



**City of St. Helena
Parks and Recreation Commission
Special Meeting
1360 Oak Avenue, St. Helena, CA 94574
Wednesday, October 23, 2019 @ 4:30 PM**

PLEASE NOTE: Any person who wishes to speak regarding an item on the agenda or make a comment under the "Oral Communication" portion of the agenda may do so, but please observe the time limit of four minutes.

Page

1. CALL TO ORDER

2. ROLL CALL

Commission Chair: Matt Demchuk

Vice Chair: Rebekah Weeman

Members: Bob Frescura, Susan Kenward, and Tye Taylor

City Council Member Liaison: David Knudsen

Staff Liaison: André Pichly, Parks & Recreation Director

3. PUBLIC FORUM:

An opportunity for the public to directly address the Commission on items of interest to the public that are not listed on the agenda. Any person addressing the Commission should provide his or her name and address, and limit comments to four minutes. Because of restrictions imposed by **the Brown Act, the Commission may not engage in substantive discussion, nor take action on matters not described on the agenda.**

4. REPORTS BY STAFF AND COMMISSION

Reports by staff and/or commission on items of general interest. Brief questions for clarification may be posed and answered, and Commission may request that items be placed on a future agenda. Except under certain circumstances, **the Brown Act prohibits any other discussion or action by the Parks and Recreation Commission.**

5. CONSENT CALENDAR:

Members of the Parks and Recreation Commission or the public may ask that any items be considered individually for purposes of considering alternative action, for extended discussion, or for public comment. Unless that is done, on motion may be used to adopt all recommendation actions.

5.1. Parks and Recreation Commission Meeting Minutes of August 19, 2019.

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[8-19-2019 Parks and Recreation Commission Meeting Minutes - signed](#)

6. SCHEDULED MATTERS:

6.1. REVISED 10/5/19: Results of GHD lighting study for Crane Park tennis courts - discussion item/report by consultant/action item seeking endorsement (Ahmann Smithies/Pichly)

5 - 34

Prepared By: Erica Ahmann Smithies, Public Works Director and City

Engineer

[Crane Park Lighting Study Report Draft - 2019-10-08](#)

[Crane Park Report Appendices](#)

- 6.2. Skate Park improvements update - information only/no staff report/not an action item (Ahmann Smithies/Pichly)

Prepared By: Erica Ahmann Smithies, Public Works Director and City Engineer

7. ADJOURNMENT

The next special meeting of the Parks and Recreation Commission meeting is scheduled for November 20, 2019 at 4:30 pm, Carnegie Building, 1360 Oak Avenue.

This agenda was posted at City Hall, 1480 Main Street and 1360 Oak Avenue on November 15, 2019.

André Pichly, Parks & Recreation Director

In compliance with the Americans with Disabilities Act, if you need special assistance to participate in the meeting, please contact City Hall at (707) 967-2792. Notification 48 hours prior to the meeting will enable the City to make reasonable arrangements to ensure accessibility to this meeting (28 CFR35.102-35.104 ADA Title II). However, City staff will attempt to assist at any time with accessibility.

Agenda Item #5.1.

**City of St. Helena
Parks and Recreation Commission
Special Meeting
August 19, 2019**

Meeting Minutes – Action Items Only

1. Call to Order 4:33 pm

2. Roll Call

The following were present:

- Commission Chair: Matt Demchuk
- Members: Bob Fresura, Susan Kenward (Tye Taylor present, but not official yet)
- Staff: Amalia Kulczycki, André Pichly, Carlos Uribe, Clayton Church
- City Council Member Liaison: David Knudsen

Absent:

- Vice-Chair: Rebekah Weeman

3. Public Forum – none.

5. Consent Calendar

- Meeting minutes from July 15, 2019, approved (moved by Kenward/Frescura 2nd).

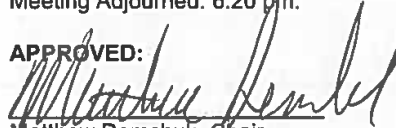
6. Scheduled Matters:

- No actions items under Scheduled Matters at the July 15th meeting.

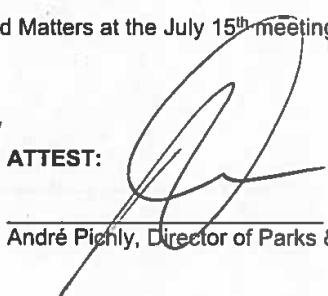
7. Adjournment

Meeting Adjourned: 6:20 pm.

APPROVED:


Matthew Demchuk, Chair

ATTEST:


André Pichly, Director of Parks & Recreation



Draft Lighting Study - Report

Crane Park
360 Crane Ave,
St. Helena, CA 94574

GHD | 2235 Mercury Way Suite 150 Santa Rosa CA 95407 USA
11199219 | Draft Report | October 8, 2019



This Lighting systems study (Report) for 360 Crane Ave, St Helena, California, 94574 (Facility) has been prepared by GHD Inc. (GHD) for the City of St Helena (hereafter referred to as "the City"). This Report may only be used and relied on by the City and must not be copied to, used by, or relied on by any person other than the City without the prior written consent of GHD. It may only be used for the purpose of submittal to the City for review and comment during the project and must not be used for any other purpose.

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than the City arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded, unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in this Report and did not include engineering disciplines and scopes of work not included within the document.

The opinions, conclusions, and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report (Assumptions), including but not limited to:

- Anecdotal historical information provided by the City
- Record and new lighting design documents provided by Musco
- Observation of existing site conditions during the nighttime walkthrough on July 11th, 2019.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from, or in connection with, any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions, and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation and may be relied on until modifications at the Facility after which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from, or in connection with, those opinions, conclusions, and any recommendations.

GHD has prepared the preliminary recommendations set out in this Report:

- Using information reasonably available to the GHD employee(s) who prepared this Report
- Based on assumptions and judgments made by GHD



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1. General

1.1 Definitions

1.1.1 Luminaire –

A lighting fixture, including housing, lamp(s), and ballast/driver.

1.1.2 Sports Field Lighting –

Sports field type or style lighting in this report refers to the 40-foot pole group mounted lighting with flood type fixtures that currently illuminate the tennis court and surrounding areas. This can be considered equal to calling out “Musco lighting”, “stadium-type” or similar terms.

1.1.3 Area Lighting –

Area lighting in this report refers to fixtures mounted on lower poles than the sports field lighting, including the lighting in the Bocce areas, the skate park, and in the optional court lighting scenario described below. Common alternate terms include “shoebox” light.

1.1.4 Metal Halide (MH) Lighting –

A type of high intensity discharge (HID) lamp, in this project referring to the 1000-watt tennis court luminaires.

1.1.5 Light Emitting Diode (LED) Lighting –

A newer alternate to MH / HID lighting based on LED technologies and characterized by enhanced light control, uniformity, and lower energy usage.

1.1.6 Foot-candle (FC)–

A unit of illuminance or illumination, equivalent to the illumination produced by a source of one candle at a distance of one foot.

1.2 Purpose

The purpose of this lighting study and report is to observe, record, and provide analysis and recommendations for the reduction in lighting glare and light trespass (onto adjacent properties) resulting from the use of the existing sports field type lighting at the existing tennis courts at Crane Park. There have been complaints issued to the City by local homeowners indicating the existing lighting system causes significant glare into and around homes on along South Crane Ave opposite the park.



1.3 Scope

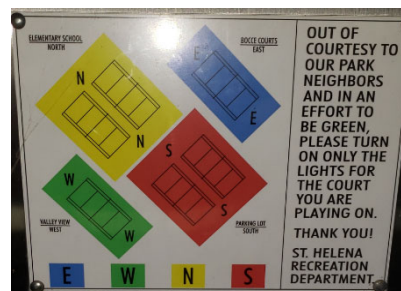
This scope of this project includes the nighttime observation and report on the existing lighting levels, review of the existing lighting system design, review of the existing controls, and preparation of a proposed LED retrofit design intended to reduce the apparent glare and light trespass of the existing system. Further, this report is intended to provide recommendations, estimates of probable cost, and descriptions of potential alternate mitigation strategies.

2. Existing Lighting System

2.1 Tennis Court Lighting

2.1.1 General Site Layout

- The general layout of the site studied consists of the six total tennis courts enclosed within gated fences. There are three completely separate enclosed spaces. There is a central fenced space that houses four tennis courts, two sets of two courts laid out next to each other, and a dividing gate and fence between the two sets of courts. In addition, there are two singular isolated tennis courts, one on each side of the central space.
- There are 12 light poles used to light the entirety of the tennis courts. Each pole has a different number of lighting fixture heads aimed toward the courts they serve.
 - All light poles are mounted on a concrete base to achieve a total mounting height of roughly 40' above finished grade (measured 39' to the bottom of the lowest fixtures).
 - All lighting fixtures use a floodlight style sports light housing, and 1000 watt metal halide lamp based on the original Musco design.
 - All fixtures have light shielding (hoods) intended to reduce the offsite glare and light trespass.
- The lighting service panel and controls cabinet is located on the south side, outside the central fenced tennis courts.
- The lighting fixtures are separated and controlled so that there are four different lighting “zones” for the tennis courts. Each zone can be turned on/off independently and the zones are divided as follows:
 - Zone W – the single court on the west side of the group.
 - Zone N – the pair of courts to the north.
 - Zone E – the single court to the east.
 - Zone S – the final pair of courts to the south.
- The surrounding areas of the tennis courts involve the rest of the park to the North & East (Bocce Ball lanes, Skate Park), fields off to the South East, and the residences to the West, along S. Crane Avenue.
 - Along S. Crane Avenue, two streetlights span the length of the road along the area of study. They are located on the park side of the street and face towards the street for roadway lighting at night.





2.1.2 Site Observation

2.1.2.1 Methodology

GHD visited the site on July 11th 2019 to observe the existing conditions during dusk and after astronomical twilight, the point considered “full dark”. On the 11th, astronomical twilight was at 10:26PM. GHD reviewed pole locations, fixture placement and counts, and controls during the evening hours, and once twilight had passed, we began to take lighting measurements and representative photographs.

It should be noted that digital photography of nighttime scenes is not necessarily consistent with the observed conditions. Camera quality, settings, and lens properties affect the resulting images. As such, while photographs were taken and a few are shown below, photography was not our primary descriptive tool for this effort. In addition, individuals have substantially different capabilities with respect to nighttime vision.

Based on the lack of objective consistency with digital photography and personal visual assessments, GHD is presenting measured foot-candle levels taken with a digital meter at several locations and presented in the sketch below. The measurements represent the measurable light trespass noted in the areas around the Park, but do not reflect the glare. Glare is caused by the direct viewing of a light source. In sports field lighting, due to the height and aiming angles it is not possible to eliminate glare. The existing system incorporates glare shields on the flood style lights to reduce the glare.

GHD took initial lighting measurements – horizontal light levels measured at ground level – at several locations along South Crane Ave. We took measurements on the park side of the street, the centerline of the street, and sidewalk on the neighbor’s side of the street. We took measurements before turning on the tennis court lights to establish the levels based on the local street lighting and the neighbor’s own decorative and exterior lighting. We then turned the court lights on and re-measured the levels at the same locations, and on the courts themselves.

2.1.2.2 Findings

The measured light levels are noted in the table below, and on the drawing in the appendix.

