ATTACHMENT NO. 10

Environmental Noise Impact Study

THE WILLOWS SCHOOL MULTIPURPOSE FIELD
CULVER CITY, CALIFORNIA

Prepared for:
The Willows School

July 2018

Report Ref:
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1 INTRODUCTION

This Noise Impact Study (Study) evaluates the potential noise impacts from the operation of the proposed Multipurpose Field at The Willows School, located in the City of Culver City, California (Project), as shown in Figure 1 (on page 2).

The objectives of this Study are to:

a) Evaluate the proposed Multipurpose Field operation related noise levels relative to the Culver City current noise Regulations; and

b) Identify noise attenuation features in the form of performance specifications to ensure noise impacts are less than significant.

2 ENVIRONMENTAL SETTING

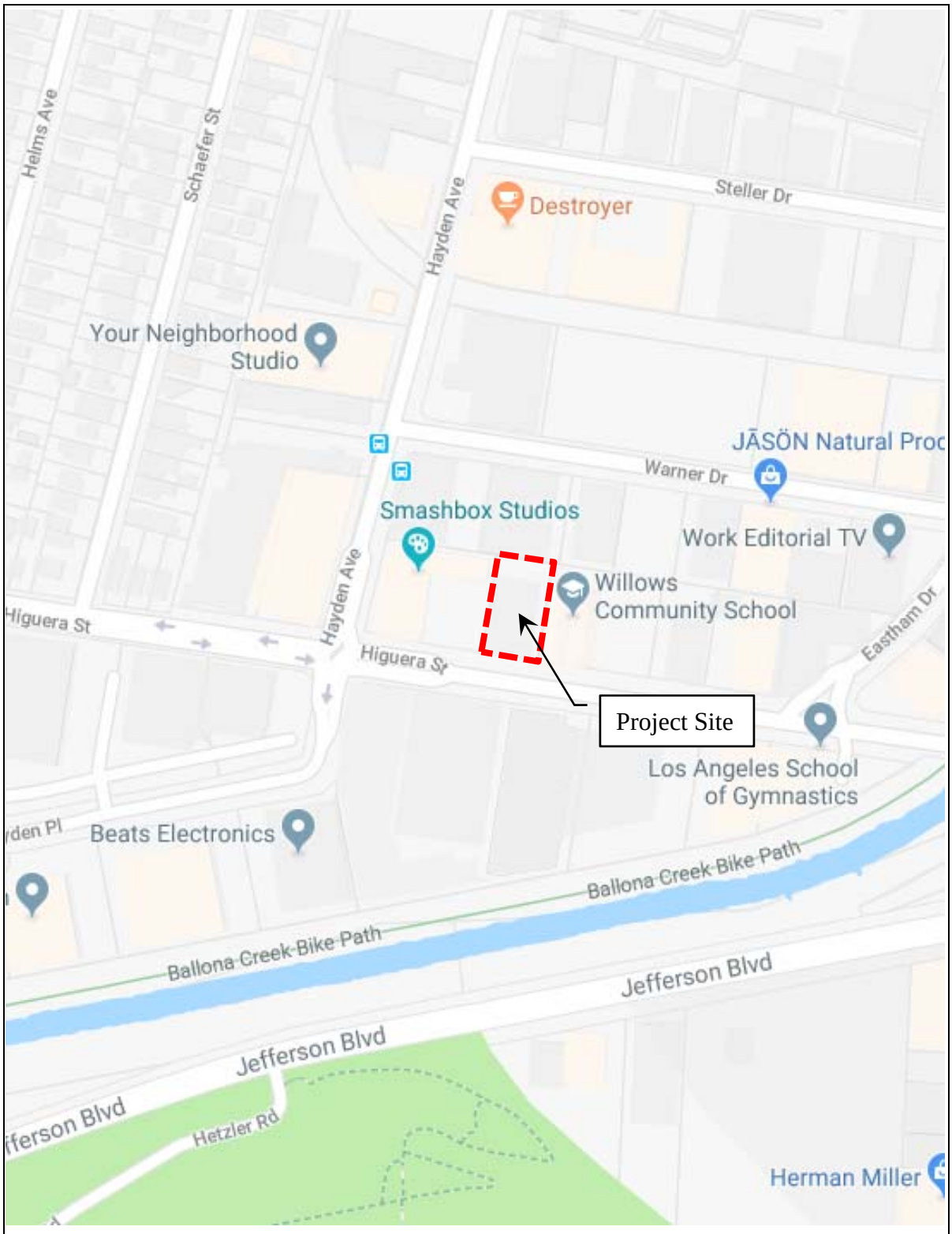
2.1 Fundamentals of Sound and Environmental Noise

Noise is commonly defined as sound that is undesirable because it can interfere with speech communication and hearing, may cause sleep disturbance, or may otherwise be considered annoying (unwanted sound). The decibel (dB) is a conventional unit for measuring the amplitude of sound because it accounts for the large variations in sound pressure amplitude and reflects the way people perceive changes in sound amplitude.[1] The human hearing system is not equally sensitive to sound at all frequencies. Therefore, to approximate this human frequency-dependent response, the A-weighted filtering system is used to adjust measured sound levels (dBA). The term "A-weighted" refers to filtering the noise signal in a manner that corresponds to the way the human ear perceives sound. Examples of various sound sources and decibel levels in outdoor and indoor environments are provided in Table 1 (on page 3).

Generally, people judge the relative magnitude of sound sensation by subjective terms such as "loudness" or "noisiness." To the normal human ear, a change in sound level of 3 dB is considered "just perceptible," a change in sound level of 5 dB is considered "clearly noticeable," and a change (i.e., increase) of 10 dB is generally recognized as "twice as loud."[2]

[1] *All sound levels measured in decibel (dB) in this study are relative to $2x10^{-5}$ N/m^2.*

[2] *Engineering Noise Control, Bies & Hansen, 1988.*



Source: Google Map, 2018

Figure 1. Project Site Map

Table 1. Typical Noise Levels

Common Outdoor Activities	Noise Levels, dBA	Common Indoor Activities
	110	Rock Band
Jet Fly-over at 1000 feet		
	100	
Gas Lawn Mower at 3 feet		
	90	
Diesel Truck at 50 feet at 50 mph		Food Blender at 3 feet
	80	Garbage Disposal at 3 feet
Noisy Urban Area, Daytime		
Gas Lawn Mower at 100 feet	**70**	Vacuum Cleaner at 10 feet
Commercial Area		Normal Speech at 3 feet
Heavy Traffic at 300 feet	**60**	
		Large Business Office
Quiet Urban Daytime	**50**	Dishwasher Next Room
Quiet Urban Nighttime	**40**	Theater, Large Conference Room (background)
Quiet Suburban Nighttime		
	30	Library
Quiet Rural Nighttime		Bedroom at Night, Concert Hall (background)
	20	
		Broadcast/Recording Studio (background)
	10	
Lowest Threshold of Human Hearing	**0**	Lowest Threshold of Human Hearing

Source: Caltrans, Technical Noise Supplement (TeNS), 2013

2.1.1 Outdoor Sound Propagation

In an outdoor environment, sound levels attenuate (reduce) through the air as a function of distance. Such attenuation is commonly referred to as "distance loss" or "geometric spreading," and is based on the noise source configuration (e.g., point source, or line source). For a point source, such as a loudspeaker with the rate of sound dissipation is about 6 dB per doubling of distance from the noise source. For example, a loudspeaker generates a sound level of 73 dBA at a distance of five feet would attenuate to 67 dBA at a distance of 10 feet. For a line source, such as a constant flow of auto traffic on a roadway, the rate of sound attenuation is about 3 dB per doubling of distance.[3]

[3] *Caltrans, "Technical Noise Supplement (TeNS)", 2013.*

In addition, structures (e.g., buildings, parapet walls) and natural topography (e.g., hills) that obstruct the acoustic line-of-sight between a noise source and a receptor further reduce the noise level if the receptor is located within the "acoustic shadow" of the obstruction, such as behind a sound wall. This type of sound attenuation is known as "barrier insertion loss." If a receptor is located behind the wall but still has a view of the source (i.e., acoustic line-of-sight is not fully blocked), some barrier insertion loss would still occur, however to a lesser extent. Additionally, a receptor located on the same side of the wall as a noise source may actually experience an increase in the perceived noise level as the wall reflects noise back to the receptor, thereby compounding the noise. Outdoor sound walls can provide noise level reductions ranging from approximately 5 dBA (where the barrier just breaks the acoustic line-of-sight between the noise source and receiver) to an upper range of 20 dBA with a more substantial barrier.[4]

2.1.2 Environmental Noise Descriptors

Several rating scales have been developed to analyze the adverse effect of community noise on people. Since environmental noise fluctuates over time, these scales consider the total acoustical energy content, as well as the time and duration of occurrence. The most frequently used noise descriptors, including those used by Culver City, are summarized below.

Equivalent Sound Level (L_{eq}). L_{eq} is a measurement of the acoustic energy content of noise averaged over a specified time period. Thus, the L_{eq} of a time-varying sound and that of a steady sound are the same if they deliver the same amount of energy to the receptor's ear during exposure. L_{eq} for one-hour periods, during the daytime or nighttime hours, and 24 hours are commonly used in environmental noise assessments. L_{eq} can be measured for any time period, but is typically measured for an increment of no less than 15 minutes for environmental studies. For evaluating community impacts, this rating scale does not vary, regardless of whether the noise occurs during day or night.

Maximum Sound Level (L_{max}). L_{max} represents the maximum sound level measured during a measurement period.

2.2 Regulatory Framework

Government agencies have established noise standards and guidelines to protect citizens from potential hearing damage and other adverse physiological and social effects associated with noise. The City provides regulations to control excessive and annoying noise, as set forth in the Culver City Municipal Code (CCMC) Chapters 9.04 and 9.07. Standards and guidelines that may be applicable to this Project are discussed below.

[4] *Caltrans, "Technical Noise Supplement (TeNS)", 2013.*

2.2.1 Culver City Municipal Code

The following sections of the Culver City Municipal Code, partially or entirely, may be applicable to the proposed operation of the Multipurpose Field:

Section 9.04.015.H Noise Disturbances

1. *General.* Any noise that is made, generated, produced, or continued, whether by a person, activity, animal, fowl, automobile, motorcycle, engine, machine, or other mechanical device, whether on public or private property, in such a manner that it unreasonably disturbs the peace and quiet of any neighborhood or which causes any discomfort or annoyance to any reasonable person of normal sensitivities, or that otherwise violates any provision of the Culver City Municipal Code, including the regulations set forth in Chapter 9.07 ("Noise Regulations") and/or the noise limits set forth in the Culver City Zoning Code. Factors which shall be considered in determining whether the noise is a nuisance shall include, but not be limited to the following:

(a) The volume of the noise;

(b) The intensity of the noise;

(c) Whether the nature of the noise is usual or unusual;

(d) Whether the origin of the noise is natural or unnatural;

(e) The volume and intensity of the background noise, if any;

(f) The proximity of the noise to residential sleeping facilities;

(g) The nature of the zoning of the area from which the noise emanates;

(h) The density of inhabitation of the area from which the noise emanates;

(i) The time of day or night the noise occurs;

(j) The duration of the noise;

(k) Whether the noise is recurrent, intermittent, or constant;

(l) Whether the noise is produced by commercial or noncommercial activity; and

(m) Whether the noise is a consequence or expected result of an otherwise lawful use.

Section 9.07.055 Amplified Sounds

A. *Electronic Devices.* It is prohibited for any person to permit the transmission of, or cause to be transmitted, any amplified sound on any public street, sidewalk, alley, right-of-way, park, or any other public place or property which sound is audible at fifty (50) feet. This Section shall not apply to any noncommercial public speaking, public assembly, or other activity for which a permit has been issued.

B. *On private property.* It is shall be prohibited for any persons to operate a loud speaker or sound amplifying equipment for the purposes of transmitting messages, giving instructions or providing entertainment which is audible at a distance of fifty (50) feet or beyond the subject's property line without first filing an application and obtaining a permit as set forth in this Chapter.

C. *Permits.* Every user of sound amplifying equipment on public or private property, except block parties which have obtained a permit from the Chief of Police or activities in public parks which have obtained a permit for use of amplifying equipment the Parks, Recreation and Community Services Department shall file an application with the Committee on Permits and Licenses at least ten (10) days prior to the day on which the sound amplifying equipment is to be used.

2. Exempt from these hours of operation are those activities which are authorized by the City of Culver City or the public school districts serving the residents of the City, including the use of the Civic Center Facilities, athletic fields and courts, community centers, and the conduct of City approved special events.

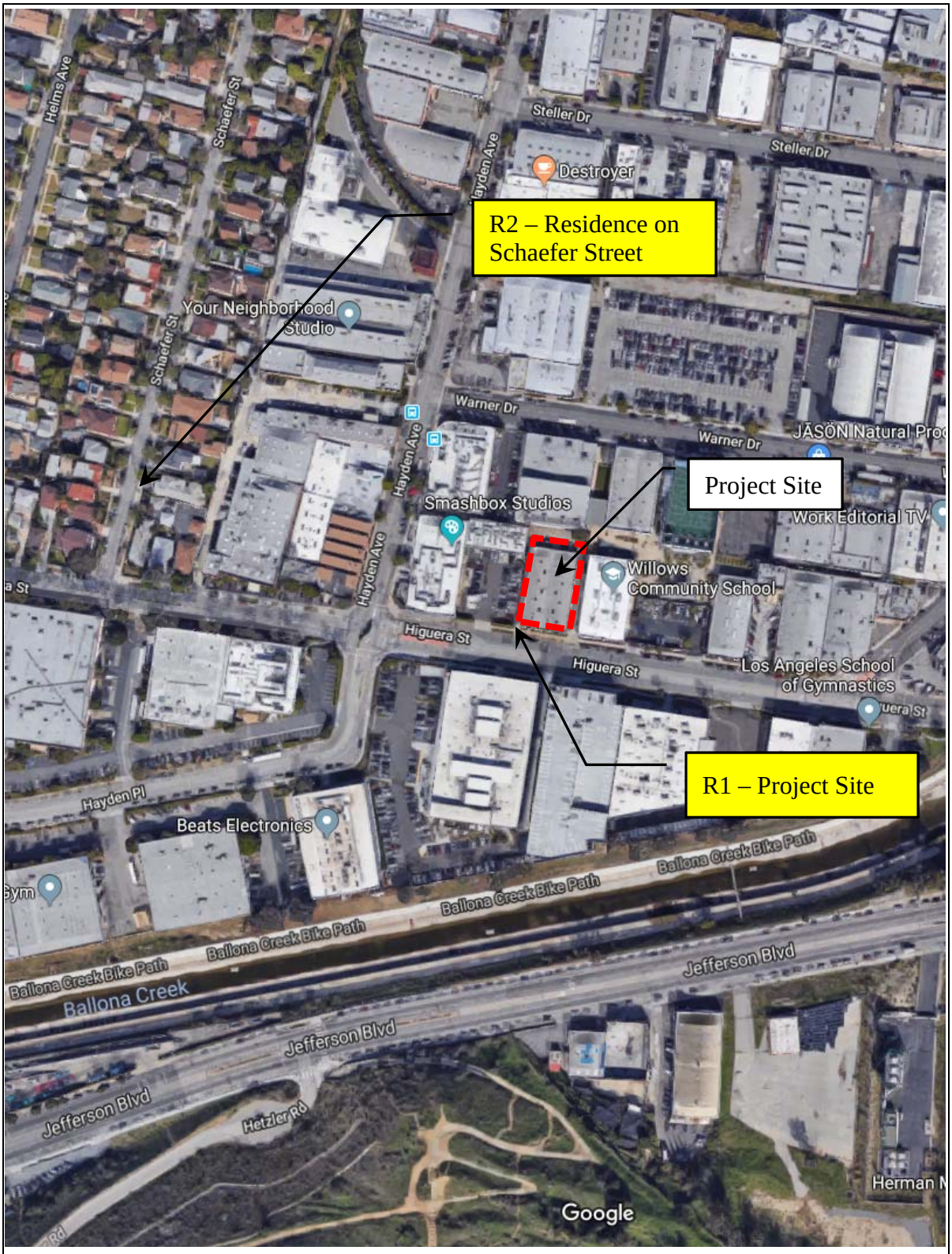
Section 9.07.060 Exemptions from Provisions

C. *Outdoor activities.* Permitted activities conducted on public playground and public or private school grounds including but not limited to school athletic and entertainment events are exempt from the provisions of this Chapter.

