CCISD Centralized Irrigation Control Final Report

Beginning June 2020, CCISD Maintenance and Operations began installing new Rainbird ESPLXME irrigation controllers with the plan to use the Wi-Fi___33 cartridge and a Wi-Fi bridge. Unfortunately, new CCISD network servers and security protocols would not allow for this to work. To proceed with central communication installation and implementation, we decided to install a cellular communication cartridge based on recommendations from Rainbird. This installation began around the beginning of July after purchase orders and order fulfilment had taken place.

Installation of the new controllers took about an hour and a half per with a few requiring mounting modifications that added about an hour of install time. Once controllers were installed, tested and programmed, Rainbird staff helped program the cellular cartridges and the Rainbird IQ cloud-based software. CCISD network security was a bit tougher than expected and required some work from our Technology department to allow access to the website which ultimately took a couple of weeks to complete. During this time, we were able to use the software via cell phone tethering and home internet access.

By September 1st, all installations had been complete, and we were fully functional. We have been using a standard watering schedule since September 1st, monitoring and modifying run times and days frequently.

In the beginning, we were watering 3-4 times per week for 15-20 minutes per cycle. This was like previous watering schedules and worked well. As the year moved on and temperatures fell, frequency and percentages were reduced as needed. By mid-October, I was able to learn the software and mobile apps well enough to start implementing rain delays to stop irrigation schedules prior to rain events and modify post rain events to keep conditions acceptable. This was the best feature to be able to utilize. In the past, a schedule change could take 3-6 hours district wide if one person was tasked to visit all 5 high school sites and make changes. This was impractical and simply did not happen. We would irrigate on a Friday evening knowing rain was happening on Saturday. On several occasions, I input rain delays from my recliner at home, from my mother in laws house in Galveston and while in the deer stand during hunting season. This functionality in invaluable in water conservation as we will be able to fine tune monthly, weekly and daily as the weather conditions change. As we move into the new growing season, I am excited to begin to use the ET watering feature that will automatically make changes to run times base on environmental factors such as wind, humidity, rainfall, temperature and solar radiation. Research has shown this can improve plant and soil health while reducing water use by as much as 30%. The next year will be exciting to monitor water use.

Total equipment cost was $64,031.36. This is $14,678.30 above the initial projected cost due to the requirement of cellular communication cartridges vs the previously specified Wi-Fi cartridge. This change will also cost CCISD $3780 annually for the cellular contract renewal.

In total, 88 hours of labor were required to complete hardware installation. This was done during normal operating hours so average labor cost was about $20 per hour, totaling $1,760.

We are still working to import water usage numbers. Unfortunately, CCISD resides in multiple municipalities and water purveyors. This causes delays in billing, processing and data entry depending on how and when the bills are sent out. League City Water department is one of the most expedient and allows us to process the quickest. Below is our irrigation usage for the last 3 years at Clear Creek High School and Clear Falls High School.

CCHS

AVG USAGE KGAL	AVG RAINFALL	KGAL Usage variance from average	rainfall variance from average	2020 usage %	rainfall %
27.25	5.436667	-29.75	-0.64333	209.17%	111.83%
90.5	3.91	-46.5	2.28	151.38%	41.69%
221.25	0.91	-70.75	0.54	131.98%	40.66%
241.75	2.536667	24.75	-0.78333	89.76%	130.88%
499	8.046667	145	-3.56333	70.94%	144.28%
441.25	6.2425	-38.75	4.4025	108.78%	29.48%
472.5	4.2575	-113.5	-4.3925	124.02%	203.17%
373.25	3.9475	-16.75	2.5075	104.49%	36.48%
250.25	12.485	15.25	2.595	93.91%	79.22%
236.75	6.8075	-5.25	5.3875	102.22%	20.86%
107.3333	3.0375	107.333333	-1.3525	0.00%	144.53%
48.33333	5.345	48.3333333	-1.185	0.00%	122.17%
275.6667	6.0175		annual	98.89%	92.10%
			August-Dec	60.12%	80.65%