Table 1 Existing Lighting Levels

Zone	Unit	AVG	MAX	MIN	AVG/MIN	MAX/MIN
Street Average, Courts Off	FC	0.16	0.74	0.01	15.5	74.0
Street Average, Courts On	FC	0.29	0.75	0.04	7.3	18.8
Street, Neighbor Side Only, Courts Off	FC	0.1	0.29	0.01	10.0	29.0
Street, Neighbor Side Only, Courts On	FC	.23	0.41	0.08	2.9	5.1
Park Sidewalk, along Courts, Courts on	FC	0.77	1.38	0.13	5.9	10.6



Zone	Unit	AVG	MAX	MIN	AVG/MIN	MAX/MIN
North Court	FC	27.2	37.9	8.4	3.2	4.5
West Court	FC	27.7	48.9	2.1	13.2	23.3
East Court	FC	13.3	24	1.5	8.9	16.0
South Court	FC	26.5	36.1	2.2	12.0	16.4

To provide some perspective for these values: In most locations, the measured light was effectively double when the court lighting was active. These levels are also lower (between 15 and 20%) than the expected maintained foot-candles of the original design, and significantly lower (40-45%) than the initial output of new lamps. This is due to the natural reduction in output from the existing lamp age. This is an important factor in considering the impact of the lighting – when these fixtures are re-lamped for normal operations, the light level and corresponding trespass and glare will increase significantly.

Below are photos that were taken from the same location and in the same direction without the court lighting and with:



Note that the ability to see the difference is also reduced by the quality of the printer, but even given the various constraints, the lighting is clearly different. Subjectively, it is clear that the courts have a significant impact on the surrounding areas. It is also worth noting that the impact is in-line with the expected values calculated in the original design, included below. Levels of over a quarter foot-candle were expected at the property lines and well beyond.

2.1.3 Electrical Power and Control System

The existing controls and power equipment were installed in 1993. They appear to be in good physical condition, operable, and do not show signs of corrosion or imminent failure.



3. System Upgrade Options

3.1 Simple Mitigation Options (retain existing lighting)

3.1.1 Re-aim existing fixtures

With an appropriate lift, lower the aiming angle of the existing fixtures facing the street to reduce the glare and light trespass.

Estimated Cost: \$5000

Payback: N/A

Pros: This is a simple and low cost method to obtain a slight reduction in glare and trespass.

Cons: The slight reduction may not resolve complaints, and it will reduce the quality of the lighting on the courts. This may create complaints from the active tennis community.

3.1.2 Disallow usage of courts nearest street at an earlier hour

Provide a new 4-relay timeclock and individually program the lighting at the four courts to disallow the use of the court(s) nearest the street at an earlier hour. A possible scenario would be allow the lighting on at 6PM, cut off the West court at 8PM, the North and South Courts at 9PM, and finally the East court at 10PM.

Estimated Cost: \$2500

Payback: Approx. 1 Year

Pros: The pattern above would reduce energy costs by 25%, and reduce the trespass and glare by reducing the number of active fixtures as the night progresses.

Cons: Players would have to switch courts as lighting was shut off, and on busy nights people may be left without enough courts before 10PM. This could be partially mitigated by keeping the North courts available longer.

3.2 Major Mitigation Options (replace existing lighting)

3.2.1 Replace existing HID luminaires with LED, reusing the existing poles.

Purchase and install new MUSCO LED luminaires on the existing poles, along with new pole-mount control hardware. Reconnect to existing power circuits.

Estimated Cost: \$285,214

Payback: Approx. 25 years

Pros: this would install fixtures with the best available glare and trespass control of currently available sports lighting technology. Trespass at the neighbor's side of the street would be essentially zero foot-candles measured on the ground, and glare would be substantially reduced as well. Improved aiming would have a smaller number of fixtures pointed towards neighbors and the



maximum calculated glare is expected to be approximately 449 candela, or roughly the output power of a large flashlight. This solution will still have glare, but it will be significantly reduced.

Cons: High Cost, and there will still be some glare.

3.2.2 Replace existing HID luminaires with Area Style LED luminaires.

Completely remove the 12 existing 40' poles and associated sports lighting and install 32 lower poles (likely 25') with 40 shoebox style area lights. These would be installed four to each side of each court (with the four between the double courts each having two luminaires), and approximately ten feet off the side of the court. This solution is reflected in a document sent by a resident to the City when the initial glare complaint was made.

Estimated Cost: \$440,717

Payback: Approx. 27 years

Pros: This solution uses even less power than the LED sports lighting option above, and almost completely eliminates glare and trespass off the court areas. There may be some angles where a resident can directly see a small number of fixtures, but the overall affect will be much less noticeable.

Cons: This is the highest cost, though the payback is only slightly extended due to lower energy costs. This would also require significant disturbance of the courts themselves, as there would have to be 32 new pole bases set into the areas courtside within several feet of each court. This would also place poles in the possible paths of running players, potentially allowing collisions.

3.2.3 Hybrid Option – Replace HID per 3.2.1, Add scheduling per 3.1.2.

Provide the sports lighting LED retrofit described in 3.2.1 and the controls/programming in 3.1.2.

Estimated Cost: \$287,714

Payback: Approx. 23 years

Pros: This reduces the payback of the LED sports lighting option by 2 years.

Cons: The same issues noted in 3.1.2 above.



4. Recommendations

4.1 Recommended Option

GHD recommends selecting option 3.2.1. The LED retrofit, while not having a favorable payback period, will reduce energy costs and will improve the neighbor's environment. Depending on input from the tennis community, it may be worthwhile to investigate option 3.1.2 as a very low cost and easy to implement change to improve the environment quickly while potential larger projects are considered.

CONSTRUCTION COST ESTIMATE - SPORTS LIGHTING OPTION										
Client: City of St. Helena						100% CD Design Review			17-Sep-19	
Work: Crane Park tennis court lighting replacement - LED Sports light replacement option										
Project No: 11199219										
Line No.	Item (1)	Unit	Qty	Material Cost		Labor Cost			Equipment Cost	Line Total
				Unit	Total	Unit	Rate	Total		
1	Musco materials - Fixtures, controls, shipping	LS	1	\$123,391	\$123,391					\$123,391
2	Musco Material Offload (2 Laborer, 1 day)*	Wk	0.4		\$0	1.00	\$1,225	\$490		\$490
3	Crane Rental (12.5 ton, 18 Days, 2 demo, 16 install)*	LS	1		\$0			\$0	\$25,751	\$25,751
4	Lift Rental (21 Days, 18 fixt install, 3 controls)*	LS	1		\$0			\$0	\$4,129	\$4,129
5										
6	Existing fixture Removal*	EA	32		\$0	0.33	\$57	\$603		\$603
7	Existing Fixture Disposal*	EA	32		\$0	0.18	\$57	\$322		\$322
8										
9	New Fixture Install (New crossbars, fixt install)*	EA	32	\$198	\$6,343	3.75	\$57	\$6,787		\$13,130
10	New Controls Install	Hr	24		\$0	1.00	\$57	\$1,357		\$1,357
11					\$0			\$0		
12	#8 AWG 600V XHHW*	CLF	24	\$28	\$673	1.25	\$57	\$1,697		\$2,370
13	#14 XHHW Control Cable*	CLF	24	\$11	\$256	0.87	\$57	\$1,181		\$1,437
14										
15	Misc Hardware	LS	1	\$1,500	\$1,500	1.00	\$500	\$500		\$2,000
16										
17	Commissioning/Testing	LS	1		\$0	1.00	\$2,500	\$2,500		\$2,500
18										
19										
					=====			=====	=====	=====
					\$132,163			\$15,436	\$29,881	\$177,480
	General Conditions @	5.0%								\$8,874
	Bonds and Insurance @	2.0%								\$3,550
	General Contractor Mark-up @	10.0%								\$17,748
	Sales Tax on Materials @	9.0%								\$11,895
	Contractor's Overhead & Profits @	12.0%								\$21,298
	Contingency @	25.0%								\$44,370
										=====
	Total Estimated Construction Cost									\$285,214
	*Costs derived from 2019 RS MEANS construction cost database.									

CONSTRUCTION COST ESTIMATE - AREA LIGHTING OPTION										
Client: City of St. Helena							100% CD Design Review		17-Sep-19	
Work: Crane Park tennis court lighting replacement - Full Cutoff Fixt Option										
Project No: 11199219										
Line No.	Item (1)	Unit	Qty	Material Cost		Labor Cost			Equipment Cost	Line Total
				Unit	Total	Unit	Rate	Total		
1	(N) Full cutoff LED on 25' pole - Shoebox style	EA	40	\$2,700	\$108,000	20.00	\$57	\$45,244		\$153,244
2	(N) Timeclock - Min 4 relay	EA	1	\$1,500	\$1,500	16.00	\$57	\$905		\$2,405
3	Cut and Patch Existing Court	EA	40	\$1,000	\$40,000	16.00	\$57	\$36,195		\$76,195
4	Second LED Fixture Head	EA	8	\$800	\$6,400	2.00	\$57	\$905		\$7,305
5	Crane Rental (12.5 ton, 2 days demo)*	LS	1		\$0				\$6,420	\$6,420
6	Existing fixture Removal*	EA	32		\$0	0.33	\$57	\$603		\$603
7	Existing Fixture Disposal*	EA	32		\$0	0.18	\$57	\$322		\$322
8	Existing Pole removal	EA	12		\$0	8.00	\$57	\$5,429		\$5,429
9	Court Patch	EA	12	\$1,000	\$12,000	8.00	\$57	\$5,429		\$17,429
10										
11					\$0			\$0		
12	#8 AWG 600V XHHW*	CLF	40	\$28	\$1,122	1.25	\$57	\$2,828		\$3,950
13										
14										
15	Misc Hardware	LS	1	\$1,500	\$1,500	1.00	\$500	\$500		\$2,000
16										
17	Commissioning/Testing	LS	1		\$0	16.00	\$57	\$912		\$912
18										
19										
					=====			=====	=====	=====
					\$170,522			\$99,272	\$6,420	\$276,214
	General Conditions @	5.0%								\$13,811
	Bonds and Insurance @	2.0%								\$5,524
	General Contractor Mark-up @	10.0%								\$27,621
	Sales Tax on Materials @	9.0%								\$15,347
	Contractor's Overhead & Profits @	12.0%								\$33,146
	Contingency @	25.0%								\$69,054
										=====
	Total Estimated Construction Cost									\$440,717
	*Costs derived from 2019 RS MEANS construction cost database.									

Crane Park Tennis Court LED Lighting Replacement Payback Time Calculation - Replace with Sports Lighting									
Calculated Payback Time (Years)				25					
25-Yr Cost Savings				\$13,457.84					
New Fixture Installation Cost									
Description	Fixture Cost	Install Cost	Quantity	Total Cost					
LED Sportslighters				\$285,214.00		See Cost Est			
			TOTAL	\$285,214.00					
Energy Cost									
Existing Fixture Type	Fixture Wattage	Quantity	Hrs/Day	Days/Week	Hrs/Yr	kWH/Yr Consumed	Base Energy Rate (\$/kWH)	Part Cost (\$/Yr)	Total Cost (\$/Yr)
MH Sportslighters	1080	32	4	7	1460.0	50457.6	0.21		\$10,596.10
								TOTAL	\$10,596.10
New Fixture Type									
LED Sportslighters	490	32	4	7	1460.0	22892.8	0.21		\$4,807.49
								TOTAL	\$4,807.49
						Initial Energy Cost Savings/Yr			\$5,788.61

[illegible]

