Utilize Higher Efficiency Lights and Install Occupancy Sensors (Arcs 2.7142 & 2.7135)

(The analysis below was extracted from one of the assessment reports by the Clemson University Industrial Assessment Center (IAC). This is only an example recommendation and hence, not all the background information and sources for numbers are included here.)

Est. Electric Consumption Savings	= ***229,221 kWh/yr***
Est. Electric Consumption Cost Savings	= ***$17,192/yr***
Est. Electric Demand Savings	= ***705 kW***
Est. Electric Demand Cost Savings	= ***$6,329/yr***
Est. Total Cost Savings	= ***$23,521/yr***
Est. Implementation Cost	= ***$20,682***
Simple Payback Period	= ***10.6 months***

Recommended Action:

It is recommended all non-LED bulbs be replaced with LED bulbs. As a rule, the number of lamps per fixture can be cut in half if using LEDs. If there are three lamps per fixture, the recommendation is typically to install two LEDs, as opposed to one. This may vary depending on lighting conditions in a specific space; in some cases, only one lamp will be needed. In addition, occupancy sensors should be installed in areas in there is a high amount of traffic, areas with people going in and out often, or areas that don't see a lot of traffic but that may have lights left on for extended periods. These include locker rooms, the grit separation facility, office rooms, the EQ fan room, and other similar areas.

Background:

The assessment team counted the number of non-LED lights, recorded the type of light, the wattage of each light, and the usage on a weekly and annual basis. Table 1 below shows the current lighting setup, and Table 2 shows the recommended lighting setup. The plant is charged $0.075/kWh. The demand charge is $8.98 per kW.

Table 1: Current Lighting

Location	Light Type	# of Fixtures	# of Bulbs per Fixture	Total Bulbs	Wattage per bulb (W)	Annual Operational Hours	Total wattage (kW)	Total consumption (kWh)
EQ Basin								
EQ Street Lights	Metal Halide	9	1	9	400	4380	3.6	15768
EQ tank Parking Lot	Metal Halide	8	2	16	400	4380	6.4	28032
EQ tank walkway	Metal Halide	8	2	16	400	4380	6.4	28032
EQ tank MCC room	T-12	12	2	24	32	1000	0.77	768
EQ tank fan room	High Pressure Sodium	12	1	12	400	1000	4.8	4800
EQ tank fan room (Wall Packs)	Metal Halide	3	2	6	400	4380	2.4	10512
Influent Pump Building								
Outside Wall Packs	Metal Halide	1	2	2	400	4380	0.8	3504
Ground Level	T-12	10	2	20	32	4380	0.64	2803
Lower 1st Floor (Inside Wall Packs)	Metal Halide	7	2	14	400	4380	5.6	24528
Lower 2nd Floor	Metal Halide	6	1	6	400	4380	2.4	10512
Street Lights	Metal Halide	4	1	4	400	4380	1.6	7008
Generator Building								
Generator room	High Pressure Sodium	5	1	5	400	1000	2	2000
Gen room MCC	T-12	30	3	90	32	1000	2.88	2880
Gen room (storage)	T-12	12	3	36	32	1000	1.15	1152
Gen Bldg - wall pack	Metal Halide	4	2	8	400	4380	3.2	14016
Grit Separation								
1st Floor	T-8	20	2	40	32	2500	1.28	3200
2nd Floor	T-8	32	2	64	32	2500	2.05	5120
Street Lights	Metal Halide	9	1	9	400	4380	3.6	15768
Outside Wall Packs	Metal Halide	4	2	8	400	4380	3.2	14016
Operation office								
Ops Office - lab	T-12	6	2	12	32	4380	0.38	1682
Ops Office - office	T-12	6	2	12	32	4380	0.38	1682
Ops Office - shower/head	T-12	8	2	16	32	4380	0.51	2243
Ops office - hall	T-12	4	2	8	32	4380	0.26	1121
Ops Office Conference Room	T-12	6	4	24	32	8760	0.77	6728

