DRAFT

Athletic Field
Lighting & Feasibility Study
Manchester Field
Winchester, MA

October 15, 2014

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enclosures

Gale JN 716550

Gale Associates, Inc.

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MANCHESTER FIELD
ATHLETIC FIELD LIGHTING FEASIBILITY STUDY
WINCHESTER, MA

Section 1.0 - Background and Feasibility Study Objectives. Gale Associates, Inc. (Gale) was engaged by the Town of Winchester (Winchester) to assist with a feasibility study for the development of a new athletic field lighting system for the Manchester Field athletic facility located in Winchester, MA. The resultant feasibility study is intended to determine the viability of installing a new athletic lighting system and the adequacy of the existing electrical infrastructure available onsite.

Figure 1: Synthetic Turf Field at Manchester Field

During the summer of 2009, the Manchester Field athletic facility was renovated to include the construction of a multipurpose synthetic turf field, 1500 person grandstand, press box, walkways and related site amenities (as can be seen on Figure 1). The most recent improvements to the facility was the reconstruction of the track and field during the summer of 2012.

The Manchester Field athletic facility is primarily bounded by the McCall Middle School to the north and northeast, residential areas to the south and southeast, and the Mystic Valley Parkway and Aberjona River to the west. As is typical with athletic facilities, the project site is predominantly flat within the playing field areas. However, the grandstands and residential area to the east are situated at higher elevations.

Section 2.0 - Proposed Athletic Lighting Improvements. The new athletic lighting system would consist of four (4) poles located just outside the perimeter of the synthetic turf field in the general locations of the field's 15-yard lines. The pole to the northeast will be located in between the recent school addition and the limits of the synthetic turf. The pole to the southeast will be located in the grass area just off the tree line south of the grandstands. The two poles to the northwest and southwest will be located in the grass areas just off the walkways.

The light pole structures would be approximately seventy (70) feet in height and have approximately eleven (11) luminaire fixtures mounted on each pole for a total of forty-four (44) luminaires (as can be seen on the pole diagram in Enclosure 1). The luminaires would be shielded to provide up to a 50% reduction in glare and light spill when compared to traditional non-shielded systems. Installing the poles at the recommended height of seventy (70) feet allows for the luminaire fixtures to be properly aimed directly onto the playing field

limits and thus decreasing the amount of light that would spill off-site when compared to light pole structures with shorter heights.

The pole foundations typically consist of a twenty (20) inch diameter precast concrete base with an embedment depth of approximately eighteen (18) feet and an additional eight (8) feet projecting above grade.

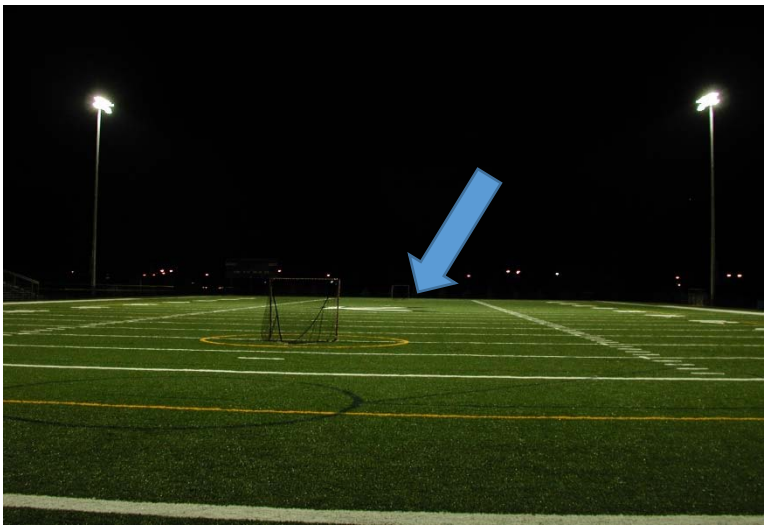


Figure 2: Athletic Lighting Focused on Field (photo by MUSCO)

The lighting system would be capable of providing an average of fifty (50) foot-candles of constant illumination within the playing field limits (as can be seen in Enclosures 3 and 4). As previously stated, the luminaires would be shielded and aimed so that the illumination would dramatically drop off once outside the playing field limits.

For example, when looking at the residential area along Manchester Road to the southwest of the field, the proposed lighting system would provide approximately forty (40) foot-candles within the end zone area of the synthetic turf field and drop off to approximately five (5) foot-candles at approximately fifteen (15) feet off the playing field limits. The illumination would further drop to approximately one (1) foot-candle at approximately forty (40) feet of the playing field limits. Similarly, when looking at the residential area to the southeast behind the grandstands and tree line, the illumination would drop off to approximately five (5) and one (1) foot-candles at distances of forty (40) and sixty (60) feet respectively.

However, the illumination plans do not take into account any additional light buffering that would result from mature tree-lines or elevation differences. This is especially true with the residential area behind the grandstands, which is approximately twenty-five (25) feet higher in elevation from the synthetic turf field. Additionally, with regards to further minimizing light spill offsite along Manchester Road, additional plantings and fence screenings may be possible options for mitigation. The amount of light spill would have to be looked at in further detail to see the degree in which light spill warranted mitigation.

Also, due to the athletic light system's ability to reduce light spill-off, it is not uncommon for additional site lighting fixtures to be mounted to the poles in order to provide the minimum lighting levels to the grandstands and peripheral walkways as recommended by the Illumination Engineering Society.

Section 3.0 - Evaluation of Existing Electrical Infrastructure and Recommendations. Upon review of the existing electrical systems currently available within the vicinity of the proposed athletic field lighting system, it would be best served from the existing mail electrical distribution system currently installed within the middle school. During the School's renovation and new classroom addition, a new 2000 ampere, 277/480 volt, 3 phase, 4 wire electrical service was installed to support the needs of the facility.