2.3 Existing Ambient Noise Levels

Based on a review of the existing land uses in the Project area, the nearest noise sensitive uses to the Project Site are residential uses located along Schaefer Street approximately 560 feet to the west. The existing ambient noise levels were measured at the nearest noise sensitive use and at the Project Site. The locations of the two noise receptors are identified as R1 (Project Site) and R2 (residence along Schaefer Street) in Figure 2 (on page 7).

The ambient noise measurement was conducted using a Quest Technologies Model 2900 Integrating/Logging Sound Level Meters, which meet and exceed the minimum industry standard performance requirements for "Type 2" standard instruments as defined in the American National Standard Institute (ANSI) S1.4. Two 15-minute measurements, one during the daytime hours (between 12 p.m. and 1 p.m.) and another during the evening hours (between 8 p.m. and 9 p.m.), were conducted on June 12, 2018.



Source: Google Earth Map, 2018

Figure 2. Noise Measurement Locations

Table 2 (below) presents the measured ambient noise levels at the selected receptors. Based on field observation and measured sound data, the current ambient noise environment in the vicinity of the Project Site is controlled primarily by vehicular traffic on local roadways and other typical urban noise.

Table 2. Existing Ambient Noise Levels

Location	Noise-Sensitive Land Use	Measured Ambient Noise Levels, dBA L_{eq}	
		Daytime Hours (7 a.m. to 7 p.m.)	Evening Hours (7 p.m. to 9 p.m.)
R1	School (Project Site)	61.9	58.6
R2	Residential	54.4	52.3
Source: AES, 2018			

3 IMPACT ANALYSIS

3.1 Significance Thresholds

Pursuant to the City of Culver City Municipal Code Section 9.07.060, noise associated with permitted activities occurring on private school grounds (including but not limited to school athletic and entertainment events) is exempt from regulation under the City's current Municipal Code. However, in the context of the CEQA Guidelines, a significant noise impact could occur if the operation of the Project's play yards would result in a substantial permanent increase in ambient noise levels in the vicinity of the Project Site.

It has been determined that the significance threshold for the proposed Multipurpose Field operation would be the maximum noise (L_{max}) as compared with the existing ambient sound level (L_{eq}) at the property line of the affected noise sensitive receptors. This is a conservative approach as it is compared the Project maximum noise level with the measured ambient noise levels. The recommended threshold ensures compliance with the City Municipal Code Section 9.04.015 restrictions on noise that is considered "*loud or unusual noise or sound, disturbing the peace of residents*". Therefore, the recommended significance threshold, as not to exceed the ambient, is based on the Project specific noise source (i.e., sound generated by students, people, and potential amplified sound), the volume of the noise, and the time of day or night the noise occurs consistent with the noise source characterization provided by the City's Municipal Code Section 9.04.015.H. In addition, the recommended significance threshold would ensure that the potential noise increase (i.e., when the Project-related noise added to the ambient) would be less than three (3) dBA, which is normally considered as human perceptible threshold.

Therefore, the Project would have a significant impact on outdoor noise environment if:

- The maximum noise level (L_{max}) generated by the Multipurpose Field operation, at the property line of a noise sensitive use, exceeds the measured ambient noise level (L_{eq}).

3.1 Operation Impacts

The proposed Multipurpose Field would be used for various activities including: physical education classes (during school hours), after school programs, athletic practices, and occasional special events. Noise impacts associated with the Multipurpose Field were determined by comparing the estimated maximum noise levels associated with the Multipurpose Field operation at the off-site sensitive receptors to the existing measured ambient noise levels.

Table 3. Multipurpose Field Proposed Uses

Proposed Uses	Time of the Day	Estimated Maximum Number of Occupants	Maximum Sound Levels at 25 feet from the Amplified Sound System, dBA
During school day	8:00 a.m. to 2:30 p.m.	60 (students/teachers)	--[a]
After-school programs	2:30 p.m. to 5:00 p.m.	50 (students/teachers)	--[a]
Athletic practices	5:00 p.m. to 9:00 p.m.	50 (students/teachers)	--[a]
Special events	Up to 9:00 p.m.	400 (guests)	100

[a] *No amplified sound would be used during these events.*
Source: The Willows School, 2018

Current noise levels associated with the School were measured on June 12, 2018, at the School's existing sport courts with the students playing. The noise levels were measured over a period of 10 minutes at the existing sport courts and are summarized in Table 4 on page 10. The measured sport courts noise levels were used as reference source level for the noise model of the proposed Multipurpose Field, as similar activities will occur on both the existing sports courts and the proposed Multipurpose Field.

Table 4. Description of Noise Measurement Locations

Measured Sound Sources	Number of Students/Teacher during the Measurements	Measured Noise Levels, dBA L_{eq}[a]	
		Average (L_{eq})	Maximum (L_{max})
Existing Sport Courts - Basketball	21	74	90

[a] *Noise levels were measured at approximately 25 feet from center of sport courts.*
Source: AES, 2018

As indicated in Table 4, the measured play yard noise levels were made with 21 students/teacher at the existing sport courts. It is estimated that the maximum number of students/teachers at the Multipurpose Field would be up to 50 during the after-school programs and athletic practices and up to 60 during the normal school day. Therefore, the measured source noise level (based on 21 students/teacher) was adjusted upward to reflect the maximum number of 50 and 60 students/teachers for the noise analysis.

Noise sources associated with special events would typically include guests (gathering and conversing) and the potential use of an amplified sound system. For this operational noise analysis, raised voice levels of 65 dBA for a male and 62 dBA for a female were assumed for people gathering at the Multipurpose Field.[5] Any outdoor amplified sound system (e.g., music or other sounds broadcast through an outdoor mounted speaker system) that may be used during a special event would be designed so as not to exceed the maximum noise level of 90 dBA at a distance of 25 feet from the face of the loudspeaker system.

The noise levels at the off-site noise sensitive receptor associated with the Multipurpose Field operations were calculated using the SoundPLAN (version 8.0) computer noise prediction model.[6] SoundPLAN is a 3-dimensional acoustic ray tracing program for outdoor noise propagation prediction developed by the German company, SoundPLAN GmbH. SoundPLAN is widely used by acoustical engineers as a noise modeling tool for environmental noise analysis.

Table 5 (on page 11) presents the estimated noise levels from the Multipurpose Field operations at the nearest residential use (receptor R2). As indicated in Table 5, the estimated noise levels from the proposed Multipurpose Field would be below the existing ambient noise levels, during both daytime and evening hours. Therefore, noise impacts associated with the Multipurpose Field would be less than significant.

[5] *Cyril M. Harris, Handbook of Acoustical Measurements and Noise Control, Third Edition, 1991, Table 16.1.*

[6] *SoundPLAN GmbH, SoundPLAN version 8.0, 2017*

Table 5. Multipurpose Field Noise Impacts

Off-Site Receptor Location	Existing Ambient Noise Levels, dBA L_{eq}		Estimated Multipurpose Field Noise Levels, dBA L_{max}			Significant Impact?
	Daytime Hours (7 a.m. to 7 p.m.)	Evening Hours (7 p.m. to 9 p.m.)	During School Day[a]	After-School Programs/ Athletic Practices[b]	Special Events[c]	
R2	54.4	52.3	43.6	42.6	44.8	No

[a] *With estimated maximum 60 students/teachers.*
[b] *With estimated maximum 50 students/teachers.*
[c] *With estimated maximum 400 guests.*
Source: AES, 2018

LIGHTING DESIGN ALLIANCE

MULTI-PURPOSE FIELD LIGHTING STUDY

WILLOWS COMMUNITY SCHOOL

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REPORT DATE: 19-JUNE-2018

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OVERVIEW

Introduction

The purpose of this study is to determine the appropriate method of lighting for Willows Community School's multi-purpose field, and to assess the potential impact of the proposed lighting system on surrounding residential and commercial areas. The study will analyze the potential impact of light trespass (light emitted onto adjacent properties), light pollution (light emitted upwards into the night sky), and visual glare, as well as propose methods to minimize these effects.

Site Survey & Discussion

During LDA's initial site survey, site conditions were reviewed in order to identify potential fixture mounting locations, field egress pathways, and adjacent buildings and structures. The primary concern from the site analysis was the close proximity of the proposed pole lighting locations to the adjacent property line. As such, careful consideration would need to be taken when designing the field's lighting layout and fixture specifications in order to minimize undesired light trespass to the surrounding properties.

It has been assumed that the proposed multi-purpose field will be used primarily for recreational athletic events by Willows Community School, but also for school assemblies and evening events. It is assumed that the field will not be used by the school past 9:00pm (exact time subject to review), thus any exterior lighting at that time can be reduced to minimal levels for safety and security (typically one (1) footcandle, average). In the future, the field may also be used for local community recreational athletics and other events.

Due to their distance from the field, residential properties are not expected to receive any significant measurable illuminance contributions (light trespass). Poles tops may be visible from nearby residential properties due to their height, however the fixture heads shall direct lighting downwards only onto the field, therefore any direct glare impacts will be minimal as well. Light reflected off of air particulates and adjacent surfaces are the only expected nighttime impact on residences, and due to their indirect reflected nature, will not be a source of glare for residents.

IESNA Design Criteria

The Illuminating Engineering Society of North America (IESNA) has developed a series of design criteria and recommended practices for athletic venue lighting. All information in this study is referenced from the *'IESNA, The Lighting Handbook, 10th Edition, Reference and Application'*, as well as the '*IESNA RP-6-15, Sports and Recreational Area Lighting'.*

IESNA defines four (4) classifications of athletic play:

- *Class I = Competition play before a large group (5,000 or more spectators).*
- *Class II = Competition play with facilities for up to 5,000 spectators.*
- *Class III = Competition play with facilities for up to 2,000 spectators.*
- *Class IV = Competition or recreational play only (limited or no provision for spectators).*

LDA recommends the IESNA 'Class IV' classification for Willows Community School's multi-purpose field, given the primary recreational usage with limited spectators. This classification is suitable for social events, recreational events, K-12 school athletics, training facilities, and amateur sports leagues. Based upon these anticipated activities and usage, LDA recommends using 'Soccer' as the baseline sport to follow IESNA's recommended design criteria:

- *Target Average Horizontal Illuminance (Soccer) =* ***20 footcandles, or greater***
- *Target Uniformity Ratio (Soccer) =* ***3:1 (max:min), or less***

Due to high possibility of glare for users on the field, LDA does not recommend light poles to be located within the primary glare zones identified by the IESNA, as illustrated by Figure 77 below, from 'IES RP-6-15'. The primary glare zones are shaded in grey in this graphic.

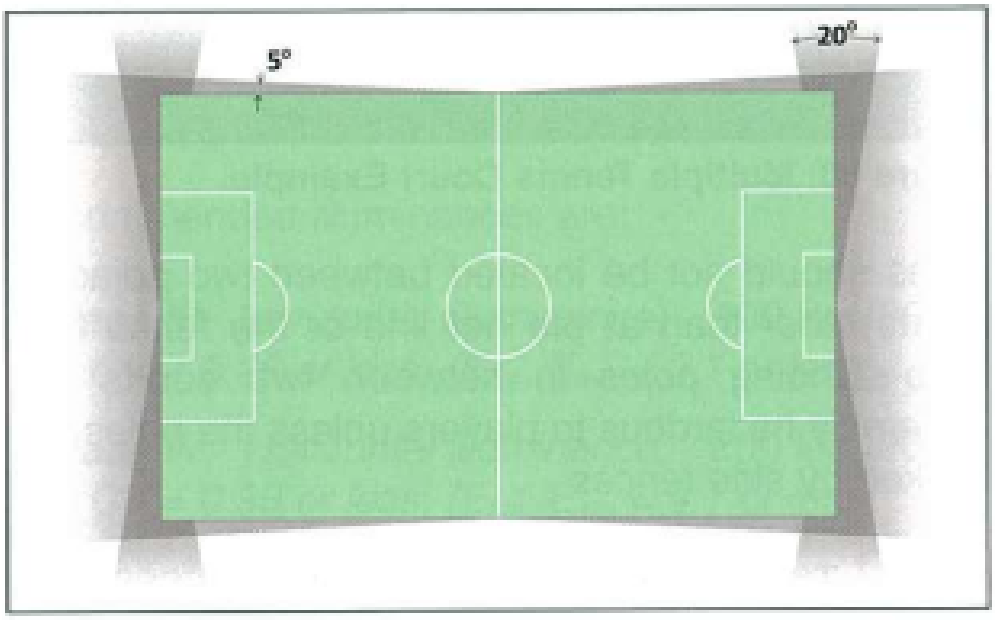


Figure 77: Soccer Field Glare Zones.

Proposed Solutions

A comparative study was proposed in order to determine the most appropriate lighting design strategy for the multi-purpose field, and also to address the light impacts and glare on neighboring buildings and community. The design shall properly illuminate the field to meet IESNA recommended criteria while taking into account the specific site conditions, with special attention to light trespass and glare upon adjacent properties. Glare and light trespass are impacted by pole height, fixture specification, and aiming angles. Light pollution, on the other hand, is primarily impacted by fixture specification and aiming angles; pole height does not make an impact on light pollution.

This study will first compare three (3) different pole heights (18'-0" vs. 25'-0" vs. 35'-0") in order to determine the resulting aiming angles for each option. Two (2) configuration options (4-pole vs. 6-pole layouts) will then be explored for each acceptable pole height.