Sludge Thickening								
Level 1	High Pressure Sodium	33	1	33	150	4380	4.95	21681
Outside Wall Packs	High Pressure Sodium	8	1	8	75	4380	0.6	2628
Level 2	T-8	8	4	32	32	4380	1.02	4485
Digester Control								
Level 1	High Pressure Sodium	12	1	12	150	4380	1.8	7884
Outside Wall Packs	High Pressure Sodium	10	1	10	75	4380	0.75	3285
Level 2	T-8	19	4	76	32	4380	2.43	10652
Filter Building								
Outside	High Pressure Sodium	8	1	8	150	4380	1.2	5256
Inside	T-8	18	4	72	32	4380	2.30	10091
Electrical Building								
Inside	T-8	12	4	48	32	4380	1.54	6728
Sludge Receiving								
Outside Wall Packs	High Pressure Sodium	4	4	16	32	4380	0.51	2243
Level 1	4 ft. LED	3	1	3	17	4380	0.05	223
Level 2	LED	8	1	8	17	4380	0.14	596
Biosolids Pumping								
Outside Wall Packs	High Pressure Sodium	3	1	3	150	4380	0.45	1971
Inside	T-8	7	4	28	32	4380	0.90	3924
Maintenance Building								
Outside Wall Packs	High Pressure Sodium	13	1	13	150	4380	1.95	8541
Inside	T-12	10	4	40	32	4380	1.28	5606
						Total	**78.94**	**303670**

Table 2: Proposed Lighting

Location	Light Type	# of Fixtures	# of Bulbs per Fixture	Total Bulbs	Wattage per bulb (W)	Annual operational hours	Total wattage (kW)	Total consumption (kWh)
EQ Basin								
EQ Street Lights	LED	9	1	9	150	4380	1.35	5913
EQ tank Parking Lot	LED	8	1	8	150	4380	1.2	5256
EQ tank walkway	LED	8	1	8	150	4380	1.2	5256
EQ tank MCC room	LED	12	1	12	17	1000	0.20	204
EQ tank fan room	LED	12	1	12	150	1000	1.8	1800
EQ tank fan room (Wall Packs)	LED	3	1	3	150	4380	0.45	1971
Influent Pump Building								
Outside Wall Packs	LED	1	1	1	150	4380	0.15	657
Ground Level	LED	10	1	10	17	4380	0.17	744.6
Lower 1st Floor (Inside Wall Packs)	LED	7	1	7	50	4380	0.35	1533
Lower 2nd Floor	LED	6	1	6	50	4380	0.3	1314
Street Lights	LED	4	1	4	150	4380	0.6	2628
Generator Building								
Generator room	LED	5	1	5	100	1000	0.5	500
Gen room MCC	LED	30	2	60	17	1000	1.02	1020
gen room (storage)	LED	12	2	24	17	1000	0.41	408
Gen Bldg - wall pack	LED	4	1	4	150	4380	0.6	2628
Grit Separation								
1st Floor	LED	20	1	20	17	2500	0.34	850
2nd Floor	LED	32	1	32	17	2500	0.54	1360
Street Lights	LED	9	1	9	150	4380	1.35	5913
Outside Wall Packs	LED	4	1	4	150	4380	0.6	2628
Operation office								
Ops Office - lab	LED	6	1	6	17	4380	0.10	447
Ops Office - office	LED	6	1	6	17	4380	0.10	447
Ops Office - shower/head	LED	8	1	8	17	4380	0.14	596
Ops office - hall	LED	4	1	4	17	4380	0.07	298
Ops Office Conference Room	LED	6	2	12	17	8760	0.20	1787

Sludge Thickening								
Level 1	LED	33	1	33	50	4380	1.65	7227
Outside Wall Packs	LED	8	1	8	17	4380	0.14	596
Level 2	LED	8	2	16	17	4380	0.27	1191
Digester Control								
Level 1	LED	12	1	12	50	4380	0.6	2628
Outside Wall Packs	LED	10	1	10	17	4380	0.17	745
Level 2	LED	19	2	38	17	4380	0.65	2829
Filter Building								
Outside	LED	8	1	8	50	4380	0.4	1752
Inside	LED	18	2	36	17	4380	0.61	2681
Electrical Building								
Inside	LED	12	2	24	17	4380	0.41	1787
Sludge Receiving								
Outside Wall Packs	LED	4	2	8	17	4380	0.14	596
Level 1	LED	3	1	3	17	4380	0.05	223
Level 2	LED	8	1	8	17	4380	0.14	596
Biosolids Pumping								
Outside Wall Packs	LED	3	1	3	50	4380	0.15	657
Inside	LED	3	2	6	17	4380	0.10	447
Maintenance Building								
Outside Wall Packs	LED	13	1	13	50	4380	0.65	2847
Inside	LED	10	2	20	17	4380	0.34	1489
						Total	**20.21**	**74448**

Anticipated Savings:

The assessment team recommends using LED bulbs in all areas. Occupancy and motion sensors are recommended for locker rooms, the grit separation facility, office rooms, the EQ fan room, and other similar areas. Though LEDs are much more efficient and use less energy than other fixtures, over lighting the area can still lead to higher than necessary energy costs. Reducing the number of LED bulbs and installing occupancy and motion sensors will provide the necessary light levels for occupants to function comfortably and safely while reducing energy consumption and costs.