The intent would be to obtain 225 ampere, 480 volt, three phase power off of the existing distribution service. There is currently a spare 225 ampere, 480 volt, 3 pole circuit breaker within the main distribution board. If necessary, a meter could be installed to monitor the power usage of the athletic field lighting and related power. A branch circuit would be run through the existing crawl space to an existing electric room located adjacent to the lower level mechanical room. The service would continue to the exterior wall of the building where a weatherproof junction box would be installed to allow for the conduits and related cabling to be extended to the new athletic lighting systems equipment.

At a determined location, a NEMA 4x cabinet would be installed to house the lighting control equipment and related electrical systems controls. In addition, from the School, additional spare conduits should be installed for future power requirements as well as the potential need for communications, CCTV, etc.

A visual survey was also done within the residential portion of the adjacent neighborhood to determine the potential of obtaining a power source from the existing utility lines currently servicing the residential homes. Unfortunately, the power was not readily accessible and would prove costly to install a new electric service to the athletic field

Section 4.0 - Estimated Project Costs. The preliminary project cost estimate for the proposed new athletic lighting system have been summarized as follows:

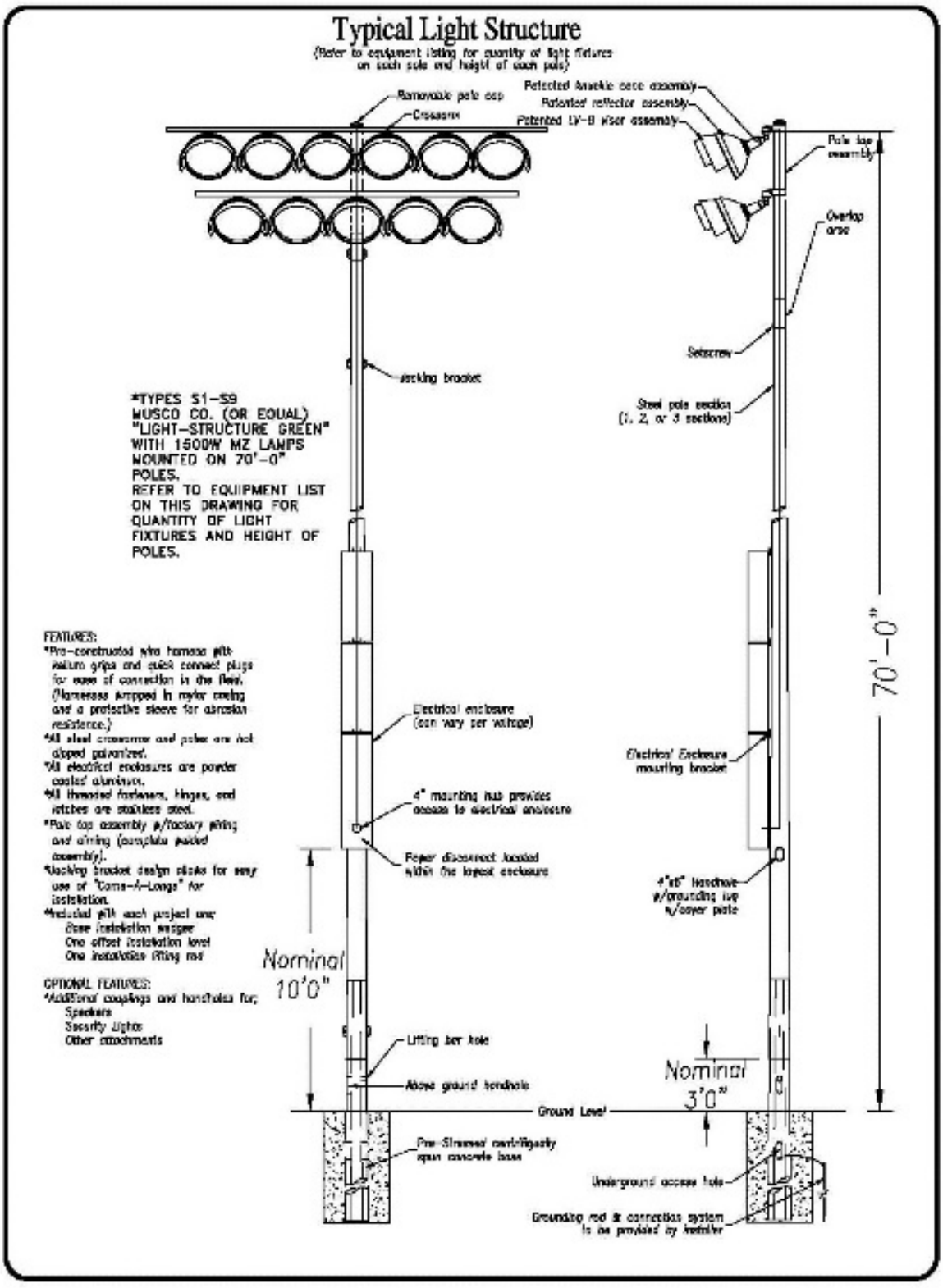
• Athletic Lighting (4-pole system)	$ 280,000
• Electrical Infrastructure for Athletic Lighting	$ 60,000
• Design Contingency (10%)	$ 34,000
• Soft Costs (5%)	$ 17,000
	$ 391,000

Costs include soft costs (design), taken as 5% of the constructed cost, as well as a 10% contingency. This estimate is an approximation and more detailed construction cost estimates will be prepared with the detailed design of the athletic lighting system.