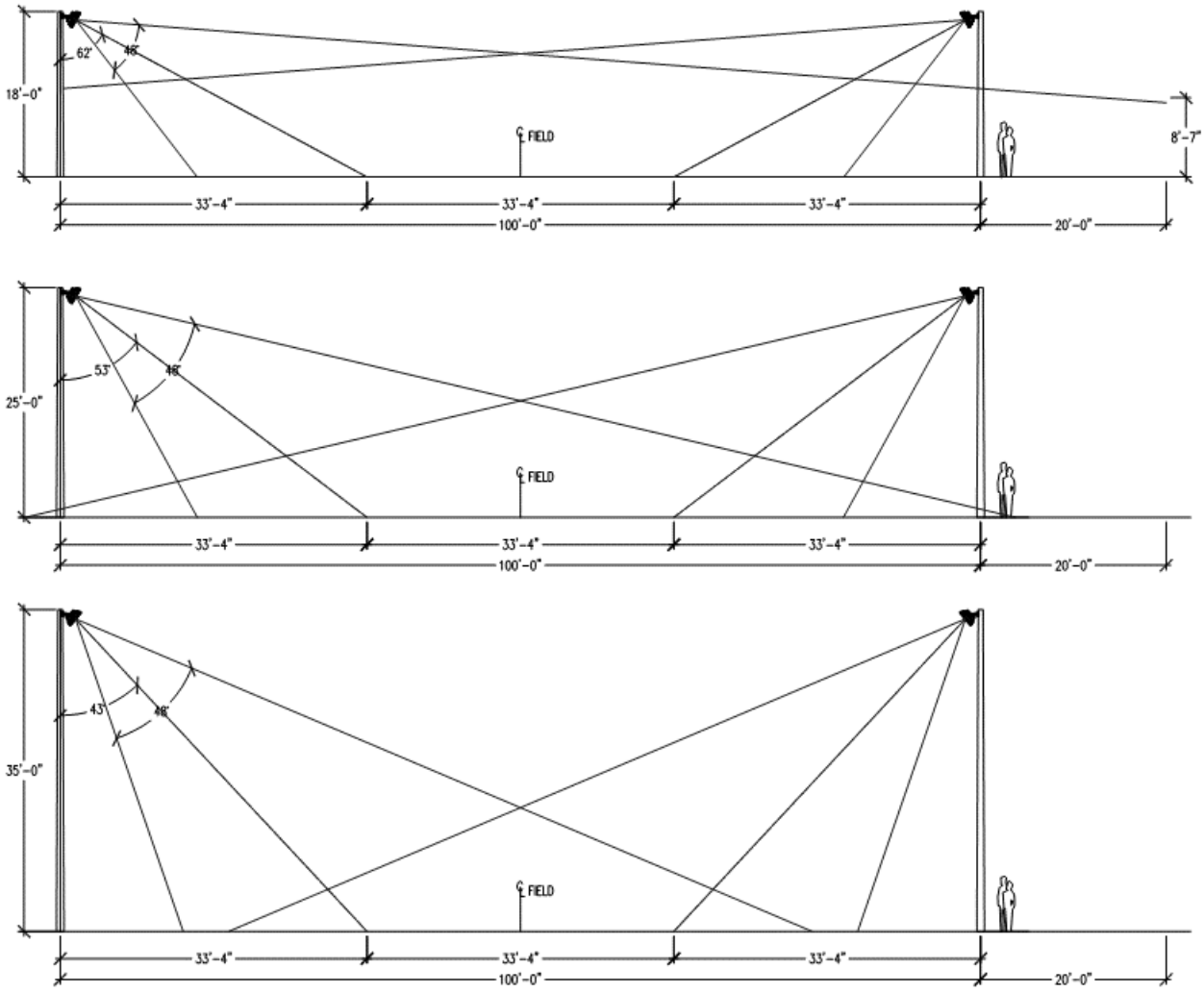
LDA has proposed (2) lighting fixture solutions for comparison, each using (3) fixtures mounted onto each pole. The first "architectural" solution uses high-output LED exterior floodlights from BEGA with a symmetrical light distribution. The second "performance" solution uses high-output LED exterior floodlights from MUSCO Lighting with a directed asymmetric light distribution. Each of these specification options has precisely aimed optics which direct the light only towards the field's ground plane. In conjunction with factory-installed glare shields, this level of optical control significantly reduces any contribution of direct light pollution (light emitted above the 0° plane and into the night sky). In terms of light pollution, the only contribution will be a result of light reflecting off of the field and immediately adjacent hardscape surfaces.

Pole Height Comparison

LDA first conducted basic section studies to analyze the three (3) pole heights and resulting aiming angles, given the geometry of the field and an estimated 100'-0" pole spacing. The BEGA floodlights with a 48° beam angle were used as the baseline option for this initial section study. When fixtures are aimed to a fixed point on the field (33'-4", or 1/3 across the width of the field), they become tilted to the below vertical angles (measured from 0°, or straight down):

- 18'-0" Pole Height – Fixture Aiming Angle = 62°
- 25'-0" Pole Height – Fixture Aiming Angle = 53°
- 35'-0" Pole Height – Fixture Aiming Angle = 43°

A graphical representation of these three (3) studies is included on the following page.

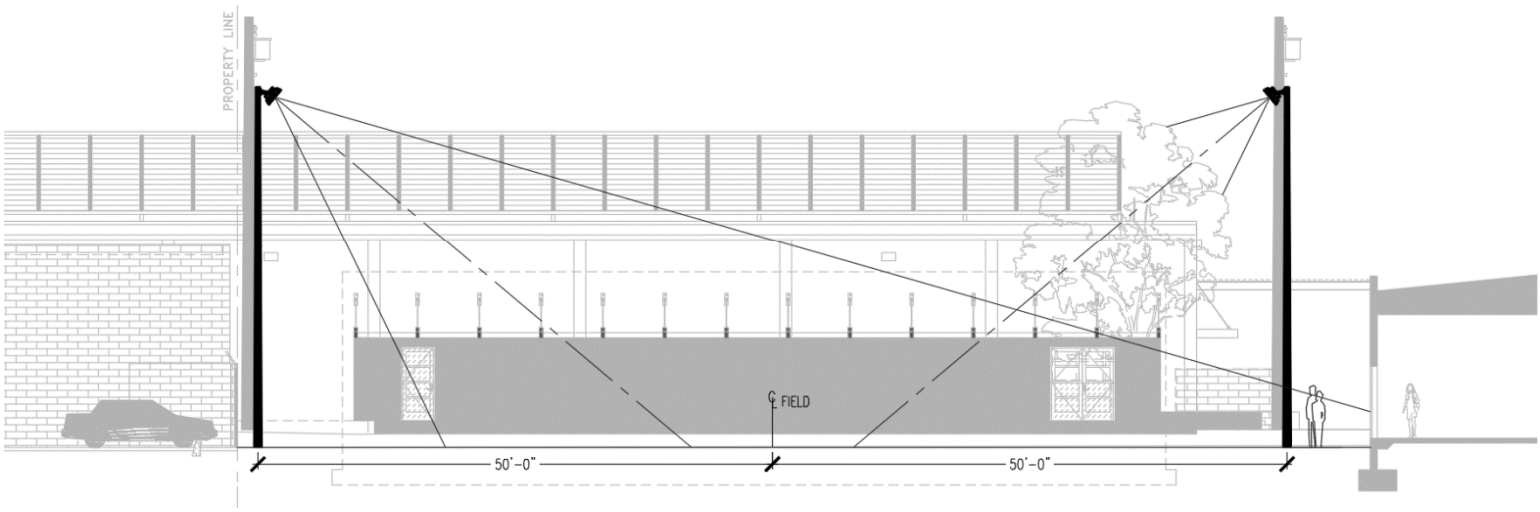


Section Diagrams – 18’-0”, 25’-0”, and 35’-0” Pole Heights

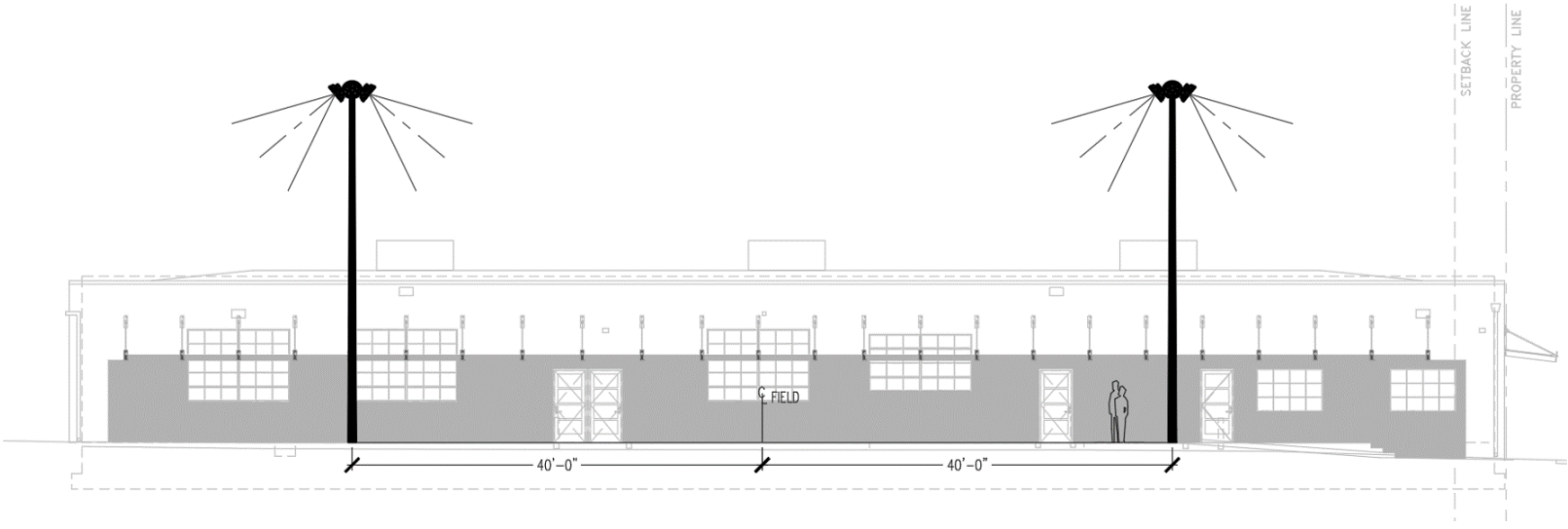
This basic section study is not intended to determine the final precise aiming angle of each fixture head, but rather to illustrate the relationship between pole height and aiming angles. These angles are dictated by the geometry of field dimensions compared to the height of light poles. Higher aiming angles result in increased probability of glare and light trespass into adjacent properties, thus greater pole heights are recommended in order to reduce glare and light trespass. This relationship is a primary reason why 18’-0” pole heights are not recommended, as they will result in a much higher probability of glare and light trespass. As previously discussed, light pollution is independent of pole height, as it is more closely tied to the fixture specification and aiming angles. The exact light fixture specification will certainly impact glare control and light trespass; the difference in specifications will be discussed in greater detail in the specific lighting calculation studies.

The below two (2) elevations illustrate the recommended 35’-0” poles in relation to the field geometry, property line, and adjacent buildings. At their highest 35’-0” level, the fixture heads are at a comparable height as the adjacent Willows IV building to the north of the field.

The poles’ close proximity to the west property line will make it difficult to eliminate 100% of the spill light onto adjacent properties, so fixtures must be selected which offer excellent optical control capable of directing as much of the emitted light as possible onto the field surface. House-side shields shall be installed to minimize light trespass along the south property line. Please refer to the specific lighting photometric studies for calculated footcandle levels at property lines and into adjacent parking lot.



North Elevation – 35’-0” Pole Height



East Elevation – 35’-0” Pole Height

LIGHTING DESIGN STUDY: BEGA

Specification Information

LDA reviewed multiple 'architectural' floodlight solutions appropriate for lighting the multi-purpose field. It was decided to use a high-performance floodlight from BEGA as the baseline option, given the manufacturer's reputation for high quality products and excellent light control. BEGA's large-scale LED floodlight (84542) proved to be the most viable option in order to achieve the performance and uniformity criteria established by the IESNA's recommended criteria. It should be noted that the beam emitted from this BEGA fixture is symmetrical with a 48° beam angle, compared to the asymmetrical distribution from MUSCO Lighting's solution. Multiple photometric iterations were calculated using the BEGA fixture.

Manufacturer: BEGA
High- Performance Floodlight, Dimmable
Part Number: 84542-K4-71105-71101-70761
Wattage: 326W, per head (x3 heads, x4 poles), Total Wattage 3,912W
Beam Angle: 48°, Symmetrical
CCT: 4000K, 80+ CRI
Output: 54,420 Lumens

Please refer to the product cut sheet attached at the end of this report for detailed information.

Calculation Parameters

Calculation Point Grid Spacing: 10'-0" X 10'-0"
Height of Grid: 3'-0" Above Grade
Pole Quantity: Four (4)-Pole and Six (6)-Pole Configurations Were Calculated
Pole Heights: 18'-0", 25'-0", and 35'-0" options were calculated.

Calculation Results

Please refer to the BEGA photometric studies attached at the end of this report for more detailed information and calculation points.

Recommended 35'-0" Pole Height, Four (4)-Pole Configuration:

- Average = 28.1 fc
- Max = 52.0 fc
- Min = 10.9 fc
- Avg:Min Uniformity Ratio = 2.58
- Max:Min Uniformity Ratio = 4.77

Calculation Comparison – 35'-0" and 25'-0" Pole Heights

For the Willows multi-purpose field, calculated values that meet the IESNA recommended criteria are shown in GREEN. Values that do not meet the criteria are shown in RED.

BEGA, (4) 35'-0" Poles					
	Avg (fc)	**Max (fc)**	**Min (fc)**	**Avg:Min**	**Max:Min**
Higuera St.	0.68	1.6	0.1	6.8	16.0
Property Line	4.14	12.1	0.1	41.4	121.0
Sidewalk	3.35	7.5	0.0	N/A	N/A
Adj. Parking	0.47	0.9	0.0	N/A	N/A
Ped. Plaza	3.96	11.9	0.0	N/A	N/A
Willows Field	28.14	52.0	10.9	2.58	4.77
BEGA, (6) 35'-0" Poles					
	Avg (fc)	**Max (fc)**	**Min (fc)**	**Avg:Min**	**Max:Min**
Higuera St.	0.75	1.8	0.1	7.5	18.0
Property Line	6.12	17.5	0.1	61.2	175.0
Sidewalk	3.38	7.5	0.1	33.8	75.0
Adj. Parking	0.77	1.5	0.1	7.7	15.0
Ped. Plaza	4.31	12.6	0.0	N/A	N/A
Willows Field	43.07	77.1	12.0	3.59	6.43
BEGA, (4) 25'-0" Poles					
	Avg (fc)	**Max (fc)**	**Min (fc)**	**Avg:Min**	**Max:Min**
Higuera St.	0.16	0.5	0.0	N/A	N/A
Property Line	4.68	21.3	0.0	N/A	N/A
Sidewalk	0.13	1.9	0.0	N/A	N/A
Adj. Parking	0.21	0.5	0.0	N/A	N/A
Ped. Plaza	1.56	5.4	0.0	N/A	N/A
Willows Field	30.35	103	6.0	5.06	17.1
BEGA, (6) 25'-0" Poles					
	Avg (fc)	**Max (fc)**	**Min (fc)**	**Avg:Min**	**Max:Min**
Higuera St.	0.18	0.6	0.0	N/A	N/A
Property Line	7.12	22.9	0.0	N/A	N/A
Sidewalk	0.13	1.9	0.0	N/A	N/A
Adj. Parking	0.35	0.7	0.0	N/A	N/A
Ped. Plaza	1.62	5.5	0.0	N/A	N/A
Willows Field	45.66	118	6.6	6.92	17.88

Calculation Comparison – 18'-0" Pole Heights

For the Willows multi-purpose field, calculated values that meet the IESNA recommended criteria are shown in GREEN. Values that do not meet the criteria are shown in RED.

BEGA, (4) 18'-0" Poles					
	Avg (fc)	**Max (fc)**	**Min (fc)**	**Avg:Min**	**Max:Min**
Higuera St.	0.03	0.1	0.0	N/A	N/A
Property Line	5.9	27.2	0.0	N/A	N/A
Sidewalk	0.02	0.3	0.0	N/A	N/A
Adj. Parking	0.12	0.3	0.0	N/A	N/A
Ped. Plaza	0.47	2.0	0.0	N/A	N/A
Willows Field	31.77	174	1.6	19.86	108.75
BEGA, (4) 18'-0" Poles, Steep Aiming Angles					
	Avg (fc)	**Max (fc)**	**Min (fc)**	**Avg:Min**	**Max:Min**
Higuera St.	0.77	2.0	0.2	3.85	10.0
Property Line	1.44	3.4	0.2	7.2	17.0
Sidewalk	0.21	2.1	0.0	N/A	N/A
Adj. Parking	0.61	1.1	0.1	6.1	11.0
Ped. Plaza	3.48	9.5	0.0	N/A	N/A
Willows Field	25.98	79.6	2.1	12.37	37.9
BEGA, (6) 18'-0" Poles					
	Avg (fc)	**Max (fc)**	**Min (fc)**	**Avg:Min**	**Max:Min**
Higuera St.	0.03	0.1	0.0	N/A	N/A
Property Line	9.16	34.1	0.0	N/A	N/A
Sidewalk	0.02	0.3	0.0	N/A	N/A
Adj. Parking	0.18	0.4	0.0	N/A	N/A
Ped. Plaza	0.50	2.0	0.0	N/A	N/A
Willows Field	48.50	183	2.1	23.1	87.19
BEGA, (6) 18'-0" Poles, Steep Aiming Angles					
	Avg (fc)	**Max (fc)**	**Min (fc)**	**Avg:Min**	**Max:Min**
Higuera St.	0.78	2.0	0.2	3.9	10.0
Property Line	2.11	4.3	0.2	10.55	21.5
Sidewalk	0.28	2.2	0.0	N/A	N/A
Adj. Parking	0.96	1.6	0.3	3.2	5.33
Ped. Plaza	4.08	10.3	0.0	N/A	N/A
Willows Field	39.27	107	4.8	8.18	22.19

LIGHTING DESIGN STUDY: MUSCO Lighting

Specification Information

To collaborate on this project, LDA approached MUSCO Lighting, a manufacturer which specializes in sports lighting. MUSCO's high output LED luminaires offer an asymmetric light distribution, providing greater optical control and directing a higher percentage of the fixtures' light towards the field itself, rather than into surrounding areas and causing unwanted glare, light trespass, or light pollution. This solution meets and exceeds the design criteria established by the IESNA's recommendations.