The estimated annual *electric consumption savings, ECS*, for installation of the proposed lamps, ballasts, and occupancy sensors is determined as shown in Table 3 by the following relation:

$$ECS = \frac{CN \times CFW \times H1}{K} - \frac{PN \times PFW \times H2}{K}$$

Where:

CN	=	Number of current fixtures,
PN	=	Number of proposed fixtures,
CFW	=	Power rating of current fixtures, (W),
PFW	=	Power rating of proposed fixtures, (W), and
H_1	=	Operating hours of fixtures, (hr./yr.).
H_2	=	New operating hours of fixtures, (hr./yr.)
K	=	Conversion factor of 1000 W/kW

ECS = 229,221 kW/yr.

The estimated annual *electric consumption cost savings, ECCS,* that results from installation of the proposed lamps, ballasts, and sensors is determined by the following relation:

ECCS = ECS consumption rate

ECCS = 229,221 kWh/yr. × $0.075/kWh

ECCS = $17, 192/yr.

The *electric demand savings, EDS,* is calculated as shown in Table 3.

EDS = 705 kW/yr.

The estimated annual *electric demand cost savings, EDCS,* for installation of the proposed lamps, ballasts, and sensors is determined by the following relation:

$$EDCS = EDS \times Demand\ Rate$$

$$EDCS = 705\ kW/yr. \times \$8.98/kW$$

$$\boldsymbol{EDCS = \$6,329/yr.}$$

The *total cost savings, TCS*, associated with installation of the proposed lamps, ballasts, and sensors is determined by the following relation:

$$TCS = (ECCS + EDCS)$$

$$TCS = \$17,192/yr. + \$6,329/yr.$$

$$\boldsymbol{TCS = \$23,521/yr.}$$

Table 3: Total Cost Savings

Fixture Location	Previous Number of Fixtures	New Number of Fixtures	Previous Number of Lamps per Fixture	New Number of Lamps per Fixture	Previous Watts Per Lamp (W)	New Watts per Lamp (W)	Previous Annual Operating Hours (hrs)	New Annual Operating Hours (hrs)	Annual Consumption Savings (kWh/yr)	Demand Savings (kW)	Annual Demand Cost Savings ($/yr)	Annual Consumption Cost Savings ($/yr)	Annual Total Cost Savings ($/yr)
EQ Basin													
EQ Street Lights	9	9	1	1	400	150	4380	4380	9855	27	242	739	982
EQ tank Parking Lot	8	8	2	1	400	150	4380	4380	22776	62	560	1708	2269
EQ tank walkway	8	8	2	1	400	150	4380	4380	22776	62	560	1708	2269
EQ tank MCC room	12	12	2	1	32	17	1000	1000	564	7	61	42	103
EQ tank fan room	12	12	1	1	400	150	1000	1000	3000	36	323	225	548
EQ tank fan room - wall packs	3	3	2	1	400	150	4380	4380	8541	23	210	641	851
Influent Pump Building													
Outside Wall Packs	1	1	2	1	400	150	4380	4380	2847	8	70	214	284
Ground Level	10	10	2	1	32	17	4380	4380	2059	6	51	154	205
Lower 1st Floor (Inside Wall Packs)	7	7	2	1	400	50	4380	4380	22995	63	566	1725	2290
Lower 2nd Floor	6	6	1	1	400	50	4380	4380	9198	25	226	690	916
Street Lights	4	4	1	1	400	150	4380	4380	4380	12	108	329	436
Generator Bldg													
Generator room	5	5	1	1	400	100	1000	1000	1500	18	162	113	274
Gen room MCC	30	30	3	2	32	17	1000	1000	1860	22	200	140	340
Gen room (storage)	12	12	3	2	32	17	1000	1000	744	9	80	56	136
Gen Bldg - wall pack	4	4	2	1	400	150	4380	4380	11388	31	280	854	1134
Grit Separation bldg													
1st Floor	20	20	2	1	32	17	2500	2500	2350	11	101	176	278
2nd Floor	32	32	2	1	32	17	2500	2500	3760	18	162	282	444