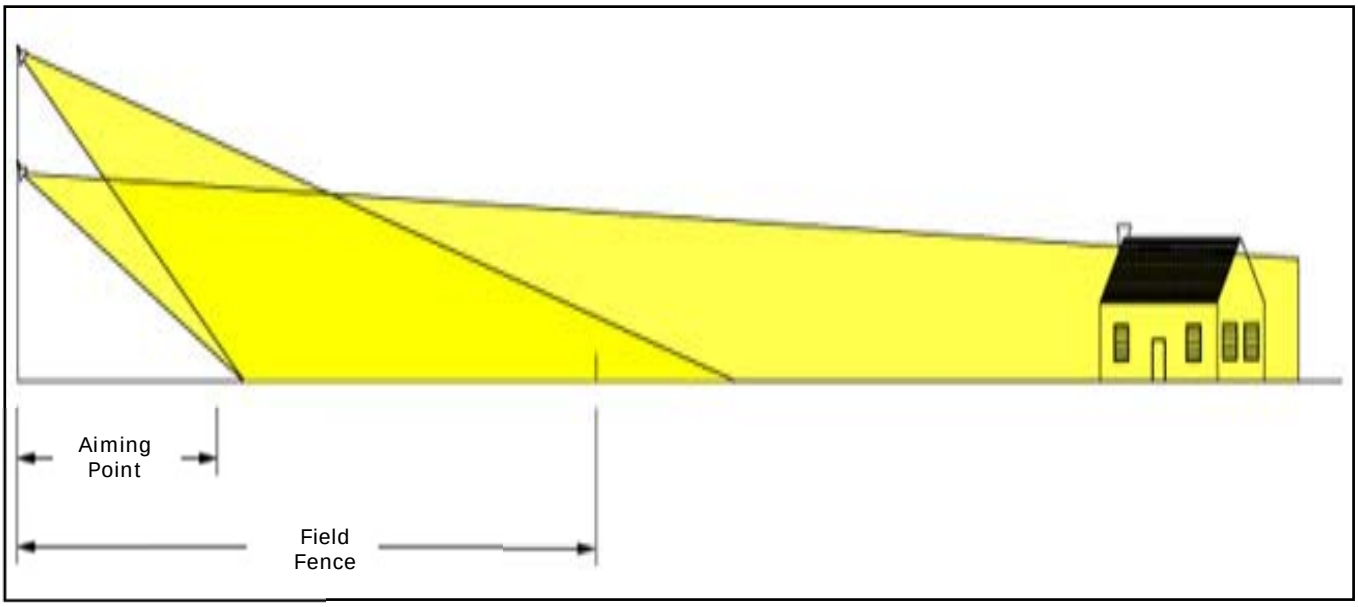
Section 5.0 - Permitting. As a feasibility study, Gale did not complete a rigorous permitting review or meet with various permitting authorities. This project will likely be reviewed by Board of Selectman and School Committee. However, it is anticipated that no other permitting requirements other than the electrical and building permits would be required.

Section 6.0 – Operations and Maintenance. In addition to the reduction in light spill and glare mentioned above, todays athletic lighting systems also see a reduction (up to 50%) in energy consumption when compared to previous systems. This is primarily due to a reduction in total fixture quantities (from approximately 70 fixtures in the previous technology down to approximately 44 fixtures with the current technology). As can be seen in Enclosure 5, the average energy consumption estimated over a 25-year span would be approximately 75.1 kW per hour per fixture.

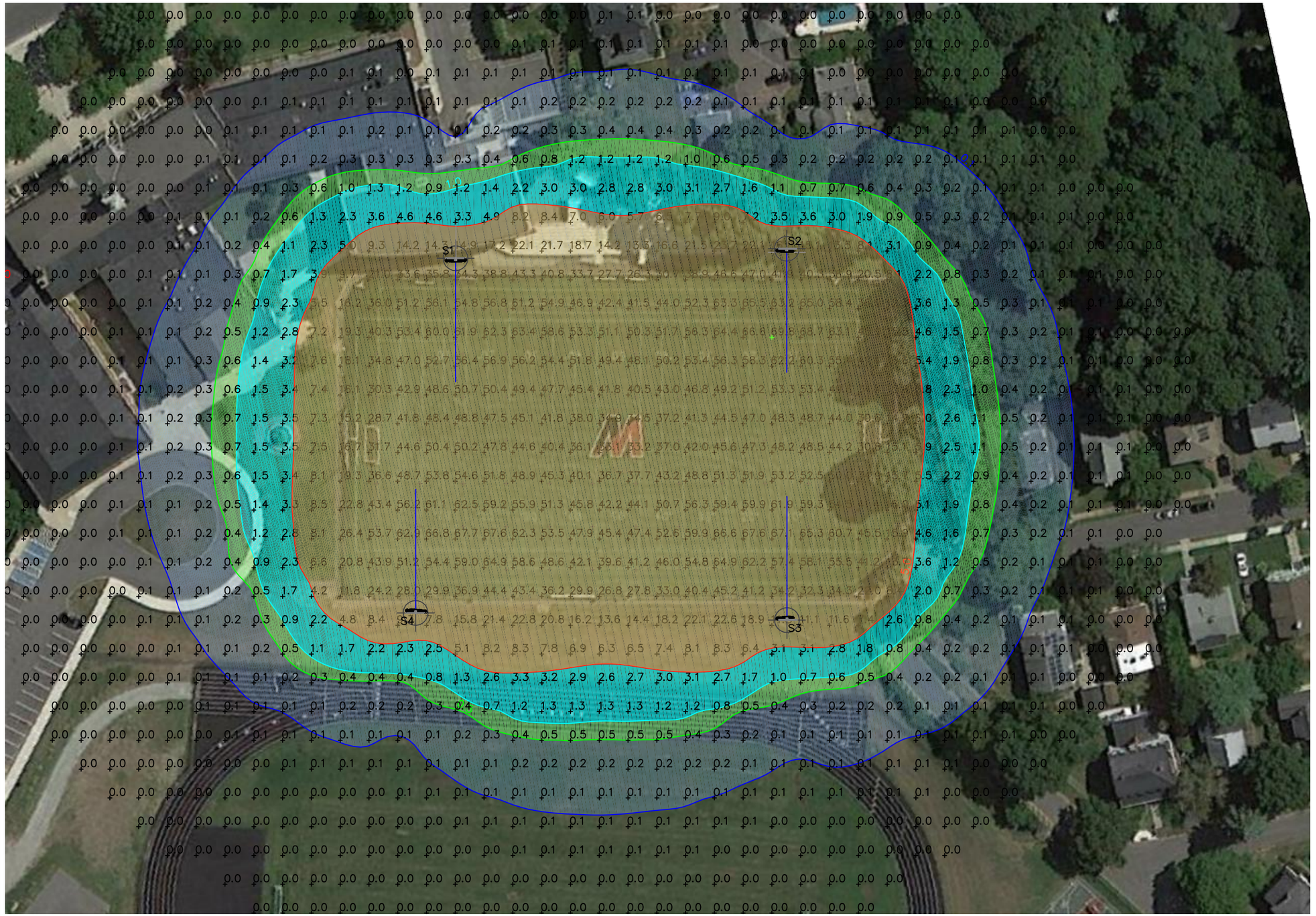
The typical 25-year warranty would include repairs to any lamp outages, control issues and a group re-lamping after 5,000 hours of operation. A summary costs breakdown table is provided in Enclosure 5 and shows that the implementation of a current technology lighting system would see a savings of approximately $152,000, $202,000, and $251,000 at 300, 400 and 500 annual operating hours respectively over the 25-year life cycle when compared to prior lighting systems.