Manufacturer: MUSCO Lighting
High- Performance Floodlight, Dimmable
Part Number: TLC-LED-400
Wattage: 400W, per head (x3 heads, x4 poles), Total Wattage 4,800W
Beam Angle: Asymmetric
CCT: 5700K, 75-CRI
Output: 38,600 Lumens

Please refer to the product cut sheet attached at the end of this report for detailed information.

Calculation Parameters

Calculation Point Grid Spacing: 10'-0" X 10'-0"
Height of Grid: 3'-0" Above Grade
Pole Quantity: Four (4)-Pole Configuration
Pole Height: 35'-0" Above Grade

Calculation Results

Please refer to the MUSCO photometric studies attached at the end of this report for more detailed information and calculation points.

Recommended 35'-0" Pole Height, Four (4)-Pole Configuration:

- Average = 35.2 fc
- Max = 42.8 fc
- Min = 22.8 fc
- Avg:Min Uniformity Ratio = 1.55
- Max:Min Uniformity Ratio = 1.88

ANALYSIS

Photometric Analysis

When analyzing the multiple iterations of the baseline BEGA photometrics, it was determined that a 35'-0" pole height should be used in order to properly illuminate the multi-purpose field to meet the IESNA recommended criteria. Lower 25'-0" and 18'-0" pole heights do not provide sufficient uniformity ratios onto the field, and they would result in a significant source of glare and light trespass due to their higher aiming angles. Pole height does not impact light pollution, however both specification options presented include glare shields and precisely aimed optics which restrict significant light pollution above the 0° horizontal plane and into the nighttime sky.

The best performance calculated from a 25'-0" pole utilized (4) pole locations. This solution provided an average of 30.3 footcandles, with an avg:min uniformity ratio of 8.06 and a max:min uniformity ratio of 17.1. As illustrated in the Calculation Comparison section (page 9), increasing the pole quantity to (6) poles also increases the average illuminance to 45.66 footcandles, but it does not necessarily improve the uniformity ratios (6.92 avg:min and 17.88 max:min). This calculation was performed with aiming angles of 30° - 40° (measured from vertical), which are acceptable values to minimize overhead glare. At these aiming angles, the illuminance contributions onto nearby residential properties (light trespass) will be negligible. Any increase in aiming angles would result in increased glare (especially from the adjacent parking lot to the west), due to the direction the poles at the east side of the field must be aimed.

The best performance calculated from an 18'-0" pole height utilized (6) pole locations and steep aiming angles (60° - 70° from vertical). This steep of an aiming angle is strongly ill-advised, as it will result in excessive glare for people on the field as well as from adjacent properties. A person standing in the adjacent parking lot to the west would experience significant glare from the poles at the east side of the field, as the light emitted is entering the person's eye at an angle of only 20° from the horizontal plane (70° from vertical). The intensity of light at this incident angle would cause both discomfort and disability glare from such high-output luminaires. From a light level perspective, this 18'-0" pole solution provided an average of 39.3 footcandles, with an avg:min uniformity ratio of 8.18 and a max:min uniformity ratio of 22.19. These values are far from meeting the IESNA recommended design criteria. Shorter light poles inherently result in steeper aiming angles, and steeper aiming angles inherently result in a sharp increase in visual glare. Light trespass onto residential properties would still likely be negligible, however due to the steep aiming angles, there is a higher risk for glare into residential properties. The section studies further support the requirement for higher poles in order to reduce aiming angles and glare.

The recommended configuration of four (4)-poles with 35'-0" height was calculated to contribute an average of approximately 0.5 footcandles onto the adjacent parking lot, with maximum isolated contributions of 12.0 footcandles immediately around each pole at the south property line. These values may vary slightly in an actual installation due to more exact site conditions, surface reflectances, and specification options.

BEGA, (4) 35'-0" Poles (RECOMMENDED)					
	Avg (fc)	**Max (fc)**	**Min (fc)**	**Avg:Min**	**Max:Min**
Higuera St.	0.68	1.6	0.1	6.8	16.0
Property Line	4.14	12.1	0.1	41.4	121.0
Sidewalk	3.35	7.5	0.0	N/A	N/A
Adj. Parking	0.47	0.9	0.0	N/A	N/A
Ped. Plaza	3.96	11.9	0.0	N/A	N/A
Willows Field	28.14	52.0	10.9	2.58	4.77

Timeclock Control

In terms of lighting control, LDA recommends using an astronomical timeclock to limit their hours of operation to nighttime up to a determined shut-off time. It is proposed that this automatic shut-off time be 9:00pm.

Dimming Control

The light fixtures are also to incorporate dimming capability in order to provide energy savings, reduce unwanted glare, and to provide flexible light levels based on the specific event taking place on the field. Of all anticipated uses for the multi-purpose field, athletic events require the highest lighting levels (20-fc recommended). The system can be commissioned so that the light fixtures are dimmed to a fixed level, providing no more than a 20-fc average on the field surface for athletic events. For reference, the BEGA and MUSCO lighting systems were calculated to provide an average of 28-fc and 35-fc, respectively.

Multiple scene presets can be programmed for even lower light levels (ie. 1-fc, 5-fc, 10-fc, and 15-fc presets), to be used for various school and recreational events which do not require as high of light levels as athletic events. This 'pre-set scene' dimming approach would further minimize any possibility of excessive glare or light trespass onto adjacent properties. The dimming control provides simple capability for low-level lighting, rather than by installing additional low level poles along the perimeter fence posts.

Mitigation

In the event the lighting system is determined to have a negative impact onto adjacent commercial or residential properties, whether the impact is subjective or measurable, the integrated dimming system shall be utilized for mitigation efforts in order to prevent excessive glare or light trespass. Refer to the attached MUSCO Lighting specification sheets for detailed information.

LDA RECOMMENDATION

While both the 'architectural' solution (BEGA) and the 'performance' solution (MUSCO) each can be used to satisfy the IESNA recommended design criteria, LDA recommends that MUSCO Lighting's product be used in a four (4)-pole configuration and a 35'-0" pole height. This fixture specification option was selected as it presents precisely controlled asymmetric optics and factory pre-aimed fixture heads in order to reduce glare, light trespass, and light pollution, all while simultaneously illuminating the field to an excellent uniformity ratio (1.88 Max:Min). The greater pole heights will actually result in reduced glare onto adjacent properties, due to the reduced aiming angles. House-side glare shields shall be installed onto each light fixture head in order to further minimize the potential for light trespass or glare. The MUSCO lighting fixtures will use a combination of astronomical timeclock with an automatic shut-off time, as well as dimming scene preset control in order to provide flexibility for a variety of field uses and corresponding light levels (1fc – 20fc).

APPENDIX A:

FIXTURE SPECIFICATIONS: BEGA

LED large scale floodlights - high ambient temperature - wide beam distribution

BEGA

Type:
BEGA Product:
Project:
Modified:

Application
LED high-performance floodlight for use in high ambient temperatures with wide beam light distribution for use on bridges, large signage and facades.

Materials
Floodlight housing constructed of die-cast, marine grade, copper free (≤0.3% copper content) A360.0 aluminum alloy
Clear safety glass
High temperature silicone gasket
Reflector surface made of pure aluminum
3/16“ stainless steel mounting yoke
Optional vibration rated mounting yoke rated for a maximum 3.0G vibration load rating per ANSI C 136.21-2010 (use suffix VR)
NRTL listed to North American Standards, suitable for wet locations
Protection class IP67
Effective projection area: 2.16 sq. ft.
Weight: 48.5 lbs

Electrical

Operating voltage	120-277V AC
Minimum start temperaure	-30°C
Maximum ambient temperature	45°C (50°C when aimed > 50°)
LED module wattage	303.0W
System wattage	326.0W
Controlability	0-10V dimmable
Color rendering index	Ra>80
Luminaire lumens	54,420 lumens (4000K)
Lifetime at Ta=15°C	280,000 h (L70)
Lifetime at Ta=40°C	150,000 h (L70)

LED color temperature
☐ 4000K - Product number + **K4**
○ 3500K - Product number + **K35**
○ 3000K - Product number + **K3**
○ 2700K - Product number + **K27**
○ 2200K - Product number + **K2**

BEGA can supply you with suitable LED replacement modules for up to 20 years after the purchase of LED luminaires - see website for details

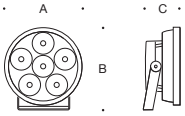
Finish
All BEGA standard finishes are matte, textured polyester powder coat with minimum 3 mil thickness.

Available colors ☐ Black (BLK) ○ White (WHT) ○ RAL:
○ Bronze (BRZ) ○ Silver (SLV) ○ CUS:

Available Accessories
☐ **71101** 180° Glare sheild
☐ **79509** 360° Glare sheild
☐ **71105** Internal louver

Mounting options
☐ **79435** Mounting bracket for pole top Ø 3“
☐ **79553** Pole mount canopy for 5” O.D. pole
☐ **79554** Wall mount canopy
☐ **79550** Pole mount arm for for 5” O.D. pole
☐ **79551** Wall mount arm
☐ **79555** Pole mount hub for pole top Ø 3“
☐ **70762** Pole top for 2 floodlights
☐ **70763** Pole top for 3 floodlights
☐ **70764** Pole top for 4 floodlights
☐ **70761** Cross beam for 3 floodlights
☐ **70765** Cross beam for 6 floodlights

See individual accessory specification sheet for details.



High-performance floodlights · very narrow beam

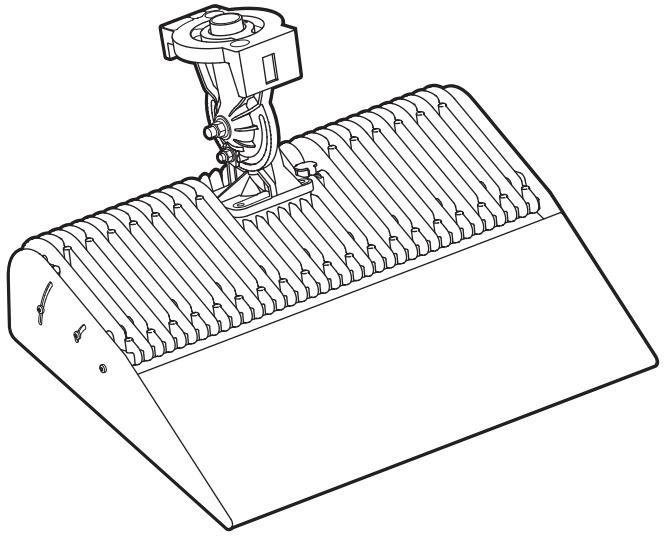
	LED	β	A	B	C
84542	303.0 W	48°	19½	20⅞	12¼

β = Beam angle

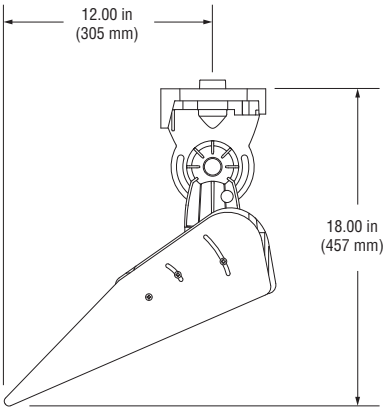
BEGA 1000 BEGA Way, Carpinteria, CA 93013 (805) 684-0533 info@bega-us.com

Updated 01/25/18

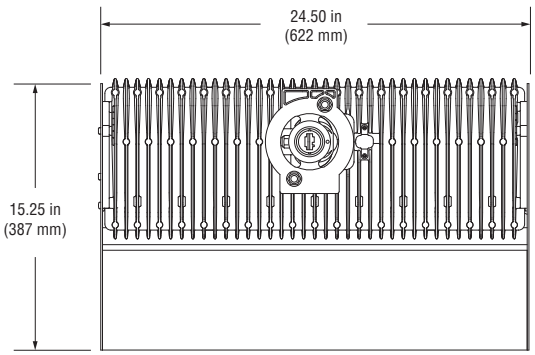
APPENDIX B:
FIXTURE SPECIFICATIONS: MUSCO LIGHTING



Side



Top



Luminaire Data

Weight (luminaire) . . . . . 35 lb (16 kg)

UL listing number E338094

UL Listed for USA / Canada UL1598 CSA-C22.2 No.250.0

Ingress protection, luminaire IP65

Material and finish . . . . . Aluminum, powder-coat painted

Wind speed rating (aiming only) . . . . . 150 mi/h (67 m/s)

Photometric Characteristics

Projected lumen maintenance per IES TM-21-11

L90(12k). . . . . =61,000 h

L80(12k). . . . . >72,000 h

L70(12k). . . . . >72,000 h

CIE correlated color temperature . . . . . 5700 K

Color Rendering Index (CRI), typical. 75

Color Rendering Index (CRI), minimum 70

Lumens[1] 38,600

Footnotes:

1) Incorporates appropriate dirt depreciation factor for life of luminaire.

Driver Data

Electrical Data

Rated wattage[1]

- Per driver . . . . . 800 W
- Per luminaire . . . . . 400 W

Number of luminaires per driver 2

Starting (inrush) current . . . . . <40 A, 256 µ

Fuse rating . . . . . 15 A

IEC ambient temperature rating, electrical components enclosure . . . . . .25°C (77°F)

UL ambient temperature rating, electrical components enclosure . . . . . 50°C (122°F)

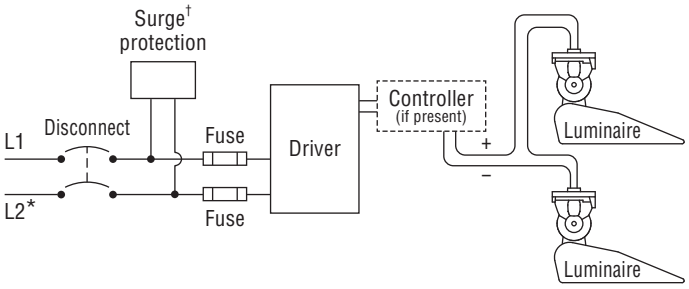
Ingress protection, electrical components enclosure IP54

Efficiency 95%

Dimming mode . . . . . optional

- Range, energy consumption . . . . . .20 – 100%
- Range, light output . . . . . .25 – 100%

Typical Wiring



* If L2 (com) is neutral then not switched or fused.
† Not present if indoor installation.