Install New LED Fixtures - Cost Over Time								
Year	Install	Relamp	Energy	Year Total	Overall Total			Cost Savings
1	\$285,214.00		\$4,807.49	\$290,021.49	\$290,021.49			-\$279,425.39
2	\$0.00		\$4,999.79	\$4,999.79	\$295,021.28			-\$273,405.24
3	\$0.00		\$5,199.78	\$5,199.78	\$300,221.05			-\$267,144.28
4	\$0.00		\$5,407.77	\$5,407.77	\$305,628.82			-\$260,632.88
5	\$0.00		\$5,624.08	\$5,624.08	\$311,252.91			-\$253,861.03
6	\$0.00		\$5,849.04	\$5,849.04	\$317,101.95			-\$239,618.31
7	\$0.00		\$6,083.01	\$6,083.01	\$323,184.96			-\$232,293.87
8	\$0.00		\$6,326.33	\$6,326.33	\$329,511.28			-\$224,676.46
9	\$0.00		\$6,579.38	\$6,579.38	\$336,090.66			-\$216,754.35
10	\$0.00		\$6,842.55	\$6,842.55	\$342,933.22			-\$208,515.35
11	\$0.00		\$7,116.26	\$7,116.26	\$350,049.47			-\$199,946.80
12	\$0.00		\$7,400.91	\$7,400.91	\$357,450.38			-\$169,435.50
13	\$0.00		\$7,696.94	\$7,696.94	\$365,147.32			-\$160,167.75
14	\$0.00		\$8,004.82	\$8,004.82	\$373,152.14			-\$150,529.30
15	\$0.00		\$8,325.01	\$8,325.01	\$381,477.16			-\$140,505.30
16	\$0.00		\$8,658.01	\$8,658.01	\$390,135.17			-\$130,080.34
17	\$0.00		\$9,004.33	\$9,004.33	\$399,139.51			-\$119,238.39
18	\$0.00		\$9,364.51	\$9,364.51	\$408,504.01			-\$100,762.76
19	\$0.00		\$9,739.09	\$9,739.09	\$418,243.10			-\$89,036.10
20	\$0.00		\$10,128.65	\$10,128.65	\$428,371.76			-\$76,840.38
21	\$0.00		\$10,533.80	\$10,533.80	\$438,905.55			-\$64,156.82
22	\$0.00		\$10,955.15	\$10,955.15	\$449,860.70			-\$50,965.93
23	\$0.00		\$11,393.36	\$11,393.36	\$461,254.06			-\$37,247.40
24	\$0.00		\$11,849.09	\$11,849.09	\$473,103.15			-\$1,380.13
25	\$0.00		\$12,323.05	\$12,323.05	\$485,426.20			\$13,457.84
25Yr Simple Cost	\$285,214.00	\$0.00	\$200,212.20	\$485,426.20				

Assumptions									
1. Fixtures operate 4hrs/day, 6 days/week									
2. Existing fixtures do not dim									
3. Relamping Costs:									
	a. HID - Means 2019, 1000W MH				HID Ballast Replacement				
		\$7,200.00			\$14,400	(every 12 Yr)			
	Lamp	9000 Hrs	(6 yrs)						
	b. LED -								
		\$0.00	(Assumed to never relamp in site lifetime)						
	Lamp	110000 Hrs	(75 yrs)						
4. Energy cost increase:									
		4%	per year						
5. Energy assumed to be \$0.21 per kWh, Based on local norm									

Crane Park Tennis Court LED Lighting Replacement Payback Time Calculation - Replace with Sports Lighting and Time of Use									
Calculated Payback Time (Years)				23					
25-Yr Cost Savings				\$61,010.89					
New Fixture Installation Cost									
Description	Fixture Cost	Install Cost	Quantity	Total Cost					
LED Sportslighters				\$285,214.00	See Cost Est				
(N) Timeclock				\$2,500.00					
			TOTAL	\$287,714.00					
Energy Cost									
Existing Fixture Type	Fixture Wattage	Quantity	Hrs/Day	Days/Week	Hrs/Yr	kWH/Yr Consumed	Base Energy Rate (\$/kWH)	Part Cost (\$/Yr)	Total Cost (\$/Yr)
MH Sportslighters	1080	32	4	7	1460.0	50457.6	0.21		\$10,596.10
								TOTAL	\$10,596.10
New Fixture Type									
LED Sportslighters	490	32	3	7	1095.0	17169.6	0.21		\$3,605.62
								TOTAL	\$3,605.62
Initial Energy Cost Savings/Yr									\$6,990.48

[illegible]

Install New LED Fixtures - Cost Over Time								
Year	Install	Relamp	Energy	Year Total	Overall Total			Cost Savings
1	\$287,714.00		\$3,605.62	\$291,319.62	\$291,319.62			-\$280,723.52
2	\$0.00		\$3,749.84	\$3,749.84	\$295,069.46			-\$273,453.42
3	\$0.00		\$3,899.83	\$3,899.83	\$298,969.29			-\$265,892.52
4	\$0.00		\$4,055.83	\$4,055.83	\$303,025.12			-\$258,029.18
5	\$0.00		\$4,218.06	\$4,218.06	\$307,243.18			-\$249,851.31
6	\$0.00		\$4,386.78	\$4,386.78	\$311,629.96			-\$234,146.32
7	\$0.00		\$4,562.25	\$4,562.25	\$316,192.22			-\$225,301.13
8	\$0.00		\$4,744.74	\$4,744.74	\$320,936.96			-\$216,102.14
9	\$0.00		\$4,934.53	\$4,934.53	\$325,871.50			-\$206,535.18
10	\$0.00		\$5,131.92	\$5,131.92	\$331,003.41			-\$196,585.55
11	\$0.00		\$5,337.19	\$5,337.19	\$336,340.60			-\$186,237.93
12	\$0.00		\$5,550.68	\$5,550.68	\$341,891.28			-\$153,876.41
13	\$0.00		\$5,772.71	\$5,772.71	\$347,663.99			-\$142,684.42
14	\$0.00		\$6,003.62	\$6,003.62	\$353,667.61			-\$131,044.76
15	\$0.00		\$6,243.76	\$6,243.76	\$359,911.37			-\$118,939.51
16	\$0.00		\$6,493.51	\$6,493.51	\$366,404.88			-\$106,350.05
17	\$0.00		\$6,753.25	\$6,753.25	\$373,158.13			-\$93,257.01
18	\$0.00		\$7,023.38	\$7,023.38	\$380,181.51			-\$72,440.25
19	\$0.00		\$7,304.32	\$7,304.32	\$387,485.83			-\$58,278.82
20	\$0.00		\$7,596.49	\$7,596.49	\$395,082.32			-\$43,550.94
21	\$0.00		\$7,900.35	\$7,900.35	\$402,982.67			-\$28,233.93
22	\$0.00		\$8,216.36	\$8,216.36	\$411,199.03			-\$12,304.25
23	\$0.00		\$8,545.02	\$8,545.02	\$419,744.04			\$4,262.62
24	\$0.00		\$8,886.82	\$8,886.82	\$428,630.86			\$43,092.16
25	\$0.00		\$9,242.29	\$9,242.29	\$437,873.15			\$61,010.89
25Yr Simple Cost	\$287,714.00	\$0.00	\$150,159.15	\$437,873.15				

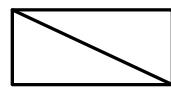
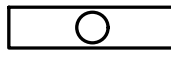
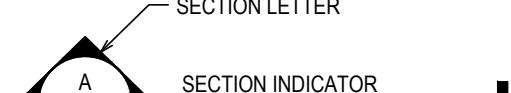
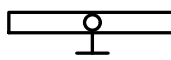
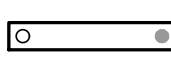
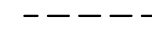
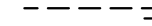
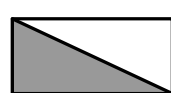
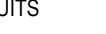
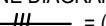
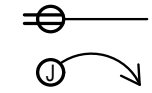
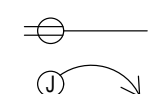
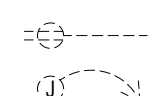
Assumptions									
1. Fixtures operate 4hrs/day, 6 days/week									
2. Existing fixtures do not dim									
3. Relamping Costs:									
	a. HID - Means 2019, 1000W MH				HID Ballast Replacement				
		\$7,200.00			\$14,400	(every 12 Yr)			
	Lamp	9000 Hrs	(6 yrs)						
	b. LED -								
		\$0.00	(Assumed to never relamp in site lifetime)						
	Lamp	110000 Hrs	(75 yrs)						
4. Energy cost increase:									
		4%	per year						
5. Energy assumed to be \$0.21 per kWh, Based on local norm									

Crane Park Tennis Court LED Lighting Replacement Payback Time Calculation - Replace with Shoebox Lighting									
Calculated Payback Time (Years)				27					
27-Yr Cost Savings				\$11,852.51					
New Fixture Installation Cost									
Description	Fixture Cost	Install Cost	Quantity	Total Cost					
LED Area style Replacement				\$440,717.00		See Cost Est			
			TOTAL	\$440,717.00					
Energy Cost									
Existing Fixture Type	Fixture Wattage	Quantity	Hrs/Day	Days/Week	Hrs/Yr	kWH/Yr Consumed	Base Energy Rate (\$/kWH)	Part Cost (\$/Yr)	Total Cost (\$/Yr)
MH Sportslighters	1080	32	4	7	1460.0	50457.6	0.21		\$10,596.10
								TOTAL	\$10,596.10
New Fixture Type									
LED area lights	150	48	4	7	1460.0	10512.0	0.21		\$2,207.52
								TOTAL	\$2,207.52
Initial Energy Cost Savings/Yr									\$8,388.58