Street Lights	9	9	1	1	400	150	4380	4380	9855	27	242	739	982
Outside Wall Packs	4	4	2	1	400	150	4380	4380	11388	31	280	854	1134
Operation office													
Ops Office - lab	6	6	2	1	32	17	4380	4380	1235	3	30	93	123
Ops Office - office	6	6	2	1	32	17	4380	4380	1235	3	30	93	123
Ops Office - shower/head	8	8	2	1	32	17	4380	4380	1647	5	41	124	164
Ops office - hall	4	4	2	1	32	17	4380	4380	823	2	20	62	82
Ops Office Conference Room	6	6	4	2	32	17	8760	8760	4941	7	61	371	431
Sludge Thickening													
Level 1	33	33	1	1	150	50	4380	4380	14454	40	356	1084	1440
Outside Wall Packs	8	8	1	1	75	17	4380	4380	2032	6	50	152	202
Level 2	8	8	4	2	32	17	4380	4380	3294	9	81	247	328
Digester Control													
Level 1	12	12	1	1	150	50	4380	4380	5256	14	129	394	524
Outside Wall Packs	10	10	1	1	75	17	4380	4380	2540	7	62	191	253
Level 2	19	19	4	2	32	17	4380	4380	7823	21	192	587	779
Filter Building													
Outside	8	8	1	1	150	50	4380	4380	3504	10	86	263	349
Inside	18	18	4	2	32	17	4380	4380	7411	20	182	556	738
Electrical Building													
Inside	12	12	4	2	32	17	4380	4380	4941	14	121	371	492
Sludge Receiving													
Outside Wall Packs	4	4	4	2	32	17	4380	4380	1647	5	40	124	164
Level 1	3	3	1	1	17	17	4380	4380	0	0	0	0	0
Level 2	8	8	1	1	17	17	4380	4380	0	0	0	0	0

Biosolids Pumping													
Outside Wall Packs	3	3	1	1	150	50	4380	4380	1314	4	32	99	131
Inside	7	3	4	2	32	17	4380	4380	3478	10	86	261	346
Maintenance Building													
Outside Wall Packs	13	13	1	1	150	50	4380	4380	5694	16	140	427	567
Inside	10	10	4	2	32	17	4380	4380	4117	11	101	309	410
Total									**229221**	**704.83**	**6329.39**	**17191.61**	**23521.00**

Implementation Cost:

The following relation determines the estimated implementation cost, IC, associated with installation of the proposed lamps, ballasts, and sensors:

$$IC = N \times IFC$$

$$IC = 82(\$80+\$16.67) + 3(\$210+\$37.50) + 12(\$115+\$16.67) + 22(\$120 + \$25) + 372(\$9.92 + \$8.33) + 10(\$32.80 + \$12.50)$$

$$\boldsymbol{IC = \$20,682}$$

Where:

N = Number of installed fixtures, and

IFC = Total Installed cost, ($/fixture)

Table 4: Summary of Cost Implementation

Number Needed	Fixture Type	Cost Per Fixture	Labor Per Fixture (mins)	Implementation Cost
82	50 Watt LED	$80	(2/6) hr./fixture × $50/hr. = $16.67/fixture	$6560 + $1367 = $7927
3	100-Watt LED Fixture	$210	(4.5/6) hr./fixture × $50/hr. = $37.50/fixture	$112.50 + $630 = $742.50
12	150-Watt LED Wall Pack	$115	(2/6) hr./fixture × $50/hr. = $16.67/fixture	$200 + $1380 = $1580
22	150-Watt LED Street Light	$120	(3/6) hr./fixture × $50/hr. = $25/fixture	$550 + $2640 = $3190
372	4 ft. LED	$9.92	(1/6) hr./fixture × $50/hr. = $8.33/fixture	$3690 + $3099 = $6789
10	Occupancy Sensor	$32.80	(1/4) hr./fixture × $50/hr. = $12.50/fixture	$125 + $328 = $453
			Total	**$20,681.50**

Simple Payback Period:

The *simple payback period*, *SPP*, associated with installation of the proposed lamps, occupancy sensors and motion sensors in each area.

$$SPP = \frac{IC}{TCS} \times 12\, months/year$$

$$SPP = \frac{\$20{,}682}{\$23{,}521} \times 12\, months/year$$

SPP = 10.6 months