CFHS

AVG USAGE KGAL	AVG RAINFALL	2020 KGAL Usage variance from average	2020 rainfall variance from average	2020 usage %	rainfall %
224	5.436667	52	-0.64333	76.79%	111.83%
138.25	3.91	95.25	2.28	31.10%	41.69%
313.75	0.91	-141.25	0.54	145.02%	40.66%
655.5	2.536667	123.5	-0.78333	81.16%	130.88%
669.5	8.046667	476.5	-3.56333	28.83%	144.28%
706	6.2425	264	4.4025	62.61%	29.48%
1000.5	4.2575	-717.5	-4.3925	171.71%	203.17%
780.5	3.9475	232.5	2.5075	70.21%	36.48%
745.25	12.485	-249.75	2.595	133.51%	79.22%
564.5	6.8075	23.5	5.3875	95.84%	20.86%
623.75	3.0375	-18.25	-1.3525	102.93%	144.53%
555.3333	5.345	555.333333	-1.185	0.00%	122.17%
710.8333	6.0175		annual	83.31%	92.10%
			August-Dec	80.50%	80.65%

It is very interesting to note that while rainfall has been below average during this approximate 4-year term, our overall irrigation usage is down 1% and 16% at the two different sites. Additionally, rainfall is 19.35% below average August thru December of 2020 and irrigation usage is down 39.88% and 19.5% at the same two campuses. This is the timeframe in which we have become capable of controlling and programming irrigation controllers remotely. It is worth noting that I lowered the August monthly average rainfall by changing the 47.69" to 7.69" as the Hurricane Harvey rainfall totals would falsely inflate the monthly average rainfall and show even higher reductions.

Intermediate field controllers have also been installed and are functioning as designed. We have zero data on them as we just turned the water supply back on in mid-March. They have been off since October 15, 2020 and current water bills have not been input at this time.

Station run time reports have showed runtimes varying from 15-27 hours depending on design, location and field type. We have been actively replacing and repairing sprinkler heads and verifying nozzle selections at each location to be the most effective. Manual run times show to be consistently about 90 minutes. This is from testing systems and fertilizer applications performed by CCISD staff.

Historically, systems would be programmed to irrigate 3.5 times per week about 20-25 minutes each cycle totaling 31.5 hours of run time. This measures to an approximate 20 percent reduction in run time which is similar to the usage reduction we are seeing in the same time frame.

Future projects will incorporate the use of flow meters at each site. This will allow for real time monitoring of systems and system efficiency, as well as data logging for usage.

I believe when a full year is completed with normal rainfall and activity, we will level out at a 15%-20% reduction in usage. Additional savings would come thru the use of ET based scheduling which could be an additional 10-15% although if we remain very active in our scheduling, that savings will likely be less.

The chart below shows the financial savings annually and since installation. Please note this chart includes a year with 8% below average rainfall and a August-December 20% below average rainfall.

2020 CFHS	AVG kGal	AVG COST		Actual Cost 2020
Jan	224	1568	76.79%	1204
Feb	138.25	967.75	31.10%	301
Mar	313.75	2196.25	145.02%	3185
Apr	655.5	4588.5	81.16%	3724
May	669.5	4686.5	28.83%	1351
June	706	4942	62.61%	3094
July	1000.5	7003.5	171.71%	12026
Aug	780.5	5463.5	70.21%	3836
Sep	745.25	5216.75	133.51%	6965
Oct	564.5	3951.5	95.84%	3787
Nov	623.75	4366.25	102.93%	4494
Dec	505	3535	70.10%	2478

		Annual Cost	Annual Savings $	Annual Savings %
$48,485.50		$46,445.00	$2,040.50	4.21%

AUG-DEC Cost		AUG-DEC Cost	AUG-DEC savings	AUG-DEC savings
$22,533.00		$21,560.00	$973.00	4.32%