Enclosure 1: Typical Athletic Light Structure (as provided by MUSCO)



Enclosure 2: Above, sketch from MUSCO illustrating the advantages that taller poles provide by decreasing off-site spill light by adjusting the aiming angle and focusing light onto the field. Below, photos of shielded luminaires manufactured by MUSCO.



GALE

Gale Associates, Inc.
Engineers and Planners

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Boston Baltimore Orlando San Francisco

PROJECT
MANCHESTER FIELD
WINCHESTER, MA

OWNER
TOWN OF WINCHESTER

REVISIONS

NO.	DATE	DESCRIPTION

CADD FILE	
DESIGNED BY	
DRAWN BY	
CHECKED BY	
DATE	9/9/14
DRAWING SCALE	

GRAPHIC SCALE
0 30' 60'

SHEET TITLE

DRAWING NO.

PROJECT NO. 716550

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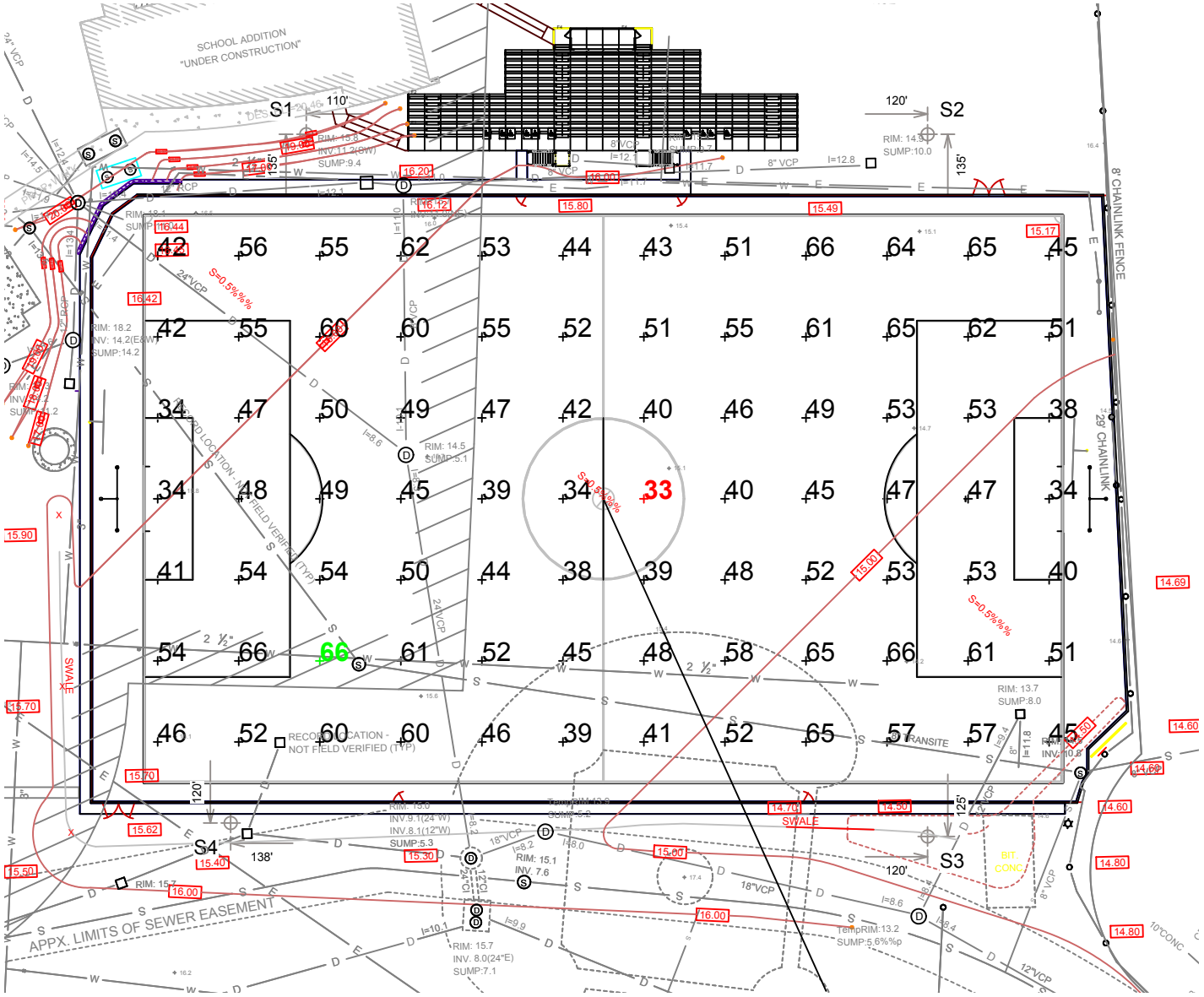
EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LAMP TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
1	S1	70'	4'	74'	1500W MZ	11	11	0
3	S2-S4	70'	-	70'	1500W MZ	11	11	0
4	TOTALS					44	44	0



