems

The homestead has two separate heating systems. The main building and museum is heated by a direct fire gas furnace, and the Historical Society offices are served by a second furnace.

Cooling Systems

Cooling for the office area is provided by a number of window units. Because the audit was conducted during the heating season, the exact number of units used is unknown.

As well as the window units, the furnace for the museum, located in a basement mechanical closet, has a cooling coil that is primarily used for dehumidification.

Temperature Control Systems

The heating and cooling systems both have local control.

Domestic Water System

The plumbing fixtures are standard flow devices. Toilets are floor mounted tank style; and sinks are standard flow threaded aerators.

Lower Falls Community Center

The Lower Falls Community Center was built in 1958, and is attached to a Newton Housing Authority building. Like other community centers and fieldhouses, the majority of the area of this building is taken up by the main gym area. There are a few other small instruction and activity rooms. The gym area is lacking any kind of thermal insulation and has poor single-pane windows throughout.

Lighting Systems

The existing lighting systems at the Lower Falls Community Center primarily consist of T8 linear fluorescent luminaires with electronic ballast others lamps compact fluorescents and incandescent. The lighting in the gymnasium consists of HID fixtures; classrooms have 2-lamp strips; and bathrooms have 1-lamp strips.

Heating Systems

Heating is provided by an oil-fired steam boiler system.

Cooling Systems

Cooling is provided by a number of window units. Because the audit was conducted during the heating season, the exact number of units used is unknown.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are wall mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; showers are standard flow; and sinks are standard flow threaded aerators.

Main Library

The Newton Main Library was opened in 1991 as the biggest library in Newton, and to serve as the City's library headquarters. The building also houses a number of exhibit rooms and lecture areas for functions.

Lighting Systems

The existing lighting systems at the Main Library primarily consist of T8 linear fluorescent luminaires with electronic ballast others lamps compact fluorescents and incandescent. The lighting in the open areas consists of 2-lamps troffers; bathrooms have 1-lamp 1'x4' recessed troffers; and halls have 2-lamp 1'x6' and 1'x8' troffers.

Heating Systems

The Library is heated by two gas-fired boilers that feed air handlers and variable air volume reheat coils.

Cooling Systems

Chilled water is provided by an ice storage system, which is served by a Trane centrifugal chiller.

Temperature Control Systems

A Powers System 600 energy management system controls the mechanical equipment in the building.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture wall mounted and floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; showers are standard flow; and sinks are standard flow threaded aerators.

Newton Centre Fieldhouse

The Newton Centre Fieldhouse was constructed in 1900 and is located next to Newton's Mason-Rice Elementary School. The Fieldhouse's main use is for an after-school and day care program for Mason-

Rice. The upper floor is an open gym space, while the lower floor has activity rooms. The interior of the upper floor has an open rafter ceiling lacking insulation. Lower floor is a combination of fieldstone foundation and concrete wall.

Lighting Systems

The existing lighting systems at the Newton Centre Fieldhouse primarily consist of T12 linear fluorescent luminaires with electronic ballast others lamps compact fluorescents and incandescent. The lighting in the gymnasium consist of HID fixtures; bathrooms have 2-lamp 2'x4' recessed troffers; and offices have 2-lamp 2'x4' recessed troffers.

Heating Systems

The Fieldhouse is heated by an oil-fired furnace that distributes forced hot air to the whole building. The furnace is run by a time clock that is also tied into separate day / night single zone thermostats that are located on the upper floor.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Newton Corner Library

The Newton Corner Library is housed in a historic home built in 1919. During the time of the audit, the building was not occupied, and has been shut down as a functioning library. Attic is lacking insulation and needs to be addressed. All windows are single-pane, with wood-frame construction.

Lighting Systems

The existing lighting systems at the Newton Corner Library primarily consist of T8 linear fluorescent luminaires with electronic ballast others lamps compact fluorescents and incandescent. The lighting in the open areas consists of 2-lamp wraparounds; bathrooms have incandescent fixtures; and halls have 2-lamp wraparounds.

Heating Systems

The building is heated by a gas-fired furnace located in the building's basement. No other sources of heating were found. The furnace is controlled by a single Honeywell digital thermostat.

Domestic Water System

The plumbing fixtures are standard flow devices. Toilets are floor mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Nahanton Park Fieldhouse

The Nahanton Park Fieldhouse is located close to the Needham city line. The building serves as a location for summer, in the middle of Nahanton Parks's walking trails, fishing ponds, and athletic fields. The field house is a brick structure with a sloped shingle roof.

Lighting Systems

The existing lighting systems at the Nahanton Park Fieldhouse primarily consist of T12 linear fluorescent luminaires with electronic ballast others include compact fluorescents and incandescent. The lighting in the bathrooms consist of 2-lamp 2'x2' recessed troffers; halls have 4-lamp 2'x4' troffers; and offices have 4-lamp 2'x4' recessed troffers.

Heating Systems

This facility is heated with hot air from an oil-fired furnace controlled by a single Honeywell digital thermostat.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are wall mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Nonantum Library

This building was built in 1957 and serves as a branch library offering limited hours. It also serves as a meeting place for a Newton Italian organization. The brick structure has inadequate insulation in the attic, and leaky door weather-stripping. Single-pane windows are original to the building's construction.

Lighting Systems

The existing lighting systems at the Nonantum Library primarily consist of T12 linear fluorescent luminaires with electronic ballast others include compact fluorescents and incandescent. The lighting in the bathrooms consists of 1-lamp vanities; halls have 1-lamp wraparounds; and stacks have 1-lamp strips.

Heating Systems

This building is heated by a single oil-fired boiler. The boiler supplies heat to a small steam H&V, as well as steam radiation on the first floor. There is also a QMark electric propeller heater in use near the back stairwell. The boiler is controlled by a single Honeywell digital thermostat.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are floor mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Public Buildings Department

The Public Buildings Department is located adjacent to the Elliot Street Garage, and is used as the department's headquarters. The east end houses office space and the west end houses a small garage with maintenance staff and equipment. Both areas have inadequate insulation, and seven windows are in need of replacement.

Lighting Systems

The existing lighting systems at the Public Buildings Department primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the shops consists of 2-lamp industrials; bathrooms have 2-lamp 2'x2' troffers; and offices have 2-lamp wraparounds.

Heating Systems

The building is heated by an oil-fired steam boiler that supplies steam to a small air handler serving the office area. The garage portion is heated by steam unit heaters. The boiler is controlled by a single digital thermostat.

Recreation Department Garage

This garage is located behind the Parks & Recreation Department headquarters building and is used for storage and maintenance of the department's vehicles. Most of the back wall of the garage is single-pane glass. Many panes have been broken and patched over with different materials. Underside of ceiling is lacking insulation.

Lighting Systems

The existing lighting systems at the Recreation Department Garage primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the shops consists of 2-lamp industrials; garages have 2-lamp industrials.

Heating Systems

This facility is heated with a combination of an oil-fired furnace and a propane unit heater.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Recreation Headquarters

The Recreation Headquarters building is located at 70 Crescent Street, and is the main office and administration building for Newton's Parks & Recreation Department. Many parts of the building including knee walls, rafters, and ceiling joists are exposed and have no insulation. Cooling is provided in many areas by window units, and is not properly sealed around the enclosures.

Lighting Systems

The existing lighting systems at the Recreation Headquarters primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the bathrooms and offices have 2-lamp wraparounds.

Heating Systems

This building is heated by an oil furnace.

Cooling Systems

Cooling is provided by a number of DX split systems and window air conditioners.

Senior Center

The Senior Center is a Nationally Accredited building that provides a gathering place and program for Newton's senior citizens. The brick & granite building was constructed in 1938. The basement and first floor are used for senior activity, and a mezzanine floor for administration and offices.

Lighting Systems

The existing lighting systems at the Senior Citizens Center primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the open areas consist of 2-lamp wraparounds; stairs have 2-lamp and 1-lamp wraparounds; and offices have 2-lamp 1'x4' troffers.

Heating Systems

This facility is heated with steam radiation supplied from an oil-fired boiler. The boiler is controlled by a Honeywell digital thermostat. There are also a number of electric baseboard heaters on the mezzanine office level.

Cooling Systems

Cooling is provided by a number of DX split systems. The condensers are typically pad- mounted outside with the evaporative coil in a air handling unit.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are wall mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Upper Falls Community Center

The Upper Falls Community Center serves as a day care and afterschool program for the Upper Falls community of Newton. It was built in 1955, and has had no renovations since its construction. The brick building has single-pane windows throughout, and many gym windows are leaking, requiring weather-stripping.

Lighting Systems

The existing lighting systems at the Upper Falls Community Center primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the open areas consists of 1-lamp wraparounds; halls have 2-lamp wraparounds; gymnasium has HID fixtures, and offices have 2-lamp wraparounds.

Heating Systems

This facility is heated with steam from a single Weil-McLain boiler. The boiler is new, and is a recent replacement. Steam is delivered to an H&V that serves the gym, unit ventilators for 1st floor classrooms, and radiation for the rest of the building.

Temperature Control Systems

The temperature control system at the Upper Falls Community Center is in disrepair. Due to a number of pneumatic system leaks, the air compressor runs nearly continually. The pneumatic controls in the mechanical room were found to be contaminated with oil.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are a mixture of wall mounted and floor mounted with exposed manual flush valves; urinals are wall mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

Waban Library

The Waban Library has been recently reopened after being closed in 2008 due to budget constraints. It is now open a five days a week, and is home to a food pantry. The historic Tudor style building was built in 1934, and has never had a major renovation. The attic is lacking any type of insulation, and several penetrations need to be sealed.

Lighting Systems

The existing lighting systems at the Waban Library primarily consist of T8 linear fluorescent luminaires with electronic ballast others include T12 lamps compact fluorescents and incandescent. The lighting in the open areas consists of 1-lamp wraparounds; and bathrooms have incandescent fixtures.

Heating Systems

The library is heated by a hot water boiler that circulates water to converted cast iron radiators, as well as cabinet unit heaters, and a small H&V unit in the basement. The boiler is controlled by a single zone thermostat.

Domestic Water System

The plumbing fixtures are a mixture of low flow and standard flow devices. Toilets are mounted with exposed manual flush valves; and sinks are standard flow threaded aerators.

SECTION B
UTILITY INFORMATION

B.1 UTILITY RATE SUMMARY

NORESCO analyzed electric, gas, water, and sewer utility data for FY 2008 through the present and reviewed these rates with City personnel. Based on these discussions, we use the average rates from FY08 through FY10 to calculate cost savings associated with electricity, natural gas, and No. 2 fuel oil. Water and sewer rates are based on the current rates from the City of Newton as of January 2010.

References for Utility Rates

Charge	Basis
Electricity	Average of FY 2008 through FY 2010
Natural Gas	Average of FY 2008 through FY 2010
No. 2 Oil	Average of FY 2008 through FY 2010
Water	Current incremental City rate as of January 2010
Sewer	Current incremental City rate as of January 2010

Summary of Utility Rates

Energy and Water Rates – Without Escalation

Building	Electricity ($ / kWh)	No. 2 Oil ($ / Gal.)	Natural Gas ($ / Therm)	Water ($ / kGal)	Sewer ($ / kGal)
School Buildings	$0.174	$2.850	$1.630	$7.968	$15.949
City Buildings	$0.174	$2.850	$1.630	$7.968	$15.949

Energy and Water Rates – With 3.0% Escalation

Building	Electricity ($ / kWh)	No. 2 Oil ($ / Gal.)	Natural Gas ($ / Therm)	Water ($ / kGal)	Sewer ($ / kGal)
School Buildings	$0.1792	$2.9355	$1.6789	$8.2070	$16.4275
City Buildings	$0.1792	$2.9355	$1.6789	$8.2070	$16.4275

Note: The rates in the table above include an upward adjustment (escalation) of 3.0% to account for expected rate increases during the construction period.

B.2 ALTERNATE RATE OPTIONS

Not applicable.

B.3 REBATE & SUBSIDY OPPORTUNITIES

NORESCO will work to obtain any available incentives or rebates available through the MassSave program, which are administered by NSTAR and National Grid. The value of the expected rebates has been accounted for in the Cash Flow table shown in the Executive Summary of this report. All incentive monies will be paid directly to the City. NORESCO has conducted a preliminary evaluation of the rebates available for the measures included in the project. These incentives are summarized in the table below. In addition, as of May 2010, NSTAR's Municipal and Stimulus Programs offer the opportunity for additional rebates, which could increase the amounts estimated below.

Summary of Incentives

ECM Description	Qualified Equipment	Entity	Estimated Incentive
Lighting Improvements	Efficient lamp & ballast systems, high efficiency fixtures	NSTAR	$50,429
Lighting Controls	Wall- and ceiling-mounted occupancy sensors	NSTAR	$10,379
Steam Traps	Steam traps	NGRID	$15,120
Energy Management Systems	Energy Management Systems	NSTAR	$144,000
VFDs and Premium Efficiency Motors	Variable Frequency Drives	NSTAR	$7,600
Photovoltaic System	Photovoltaic System		$5,500
TOTALS			$233,028

SECTION C
SAVINGS OPPORTUNITIES

C.1 SUMMARY TABLE

Energy Savings Table

ECM	Electricity kWh	#2 Fuel Oil Gal.	Nat. Gas Therms	Water KGal	Sewer KGal
Lighting Improvements	468,258	(764)	(1,744)	0	0
Lighting Controls	55,247	0	0	0	0
Water Conservation	1,003	0	159	3,572	3,572
Steam Trap Improvements	0	8,151	14,266	0	0
Thermostatic Radiator Valves	0	0	0	0	0
Weatherization & Insulation	3,722	13,344	21,243	0	0
Thermal Panels	0	0	0	0	0
New Windows	0	0	0	0	0
Pipe & Fitting Insulation	0	1,115	552	0	0
HVAC Controls	5,283	12,274	19,728	0	0
Boiler Controls	0	2,593	1,145	0	0
Programmable Thermostats	0	845	3,272	0	0
VFDs & PE Motors	15,760	0	0	0	0
Photovoltaic System	7,978	0	0	0	0
Energy Conservation through Behavior Change	0	0	0	0	0
TOTAL	**557,250**	**37,557**	**58,620**	**3,572**	**3,572**

C.2 ENERGY CONSERVATION MEASURES

This section presents the Energy Conservation Measures for the City of Newton Phase 3 buildings.

#	ECM	Tab
1	**Lighting Improvements & Controls**	1
2	**Water Conservation**	2
3	**Steam Trap Improvements**	3
4	**Weatherization Improvements**	4
5	**Pipe & Fitting Insulation**	5
6	**HVAC Controls**	6
6a	Boiler Controls	6
6b	Programmable Thermostats	6
7	**VFDs & PE Motors**	7
8	**Photovoltaic System**	8
9	**Energy Conservation through Behavior Change**	9

Brief Descriptions of Energy Conservation Measures

ECM 1: Lighting System Improvements and Controls

NORESCO evaluated 39 facilities and discovered that although many already utilize energy efficient T8 lighting systems, there is still significant opportunity for further improvements. The existing lighting systems are controlled individually, and the use of occupancy sensor controllers in limited areas will further reduce energy consumption. NORESCO proposes to install efficient lighting systems and to control the existing lighting fixtures with occupancy sensors, thus saving energy. Energy savings achieved by installing occupancy sensors are directly related to the activities in the space. In areas where activities are sporadic and lights are left on, installing sensors will automatically shut the lights off.

ECM 2: Domestic Water Conservation

NORESCO conducted an investigation of 40 facilities for the City of Newton and found significant opportunities for water conservation improvements. Most of the sanitary water fixtures (toilets, urinals, faucets, and showers) utilize standard flow devices and are over ten years old. The majority of toilet fixtures in the schools have flushometer (or tankless) toilets. Most of the existing plumbing fixtures consume water at levels well above current standards.

NORESCO will replace selected existing standard flow devices with low flow units to reduce water and energy consumption. NORESCO will replace only the flushometers, faucet aerators, and showerheads that will help the overall economics of the program. Water conserving flushometers, aerators, and showerheads not only generate dramatic water savings, but also reduce the energy required to heat the water, ensuring an economically-attractive measure.

ECM 3: Steam Trap Improvements

Buildings throughout the city have systems that generate steam for space heating. Integral components of an efficient steam system are the steam traps, which remove condensate from the distribution system and return it to the boiler plant. Older and unmaintained steam traps will fail over time and eventually allow live steam to pass through the trap into the condensate system, wasting significant energy.

NORESCO will repair or replace steam traps with new, properly functioning components to improve comfort conditions and reduce thermal energy losses. Further, NORESCO will provide a comprehensive steam trap maintenance program that will help maintain energy savings and verify that the traps continue to function properly throughout the contract term

ECM 4: Weatherization

NORESCO will implement weatherization improvements to reduce infiltration, as well as install insulation or insulating systems to reduce thermal transmission losses. NORESCO will weatherize and insulate buildings to reduce infiltration, exfiltration, and transmission losses. These improvements will deliver heating and cooling savings and reduce drafts and energy losses from the exterior envelope, while also improving space comfort conditions. An added benefit will be the increased occupant comfort through the reduction of drafts. With these improvements, NORESCO will:

- Install weather-stripping on doors, hatches, and windows;
- Seal selected envelope penetrations such as vents, roof/wall joints, soffits, ducts, pipes, conduits, and windows (caulked shut);
- Install insulation in ceilings, attics, and walls; and

- Install thermal panel systems.

ECM 5: Pipe and Fitting Insulation

NORESCO discovered uninsulated and poorly insulated steam and condensate piping. This exposed piping results in energy loss as well as overheating of adjacent spaces. For example, at the Underwood School, exposed steam piping in the boiler room overheats the Principal's office above. As a result, the windows are left open throughout winter, allowing heat to escape the conditioned space. This ECM will insulate selected bare steam and condensate piping to improve comfort and reduce energy loss.

ECM 6: HVAC Controls

NORESCO will upgrade existing control systems in several elementary schools across the City by installing Direct Digital Control (DDC) Energy Management Systems (EMS) in concert with a retro commissioning of the existing pneumatic control systems. These improvements will allow for the comprehensive implementation of energy efficient control strategies and for improved monitoring and control of building HVAC equipment, as well as the ability to access building systems from a networked communication infrastructure via the internet and standard web browsers.

ECM 6a: EMS Improvements – Boiler Controls

Several buildings have standalone steam boiler systems that utilize standard steam pressure (high/low limit) controls. While these controls are adequate to safely provide heat for the individual buildings, they are not configured for efficiency in functionality or operation. This results in unnecessary energy loss as well as overheating of the spaces. NORESCO will install new boiler control systems to provide increased functional efficiency of the heating system boilers. This ECM will reduce heating energy consumption while improving occupant comfort by avoiding overheating on mild days.

ECM 6b: Programmable Thermostats

Crafts Street Garage, Jackson Homestead, and Newton Centre Fieldhouse all contain single zone systems or standalone terminal heating equipment such as furnaces or unit heaters. These systems are simple, but currently controlled by basic non-programmable thermostats. As such, these controls are not capable of utilizing energy savings strategies such as scheduling and unoccupied setback, and thus maintain occupied space temperatures whether or not the space is in use. This lack of capability in the existing controls results in relatively significant energy waste.

NORESCO will install new programmable thermostats to provide the City the ability to schedule occupied/unoccupied periods and space temperature setpoints for the selected systems. This ECM will reduce energy consumption while improving occupant comfort by providing more accurate space temperature control.

ECM 7: Variable Frequency Drives and Premium Efficiency Motors

Several City facilities circulate heating hot water to the building air handling units (AHUs), unit ventilators and other unitary equipment at a constant flow rate. NORESCO identified some systems that will benefit from variable frequency drive (VFD) installations and premium efficiency (PE) motor upgrades. These upgrades will reduce the energy consumption of the existing systems while improving overall performance. Upon completion, the VFDs and PE motors will allow for reduced energy consumption and tighter response to transient zone conditions, effectively providing the served spaces with increased comfort conditions.

ECM 8: Photovoltaic System

NORESCO will install a 7.5 kW photovoltaic (PV) system at the Lower Falls Community Center. The system will be installed on the existing roof structure and will be incorporated into the existing building electrical service. A visual display will be included to allow visitors and interested parties to view the system's output over the internet. The 36-panel system will be self-ballasted, requiring no roof penetrations. Once installed, the PV system will not only help displace electricity purchased from the utility, but also serve as a symbol of Newton's effort to promote sustainability and environmental stewardship.

ECM 9: Energy Conservation through Behavior Change®

NORESCO's holistic approach toward performance contracting leverages the complex interaction between people and their environment to promote participation in the energy efficiency process. To achieve the optimal benefit from newly installed high efficiency equipment and systems, in addition to generating added energy savings, NORESCO will create a comprehensive, custom-tailored, program known as Energy Conservation Through Behavior Change® or ECTBC. This program is comprised of three components: (1) Awareness-Communication; (2) Green Schoolhouse Energy Education; and (3) a Sustainable Behavior Change intervention. Using the inherent opportunity to "go green" within performance contracting, the ECTBC program instills and sustains a culture of energy efficiency within your school system, and throughout your community.

Other Energy Conservation Measures Considered

NORESCO considered several other energy conservation opportunities in addition to those described above.

EnergyStar Window A/C installations

Many of the facilities included in the Phase 3 Audit do not have centralized cooling systems. As such, window mounted air conditioning units are installed in spaces that are utilized during the summer months. Many of the window AC units inspected were found to be nearing the end of their useful life expectancy. By installing newer units, the City would benefit from reduced electrical consumption through more efficient cooling of its year-round occupied spaces.

Unfortunately, the savings are small compared to the cost of the AC units. Therefore, NORESCO does not recommend this measure.

Thermostatic Radiator Valves

A significant number of the steam radiators and convectors found across the City do not have operable manual shutoff valves and/or have failed thermostatic or pneumatic control valves. These end devices are typically located in the spaces in buildings that are prone to overheating. As a remedy, occupants often open windows or doors, or run the air conditioning to control the space temperatures. This behavior results in substantial energy losses.

Unfortunately, this measure has a long payback because the installed cost of the TRVs is high compared to the savings. Therefore, NORESCO does not recommend this measure.

Infrared Heating Systems

The City's public works division and fire departments utilize garage space for vehicle storage and maintenance. As expected, these high use facilities see very high infiltration rates due to overhead doors opening and closing, or being left open as necessary. Currently, these spaces are predominantly heated by gas-fired unit heaters or make-up air units. This heating method utilizes sensible energy exchange to cold air passed over a hot coil to heat the ambient air and warm the space. Unfortunately, this warmed air easily escapes the building once the doors are opened, resulting in significant energy waste.

Due to the high cost to implement this ECM compared to the savings, NORESCO does not recommend this measure be included as part of the Phase 3 project.

High-Efficiency Boiler Installations

Most of the elementary schools investigated were found to have boilers original to the construction of the buildings; some over 60 years old. Originally installed to be coal fired, these units are very large (high mass) and have been retrofitted over the years to alternate fuels (#2 oil and natural gas). These boilers are reaching the end of their useful lives and are incapable of operating at efficiencies modern units typically achieve.

Replacing the City's aging boilers with new high efficiency units will not only reduce heating energy consumption due to increased system efficiency, but also reduce maintenance costs associated with keeping the old boilers running. However, the City is planning to retrofit or replace some boilers separate from the NORESCO project. Additionally, due to the high cost to implement this ECM, NORESCO does not recommend this measure be included as part of the Phase 3 project.

Dual-Fuel Burner Upgrades

In the past few years, the City has begun to replace aging oil fired burners on existing boilers with new dual-fuel, high efficiency burners. This retrofit provides significant energy savings due to burning fuel more efficiently as well as cost savings due to burning natural gas, which at today's energy rates have a lower cost per BTU than oil. Operations and maintenance savings are also realized via reduced maintenance on the existing burners, which are reaching the end of their useful service term.

City of Newton personnel indicated that the City plans to install the burner upgrades in the remaining buildings on their own. As such, NORESCO has not included this ECM as part of the Phase 3 project.

Hydronic Heating Conversions

Many buildings utilize low-pressure steam to deliver space heating during the winter months. End devices include radiation, unit ventilators, and heating and ventilation units to heat the occupied spaces. By nature, steam systems tend to be less efficient and more costly to maintain as compared to hot water systems. Some newer renovated areas in the City have already been switched to hot water by using steam to hot water heat exchangers. Converting systems to hot water will eliminate the losses inherent to steam systems, increase the controllability of the heating system, increase comfort conditions, and reduce maintenance and repair costs. However, hydronic conversions are very expensive due to the high cost of piping and controls. The payback for this type of measure is typically well in excess of 30 years. Therefore, NORESCO does not recommend this measure be included as part of the Phase 3 project.

Pool Cover Installations at Gath Pool Facility

The Gath Pool Facility is open from May through August. Currently, the pool remains uncovered during unoccupied hours that the pool is in operation. This allows significant heat and chemical waste to occur through evaporative losses. Pools lose energy in a variety of ways, but evaporation is the most significant mechanism for energy loss. One BTU is required to raise one pound of water one degree, but each pound of water that evaporates results in approximately 1,000 Btu of thermal energy lost. This evaporative energy loss resulting in the lowering of water temperature must be made up by the pool water heating system. By covering the pool during unoccupied hours, evaporation is greatly reduced and heating energy is saved. In addition, the requirement for make-up water is reduced. This lowers water consumption and chemical treatment costs.

Installing pool covers to save energy and water costs tends to be cost effective for pools that operate year-round. However, for seasonal pools that only operate during the summer months, the savings are commensurately less and the payback is much higher. For these reasons, a pool cover for the Gath pool is not cost effective and this measure is not recommended.