	200 Vac 50/60 Hz	208 Vac 60 Hz	220 Vac 50/60 Hz	230 Vac 50 Hz	240 Vac 50/60 Hz	277 Vac 60 Hz	347 Vac 60 Hz	380 Vac 50/60 Hz	400 Vac 50 Hz	415 Vac 50 Hz	480 Vac 60 Hz
Max operating current[2]	5.12 A	4.92 A	4.66 A	4.44 A	4.26 A	3.70 A	2.96 A	2.70 A	2.56 A	2.48 A	2.14 A

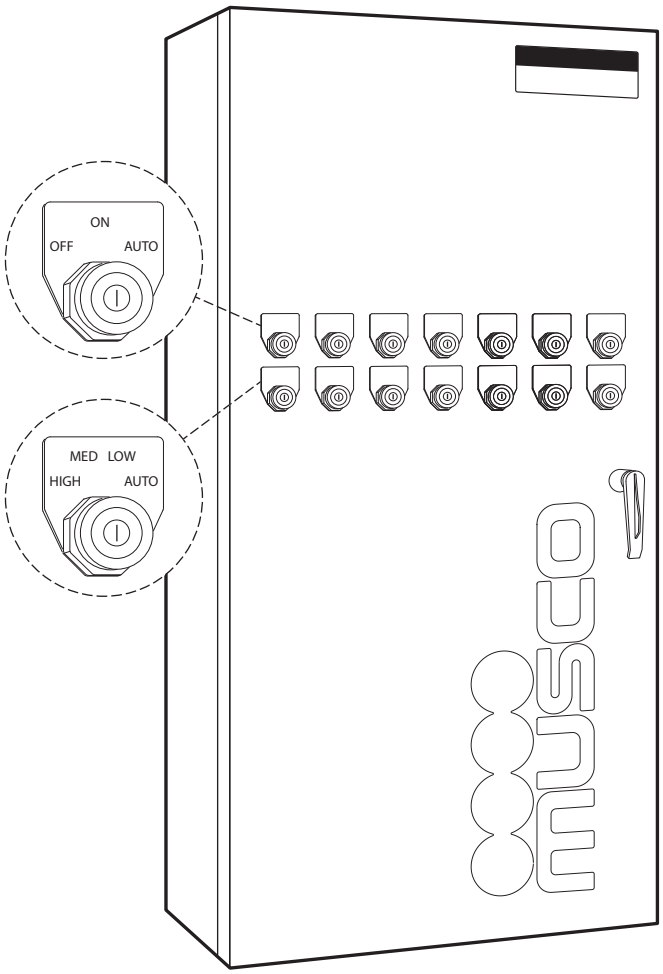
Footnotes:

1) Rated wattage is the power consumption, including driver efficiency losses, at stabilized operation in 25˚C ambient temperature environment.

2) Operating current includes allowance for 0.90 minimum power factor, operating temperature, and LED light source manufacturing tolerances.

Notes

1. Use thermal magnetic HID-rated or D-curve circuit breakers.
2. See Musco *Control System Summary* for circuit information.



Overview

The Multi-Watt™ dimming control system makes it possible to operate your lighting system at multiple energy and light levels appropriate to the activities taking place.

	Electrical Consumption	Energy Savings	Light Output
High	100%	—	100%
Medium	50%	50%	50%
Low	20%	Up to 80%	25%

Features

- Reduces system electrical consumption
- Key-activated switches allow for automated dimming control or manual override with switches
- Engineered to work with Musco's industry-leading LED sports-lighting systems
- Durable construction may be mounted inside or outside
- Factory assembled and wired, in our UL-authorized manufacturing facility
- Fully integrated with Musco lighting control system—Control-Link® control and monitoring system or lighting contactor cabinet
- Separate dimming control box provided if not utilizing Musco lighting control system

Control-Link® Control and Monitoring System

- Allows administrator to set dimming schedule for various activity needs. High, medium, and low light level schedules can be pre-set

Key Override

- Allows authorized users to override normal dimming schedule

Technical Specifications

Construction

- NEMA 4, IP65 cabinet (separate cabinet provided if lighting control system not provided by Musco)
- Operates on either 120 Vac or 230 Vac phase-to-neutral power

1

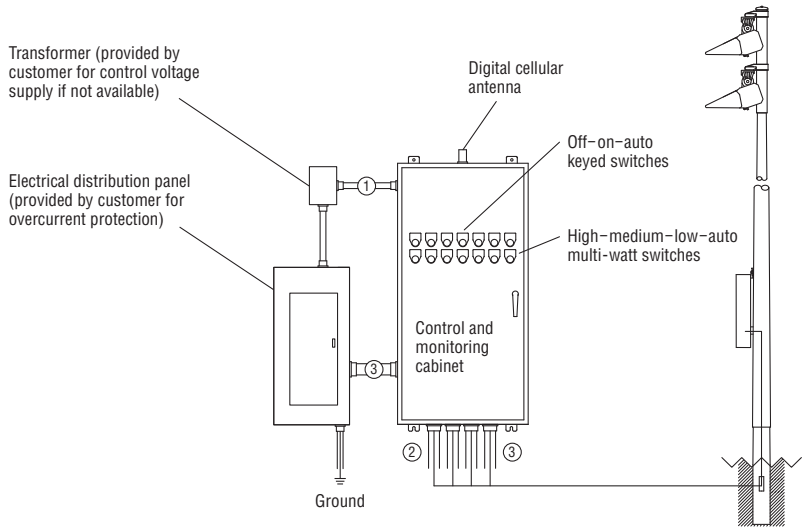
Supplied by Contractor

- Proper circuit protection per NEC
- 120 Vac or 230 Vac phase-to-neutral circuit from service distribution panel to control cabinet continuing to the electrical components enclosure at each pole location in lighting zone.
  - Use 2-wire circuit for high/low systems
  - Use 3-wire circuit for high/med/low systems
  - Max distance of 2500 ft for 14 AWG wires (760 m for 2.5 mm^2 wires). For longer distances, contact Musco for wire sizing 800-825-6020 or +1-641-673-0411.

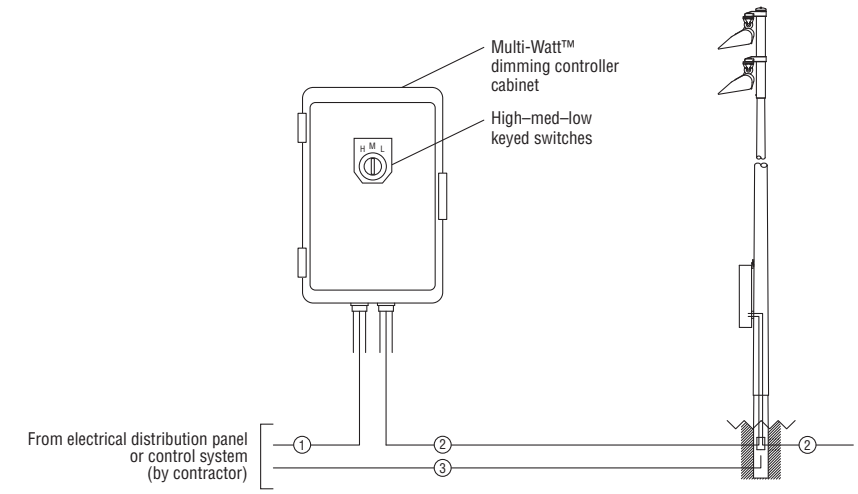
Connecting the Lighting Equipment

At each electrical components enclosure, the control circuit connects to the auxiliary contacts on the disconnect switch and neutral lugs.

With Musco Lighting Control System



Standalone System



Wire	Description	# of Wires	Typ. Wire Size	Max. Wire Length	Wire from Musco	Notes
1	Multi-Watt™ control power	3	14 AWG (2.5 mm^2)	See Note D	No	A, B, D
2	Switched Multi-Watt™ control power	See Note A	14 AWG (2.5 mm^2)	See Note D	No	A, B, D
3	Power to lighting circuits	See Note C				

Notes:
A. High/med/low requires 3 conductors (Sw1, Sw2, N). High/low requires 2 conductors (Sw1, N).
B. Multi-Watt control power is routed from first lighting pole to additional poles in lighting zone.
C. See Musco Control System Summary for lighting circuit details including full load amps, max wire length, and conduit sizing.
D. Total wire length for 1 & 2 not to exceed 2500 ft (762 m) for up to 150 luminaires.

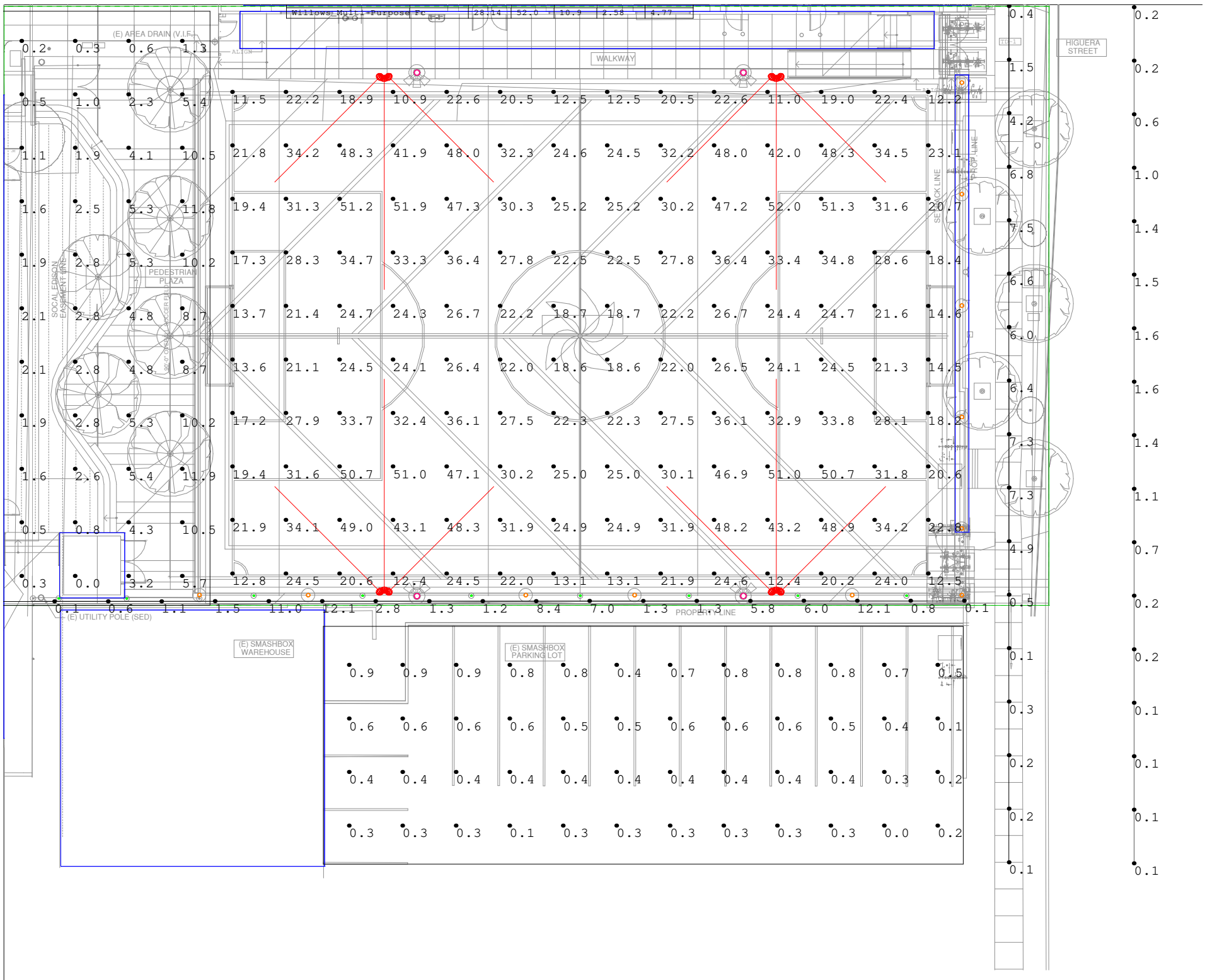
APPENDIX C:

PHOTOMETRIC STUDY: BEGA

LIGHTING DESIGN ALLIANCE
WILLOWS COMMUNITY SCHOOL - MULTI-PURPOSE FIELD
PHOTOMETRIC STUDY
(4) 35'-0" POLES
05-JUNE-2016

LIGHTING DESIGN ALLIANCE

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Higuera Street	Illuminance	Fc	0.68	1.6	0.1	6.80	16.00
Property Line	Illuminance	Fc	4.14	12.1	0.1	41.40	121.00
Sidewalk	Illuminance	Fc	3.35	7.5	0.0	N.A.	N.A.
Smaxhbox Parking Lot	Illuminance	Fc	0.47	0.9	0.0	N.A.	N.A.
Willows Pedestrian Plaza	Illuminance	Fc	3.96	11.9	0.0	N.A.	N.A.
Willows_Multi-Purpose Field	Illuminance	Fc	28.14	52.0	10.9	2.58	4.77

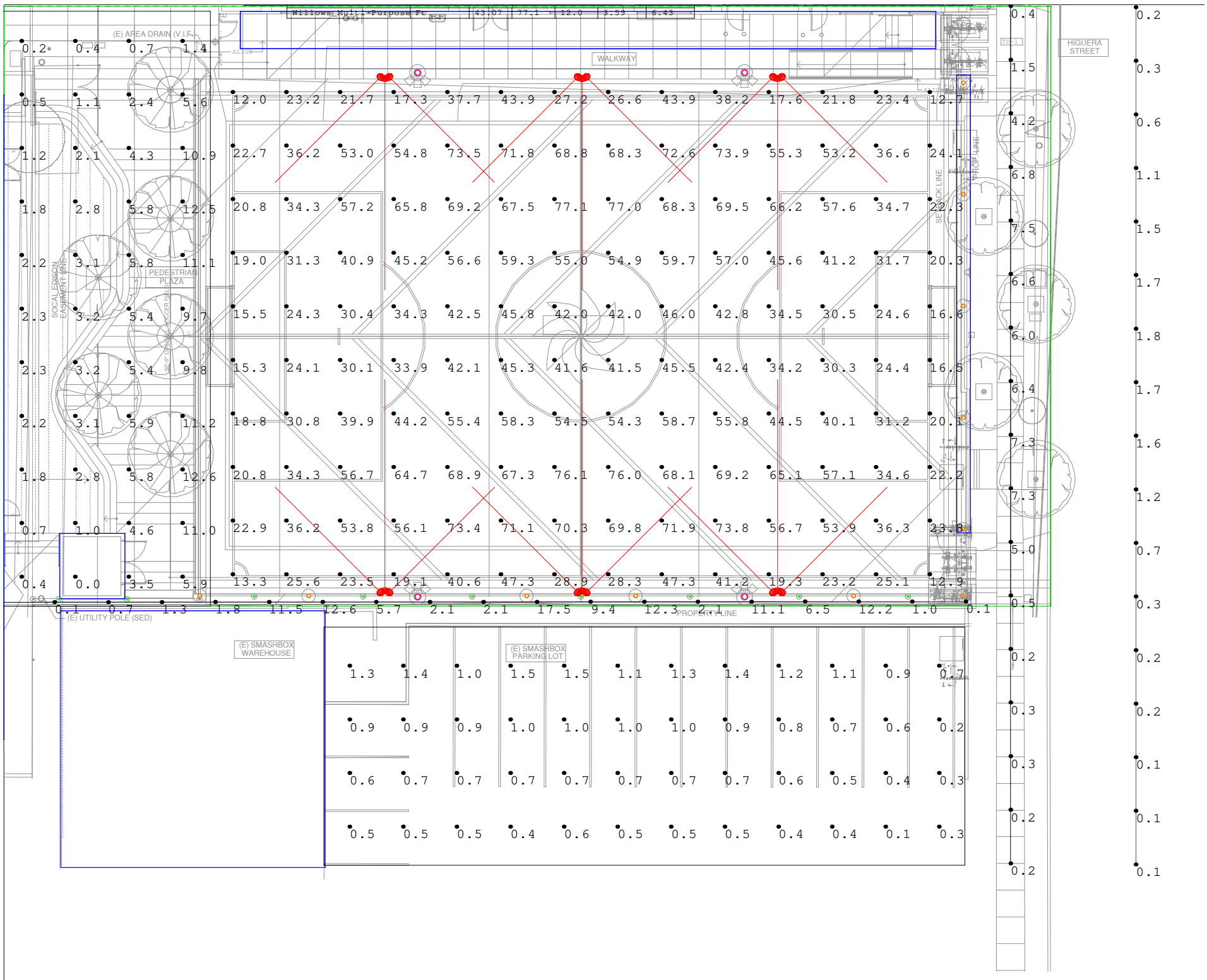


Illuminance Values (FC)