MY PROJECT

Name:	**Manchester Field**
Location:	Winchester,MA

GRID SUMMARY

Name:	**Soccer**
Size:	340' x 210'
Spacing:	30.0' x 30.0'
Height:	3.0' above grade

CONSTANT ILLUMINATION

SUMMARY	HORIZONTAL FOOTCANDLES
	Entire Grid
Guaranteed Average:	**50**
Scan Average:	50.45
Maximum:	66.3
Minimum:	33
Avg / Min:	1.51
Guaranteed Max / Min:	**2**
Max / Min:	1.98
UG (adjacent pts):	1.44
CU:	0.65
CV:	0.18
No. of Points:	84
LUMINAIRE INFORMATION	
Luminaire Type:	Green Generation
Rated Lamp Life:	5,000 hours
Design Lumens:	134,000
Avg Lamp Tilt Factor:	1.000
No. of Luminaires:	44
Avg KW:	68.82 (74.8 max)

Guaranteed Performance: The Guaranteed Average CONSTANT ILLUMINATION described above is guaranteed for the rated life of the lamp.

Field Measurements: Illumination measured in accordance with IESNA LM-5-04 and CIBSE LG4. Individual values may vary. See the Warranty document for details.

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 ballast and structures located within 3 feet (1m) of design locations.

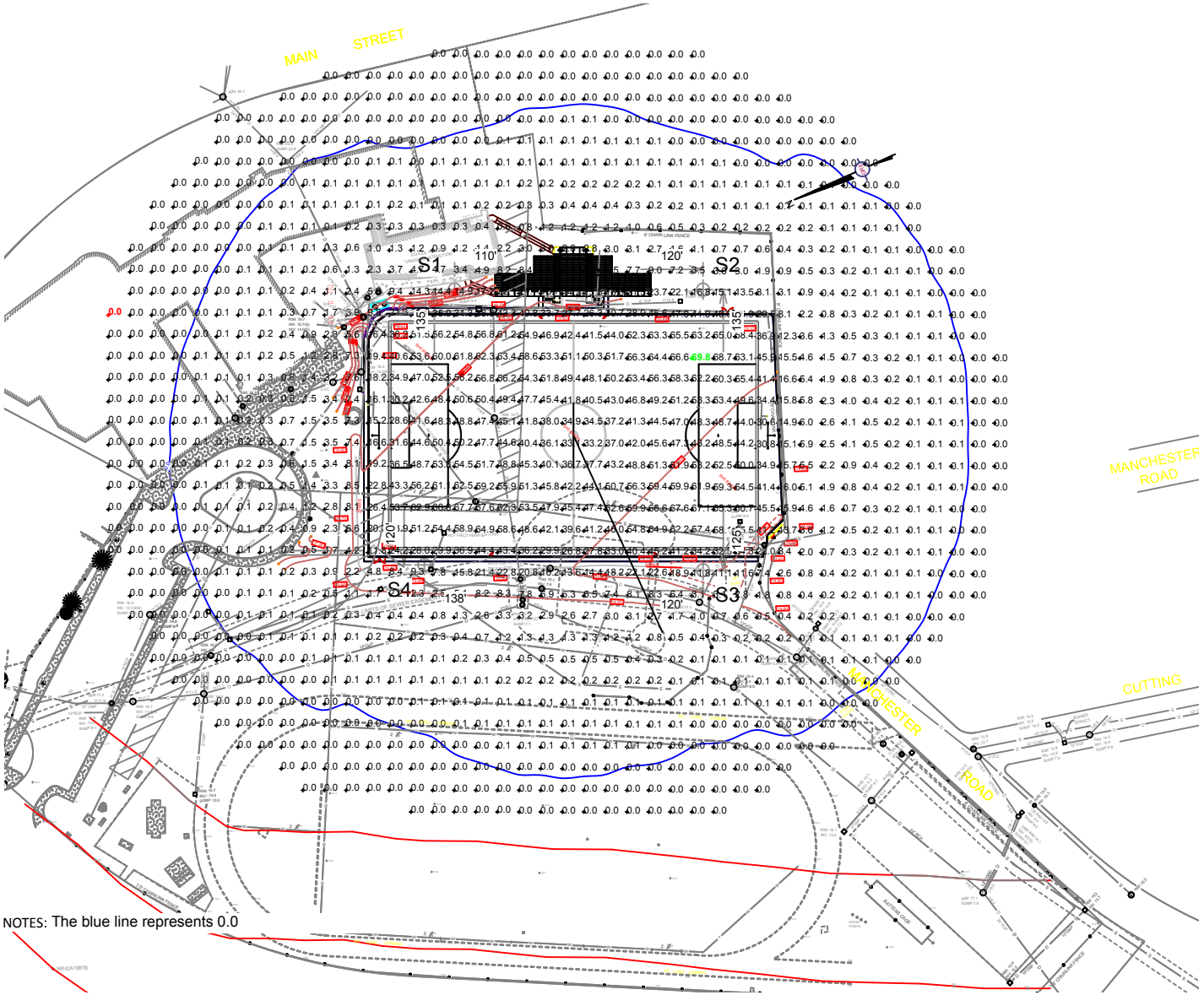
ENGINEERED DESIGN

By:	**Ryan A. Marsh, LC**	
File # / Date:	123893R1	27-Aug-14

ILLUMINATION SUMMARY

EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LAMP TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
1	S1	70'	4'	74'	1500W MZ	11	11	0
3	S2-S4	70'	-	70'	1500W MZ	11	11	0
4	TOTALS					44	44	0