New Windows

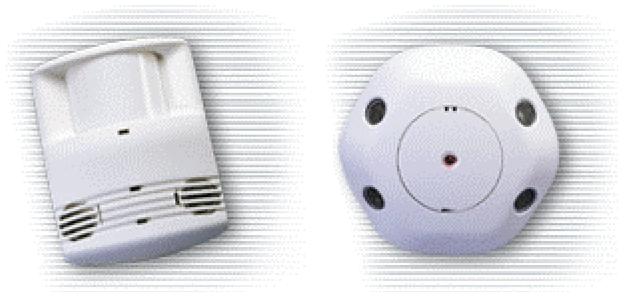
Several buildings surveyed were found to have existing windows in poor condition and allow significant amounts of unconditioned outdoor air to enter the buildings. Old windows can be the weakest link in a building's envelope, often contributing to energy losses, moisture problems, and noise transmission. New windows provide for improved thermal performance and reduce infiltration around the windows. Heating and cooling requirements are reduced, thus saving energy while improving comfort conditions.

The City indicated that they plan to replace older single-pane windows in schools on their own. For City buildings, due to the high cost of installation, NORESCO does not recommend this measure be included as part of the Phase 3 project. Weather-stripping the windows as a means to reduce infiltration is a more cost-effective option.

LIGHTING SYSTEM IMPROVEMENTS & CONTROLS

Overview

NORESCO evaluated 39 facilities and discovered that although many already utilize energy efficient T8 lighting systems, there is still significant opportunity for further improvements. NORESCO proposes to install efficient lighting systems and to control the existing lighting fixtures with occupancy sensors, saving energy.



Detailed Description

Existing Systems

Albemarle Field House

The existing luminaires in the Albermarle Field House consist primarily of fluorescent fixtures with energy efficient T12 lamps and magnetic ballasts. The most common fluorescent fixture types are recessed 2'x4', surface mount 1'x4', and chain hung1'x8' fixtures.

Angier Elementary School

The existing luminaires in the Angier Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', wraparound, and 4' vapor tight fixtures.

Auburndale Library

The existing luminaires in the Auburndale Library consist primarily of fluorescent fixtures with energy efficient T12 lamps and magnetic ballasts. The most common fluorescent fixture types are wraparound, and incandescent fixtures.

Bowen Elementary School

The existing luminaires in the Bowen Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', wraparound, and HID fixtures.

Burr Elementary School

The existing luminaires in the Burr Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', and wraparound fixtures.

Cabot Elementary School

The existing luminaires in the Cabot Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', and wraparound fixtures.

Countryside Elementary School

The existing luminaires in the Countryside Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', surface mount 1'x4', and wraparound fixtures.

Crafts Street DPW Operations Center

The existing luminaires in the Crafts Street DPW Operations Center consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', strip, wraparound, and incandescent fixtures.

Crafts Street Garage

The existing luminaires in the Crafts Street Garage consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', wraparound, strip, industrial, and HID fixtures.

Elliot Street Garage

The existing luminaires in the Elliot Street Garage consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are, strip, industrial, and HID fixtures.

Elliot Street Operations Center

The existing luminaires in the Elliot Street Operations Center consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', wraparound, strip, industrial, and HID fixtures.

Fire Alarm Headquarters

The existing luminaires in the Fire Alarm Headquarters consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 1'x8', wraparound, and HID fixtures.

Fire Station #3

The existing luminaires in the Fire Station #3 consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', wraparound, strip, and industrial fixtures.

Franklin Elementary School

The existing luminaires in the Franklin Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', wraparound, and industrial fixtures.

Gath Pool Facility

The existing luminaires in the Gath Pool Facility consist primarily of fluorescent fixtures with T12 lamps and magnetic ballasts. The most common fluorescent fixture types are recessed, wraparound, and incandescent fixtures.

Hawthorne Field House

The existing luminaires in the Hawthorne Field House consist primarily of fluorescent fixtures with T12 lamps and magnetic ballasts. The most common fluorescent fixture types are resurface mount 1'x4', recessed 2'x2', wraparound, and HID fixtures.

Health Department

The existing luminaires in the Health Department consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', and wraparound fixtures.

Horace-Mann Elementary School

The existing luminaires at the Horace-Mann Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', wraparound, and HID fixtures.

Jackson Homestead

The existing luminaires in the Jackson Homestead consist primarily of incandescent fixture with screw in lamps ranging from 40W to 250W.

Lincoln-Elliot Elementary School

The existing luminaires in the Lincoln-Elliot Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 1'x4', strips, wraparound, and HID fixtures.

Lower Falls Community Center

The existing luminaires in the Lower Falls Community Center consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', incandescent, strips, and HID fixtures.

Main Library

The existing luminaires in the Main Library consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', wraparound, and pendant mount.

Mason Rice Elementary School

The existing luminaires in the Mason Rice Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', and wraparound.

Memorial-Spaulding Elementary School

The existing luminaires in the Memorial-Spaulding Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 2'x2', recessed 1'x4', wraparound, and HID fixtures.

Nahanton Park Field House

The existing luminaires at the Nahanton Park Field House are energy saving T12 electromagnetic with some incandescent lamps. The most common fixture types are recessed 2'x4' and recessed 2'x2' style fixtures.

Newton Centre Field House

The existing luminaires in the Newton Centre Field House consist primarily of fluorescent fixtures with energy saving T12 electromagnetic with some incandescent lamps. The most common fixture types are recessed 2'x4', recessed 1'x4', and HID fixtures.

Newton Corner Library

The existing luminaires in the Newton Corner Library consist primarily of fluorescent fixtures with energy saving T12 electromagnetic with some incandescent lamps. The most common fixture types are wraparound and incandescent fixtures.

Nonantum Library

The existing luminaires in the Nonantum Library consist primarily of fluorescent fixtures with energy saving T12 electromagnetic with some incandescent lamps. The most common fixture types are recessed 2'x4', recessed 1'x4', and wraparound.

Pierce Elementary School

The existing luminaires in the Pierce Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fixture types are recessed 2'x4', recessed 1'x4', wraparound, and HID fixtures.

Public Building Maintenance Shop

The existing luminaires in the Public Building Maintenance Shop consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x2', industrial, wraparound, and HID fixtures.

Recreation Garage

The existing luminaires in the Recreation Garage consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 1'x4', strips, and wraparound fixtures.

Recreation Headquarters

The existing luminaires in the Recreation Headquarters consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are wraparound, industrial, and HID fixtures.

Senior Center

The existing luminaires in the Senior Citizens Center consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2'x4', recessed 1'x4', strip, and wraparound fixtures.

Underwood Elementary School

The existing luminaires in the Underwood Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2’x4’, surface mount 1’x4’, strip, and wraparound fixtures.

Upper Falls Community Center Library

The existing luminaires in the Upper Falls Community Center Library consist primarily of fluorescent fixtures with T12 lamps and magnetic ballasts. The most common fluorescent fixture types are recessed 2’x2’, wraparound, and HID fixtures.

Waban Library

The existing luminaires in the Waban Library consist primarily of fluorescent fixtures with T12 lamps and magnetic ballasts. The most common fluorescent fixture types are recessed 2’x2’, wraparound, and incandescent fixtures.

Ward Elementary School

The existing luminaires in the Ward Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2’x4’, recessed 2’x2’, wraparound and HID fixtures.

Williams Elementary School

The existing luminaires in the Williams Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2’x4’, recessed 2’x2’, wraparound, and HID fixtures.

Zervas Elementary School

The existing luminaires in the Zervas Elementary School consist primarily of fluorescent fixtures with T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed 2’x4’, recessed 2’x2’, wraparound and HID fixtures.

Although the existing lighting systems have undergone retrofits over the last few years, there are still significant opportunities for improvement. The existing lighting systems are controlled individually, and the use of occupancy sensor controllers in limited areas will further reduce energy consumption.

Recommended Improvements

In order to maximize the overall electric savings at these facilities, NORESCO recommends optimizing the existing lighting and controls systems. Energy savings achieved by installing occupancy sensors are directly related to the activities in the space. In areas where activities are sporadic and lights are left on, installing sensors will automatically shut the lights off.

Scope of Work

NORESCO will retrofit existing lighting systems with high-efficiency lighting systems throughout the 39 buildings.

Lighting System Improvements

The following is a brief description of the work to be accomplished at the City of Newton facilities:

Albemarle Field House

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	4	4
Relamp & Reballast - Linear Fluorescent	17	17
Total	21	21

Angier Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	3	3
New Fixtures - Exit Signs	1	1
Relamp & Reballast - Linear Fluorescent	437	437
Screw In - Compact Fluorescent	9	9
Total	450	450

Auburndale Library

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	5	5
New Fixtures - Exit Signs	4	4
Relamp & Reballast - Linear Fluorescent	42	42
Screw In - Compact Fluorescent	26	26
Total	77	77

Bowen Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
New Fixtures - Exit Signs	30	30
New Fixtures - T5 Linear Fluorescent	8	8
Relamp & Reballast - Linear Fluorescent	90	90
Screw In - Compact Fluorescent	8	8
Total	136	136

Burr Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	103	103
Relamp & Reballast - Linear Fluorescent	364	364
Screw In - Compact Fluorescent	1	1
Total	468	468

Cabot Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
New Fixtures - T5 Linear Fluorescent	8	8
Relamp & Reballast - Linear Fluorescent	30	30
Centering Kits - Linear Fluorescent	11	11
Screw In - Compact Fluorescent	1	1
Total	50	50

Countryside Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	93	93
New Fixtures - Compact Fluorescent	2	2
New Fixtures - Exit Signs	1	1
Relamp & Reballast - Linear Fluorescent	470	470
New Reflectors - Linear Fluorescent	76	76
Screw In - Compact Fluorescent	63	63
Total	705	705

Crafts Street DPW Operations Center

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	3	3
New Fixtures - T8 Linear Fluorescent	10	10
New Fixtures - Compact Fluorescent	1	1
Relamp & Reballast - Linear Fluorescent	13	13
New Reflectors - Linear Fluorescent	40	40
Screw In - Compact Fluorescent	10	10
Total	77	77

Crafts Street Garage

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	53	53
New Fixtures - T8 Linear Fluorescent	1	1
New Fixtures - T5 Linear Fluorescent	63	63
Relamp & Reballast - Linear Fluorescent	148	148
New Reflectors - Linear Fluorescent	10	10
Screw In - Compact Fluorescent	1	1
Total	276	276

Elliot Street Garage

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	6	6
Relamp & Reballast - Linear Fluorescent	46	46
Screw In - Compact Fluorescent	3	5
Total	55	57

Elliot Street Operations Center

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	21	21
New Fixtures - Compact Fluorescent	3	3
Relamp & Reballast - Linear Fluorescent	81	81
Screw In - Compact Fluorescent	4	4
Total	109	109

Fire Alarm Headquarters

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	6	6
Relamp & Reballast - Linear Fluorescent	58	58
Screw In - Compact Fluorescent	7	8
Total	71	72

Fire Station #3

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	28	28

Relamp & Reballast - Linear Fluorescent	84	84
Screw In - Compact Fluorescent	17	17
Total	129	129

Franklin Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	62	62
Lighting Controls Only	43	43
Relamp & Reballast - Linear Fluorescent	405	405
New Reflectors - Linear Fluorescent	5	5
Screw In - Compact Fluorescent	3	3
Total	518	518

Gath Pool Facility

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	21	21
New Fixtures - T8 Linear Fluorescent	6	6
Relamp & Reballast - Linear Fluorescent	30	30
Screw In - Compact Fluorescent	9	14
Total	66	71

Hawthorne Field House

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	3	3
New Fixtures - Compact Fluorescent	1	1
New Fixtures - Exit Signs	1	1
New Fixtures - T5 Linear Fluorescent	8	8
Relamp & Reballast - Linear Fluorescent	24	24
Screw In - Compact Fluorescent	7	7
Total	44	44

Health Department

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	10	10
New Fixtures - Exit Signs	2	2
Relamp & Reballast - Linear Fluorescent	31	31
Screw In - Compact Fluorescent	36	37
Total	79	80

Horace-Mann Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	46	46
Lighting Controls Only	8	8
New Fixtures - Compact Fluorescent	4	4
Relamp & Reballast - Linear Fluorescent	313	313
New Reflectors - Linear Fluorescent	2	2
Screw In - Compact Fluorescent	32	34
Total	405	407

Jackson Homestead

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	113	113
Relamp & Reballast - Linear Fluorescent	5	5
Screw In - Compact Fluorescent	8	8
Total	126	126

Lincoln-Elliot Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	54	54
New Fixtures - Compact Fluorescent	3	3
New Fixtures - Exit Signs	2	2
New Fixtures - T5 Linear Fluorescent	10	10
Relamp & Reballast - Linear Fluorescent	508	508
Screw In - Compact Fluorescent	45	54
Total	622	631

Lower Falls Community Center

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	16	16
New Fixtures - Compact Fluorescent	1	1
New Fixtures - T5 Linear Fluorescent	6	6
Relamp & Reballast - Linear Fluorescent	150	150
Screw In - Compact Fluorescent	11	11
Total	184	184

Main Library

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	828	828
Lighting Controls Only	38	38
New Fixtures - T8 Linear Fluorescent	10	8
New Fixtures - Exit Signs	68	68
Relamp & Reballast - Linear Fluorescent	892	892
Screw In - Compact Fluorescent	12	12
Screw In - Halogen	34	34
Total	1,882	1,880

Mason Rice Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	43	43
Lighting Controls Only	20	20
New Fixtures - Induction Fluorescent	21	15
New Fixtures - Exit Signs	5	5

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
Relamp & Reballast - Linear Fluorescent	401	401
New Reflectors - Linear Fluorescent	23	23
Screw In - Compact Fluorescent	39	41
Total	552	548

Memorial-Spaulding Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	92	92
Lighting Controls Only	7	7
New Fixtures - T8 Linear Fluorescent	45	50
New Fixtures - Compact Fluorescent	1	1
New Fixtures - T5 Linear Fluorescent	8	8
Relamp & Reballast - Linear Fluorescent	437	437
New Reflectors - Linear Fluorescent	80	80
Screw In - Compact Fluorescent	24	24
Total	694	699

Nahanton Park Field House

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	5	5
New Fixtures - Exit Signs	1	1
Relamp & Reballast - Linear Fluorescent	11	11
New Reflectors - Linear Fluorescent	3	3
Total	20	20

Newton Centre Field House

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	7	7
New Fixtures - Exit Signs	3	3
New Fixtures - T5 Linear Fluorescent	6	6
Relamp & Reballast - Linear Fluorescent	16	16
Retrofit Kits - LED	2	2
Screw In - Compact Fluorescent	9	9
Total	43	43

Newton Corner Library

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
Relamp & Reballast - Linear Fluorescent	33	33
Screw In - Compact Fluorescent	16	19
Total	49	52

Nonantum Library

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	8	8
New Fixtures - Exit Signs	7	7
Relamp & Reballast - Linear Fluorescent	74	74
Screw In - Compact Fluorescent	5	8
Total	94	97

Pierce Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	89	89
New Fixtures - Compact Fluorescent	10	10
New Fixtures - T5 Linear Fluorescent	6	6
Relamp & Reballast - Linear Fluorescent	332	332
New Reflectors - Linear Fluorescent	8	8
Screw In - Compact Fluorescent	16	17
Total	461	462

Public Building Maintenance Shop

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	5	5
Lighting Controls Only	1	1
New Fixtures - T8 Linear Fluorescent	2	2
New Fixtures - Compact Fluorescent	1	1
Relamp & Reballast - Linear Fluorescent	77	77
Retrofit Kits - LED	2	2
Total	88	88

Recreation Garage

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	5	5
New Fixtures - Compact Fluorescent	1	1
New Fixtures - T5 Linear Fluorescent	3	3
Relamp & Reballast - Linear Fluorescent	29	29
Screw In - Compact Fluorescent	3	5
Total	41	43

Recreation Headquarters

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	16	16
Relamp & Reballast - Linear Fluorescent	28	28
Total	44	44

Senior Center

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	50	50
New Fixtures - Exit Signs	1	1
Relamp & Reballast - Linear Fluorescent	50	50
Screw In - Compact Fluorescent	33	40
Total	134	141

Underwood Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	76	76
Lighting Controls Only	14	14
Relamp & Reballast - Linear Fluorescent	375	375
New Reflectors - Linear Fluorescent	12	12
Screw In - Compact Fluorescent	29	29
Total	506	506

Upper Falls Community Center Library

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	22	22
New Fixtures - Exit Signs	2	2
New Fixtures - T5 Linear Fluorescent	10	10
Relamp & Reballast - Linear Fluorescent	66	66
Screw In - Compact Fluorescent	3	5
Total	103	105

Waban Library

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	9	9
New Fixtures - Exit Signs	3	3
Relamp & Reballast - Linear Fluorescent	32	32
Screw In - Compact Fluorescent	26	29
Total	70	73

Ward Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	75	75
Lighting Controls Only	12	12
New Fixtures - Induction Fluorescent	3	3
Relamp & Reballast - Linear Fluorescent	368	368
Screw In - Compact Fluorescent	4	7
Total	462	465

Williams Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	68	68
New Fixtures - Exit Signs	9	9
New Fixtures - T5 Linear Fluorescent	8	8
Relamp & Reballast - Linear Fluorescent	312	312
New Reflectors - Linear Fluorescent	108	108
Screw In - Compact Fluorescent	5	5
Total	510	510

Zervas Elementary School

Retrofit Type	Pre Fixture Qty	Post Fixture Qty
No Retrofit	49	49
New Fixtures - Compact Fluorescent	7	7
New Fixtures - Exit Signs	2	2
New Fixtures - T5 Linear Fluorescent	10	10
Relamp & Reballast - Linear Fluorescent	280	280
Retrofit Kits - LED	3	3
Screw In - Compact Fluorescent	35	36
Screw In - Halogen	4	4
Total	390	391

Occupancy Sensors

The classrooms, halls, offices, bathrooms, and gymnasiums are all areas were occupancy patterns change. Even though the existing lighting fixtures are energy efficient, occupants do not consistently turn the lights off when leaving the space. Data loggers are used to determine the occupancy pattern or the amount of time lights are left on with the space empty. During the detailed audit NORESCO installed data loggers throughout the buildings in order to log the occupancy rates and the total hours that lights are left on. Attachment II, Logger Occupancy Data, presents the time or wasted time lights are left on with the space empty.

NORESCO recommends installing two types of occupancy sensors, a switch-mounted sensor and a wall/ceiling-mounted sensor. Both types of sensors utilize either passive infrared or "dual technology" sensors. Dual technology devices use both passive infrared sensors and microphones to "see and hear" occupants and reduce the possibility of the lights shutting off with occupants in the space.

Switch-mounted sensors will be utilized in smaller spaces such as offices and small classrooms. Switch sensors replace the existing light switch recessed in the wall and have a manual on/off switch built in.

Ceiling or wall sensors will be installed remotely in the ceiling or mounted tight to the ceiling in a corner of the room. Existing light switches will remain and operate as they do now. A power pack or packs are installed in a junction box above the ceiling and shielded low voltage cables connect to the sensor.

Interface with Existing Systems and Operations

Impact on Facility Operations and Performance

The facility will benefit from reduced energy consumption and improved lighting conditions.

Maintenance

Maintenance costs associated with replacement of failed lamps and ballasts will be reduced during the first few years of the contract. NORESCO expects maintenance practices for the installed equipment to be comparable to or less than current systems.

Customer Training

NORESCO will provide O&M manuals for the installed equipment. No special training is required.

Equipment Information

Manufacturer and Type

The proposed lighting equipment will be manufactured by one of the following corporations or equal:

Lamps:

- **Phillips Lighting Co.,** 200 Franklin Square Dr., Somerset, NJ, 08875, (908) 563-3000
- **Osram-Sylvania Inc.,** 100 Endicott St., Danvers, MA, 01923, (800) 544-4828
- **General Electric Co.,** 3135 Easton Turnpike, Fairfield, CT, 06828-0001, (941) 418-5070

Ballasts:

- **Advance Transformer Co.,** 10275 West Higgins, Rosemont, IL, 60018, (708) 390-5109
- **Howard Industries,** PO Box 1590, Laurel, MS, 39441, (800) 956-3456
- **General Electric Co.,** 3135 Easton Turnpike, Fairfield, CT, 06828-0001, (941) 418-5070
- **Osram-Sylvania Inc.,** 100 Endicott St., Danvers, MA, 01923, (800) 544-4828
- **Universal Lighting Prod. Gr.,** 26 Century Blvd., Nashville, TN, 1 (800) BALLAST

Luminaires:

- **Renova Lighting,** 15 Wellstown Road, Ashway, RI, 02804, (800) 635-6682
- **Lithonia Hi-Tek,** PO Box 72, Crawfordsville, IN, 47933, (317) 362-1837
- **Simkar Corp.,** 700 Ramona Ave., Philadelphia, PA, 19120-4691, (215) 831-7700
- **Thomas Lighting (Daybrite),** Commercial & Industrial Div., 1015 S. Green St., Tupelo, MS, 38802, (601) 842-7212
- **Crescent Lighting,** 120 East Gloucester Pike, Barrington, NJ, 08007, (609) 546-5000

Reflectors:

- **Energy Planning Associates,** 148 Maritime Drive, Sanford, FL, 32771 (407) 302-0001
- **Reflect-A-Light,** U.S. 17 North, Route 6, Box 800, Palatka, FL, 32177, (904) 328-1580

Sensors:

- **Hubbell,** 185 Plains Road, Milford, CT 06460-2420, (203) 882-4800
- **The Watt Stopper,** 2800 De La Cruz Blvd., Santa Clara, CA 95050, (408) 988-5331
- **Sensor Switch,** 10 Capital Drive, Wallingford, CT 06492, (203) 265-2842

Material Specifications

Low Mercury T8 Lamps: The new, medium bi-pin T8 lamps will be 4100° Kelvin with 20,000 hours of average rated life and a Color Rendering Index (CRI) of 85.

Ballasts: The UL, CBM and CSA certified lighting ballasts will be instant-start electronic ballasts with a total harmonic distortion rating of less than 20 percent.

Compact Fluorescent Lamps: These UL and CSA certified lamps utilize high quality phosphors for outstanding CRI from 80 to 85. The lamp temperature ranges from 2,700° to 4,100° Kelvin. Average rated life of the lamps is 10,000 hours.

Compact Fluorescent Luminaires: The new UL and CSA certified luminaires utilize heavy gauge post painted steel pans, durable two-pin thermoplastic sockets and socket clips for excellent lamp alignment and photometrics. Luminaires are either surface mount or designed for suspended ceiling or air handling plenums. All ballasts are factory tested.

Fluorescent Lighting Luminaires: The new luminaires will consist of heavy die-formed steel to insure uniformity and dimensional stability with quality rust-resistant high-gloss white enamel paint. The paint is baked on at high temperatures to ensure durability. Luminaires are all approved by UL. Luminaires are constructed with convenient knock-outs for ease of installation in a wide variety of applications that can be mounted using many usual methods. The lenses are constructed of high quality extruded virgin acrylic with excellent UV resistance.

Reflectors: The reflectors are designed to maximize light output for even light distribution, ease of installation, and achieve ballast access without tools. Material form, fit and thickness requirements meet UL Standard 1570 requirements. The reflectors with be aluminum with a powder coat high reflective white finish. New sockets and lamp centering brackets will be included.

Occupancy Sensors: The occupancy sensors will be ceiling or wall mounted and may use passive infrared technology, a microphone, or both. All sensors and related components specified meet UL requirements.

Lighting System Improvements
I. Savings Calculations

Lighting System Improvements
II. Logger Occupancy Data

DOMESTIC WATER CONSERVATION

Overview

NORESCO conducted an investigation of 40 facilities for the City of Newton and found significant opportunities for water conservation improvements. NORESCO will replace selected existing standard flow devices with low flow units to reduce water and energy consumption.

Affected Areas

Facilities included in this measure are presented in the following table:

School Buildings	City Buildings	City Buildings
Angier Elementary School	Fire Headquarters	Lower Falls Comm. Center
Bowen Elementary School	Fire Station #3	Recreation Garage
Burr Elementary School	Main Library	Albermarle Field House
Cabot Elementary School	Auburndale Library	Gath Pool Facility
Countryside Elementary School	Newton Corner Library	Nahanton Park Field House
Franklin Elementary School	Nonantum Library	Upper Falls Comm. Center
Lincoln-Elliot Elementary School	Waban Library	Newton Centre Field House
Horace-Mann Elementary School	Jackson Homestead	Crafts Street DPW Oper. Ctr.
Pierce Elementary School	Hawthorne Field House	Elliot Street Operations Center
Memorial-Spaulding Elementary School	Health Department	Crafts Street Garage
Mason Rice Elementary School	Senior Citizens Center	Elliot Street Garage
Underwood Elementary School	Public Building Maint. Shop	Recreation Headquarters
Ward Elementary School	Quinobequin Pumping Station	
Williams Elementary School		
Zervas Elementary School		

Detailed Description

Existing System

NORESCO surveyed plumbing fixtures to identify opportunities for water conservation improvements. Most of the sanitary water fixtures (toilets, urinals, faucets, and showers) utilize standard flow devices and are over ten years old. The majority of toilet fixtures in the schools have flushometer (or tankless) toilets. Most of the existing plumbing fixtures consume water at levels well above current standards.