LIGHTING DESIGN ALLIANCE
WILLOWS COMMUNITY SCHOOL - MULTI-PURPOSE FIELD
PHOTOMETRIC STUDY
(6) 35'-0" POLES
05-JUNE-2016

LIGHTING DESIGN ALLIANCE

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Higuera Street	Illuminance	Fc	0.75	1.8	0.1	7.50	18.00
Property Line	Illuminance	Fc	6.12	17.5	0.1	61.20	175.00
Sidewalk	Illuminance	Fc	3.38	7.5	0.1	33.80	75.00
Smaxhbox Parking Lot	Illuminance	Fc	0.77	1.5	0.1	7.70	15.00
Willows Pedestrian Plaza	Illuminance	Fc	4.31	12.6	0.0	N.A.	N.A.
Willows_Multi-Purpose Field	Illuminance	Fc	43.07	77.1	12.0	3.59	6.43

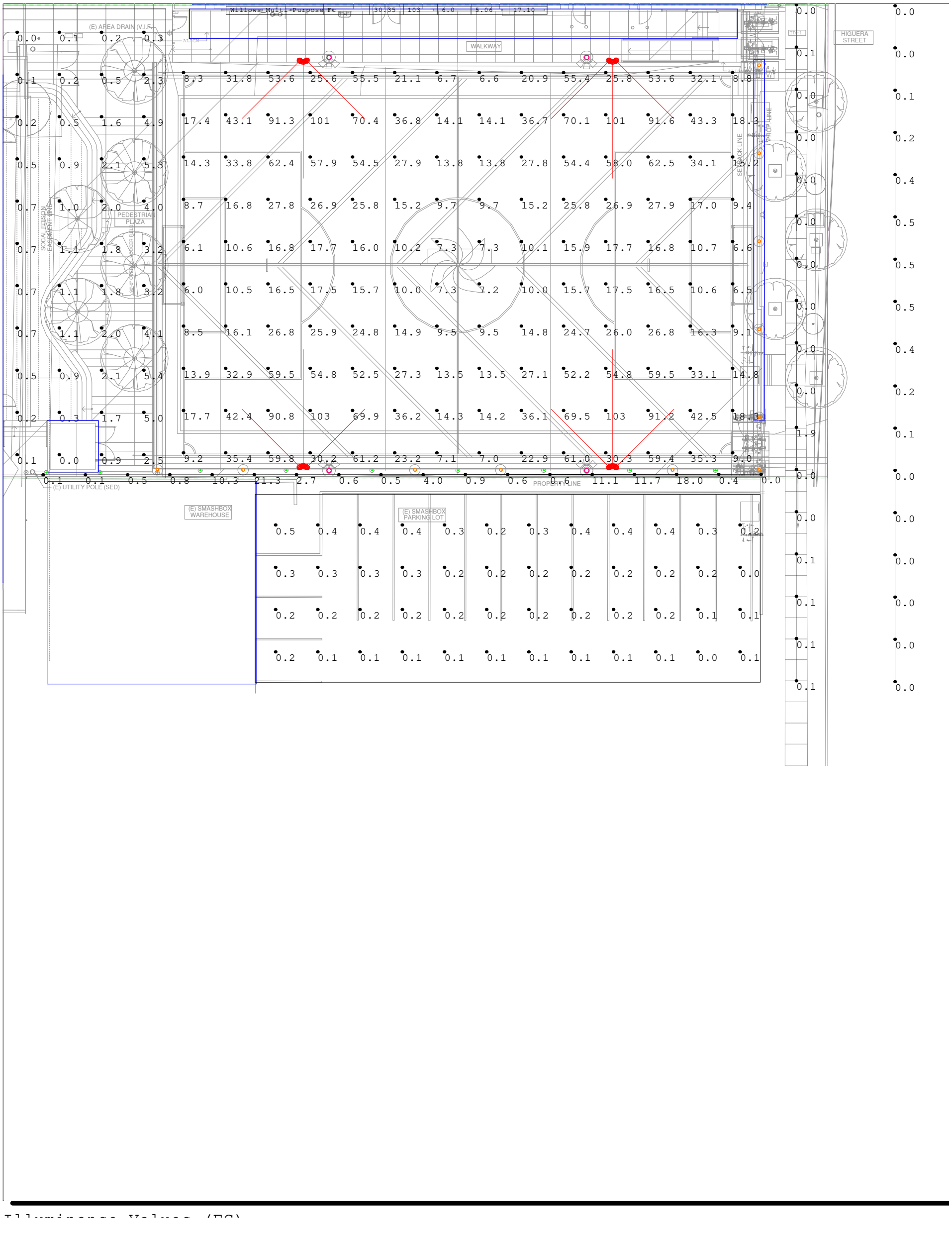


Illuminance Values (FC)

LIGHTING DESIGN ALLIANCE
WILLOWS COMMUNITY SCHOOL - MULTI-PURPOSE FIELD
PHOTOMETRIC STUDY
(4) 25'-0" POLES
05-JUNE-2016

LIGHTING DESIGN ALLIANCE

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Higuera Street	Illuminance	Fc	0.16	0.5	0.0	N.A.	N.A.
Property Line	Illuminance	Fc	4.68	21.3	0.0	N.A.	N.A.
Sidewalk	Illuminance	Fc	0.13	1.9	0.0	N.A.	N.A.
Smaxhbox Parking Lot	Illuminance	Fc	0.21	0.5	0.0	N.A.	N.A.
Willows Pedestrian Plaza	Illuminance	Fc	1.56	5.4	0.0	N.A.	N.A.
Willows_Multi-Purpose Field	Illuminance	Fc	30.35	103	6.0	5.06	17.10

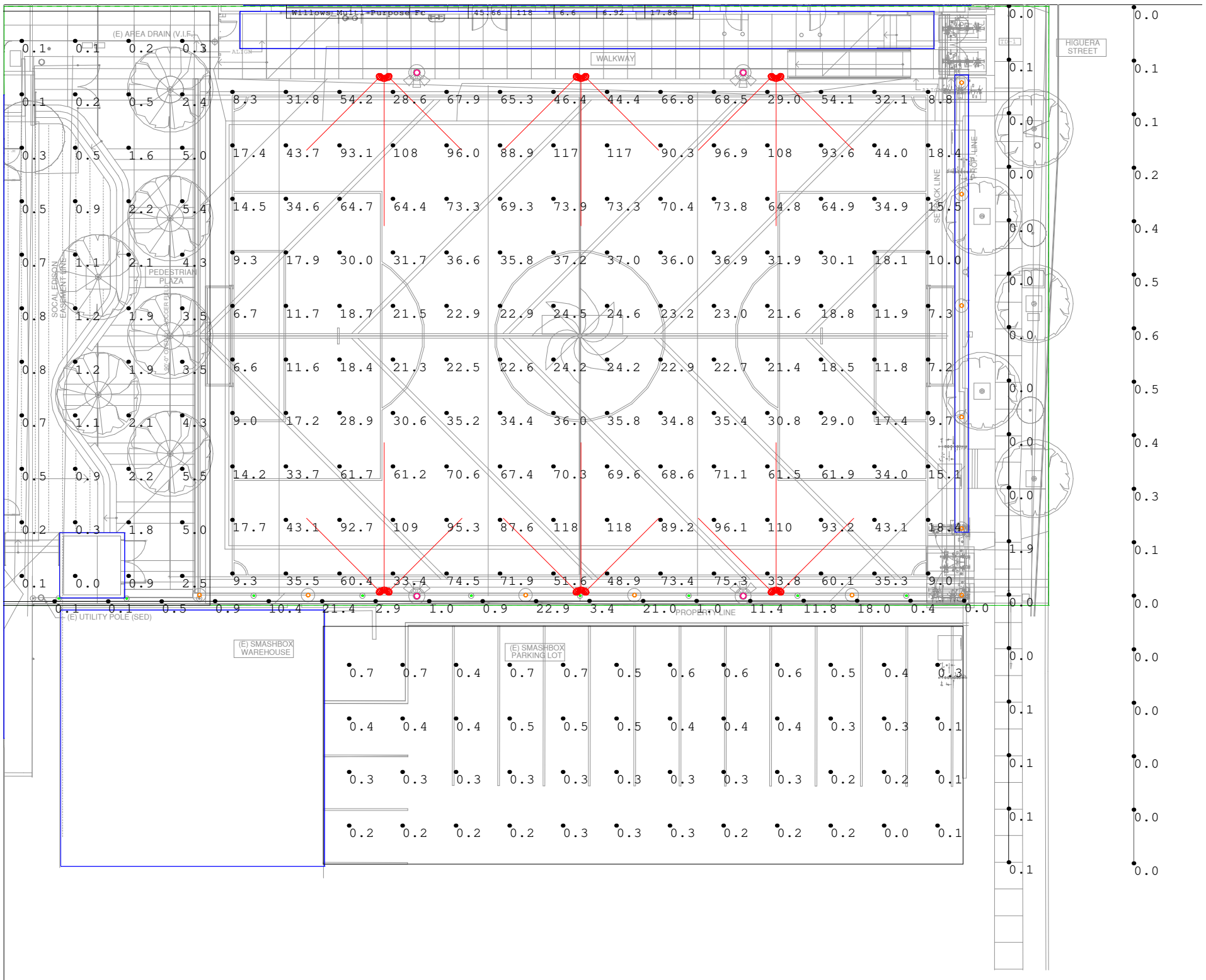


Illuminance Values (FC)

LIGHTING DESIGN ALLIANCE
WILLOWS COMMUNITY SCHOOL - MULTI-PURPOSE FIELD
PHOTOMETRIC STUDY
(6) 25'-0" POLES
05-JUNE-2016

LIGHTING DESIGN ALLIANCE

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Higuera Street	Illuminance	Fc	0.18	0.6	0.0	N.A.	N.A.
Property Line	Illuminance	Fc	7.12	22.9	0.0	N.A.	N.A.
Sidewalk	Illuminance	Fc	0.13	1.9	0.0	N.A.	N.A.
Smaxhbox Parking Lot	Illuminance	Fc	0.35	0.7	0.0	N.A.	N.A.
Willows Pedestrian Plaza	Illuminance	Fc	1.62	5.5	0.0	N.A.	N.A.
Willows_Multi-Purpose Field	Illuminance	Fc	45.66	118	6.6	6.92	17.88

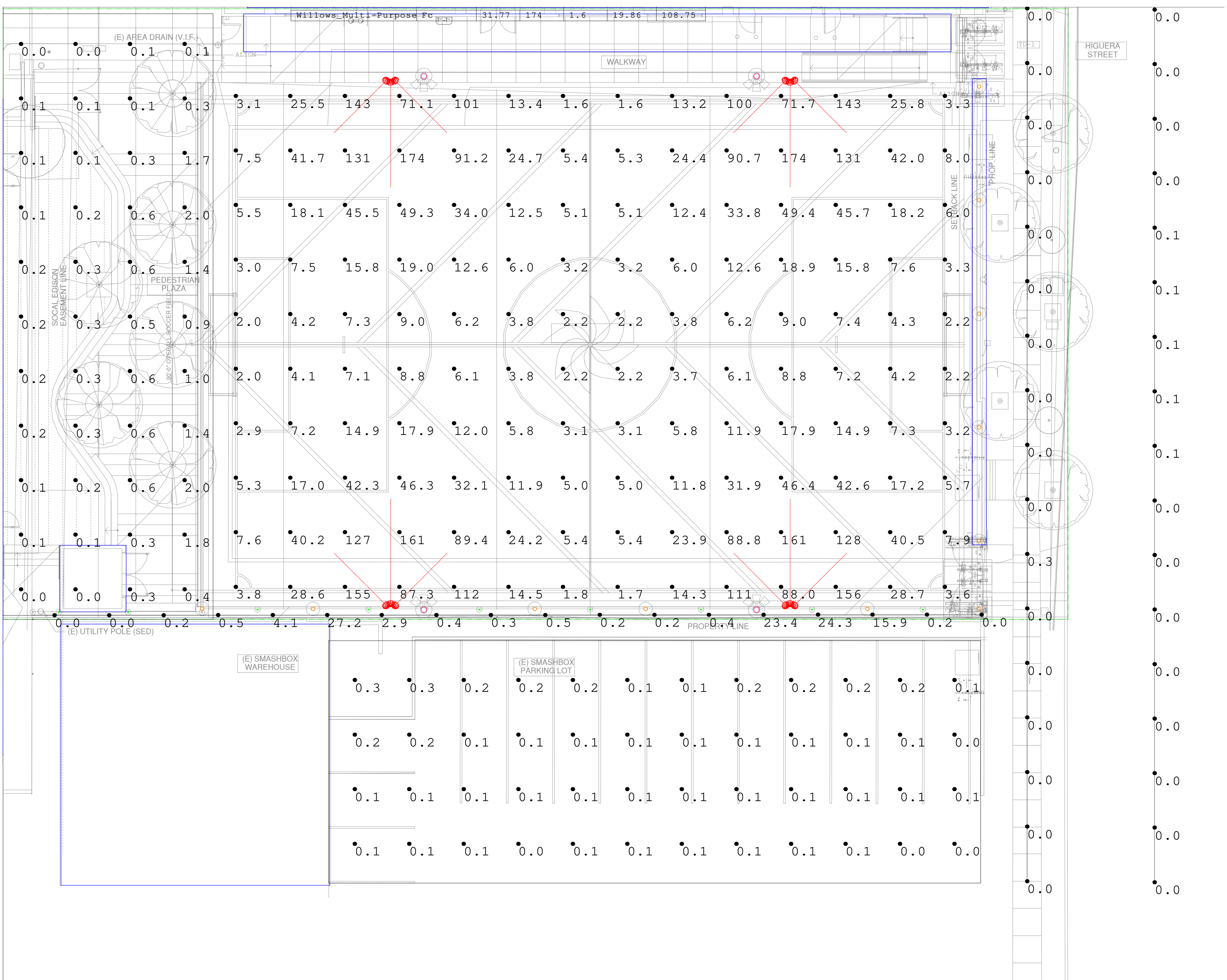


Illuminance Values (FC)

LIGHTING DESIGN ALLIANCE
WILLOWS COMMUNITY SCHOOL - MULTI-PURPOSE FIELD
PHOTOMETRIC STUDY
(4) 18'-0" POLES
05-JUNE-2016

LIGHTING DESIGN ALLIANCE

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Higuera Street	Illuminance	Fc	0.03	0.1	0.0	N.A.	N.A.
Property Line	Illuminance	Fc	5.59	27.2	0.0	N.A.	N.A.
Sidewalk	Illuminance	Fc	0.02	0.3	0.0	N.A.	N.A.
Smaxhbox Parking Lot	Illuminance	Fc	0.12	0.3	0.0	N.A.	N.A.
Willows Pedestrian Plaza	Illuminance	Fc	0.47	2.0	0.0	N.A.	N.A.
Willows_Multi-Purpose Field	Illuminance	Fc	31.77	174	1.6	19.86	108.75