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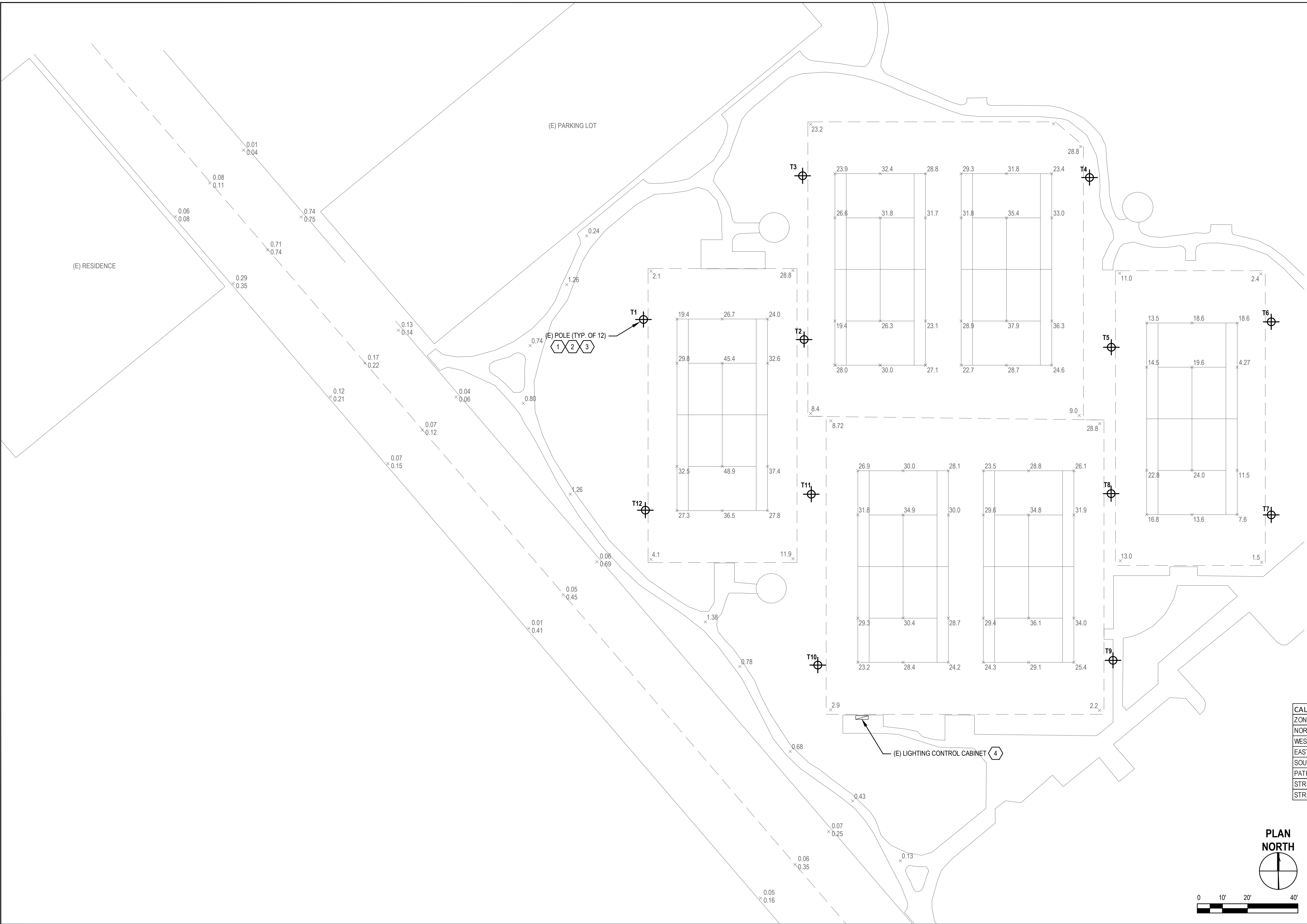
Install New LED Fixtures - Cost Over Time								
Year	Install	Relamp	Energy	Year Total	Overall Total			Cost Savings
1	\$440,717.00		\$2,207.52	\$442,924.52	\$442,924.52			-\$432,328.42
2	\$0.00		\$2,295.82	\$2,295.82	\$445,220.34			-\$423,604.30
3	\$0.00		\$2,387.65	\$2,387.65	\$447,607.99			-\$414,531.22
4	\$0.00		\$2,483.16	\$2,483.16	\$450,091.15			-\$405,095.21
5	\$0.00		\$2,582.49	\$2,582.49	\$452,673.64			-\$395,281.77
6	\$0.00		\$2,685.79	\$2,685.79	\$455,359.43			-\$377,875.78
7	\$0.00		\$2,793.22	\$2,793.22	\$458,152.64			-\$367,261.56
8	\$0.00		\$2,904.95	\$2,904.95	\$461,057.59			-\$356,222.76
9	\$0.00		\$3,021.14	\$3,021.14	\$464,078.73			-\$344,742.42
10	\$0.00		\$3,141.99	\$3,141.99	\$467,220.72			-\$332,802.86
11	\$0.00		\$3,267.67	\$3,267.67	\$470,488.39			-\$320,385.72
12	\$0.00		\$3,398.38	\$3,398.38	\$473,886.77			-\$285,871.89
13	\$0.00		\$3,534.31	\$3,534.31	\$477,421.08			-\$272,441.51
14	\$0.00		\$3,675.68	\$3,675.68	\$481,096.76			-\$258,473.91
15	\$0.00		\$3,822.71	\$3,822.71	\$484,919.47			-\$243,947.61
16	\$0.00		\$3,975.62	\$3,975.62	\$488,895.09			-\$228,840.26
17	\$0.00		\$4,134.64	\$4,134.64	\$493,029.73			-\$213,128.62
18	\$0.00		\$4,300.03	\$4,300.03	\$497,329.76			-\$189,588.50
19	\$0.00		\$4,472.03	\$4,472.03	\$501,801.79			-\$172,594.79
20	\$0.00		\$4,650.91	\$4,650.91	\$506,452.70			-\$154,921.32
21	\$0.00		\$4,836.95	\$4,836.95	\$511,289.65			-\$136,540.92
22	\$0.00		\$5,030.43	\$5,030.43	\$516,320.08			-\$117,425.30
23	\$0.00		\$5,231.64	\$5,231.64	\$521,551.72			-\$97,545.06
24	\$0.00		\$5,440.91	\$5,440.91	\$526,992.63			-\$55,269.61
25	\$0.00		\$5,658.55	\$5,658.55	\$532,651.18			-\$33,767.13
26	\$0.00		\$5,884.89	\$5,884.89	\$538,536.06			-\$11,404.56
27	\$0.00		\$6,120.28	\$6,120.28	\$544,656.34			\$11,852.51
28	\$0.00		\$6,365.09	\$6,365.09	\$551,021.44			\$36,039.87
28Yr Simple Cost	\$440,717.00	\$0.00	\$110,304.44	\$551,021.44				

Assumptions									
1. Fixtures operate 4hrs/day, 6 days/week									
2. Existing fixtures do not dim									
3. Relamping Costs:									
	a. HID - Means 2019, 1000W MH				HID Ballast Replacement				
		\$7,200.00			\$14,400	(every 12 Yr)			
	Lamp	9000 Hrs	(6 yrs)						
	b. LED -								
		\$0.00	(Assumed to never relamp in site lifetime)						
	Lamp	110000 Hrs	(75 yrs)						
4. Energy cost increase:									
		4%	per year						
5. Energy assumed to be \$0.21 per kWh, Based on local norm									

ABBREVIATIONS				ELECTRICAL SYMBOLS LEGEND				GENERAL ELECTRICAL NOTES			
(D) (E) (F) (N)	DEMOLISH EXISTING FUTURE NEW	IG JB	ISOLATED GROUND JUNCTION BOX	 LIGHTING FIXTURE, RECESSED	 DUPLEX RECEPTACLE, 20A 125V 2P 3W, GROUNDING TYPE, HEAVY DUTY MOUNTING HEIGHT: +18" AFF UON ↑ DENOTES HEIGHT IN INCHES AFF (INTERIOR) AFG (EXTERIOR)	 KEYNOTE	1. UNLESS SPECIFICALLY INDICATED OTHERWISE, ALL EQUIPMENT INDICATED SHALL BE CONSIDERED NEW AND PROVIDED BY THE CONTRACTOR COMPLETE, INSTALLED, TESTED AND FUNCTIONING. 2. CONSTRUCTION MATERIALS AND INSTALLATION SHALL MEET ALL RECOGNIZED CODES OF THE AUTHORITY HAVING JURISDICTION. 3. MAINTAIN AS BUILT CONDITIONS OF THE INSTALLATION DURING CONSTRUCTION AND SUBMIT THE FINAL CONSTRUCTED CONDITIONS TO THE OWNER/ARCHITECT FOR THEIR RECORDS. 4. DRAWINGS INDICATE THE REQUIRED EQUIPMENT, DEVICES, FIXTURES, ETC. AND THEIR RELATED CIRCUITING REQUIREMENTS. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATION OF THE DEVICE LOCATIONS WITH ALL DISCIPLINES. 5. COORDINATE SHUTDOWNS EXCEEDING 4 HOURS A MINIMUM OF 28 DAYS IN ADVANCE. SHUTDOWNS MAY NOT EXCEED 24 HOURS UNDER ANY CIRCUMSTANCES. COORDINATE ALL OTHER SHUTDOWNS WITH OWNER A MINIMUM OF 14 DAYS IN ADVANCE. 6. ALL LIGHTING FIXTURES ARE TO BE DLC OR ENERGY STAR LABELED. 7. REFER TO ATTACHED MUSCO DRAWINGS FOR FIXTURE TYPES, QUANTITIES, AND (N) CONTROL EQUIPMENT				
A AC AF AFF AFG AHU AIC ANN ATS AWG	AMPERES ALTERNATING CURRENT AMP FRAME ABOVE FINISHED FLOOR ABOVE FINISHED GRADE AIR HANDLING UNIT AMPS INTERRUPTING CAPACITY ANNUNCIATOR AUTOMATIC TRANSFER SWITCH AMERICAN WIRE GAUGE	KAIC KV KVA KW KWH LPS LV MCC MCP MFR MH MLO MV	KILO-AMPS INTERRUPTING CAPACITY KILOVOLT KILOVOLT-AMP KILOWATT KILOWATT-HOUR LOW PRESSURE SODIUM LOW VOLTAGE MOTOR CONTROL CENTER MOTOR CIRCUIT PROTECTOR MANUFACTURER METAL HALIDE MAIN LUGS ONLY MEDIUM VOLTAGE	 RECESSED DOWN LIGHT FIXTURE	 DUPLEX RECEPTACLE - EMERGENCY POWER	 LIGHTING FIXTURE TYPE DESIGNATION (SEE SCHEDULE)					
BAT BFG	BATTERY BELOW FINISH GRADE	MCB MCC MCP MFR MH MLO MV	MAIN CIRCUIT BREAKER MOTOR CONTROL CENTER MOTOR CIRCUIT PROTECTOR MANUFACTURER METAL HALIDE MAIN LUGS ONLY MEDIUM VOLTAGE	 RECESSED DIRECTIONAL FIXTURE (ARROW INDICATES AIMING)	 DUPLEX RECEPTACLE - CEILING MOUNTED	 DETAIL INDICATOR					
CATV C CB CCTV CO CPT CT CU	TELEVISION CONDUIT CIRCUIT BREAKER CLOSED CIRCUIT TELEVISION CONDUIT ONLY CONTROL POWER TRANSFORMER CURRENT TRANSFORMER COPPER	NIC NL NTS OC PA PT PVC PB	NOT IN CONTRACT NIGHT LIGHT NOT TO SCALE ON CENTER PUBLIC ADDRESS POTENTIAL TRANSFORMER POLYVINYL CHLORIDE PULL BOX, ELECTRICAL	 LIGHTING FIXTURE, SURFACE MOUNTED	 FLOOR RECEPTACLE, 20A 125V 2P 3W, GROUNDING TYPE, FLUSH TYPE UON	 SECTION INDICATOR					
DC	DIRECT CURRENT	NTS OC PA PT PVC PB	NOT TO SCALE ON CENTER PUBLIC ADDRESS POTENTIAL TRANSFORMER POLYVINYL CHLORIDE PULL BOX, ELECTRICAL	 LIGHTING FIXTURE, WALL MOUNTED	 DOUBLE DUPLEX RECEPTACLE, 20A 125V 2P 3W, GROUNDING TYPE, MOUNTING HEIGHT: +18" AFF UON	 SHEET NUMBER ON WHICH DETAIL APPEARS					
EF EGU EM RGS ENT EP	EXHAUST FAN ENGINE GENERATOR UNIT EMERGENCY ELECTRICAL METALLIC TUBING ELECTRICAL NON-METALLIC TUBING EXPLOSION PROOF	RECPT RGS RVSS RTU	RECEPTACLE, OUTLET RIGID GALVANIZED STEEL (CONDUIT) REDUCED VOLTAGE SOFT START REMOTE TERMINAL UNIT	 LIGHTING FIXTURE, PENDANT OR CABLE HUNG	 SINGLE RECEPTACLE, 20A 125V 2P 3W, GROUNDING TYPE, MOUNTING HEIGHT: +18" AFF UON	 MECHANICAL EQUIPMENT DESIGNATION (SEE SCHEDULE)					
FA FACP FC FU	FIRE ALARM FIRE ALARM CONTROL PANEL FOOT CANDLE FUSE	TV TVSS UF UG UON UPS	TELEVISION MONITOR (SET) TRANS. VOLT. SURGE SUPPRESSOR UNDER FLOOR UNDERGROUND UNLESS OTHERWISE NOTED UNINTERRUPTIBLE POWER SUPPLY	 LIGHT TRACK AND TRACK-MOUNTED FIXTURES	 SPECIAL PURPOSE RECEPTACLE AS DESIGNATED SEE 'SPECIAL SYMBOLS' ON EACH SHEET	SWITCHING					
GND GFCI GFI GFR	GROUND GROUND FAULT CIRCUIT INTERRUPTER GROUND FAULT INTERRUPTER GROUND FAULT RELAY	V VA VFD	VOLT VOLT-AMP VARIABLE FREQUENCY DRIVE	 BATH FAN WITH INTEGRAL LIGHT	 DUAL SERVICE RECESSED FLOOR BOX WITH DUPLEX AND DATA RECEPTACLES	 LIGHT SWITCH, SPST - MOUNTING HEIGHT: +44" AFF, UON					
HD HID HOA HP HPS HVAC	HEAVY DUTY HIGH INTENSITY DISCHARGE "HAND-OFF-AUTO" SWITCH HORSEPOWER HIGH PRESSURE SODIUM HEATING, VENTILATION & AIR-CONDITIONING	WP WPI	WEATHERPROOF WEATHERPROOF IN USE	 EXIT SIGN, SINGLE FACE WITH DIRECTIONAL ARROWS AS INDICATED	 JUNCTION BOX, CODE SIZED UON, SEE FLOORPLAN(S) FOR ADDITIONAL TYPES	 LIGHT SWITCH, DPST - MOUNTING HEIGHT: +44" AFF, UON					
CONDUIT				 EXIT SIGN, DOUBLE FACE WITH DIRECTIONAL ARROWS AS INDICATED	 DISCONNECT SWITCH - FUSED WHERE APPLICABLE	 LIGHT SWITCH, 3-WAY - MOUNTING HEIGHT: +44" AFF, UON					
 CONDUIT INSTALLED ABOVE GRADE				 EXIT SIGN, LOW LEVEL	 MOTOR STARTER, COMBINATION WITH DISCONNECT SWITCH	 LOW VOLTAGE SWITCH, MOMENTARY CONTACT, 3-POS., CENTER-OFF, MOUNTING HEIGHT: +44" AFF, UON					
 CONDUIT INSTALLED UNDERGROUND OR UNDER SLAB				 COMBINATION EXIT/EMERGENCY LIGHT FIXTURE MOUNTING HEIGHT: +8'-0" AFF, UON	 MOTOR STARTER OR CONTROLLER	 TIMER SWITCH - MOUNTING HEIGHT: +44" AFF, UON					
 CONDUIT STUB-OUT WITH CAP				 EMERGENCY FIXTURE MOUNTING HEIGHT: +8'-0" AFF, UON	 MOTOR CONNECTION	 CIRCUIT AND SWITCH DESIGNATION FOR LIGHTING FIXTURE					
 FLEXIBLE CONDUIT WHIP TO LIGHT FIXTURE OR EQUIPMENT				 DENOTES FIXTURE CONNECTED TO EMERGENCY CIRCUIT	 CEILING EXHAUST FAN	 CIRCUIT AND RELAY DESIGNATION FOR LIGHTING FIXTURES (SEE CORRESPONDING LIGHTING CONTROL PANEL RELAY SCHEDULE)					
 INDICATES CIRCUIT BREAKER I.D.				 ADJUSTABLE SPOT OR FLOOD (ARROW INDICATES AIMING)	 WATER HEATER						
 CONDUIT HOME RUN TO DESIGNATED PANEL, TERMINAL, OR CONTROL CABINET EXAMPLES:  L-1,4  L-1-6,8  L-1-10/12				 OUTDOOR SITE LIGHT, POLE MOUNTED LUMINAIRE ARROW INDICATES AIMING DIRECTION, IF APPLICABLE	 THERMOSTAT (SEE MECHANICAL DRAWINGS) COORDINATE MOUNTING HEIGHT						
 INDICATES BRANCH PANEL				 BOLLARD OR POST-TOP FIXTURE	 BYPASS TIMER OR TIME SWITCH						
 COMMA INDICATES MULTIPLE SINGLE POLE CIRCUITS				 DENOTES # OF TELEPHONE JACKS	 PUSHBUTTON						
 SLASH INDICATES MULTI-POLE CIRCUIT				 DENOTES # OF DATA JACKS	 LIGHTING CONTACTOR						
NOTE FOR CONDUIT: THE TIC MARKS INDICATE THE QUANTITY OF #12 AWG WIRES OR, IF INDICATED, THE QUANTITY OF OTHER SIZE WIRE OR CABLES.				 SURFACE RACEWAY WITH POWER AND TELEPHONE/DATA RECEPTACLES AS INDICATED	 EQUIPMENT						
SEE THE SINGLE LINE DIAGRAM FOR FEEDER SIZES. EXAMPLES:  = (3) #12  = (2) #10				 CATV OUTLET - MOUNTING HEIGHT: +96" AFF UON	 MAIN SWITCHBOARD						
 = (1) TYPE F1 CABLE. SEE CABLE SCHEDULE.				 AUDIO/VIDEO OUTLET - MOUNTING HEIGHT: +18" AFF UON	 DISTRIBUTION PANEL BOARD						
OBJECT LINES				 CLOCK WITH BUZZER - MOUNTING HEIGHT: SEE PLANS	 COMBINATION METER/MAIN SERVICE PANEL						
 NEW OBJECTS (HEAVY CONTINUOUS LINES, UNDERGROUND CONDUIT HEAVY DASHED LINES)				 BELL, STANDARD 6" - MOUNTING HEIGHT: SEE PLANS PA SYSTEM	 BRANCH CIRCUIT PANEL BOARD, SURFACE OR FLUSH MOUNTED						
 EXISTING OBJECTS TO REMAIN, MAY INCLUDE NEW CIRCUITING ETC. (FINE CONTINUOUS LINES, UNDERGROUND CONDUIT FINE DASHED LINES)				 SPEAKER - WALL MOUNTED	 LIGHTING CONTROL PANEL						
 EXISTING OBJECTS TO BE DEMOLISHED (EXTRA FINE DASHED LINES, SCREENED)				 PA SYSTEM SPEAKER - CEILING MOUNTED	 SIGNAL TERMINAL CABINET OR CONTROL PANEL SURFACE OR FLUSH MOUNTED						
				 PA SYSTEM HORN - MOUNTING HEIGHT: SEE PLANS	 SIGNAL TERMINAL BACKBOARD						
					 CONCRETE UNDERGROUND HAND HOLE (NUMBER DENOTES CHRISTY SIZE)						
					 TRANSFORMER						
					</						