The following table lists typical standard flow rates of various older fixtures. Although NORESCO found that some toilets, faucets, and urinals have already been replaced with lower flow devices than those listed below, most existing fixtures are older, higher flow devices and can benefit from low flow retrofits:

Fixture	Description	Estimated Flow Rate *
Toilets	Floor Mount Flushometer	3.5 gpf
Faucets	Male Threaded Aerator	2.2 gpm
Urinals	Wall Mount w/ Flushometer	1.5 gpf
Showers	Showerheads	2.5 gpf

Note: GPF = gallons per flush; GPM = gallons per minute

Standard flow aerators will be retrofitted.

Flushometer (tankless) toilets will be retrofitted.

Recommended Improvements

With the advent of efficient fixture design developed to conserve water, it is cost-effective to replace and/or retrofit most of the higher flow rate fixtures. NORESCO has successfully implemented water conservation improvements on many previous projects, and expects to achieve equal or greater results with low-flow technology that continues to improve.

NORESCO will replace only the flushometers, faucet aerators, and showerheads that will help the overall economics of the program. Water conserving flushometers, aerators, and showerheads not only generate dramatic water savings, but also reduce the energy required to heat the water, ensuring an economically-attractive measure. The approximate flow rates of the new, reliable low-flow fixtures will be:

Fixture	Description	Flow Rate *
Toilets	New Flushometer	1.28 gpf
Faucets	New Laminar Aerators	0.5 or 1.0 gpm
Urinals	New Urinal and Flushometer	0.125 gpf
Showers	New Showerhead	1.0 gpm

Note: GPF = gallons per flush; GPM = gallons per minute

The water savings analysis is based on the comparison of rated water usage between new and old fixtures, calculated daily usage frequency, and quantity of fixtures converted. Cost savings is based on both water and sewer volumetric charges, as well as reduced heating of hot water. Function of the existing fixtures will be unimpaired and may even improve in some cases.

Advantages

- Reduced water use and, therefore, reduced water and sewer utility expense.
- Reduced heating load proportional to reduced hot water use.
- Reduced materials expense associated with plumbing fixture maintenance. NORESCO has not included these additional cost savings in the project cash flow.
- Less labor required for plumbing fixture maintenance. NORESCO has not included these additional cost savings in the project cash flow.
- Less water leakage from new fixtures lessens the occurrence of freestanding water forming which can increase the incidence of mold and pests.

Scope of Work

The following briefly describes the scope work in each area:

- Obtain City approval for fixtures and installation plan
- Close and secure the water shut-off valve in preparation for retrofit
- Remove and dispose of existing fixtures
- Install new low-flow aerators, low flow urinals and toilets where applicable, and flushometer valves
- Repair incidentals to removal and installation
- Open the existing water valve and reinstate water flow to the new low flow devices
- Check, test, and validate the operation of the new equipment
- Provide maintenance and operating manuals for the installed equipment

Albemarle Field House

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	3
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	4
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
No Retrofit Proposed	1
Total	10

Angier Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	5
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	6
New 0.5 gpm Spray Nozzle w/ Large Female Thread	1
New 0.5 gpm Spray Nozzle w/ Large Male Thread	7
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	6
New 1.6 gpf Flush-Valve Toilet w/ Back Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	1
New 1.6 gpf Flush-Valve Toilet w/ Back Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length, Offset	10
Total	36

Auburndale Library

Retrofit Description	Post Fixture Qty
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Round Open Seat	6
No Retrofit Proposed	2
Total	8

Bowen Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	16
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	8
New 0.5 gpm Spray Nozzle w/ Large Male Thread	6
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	17
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length Mounted - Floor Discharge China, 14" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	1

Retrofit Description	Post Fixture Qty
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	22
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	6
Total	76

Burr Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	2
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	10
New 0.5 gpm Spray Nozzle w/ Large Male Thread	4
New 0.5 gpm Spray Nozzle w/ Small Male Thread	15
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	21
New 1.0 gpm Aerator Nozzle w/ Small Male Thread	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	18
New 1.5 gpm Chromed Showerhead, Neoprene Faceplate	1
No Retrofit Proposed	4
Retrofit Toilet w/ 1.3 gpf Flush-Valve, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	1
Total	77

Cabot Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	1
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	10
New 0.5 gpm Spray Nozzle w/ Large Male Thread	25
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	4
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Elongated Open Seat	2

Retrofit Description	Post Fixture Qty
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	8
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	16
Total	69

Crafts Street DPW Operations Center

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	4
New 0.5 gpm Spray Nozzle w/ Large Male Thread	6
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat	4
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
Total	16

Countryside Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	3
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	6
New 0.5 gpm Spray Nozzle w/ Large Female Thread	8
New 0.5 gpm Spray Nozzle w/ Large Male Thread	1
New 0.5 gpm Spray Nozzle w/ Small Male Thread	4
New 1.0 gpm Aerator Nozzle w/ Large Female Thread	5
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	20

Retrofit Description	Post Fixture Qty
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	22
No Retrofit Proposed	6
Retrofit Urinal w/ 1.0 gpf Flush-Valve, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
Total	78

Crafts Street Garage

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	3
New 0.5 gpm Spray Nozzle w/ Large Male Thread	7
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	5
Total	15

Elliot Street Garage

No retrofits proposed.

Elliot Street Operations Center

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	8
New 0.5 gpm Spray Nozzle w/ Small Male Thread	4
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 3 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
Total	15

Fire Alarm Headquarters

Retrofit Description	Post Fixture Qty
New 0.5 gpm Spray Nozzle w/ Large Male Thread	5
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Round Open Seat	1
New 1.5 gpm Chromed Showerhead, Neoprene Faceplate	1
New 1.6 gpf Flush-Valve Toilet w/ Back Spud - 4 Bolt - Floor Mounted - Rear Discharge China, Standard Rim Height, Elongated Closed Seat, Exposed Sensor Actuator, 1-1/2" Dia. VBt, 9 Length	3
No Retrofit Proposed	1
Total	11

Fire Station #3

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	2
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	7
New 0.5 gpm Spray Nozzle w/ Large Male Thread	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	7
New 1.5 gpm Chromed Showerhead, Neoprene Faceplate	8
No Retrofit Proposed	8
Total	33

Franklin Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	23
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	12
New 0.5 gpm Spray Nozzle w/ Large Male Thread	1
New 0.5 gpm Spray Nozzle w/ Small Male Thread	7
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	2
New 1.0 gpm Aerator Nozzle w/ Small Male Thread	4

Retrofit Description	Post Fixture Qty
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	25
New 1.6 gpf Flush-Valve Toilet w/ Back Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length, Offset	2
New 1.6 gpf Flush-Valve Toilet w/ Back Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length, Offset	6
No Retrofit Proposed	10
Total	94

Gath Pool Facility

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	7
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	3
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Elongated Open Seat	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	7
New 1.5 gpm Chromed Showerhead, Neoprene Faceplate	11
No Retrofit Proposed	2
Total	32

Hawthorne Field House

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	1
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	1
New 0.5 gpm Spray Nozzle w/ Large Male Thread	2

Retrofit Description	Post Fixture Qty
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
No Retrofit Proposed	1
Total	9

Health Department

Retrofit Description	Post Fixture Qty
New 0.5 gpm Spray Nozzle w/ Large Female Thread	1
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	1
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat	2
Total	4

Horace-Mann Elementary School

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	5
New 0.5 gpm Spray Nozzle w/ Large Male Thread	13
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	3
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	13
New 1.6 gpf Flush-Valve Toilet w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 10" Rough-In, Baby Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
No Retrofit Proposed	17
Total	53

Jackson Homestead

Retrofit Description	Post Fixture Qty
New 0.5 gpm Spray Nozzle w/ Large Female Thread	2
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Elongated Open Seat	1
New 1.1 gpf Pressure-Assist Tank Toilet w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Round Open Seat	1
Total	4

Lincoln-Elliot Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	9
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	7
New 0.5 gpm Spray Nozzle w/ Large Female Thread	3
New 0.5 gpm Spray Nozzle w/ Large Male Thread	12
New 0.5 gpm Spray Nozzle w/ Small Male Thread	2
New 1.0 gpm Aerator Nozzle w/ Large Female Thread	6
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	8
New 1.0 gpm Aerator Nozzle w/ Small Male Thread	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	15
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	12
New 1.5 gpm Chromed Showerhead, Neoprene Faceplate	1
New 1.6 gpf Flush-Valve Toilet w/ Back Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
New 1.6 gpf Flush-Valve Toilet w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Baby Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	3
No Retrofit Proposed	9
Retrofit Toilet w/ 1.6 gpf Flush-Valve, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	2
Total	93

Lower Falls Community Center

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	2
New 0.5 gpm Spray Nozzle w/ Large Female Thread	5
New 0.5 gpm Spray Nozzle w/ Large Male Thread	1
New 1.0 gpm Aerator Nozzle w/ Large Female Thread	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	5
Total	14

Main Library

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	4
New 0.5 gpm Spray Nozzle w/ Large Male Thread	7
New 0.5 gpm Spray Nozzle w/ Small Male Thread	11
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat	3
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	15
New 1.5 gpm Chromed Showerhead, Neoprene Faceplate	1
No Retrofit Proposed	2
Total	43

Mason Rice Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	1
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	10
New 0.5 gpm Spray Nozzle w/ Large Female Thread	3
New 0.5 gpm Spray Nozzle w/ Large Male Thread	7
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	32
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	2

Retrofit Description	Post Fixture Qty
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	17
No Retrofit Proposed	4
Total	76

Memorial-Spaulding Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	19
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	6
New 0.5 gpm Spray Nozzle w/ Large Male Thread	22
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	25
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Round Open Seat	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 10" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 10" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9"	18
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	4
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Closed Seat w/ Lid, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9"Length	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	4
New 1.6 gpf Flush-Valve Toilet w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 10" Rough-In, Baby Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	4
New 1.6 gpf Flush-Valve Toilet w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Baby Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	1
New 1.6 gpf Flush-Valve Toilet w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Baby Height, Round Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	1

Retrofit Description	Post Fixture Qty
Retrofit Urinal w/ 1.0 gpf Flush-Valve, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	6
Total	115

Nahanton Park Field House

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	1
New 0.5 gpm Spray Nozzle w/ Small Male Thread	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	3
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
Total	8

Newton Centre Field House

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	1
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	3
No Retrofit Proposed	4
Total	9

Newton Corner Library

Retrofit Description	Post Fixture Qty
New 0.5 gpm Spray Nozzle w/ Large Male Thread	1
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat	1
Total	2

Nonantum Library

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	2
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
No Retrofit Proposed	4
Retrofit Urinal w/ 1.0 gpf Flush-Valve, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	1
Total	10

Pierce Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	9
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	5
New 0.5 gpm Spray Nozzle w/ Large Male Thread	6
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	14
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 10" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	3
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 10" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9"	16
New 1.6 gpf Flush-Valve Toilet w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 10" Rough-In, Baby Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	3
Total	56

Public Building Maintenance Shop

No retrofits proposed.

Quinobequin Pumping Station

Retrofit Description	Post Fixture Qty
New 0.5 gpm Spray Nozzle w/ Large Male Thread	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	1
Total	2

Recreation Garage

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	3
New 0.5 gpm Spray Nozzle w/ Large Female Thread	4
New 0.5 gpm Spray Nozzle w/ Small Male Thread	1
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Round Open Seat	3
Total	11

Recreation Headquarters

No retrofits proposed.

Senior Citizens Center

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	1
New 0.5 gpm Spray Nozzle w/ Small Male Thread	6
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	6
Total	13

Underwood Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	1
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	8
New 0.5 gpm Spray Nozzle w/ Large Male Thread	12

Retrofit Description	Post Fixture Qty
New 0.5 gpm Spray Nozzle w/ Small Male Thread	1
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	25
New 1.0 gpm Aerator Nozzle w/ Small Male Thread	1
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	12
New 1.6 gpf Flush-Valve Toilet w/ Back Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	4
No Retrofit Proposed	5
Total	73

Upper Falls Community Center Library

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	1
New 0.5 gpm Spray Nozzle w/ Large Female Thread	2
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	2
No Retrofit Proposed	6
Retrofit Toilet w/ 1.6 gpf Flush-Valve, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	1
Total	16

Waban Library

Retrofit Description	Post Fixture Qty
New 0.5 gpm Spray Nozzle w/ Large Male Thread	1
New 0.5 gpm Spray Nozzle w/ Small Male Thread	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 10" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 30" Length	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 10" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9"	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	1
No Retrofit Proposed	3
Total	

Ward Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	5
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	9
New 0.5 gpm Spray Nozzle w/ Large Female Thread	4
New 0.5 gpm Spray Nozzle w/ Large Male Thread	6
New 1.0 gpm Aerator Nozzle w/ Large Female Thread	7
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	11
New 1.0 gpm Aerator Nozzle w/ Small Male Thread	1
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Elongated Open Seat	1
New 1.1 gpf Pressure-Assist Tank High Efficiency Toilet (HET) w/ 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	1
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	8
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 13" Length	1

Retrofit Description	Post Fixture Qty
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 4 Bolt - Wall Mounted - Rear Discharge China, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	6
New 1.6 gpf Flush-Valve Toilet w/ Back Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 14" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length, Offset	2
No Retrofit Proposed	7
Total	70

Williams Elementary School

Retrofit Description	Post Fixture Qty
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	4
New 0.5 gpm Spray Nozzle w/ Large Female Thread	11
New 0.5 gpm Spray Nozzle w/ Large Male Thread	8
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	2
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	7
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	12
Retrofit Urinal w/ 1.0 gpf Flush-Valve, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	1
Total	45

Zervas Elementary School

Retrofit Description	Post Fixture Qty
Install New Basin and New 0.5 gpm Single Mixing Valve Faucet, 0.5 gpm Spray Nozzle	2
New "Small Pint" 1/8 gpf (0.125 gallon per flush) Flush-Valve Wall Mounted Urinal w/ large footprint, Exposed Sensor Actuator, 3/4" Dia. VBt, 9" Length	5
New 0.5 gpm Spray Nozzle w/ Large Male Thread	11
New 1.0 gpm Aerator Nozzle w/ Large Male Thread	16
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Handicapped Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	2

Retrofit Description	Post Fixture Qty
New 1.3 gpf Flush-Valve High Efficiency Toilet (HET) w/ Top Spud - 2 Bolt - Floor Mounted - Floor Discharge China, 12" Rough-In, Standard Rim Height, Elongated Open Seat, Exposed Hand Actuator, 1-1/2" Dia. VBt, 9" Length	14
New 1.5 gpm Chromed Showerhead, Neoprene Faceplate	1
No Retrofit Proposed	4
Total	55

Interface with Existing Systems and Operations

Impact on Facility Operations and Performance

The facility will benefit from reduced water consumption. NORESCO will coordinate construction with City personnel.

Maintenance

NORESCO expects maintenance of the installed equipment to be comparable to or less than current maintenance requirements.

Customer Training

NORESCO will provide O&M manuals for the installed equipment. No special training is required.

Equipment Information

Manufacturer and Type

The proposed equipment will be manufactured by one of the following, or equal:

Flushometers:
Sloan • 10500 Seymour Ave., Franklin Park, IL 60131 • (800) 982-5839
Zurn • 3724N Peachtree Rd, Chamblee, GA (770) • 451-6765

Aerators:
Neoperl Inc. • P. O. Box 320049, Fairfield, CT 06432 • (203) 259-6800

Showerheads:
AM Conservation • 2301 Charleston Regional PWY, Charleston, SC 29492 • (800) 777-5655

Toilets:
Kohler • 444 Highland Drive, Kohler, WI 53044 • (800) 456-4537
Crane • 41 Cairns Road, Mansfield, OH 44903 • (800) 546-5476
Zurn • 3724N Peachtree Rd, Chamblee, GA • (770) 451-6765

Toilet Seats:
Bemis Manufacturing Co • P. O. Box 901, Sheboygan Falls, WI 53085 • (800) 558-7651

Domestic Water Conservation
I. Savings Calculations

STEAM TRAP IMPROVEMENTS

Overview

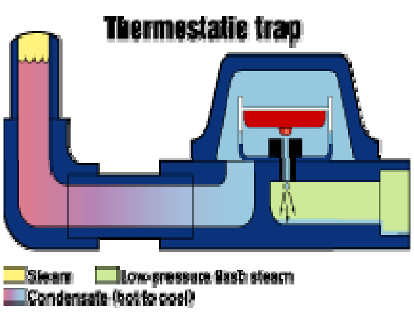
Buildings all over the city have systems that generate steam for space heating. Integral components of an efficient steam system are the steam traps, which remove condensate from the distribution system and return it to the boiler plant. Older and unmaintained steam traps will fail over time and eventually allow live steam to pass through the trap into the condensate system, wasting significant energy. NORESCO's experience is that without a comprehensive maintenance program that includes the repair or replacing of failed traps, a significant number of traps will fail to operate properly over time.

Thermostatic Steam Trap

NORESCO will repair or replace steam traps with new, properly functioning components to improve comfort conditions and reduce thermal energy losses. Further, NORESCO will provide a comprehensive steam trap maintenance program that will help maintain energy savings and verify that the traps continue to function properly throughout the contract term.

Detailed Description

Existing System



Each facility has boilers that generate steam for space heating. As the steam in the individual heating systems exchanges its energy for space heating, it condenses back into water. Steam traps capture this condensate after the heat energy has been transferred to the end use. The majority of the traps surveyed were Float and Thermostatic ("F&T") and Thermostatic type traps. Conventional steam traps can fail in the open or closed position. When a steam trap fails in the open position, the energy that was added at the boiler is lost into the condensate return system. The energy contained in steam is intended to be utilized when it condenses in a heat exchanger (radiator, unit convector, water heater, AHU coil, etc.) and releases its latent heat in the process. It is at this point the steam trap should allow the condensate (which has a low energy value in comparison to steam) into the piped return system where it will begin its journey back to the boiler room. Conversely, a steam trap that fails in the closed position does not allow the condensate to enter the condensate return system. This condensate will sub-cool (cool below saturation temperature) in the steam line and form carbonic acid, which will attack the piping and its components, and result in the space under heating.

NORESCO tested steam traps in the selected buildings to determine if traps are operating properly or leaking steam. Notes were recorded concerning the condition of the traps and the related piping. NORESCO performed ultrasonic testing of 50% of the traps in these selected buildings, including: Angier School, Auburndale Library, Bowen School, Countryside School, Franklin School, Health Department, Lincoln-Eliot School, Memorial-Spaulding School, Pierce School, Senior Center, Ward School, Williams School and Zervas School. Based on this testing, we determined that on average, 18% of the steam traps were deficient. NORESCO used the results of the steam trap testing to estimate failure rates for the remaining buildings, including Cabot School, Eliot Street Operations Center, Fire Station #3, Hawthorne Field House, Nonantum Library, Upper Falls Community Center and Underwood School.

Recommended Improvements

NORESCO will repair or replace 1,044 steam traps in the following buildings:

Building	Qty
Angier School	87
Auburndale Library	18
Bowen School	82
Cabot School	51
Countryside School	55
Eliot Street Operations Center	32
Fire Station 3	32
Franklin School	88
Hawthorne Field House	13
Health Department	20
Lincoln-Eliot School	64
Nonantum Library	30
Memorial-Spaulding School	70
Pierce School	52
Senior Center	39
Ward School	79
Williams School	31
Zervas School	91
Upper Falls Community Center	26
Underwood School	84
TOTAL	1,044

Maintenance Program

NORESCO will provide an annual steam trap maintenance program for the City of Newton to deliver energy and maintenance savings and reduce the maintenance burden on the facility staff. Beginning in year three and for each year thereafter, NORESCO will:

- Test 30% of the steam traps annually and tag failed or leaking traps.
- Repair, replace failed, or leaking steam traps as required.
- Document results of the testing and repairs in an Annual Report.

The steam trap maintenance program is further described in the section below.

Scope of Work

NORESCO will repair or replace the existing mechanical steam traps with Tunstall equipment (or approved equal), including all miscellaneous materials. These materials will include installation of permanent stainless steel or brass valve tags that uniquely identify each steam trap with a number that can be traced back to the as-built steam trap audit. These materials include, but are not limited to mounting hardware, plumbing pipe, and plumbing fittings.

The following items are excluded:

- NORESCO assumes that all existing isolation valves are in good working order; replacement of faulty steam distribution and condensate return system isolation valves is not included in the scope of work.
- Painting or patching unless required as a result of damage during installation.

Steam Trap Service & Maintenance Program

Beginning in year three, NORESCO will test and inspect 33% of the traps repaired or replaced by NORESCO annually for the contract term. The complete results for the year will be published in an Annual Trap Survey Report.

- Trap components to be tested and inspected include the trap body, nozzles and internal strainer screens; external strainers, including the body, screen and drain valves; and pipe, valves and fittings installed by NORESCO.
- Failed traps and trap components will be repaired or replaced following the inspection and resolution published in the Annual Trap Survey Report.

The following table summarizes NORESCO's steam trap maintenance and testing program:

Summary of NORESCO Steam Trap Maintenance Services

	Years 1-2	Years 3 – 12
Test & Inspect Traps Installed by NORESCO		✓
Clean Traps & Strainers Installed by NORESCO		✓
Provide Annual Trap Survey Report		✓
Materials & Labor to Repair or Replace Failed Traps	✓	✓
Materials & Labor to Repair or Replace Failed External Strainers, Piping, Valves, and Fittings	Cost +30%	Cost +30%

Operational Tasks

The Steam Trap Maintenance Program includes Survey and Preventive Maintenance only. This program excludes any operational tasks such as daily equipment checks, or equipment scheduling.

Water Chemistry

Steam traps require precise water chemistry to perform effectively. Steam leaks and broken or leaking condensate return lines require the use of excessive make up feed water and can significantly increase the levels of sludge and or scale in the condensate return systems. Any service for steam traps necessitated by inadequate water chemistry or debris in the steam lines will be recognized as a Repair Call and will be billed accordingly.

Service Calls

Service calls are non-scheduled visits conducted during normal business hours that include any system condition, which requires service as determined, by the OWNER or NORESCO. Service calls for repairs are outside the scope of this maintenance agreement and are billable at the then current NORESCO service rate.

EMERGENCY service calls for repairs are outside the Scope of Maintenance and are always billable at the then current NORESCO emergency service rate.

General Warranty Conditions

NORESCO will provide a one-year workmanship warranty on the Steam Traps installed as part of this project. This warranty covers issues such as improper installation and systemic product failure. In addition to the NORESCO warranty listed above, all manufacturers' extended warranties will be passed through to the City of Newton. The warranty period will commence on the date of Substantial Completion.

NORESCO Warranty Responsibilities

NORESCO will provide repair and replacement of failed steam traps installed by NORESCO as follows:

Traps	Repair & replacement of Steam Trap assemblies installed by NORESCO, is covered when performed during the annual survey. This warranty excludes External Strainers, Pipes, Valves, fittings and service at any time other than the annual inspection.
External Strainers, Pipes, Valves, & Fittings	One-year warranty on external strainers, pipes, valves and fittings installed by NORESCO.

Warranty coverage is subject to certain limitations as listed in the *Service & Maintenance Program Limitations* section.

Consumables

NORESCO's maintenance program includes the cost of minor consumables as part of the expected maintenance and inspection cycle. For year one, NORESCO will absorb the cost of all consumables installed by NORESCO under the *Workmanship Warranty*. Starting in year two, NORESCO will assist the City with the procurement of any Warranty Claim items such as steam traps. However, for items not under warranty - *Pipes, Valves, Nipples, Strainers, Strainer Baskets, etc.* – NORESCO will invoice the City at the NORESCO rate of parts plus 30%.

City of Newton Responsibilities

The City shall be responsible for the following:

- Ensure that all systems are operated per the NORESCO design specifications.
- Inform the NORESCO contact immediately in the event of any situation requiring NORESCO's attention, such as abnormal equipment readings or alarm conditions.
- Provide first response for any exigent circumstance. Use accepted practices in the handling of any emergency requiring action prior to the arrival of NORESCO staff or its agents. Contact NORESCO O&M personnel as soon as possible for further instructions.
- Restrict access to equipment installed in non-public locations to authorized personnel only.
- Perform housekeeping duties.
- Correct leaks in a timely manner in roofs, building penetrations, or open or closed systems for which NORESCO does not have complete responsibility or that could affect equipment performance and energy savings.
- Engage NORESCO, in advance, to review and approve any system changes that may result in adverse effects on the performance or reliability of NORESCO-installed equipment or systems.
- Provide escorts to NORESCO and its agents in a timely manner and as necessary for completing the O&M tasks.
- Provide NORESCO staff access to all machine areas. NORESCO's subcontractors shall be granted timely access to respond to service calls and effect repairs.
- Provide security as may be necessary for service calls or repair work in unsafe areas or after hours. Work that cannot be performed due to unsafe conditions may be postponed until reasonable safety can be assured.
- Provide first response for all trouble, or service calls.

Service & Maintenance Program Limitations

NORESCO will provide Long-Term Maintenance and Service coverage for certain equipment installed under this contract for the contract term as described above. In general, this provides for the maintenance, repair and replacement of installed equipment that fails. However, this coverage has limitations. NORESCO is not liable for problems that result from an event that is out of NORESCO's control. This includes all costs of service calls, repairs, or lost savings resulting from any failure that is determined to have been caused by:

- An item listed under City of Newton Responsibilities herein or in the O&M Manuals not being fulfilled.
- A problem that is unrelated to NORESCO responsibilities.
- Inadequate chemical water treatment, corrosion, scale or other debris in the steam or water lines
- An act of any persons other than NORESCO staff or its agents
- A problem that proves to be unrelated to a defect in manufacturing or installation.

At the City's request, NORESCO will provide an estimate to perform the required repairs for situations falling in this category. The customer will be invoiced at the then current NORESCO rates. In the event of a service call that is determined to fall in this category, the City will be invoiced for all costs incurred.