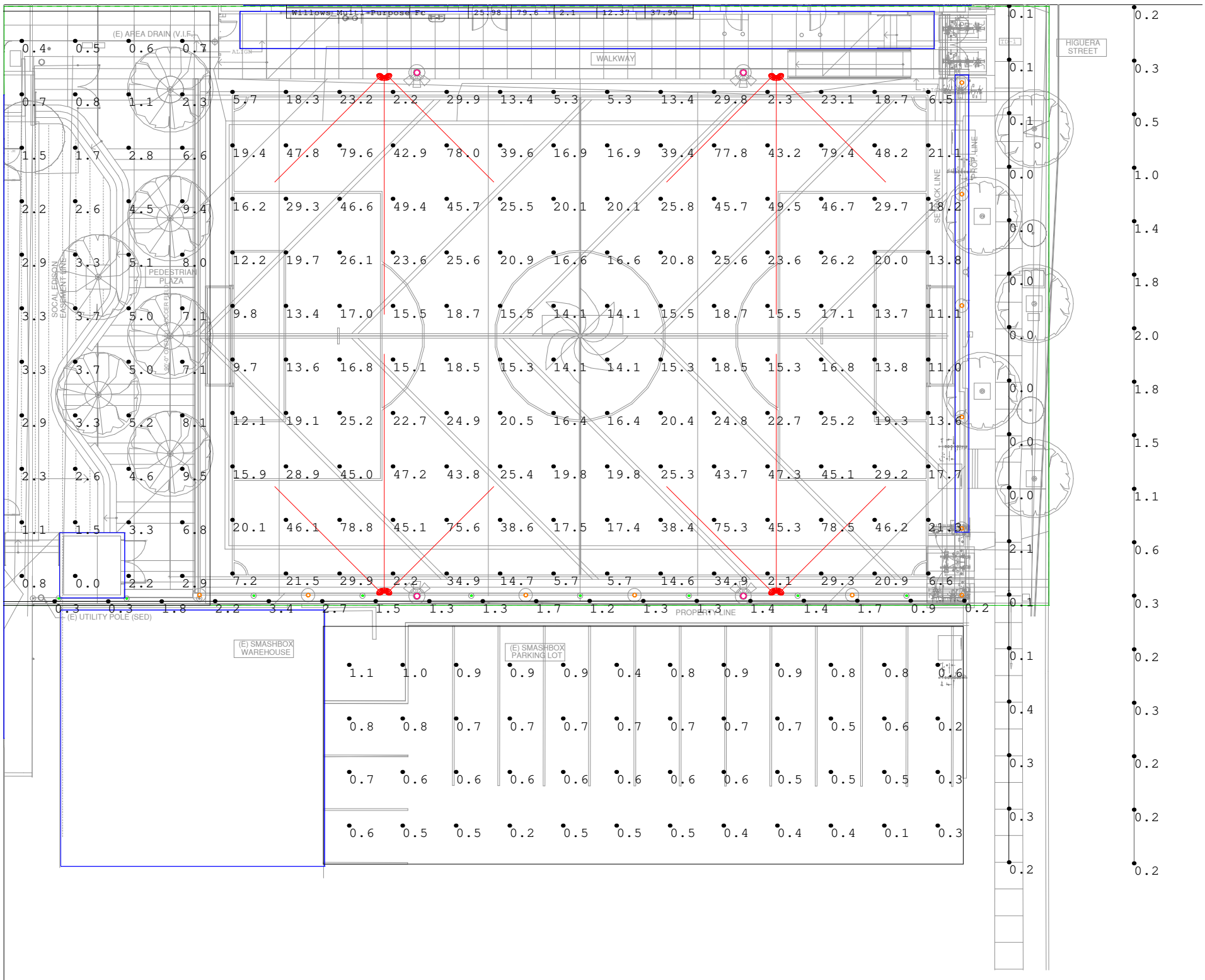


Illuminance Values (FC)

LIGHTING DESIGN ALLIANCE
WILLOWS COMMUNITY SCHOOL - MULTI-PURPOSE FIELD
PHOTOMETRIC STUDY
(4) 18'-0" POLES, 60°-70° AIMING
05-JUNE-2016

LIGHTING DESIGN ALLIANCE

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Higuera Street	Illuminance	Fc	0.77	2.0	0.2	3.85	10.00
Property Line	Illuminance	Fc	1.44	3.4	0.2	7.20	17.00
Sidewalk	Illuminance	Fc	0.21	2.1	0.0	N.A.	N.A.
Smaxhbox Parking Lot	Illuminance	Fc	0.61	1.1	0.1	6.10	11.00
Willows Pedestrian Plaza	Illuminance	Fc	3.48	9.5	0.0	N.A.	N.A.
Willows_Multi-Purpose Field	Illuminance	Fc	25.98	79.6	2.1	12.37	37.90

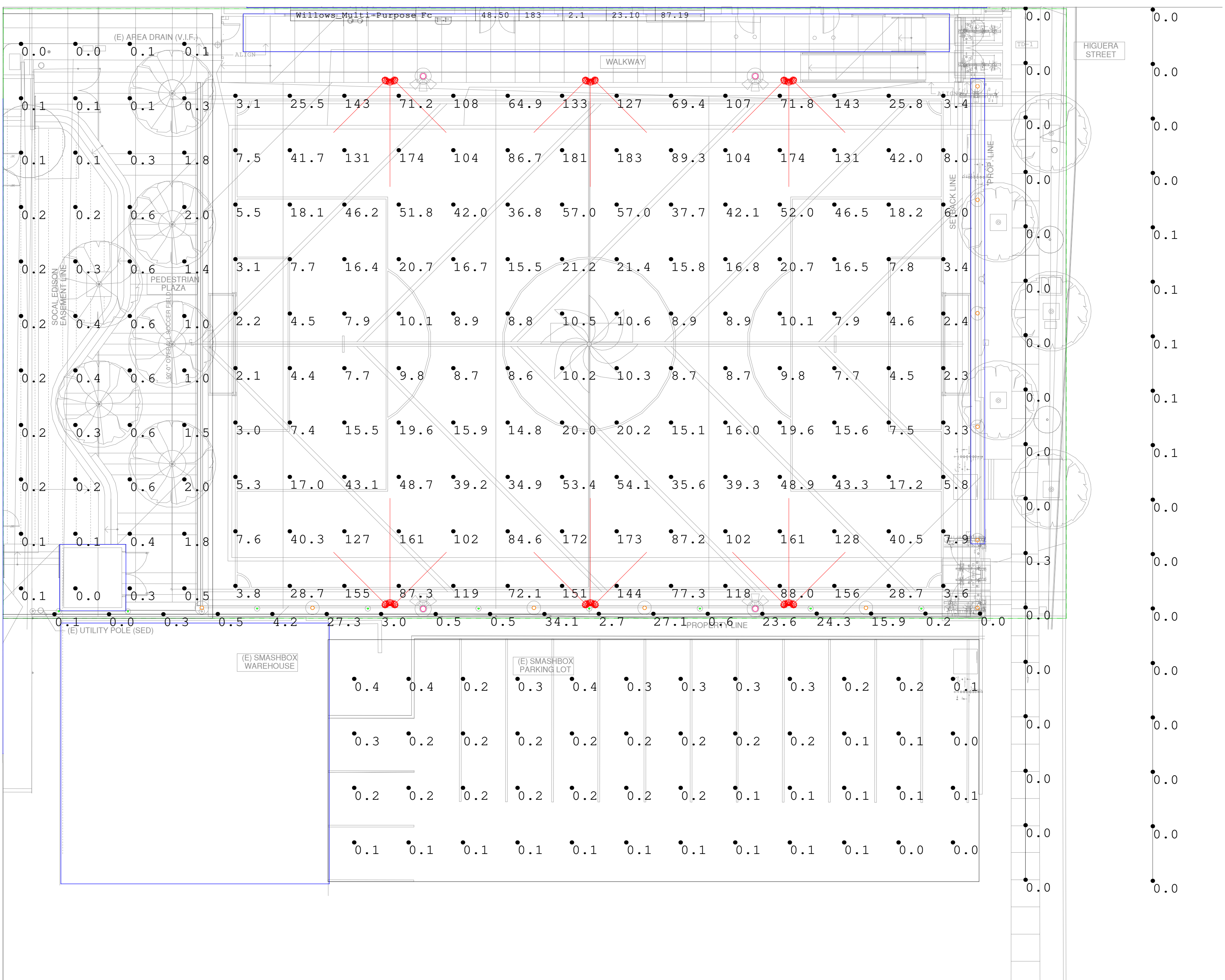


Illuminance Values (FC)

LIGHTING DESIGN ALLIANCE
WILLOWS COMMUNITY SCHOOL - MULTI-PURPOSE FIELD
PHOTOMETRIC STUDY
(6) 18'-0" POLES
05-JUNE-2016

LIGHTING DESIGN ALLIANCE

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Higuera Street	Illuminance	Fc	0.03	0.1	0.0	N.A.	N.A.
Property Line	Illuminance	Fc	9.16	34.1	0.0	N.A.	N.A.
Sidewalk	Illuminance	Fc	0.02	0.3	0.0	N.A.	N.A.
Smaxhbox Parking Lot	Illuminance	Fc	0.18	0.4	0.0	N.A.	N.A.
Willows Pedestrian Plaza	Illuminance	Fc	0.50	2.0	0.0	N.A.	N.A.
Willows_Multi-Purpose Field	Illuminance	Fc	48.50	183	2.1	23.10	87.19

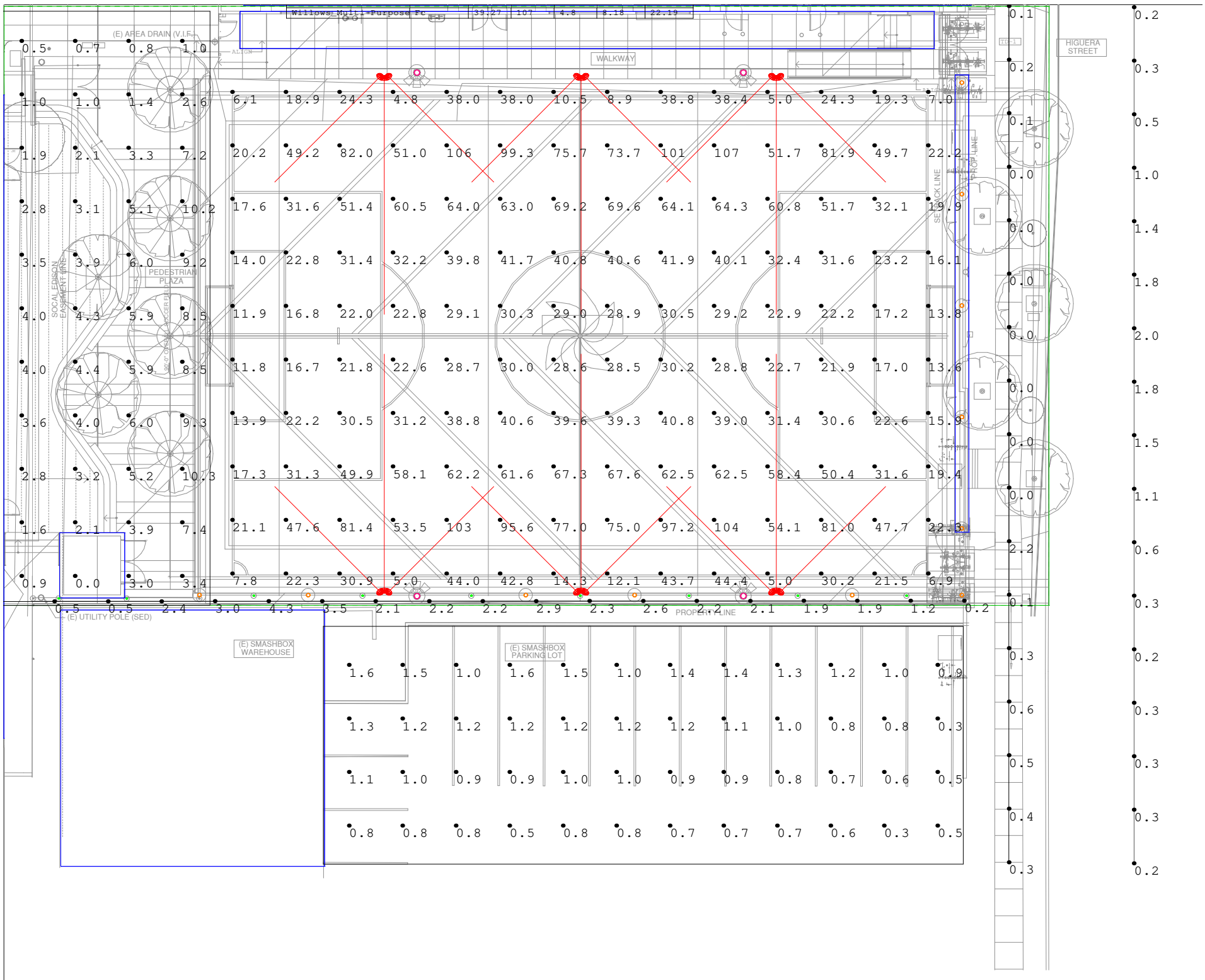


Illuminance Values (FC)

LIGHTING DESIGN ALLIANCE
WILLOWS COMMUNITY SCHOOL - MULTI-PURPOSE FIELD
PHOTOMETRIC STUDY
(6) 18'-0" POLES, 60°-70° AIMING
05-JUNE-2016

LIGHTING DESIGN ALLIANCE

Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Higuera Street	Illuminance	Fc	0.78	2.0	0.2	3.90	10.00
Property Line	Illuminance	Fc	2.11	4.3	0.2	10.55	21.50
Sidewalk	Illuminance	Fc	0.28	2.2	0.0	N.A.	N.A.
Smaxhbox Parking Lot	Illuminance	Fc	0.96	1.6	0.3	3.20	5.33
Willows Pedestrian Plaza	Illuminance	Fc	4.08	10.3	0.0	N.A.	N.A.
Willows_Multi-Purpose Field	Illuminance	Fc	39.27	107	4.8	8.18	22.19



Illuminance Values (FC)

APPENDIX D:

PHOTOMETRIC STUDY: MUSCO LIGHTING

Willows Community School

Culver City, CA

Lighting System

Pole / Fixture Summary

Pole ID	Pole Height	Mtg Height	Fixture Qty	Luminaire Type	Load	Circuit
P1-P4	35'	35'	3	TLC-LED-400	1.20 kW	A
4			***12***		***4.80 kW***	

Circuit Summary

Circuit	Description	Load	Fixture Qty
A	Soccer	4.8 kW	12

Fixture Type Summary

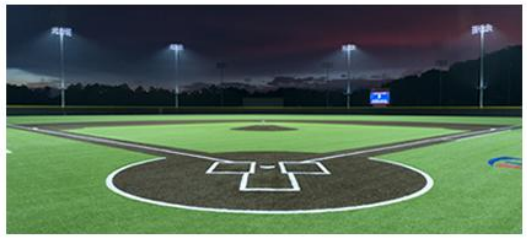
Type	Source	Wattage	Lumens	L90	L80	L70	Quantity
TLC-LED-400	LED 5700K - 75 CRI	400W	46,500	>63,500	>63,500	>63,500	12

Light Level Summary

Calculation Grid Summary

Grid Name	Calculation Metric	Illumination					Circuits	Fixture Qty
		Ave	Min	Max	Max/Min	Ave/Min		
Soccer	Horizontal Illuminance	35.2	22.8	42.8	1.88	1.54	A	12