SECTION 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL PART 1 - GENERAL 1.1WORK NOT INCLUDED A. Cooperate with the other trades who may or may not be party to this Contract for the purpose of coordinating the electrical requirements and installation of equipment, materials, and furnishings provided by those other trades, including the Owner. 1.2CODES AND STANDARDS A. Provide equipment and materials which conform to, and perform the installation thereof in accordance with the following codes and industry standards: 1. California Electrical Code (CEC), National Electrical Code (NEC), California Building Code (CBC), California Fire Code (CFC), Titles 8, 19 and 24 of the California Code of Regulations (CCR), American National Standards Institute (ANSI), California State Fire Marshal (CSFM), Underwriters Laboratories (UL), National Electrical Manufacturers' Association (NEMA), Institute of Electrical and Electronics Engineers (IEEE), National Electrical Safety Code (NESC), Electrical Safety Orders. 2. Other applicable local codes and ordinances. B. Where the authority-having-jurisdiction makes an interpretation or decision, as is its prerogative in accordance with the Code, such direction shall be considered a part of these Contract Documents as if contained herein. With respect to completing the intent of the Contract Documents, comply with any and all requirements of the authority-having-jurisdiction and utility company field inspectors, at no additional cost. C. The above referenced codes and standards are considered to be absolute minimum requirements. The Drawings and Specifications shall take precedence over the above referenced codes and standards where materials or workmanship of higher quality or larger size is indicated. Nothing in these Drawings or Specifications shall be construed to allow work not conforming to the applicable codes and standards. 1.3UTILITY FEES A. Pay utility company charges for normal or after hours shutdowns, service calls, repairs, and cable locating that are directly related to the installation of the Electrical Work. 1.4WORKING SPACE A. Maintain adequate work space around, and access to, electrical and mechanical equipment in strict accordance with the applicable Codes. Verify during the course of construction that sufficient space will be available for the installation and maintenance of equipment, fixtures, etc. 1.5MATERIALS AND SUBSTITUTIONS A. Specific trade names are used in the Drawings and Specifications in order to establish the standard grade and characteristics of said items. This does not imply the right upon the part of the Contractor to use other materials or methods without the approval of the Owner. B. Electrical materials and equipment shall bear the label of, or be listed by, the Underwriters' Laboratories (UL) whenever standards have been established and label service is regularly furnished by that agency. Comply with the installation and application requirements of UL as documented in their published directories. Common Work Results for Electrical - 26 05 00 Page - 1					C. Maintain uniformity throughout the Project by making use of only one make or brand of material for each material used. 1.6ELECTRICAL SUBMITTALS A. Shop Drawings for equipment and materials for each major component. Produce the submittals as complete volumes according to classification of equipment such as power, lighting, fire alarm, etc. B. Arrange panelboard submittals to show bussing, circuit numbering, and branch circuit protective devices similar the schedules as indicated. Show elevations of switchboards, motor control centers, and distribution centers indicating the layout of devices, meters, handles, etc. Provide device ratings, circuit numbers, and nameplate descriptions in table form. Include terminal strip mounting arrangements on elevations for terminal cabinets. 1.7DRAWINGS AND SPECIFICATIONS A. The data and information contained on the Drawings is as accurate as was reasonably possible at the time they were produced, but absolute accuracy is not guaranteed. Exact locations, distances, elevations, etc., will be dictated by the actual building and the conditions at the site. B. The layout of electrical equipment, wiring, and accessories is shown in a diagrammatic fashion (not pictorially) in order to achieve clarity and legibility. Although the size and location of electrical equipment is drawn to scale wherever possible, refer to all data in the Contract Documents and field verify this information as the project progresses. Examine architectural, structural, mechanical, and other drawings to determine the exact location of conduits, outlets, fixtures, and equipment and to note any conditions which may affect the electrical work. C. Because the Electrical Drawings may be distorted for clarity of representation, it may be necessary to field verify the exact location of electrical outlets, lights, switches, etc. In order to conform to the architectural elements. The Owner reserves the right to make minor changes to the locations of equipment, devices, and wiring shown, at no additional cost, providing the changes are ordered before the rough-in of conduit, boxes, or related items is completed, and no extra material are required. D. Conduit quantities, sizes, termination points, and wiring are indicated. However, not all conduit bends or routing details are indicated. Route conduit so as to conform to the structural conditions, avoid obstructing other trades, maintain space restrictions and keep circulation areas and access openings clear. 1.8WORKMANSHIP A. Constantly supervise the work personally or through an authorized and competent representative. Keep the same foreman or supervisor on the project from commencement through completion. 1.9MANUFACTURER'S DIRECTIONS A. Adhere to the manufacturer's directions regarding the proper installation and configuration of electrical equipment where those directions cover points not included in these Drawings and Specifications. 1.10DELIVERY, STORAGE, AND HANDLING A. Deliver electrical materials to the site new, and in unbroken packages. Protect electrical equipment and materials during transit, storage and handling to prevent damage, soiling and deterioration. B. During shipping storage and handling protect electrical materials from damage of any type including dust, water, over-spray, and temperature. Avoid damage during construction to the work and materials of other trades as well as the electrical work and material. Repair or replace, at the Contractor's expense, defective or damaged items such that the entire Work is completed in a condition satisfactory to the Owner. Common Work Results for Electrical - 26 05 00 Page - 2					1.11EXCAVATION, CUTTING, PATCHING, AND REPAIR A. Perform excavation and backfill required for the installation of electrical sub-structures. Restore grounds, walkways, roadways, curbs, walls, and other existing underground facilities to their original condition. B. Cut, core-drill, and demolish existing walls, floors, ceilings and other building surfaces as required for the installation of Electrical Work. Obtain the approval of the Owner prior to performing any operation which may affect any structural elements of the building. C. Patch and repair wood, plaster, tile, or concrete surfaces which have been damaged by the installation of the Electrical Work so that the finished surface matches the surrounding conditions. 1.12FLASHING, WATERPROOFING AND SEALING A. In general, install in an approved watertight manner. Electrical Work which pierces exterior walls or waterproofing membranes. Flash and counter-flash roof and wall penetrations in a manner described in other applicable sections of this Specification and as approved by the Owner. B. Fit conduits passing through finished walls with steel escutcheon plates of brass, chrome, or painted finish as directed by the Owner. GROUT penetrations of floor slabs, concrete or masonry walls with an approved grout or silicone elastomeric caulk. 1.13CLEANING, ADJUSTING, AND TOUCH-UP A. Remove on a daily basis electrical debris, scraps, packaging material and other rubbish. Dispose of such items off-site in an approved manner and debris. Maintain the site free from physical hazards at all times in accordance with OSHA regulations. B. After installation, completely clean electrical equipment, fixtures, and materials of excess paint, over-spray, plaster, cement, insulating products, and other foreign matter. Leave the Electrical Work in a clean, finished, dry, level, like new condition. C. Touch-up paint scratches and scuffs on electrical equipment and lighting fixtures with paint recommended by the manufacturer and matching the original item finish. D. Make setting, adjustments, and programming in accordance with the manufactures' operating and installation instructions. Settings and program variables will be issued by the Owner prior to commissioning of the electrical system. 1.14AS-BUILT DRAWINGS A. Throughout the project, maintain accurate and current record documents. Show on the record drawings deviations from the Electrical Drawings, locations of underground conduits and pull-boxes, and concealed equipment which is not readily apparent. Dimension the record drawings using permanent, readily identified benchmarks such as column or wall lines. 1.15INSPECTIONS AND TESTING A. Arrange for the inspection of the Work at various stages of completion by the Authority Having Jurisdiction, utility company representatives, and the Owner. Comply with all directions and remedial measures issued thereby. Any objections to these orders on the part of the Contractor must be presented to the Owner in writing within forty eight (48) hours of the inspection report. B. Coordinate the installation of the Work so that observation of all rough-in, concealed, or underground Work can take place by the Owner. Provide a minimum of seventy two (72) hours notice to the Owner prior to covering up the work. Uncover Work that has not been properly observed and make repairs to restore the Work and adjoining surfaces to their proper condition at no additional cost. Common Work Results for Electrical - 26 05 00 Page - 3					C. Perform tests of the electrical system during the course of the project and at project completion to ensure safe and proper function in accordance with the Contract Documents, manufacturers' recommendations, and applicable codes. D. Demonstrate to the Owner that the entire installation is complete, in proper operation condition. Activate all circuits, lights, devices, and controls under full load and normal operating conditions. Identify faulty items and immediately replace or repair defective equipment, workmanship, and materials to like new condition and retest in the presence of the Owner. E. Demonstrate to the Owner that the entire electrical system is free from short circuits and improper grounds, or upon request of the Owner anytime, make necessary tests under the observation of the Owner which will ensure that electrical equipment, materials and installation methods are as specified. 1.16WARRANTIES, CERTIFICATES, AND OPERATING MANUALS A. Properly fill out and deliver to the Owner, all warranties, guarantees, certificates, etc. for equipment and materials. The effective date on each item shall be the date of acceptance of the work by the Owner. PART 2 - PRODUCTS Not used. PART 3 - EXECUTION Not used. END OF SECTION Common Work Results for Electrical - 26 05 00 Page - 4																																													
SECTION 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES PART 1 - GENERAL 1.1SUMMARY A. This section includes building wire and cable, service entrance cable, control cables, wiring connectors and connections. B. All circuit wiring and cables shall be installed in conduit. This includes power, lighting, fire alarm, and security cables. Data cables may be installed open above suspended ceilings provided they are bundled and supported from structure in a clean and workmanlike manner. 1.2SYSTEM DESCRIPTION A. The applications for required cable, wire, and connectors include, but are not limited to: 1. Power distribution circuitry. 2. Lighting circuitry. 3. Appliance and equipment circuitry. 4. Wiring for motors of mechanical equipment 5. Line voltage wiring to thermostats, alarm system components, security system components and other miscellaneous equipment. 1.3PROJECT CONDITIONS A. All wire and cables shall be minimum No. 12 AWG copper conductor unless otherwise indicated. B. All conductor sizes are based on copper. C. Wire and cable routing indicated is diagrammatic unless dimensioned. D. Route wire and cable as required to complement project conditions. E. The Contractor shall be responsible for any and all raceways and raceway/cable supports in accordance with all other sections of these Specifications. PART 2 - PRODUCTS 2.1BUILDING WIRE AND CABLE A. Building wire and cable shall be UL83 compliant, insulated, single conductor, copper, solid or stranded, rated for 600-volts AC. The insulation shall be thermoplastic material rated for 90 degrees Celsius, THW, THHN/THWN, RHW or XHHW, per ANSINFPA 70. All cable shall be selected and installed per its listed usage conditions. 2.2SERVICE ENTRANCE CABLES A. Service entrance cables shall be insulated, single conductor, copper, stranded, rated for 600-volts AC, type XHHW insulation. Low-Voltage Electrical Power Conductors & Cables - 26 05 19 Page - 1					B. Overhead Service entrance cables shall be insulated, single conductor, copper, stranded, rated for 600-volts AC, type SE insulation. 2.3WIRE COLOR CODE A. Color-code all conductors: 1. Wire sizes No. 10 AWG and smaller shall have integral color-coded insulation. 2. Wire sizes No. 8 AWG and larger may have black insulation but shall be identified by color-coded electrical tape at all junction, splice, pull, or termination points. 3. Color tape shall be applied to at least 3 inches of the conductor at the termination ends and in junction or pull boxes or where readily accessible. 