The City will be invoiced for services rendered that are determined to be caused by items excluded from NORESCO's responsibilities. NORESCO's responsibilities are limited to the equipment installed as part of this project.

The City is responsible for any cost or negative saving impact resulting from the City altering the NORESCO installed systems or operating parameters.

Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The new steam traps will deliver significant steam energy savings. All work will be done during normal business hours. NORESCO will coordinate all work with facilities staff to minimize the impact on the building occupants. The direct impact to the building occupants will be proper operation of the steam and condensate distribution piping. Traps that failed in the closed position would have left the space feeling cold since steam would not have been able to pass through the coil. Conversely, traps that had been passing steam will leave the spaces overheated. These conditions will be alleviated through the proper operation of the new condensate removal equipment.

Maintenance

In order to sustain the energy savings throughout the contract term, it will be necessary for the steam traps to be periodically inspected and maintained for proper operation.

Customer Training

Customer training and O&M Manuals for this measure will be provided.

Equipment Information

Manufacturer and Type

NORESCO will install conventional mechanical steam traps and components manufactured by Tunstall Associates or approved equal.

- **Tunstall Corporation** 118 Exchange Street, Chicopee, MA 01013 Phone: (413) 594-8695 Fax: (413) 598-8109

Steam Trap Improvements
I. Energy Savings Calculations

WEATHERIZATION

Overview

NORESCO will implement weatherization improvements to reduce infiltration, as well as install insulation or insulating systems to reduce thermal transmission losses. The recommended improvements will reduce energy via reduced infiltration and thermal losses. An added benefit will be the increased occupant comfort through the reduction of drafts. With these improvements, NORESCO will:

- Install weatherstripping on doors, hatches, and windows;
- Seal selected envelope penetrations such as vents, roof/wall joints, soffits, ducts, pipes, conduits, and windows (caulked shut);
- Install insulation in ceilings, attics, and walls; and
- Install thermal panel systems.

The following City of Newton buildings are included in Phase 3:

- Angier Elementary School
- Bowen Elementary School
- Burr Elementary School
- Cabot Elementary School
- Countryside Elementary School
- Franklin Elementary School
- Horace-Mann Elementary School
- Lincoln-Eliot Elementary School
- Mason-Rice Elementary School
- Memorial-Spaulding Elementary
- Pierce Elementary School
- Underwood Elementary School
- Ward Elementary School
- Williams Elementary School
- Zervas Elementary School
- Albermarle Fieldhouse
- Auburndale Library
- Crafts St DPW Operations Center
- Crafts Street Garage and Car Wash
- Elliot Street Garage
- Elliot Street Operations Center
- Fire Headquarters
- Fire Station #3
- Hawthorne Fieldhouse
- Health Department
- Jackson Homestead
- Lower Falls Community Center
- Main Library
- Nahanton Park Fieldhouse
- Newton Center Fieldhouse
- Newton Corner Library
- Nonantum Library
- Public Buildings Department
- Recreation Headquarters
- City Hall
- Recreation Headquarters Garage
- Senior Citizens Center
- Upper Falls Community Center
- Waban Library
- Education Center Annex

Detailed Description

Existing System

The majority of buildings surveyed and listed above are older construction, most in the 50 to 75 year old range, with some dating back 200 years. Having weathered the test of time, many have seen multiple renovations and include construction materials and techniques that are substandard to today's accepted practices. A high percentage of the areas of concern identified in the audit relate to the oldest sections of the buildings. Other concerns relate to envelope construction or modifications that have been made without regard to energy efficiency or best practices. The following items were identified to be major contributors to the concerns noted above:

1. Air Infiltration: There are air pathways allowing air infiltration into all buildings that were evaluated through direct penetration points.
2. Air Intrusion (ceiling and wall cavities): Air intrusion differs from air infiltration in that air infiltration pierces the exterior envelope and travels through the interior skin of the unit causing nuisance drafts. Air intrusion does not enter the interior space; it simply cools the skin of the room, using up the heat in the room to continually warm the skin surface while reducing the heat needed for the building occupants.
3. Chases: Unsealed chases were identified throughout some of the buildings. These allow conditioned air to escape and unconditioned air to infiltrate occupied spaces.
4. Envelope Definition: In some buildings direct contact between some occupied spaces and the areas outside the thermal building envelope were found. Also, thermal barriers in some buildings were found to be improperly defined, allowing air and moisture to penetrate beyond their intended barriers.
5. Mechanical Rooms: Mechanical rooms have not been "compartmentalized". Doors are not weather-stripped and some pipe, conduit and duct penetrations entering the mechanical room have not been sealed effectively.
6. Weatherstripping: Weatherstripping of pedestrian doors, access doors, and hatches was found to be damaged, of poor quality, or in some cases, absent.
7. Access Door/Hatch Insulation: Many access doors and hatches are not properly insulated.
8. Glass Walls: Large glass walls need attention. These areas provide significant opportunity for solar heat loss/gain to occur.
9. Windows: Windows need attention. Many were found to permit high rates of infiltration and/or poor thermal performance.
10. Wind and Stack Effects: The Wind and Stack Effects play major roles in the energy consumption and comfort in many areas of the buildings. See detailed description below for more information.

General Observations

The surveyed buildings consist of various designs, including converted homes, large single-story buildings, and commercial offices. Each building, regardless of type, was found to have building envelope deficiencies. Some buildings had basic issues such as weatherstripping replacement while others had more complex problems that may necessitate physical changes to the buildings' appearances (some interior and some exterior). The most significant concerns deal with thermal deficiencies and openings in the building skin that are either built-in during the original construction, created during a retrofit period, or are the result of deterioration over time.

Recommended Improvements

NORESCO will weatherize and insulate the Phase 3 buildings to reduce infiltration, exfiltration, and transmission losses. These improvements will deliver heating and cooling savings and reduce drafts and energy losses from the exterior envelope, while also improving space comfort conditions. The following describes some of the problems identified and indicates what improvements will be made in selected buildings:

Weather-stripping and Caulking

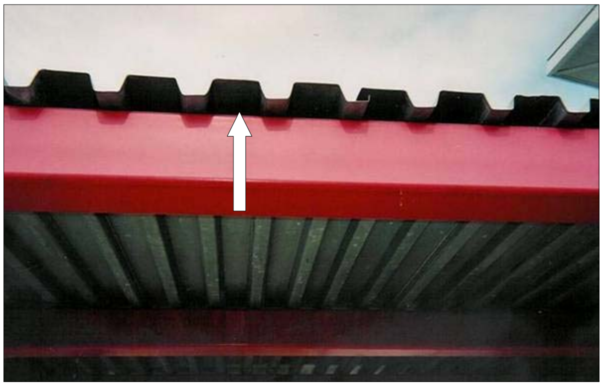
Window and door openings present a challenge to reducing infiltration in a building. They must not only seal but also allow access. While most sealing installations are permanent, windows and doors must continue to operate as designed. As such there is friction from the constant opening and closing. These areas will be weather-stripped with a durable product that is both flexible and strong enough to withstand abuse, wear and tear.



Weatherstripping Materials

Seal Roof/Wall Joint: Panning

In several buildings, metal panning is installed as part of the roof system on top of a block wall, "I"-beams and/or bar joist. The corrugated metal panning, by design, does not seal. The openings between each rib (the roof/wall intersection running parallel with the panning and the bar joist penetrations) should be sealed. See photos below.

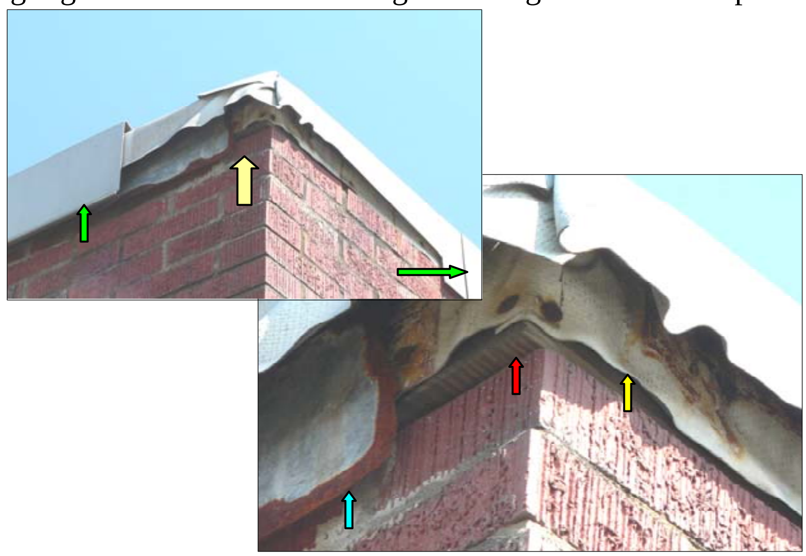



File Photos of roof panning (notice the gap between corrugations)

Seal Roof/Wall Joints to Reduce Leakage

All buildings leak air. Fresh air is required for all public buildings; it insures healthier conditions inside of the building and helps reduce sick building syndrome. Air leakage needs to be controlled however, to allow fresh air to be delivered in the most efficient, effective way.

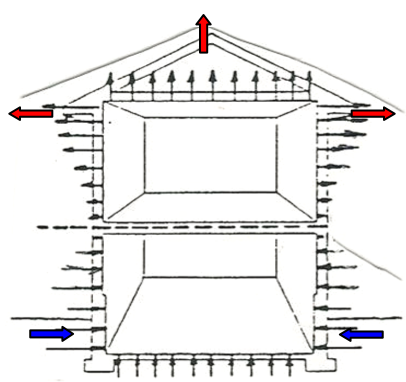
These two photos shed light on what is really under the metal flashing at the roof parapet. A closer look at the exterior portion of a roof/wall intersection reveals openings in the construction. The upper photo (green arrows) highlights the final trim flashing. The beige arrow in the photo indicates the location of the close-up photo to the right. In this photo the red arrow reveals an opening at the masonry and wood sill plate. The yellow arrow depicts the ends of the first felt layer which is not sealed**.** The light blue arrow details the second heavier layer which is also not sealed**.** This allows air, moisture and insect migration into the building. There are several buildings with this type of roof flashing that needs to be sealed.



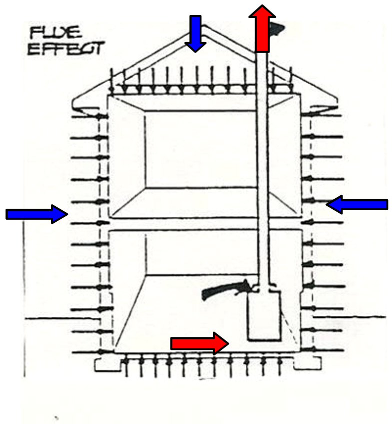
Stack, Wind, and Mechanical Effects

As warm air rises to the top most point in the building, any penetrations will allow heat loss to occur as this air continues to the exterior. The escaped conditioned air is replaced by unconditioned air. This loss can be compounded by the introduction of the stack, wind and mechanical effects which affect the interior conditions.

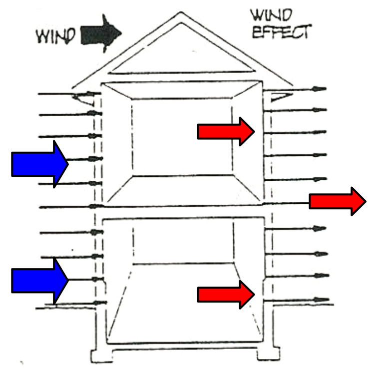
Stack Effect: In winter the air inside the building is warmer than that outside. As such, the air in the conditioned space has a lower density than the cold air on the exterior. This condition sets up a pressure difference across the building envelope. Any openings in the building envelope will allow air to move along this gradient. The drawing to the right highlights the effect; the arrows show the direction and relative size of the pressure effect. This pattern is present in all heated buildings, and is known as the stack effect.



Stack Effect



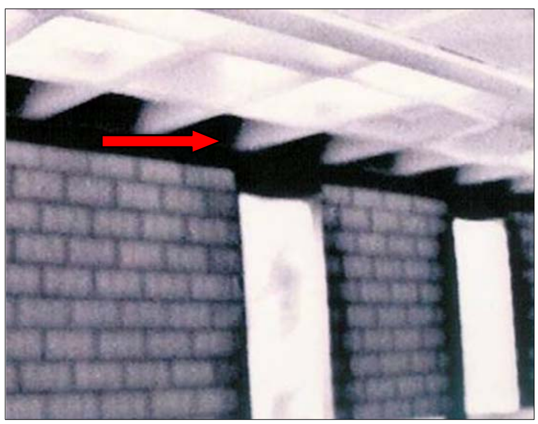
Mechanical Venting: If a building has a mechanical venting system then the flue effect is important. The venting can create negative pressure causing a vacuum on the building. This phenomenon sucks air out of the rest of the building and reduces its pressure. Cold air is pulled into the building through every crack and opening.



Wind Effect: From everyday experience, it is known that wind creates pressure – the stronger the wind, the greater the pressure. When a wind blows around a building it creates an inward pressure on the up-wind side. A very simplified form of wind effect is shown in the photo to the right. In practice, there is also a complicated wind pressure pattern across the building's ceiling which, like the other effects, will increase infiltration across the building envelope.

<u>Improved Insulation (Thermal Panels)</u>

Several buildings could benefit from adding some type of insulation. In exposed areas where the installed product will be seen by occupants, the typical insulation that is installed is a pre-finished thermal panel. This product comes as a "sheets good". One side of the product has a white pebble finish which helps maintain light reflectivity and thermal performance. The panel surface can be pressure washed if soiled and can also be painted. Its appearance is similar to a suspended ceiling; however, the panels are larger.

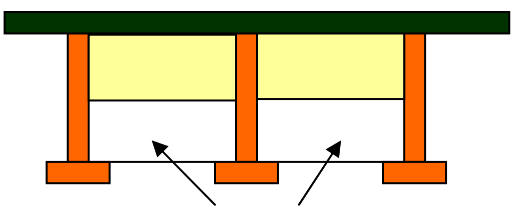


Thermal Bridging

The primary benefit of installing a thermal panel insulation system is the reduction and/or elimination of thermal bridging. A material's thermal conductivity describes how much heat flows through a one-inch-thick by one-foot square slab of that material each hour, when there is a one degree Fahrenheit temperature difference between the slab's two surfaces. The (archive) photo to the right is an infrared image of the top floor in a library. The cold area (black image-red arrow) reveals a tremendous amount of heat loss through conduction. Aluminum (117 btu/hr/SF) is the most conductive common building material. Its thermal conductivity is about 5 times greater than steel, 1,000 times greater than wood and 10,000 times greater than air. One square foot of steel (26 btu/hr/SF), [the next most conductive building material], conducts as much heat as 50 square feet of concrete, 200 square feet of wood, or 1,000 square feet of glass wool if all are the same thickness. When this type of construction is used for the roof or wall system, the heat conducts through the concrete and escapes the building comfort zone. When very conductive materials touch one another heat flows rapidly through the building shell, effectively pumping heat through the envelope. This phenomenon is called thermal bridging. It results in cold interior surfaces during winter and hot surfaces during summer. This is a major point when considering changes in the glass wall areas or adding Thermax to open roof areas.

Ceilings, either metal or masonry, can benefit from this installation and reduce this conductivity. There are areas where adding thermal panels to an existing ceiling will enhance R-value and help increase lighting as well as reduce the amount of cubic footage being heated and cooled. An entire ceiling can be thermally enhanced by added panels in between the "I-beams" or bar joist with no additional structural requirements.

Ceiling Mounted Thermal Panel Installation Schematic



The specified product for this installation is STYROFOAM™ Ag Board and THERMAX White Finish/AG-THERM. These rigid boards have a reliable R-value of 5 or 6.5 per inch and provide quick installation. Durable acrylic facers withstand high-pressure cleaning. Once installed the product reduces air infiltration and acts as a good moisture resistant surface to prevent moisture intrusion.

Thermal Panel Installation (Wall/Ceiling)

In some locations, a thermal ceiling will be installed. This energy savings measure allows the total conditioned building volume to be reduced. In the photo to the right the ceiling was installed using the bottom cord of the bar joists, however conditioned space volume could have been reduced had the ceiling been installed on the bottom cord of the metal truss (red arrow). Unfortunately in this application shown the height was needed for raising equipment into the air on lifts to be worked on from below. Not only does this ECM reduce heat loss in the winter; it also reduces heat gain in the summer which is an added benefit to areas that have no air conditioning or where the air conditioning seems to not coo

Thermal Panel Installation (Attic)

Thermal Panel Installation in Attics: The photo to the left details another roof style which can utilize the Thermax ceiling. The rafters are exposed to the occupants. Regardless of construction material, the Thermax ceiling can be installed as large sheets (much like sheetrock) except that the sheets are already prefinished and thermally enhanced. This reduces the labor costs for installation. The resulting ceiling will exhibit improved thermal performance.

Thermal Panels on Glass Walls: There are several areas identified where thermal panels will increase the R-value of glass walls. The photo to the right is an archive example of utilizing the thermal panel in a glass wall. In this case the top transom was closed off to reduce energy costs. The glass remains in place and the panel is installed from the inside. It has a finished surface on the inside which is white but is also paintable. This system can be installed with little or no structural changes to the existing systems.

Thermal Panel Installation (Window)

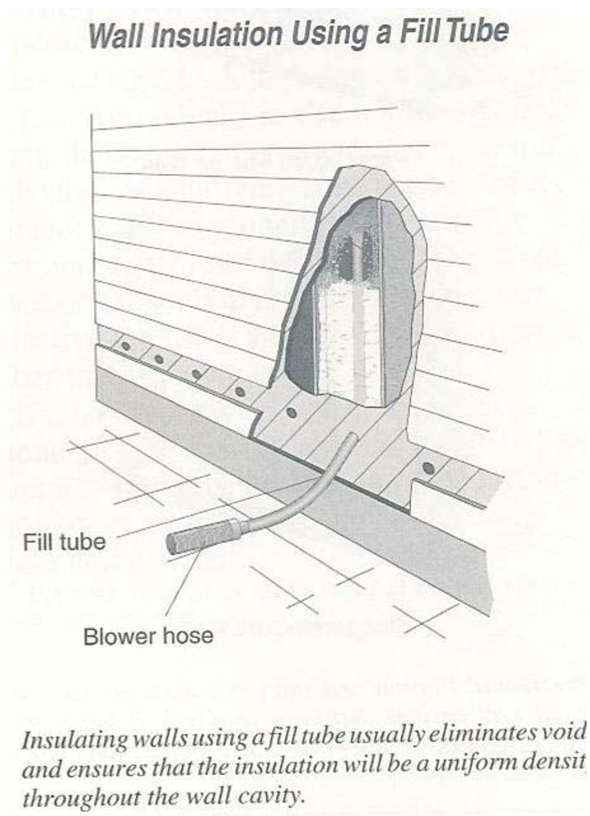
Thermal Panels on Windows: Windows create comfort problems in three ways:

1. Infiltration allows the unconditioned air to enter rooms
2. Convective currents are formed when air near the colder window surface cools, becomes denser and flows downward, causing a continuous flow pattern.
3. Heat Radiation:
   a. Heat radiation from the occupant’s warm skin to the cold window surface causes comfort problems.
   b. Heat radiation from single pane, un-shaded windows transmit about 85% of the solar heat striking them. This can account for up to 40% of a building’s overheating. Below is a chart which details some of the benefits of new windows as well as detailing what is “wrong” with the existing window. It is a combination of issues, low R-value, no thermal break in the sash or frame and lots and lots of air infiltration.

In several buildings, windows could be reduced in size thus providing energy savings due to increased thermal performance and reduced infiltration. If the exterior finish is a consideration, there are two options for covering the glass as viewed in the photos below. By adding the Thermax on the interior side, windows can become an option. The total glass area is reduced but the thermal performance of the glazing system will be improved significantly.

Thermal Panel Installation (Windows)



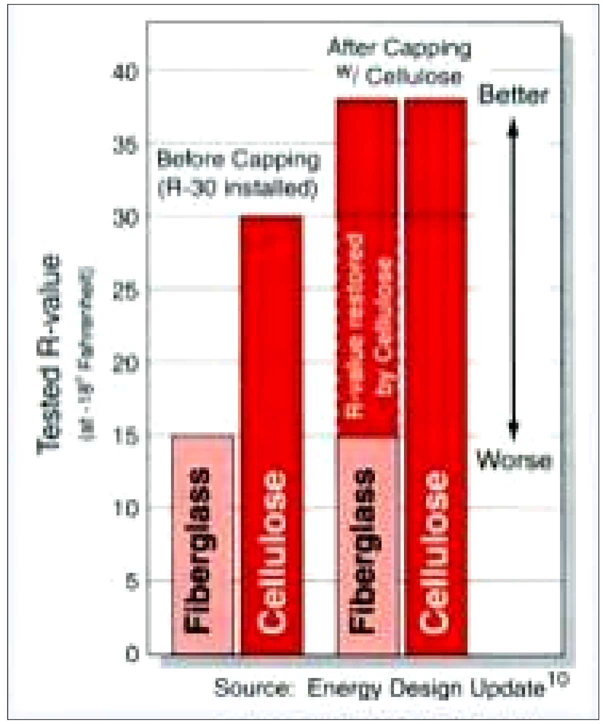
Insulate Walls and Attics (Cellulose):

Many buildings with standard attics provide a good opportunity for cellulose insulation installation. Cellulose insulation is an environmentally safe insulating product. While many buildings have some level of existing fiberglass insulation, studies have shown that blanketing fiberglass insulation with cellulose has not only increased the insulating value by the amount of the installed product, but also revived the existing insulation to its specified capacity. This is due to the fact that fiberglass loses R-value as attic temperatures get lower. A cellulose layer above the fiberglass prevents air from intruding the product, allowing it to maintain its specified insulating capacity**.** Researchers at Oak Ridge National Laboratory found that capping fiberglass with cellulose not only adds R-value, it actually restores the effective R-value that fiberglass loses during cold weather. The researchers also learned that capping fiberglass with more fiberglass fails to restore the R-value. Older buildings are frequently insulated with loose fill fiberglass. Adding a layer of cellulose insulation helps control convection and boosts the R-value. New buildings are sometimes insulated with fiberglass batts. A layer of cellulose insulation fills in around the gaps and seams and helps restore lost R-value.

The following scope will be for walls identified as candidates for dense packed insulation:

Interior Installation

- Examine surfaces affected by the installation of the insulation and notify the client in writing if substrates are unsatisfactory or weak.
- All items such as furniture, rugs and wall-hung items must be removed and set at least four feet from the wall being treated.
- Provide an infrared scan of the area to be insulated to determine the amount of holes needed to completely fill the cavity inside of the wall.
- There will be a minimum of one hole per cavity for access.
- Additional holes may be needed to ensure that there is complete coverage of the area.
- Cover items in room.
- Items to remain covered until the completion of the service work.



- Access each cavity by cutting a 2 1/2” x 4” hole (size may vary depending on the size and condition of the cavity).
- Remove the hole plug for reinstallation later.
- Mark each plug to the corresponding hole.
- Insert dense packing hose in access point and fill cavity with cellulose materials according to manufacturer’s recommendations.
- Check area with an infrared camera to ensure at least a 98% coverage.
- When sufficiently filled reinsert plug and secure it in place using appropriate sealant.
- Re-coat surface with like materials and bring surface to paintable grade.
- Broom sweep area
- Remove coverings from furniture and belongings
- Clean up debris and surplus materials.

Cellulose Installation

Exterior Installation

- Examine surfaces affected by the installation of the insulation and notify the client in writing if substrates are unsatisfactory or weak.
- Provide an infrared scan of the area to be insulated to determine the amount of holes needed to completely fill the cavity inside of the wall.
- There will be a minimum of one hole per cavity for access.
- Additional holes may be needed to ensure that there is complete coverage of the area.
- Cover items in room.
- Remove existing exterior surface and preserve for reinstallation.
- Access each cavity by cutting a 2 1/2” x 4” hole (size may vary depending on the size and condition of the cavity) into the substrate.
- Insert dense packing hose in access point and fill cavity with cellulose materials according to manufacturer’s recommendations.
- Check area with an infrared camera to ensure at least a 98% coverage
- When sufficiently filled seal hole using appropriate sealant.
- Re-install exterior materials
- Clean up debris and surplus materials.

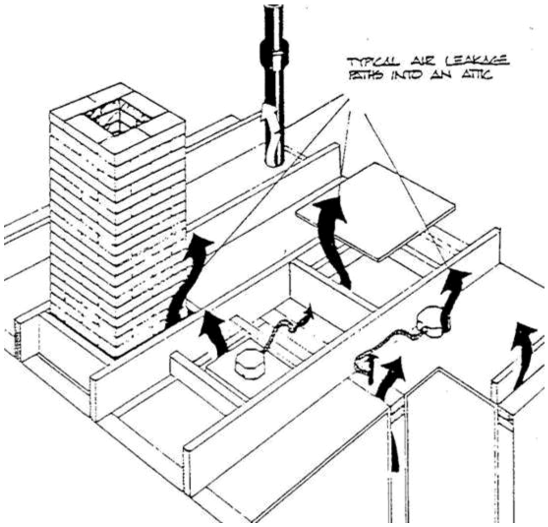
Considerations

1. Owner to be responsible to remove furniture, wall hanging items and rugs from the four foot area.
2. Some areas in walls may be purposefully left unfilled as they may be part of an air distribution system or may create an unsafe condition.
3. Over blow may occur at the joist area which means that additional materials may blow back into the joist cavity. This normally occurs when walls are balloon framed or have a void cut at the base plate. This is not a negative issue, in fact, it further insulates the area.
4. There may be some required small sanding before the painting is complete.
5. Other reasons for less production may include delays in reaching the area to be insulated and/or having to remove items from the work area.