From Hometown to Professional



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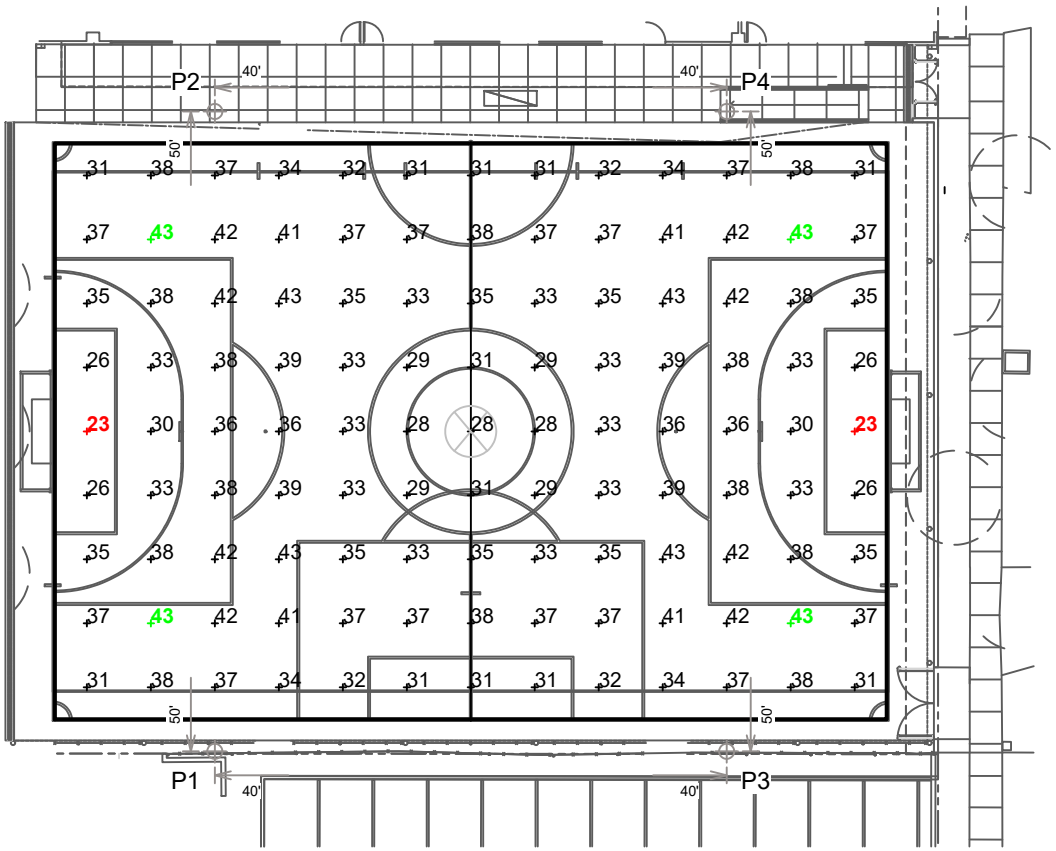
EQUIPMENT LIST FOR AREAS SHOWN								
Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
4	P1-P4	35'	-	35'	TLC-LED-400	3	3	0
4	TOTALS					12	12	0



SCALE IN FEET 1 : 30

0' 30' 60'

Pole location(s) ⊕ dimensions are relative to 0,0 reference point(s) ⊗

ENGINEERED DESIGN By: Daniel Lohman • File #192549A • 22-May-18

Willows Community School

Culver City, CA

GRID SUMMARY

Name:	**Soccer**
Size:	130' x 90'
Spacing:	10.0' x 10.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY

MAINTAINED HORIZONTAL FOOTCANDLES

	Entire Grid
Scan Average:	**35.2**
Maximum:	42.8
Minimum:	22.8
Avg / Min:	1.55
Max / Min:	**1.88**
UG (adjacent pts):	1.32
CU:	0.77
No. of Points:	117

LUMINAIRE INFORMATION

Color / CRI:	5700K - 75 CRI
Luminaire Output:	46,500 lumens
No. of Luminaires:	**12**
Total Load:	4.8 kW

Lumen Maintenance

Luminaire Type	L90 hrs	L80 hrs	L70 hrs
TLC-LED-400	>63,500	>63,500	>63,500

Reported per TM-21-11. See luminaire datasheet for details.

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document and includes a 0.95 dirt depreciation factor.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

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Willows Community School

Culver City, CA

EQUIPMENT LAYOUT

INCLUDES:

· Soccer

Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

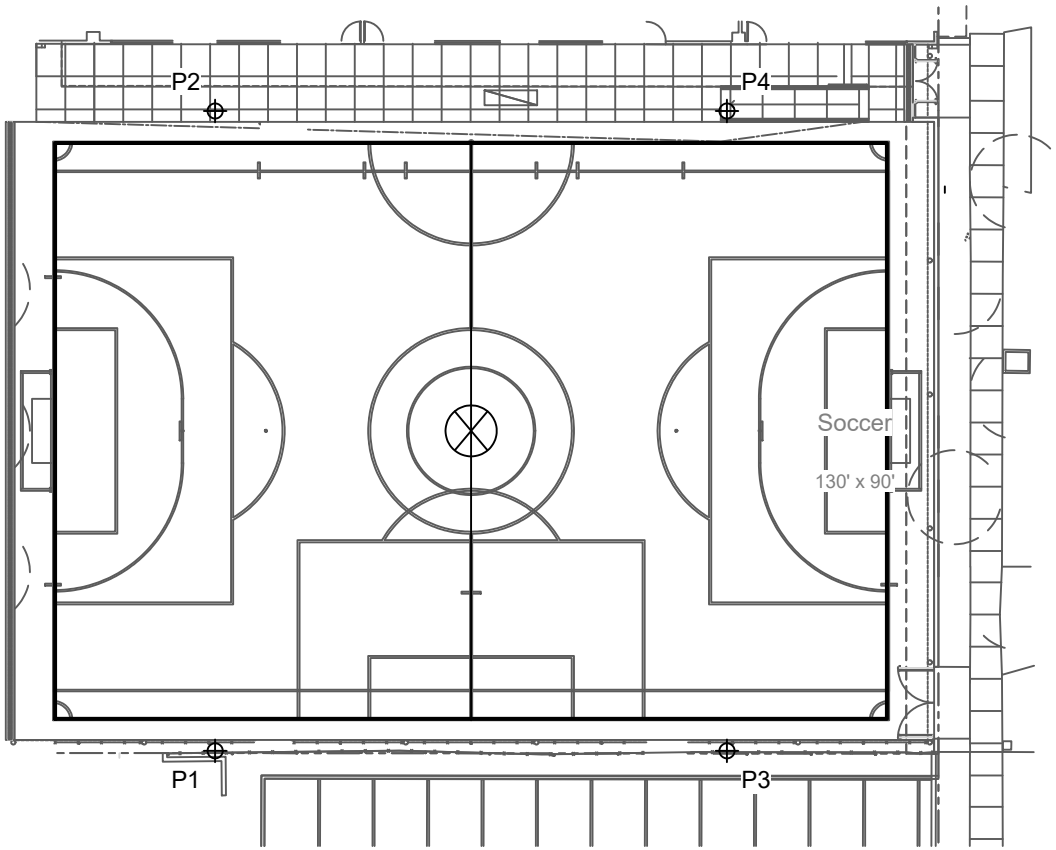
Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires		
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE
4	P1-P4	35'	-	35'	TLC-LED-400	3
4	TOTALS					12

SINGLE LUMINAIRE AMPERAGE DRAW CHART

Ballast Specifications (.90 min power factor)	Line Amperage Per Luminaire (max draw)						
Single Phase Voltage	208 (60)	220 (60)	240 (60)	277 (60)	347 (60)	380 (60)	480 (60)
TLC-LED-400	2.3	2.2	2.0	1.7	1.4	1.3	1.0



SCALE IN FEET 1 : 30

0' 30' 60'

Pole location(s) ⊕ dimensions are relative to 0,0 reference point(s) ⊗

ENGINEERED DESIGN By: Daniel Lohman • File #192549A • 22-May-18

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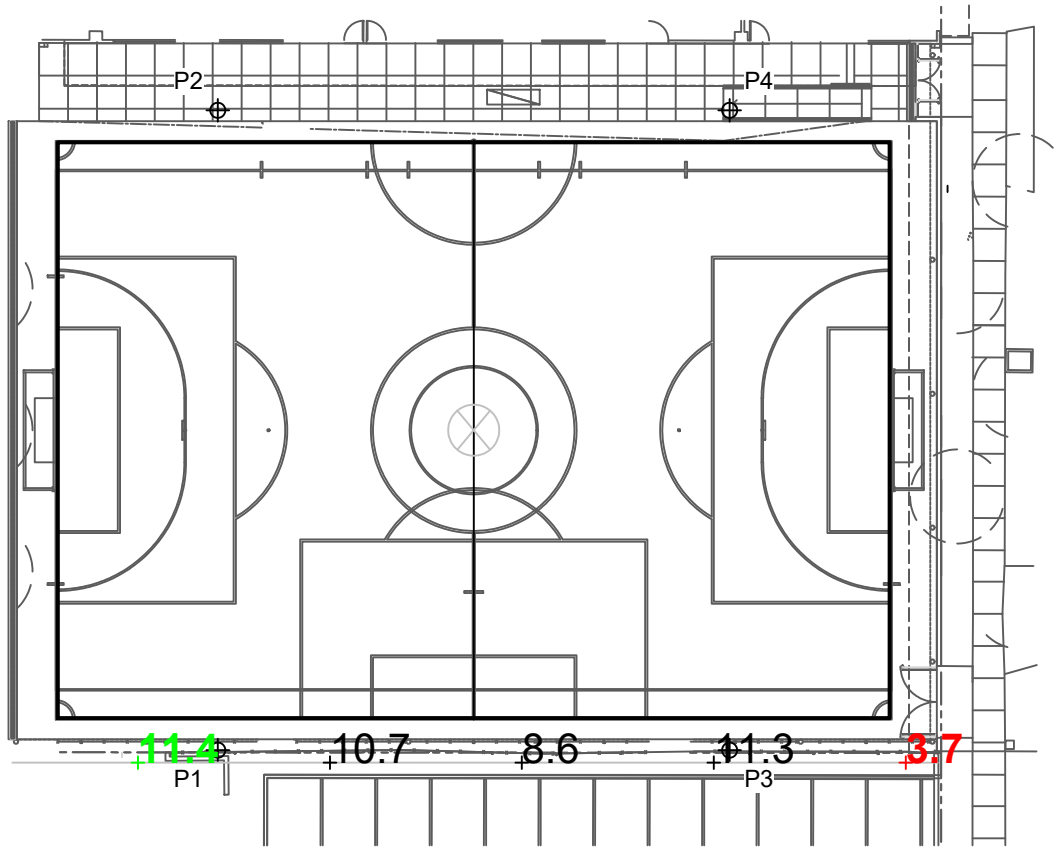
EQUIPMENT LIST FOR AREAS SHOWN								
Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
4	P1-P4	35'	-	35'	TLC-LED-400	3	3	0
4	TOTALS					12	12	0



SCALE IN FEET 1 : 30

0' 30' 60'

Pole location(s) ⊕ dimensions are relative to 0,0 reference point(s) ⊗

ENGINEERED DESIGN By: Daniel Lohman • File #192549a Spill • 31-May-18

Willows Community School

Culver City, CA

GRID SUMMARY

Name:	**Spill @ Property Line**
Spacing:	30.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY

MAINTAINED HORIZONTAL FOOTCANDLES

	Entire Grid
Scan Average:	**9.143**
Maximum:	11.410
Minimum:	3.717
No. of Points:	5

LUMINAIRE INFORMATION

Color / CRI:	5700K - 75 CRI
Luminaire Output:	46,500 lumens
No. of Luminaires:	**12**
Total Load:	4.8 kW

Lumen Maintenance

Luminaire Type	L90 hrs	L80 hrs	L70 hrs
TLC-LED-400	>63,500	>63,500	>63,500

Reported per TM-21-11. See luminaire datasheet for details.

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document and includes a 0.95 dirt depreciation factor.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

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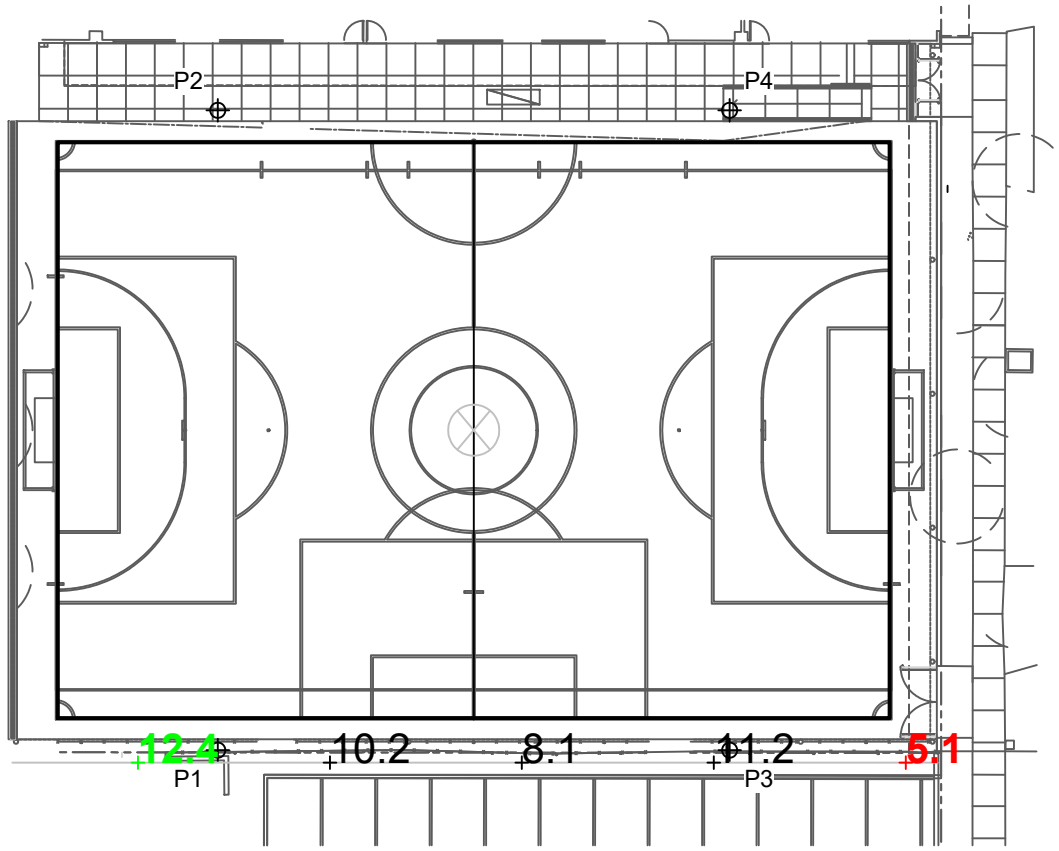
Willows Community School

Culver City, CA

EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
4	P1-P4	35'	-	35'	TLC-LED-400	3	3	0
4	TOTALS					12	12	0



SCALE IN FEET 1 : 30

0' 30' 60'

Pole location(s) ⊕ dimensions are relative to 0,0 reference point(s) ⊗

GRID SUMMARY

Name:	**Spill @ Property Line**
Spacing:	30.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY

MAINTAINED MAX VERTICAL FOOTCANDLES

	Entire Grid
Scan Average:	**9.391**
Maximum:	12.379
Minimum:	5.058
No. of Points:	5

LUMINAIRE INFORMATION

Color / CRI:	5700K - 75 CRI
Luminaire Output:	46,500 lumens
No. of Luminaires:	**12**
Total Load:	4.8 kW

Lumen Maintenance

Luminaire Type	L90 hrs	L80 hrs	L70 hrs
TLC-LED-400	>63,500	>63,500	>63,500

Reported per TM-21-11. See luminaire datasheet for details.

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document and includes a 0.95 dirt depreciation factor.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

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