NOTES: The blue line represents 0.0

SCALE IN FEET 1 : 150

0' 150' 300'

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

MY PROJECT

Name:	**Manchester Field**
Location:	Winchester,MA

GRID SUMMARY

Name:	**Blanket Grid**
Size:	340' x 210'
Spacing:	20.0' x 20.0'
Height:	3.0' above grade

CONSTANT ILLUMINATION

SUMMARY	HORIZONTAL FOOTCANDLES
	Entire Grid
Scan Average:	**9.52**
Maximum:	69.8
Minimum:	0
Avg / Min:	776.83
Max / Min:	**5696.99**
UG (adjacent pts):	5.83
CU:	0.81
CV:	1.94
No. of Points:	1248

LUMINAIRE INFORMATION	
Luminaire Type:	Green Generation
Rated Lamp Life:	5,000 hours
Design Lumens:	134,000
Avg Lamp Tilt Factor:	1.000
No. of Luminaires:	44
Avg KW:	68.82 (74.8 max)

Guaranteed Performance: The CONSTANT ILLUMINATION described above is guaranteed for the rated life of the lamp.

Field Measurements: Illumination measured in accordance with IESNA LM-5-04 and CIBSE LG4. Individual values may vary. See the Warranty document for details.

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 ballast and structures located within 3 feet (1m) of design locations.

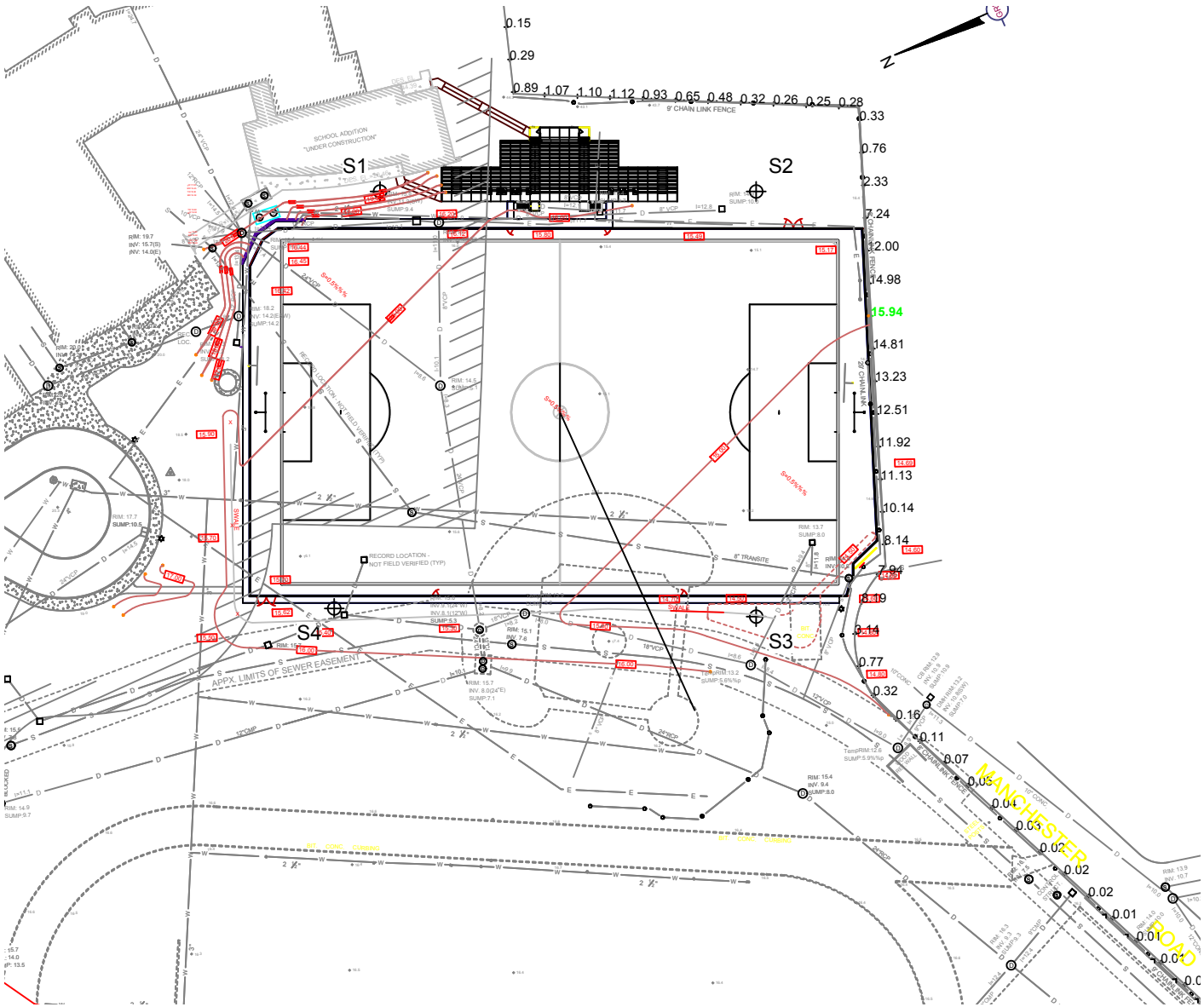
ENGINEERED DESIGN

By:	**Ryan A. Marsh, LC**	
File # / Date:	123893R1	27-Aug-14

ILLUMINATION SUMMARY

EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LAMP TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
1	S1	70'	4'	74'	1500W MZ	11	11	0
3	S2-S4	70'	-	70'	1500W MZ	11	11	0
4	TOTALS					44	44	0