Blown attic insulation should emerge from the hose in a fairly dense continuous slug to prevent fluffing. Adequate density is necessary to minimize both settling and convection of air through the insulation

Seal Attic Bypasses

This category covers hidden air passageways that lead from the heated space into the attic. Because warm air rises, it is continually moving up these passageways and escaping into the attic during cold weather. Even though the attic should be cold, the bypasses make it a semi-heated space, which is a waste of energy. These bypass leaks can cut the effectiveness of attic insulation by 30 to 70 percent. If you have any of these air leaks into your attic, adding insulation alone without sealing air leaks is not going to help much. Also, water vapor carried with the escaping warm air may condense, freeze and build up in the insulation. When this water builds up, it can soak the insulation. In addition to wet insulation having almost no insulating value, these conditions can cause plaster to crack, paint to peel, and other additional structural damage. When moisture problems appear in the attic after it has been insulated, attic bypasses are often the cause.



Seal Attic Penetrations in Accessible Areas

Exfiltration occurs at the high pressure plane in a building. It is enhanced by the stack effect. Exfiltration increases proportionately to the amount of pathways, voids and chases in the structure.

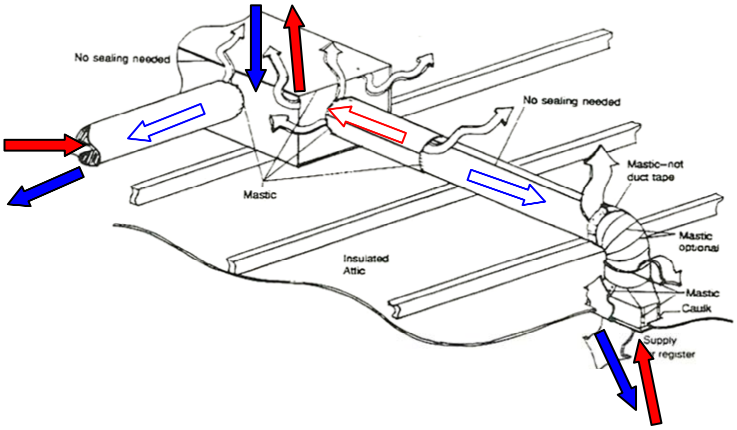
Where the attic is accessible, there are many exfiltration points that can be sealed. The drawing to the left shows some of those areas where leakage occurs. These will be sealed before insulation is installed or re-insulation occurs.

Seal Penetrations

Penetration points are areas where, during initial construction and/or retrofits, holes have been opened to accommodate conduits, pipes and ductwork. These were never sealed. When open to outside, they are direct points of entry through the building envelope allowing the outside air to enter the building uncontrolled and unconditioned. Holes allow the flow of air between floors, areas above drop ceilings and attics causing increases in the stack effect on buildings and impact negatively on the comfort of the occupants.

Air Barriers

Heat flow through the building shell happens in three ways: conduction through floors, walls, and roofs; air leakage; and fenestration (windows and doors). Conduction through the building shell depends on two factors: the shell's thermal resistance and its surface area. Air leakage depends on the number of cubic feet per minute (CFM) of air leaking into and out of the building. That number of CFM will depend on the leakiness of the floors, walls, and roofs and their surface areas.



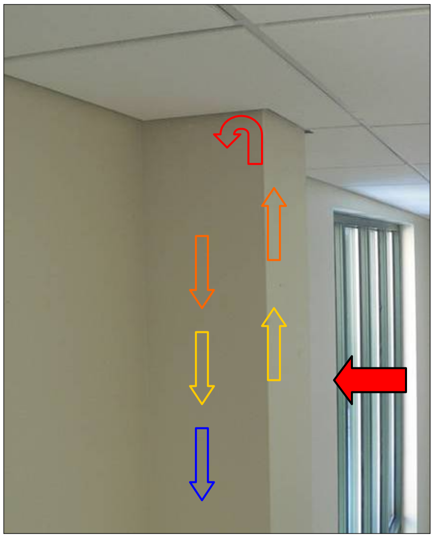
Ductwork in Unconditioned Spaces

Air leakage also depends on the surface area and location of the shell's major penetrations such as pipes and chimneys.

Ductwork in Unconditioned Spaces

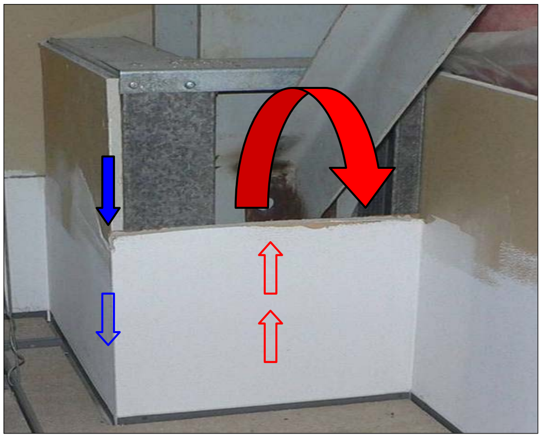
If there is abandoned ductwork in the attic which is still attached to the occupied space; there is a tremendous amount of heat loss in the winter through this ductwork. Warmer air per cubic foot has fewer molecules than colder air. Therefore as the cold air falls from the attic the warmer air is pushed out of the building. Contributors to this transfer are the vents in the ceiling and the pathway to the attic (ductwork). The warmest air flows into the ductwork in the attic and "leaks" out through the joints, seams and connections. Other warmth is lost through conduction of the ductwork. When ductwork is still in use, there is the issue of heat loss/gain when the unit is running. Air moves on static pressure. The fan forces air through the ductwork. If the ductwork is totally sealed, then all of the conditioned air that is forced into the ductwork exits from the supply ducts. If there are leaks at the seams, joints, and connections, less conditioned air makes it to its destination, leaving rooms less comfortable; the ductwork diagram details both the leakage patterns for the loose joints, seams and connections as well as the losses through conduction (through the material).

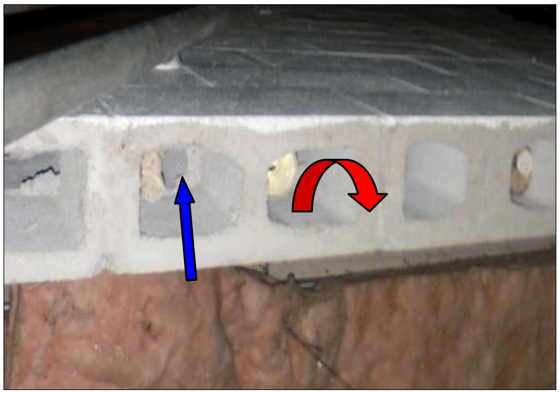
Convective Looping



This is a process by which heat is transferred by a moving fluid like air or water. Convection happens because of the density differences between warmer and cooler parts of the fluid. In walls this becomes a very costly phenomenon. The photo to the right is an archive example of an interior column at a campus where convective looping is currently taken place. As the warmth of the interior warms the hollow wall (large red arrow), the air in the wall becomes less dense and rises. As it reaches the top, the heat from the warmed air leaves the area and the air cools and falls back down where it is again warmed and the looping becomes continuous.

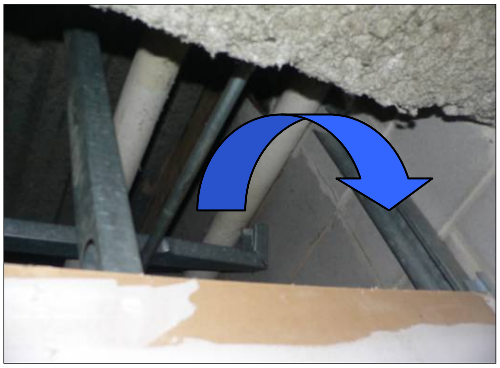
When the top of the column is open to area above the ceiling the effects of the heat loss increases dramatically. Instead of





Block Wall Exhibiting Convective Looping just looping back down to be reheated, the air escapes from the top of the open column and leaves the building through the direct penetration points. The convective looping continues but at a more drastic temperature differential meaning that colder air comes in and it takes more BTUs of heat to warm the cavity and the conditioned air never returns. The warm air escapes through the breaches in the exterior skin.

Block Walls: Hollow block walls are pathways for air to flow up and out or down and into. Convective looping can be exhibited in these structures as well.

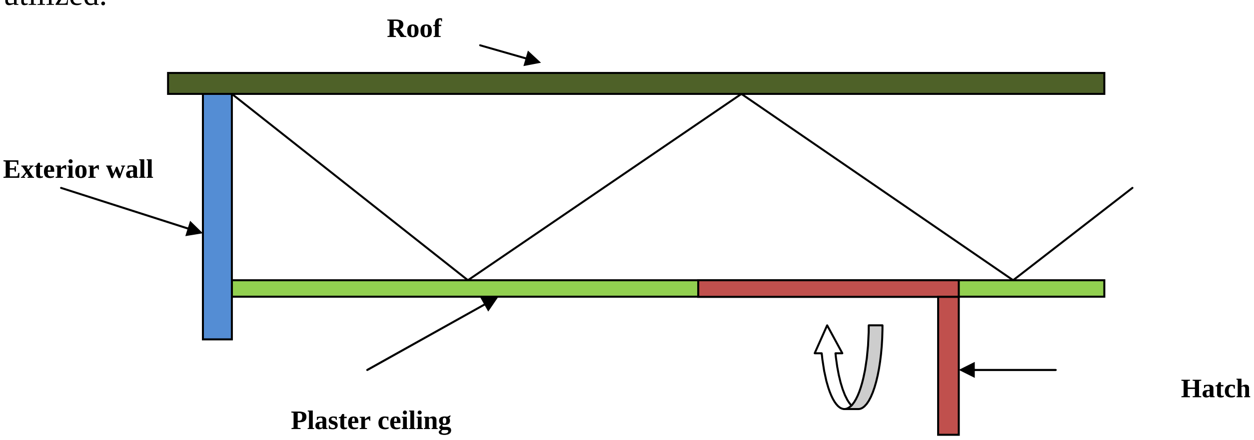


Open Soffit

Open Soffits: Some overhangs and soffits are open to the exterior. There are seams, cracks and joints in these soffits that allow the free flow of air beyond their exterior "skin"; some of these even have recessed lighting. The holes that were created to receive the light fixtures are also entrance points for moisture and insect migration and exit points for heat in the winter. Since heat always travels to cold, the conditioned heat is lost in the winter and the hot humid air gains access in the summer. These need to be sealed along with the edges. Heat enters through this opening into the building through breaches and through conduction. This can affect the comfort of occupants near this area as well as occupants across the building. These areas (abandoned ductwork, convective looping and soffits) will be sealed as part of the air barrier installation.

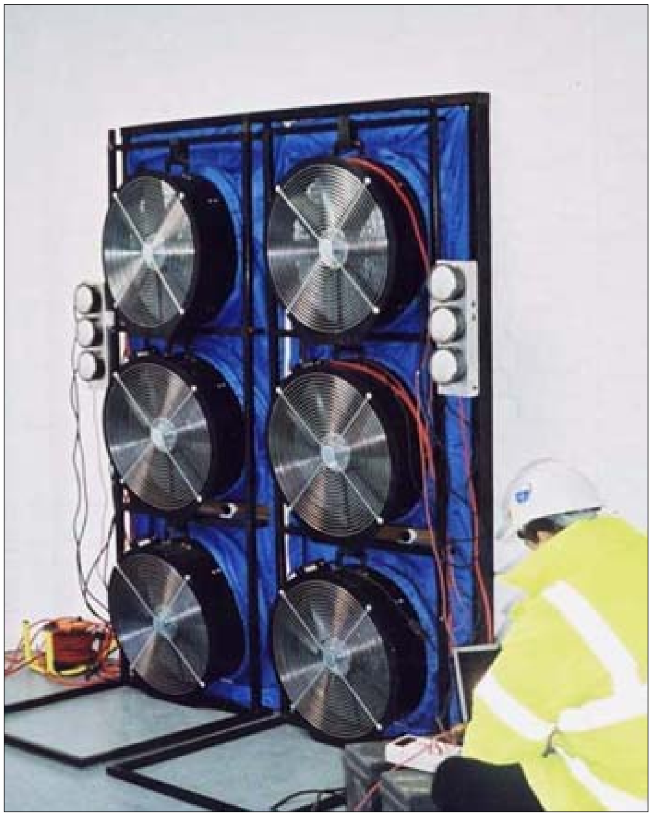
Special Insulation Measure

On some schools there is a plaster ceiling which is the interior finish in classrooms; however there is no insulation above that plaster ceiling. Normally this installation is performed through the hallway space. If this is not available then in order to insulate the cavities above the plaster ceiling an access hatch would need to be installed in each room where the insulation would be utilized.



Blower Door Methodology

To accurately measure the infiltration rate in a building; a blower door is used for testing. This device allows us to instantaneously measure the pre-leakiness and post-leakiness of a structure. The difference is considered the success of the weatherization work completed. Once that measurement is derived it can be imported into any one of many modeling programs which measure cost effectiveness of air sealing. For most structures a series of standard blower doors (photo right) is all that is needed to create air flow for evaluating the leakage points in buildings. While the equipment is exhausting air through the fans outside air is entering through the holes, voids, and seams of the structure. This information can be used to create a scope of work.



There are times when identifying the actual leakage points can be difficult as it may be hidden. On those occasions an infrared camera is used to help identify where the leakage is entering the building.

For large buildings the blower door may be larger as depicted above, however the process is the same. Pressure differentials are created to measure the uncontrolled leakiness of the structure.

Scope of Work

Door Weather-Stripping Installation Protocol

1. Weather-strip fire, mechanical, access and exterior doors by:
   - Examine surfaces affected by the installation of weatherstripping and notify ESCO in writing if substrates are unsatisfactory.
   - Test doors to be weather-stripped for proper closing. Notify ESCO in writing if any door hardware needs to be adjusted to ensure proper operation.
   - Remove any old weatherstripping and door sweeps.
   - Attach new weather-strip DX 1000 with self tapping screws; consisting of an aluminum carrier with a clad foam insert.
   - Install door sweep DSS 10914 consisting of heavy duty extruded aluminum, single line 13mm Finseal.
   - Install weather-stripping/seals plumb, square and level, wherever possible.
   - Remove debris and surplus materials upon completion of work.

Two Part & One Part Foam Installation Protocol

- Differentiate eligible leakage areas through the thermal barrier from interior holes.
- Examine sizes and conditions of voids to be sealed to establish correct thickness and installation of materials.
- Verify that the surfaces are ready to accept the work.
- Foam pipe, duct and conduit penetrations at various locations throughout the building (i.e. mechanical rooms, attic, etc.), installed per manufacturer specifications.
- Materials include one-component and two component polyurethane foam.
- Use one component foam for cracks and openings 6 mm to 50 mm wide.
- Use two component foam sealant for gaps over 50 mm and voids in hidden cavities.
- Remove debris and surplus material.

Seal Roof/Wall Intersection

- Differentiate eligible leakage areas through the thermal barrier from interior holes.
- Examine sizes and conditions of voids to be sealed to establish correct thickness and installation of materials.
- Verify that the surfaces are ready to accept the work.
- Apply sealants per manufacturer specifications.
- Materials include one-component and two component polyurethane foam.
- Use one component foam for cracks and openings 6 mm to 50 mm wide.
- Use two component foam sealant for gaps over 50 mm and voids in hidden cavities
- Remove debris and surplus material.

Roof/Attic Work

- Differentiate eligible leakage areas through the thermal barrier from exterior holes.
- Examine sizes and conditions of voids to be sealed to establish correct thickness and installation of materials.
- Verify that the surfaces are ready to accept the work.

- Apply sealants per manufacturer specifications.
- Materials include one-component and two component polyurethane foam.
- Use one component foam for cracks and openings 6 mm to 50 mm wide.
- Use two component foam sealant for gaps over 50 mm and voids in hidden cavities
- For large, open areas a R-max foam board product, plywood and/or sheetrock material may be used to close off and span large gaps.

Caulking

- Caulking is used for sealing areas that are exposed in lieu of foam. The same steps are used when utilizing caulk.

Thermax Light Duty

- This product is used for sealing large open areas too big for two part foam, normally in hidden areas such as soffits. It comes as “sheet goods” and can be cut to fit; then the seams and joints are either caulked or foamed to complete the seal of the opening.

Insulation

- Seal pipe and conduit penetrations, ductwork and open chases and pathways as described in the Blown Attic Insulation section above to prevent fluffing. Adequate density is necessary to minimize both settling and convection of air through the insulation.

Location Specific Scope of Work

The following scope will be installed at the locations as follows:

Angier Elementary School (Short Term Building: Focus on Measures with <5 Year Payback)

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (18 standard and 1 small door)
2. Seal (1) a/c unit
3. Seal (3) metal vents
4. Install 2,050 square feet of thermal panels on the interior side of the weather panel
5. Seal (10) other penetrations throughout the structure

Bowen Elementary School

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (21 standard doors)
2. Seal (1) a/c unit
3. Seal (18) other penetrations throughout building
4. Install 16,940 square feet of R-38 attic insulation in older section of building
5. Seal approx 586 linear feet of roof/wall intersection
6. Install 1,120 square feet of thermal panels behind existing weather panels

Burr Elementary School

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (20 standard doors)
2. Seal (4) a/c units
3. Seal (18) other penetrations throughout the building
4. Seal 950 linear feet of roof/wall intersection
5. Install 2,304 linear feet of window weather-stripping

Cabot Elementary School (Short Term Building: Focus on Measures with <5 Year Payback)

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (21 old and 2 new standard doors)
2. Seal (2) a/c units
3. Seal (22) other penetrations throughout the building
4. Install 7,068 square feet of R-38 insulation in main attic
5. Install 300 square feet of R-38 attic insulation in the hallway of new section
6. Seal 232 linear feet of roof/wall intersection
7. Install 80 linear feet of window weatherstripping on old windows
8. Install 1,660 square feet of thermal panels on the interior side of the existing weather panels
9. Add interior thermal panels to the gym gable to reduce heat loss/gain (600 sq ft)

Countryside Elementary

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (24 standard doors)
2. Replace (3) doors
3. Seal (1) a/c unit
4. Seal (35) other penetrations throughout building
5. Install 3,980 square feet of R-38 attic insulation in modular classroom areas
6. Seal approx 538 linear feet of roof/wall intersection on oldest addition
7. Install 2,580 square feet of thermal weather panels on the interior of the large glass walls of the oldest addition rear of school
8. Install R-38 cellulose insulation above plaster ceilings of original school (24,870 square feet)

Franklin Elementary School

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (25 standard doors)
2. Seal (2) a/c units
3. Seal (32) other penetrations throughout the building
4. Install 16,965 square feet of R-19 cellulose wall insulation
5. Install 890 square feet of thermal panels on the interior side
6. Provide blower door directed air sealing on trapezoid one story addition (4 hours)

Horace Mann Elementary School (Short Term Building: Focus on Measures with <5 Year Payback)

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (11 standard doors)
2. Seal (2) a/c units
3. Seal 420 linear feet of roof/wall intersection in boiler room and gym area
4. Install 540 linear feet of window weather-stripping
5. Install 350 square feet of thermal panels below windows on the second floor

Lincoln-Eliot Elementary School

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (14 standard and 7 new doors)
2. Seal (1) a/c units
3. Seal (26) other penetrations throughout the building
4. Install 7,590 square feet of R-19 cellulose insulation in existing attic
5. Seal approx 300 square feet of energy wall above suspended ceiling in bridge between buildings
6. Seal approx 100 linear feet of roof/wall intersection at bridge area
7. Install 400 linear feet of window weather-stripping
8. Install 370 square feet of thermal panels on the interior side of weather panels
9. Install 300 square feet of thermal panels on the interior side of glass panels on rear stairwell
10. Caulk shut 400 linear feet of old windows

Mason-Rice Elementary School

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (4 old standard and 9 new standard doors)
2. Seal (6) a/c units
3. Seal 88 square feet of energy wall at the main entrance
4. Seal approx 634 linear feet of roof/wall intersection in oldest section

Memorial-Spaulding Elementary School

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (24 standard doors)
2. Seal 895 linear feet of roof/wall intersection

Pierce Elementary School

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (14 standard doors)
2. Install 1,200 square feet of R-38 insulation

Underwood Elementary School

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (16 old standard and 7 new doors)
2. Install 1,270 square feet of thermal panels to the interior side of the existing weather panels

Ward Elementary School

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (9 old standard and 7 new doors)
2. Install 3,850 square feet of R-19 cellulose insulation over existing insulation
3. Seal (26) penetrations throughout the structure
4. Install 880 square feet of thermal panels on the interior side of the weather panels
5. There is space between the roof deck and the plaster ceiling. Cellulose can be blown into this cavity. Install 5,800 square feet of R-38 cellulose above plaster ceiling.

Williams Elementary School

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (12 old standard and 7 new doors)
2. Seal 524 linear feet of roof/wall intersection

Zervas Elementary School (Short Term Building: Focus on Measures with <10 Year Payback)

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (4 old standard and 19 new doors)
2. Install 3,060 square feet of R-38 insulation above the ceiling in modular classrooms

Fire Headquarters (Short Term Building: Focus on Measures with <5 Year Payback)

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (6 standard doors)
2. Seal (4) a/c units
3. Seal (6) penetrations throughout the building
4. Install 4,851 square feet of R-38 attic insulation
5. Install 400 square feet of thermal panels behind existing weather panels
6. Seal (3) vents on roof

Fire Station #3 (Short Term Building: Focus on Measures with <5 Year Payback)

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (6 standard and 8 garage doors)
2. Seal (12) a/c units
3. Seal (8) penetrations throughout the building
4. Seal (1) hatch to roof area
5. Install 3,000 square feet of R-38 insulation in attic space
6. Install 2,080 linear feet of window weatherstripping

Main Library

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (21 standard & 1 roof hatch door)
2. Seal (9) vents on roof

Auburndale Library

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (3 standard & 3 hatch doors)

2. Install 2,920 square feet of R-38 insulation in attic
3. Seal (8) penetration throughout the building

Newton Corner Library

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (6 standard doors)
2. Install 2,030 square feet of R-38 insulation in attic
3. Seal (12) penetrations throughout the building
4. Dense pack side walls with cellulose insulation (3,000 square feet)

Nonantum Library

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (5 standard doors)
2. Install 2,500 square feet of R-38 insulation in attic
3. Seal (15) penetrations throughout the building

Waban Library

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (3 standard and 3 hatch doors)
2. Install 3,030 square feet of R-38 insulation in attic
3. Seal (8) penetrations throughout the building

Hawthorne Fieldhouse

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (4 standard doors)
2. Seal (1) a/c unit
3. Seal 200 linear feet of roof/wall intersection in gym area
4. Caulk shut 15 windows (225 linear feet)
5. Install approx 400 square feet of thermal panels over exposed "I-beams" at the roof/wall intersection of the gym

Recreation Headquarters

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (3 standard, 3 access hatch, & 2 garage doors)
2. Seal (5) a/c units
3. Install 1,200 square feet of insulation in attic area (knee walls, roof rafters, collar beam and outer ceiling joist)
4. Dense pack side walls with cellulose insulation (2,100 square feet)
5. Construct an energy wall (Thermax) on the interior side of the abandoned garage doors (240 square feet).

Recreation Headquarters Garage

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (1 standard & 5 garage doors)
2. Add 4,200 square feet of Thermax insulation panels to garage ceiling

3. Install thermal panels to the interior side of the large glass walls to reduce heat loss/gain (800 square feet)

Lower Falls Community Center
1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (7 standard doors)
2. Seal (3) a/c units
3. Install 9,765 square feet of thermal panels in the interior ceiling of the gym to create a thermal "suspended" ceiling
4. Install 320 square feet of insulating panels behind existing weather panels on newly installed windows
5. Install 200 linear feet of thermal break at support beams of newly installed windows
6. Seal 435 linear feet of roof/wall intersection
7. Install 825 linear feet of window weatherstripping

Albermarle Fieldhouse
1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (4 standard doors)
2. Install 200 linear feet of window weather-stripping

Gath Pool Facility - 256 Albemarle Road
This building has no heat source therefore no improvements are needed.

Nahanton Park Fieldhouse
1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (2 standard doors)

Upper Falls Community Center
1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (5 standard doors)
2. Seal 550 linear feet of roof/wall intersection
3. Install 450 linear feet of window weatherstripping

Newton Center Fieldhouse
1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (5 standard doors)
2. Dense pack sidewalls with cellulose (2,000 square feet)
3. Install 2,600 square feet of thermal panels to the interior side of the roof rafters

Public Buildings Department
1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (3 standard and 3 garage doors)
2. Install 3,200 square feet of R-38 insulation in the metal structure
3. Install 1,600 square feet of R-38 insulation in the block structure
4. Dense pack roof of back office (trailer area) with cellulose (600 square feet)

Elliot Street Operations Center Building #2

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (5 standard and 4 large garage doors)
2. Install 4,000 square feet of R-38 insulation above suspended ceiling

Elliot Street Garage

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (3 standard and 6 large garage doors)
2. Seal 440 linear feet of roof/wall intersection
3. Install 9,000 square feet of thermal suspended ceiling

Crafts Street DPW Operations Center

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (5 standard and 5 garage doors)
2. Seal (3) a/c units
3. Install 6,600 square feet of R-38 insulation in attic area
4. Dense pack walls between normal occupied space and garage area to compartmentalize regularly heated space (1,000 square feet)

Crafts Street Garage and Car Wash

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (17 standard, 2 regular garage and 12 oversized garage doors)
2. Seal approx 30 linear feet of roof/wall intersection at newest entrance
3. Replace door and frame at carwash

Jackson Homestead

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (8 standard doors)
2. Seal (2) a/c units

Health Department

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (1 standard door)
2. Seal (1) a/c unit
3. Install 3,275 square feet of R-19 cellulose insulation over existing fiberglass in attic

Senior Citizens Center

1. Inspect and adjust each exterior, fire, hatch and mechanical door weather-stripping. Repair or replace as necessary (5 standard and 2 hatch doors)
2. Install 2,960 square feet of R-38 insulation
3. Install (3) Arius air circulators

Newton City Hall

1. Install 4,620 linear feet of weather-stripping on windows

Education Center Annex

1. Weather-strip doors and windows utilizing blower door directed air sealing.
2. Weather-strip and insulate access hatches for the basement crawl space.