4. Conductors for all systems shall not change color at splice points. 5. Where there are two or more neutrals in one conduit, each shall be individually identified with the proper circuit. 6. For No. 4 AWG and larger ground conductors, identify with green tape at both ends and all visible points, included in all junction boxes. PART 3 - EXECUTION 3.1EXISTING WORK A. Disconnect and remove exposed and/or abandoned wire and cable. Patch surfaces where removed cable pass through building finishes. B. Disconnect abandoned circuits and remove wire and cable. Remove abandoned boxes if wire and cable servicing them is abandoned and/or removed. Provide blank cover for abandoned boxes that are not removed. C. Ensure access to existing wiring connections which remain active and which require access. Modify installation or provide access panel as appropriate. D. Extend existing circuits using materials and methods and compatible with existing electrical installations, or as otherwise specified. E. Tag and repair existing wire and cable that remain or are being reused. 3.2INSTALLATION A. General: 1. Install wire and cable in accordance with manufacturer's instructions and NECA "Standard of Installation". 2. Route wire and cable as required to meet project conditions. 3. Identify and color code wire and cable. Identify each conductor with its circuit number or other designation indicated. 4. Do not exceed cable manufacturer's recommended pulling tension limits when installing wire or cable. 5. Support cables above accessible ceiling using standard support methods to support cables from structure. Do not rest cable on ceiling panels. 6. Neatly train and lace wiring inside boxes, equipment, and panelboards Low-Voltage Electrical Power Conductors & Cables - 26 05 19 Page - 2					B. Cable and Wire Size: 1. Conductor sizes are based on copper unless specifically indicated as aluminum or "AL". 2. Refer to panel schedules and drawings for conductor sizes. In no case shall the combined voltage drop of a feeder and branch circuit exceed 5%. 3. Use stranded conductor for all feeders, branch and control circuits. C. Special Techniques - Wiring Connections: 1. Clean conductor surfaces before installing lugs and connectors. Where an anti-oxidation lubricant is used, apply liberally, coating all exposed conductor surfaces. 2. Use suitable cable fittings and connectors. 3. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise. 4. Use split bolt connectors for copper conductor splices and taps, No. 8 AWG and larger. 5. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, No. 8 AWG and smaller. 6. Tape un-insulated conductors and connector with two layers of half-lapped rubber insulating compound tape and two layers of half-lapped, 7-mil electrical tape, Scotch 33+, or approved equal. 7. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, No. 10 AWG and smaller. 8. Stranded conductors for control circuits shall have ring terminals crimped on for all device terminations. Bare stranded conductors shall not be placed directly under the screws. 3.3FIELD QUALITY CONTROL A. Field inspection and test shall be performed under provisions of NETA ATS section 7.3 (2) - Low Voltage Cables, 600-Volt Maximum. END OF SECTION Low-Voltage Electrical Power Conductors & Cables - 26 05 19 Page - 3					SECTION 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS PART 1 - GENERAL 1.1SUMMARY A. Scope of work for this project: Provision of a new complete building power and telecom system grounding system consisting of the following elements: 1. Metal underground water pipe, Metal frame of the building, Concrete encased electrode, Rod electrodes, Service equipment, Enclosures, Separately derived systems. 1.2DESIGN REQUIREMENTS A. Furnish products listed and classified by Underwriters Laboratories, Inc. (UL), Electrical Testing Laboratories, Inc. (ETL), or other recognized, acceptable testing and listing agencies as suitable for purpose specified and shown. B. Grounding shall be in accordance with the National Electrical Code (NEC). Where size, type, rating and quantities indicated or specified are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern. C. Select materials, sizes, and types of anchors, fasteners, and supports to carry at least twice the loads of equipment and raceway, including weight of wire and cable in raceway. PART 2 - PRODUCTS 2.1GROUNDING SYSTEM A. Except as indicated elsewhere, provide materials for electrical grounding system, including, but not limited to, cables, wires, connectors, terminals (solderless lugs) and exothermic welds, grounding rods and electrodes, bonding jumper and braided straps, and other items and accessories required for a complete installation. Where more than one type of material or equipment meets indicated requirements, selection shall be at Contractor's option. Where materials or components are not otherwise indicated, provide products as recommended by the accessories manufacturers and in compliance with the NEC and established industry standards. B. All grounding materials required shall be furnished new and undamaged in accordance with the requirements of these specifications. 2.2WIRE A. Service Equipment Grounding Electrode Conductor: Bare, soft-drawn copper, Class AA stranding, ASTM B 8. Size per NEC Table 250-66, unless otherwise noted. B. Electrical Equipment Grounding Conductor: Insulated, soft-drawn copper, Class B stranding or solid, with green colored polyvinyl chloride insulation per Section 16123. Size per NEC Article 250-122, unless otherwise noted. 2.3MECHANICAL CONNECTORS A. Bolt-on bronze connectors, suitable for grounding and bonding applications in configurations required for the particular installation. 2.4FLEXIBLE JUMPER STRAP A. Flexible flat conductor, 480 strands of 30-gauge, bare copper wire; 3/4-inch width, 9-1/2-inch-long; 48.25 kCMIL, minimum. Protect braid with copper bolt-hole ends with holes sized for 3/8-inch diameter bolts. Grounding and Bonding for Electrical Systems - 26 05 26 Page - 1																																													
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25 UFER GROUND A. In accordance with the National Electrical Code. 26 RDD ELECTRODES A. Copper-clad steel, 5/8-inch (16 mm) minimum diameter, 10 feet (3,000 mm) long, coupling type unless otherwise noted. PART 3 - EXECUTION 3.1 EXISTING WORK A. Modify existing grounding system to maintain continuity to accommodate renovations. B. Extend existing grounding system using materials and methods as specified. C. Install temporary wiring and connections to maintain existing grounding systems in service during construction. D. Remove, relocate, and extend existing installations to accommodate new construction. E. Repair adjacent construction and finishes that are damaged during demolition and extension work. F. Remove exposed and/or abandoned grounding and bonding components, fasteners, supports and electrical identification labels. Cut embedded support elements below surface of walls and floors. Patch surfaces damaged by removal of existing components to match surrounding finishes. 3.2 GROUNDING AND BONDING INSTALLATION: A. Verify that final backfill and compaction has been completed before driving rod electrodes. B. Install grounding well with cover at all rod locations as indicated. Install well top flush with finished grade. C. Installation: 1. Remove paint, rust, mill-oids, and surface contaminants at connection points. 2. Install grounding electrode conductor and connect to reinforcing steel in slab or foundation. 3. Bond together metal siding not attached to grounded structure; bond to ground. 4. Bond together reinforcing steel and metal accessories. 5. Connect to site grounding system. 6. Install continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, provide an artificial strand ground by means of driven rods or buried electrodes. 7. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panel boards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment. 8. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel in accordance with IEEE 1109. Grounding and Bonding for Electrical Systems – 26 05 26 Page - 2		9. Accomplish grounding of electrical system by installing insulated grounding conductor with each feeder and branch circuit conductor in conduit. Install separate insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing. Size grounding conductor in accordance with the NEC. 10. Install grounding conductor from ground bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes, and metal enclosures of service equipment. 11. Bond all metallic conduits to grounding bus at service panel by means of grounding bushings using minimum No. 12 AWG conductor. 12. Ground electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC. Bond together each metallic raceway, pipe, duct and other metal object entering enclosures and exiting slabs. 13. Permanently bond all equipment, grounding conductors, lightning protection system and grounding system prior to energizing equipment. 3.3 GROUND CONDUCTORS A. Grounding conductors shall be located and connected as indicated or as required by Code. B. Ground conductors under buildings or structures shall be buried with at least 6 inches of earth cover. Buried grounding conductors extending beyond the foundations of buildings or structures shall have at least 18 inches of earth cover. C. Exposed conductors shall be installed inconspicuously in vertical or horizontal positions on supporting structures. When located on irregular supporting surfaces or equipment, the conductors shall run parallel to or normal to dominant surfaces. D. Conductors routed over concrete, steel, or equipment surfaces shall be kept in close contact with those surfaces by using fasteners located at intervals not to exceed 3 feet. E. Conductors passing through floor slabs shall be installed in conduit sleeves that extend above the floor slab, a minimum of 1-1/2 inches to provide protection. Sleeves shall be sealed to maintain fireproof integrity. F. Provide isolated grounding conductor for circuits supplying equipment and systems as indicated. G. Provide a separate equipment-grounding conductor for low voltage distribution systems, single or three phase feeder circuit and each branch circuit with single or three phase protective devices. Install a grounding conductor in conduit with phase and neutral conductors. Single-phase branch circuits for 120 and 277 volt lighting, receptacles, and motors shall have a phase, neutral, and ground conductors installed in the common conduit. Provide suitable bonding jumpers and approved grounding type bushings for flexible conduits used for equipment connection utilized in conjunction with the above branch circuits. Single-phase circuits for equipment and all branch circuits installed in non-metallic or flexible conduits shall be provided with a separate grounding conductor. H. Ground the neutral of separately derived systems with a bare copper conductor, installed in conduit, from the neutral directly to the building interior cold water pipe or nearest solidly grounded structural reinforcing steel, in accordance with the provisions of NEC Article 250-24. Use bolted accessible connections to the ground system so that the neutral ground can be disconnected for test. Ground the system ground conduit as detailed on drawing. Size the grounding electrode conductors in accordance with the NEC, Table 250-66, or as indicated. 3.4 CONNECTIONS A. All contact surfaces of bolted and screwed connectors shall be thoroughly cleaned and coated with oxide inhibitor before being securely tightened. Grounding and Bonding for Electrical Systems – 26 05 26 Page - 3		3.5 CONDUIT GROUNDING A. All grounding bushings within all enclosures, including equipment enclosures, shall be wired together and connected normally to the enclosure grounding lug or grounding bus with a bare copper conductor. Grounding bushings shall be grounded with conductors sized in accordance with NEC, but not smaller than No. 8 AWG. 3.6 EQUIPMENT GROUNDING A. Comply with NEC 250, except where larger sizes or more conductors are indicated. 1. All electrical equipment shall be connected to the grounding system with an insulated, green, stranded or solid copper equipment-grounding conductor. 2. Terminate each end on suitable lug, bus, or bushing. The term "electrical equipment", as used in this article, shall include, but not be limited to, all enclosures containing electrical connections or bare conductors, except that individual devices, such as solenoids, pressure switches, and limit switches, shall be exempt from this requirement, unless the device requires grounding for proper operation. 3. Large equipment, such as metal-clad or metal-enclosed switchgear, will be furnished with a grounding bus that shall be connected to the grounding system. 4. Most other equipment will be furnished with grounding pads and/or grounding lugs which shall be connected to the grounding system. All ground connection surfaces shall be cleaned immediately prior to connection. 5. Contractor shall furnish all grounding material required, if not furnished with the equipment. B. Install equipment grounding system such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with electrical circuits will operate continuously at ground potential and provide a low impedance path for possible ground fault currents. C. Where grounding system extension stingers are indicated to be provided for connection to electrical equipment, the Contractor shall connect the bare grounding conductor to the equipment ground bus, pad, or lug. Except where otherwise indicated, all equipment ground conductors that are not an integral part of a cable assembly, shall be sized in accordance with the requirements of NEC. All ground conductors installed in conduit shall be insulated. D. Suitable grounding facilities, acceptable to the Owner, shall be furnished on electrical equipment not so equipped. The grounding facilities shall consist of compression type terminal connectors bolted to the equipment frame or enclosure and providing a minimum of joint resistance. E. The conduit system is not considered to be a grounding conductor, except for lighting fixtures. No grounding conductor shall be smaller in size than No. 12 AWG, unless it is a part of an acceptable cable assembly. 