SCALE IN FEET 1 : 100

0' 100' 200'

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

MY PROJECT

Name:	**Manchester Field**
Location:	Winchester,MA

GRID SUMMARY

Name:	**Property Line**
Spacing:	20.0'
Height:	3.0' above grade

CONSTANT ILLUMINATION

SUMMARY	HORIZONTAL FOOTCANDLES
	Entire Grid
Scan Average:	**1.8738**
Maximum:	15.941
Minimum:	0.00
No. of Points:	88
LUMINAIRE INFORMATION	
Luminaire Type:	Green Generation
Rated Lamp Life:	5,000 hours
Design Lumens:	134,000
Avg Lamp Tilt Factor:	1.000
No. of Luminaires:	44
Avg KW:	68.82 (74.8 max)

Guaranteed Performance: The CONSTANT ILLUMINATION described above is guaranteed for the rated life of the lamp.

Field Measurements: Illumination measured in accordance with IESNA LM-5-04 and CIBSE LG4. Individual values may vary. See the Warranty document for details.

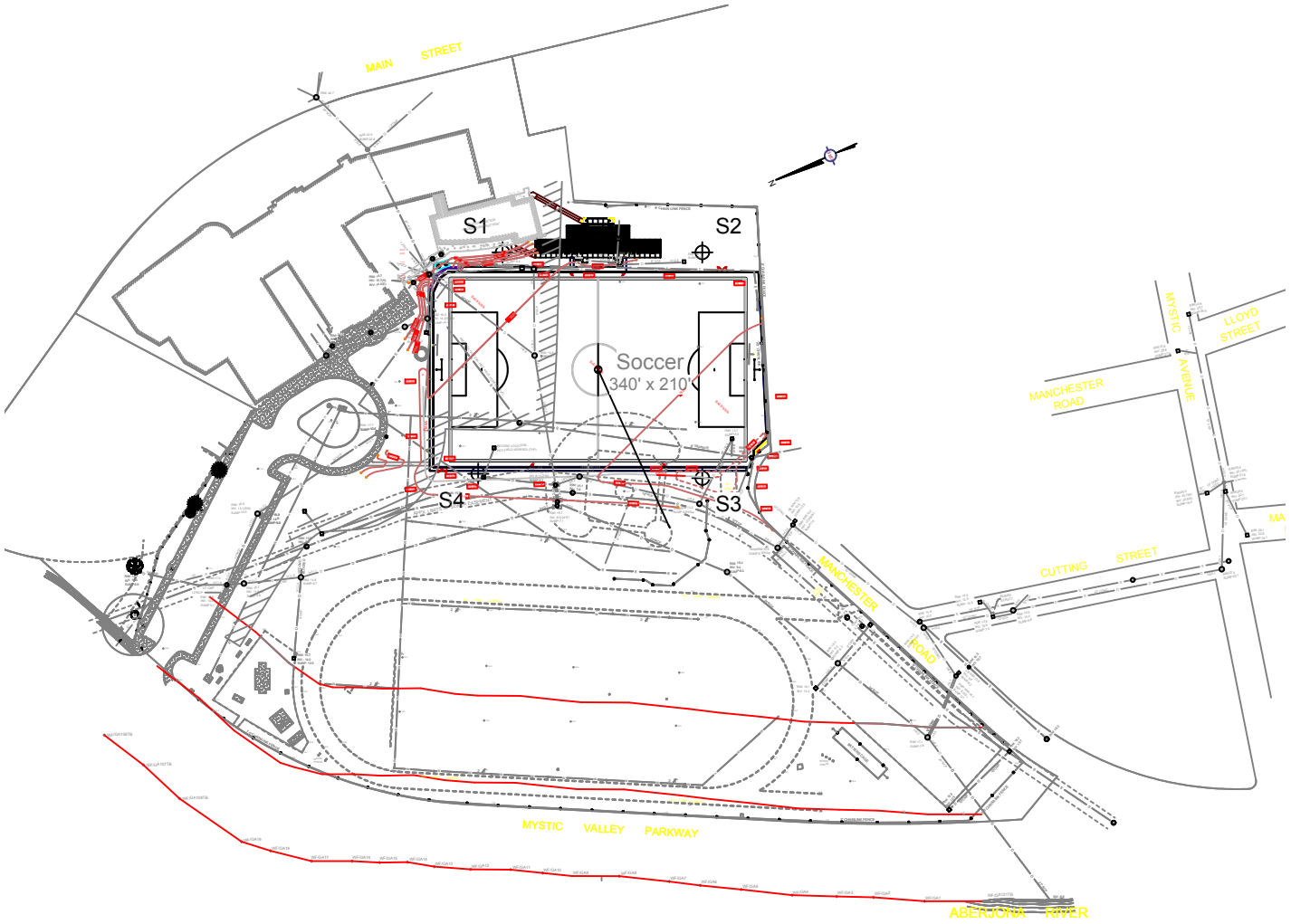
Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

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

ENGINEERED DESIGN

By:	**Ryan A. Marsh, LC**	
File # / Date:	123893R1	27-Aug-14

ILLUMINATION SUMMARY



SCALE IN FEET 1 : 200

0' 200' 400'

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

MY PROJECT

Name: Manchester Field
Location: Winchester,MA

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 ballast and structures located within 3 feet (1m) of design locations.

EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires		
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LAMP TYPE	QTY / POLE
1	S1	70'	4'	74'	1500W MZ	11
3	S2-S4	70'	-	70'	1500W MZ	11
4	TOTALS					44

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)
1500 watt MZ	8.6	8.3	7.5	6.5	5.1	4.7	3.7

ENGINEERED DESIGN

By: Ryan A. Marsh, LC
File # / Date: 123893R1 27-Aug-14

25-Year Life-Cycle Cost

Manchester Field
Winchester, MA

Prepared for: Mr. Peter Spanos, Gale Associates Inc

10/14/14

	Typical Floodlighting Equipment	Musco Green	Your Savings
Hours	**7,500**	**7,500**	
Average kW	**129.6**	**75.1**	**54.5**
Total kW	**972,000.0**	**563,040.0**	**408,960.0**
Metric Tons of CO2	**670.3**	**388.2**	**282.0**
Energy	**$184,680**	**$106,978**	**$77,702**
Group Relamp	$25,000	$0	$25,000
Lamp Maintenance	$3,750	$0	$3,750
Controls - Energy	$46,170	$0	$46,170
25-Year Life-Cycle Cost	**$259,600**	**$106,978**	**$152,622**

Assumptions

Field Name	Annual Operating Hours	Energy Cost per kWh	Typical Floodlighting Equipment		Musco Green		Controls Energy Savings	Fixture Wattage
			Fixtures	Avg kW	Fixtures	Avg kW		
Soccer	300	$0.19	80	129.6	48	75.1	25.0%	1500W MZ

NOTES:

Carbon dioxide (CO_2) is emitted by the power plant when generating the total kWh used by the lighting system. Generating one kWH of electricity in the United States emits an average of 1.52 lbs. of CO_2. One metric ton equals 2,204.6 lbs. Source for CO_2 calculations: http://www.epa.gov/cleanenergy/energy-resources/refs.html (10-26-12)

Life-cycle costs are based upon the assumptions above per the project specifications.

Any variation in this data will change the life-cycle cost proportionately. Typical Floodlighting Equipment total kWh includes base operating hours plus extra kWh consumed if no controls system included. Musco guarantees the average Green Generation Lighting system kW per hour and useful life of the lamp.

123893 PV16 Rachel Madlock

We Make It Happen.

25-Year Life-Cycle Cost

Manchester Field
Winchester, MA

Prepared for: Mr. Peter Spanos, Gale Associates Inc

10/14/14

	Typical Floodlighting Equipment	Musco Green	Your Savings
Hours	**10,000**	**10,000**	
Average kW	**129.6**	**75.1**	**54.5**
Total kW	**1,296,000.0**	**750,720.0**	**545,280.0**
Metric Tons of CO2	**893.7**	**517.7**	**376.0**
Energy	**$246,240**	**$142,637**	**$103,603**
Group Relamp	$33,333	$0	$33,333
Lamp Maintenance	$3,750	$0	$3,750
Controls - Energy	$61,560	$0	$61,560
25-Year Life-Cycle Cost	**$344,883**	**$142,637**	**$202,247**

Assumptions

Field Name	Annual Operating Hours	Energy Cost per kWh	Typical Floodlighting Equipment		Musco Green		Controls Energy Savings	Fixture Wattage
			Fixtures	Avg kW	Fixtures	Avg kW		
Soccer	400	$0.19	80	129.6	48	75.1	25.0%	1500W MZ

NOTES:

Carbon dioxide (CO_2) is emitted by the power plant when generating the total kWh used by the lighting system. Generating one kWH of electricity in the United States emits an average of 1.52 lbs. of CO_2. One metric ton equals 2,204.6 lbs. Source for CO_2 calculations: http://www.epa.gov/cleanenergy/energy-resources/refs.html (10-26-12)

Life-cycle costs are based upon the assumptions above per the project specifications.

Any variation in this data will change the life-cycle cost proportionately. Typical Floodlighting Equipment total kWh includes base operating hours plus extra kWh consumed if no controls system included. Musco guarantees the average Green Generation Lighting system kW per hour and useful life of the lamp.

123893 PV16 Rachel Madlock

We Make It Happen.

25-Year Life-Cycle Cost

Manchester Field
Winchester, MA

Prepared for: Mr. Peter Spanos, Gale Associates Inc

10/10/14

	Typical Floodlighting Equipment	Musco Green	Your Savings
Hours	**12,500**	**12,500**	
Average kW	**129.6**	**75.1**	**54.5**
Total kW	**1,620,000.0**	**938,400.0**	**681,600.0**
Metric Tons of CO2	**1,117.1**	**647.1**	**470.0**
Energy	**$307,800**	**$178,296**	**$129,504**
Group Relamp	$41,667	$0	$41,667
Lamp Maintenance	$3,750	$0	$3,750
Controls - Energy	$76,950	$0	$76,950
Controls - Labor	$0	$0	$0
25-Year Life-Cycle Cost	**$430,167**	**$178,296**	**$251,871**

Assumptions

Field Name	Annual Operating Hours	Energy Cost per kWh	Typical Floodlighting Equipment Fixtures	Typical Floodlighting Equipment Avg kW	Musco Green Fixtures	Musco Green Avg kW	Controls Energy Savings	Controls Labor Savings	Fixture Wattage
Soccer	500	$0.19	80	129.6	48	75.1	25.0%	0.0	1500W MZ

NOTES:

Carbon dioxide (CO_2) is emitted by the power plant when generating the total kWh used by the lighting system. Generating one kWH of electricity in the United States emits an average of 1.52 lbs. of CO_2. One metric ton equals 2,204.6 lbs. Source for CO_2 calculations: http://www.epa.gov/cleanenergy/energy-resources/refs.html (10-26-12)

Life-cycle costs are based upon the assumptions above per the project specifications.

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