Other Measures Considered but Not Recommended

The following measures were evaluated by NORESCO but are not included in the project either because (a) other weatherization measures are recommended in lieu of these options or (b) the payback is long and the project cash flow does not support the cost of the improvements.

Countryside Elementary

- Encapsulate entire glass wall area with a combination thermal wall and small hopper windows (4,250 square feet and 54 windows)

Memorial-Spaulding Elementary School

- There is space between the roof deck and the plaster ceiling. Cellulose can be blown into this cavity. Install 32,050 square feet of R-38 cellulose above plaster ceiling

Zervas Elementary School

- There is space between the rood deck and the plaster ceiling. Cellulose can be blown into this cavity. Install 27,000 square feet of R-38 cellulose above plaster ceiling.

Fire Station #3

- In lieu of weather-stripping windows; install a combination thermal panel and new hopper window (58 windows and 1,960 square feet of thermal panel and 6 other window replacements with no added thermal panels)

Lower Falls Community Center

- In lieu of weather-stripping windows; install a combination thermal panel and new hopper window (50 windows and 2,000 square feet of thermal panel)

Albemarle Fieldhouse

- In lieu of weatherstripping the windows caulk shut windows (200 linear ft).

Health Department

- Replace (23) windows and (3) glass wall areas with (24) separate glass areas.

Newton City Hall

1. Caulk shut on the interior sash and/or jamb of all windows

Education Center Annex

- Install additional wall insulation on the exterior of the building envelop using an exterior insulating finish system (EIFS).
- Crawl-space insulation improvements. Repair existing insulation, install new insulation, install supports for existing insulation, and repair steam and condensate piping insulation as required to improve insulation and save energy.
- Install vapor barrier in crawl space. Although this measure will reduce moisture infiltration, there are no energy savings associated with this measure.
- For the dropped ceiling, install an insulated thermal panel.
  - As an alternate approach, the underside of the roof deck could be insulated. However, this approach has a longer payback compared to installing an insulated thermal panel.

Interface with Existing Systems and Operations

Impact on Facility Operations and Performance

The facility will benefit from reduced energy consumption due to a reduction in building envelope heating and cooling losses, and improved occupant comfort for those near exterior building doors or drafty areas.

Maintenance

NORESCO expects maintenance of the installed systems to be comparable to current maintenance requirements.

Customer Training

NORESCO will provide O&M manuals for the installed equipment.

Equipment Information

Manufacturer and Type

NORESCO will install products as manufactured by the following (or approved equal).

- **DAP Products Inc.**, 2400 Boston Street, Suite 200, Baltimore, MD 21224
  - Ph: (410) 675-2100
- **Applegate Insulation**, 1000 Highview Drive, Webberville, MI 48892-9007
  - Ph: (800) 627-7536
- **Zerodraft**, 5865-A Coopers Ave, Mississauga, Ontario, Canada, L4Z 1R9
  - Ph: (877) 272-2626
- **The Dow Chemical Company**: 2030 Dow Center, Midland, MI 48674
  - Ph: (800) 422-8193

Weatherization
I. Energy Savings Calculations

Weatherization
II. Cut Sheets

PIPE & FITTING INSULATION

Overview

Exposed & Under-insulated Steam Piping

During the Audit, NORESCO discovered uninsulated and poorly insulated steam and condensate piping. This exposed piping results in energy loss as well as overheating of adjacent spaces. This ECM will insulate selected bare steam and condensate piping to improve comfort and reduce energy loss.

Affected Areas

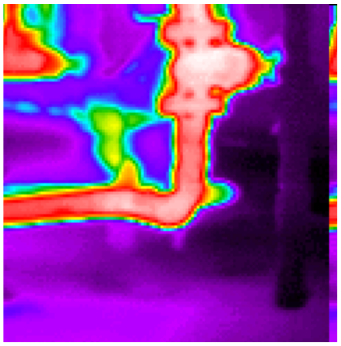
- Countryside Elementary School
- Underwood Elementary School
- Senior Citizens Center
- Pierce School

Detailed Description

Existing Conditions

The majority of steam and condensate piping in the affected buildings is properly insulated. However, there are some exposed pipe sections. Exposed steam and condensate piping is prevalent in the boiler mechanical rooms and in some crawlspaces. At the Underwood School, exposed steam piping in the boiler room overheats the Principal's office above. As a result, the windows are left open throughout winter, allowing heat to escape the conditioned space.

The adjacent images illustrate the energy loss associated with exposed piping. These photographs are representative of the types of situations observed during the detailed energy audit. The image on the left is a photograph of exposed piping and fittings, similar to those that are addressed under this measure. The image on the right shows a thermographic photo of the same equipment. In the thermographic photo, the blue and black hues represent cooler surfaces while red and white represents hotter surfaces.



Recommended Improvements

Exposed steam piping represents both a safety issue and wasted energy. Insulating exposed fittings and piping will reduce the steam load and save energy. The building will benefit from a reduced internal heat load, and will no longer overheat mechanical rooms and adjacent rooms and crawlspaces. The identified exposed steam and condensate fittings and piping will be insulated with fiberglass and all-service jacket. The insulation will be of the appropriate thickness.

Scope of Work

NORESCO will insulate the exposed steam and condensate piping in mechanical rooms and crawlspaces in the affected buildings as detailed below. All new fiberglass piping insulation will be installed to industry recommended thicknesses.

a. Underwood Elementary School Boiler Room
    - Low Pressure Steam
        - 4" – 12' pipe, (3) elbows, (6) valves
        - 3" – 2' pipe, (2) elbows, (1) valve
        - 2" – 8' pipe, (8) elbows, (8) valves
    - Steam Condensate
        - 3" – 30' pipe, (4) elbows

b. Countryside Elementary School Boiler Room
    - Low Pressure Steam
        - 4" – 4' pipe, (2) valves
    - Steam Condensate
        - 3" – 30' pipe, (4) elbows

c. Senior Citizens Center Boiler Room
    - Low Pressure Steam
        - 1-1/2" – 12' piping, (4) elbows
        - 1" – 10' piping, (2) elbows, (2) valves
    - Steam Condensate
        - 5" – 50' piping, (4) elbows
        - 4" – 6' piping
        - 1" – 22' piping, (6) elbows, (2) valves

d. Pierce Elementary School Crawlspace
    - Low Pressure Steam
        - 2" – 60' piping, (8) elbows

Interface with Existing Systems and Operations

Impact on Facility Operations and Performance

All work under this ECM will be performed during normal working hours, and NORESCO will coordinate all work with facilities personnel. Because a majority of the work takes place in the mechanical spaces, there should be little impact on building occupants. Work in occupied areas will be coordinated with the Owner.

Maintenance

Maintenance for the new insulation will be similar to maintenance for the existing insulation, including periodic inspection to verify condition.

Customer Training

No specialized training is required for the insulation systems. NORESCO will provide O&M manuals for the installed equipment.

Equipment Information

Manufacturer and Type

NORESCO proposes to install fiberglass piping insulation manufactured by Owens Corning, or approved equal.

Environmental Issues

No environmental impacts are expected.

Piping & Fitting Insulation Savings Calculations

HVAC CONTROLS

Overview

NORESCO will upgrade existing control systems in several elementary schools across the City by installing Direct Digital Control (DDC) Energy Management Systems (EMS) in concert with a retro commissioning of the existing pneumatic control systems. These improvements will allow for the comprehensive implementation of energy efficient control strategies and for improved monitoring and control of building HVAC equipment, as well as the ability to access building systems from a networked communication infrastructure via the internet and standard web browsers.

Description

The existing temperature control systems in the buildings are primarily of the electro-pneumatic type. Each of these standalone control systems are in place to provide control of HVAC equipment via sensors, transmitters, relays, and the operation of end devices such as valve and damper actuators. The existing electro-pneumatic control systems are original to the buildings and are quite complex in terms of the number of components and device connections required. Due to the difficulties involved in servicing and maintaining these types of systems, NORESCO believes that these existing controls do not provide operations that are energy efficient or that optimize the original design intent of the HVAC systems.

The building controls systems utilize pneumatic (or air powered) technology, which consists of tubes through which pressurized air is used to sense conditions and control equipment. Pneumatic systems by their nature do not meet today's standards for even minimal control as related to energy efficient performance. Pneumatic controls are basic in functionality, performance cannot be monitored, and their ability to adapt to changing conditions is limited. In pristine condition and optimized for functionality, these systems still cannot compete with even basic DDC systems in terms of functionality, performance, adaptability, service, and maintenance. DDC systems use computers, electronic hardware, and interactive software to allow numerous variables (including operator input) to control simple to complicated equipment and systems. The ability of these systems to automatically adapt to these changing conditions allows for the optimized operation of the building and its many interactive systems.

The installed DDC system will be tied into the existing citywide system allowing for the seamless integration of the new systems with the existing. Remote system access via the internet using a laptop or home PC and standard web browsers will be available.

To improve the energy efficiency of buildings and capture the sizable opportunities that exist within them, commissioning principles are being applied to existing buildings more often. Fortunately, commissioning of existing buildings - also known as *retro commissioning* - when appropriately applied goes beyond quick-fix solutions to systematically optimize building systems so that they operate efficiently and effectively, often eliminating the need for costly capital improvements. Not only does retro commissioning identify problems that occurred at construction just as traditional commissioning does, but it also identifies and solves problems that have developed during the building's life.

The benefits of retro commissioning are numerous. Retro commissioning:

- Identifies system operating, control and maintenance problems
- Aids in long-term planning and major maintenance budgeting
- Helps ensure a healthy, comfortable, and productive working environment for occupants
- Reduces energy waste and ensures that energy using equipment operates efficiently
- Provides energy cost savings that often payback investment

- Reduces maintenance costs
- Reduces premature equipment failure
- Provides more complete building documentation
- Expedites troubleshooting
- Provides appropriate training to operating staff to increase skill levels
- Increases staff effectiveness in serving customers or tenants and
- Reduces risk and increases the asset value of the building.

Retro commissioning seeks to ensure the functionality of equipment and systems and to optimize how they operate together in order to reduce energy waste and improve building operation and comfort. Thus, the goal of ensuring comfort and productivity of the building occupants accompanies the goal of cost savings. The process includes investigating and documenting the condition of the selected systems, identifying existing problems in buildings, optimizing building energy systems and formalizing operational procedures, as well as measuring and documenting the energy savings and comfort improvements.

Affected Areas

NORESCO will provide new DDC energy management systems and Retro-Commissioning of the remaining electro-pneumatic control systems in the following buildings:

- Bowen Elementary School
- Burr Elementary School
- Countryside Elementary School
- Franklin Elementary School
- Lincoln-Eliot Elementary School
- Mason-Rice Elementary School
- Memorial-Spaulding Elementary School
- Pierce Elementary School
- Underwood Elementary School
- Ward Elementary School
- Williams Elementary School

Detailed Description – New DDC Energy Management System

NORESCO will install new Direct Digital Control (DDC) Energy Management Systems (EMS) and retro-commission existing controls for selected buildings. These improvements will deliver energy savings by implementing efficiency-based control strategies and will provide for improved monitoring and control of building HVAC equipment. The following describes the scope of work for each building.

Bowen Elementary School

Existing System Description

Bowen School is heated by one oil-fired steam boiler in the basement boiler room. Boiler #2 does not currently run. The majority of the building is supplied steam heat, with the exception of a newer hydronic section built in 2000. This section is supplied heating hot water via a shell and tube heat exchanger and pumps located in the boiler room. Classrooms original to the building are heated by steam unit vents and steam radiation. Hot water unit ventilators and hot water fin-tube radiation heat five new classrooms. Steam H&V units heat both the gym and auditorium. The majority of the building systems are controlled by a recently refurbished Johnson Controls electro-pneumatic control system with 5 control zones (Auditorium, Gym, Old Classrooms, New Wing Classrooms, and Custodian). Much of its functionality, however, is inoperable. The system does not automatically switch from day to night mode, and as such the City must rely on the custodian to manually turn the system from day to night mode. The HVAC terminal equipment is controlled by an aging, obsolete, and maintenance intensive pneumatic control system.

Recommended Improvements

NORESCO will install new hardware and software to provide DDC control of the HVAC systems identified in the scope of work, and will integrate the new energy management system into a single front-end interface, including graphics and web-based remote access and functionality. Implementation of new control sequences and strategies to allow for increased system control and energy efficient control schemes will be included. The pneumatic distribution system will be purged and cleaned to remove any existing water, oil, and other contaminants. Existing to remain control end devices such as thermostats, valves, and actuators will be retro-commissioned, and deficient equipment will be documented, prioritized, and addressed under the repair/replace equipment budget. The result will be reduced energy consumption, improved space comfort conditions, and greater capability for facilities staff to monitor and control the school's HVAC systems.

Scope of Work

At Bowen Elementary School, NORESCO will:

- Provide a comprehensive, web-based DDC energy management system, including hardware/software points and control applications.
- Provide new DDC equipment and application software for the following (See attached Points List for details):
  - Control of (2) steam boilers, including enable/disable, status, and pressure
  - Control of (1) steam-to-hot water heat exchanger, including steam valve, and temperature sensors (hot water supply and return).
  - Control of (2) existing hot water pumps, including start/stop, status and alarm.
  - Control of unit ventilators, including (4) zone start/stop (New Wing Classrooms, Old Classrooms, Gymnasium, Custodian). Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic.
  - Control of (1) H&V Unit (Auditorium), including start/stop. Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic.
  - Control of exhaust fans, including (1) zone start/stop.
- Provide relays, sensors, electric-to-pneumatic transducers, and other field interface devices as necessary to provide the required control and monitoring functions for each system. Perform point-to-point checkout, testing, and commissioning of the EMS input and output points and control sequences, as well as retro-commissioning of the existing to remain control end devices.
- Remove existing pneumatic controllers and devices made obsolete by the new EMS. Remove and/or neatly cut and cap pneumatic lines that will no longer be in use.
- New work includes equipment, wiring, installation labor, application and graphical software and programming.

Burr Elementary School

Existing System Description

Burr is heated by two new natural gas fired boilers which deliver heating hot water to classroom unit ventilators and convectors. The Gym, Cafetorium, and Music Room are served by H&V units. Both boilers have burners rated for 2,500 MBH of heating capacity. Two 7.5 HP pumps circulate hot water throughout the building. The majority of the HVAC systems are controlled by an aging Honeywell electro-pneumatic control system. Widespread oil infiltration was observed in two of the control panels as well as at the thermostats. This, in combination with the aging pneumatic control system on the terminal devices, has rendered much of the control capabilities of the system inoperable.

Recommended Improvements

NORESCO will install new hardware and software to provide DDC control of the HVAC systems identified in the scope of work, and will integrate the new energy management system into a single front-end interface, including graphics and web-based remote access and functionality. Implementation of new control sequences and strategies to allow for increased system control and energy efficient control schemes will be included. The pneumatic distribution system will be purged and cleaned to remove any existing water, oil, and other contaminants. Existing to remain control end devices such as thermostats, valves, and actuators will be retro-commissioned, and deficient equipment will be documented, prioritized, and addressed under the repair/replace equipment budget. The result will be improved space comfort conditions, and greater capability for facilities staff to monitor and control the school's HVAC systems.

Scope of Work

At Burr Elementary School, NORESCO will:

- Provide a comprehensive, web-based DDC energy management system, including hardware/software points and control applications.
- Provide new DDC equipment and application software for the following (See attached Points List for details):
  - Control of (2) hot water boilers, including enable/disable, status, supply temperature, and return temperature
  - Control of (2) existing hot water pumps, including start/stop, status and alarm.
  - Control of (2) existing mixing valves including hot water supply and return temperatures
  - Control of (2) differential pressure valves, and supply and return pressures. (This item included only if VFD ECM is NOT included in the project)
  - Control of unit ventilators, including (1) zone start/stop. Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic.
  - Control of (3) AHU's (Gym, Cafetorium, Day Care), including start/stop (New Wing Classrooms, Old Classrooms). Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic.
  - Control of exhaust fans, including (7) zone start/stop.
- Provide relays, sensors, electric-to-pneumatic transducers, and other field interface devices as necessary to provide the required control and monitoring functions for each system. Perform point-to-point checkout, testing, and commissioning of the EMS input and output points and control sequences, as well as retro-commissioning of the existing to remain control end devices.
- Remove existing pneumatic controllers and devices made obsolete by the new EMS. Remove

and/or neatly cut and cap pneumatic linesthat will no longer be in use.

- New work includes equipment, wiring, installation labor, application and graphical software and programming.

Countryside Elementary School

Existing System Description

Countryside is served by two oil-fired steam boilers. One boiler has been replaced recently, but remains oil, and the backup boiler is still burning oil as well. The aging boiler is scheduled to be replaced. Steam unit ventilators service the classrooms, Auditorium, and Gym. A single steam H&V serves the Cafetorium. The building systems are controlled by an aging electro-pneumatic control system with 4 zones (Old Classrooms A, Old Classrooms B, Auditorium, Gym). Much of its functionality, however, is inoperable. The terminal equipment is controlled by an aging, obsolete, and maintenance intensive pneumatic air system.

Recommended Improvements

NORESCO will install new hardware and software to provide DDC control of the HVAC systems identified in the scope of work, and will integrate the new energy management system into a single front-end interface, including graphics and web-based remote access and functionality. Implementation of new control sequences and strategies to allow for increased system control and energy efficient control schemes will be included. The pneumatic distribution system will be purged and cleaned to remove any existing water, oil, and other contaminants. Existing to remain control end devices such as thermostats, valves, and actuators will be retro-commissioned, and deficient equipment will be documented, prioritized, and addressed under the repair/replace equipment budget. The result will be reduced energy consumption, improved space comfort conditions, and greater capability for facilities staff to monitor and control the school's HVAC systems.

Scope of Work

At Countryside Elementary School, NORESCO will:

- Provide a comprehensive, web-based DDC energy management system, including hardware/software points and control applications.
- Provide new DDC equipment and application software for the following (See attached Points List for details):
    - Control of (2) steam boilers, including enable/disable, status, and pressure
    - Control of (1) steam-to-hot water heat exchanger, including steam valve, and temperature sensors (hot water supply and return)
    - Control of (1) existing hot water pump, including start/stop, status and alarm
    - Control of unit ventilators, including (4) zone start/stop (Old Classrooms A, Old Classrooms B, Auditorium, Gym). Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic
    - Control of (1) H&V Unit (Cafetorium), including start/stop. Terminal control of valve, damper, space temperature, etc. to remain pneumatic
    - Control of exhaust fans, including (1) zone start/stop
- Provide relays, sensors, electric-to-pneumatic transducers, and other field interface devices as necessary to provide the required control and monitoring functions for each system. Perform point-to-point checkout, testing, and commissioning of the EMS input and output points and

control sequences, as well as retro commissioning of the existing to remain control end devices.

- Remove existing pneumatic controllers and devices made obsolete by the new EMS. Remove and/or neatly cut and cap pneumatic lines that will no longer be in use.
- New work includes equipment, wiring, installation labor, application and graphical software and programming.

Franklin Elementary School

Existing System Description

Franklin is served by two gas fired Smith steam boilers. Terminal equipment includes steam unit vents and radiation in common areas. A newer "Pentagon" area is served by a hot water heat exchanger and pumps, which deliver heat to unit ventilators in the associated spaces. The gym is served by radiation, as well as a steam H&V unit. The majority of the building systems are controlled an aging electro-pneumatic control system with 18 control zones. Much of its functionality, however, is no longer operable. Time clocks were observed to have no pins installed, allowing equipment to run 24/7. The HVAC terminal equipment is controlled by an aging, obsolete, and maintenance intensive pneumatic air system.

Recommended Improvements

NORESCO will install new hardware and software to provide DDC control of the HVAC systems identified in the scope of work, and will integrate the new energy management system into a single front-end interface, including graphics and web-based remote access and functionality. Implementation of new control sequences and strategies to allow for increased system control and energy efficient control schemes will be included. The pneumatic distribution system will be purged and cleaned to remove any existing water, oil, and other contaminants. Existing to remain control end devices such as thermostats, valves, and actuators will be retro-commissioned, and deficient equipment will be documented, prioritized, and addressed under the repair/replace equipment budget. The result will be reduced energy consumption, improved space comfort conditions, and greater capability for facilities staff to monitor and control the school's HVAC systems.

Bowen Elementary School

Scope of Work

- Provide a comprehensive, web-based DDC energy management system, including hardware/software points and control applications.
- Provide new DDC equipment and application software for the following (See attached Points List for details):
  - Control of (2) steam boilers, including enable/disable, status, and pressure
  - Control of (1) steam-to-hot water heat exchanger, including steam valve, and temperature sensors (hot water supply and return)
  - Control of (2) existing hot water pumps, including start/stop, status and alarm.
  - Control of unit ventilators, including (19) zone start/stop (18 original building, 1 Pentagon area hot water section). Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic
  - Control of (2) H&V Units (Auditorium, Gym), including start/stop. Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic
  - Control of exhaust fans, including (2) zone start/stop

- Provide relays, sensors, electric-to-pneumatic transducers, and other field interface devices as necessary to provide the required control and monitoring functions for each system. Perform point-to-point checkout, testing, and commissioning of the EMS input and output points and control sequences, as well as retro commissioning of the existing to remain control end devices.
- Remove existing pneumatic controllers and devices made obsolete by the new EMS. Remove and/or neatly cut and cap pneumatic lines that will no longer be in use.
- New work includes equipment, wiring, installation labor, application and graphical software and programming.

Lincoln-Eliot Elementary School

Existing System Description

Lincoln Eliot was originally built in 1935 and has had two subsequent renovations, in 1965 and 1975. Heat is delivered via steam to the original section and dedicated hot water heat exchangers and pump sets for each of the two additions. Two aging oil fired steam boilers supply steam to these end devices and heat exchangers. The classrooms are heated primarily by unit ventilators, and radiation serves the hallways. Heating and ventilating units serve the larger spaces of the most recent addition.

Given the piecemeal nature of the current structure, three separate electro-pneumatic control systems exist in the building. The original 1935 section is controlled by an aged Honeywell system with no functionality. Oil migration was observed in the main panel and time clocks were found to have no pins, allowing 24/7 operation. The 1965 section has a newer pneumatic system, but with limited functionality. The time clock is jumped out, and does not control scheduling as intended. Similarly, the 1975 addition has a pneumatic system, which includes a hot water reset, and day/night controller, which does not operate. All of the EPs and PEs inside the panel are disconnected. The HVAC terminal equipment is controlled by an aging, obsolete, and maintenance intensive pneumatic air system.

Recommended Improvements

NORESCO will install new hardware and software to provide DDC control of the HVAC systems identified in the scope of work, and will integrate the new energy management system into a single front-end interface, including graphics and web-based remote access and functionality. Implementation of new control sequences and strategies to allow for increased system control and energy efficient control schemes will be included. The pneumatic distribution system will be purged and cleaned to remove any existing water, oil, and other contaminants. Existing to remain control end devices such as thermostats, valves, and actuators will be retro-commissioned, and deficient equipment will be documented, prioritized, and addressed under the repair/replace equipment budget. The result will be reduced energy consumption, improved space comfort conditions, and greater capability for facilities staff to monitor and control the school's HVAC systems.

Scope of Work

At Lincoln-Eliot Elementary School, NORESCO will:

- Provide a comprehensive, web-based DDC energy management system, including hardware/software points and control applications.

- Provide new DDC equipment and application software for the following (See attached Points List for details):

- Control of (2) steam boilers, including enable/disable, status, and pressure
- Control of (2) steam-to-hot water heat exchangers, including (4) steam valves, and associated temperature sensors (hot water supply and return).
- Control of (4) existing hot water pumps, including start/stop, status and alarm.
- Control of steam unit ventilators in the 1935 section, including (3) zone start/stop. Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic.
- Control of hot water unit ventilators in the 1965 section, including (1) zone start/stop. Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic.
- Control of steam unit ventilators in the 1975 section, including (2) zone start/stop (Existing Classroom Area, Classroom Cluster). Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic.
- Control of (2) H&V Units (S-1, S-2), including start/stop. Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic.
- Control of exhaust fans, including (2) zone start/stop.

- Provide relays, sensors, electric-to-pneumatic transducers, and other field interface devices as necessary to provide the required control and monitoring functions for each system. Perform point-to-point checkout, testing, and commissioning of the EMS input and output points and control sequences, as well as retro-commissioning of the existing to remain control end devices.
- Remove existing pneumatic controllers and devices made obsolete by the new EMS. Remove and/or neatly cut and cap pneumatic lines that will no longer be in use.
- New work includes equipment, wiring, installation labor, application and graphical software and programming.