3.7 ACCEPTANCE TESTING A. Grounding and Bonding: Perform inspections and tests as required by NETA ATS, Section 7.13 – Grounding Systems. 1. Test Values a. Ground resistance of the system shall be no greater than five (25) ohms. Where system tests exceed this, provide additional components to reduce the resistance to ground as required. b. Investigate and correct point-to-point resistance values which exceed 0.5 ohm. END OF SECTION Grounding and Bonding for Electrical Systems – 26 05 26 Page - 4		SECTION 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS PART 1 - GENERAL 1.1 SUMMARY A. Section includes conduit and tubing, surface and buried raceways, wireways, outlet boxes, pull boxes, junction boxes, hand holes and concrete manholes. 1.2 CONDUIT APPLICATION A. Acceptable raceway systems and their limitations are as follows: B. Exterior locations: Wet or subject to physical damage – RSC, LPMC (final 6' of an equipment connection) C. Exterior locations: Damp and not subject to physical damage – RSC, LFMC D. Interior locations: Wet or subject to physical damage – RSC E. Interior locations: Exposed, damp and not subject to physical damage – RSC, EMT, FMC (note 5), LFMC F. Interior locations: Concealed – RSC, RNC (note 4), EMT, FMC (note 5), LFMC G. Underground – RSC (tape wrapped), RNC (note 6) H. Notes for Conduit Application: 1. RSC = rigid steel conduit, RNC = rigid nonmetallic conduit, EMT = electrical metallic tubing, FMC = flexible metal conduit, LFMC = liquidtight flexible metal conduit. 2. For the purposes of these specifications, locations subject to physical damage include, but are not limited to, those areas less than 8 feet above the finished floor or grade. 3. Liquidtight flexible metal conduit may also be used in wet or damp, exterior or interior locations not subject to physical damage, where used for flexible equipment connections in lengths not exceeding 3 feet. 4. Rigid nonmetallic conduit may also be used above grade, where totally concealed in walls, for transitions from underground up to a height of 24 inches above the concrete sill. 5. The use of flexible metal conduit is limited to lengths not exceeding 6 feet for flexible connections to equipment and lighting fixtures, or where necessitated by structural obstacles and explicitly approved by the Engineer. 6. The use of RNC underground is acceptable for horizontal runs and bends not exceeding 45 degrees. For bends over 45 degrees and for 90-degree conduit stub ups, provide RSC with tape wrappings. 1.3 BOX APPLICATION A. Provide raceway, boxes and manholes located as indicated and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements and for a complete wiring system. 1.4 CONDUIT SIZE A. Unless otherwise noted on the drawings, minimum acceptable conduit sizes is ½" for fire alarm and security and ¾" for all other applications. Raceways and Boxes for Electrical Systems – 26 05 33 Page - 1	
PART 2 - PRODUCTS 2.1 CONDUIT A. Galvanized Rigid Steel Conduit (GRSC or RGS), couplings and elbows shall be hot-dip galvanized, rigid mild steel in accordance with ANSI C80.1 and UL 6. The conduit interior and exterior surfaces shall have a continuous zinc coating with a transparent overcoat of enamel, lacquer, or zinc chromate. Coating shall be formed with continuous welded seams with a uniform wall thickness, in minimum 10-foot lengths, with threaded ends. B. Electrical Metallic Tubing (EMT). Electrical metallic tubing, including elbows and bends, shall be zinc coated, mild steel in accordance with the requirements of ANSI C80.3 and UL 797. The interior and exterior surfaces of the tubing shall have a continuous zinc coating. Conduit shall be formed with a continuous welded seam, with a uniform wall thickness, in minimum 15-foot lengths. C. Flexible Metal Conduit shall be galvanized steel meeting the requirements of UL 1. Flexible aluminum conduit is not permitted. D. Liquid-Tight Flexible Metal Conduit shall be plastic-jacketed, galvanized steel, "Sealtite" Type EF for general service areas or Type HC for high-temperature when used under raised floor or in air plenums. Conduit shall be UL listed. E. Non-Metallic Conduit shall be as follows: 1. Schedule 40; Conduit shall be 90 degree Celsius, polyvinyl chloride in conformance with NEMA TC-2 and UL 651 requirements. 2. Spacers used in duct bank installations shall be high impact plastic, interlocking bases, and intermediate type spacers. Place spacers between 6 and 10 feet apart. F. Rigid aluminum, flexible aluminum, or flexible non-metallic conduits shall not be used on this project. 2.2 CONDUIT BODIES A. Malleable iron conduit bodies shall be cast malleable iron with tensile strength meeting ASTM A 48, Class 30A requirements. Malleable conduit bodies shall be finished with an epoxy powder coating. Cover shall be malleable iron with captive screws. B. All conduit bodies shall be equipped with a sealed and gasketed cover. Cover shall be secured using stainless steel machine screws. 2.3 OUTLET BOXES AND SWITCH BOXES A. Sheet Metal Outlet Boxes: ANSINEMA OS 1, galvanized flat rolled sheet steel outlet wiring boxes of types, shapes and sizes, including box depths, to suit each respective location and installation; construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices. B. Outlet boxes used in wet outdoor locations, surface mounted shall be cast metal (FS or FD type) with mounting lugs and gasketed covers. C. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported, per NEC requirements. D. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, future studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used and meeting requirements of individual wiring situations. Raceways and Boxes for Electrical Systems – 26 05 33 Page - 2		2.4 PULL BOXES, JUNCTION BOXES A. Sheet Metal Boxes shall be NEMA OS 1, NEMA ratings as indicated. Minimum 16 gauge galvanized steel construction with stainless steel hinged cover and neoprene gasket. Cover shall be secured to the body with a continuous, full length, piano type hinge and stainless steel pin on one side and captive screw on the other side. Door shall be equipped with padlock hasp with sealing hole provision. B. Surface-Mounted Cast Metal Box: NEMA 250, NEMA Type 3R or 4 as indicated, flat-flanged, surface-mounted junction box. 2.5 SEALING AND FIREPROOFING A. Penetrations. All conduits, raceways, cables and sleeve penetrations through fire rated and hazardous location walls, shafts, floor, ceilings, etc., shall be sealed with a UL-approved fire stopping system. B. Furnish UL listed products or products tested by a nationally recognized independent testing laboratory. Select products with rating not less than the rating of the wall, ceiling or floor being penetrated. C. Use stamped steel, chrome plated, hinged, split ring escutcheons or floor/ceiling plates for covering openings in occupied areas where conduit is exposed. D. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit and the cured opening of a water-stop type wall sleeve. E. At non-rated interior wall or floor openings use Tremco Fyre-Sil, Sik Corp, Sikaflex Ia, Sonobeon Sonoelastic NPT, or Mamco Vulkem 116 urethane caulk or approved equal. PART 3 - EXECUTION 3.1 EXISTING WORK A. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified. B. Clean and repair existing raceway and boxes to remain or to be reinstalled. 3.2 INSTALLATION OF RACEWAYS A. Routing 1. Install raceway and boxes in accordance with NECA "Standard of Installation." 2. Conduit routing is diagrammatic only. Contractor shall field route conduit and raceways between equipment and devices as required to obtain a complete wiring system. B. Couplings and Unions 1. Metal conduit shall be joined by threaded conduit couplings, with the conduit ends butted. 2. The use of running threads, Erickson type couplings, split couplings or similar unions are not permitted. C. Conduit Bodies 1. Conduit bends shall meet the requirements of NEC, minimum bend radius of the cable installed or as indicated, whichever is greater. 2. Conduits or tubing deformed or crushed in any way shall be removed from the site. D. Support Boxes Independently of conduits. E. Use code sized gang box where more than one device is mounted together. Do not use sectional box. Use code sized gang box with plaster ring for single device outlets. F. Use cast outlet box in exterior locations where exposed to the weather and wet locations (interior or exterior). G. Fasten boxes rigidly to substrate or structural surfaces to which they are being mounted, or solidly embed electrical boxes in concrete or masonry as appropriate. H. Cabinets and boxes shall be rigidly mounted. 1. Mounting on concrete shall be secured by self-drilling anchors. 2. Mounting on steel shall be by drilled and tapped screw holes, or by special support channels welded to the steel, or by both. 3. Cabinets shall be leveled and fastened to the mounting surface with not less than ¼-inch air space between the enclosure and mounting surface. END OF SECTION Raceways and Boxes for Electrical Systems – 26 05 33 Page - 3		D. All steel conduit, exposed to weather or in contact with earth, shall be re-galvanized after threading with "Galvanizing Powder M-321" or approved equal. The Contractor shall furnish this protective material and shall apply it in the field. E. Empty Conduit 1. All conduits installed for future use shall have a polypropylene pull line with a minimum tensile strength of 200 lbs., Jet Line, Cat. No. 232, polyolefin, or approved equal. F. Rooftop Conduits 1. Provide redwood sleepers on waterproof mastic base for all conduit runs exposed on roofs. 3.3 CABINET AND BOX INSTALLATION A. Install electrical boxes as indicated, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements. B. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. In inaccessible ceiling areas, install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire. C. Use flush mounting outlet boxes in finished areas. 1. Do not install flush mounting boxes back-to-back in walls. 2. Provide minimum 6-inch separation between adjacent boxes. 3. Secure flush mounting box to interior wall and partition studs. D. Support boxes independently of conduits. E. Use code sized gang box where more than one device is mounted together. Do not use sectional box. Use code sized gang box with plaster ring for single device outlets. F. Use cast outlet box in exterior locations where exposed to the weather and wet locations (interior or exterior). G. Fasten boxes rigidly to substrate or structural surfaces to which they are being mounted, or solidly embed electrical boxes in concrete or masonry as appropriate. H. Cabinets and boxes shall be rigidly mounted. 1. Mounting on concrete shall be secured by self-drilling anchors. 2. Mounting on steel shall be by drilled and tapped screw holes, or by special support channels welded to the steel, or by both. 3. Cabinets shall be leveled and fastened to the mounting surface with not less than ¼-inch air space between the enclosure and mounting surface. END OF SECTION Raceways and Boxes for Electrical Systems – 26 05 33 Page - 4		SECTION 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS PART 1 - GENERAL 1.1 SYSTEM DESCRIPTION A. Label the following electrical equipment with permanent nameplates which clearly identify each item, the function or use of the item, and the circuit identification of the feed to the item: 1. All Metal-Clad Switchgear, Metal-Enclosed Switchgear, Switchboards, Distribution Panelboards, Power and Lighting Panels, Motor Control Centers, Local Control Panels, Terminal Cabinets and all electrical equipment enclosure shall be identified using laminated plastic nameplates. Show the equipment number, voltage rating, current rating, number of phases, connection type, short circuit interrupting rating, and circuit number 2. Identify all receptacles and lighting switches, by the circuit number indicated using ¼-inch high white characters on ½-inch wide black stick-on tape placed on the wall directly above the device if the device is wall mounted. Place the tape on the device enclosure if the device is not wall mounted. 3. All motors, starters, disconnect switches, Time Switches, Special Function Pushbuttons and Switches, and miscellaneous control devices shall be identified by function and circuit number, with ½-inch high white characters on a ½-inch wide black stick-on tape where installed indoors and engraved plastic nameplates where installed outdoors. 4. All underground raceway or cable shall be marked with buried warning tape along its entire length. 5. All exposed raceway longer than 10 feet in length shall be identified. 6. Panelboard Directories: Furnish all panelboards with a complete 8-1/2-inch by 11-inch typewritten directory mounted in the inner door under a clear plastic cover set in a metal frame. B. Branch circuits and devices: 1. Label all individual receptacle outlets at the outlet faceplate to indicate the panelboard of origin and branch circuit number. Label modular furniture feeds at the power pole drop in a visible and consistent location. Labels shall be self adhesive, thermal machine printed type such as Brothers, Panduit, T&B, or approved equal and shall be clear plastic with black lettering. 2. All branch circuits in outlet boxes shall be identified with circuit number using wrap-around labels (T&B, BRADY, 3M, or approved equal). 3. As an alternative to separate nameplates, device plates may be engraved directly with lettering filled with black enamel. END OF SECTION Identification for Electrical Systems – 26 05 53 Page - 1	