Mason-Rice Elementary School

Existing System Description

Mason-Rice is served by two hot water boilers - one oil fired and the other gas fired. Most classrooms have a combination of unit ventilators and radiation with two-way valves. A self-compensating differential pressure valve modulates the flow of heat out to the building from the boiler room. The Library and Art Room have ceiling mounted electric unit heaters, but they were not observed to operate at the time of the Audit. The existing electro-pneumatic control system remains in decent condition, and has retained some of its functionality. Signs of oil or water migration were not found in the distribution system. The time clock does not seem to work, and the boilers run 24/7 to maintain the constant setpoint heating hot water temperature. An outdoor air reset controller was found to be disconnected. The HVAC terminal equipment is controlled by an aging, obsolete, and maintenance intensive pneumatic air system.

Recommended Improvements

NORESCO will install new hardware and software to provide DDC control of the HVAC systems identified in the scope of work, and will integrate the new energy management system into a single front-end interface, including graphics and web-based remote access and functionality. Implementation of new control sequences and strategies to allow for increased system control and energy efficient control schemes will be included. The pneumatic distribution system will be purged and cleaned to remove any existing water, oil, and other contaminants. Existing to remain control end devices such as thermostats, valves, and actuators will be retro-commissioned, and deficient equipment will be documented, prioritized, and addressed under the repair/replace equipment budget. The result will be reduced energy consumption, improved space comfort conditions, and greater capability for facilities staff to monitor and control the school's HVAC systems.

Scope of Work

At Mason-Rice Elementary School, NORESCO will:

- Provide a comprehensive, web-based DDC energy management system, including hardware/software points and control applications.
- Provide new DDC equipment and application software for the following (See attached Points List for details):
  - Control of (2) hot water boilers, including enable/disable, status, supply temperature, and return temperature
  - Control of (2) existing hot water pumps, including start/stop, status and alarm
  - Control of (1) existing mixing valve including hot water supply and return temperatures
  - Control of unit ventilators, including (2) zone start/stop (Kindergarten, Classroom). Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic.
  - Control of (2) H&V's (Gymnasium, Auditorium) including start/stop (New Wing Classrooms, Old Classrooms). Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic
  - Control of exhaust fans, including (1) zone start/stop
- Provide relays, sensors, electric-to-pneumatic transducers, and other field interface devices as necessary to provide the required control and monitoring functions for each system. Perform point-to-point checkout, testing, and commissioning of the EMS input and output points and control sequences, as well as retro commissioning of the existing to remain control end devices.
- Remove existing pneumatic controllers and devices made obsolete by the new EMS. Remove and/or neatly cut and cap pneumatic lines that will no longer be in use.
- New work includes equipment, wiring, installation labor, application and graphical software and programming.

Memorial-Spaulding Elementary School

Existing System Description

Memorial-Spaulding is heated by two gas-fired steam boilers. Like many of Newton's elementary schools, the original section is heated with steam while a newer addition utilizes a hot water heat exchanger to deliver hot water to unit ventilators in the spaces. The existing electro-pneumatic control system is in poor condition; in addition to failed components, water and oil migration was identified in the distribution system. Heat-Timer controllers are installed on the boilers but do not operate, instead the boilers run 24/7 during the heating season. The pneumatic control panel indicates 5-zone control. The HVAC terminal equipment is controlled by an aging, obsolete, and maintenance intensive pneumatic air system.

Recommended Improvements

NORESCO will install new hardware and software to provide DDC control of the HVAC systems identified in the scope of work, and will integrate the new energy management system into a single front-end interface, including graphics and web-based remote access and functionality. Implementation of new control sequences and strategies to allow for increased system control and energy efficient control schemes will be included. The pneumatic distribution system will be purged and cleaned to remove any existing water, oil, and other contaminants. Existing to remain control end devices such as thermostats, valves, and actuators will be retro-commissioned, and deficient equipment will be documented, prioritized, and addressed under the repair/replace equipment budget. The result will be reduced energy consumption, improved space comfort conditions, and greater capability for facilities staff to monitor and control the school's HVAC systems.

Scope of Work

At Memorial-Spaulding School, NORESCO will:

- Provide a comprehensive, web-based DDC energy management system, including hardware/software points and control applications.
- Provide new DDC equipment and application software for the following (See attached Points List for details):
    - Control of (2) steam boilers, including enable/disable, status, and pressure
    - Control of (1) steam-to-hot water heat exchanger, including steam valve, and temperature sensors (hot water supply and return).
    - Control of (2) existing hot water pumps, including start/stop, status and alarm
    - Control of unit ventilators, including (5) zone start/stop (New Wing, Existing Wings, Gym, Auditorium, Admin). Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic
    - Control of exhaust fans, including (1) zone start/stop
- Provide relays, sensors, electric-to-pneumatic transducers, and other field interface devices as necessary to provide the required control and monitoring functions for each system. Perform point-to-point checkout, testing, and commissioning of the EMS input and output points and control sequences, as well as retro commissioning of the existing to remain control end devices.
- Remove existing pneumatic controllers and devices made obsolete by the new EMS. Remove and/or neatly cut and cap pneumatic lines that will no longer be in use.
- New work includes equipment, wiring, installation labor, application and graphical software and programming.

Pierce Elementary School

Existing System Description

Pierce is heated by two oil fired Smith steam boilers. The boilers supply steam to unit vents and radiation throughout the school, as well as H&Vs in the gym and auditorium. The boilers are controlled and scheduled via Heat-Timer controller, which was recently installed. The building has no existing day/night control, rather, the City must rely on the facility custodian to enable and disable the building systems as needed. The HVAC terminal equipment is controlled by an aging, obsolete, and maintenance intensive pneumatic air system.

Recommended Improvements

NORESCO will install new hardware and software to provide DDC control of the HVAC systems identified in the scope of work, and will integrate the new energy management system into a single front-end interface, including graphics and web-based remote access and functionality. Implementation of new control sequences and strategies to allow for increased system control and energy efficient control schemes will be included. The pneumatic distribution system will be purged and cleaned to remove any existing water, oil, and other contaminants. Existing to remain control end devices such as thermostats, valves, and actuators will be retro-commissioned, and deficient equipment will be documented, prioritized, and addressed under the repair/replace equipment budget. The result will be reduced energy consumption, improved space comfort conditions, and greater capability for facilities staff to monitor and control the school's HVAC systems.

Scope of Work

At Pierce Elementary School, NORESCO will:

- Provide a comprehensive, web-based DDC energy management system, including hardware/software points and control applications.
- Provide new DDC equipment and application software for the following (See attached Points List for details):
  - Control of (2) steam boilers, including enable/disable, status, and pressure.
  - Control of (1) steam zone valve
  - Control of unit ventilators, including (1) zone start/stop. Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic
  - Control of exhaust fans, including (1) zone start/stop
- Provide relays, sensors, electric-to-pneumatic transducers, and other field interface devices as necessary to provide the required control and monitoring functions for each system. Perform point-to-point checkout, testing, and commissioning of the EMS input and output points and control sequences, as well as retro-commissioning of the existing to remain control end devices.
- Remove existing pneumatic controllers and devices made obsolete by the new EMS. Remove and/or neatly cut and cap pneumatic lines that will no longer be in use.
- New work includes equipment, wiring, installation labor, application and graphical software and programming.

Underwood Elementary School

Existing System Description

The boiler room houses two gas fired Smith steam boilers. The terminal devices are all steam. A Heat-Timer boiler controller is installed to control scheduling and setback for the boiler. The remainder of the buildings' systems is controlled via an aging electro-pneumatic control system with limited inherent functionality. Three existing Honeywell zone controllers (North, South, and Auditorium) were found in auto but are currently running in day mode 24/7. The time clock does function, but the EPs have no air supplied to them, disabling their functionality. The control panel was noted to be as full of oil as to prevent air from passing to the rest of the distribution system. Beyond the mechanical room, the terminal equipment is controlled by an aging, obsolete, and maintenance intensive pneumatic air system.

Recommended Improvements

NORESCO will install new hardware and software to provide DDC control of the HVAC systems identified in the scope of work, and will integrate the new energy management system into a single front-end interface, including graphics and web-based remote access and functionality. Implementation of new control sequences and strategies to allow for increased system control and energy efficient control schemes will be included. The pneumatic distribution system will be purged and cleaned to remove any existing water, oil, and other contaminants. Existing to remain control end devices such as thermostats, valves, and actuators will be retro-commissioned, and deficient equipment will be documented, prioritized, and addressed under the repair/replace equipment budget. The result will be reduced energy consumption, improved space comfort conditions, and greater capability for facilities staff to monitor and control the school's HVAC systems.

Scope of Work

At Underwood Elementary School, NORESCO will:

- Provide a comprehensive, web-based DDC energy management system, including hardware/software points and control applications.
- Provide new DDC equipment and application software for the following (See attached Points List for details):
  - Control of (2) steam boilers, including enable/disable, status, and pressure
  - Control of unit ventilators, including (3) zone start/stop (North, South, Auditorium) Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic
  - Control of exhaust fans, including (1) zone start/stop
- Provide relays, sensors, electric-to-pneumatic transducers, and other field interface devices as necessary to provide the required control and monitoring functions for each system. Perform point-to-point checkout, testing, and commissioning of the EMS input and output points and control sequences, as well as retro commissioning of the existing to remain control end devices.
- Remove existing pneumatic controllers and devices made obsolete by the new EMS. Remove and/or neatly cut and cap pneumatic lines that will no longer be in use.
- New work includes equipment, wiring, installation labor, application and graphical software and programming.

Ward Elementary School

Existing System Description

Ward School is heated by two gas-fired steam boilers. The facility is dual fuel capable, but burns gas predominantly. Steam unit ventilators serve most of the building spaces, with radiation handling the balance of the heat load. The building systems are controlled by an electro-pneumatic control system with limited functionality. During the Audit, a moderate amount of water and oil was observed in the distribution system, substantiating some of the system operational deficiencies. The unit ventilators were observed to run 24/7. Beyond the mechanical room, the terminal equipment is controlled by an aging, obsolete, and maintenance intensive pneumatic air system.

Recommended Improvements

NORESCO will install new hardware and software to provide DDC control of the HVAC systems identified in the scope of work, and will integrate the new energy management system into a single front-end interface, including graphics and web-based remote access and functionality. Implementation of new control sequences and strategies to allow for increased system control and energy efficient control schemes will be included. The pneumatic distribution system will be purged and cleaned to remove any existing water, oil, and other contaminants. Existing to remain control end devices such as thermostats, valves, and actuators will be retro-commissioned, and deficient equipment will be documented, prioritized, and addressed under the repair/replace equipment budget. The result will be reduced energy consumption, improved space comfort conditions, and greater capability for facilities staff to monitor and control the school's HVAC systems.

Scope of Work

At Ward Elementary School, NORESCO will:

- Provide a comprehensive, web-based DDC energy management system, including hardware/software points and control applications.
- Provide new DDC equipment and application software for the following (See attached Points List for details):
    - Control of (2) steam boilers, including enable/disable, status, and pressure
    - Control of unit ventilators, including (4) zone start/stop (Basement, First Floor, Second Floor, Gymnasium). Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic
    - Control of exhaust fans, including (1) zone start/stop
- Provide relays, sensors, electric-to-pneumatic transducers, and other field interface devices as necessary to provide the required control and monitoring functions for each system. Perform point-to-point checkout, testing, and commissioning of the EMS input and output points and control sequences, as well as retro commissioning of the existing to remain control end devices.
- Remove existing pneumatic controllers and devices made obsolete by the new EMS. Remove and/or neatly cut and cap pneumatic lines that will no longer be in use.
- New work includes equipment, wiring, installation labor, application and graphical software and programming.

Williams Elementary School

Existing System Description

Williams School is served by two gas-fired steam boilers. The facility, like many across the City, has seen renovation since its original construction. Classrooms original to the building are served by steam unit ventilators and radiation, while a hot water heat exchanger and pumps deliver heat to the newer section. The existing electro-pneumatic control system was recently upgraded, and a new Johnson Controls control panel was installed. Due to lack of maintenance, the system is not operating properly and the HVAC systems currently run uncontrolled. A hot water reset controller is installed on the heat exchanger, but similar to the newer pneumatics, has not been maintained and is not functioning properly. The building exhaust was observed to run 24/7. The HVAC terminal equipment is controlled by an aging, obsolete, and maintenance intensive pneumatic air system.

Recommended Improvements

NORESCO will install new hardware and software to provide DDC control of the HVAC systems identified in the scope of work, and will integrate the new energy management system into a single front-end interface, including graphics and web-based remote access and functionality. Implementation of new control sequences and strategies to allow for increased system control and energy efficient control schemes will be included. The pneumatic distribution system will be purged and cleaned to remove any existing water, oil, and other contaminants. Existing to remain control end devices such as thermostats, valves, and actuators will be retro-commissioned, and deficient equipment will be documented, prioritized, and addressed under the repair/replace equipment budget. The result will be reduced energy consumption, improved space comfort conditions, and greater capability for facilities staff to monitor and control the school's HVAC systems.

Scope of Work

At Williams Elementary School, NORESCO will:

- Provide a comprehensive, web-based DDC energy management system, including hardware/software points and control applications.
- Provide new DDC equipment and application software for the following (See attached Points List for details):
    - Control of (2) steam boilers, including enable/disable, status, and pressure.
    - Control of (1) steam-to-hot water heat exchanger, including steam valve, and temperature sensors (hot water supply and return).
    - Control of (2) existing hot water pumps, including start/stop, status and alarm
    - Control of (2) existing steam zone valves (Gym, Auditorium)
    - Control of unit ventilators, including (2) zone start/stop (Old Classrooms, New Classrooms). Terminal unit control of valve, damper, space temperature, etc. to remain pneumatic
    - Control of exhaust fans, including (1) zone start/stop
- Provide relays, sensors, electric-to-pneumatic transducers, and other field interface devices as necessary to provide the required control and monitoring functions for each system. Perform point-to-point checkout, testing, and commissioning of the EMS input and output points and control sequences, as well as retro commissioning of the existing to remain control end devices.
- Remove existing pneumatic controllers and devices made obsolete by the new EMS. Remove and/or neatly cut and cap pneumatic lines that will no longer be in use.
- New work includes equipment, wiring, installation labor, application and graphical software and programming.

Detailed Description – Retro-Commissioning Repairs

With this measure, NORESCO has included an allowance to repair or replace existing failed control end devices and mechanical equipment, such as thermostats, motors, valves, damper actuators, and exhaust fans in the buildings included under this ECM. This allowance is included in addition to the work detailed in the Scope of Work, and includes repairs to the pneumatic distribution equipment. NORESCO will use these allocated funds to pay for malfunctioning components identified in the retro-commissioning deficiency report. The allowance for repairs is limited to $166,000. NORESCO will coordinate with City of Newton facilities personnel to prioritize the repair/replace components on the deficiency list.

This retro-commissioning allowance will provide for the repair or replacement of a limited quantity of failed control components. The actual cost of repairing all items in the deficiency report may be more or less than this allowance. NORESCO and the City of Newton can negotiate any additional costs and scopes to complete the work identified during the retro commissioning which are not addressed due to the depletion of the allocated funds.

Interface with Existing Systems and Operations

Impact on Facility Operations and Performance

The facility will benefit from reduced energy consumption and improved occupant comfort.

Maintenance

The City will continue to be responsible for maintenance of the energy management systems. NORESCO expects maintenance of the installed equipment to be comparable to current maintenance requirements.

Customer Training

NORESCO is providing training for the Delta energy management system under Phases 1 and 2. For Phase 3, NORESCO will provide eight hours of customer training for the new EMS. We can provide additional training at the City's request. We will provide O&M manuals for the installed equipment.

Equipment Information

Manufacturer and Type

As requested by the City, the installed EMS systems will be manufactured by Delta Controls.

- **Delta Controls, Inc.,** 17850 - 56th Avenue, Surrey, British Columbia, Canada V3S 1C7

Material Specifications

Energy Management System shall be a complete working system with all controllers being the product of a single manufacturer. The system shall be a web-enabled system, with networked communications installed on the school and city's existing IT infrastructure with a separate communication bus for the DDC controllers. System shall provide multiple levels of security and shall be configured to perform all required temperature control and energy management functions.

HVAC Controls
I. Points List

HVAC Controls
II. Energy Savings Calculations

EMS IMPROVEMENTS: BOILER CONTROLS

Overview

Several buildings included in Phase 3 have standalone steam boiler systems, which utilize standard steam pressure (high/low limit) controls. While these controls are adequate to safely provide heat for the individual buildings, they are not configured for efficiency in functionality or operation. This results in unnecessary energy loss as well as overheating of the spaces.

NORESCO will install new boiler control systems to provide increased functional efficiency of the heating system boilers. This ECM will reduce heating energy consumption while improving occupant comfort by avoiding overheating on mild days.

Automatic Boiler Controller

Affected Areas

- Auburndale Library
- Elliot Street Operations Center
- Fire Station #3
- Public Buildings Department
- Senior Center

Detailed Description

Existing System

The existing standalone boilers and heating systems serving the Auburndale Library, Elliot Street Operations Center, Fire Station #3, Public Building Department and Senior Center are typical steam heating systems. They burn fuel to generate steam, which is then transported through a piping distribution system to terminal equipment. Terminal equipment includes, but is not limited to: cast iron radiation, convectors, and air handling coils. The boilers use standard pressure controls, which means the boiler turns on when a low limit setpoint is sensed and turns off when the high limit (or differential) setpoint is reached.

When the steam pressure reaches the low limit setting, a signal is sent to the boiler to turn ON and generate steam, which in turn heats the buildings. Unfortunately, the pressure-trol only “tells” the boiler to turn ON when the pressure or temperature is too low or turn OFF when the pressure or temperature is above setpoint. There is no in-between, which often times results in short cycling of the boiler or overheating of the buildings. The boiler does not “know” if it is a sub-zero winter day or a mild spring day, so it operates as if it is always the worst-case scenario (sub-zero).

Recommended Improvements

The actual pressure in a steam heating system is indirectly affected by several factors, one of which is the outside air temperature. While the occupants may be able to adjust a thermostat setpoint, thus adjusting for a portion of the heating load, the outside air temperature factor varies and cannot normally be adjusted for directly. Depending on the load this results in the boiler running for a few minutes (least efficient) to indefinitely (most efficient). By providing a boiler control that allows the capability to lockout boiler operations based on the outside air temperature, temperature setback, and system scheduling; the functionality and operation of the boiler system can be tailored and optimized for the specific heating system. The building will not only be able to provide better building control, but also allow Newton's Public Buildings Department to monitor indoor space temperature, steam header pressure, boiler status, fuel valve status and flame fail status. Heat-Timer controllers NORESCO is specifying will be able to be tied into existing network connections and be monitored via the BACnet card internal to the boiler controller.

Scope of Work

NORESCO will install new boiler controls in the buildings listed in the table below. Installation of a boiler control system will improve heating system control while reducing energy consumption and improving comfort conditions.

Boiler Controls	
Building	Notes
Auburndale Library	Oil-Fired Steam Boiler
Elliot Street Operations Center	Gas-fired Steam Boiler
Fire Station #3	Oil-Fired Steam Boiler
Public Buildings Department	Oil-Fired Steam Boiler
Senior Center	Oil-Fired Steam Boiler

Interface with Existing Systems and Operations

Impact on Facility Operations and Performance

The facility will benefit from reduced energy consumption and improved occupant comfort.

The City is responsible for providing broadband access to the energy management system via the Local Area Network (LAN).

Maintenance

NORESCO expects maintenance of the installed equipment to be comparable to current maintenance requirements.

Customer Training

The new boiler control systems are similar to systems used in other buildings. No special training is required. NORESCO will provide O&M manuals for the installed equipment.

Equipment Information

Manufacturer and Type

NORESCO proposes to install boiler controls as manufactured by Heat-Timer, or approved equal.

- **Heat-Timer Corporation.** 20 New Dutch Lane, Fairfield, NJ 07004 Ph: (973) 575-4004

Environmental Issues

No environmental impacts are expected.

Boiler Controls
I. Energy Savings Calculations

PROGRAMMABLE THERMOSTATS

Overview

Crafts Street Garage, Jackson Homestead, and Newton Centre Fieldhouse all contain single zone systems or standalone terminal heating equipment such as furnaces or unit heaters. These systems are simple, but currently controlled by basic non-programmable thermostats. As such, these controls are not capable of utilizing energy savings strategies such as scheduling and unoccupied setback, and thus maintain occupied space temperatures whether or not the space is in use. This lack of capability in the existing controls results in relatively significant energy waste.

Programmable Thermostat

NORESCO will install new programmable thermostats to provide the City the ability to schedule occupied/unoccupied periods and space temperature setpoints for the selected systems. This ECM will reduce energy consumption while improving occupant comfort by providing more accurate space temperature control.

Affected Areas

- Crafts Street Garage
- Jackson Homestead
- Newton Centre Fieldhouse

Detailed Description

Existing System

The existing single zone systems throughout the City's buildings are primarily controlled by simple low or line-voltage thermostats that are incapable of being programmed for occupied/unoccupied periods and/or setback. They have a single setpoint for occupied periods that does not automatically change when the space is unoccupied, such as at night or during weekend hours.

For a space that is used for a typical forty-hour work week, the total unoccupied hours over the course of a year are more than three times the occupied hours. With a non-programmable thermostat, the savings from maintaining lower (or higher during cooling season) unoccupied space temperatures are lost.

Recommended Improvements

NORESCO will install new programmable thermostats for the selected systems. Installation of a programmable thermostat with 5-1-1 day scheduling will improve unitary system operation and control while reducing energy consumption and improving comfort conditions.

The following table lists the selected buildings and equipment associated with this measure:

	Programmable Thermostats	
Building	No. Of Thermostats	Equipment & Notes
Crafts Street Garage	10	Gas fired Sterling heaters
Jackson Homestead	1	Gas fired furnace
Newton Centre Fieldhouse	1	Oil fired furnace

Interface with Existing Systems and Operations

Impact on Facility Operations and Performance

The facilities will benefit from reduced energy consumption.

Maintenance

NORESCO expects maintenance of the installed equipment to be comparable to current maintenance requirements.

Customer Training

NORESCO will provide O&M manuals for the installed equipment. No special training is required.

Equipment Information

Manufacturer and Type

NORESCO proposes to install programmable thermostats as manufactured by Honeywell, or approved equal.

- **Honeywell International Inc.** 101 Columbia Road, Morristown, NJ 07962 Ph: (973) 455-2000 Fax: (973) 455-4807

Environmental Issues

No environmental impacts are expected.

Programmable Thermostats
I. Energy Savings Calculations

VARIABLE FREQUENCY DRIVES & PREMIUM EFFICIENCY MOTORS

Overview

NORESCO identified some systems in Newton's buildings that will benefit from variable frequency drive (VFD) installations and premium efficiency (PE) motor upgrades. These upgrades will reduce the energy consumption of the existing systems while improving overall performance. Upon completion, the VFDs and PE Motors will allow for reduced energy consumption and tighter response to transient zone conditions, effectively providing the served spaces with increased comfort conditions. NORESCO will implement this measure in the following buildings:

- Burr School
- Mason-Rice School
- Upper Falls Community Center

Detailed Description

Existing System

Several of the City of Newton facilities circulate heating hot water to the building air handling units (AHUs), unit ventilators and other unitary equipment at a constant flow rate. Through the use of variable frequency drives on selected pump motors, the City of Newton will be able to recognize energy savings derived from the reduction of power required to pump the water through the buildings' heating coils. As shown in the following equations, energy savings are realized in the reduction of flow, which follows the cube of power consumed by the motor:

$$\frac{GPM_{Initial}}{GPM_{Final}} = \frac{RPM_{Initial}}{RPM_{Final}}$$

$$\frac{Power_{Initial}}{Power_{Final}} = \left(\frac{RPM_{Initial}}{RPM_{Final}}\right)^3$$

An essential part of a variable frequency drive installation is confirming motor compatibility for the application. Motors are rated for maximum operating temperature on their nameplate and are either A, B, F, or H. These letters correspond to a specific temperature the insulation can stand before failure. If the motor does not have the correct insulation type, the motor life can be reduced and may consistently overload and cause breakers to trip. VFD applications require a minimum of Class F insulation. Because of this requirement, even if the existing motor is high efficiency, it will have to be upgraded to a higher insulation class.

Recommended Improvements

The hot water pumps 1 & 2 (lead/lag) at both the Burr School and Mason-Rice School will have variable frequency drive equipment installed. The VFD will be integrated into the existing hot water distribution system and programmed through the energy management system to automatically respond to the fluctuating need for heating hot water throughout the building zones.

Where two pumps exist to serve one hot water supply or return leg, i.e. a “lead/lag” situation, one VFD with a manual switchover will be installed to service both pumps. The variable frequency drives will be microprocessor-based, Pulse Width Modulating (PWM) units, having keypad control with alpha-numeric display, H-O-A switch with speed potentiometer, manual bypass, safety features and programmable inputs and outputs. The VFD will be controlled by sensors and application software interfaced with the energy management system (EMS).

Also included in this measure will be the replacement of the following motors with premium efficiency type:

Building/ Equipment	Motor Description				Existing Efficiency	Proposed Efficiency	Inverter Rated
	HP	Encl	Voltage	RPM			
Mason Rice School P-1	7.5	DP	230/460	1750	91.7%	91.7%	Yes
Mason Rice School P-2	7.5	DP	230/460	1750	91.7%	91.7%	Yes
Upper Falls CC HV-1	5.0	ODP	220	1750	75%*	89.5%	No

*estimated

The pumps in Burr Elementary School have existing PE, inverter rated motors.

Although HV-1 at Upper Falls Community center is not being converted to variable flow systems, the City of Newton will benefit from a motor replacement. The installation of a new, National Electrical Manufacturers Association (NEMA) rated premium efficiency (PE) motor will reduce energy losses through improved design, better materials, and improved manufacturing techniques. With proper installation, energy-efficient motors run cooler and consequently have higher service factors, longer bearing and insulation life, and less vibration.

Scope of Work

The Variable Frequency Drive installations will include the following:

- Furnish and install one VFD for the hot water pumps (HWP-1 & HWP-2) at the Mason-Rice School. Furnish and install one VFD for the hot water pumps (HWP-1 & HWP-2) at the Burr School. The installation of the VFDs shall include the ability to isolate the VFD via disconnect. Each VFD will include a main selector switch with OFF/VFD/BYPASS speed control selections mounted on the drive. A second VFD selector switch shall be mounted below the main switch, allowing only two modes, HAND and AUTO, when the drive is engaged. It should be impossible to energize the drive with the main switch and put the drive in the OFF position with the second switch. Existing motor starter shall be reused as a source of power to the VFD. The selected motor will be replaced and the new motor will be Premium Efficiency and rated for inverter (VFD) duty. The drive will be mounted in a suitable location, near the motor starter panel.
- Provide direct digital controls for control and monitoring of the new VFDs, including VFD inputs and outputs, and application software as specified in the EMS scope of work and point lists.
- Provide checkout, start up, and commissioning.

The Premium Efficiency motor upgrades will include the following:

- Removal and disposal of the old motor, belts, and coupling inserts.
- Installation of the new PE motors on the existing HVAC equipment.
- Inspection of belt sheaves and replacement of belts as required.
- Provide checkout, start up and commissioning.

Interface with Existing Systems and Operations

Impact on Facility Operations and Performance

Work under this ECM will be done during normal working hours. The majority of the work will take place in the mechanical room spaces. NORESCO will coordinate work with the City of Newton maintenance personnel.

Maintenance

NORESCO expects maintenance of the installed equipment to be comparable to current maintenance requirements.

Customer Training

NORESCO will provide O&M manuals as well as training for the installed equipment and controls systems.

Equipment Information

Manufacturer and Type

NORESCO will install premium efficiency manufactured by Baldor Electric Company, or approved equal.

- **Baldor Electric Company,** 5711 R.S. Boreham, Jr. St. Fort Smith, AR 72901 Phone: (479) 646-4711

The VFDs will be equal to the ACH 400 Series from ABB Drives Inc.

- **ABB Drives Inc., Standard Drives Division,** 16250 W. Glendale Dr. New Berlin, WI 53151 Phone: (414) 785-3200

Variable Frequency Drive and Premium Efficiency Motor
I. Energy Savings Calculations

PHOTOVOLTAIC SYSTEM

Overview

NORESCO will install a 7.5 kW photovoltaic (PV) system at the Lower Falls Community Center. The system will be installed on the existing roof structure and will be incorporated into the existing building electrical service. A visual display will be included to allow visitors and interested parties to view the system's output over the internet. The 36-panel system will be self-ballasted, requiring no roof penetrations. Once installed, the PV system will not only help displace electricity purchased from the utility, but also serve as a symbol of Newton's effort to promote sustainability and environmental stewardship.

Solar PV Panel

Detailed Description

Existing System

The Lower Falls Community Center is a single story, flat roof building constructed in 1958. The roof construction is a built-up type with no overhangs. According to NORESCO's baseline energy analysis, the building consumes approximately 40,000 kWh of electrical energy each year, costing roughly $6,000 based on calendar year 2009 energy data.

Recommended Improvements

NORESCO will install a PV array on the roof of the Lower Falls Community Center to offset the building's electrical energy usage. The PV array will utilize a mounting system that will incorporate adhesive and ballasting, rather than roof penetrations, to secure it to the roof. The installation will also include a data acquisition system (DAS) that will provide remote access to such data as solar irradiance; wind speed; ambient and cell temperatures; and system volts, amps, watts, and watt-hours. Information from the DAS will be used for monitoring of the system and the remote access feature will allow for expedited diagnosis of any problems that should arise.

This ECM includes a complete turnkey installation, including all necessary associated equipment. The unit will generate DC electricity up to its rated capacity, depending on weather conditions and time of year, and convert it to AC electricity. The system is sized so that all of the electricity produced will be used by the Community Center and will not be exported to the electrical grid.

Scope of Work

NORESCO will install a 36-panel, 7.5 kW_{DC} solar photovoltaic systems on the roof of the Lower Falls Community Center. The array will be installed at a fixed angle (10° to 15°), and will be oriented towards the south-southeast. Installation shall include PV modules, inverters, combiner boxes, AC and DC disconnects, isolation transformers (as required), protective relays, grounding system, structural materials, automated controls, over-current protection, lightning protection, interconnecting wiring and conduits.

- NORESCO shall provide Evergreen 210 PV modules or approved equal.
- Shall furnish and install the array panels for system capacity of approximately 7.5 kW DC
- PV system shall be connected to an existing power panel located in basement
- Wind gusts of 110 mph shall be taken into consideration during design. The metal structure shall be electrically grounded
- All installations shall utilize mounting/racking systems and hardware specifically designed for use with photovoltaic systems, incorporating rust and corrosion-resistant components and appropriately engineered to withstand anticipated structural and wind loading conditions.
- All equipment shall be installed in accordance with manufacturer's instructions.
- NORESCO shall provide an electrical meter to measure the energy produced by the solar electric system.
- The PV system utility interconnection shall have an isolation transformer and manual, lockable disconnect in the designated electrical equipment room.
- The PV system inverter's electrical output at the utility connection point shall be pure sine wave, 60 Hz and match the site-specific utility voltage and phase.
- The Data Acquisition System (DAS) shall be, at minimum, in compliance with the Utility Photovoltaic Group (UPVG) Technical Performance Specifications. The DAS shall provide irradiance, wind speed and direction, ambient and cell temperatures, and system volts, amps, watts and watt-hours.
- The DAS display will have an attractive, educational, user-friendly interface.

Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The new PV system will deliver electrical energy savings. All work will be done during normal business hours. NORESCO will coordinate all work with facilities staff to minimize the impact on the building occupants.

Maintenance

In order to sustain the energy savings throughout the contract term, the City will be responsible for cleaning dirt and debris from the solar panels.

Customer Training

NORESCO will provide customer training and O&M Manuals for the PV systems.

Equipment Information

Manufacturer and Type

NORESCO will install PV panels as manufactured by Evergreen or approved equal.

- **Evergreen Solar, Inc.** 138 Bartlett Street, Marlboro MA 01752 Phone: (508) 357-2221

Photovoltaic System
I. Energy Savings Calculations

Energy Conservation through Behavior Change®

Overview

NORESCO's holistic approach toward performance contracting leverages the complex interaction between people and their environment to promote participation in the energy efficiency process. To achieve the optimal benefit from newly installed high efficiency equipment and systems, in addition to generating added energy savings, NORESCO will create a comprehensive, custom-tailored, program known as Energy Conservation Through Behavior Change® or ECTBC. This program is comprised of three components: (1) Awareness-Communication; (2) Green Schoolhouse Energy Education; and (3) a Sustainable Behavior Change intervention. Using the inherent opportunity to "go green" within performance contracting, the ECTBC program instills and sustains a culture of energy efficiency within your school system, and throughout your community.

This energy conservation measure is a cognitive-social-based program that promotes cultural change through information, knowledge, and by reinforcing energy conserving behaviors while discouraging energy wasting behaviors. It relies on a tested and proven process which assesses attitudes, social norms, control perceptions, knowledge, behaviors, and other aspects of energy use among the focal community. Assessing these factors allows NORESCO to custom-tailor a program specifically for you. Our program has multiple associated individual, organizational, and community benefits in addition to reducing energy consumption. These benefits occur while enhancing the educational learning experience and increasing conservaiton sustainability.

Utilizing archival data, individual meetings, focus groups, and a behavioral survey, our program is designed to use existing mechanisms to target impactful energy wasting behaviors. It is also structured to enhance energy consumption knowledge and promote other energy efficiencies. Students enjoy the Green Schoolhouse cirruculmn enhancement while teachers and/or staff are often the logical focal group to participate in the Sustaible Behavior Change intervention. Influential change agents are then trained in the use of seven behavioral change tools to effect targeted behavior change where substancial energy savings can be achieved.

The program's objective is to initiate and sustain an ever increasing culture of energy efficiency community-wide, begining with project Awareness-Communication activities. Concurrently, hands-on educational activities for students, often created from the building retrofits themselves, strengthen and enhance academic learning. In this way, students also participate in the performance contract, while utilizing project-based instruction and tools to become better Earth stewards at an impressionable age. From a specially designed homework assignment, students bring family and community into the energy efficiency process also. This holistic approach impacts all stakeholders through a well-received initiative – that of saving money, energy, and carbon emissions, while upgrading existing structures – all paid from energy savings.

A brief description of the ECTBC process follows, which will guide the development, implementation, and assessment of your custom-tailored program.

ECTBC #1: AWARENESS-COMMUNICATION

The Awareness-Communication component begins by informing all organizational members about the purpose and benefits of the project, communicating the changes that can be expected resulting from the project, and providing a means for questions, concerns, and/or suggestions to be addressed directly to the project manager. Our process includes face-to-face meetings, lectures-workshops, and the use of web sites, newspapers, and other communications media. Next, we disseminate information about the benefits of the project on a larger scale. This information is designed to enhance both internal and external perceptions of the City of Newton and Newton Public Schools, which can lead to multiple positive outcomes. Communicating this enhanced environmentalism and stewardship of the Earth's resources, along with your increased competitiveness (due to enhanced, smart buildings) can bolster confidence that your staff and faculty are employed by a sustainable organization. In essence, because reducing pollution, decreasing natural resource consumption, and increasing operational efficiency are so universally well received, NORESCO wants to communicate this project's activities to the widest possible audience.

The goals of NORESCO's Awareness-Communication component are to:

- Inform members of efforts to reduce operating costs, conserve natural resources, and provide facilities that are more comfortable.
- Ensure that those who will be affected by the changes are well informed and have had their views and issues addressed.
- Present an opportunity for interested individuals to interact or to incorporate sections of this program into their work and/or educational experience.
- Raise awareness of energy consumption and conservation efforts through custom-designed promotional media while encouraging everyone to reduce personal energy use.
- Provide updates, changes, status, and impacts of the ECM benefits and savings to an interested and aware audience. A Newton-specific web site will be created to help with this task.
- Generate awareness and recognition of all energy conservation activities and accomplishments to a regional and statewide audience.

ECTBC #2: GREEN SCHOOLHOUSE ENERGY EDUCATION

The Green Schoolhouse Energy Education component makes use of your buildings' energy efficient retrofit activity occurring in an educational setting. Other energy efficiencies, and/or alternative energy projects, perhaps outside the scope of this ESPC, may also be incorporated into this component. Infusing green values in students at the same time the buildings and community in which they learn are becoming energy efficient is an exciting opportunity to engage students in the energy efficiency process. Utilizing hands-on, project-based instruction and tools will motivate students toward achieving a deeper understanding of what it means to be energy conscious. Similar to the old adage, "Let your actions speak for you;" NORESCO lets the buildings "speak" to the students. When students discover first-hand the impact of lighting upgrades, insulated windows, and automatically adjusted temperatures with set points, they realize that they are living a daily lesson of what it means to be energy efficient.

The goals of NORESCO's Green Schoolhouse Energy Education component are to:

- Incorporate existing conservation activities (i.e., recycling, student energy patrol, green team) into the Awareness-Communication activities.

- Offer components of the project to interested teachers, students, and clubs to facilitate conservation activities and enhance educational processes.
- Place energy and emission reduction displays on site at visible locations describing a specific ECM, how it functions, and how this ECM benefits students, teachers, staff, and the community at large.
- Create hands-on learning activities for students of all ages utilizing actual old and new technologies within their buildings. Existing and newly installed building retrofits, real-time consumption displays, along with custom animations and computer simulations are often used to accomplish this task.
- Conduct educational workshops (staff, students, classroom, community, etc) describing in detail the benefits of specific ECMs for specific buildings and the ESPC in general.
- Create "homework" or other activities that allow students to display and enhance their newly learned energy efficiency knowledge, while possibly saving their parents money on their home energy bill.
- Assist and enhance existing green curriculum. Use and/or incorporate class projects to advance this Energy Conservation Measure.

ECTBC #3: SUSTAINABLE BEHAVIOR CHANGE FOR ONE FOCAL GROUP OF "LIKE" ENERGY CONSUMERS

Our Sustainable Behavior Change component consists of a scientifically rigorous and well-documented process designed by Dr. Scott Finlinson that is implemented in conjunction and cooperation with staff. First, a focal group is chosen who can influence a substantial amount of your energy consumption. Next, a Human Behavior Energy Audit™ collects data regarding energy consuming behaviors, knowledge, and the facilitators and barriers driving these behaviors.

After data analysis, specific behaviors are targeted for change, guided by the enhanced understanding of environmental attitudes, social systems, control perceptions and knowledge of energy use among members of the community at large and the focal group specifically. Targeted behavior change and organization-wide supporting actions, in combination with the Awareness-Communication and Green Schoolhouse Energy Education components, initiate and sustain this behavior change. Hence, a culture of energy efficiency that minimizes greenhouse gas emissions and maximizes energy savings is established.

The goals of NORESCO's Behavior Change Intervention component are to:

- Incorporate existing conservation activities and all ECTBC components into the focal group's daily activities.
- Target for change 3-4 impactful energy consumption behaviors.
- Legitimize the focal group's influence in persuading others to change their energy wasting behaviors.
- Create awareness of the focal group's accomplishments to further generate widespread behavior change.
- Promote and recognize the focal group's individual members as energy efficiency leaders, while encouraging additional conservation activities.

ECTBC PROGRAM EXAMPLE IMPLEMENTATION SCHEDULE

Intial Component

- Create and distribute initial announcement of the project to all organizational members, complete with a general overview, specific details of the ECMs, projected schedules, savings and benefits, and contact information for additional questions and/or issues.
- Meet with representative members @ 30-minute meetings to explain the ECMs and purpose of the project, solicit support and ideas, address questions and issues, put a face on the project, and leave contact information.
- Initiate a web-based energy survey to collect information relating to energy efficiency for the purpose of developing an energy efficiency campaign/program.
- Identify specific ECMs to highlight in the Green Schoolhouse Energy Education component.

2-3 Months Later

- Create and distribute a press release announcing the initial performance contract, any previous phases or other energy work, and current project activities. Write an article for newsletters.
- Augment and incorporate existing energy conservation activities into press announcements and other promotional activities.
- Assist interested members in augmenting existing environmental activities or creating new ones.
- Work with web site personnel to create a continuing information section or "box" displaying energy saved, pollution and emission reductions, scheduled changes, etc.
- Design, implement, and assess a custom-tailored Sustainable Behavior Change intervention aimed at reducing energy consumption among the custodial staff, faculty, or other focal group.
- Create custom-tailored information kits fact sheet, calendar, suggested action timeline, conservation posters, prompts/reminders, incentives, and promotionals. Create a "Champion" packet for emerging leaders to champion the conservation cause.
- Construct a display and/or other materials promoting NORESCO-led physical changes (e.g., before-after pictures for lighting, projected savings, emission reductions, etc.).

Several Months Later

- Post-survey a representative sample of focal group members.
- Analyze post program global and specific attitudes, social norms, perceived behavioral control, volitional energy consuming behaviors, motivational factors, barriers, future improvements, program satisfaction, and other suggestions.
- Write and submit recognition/award documents as appropriate.
- Write report: executive summary, introduction, methodology, key findings, future directions and suggested modifications and appendices.

OTHER MEASURES CONSIDERED

EnergyStar Window A/C installations

Many of the facilities included in the Phase 3 Audit do not have centralized cooling systems. As such, window mounted air conditioning units are installed in spaces that are utilized during the summer months.

EnergyStar Window A/C Unit

Many of the window AC units inspected were found to be nearing the end of their useful life expectancy. Given the age and condition of the units, it is estimated that they currently operate at an efficiency level of 8.0 EER. Newer EnergyStar rated units can have efficiencies upwards of 11.0 EER. By installing newer units, the City would benefit from reduced electrical consumption through more efficient cooling of its year-round occupied spaces.

Unfortunately, the savings are small compared to the cost of the AC units. Therefore, NORESCO does not recommend this measure.

Thermostatic Radiator Valves

A significant number of the steam radiators and convectors found across the City do not have operable manual shutoff valves and/or have failed thermostatic or pneumatic control valves. These end devices are typically located in the spaces in buildings that are prone to overheating. As a remedy, occupants often open windows or doors, or run the air conditioning to control the space temperatures. This behavior results in substantial energy losses.

Thermostatic Radiator Valve

NORESCO identified the following buildings as candidates for TRV replacement:

- Angier Elementary School
- Bowen Elementary School
- Countryside Elementary School
- Franklin Elementary School
- Lincoln-Eliot Elementary School
- Memorial-Spaulding Elementary School
- Pierce Elementary School
- Underwood Elementary School
- Ward Elementary School
- Williams Elementary School
- Zervas Elementary School
- Auburndale Library
- Elliot Street Operations Center

New TRVs will provide occupants the ability to manually adjust and automatically regulate individual heating output on an end-use level. This will not only reduce heating consumption, but also significantly improve occupant comfort by allowing for greater space temperature control.

Unfortunately, this measure has a high payback because the installed cost of the TRVs is high compared to the savings. Therefore, NORESCO does not recommend this measure.

Infrared Heating Systems

The City's public works division and fire departments utilize garage space for vehicle storage and maintenance. As expected, these high use facilities see very high infiltration rates due to overhead doors opening and closing, or being left open as necessary. Currently, these spaces are predominantly heated by gas-fired unit heaters or make-up air units. This heating method utilizes sensible energy exchange to cold air passed over a hot coil to heat the ambient air and warm the space. Unfortunately, this warmed air easily escapes the building once the doors are opened, resulting in significant energy waste.

Fire Station 3 Apparatus Bays

Installing infrared heating systems in these spaces would deliver energy savings compared to the heating associated with the existing systems. By using a radiant heat system, the occupants and objects would be heated rather than the air. As a result, the air near the roof deck would be at least 5°F cooler than with air-based heating systems, the walls 3°F cooler, and the closed-door infiltration rate proportionately reduced because of the lower stratification and "chimney" effect driving it. Similarly, the heat loss associated with open doors will be reduced because the air being displaced is cooler. Even though the ambient space temperatures are somewhat cooler, IR heating provides superior occupant comfort in high bay open spaces, is quiet, and provides rapid heat recovery after doors are opened.

Due to the high cost to implement this ECM compared to the savings, NORESCO does not recommend this measure be included as part of the Phase 3 project.

High Efficiency Boiler Installations

Most of the Elementary Schools investigated during the Audit were found to have boilers original to the construction of the buildings; some over 60 years old. Originally installed to be coal fired, these units are very large (high mass) and have been retrofitted over the years to alternate fuels (#2 oil and natural gas). These boilers are reaching the end of their useful lives and are incapable of operating at efficiencies modern units typically achieve.

Boilers built today benefit from better insulation, more efficient burners, and overall smaller footprint than the units they often replace. New installations can also benefit from the opportunity to reassess building loads and size the newly installed boiler appropriately. Boilers installed in the era of these units were often oversized. This practice provides security against under-heating on a design day, but renders the unit incapable of achieving maximum efficiency on most moderate winter days due to repeated short cycling. A smaller boiler or modular boiler system will allow the boiler to run at peak efficiency for more hours of the heating season.

Replacing the City's aging boilers with new high efficiency units will not only reduce heating energy consumption due to increased system efficiency, but also reduce maintenance costs associated with keeping the old boilers running. However, the City is planning to retrofit or replace some boilers separate from the NORESCO project. Additionally, due to the high cost to implement this ECM, NORESCO does not recommend this measure be included as part of the Phase 3 project.

Dual-Fuel Burner Upgrades

In the past few years, the City of Newton has begun to replace aging oil fired burners on existing boilers with new dual-fuel, high efficiency burners. This retrofit provides significant energy savings due to burning fuel more efficiently as well as cost savings due to burning natural gas, which at today's energy rates have a lower cost per BTU than oil. Operations and maintenance savings are also realized via reduced maintenance on the existing burners, which are reaching the end of their useful service term.

City of Newton personnel indicated that the City plans to install the burner upgrades in the remaining buildings on their own. As such, NORESCO has not included this ECM as part of the Phase 3 project.

Hydronic Heating Conversions

Many buildings included in the Phase 3 utilize low-pressure steam to deliver space heating during the winter months. End devices include radiation, unit ventilators, and heating and ventilation units to heat the occupied spaces. By nature, steam systems tend to be less efficient and more costly to maintain as compared to hot water systems. Some newer renovated areas in the City have already been switched to hot water by using steam to hot water heat exchangers. Converting systems to hot water will eliminate the losses inherent to steam systems, increase the controllability of the heating system, increase comfort conditions, and reduce maintenance and repair costs. However, hydronic conversions are very expensive due to the high cost of piping and controls. The payback for this type of measure is typically well in excess of 30 years. Therefore, NORESCO does not recommend this measure be included as part of the Phase 3 project.

Pool Cover Installations at Gath Pool Facility

The Gath Pool Facility serves as the City's community pool during the summer months. The outdoor facility houses one large pool with a diving, competition, and multipurpose area, as well as a splash pool play area for children. The facility is open from May through August. Currently, the pool remains uncovered during unoccupied hours that the pool is in operation. This allows significant heat and chemical waste to occur through evaporative losses.

Pools lose energy in a variety of ways, but evaporation is the most significant mechanism for energy loss. One BTU is required to raise one pound of water one degree, but each pound of water that evaporates results in approximately 1,000 Btu of thermal energy lost. This evaporative energy loss resulting in the lowering of water temperature must be made up by the pool water heating system. By covering the pool during unoccupied hours, evaporation is greatly reduced and heating energy is saved. In addition, the requirement for make-up water is reduced. This lowers water consumption and chemical treatment costs.

Pool owners typically find that installation and removal of pool cover systems is easy enough for facility lifeguards to manage on a daily basis. Lifeguards install the covers at the close of their shift, and remove them prior to pool operating hours. The location of this pool facility in a Northern climate where nighttime temperatures can dip far below the 80°F pool temp makes this good application for a pool cover installation.

Installing pool covers to save energy and water costs tends to be cost effective for pools that operate year-round. However, for seasonal pools that only operate during the summer months, the savings are commensurately less and the payback is much higher. For these reasons, a pool cover for the Gath pool is not cost effective and this measure is not recommended.

New Windows

Several buildings surveyed during the audit were found to have existing windows in poor condition and allow significant amounts of unconditioned outdoor air to enter the buildings. Old windows can be the weakest link in a building's envelope, often contributing to energy losses, moisture problems, and noise transmission. New windows provide for improved thermal performance and reduce infiltration around the windows. Heating and cooling requirements are reduced, thus saving energy while improving comfort conditions.

Windows at Countryside Elementary School, Fire Station 3, Lower Falls Community Center, Public Buildings Department, and Health Department were identified as candidates for replacement. These windows have deteriorated to the point that they have exceeded their useful lives. Many occupants in these buildings had complaints about the draftiness of these windows. Leaks around the edge of the glass and frames allow cold air to blow in during the winter months. In a climate such as Newton's, leaky windows result in significant heating energy loss through conduction and infiltration.

Existing Windows at Health Department Headquarters

New windows will be tight, thus reducing infiltration. They will also have a lower U-factor and shading coefficient, which will reduce the amount of conductive and radiation heat transfer attributed to the windows.

The City indicated that they plan to replace older single-pane windows in schools on their own. For City buildings, due to the high cost of installation, NORESCO does not recommend this measure be included as part of the Phase 3 project. Weather-stripping the windows as a means to reduce infiltration is a more cost-effective option.

Miscellaneous Envelope Improvements

During the audit, NORESCO utilized a third-party consultant specializing in weatherization and other building envelope savings measures. While NORESCO has included specific weatherization measures for each building, including some insulation upgrades for selected areas, there are other long payback improvements that would reduce energy consumption or help address capital issues. These improvements are not supported by the program savings. Brief descriptions of these measures are listed below:

- <u>Albemarle Fieldhouse:</u> Caulk shut 200 linear feet of windows.

- Countryside Elementary School: Encapsulate entire glass wall area with a combination thermal wall and small hopper windows (4,250 SF and 54 windows).
- Fire Station 3: Install a combination thermal panel and new hopper windows (58 windows and 1,960 square feet of thermal panel + 6 additional window replacements without thermal panels).
- Lower Falls Community Center: Install a combination thermal panel and new hopper windows (50 windows and 2,000 square feet of thermal panel).
- Elliot Street Garage: Install 9,000 square feet of thermal suspended ceiling in garage area.
- Zervas Elementary School: Install 27,000 SF blown in cellulose to R-38 above plaster ceiling.
- Public Buildings Department: Replace windows with new double-pane windows.

SECTION D
APPENDIX

D.1 SOURCES OF INFORMATION

City of Newton

David Tannozinni
Public Buildings Department
Tel: (617) 796-1605

Carol Chafetz
Director of Operations & Environmental Affairs
Newton Public Schools
Tel: (617) 559-9000

Josh Morse
Public Buildings Department
HVAC Technician
Tel: (617) 594-2564

NORESCO

1 Research Drive, Suite 400C
Westborough, MA 01581
(508) 614-1000

John Kauppinen
Senior Account Executive
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Utility Information

NSTAR

Steven Grattan
Energy Efficiency Program Manager, NSTAR
Tel: (781) 441-8243

NGRID

Domenic Musco
Program Manager
(781) 907-1578

D.2 CALCULATIONS

Energy and water savings calculations are included within each tabbed ECM