SHEET GENERAL NOTES

- 1. SEE ATTACHED MUSCO DESIGN DRAWINGS FOR (N) FIXTURE TYPES AND LOCATIONS
- 2. UPON COMPLETION OF FIXTURE INSTALLATION, COORDINATE AIMING OPERATIONS WITH MUSCO
- 3. (E) MEASURED LIGHTING LEVELS SHOWN FOR REFERENCE ONLY

SHEET KEYNOTES

- 1. PROVIDE (N) FIXTURES AND ASSOCIATED MOUNTING HARDWARE AND MOUNT (N) MUSCO LIGHTING PER MUSCO DESIGN.
- 2. PROVIDE (N) LIGHTING CONTACTORS AND ASSOCIATED ENCLOSURES AND MOUNT MIDWAY UP (E) POLES PER MUSCO REQUIREMENTS.
- 3. PROVIDE (N) WIRE TO MATCH (E) FEEDERS AND RECONNECT (N) LIGHTS AND (N) CONTACTORS TO (E) LIGHTING POWER CIRCUITS.
- 4. PROVIDE (N) CONTROL EQUIPMENT IN (E) CONTROL CABINET AND CONNECT TO (E) POWER CIRCUITS PER MUSCO REQUIREMENTS.

CALCULATION SUMMARY

ZONE NAME	CALCTYPE	UNITS	AVG	MAX	MIN	AVG/MIN	MAX/MIN
NORTH	ILLUMINANCE	FC	27.2	37.9	8.4	3.2	4.5
WEST	ILLUMINANCE	FC	27.7	48.9	2.1	13.2	23.3
EAST	ILLUMINANCE	FC	13.3	24	1.5	8.9	16.0
SOUTH	ILLUMINANCE	FC	26.5	36.1	2.2	12.0	16.4
PATHWAY	ILLUMINANCE	FC	0.77	1.38	0.13	5.9	10.6
STREET OFF	ILLUMINANCE	FC	0.16	0.74	0.01	15.5	74.0
STREET ON	ILLUMINANCE	FC	0.29	0.75	0.04	7.3	18.8

PLAN NORTH



No.	Issue	Drawn	Approved	Date

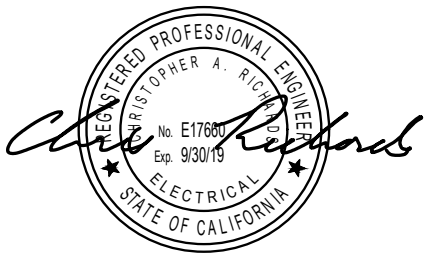
Plot Date: 17 September 2019 - 3:58 PM

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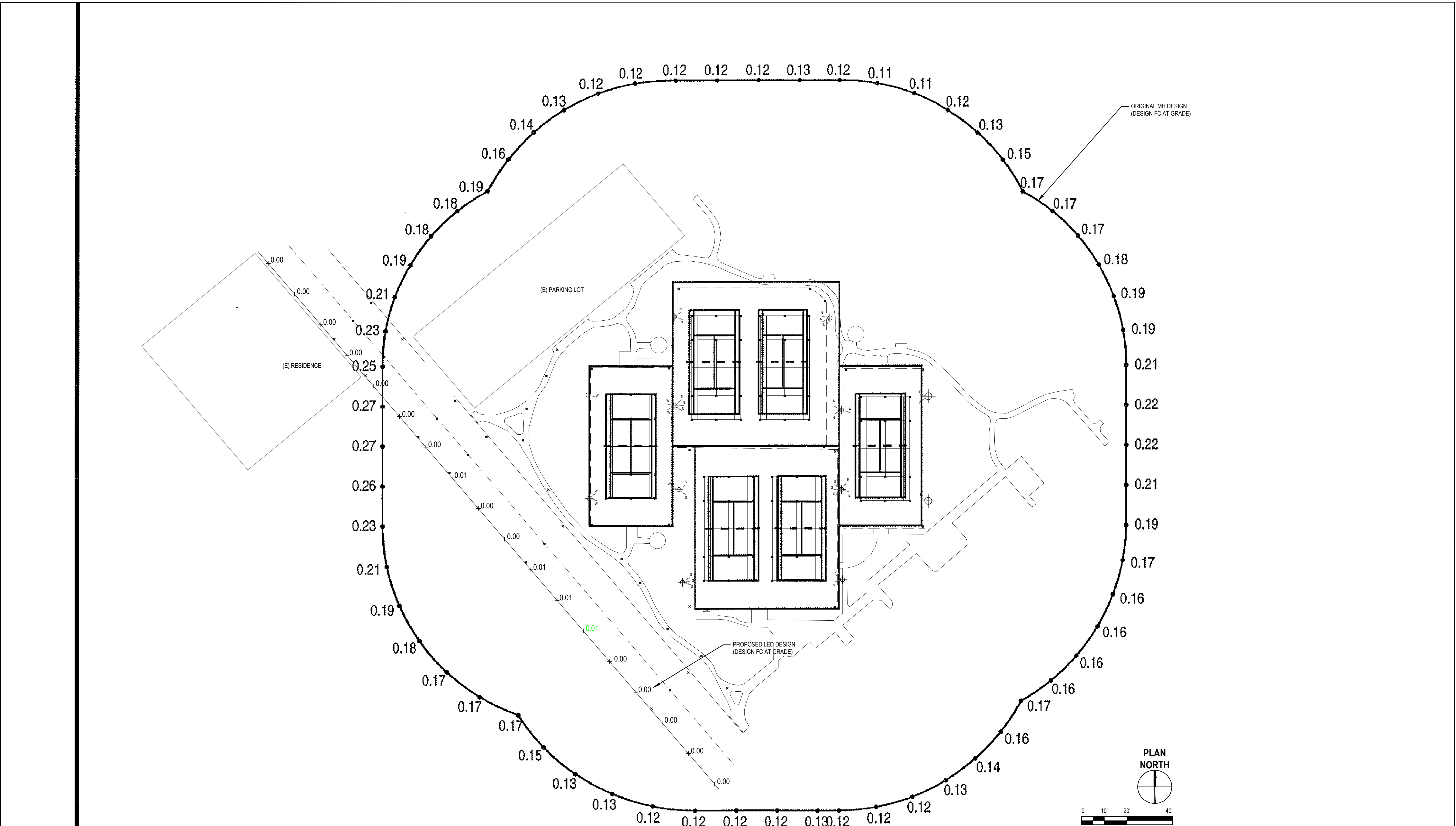
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Drafting Check	Design Check
Project Manager C. RICHARDS	Date 09/17/2019
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Client	CITY OF ST. HELENA		
Project	CRANE PARK LIGHTING		
Title	ELECTRICAL LIGHTING		
	SITE PLAN		
Project No.	11199219		
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