



Daylighting Contours



Millennium Science Complex

University Park, PA

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Paul Kuehnel

Mike Lucas

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04.07.2011

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Solar Shades



Solar Shading Systems



All AWV solar shade devices are licensed products of Colt International Ltd.



Architectural Solutions

Thesis Proposal



Introduction

Front Page: Berlaymont, Brussels

Over 236,800 sq. ft. of controllable Colt Shadoglass louvers were installed onto the European Commission Headquarters. These act as a high performance secondary facade. The control system was supplied by Colt and adjusts the position of the blades in response to changing climatic conditions and available daylight.

INTRODUCTION

Excessive solar heat gain and solar glare can be a costly and unwanted hindrance for building owners. In addition, owners require designers to reduce heat gain, with solar shading recommended as a preventative measure unless glass areas are minimized.

AWV solar shading systems offer designers the opportunity for distinctive architectural impact, while reducing solar heat gain.

SOLAR RADIATION & LOUVERS

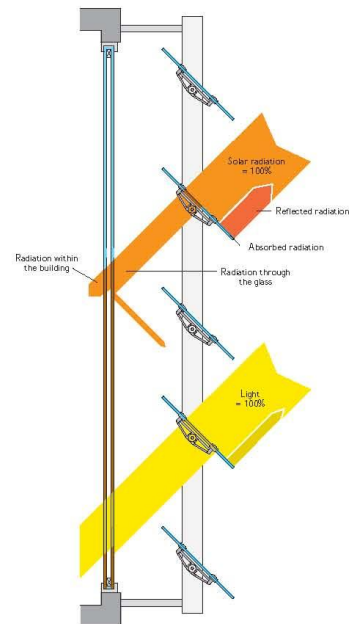
External solar shading is one of the most effective ways to control the internal conditions of a building.

Radiation from the sun is transmitted, absorbed and reflected by the blades. As a result, solar heat gain is prevented from passing into the building, minimizing ventilation requirements and reducing cooling loads. If a controllable system is installed, adjustable blades track the position of the sun, thereby reducing the numbers of days when the building overheats. Equally, in winter the blades may be adjusted in such a way that the building benefits from the heat from the sun, and they can be closed at night reducing heat loss.

Simultaneously, daylight levels are enhanced, and levels of glare are reduced.

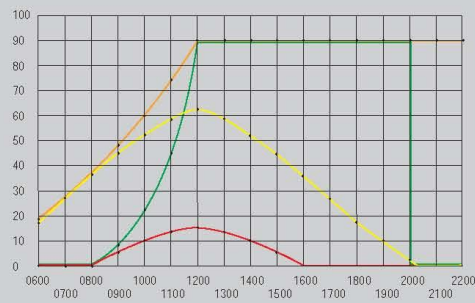
AWV's OFFER

- Calculation of sun angles and heat loads.
- Selection of the most appropriate system from a wide range of options.
- Solar Shading panels are available in various configurations, materials, finishes and coatings to meet the requirements of almost any project.
- Three advanced control options are available, ICS 4-Link for large or medium sized projects, Soltronic for smaller projects, and the innovative Girasol thermohydraulic system, which requires no external energy source.
- All systems are durable and reliable with low maintenance needs.

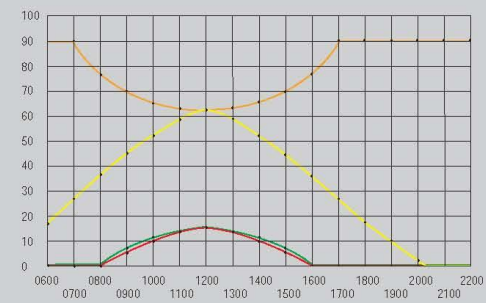


SUN PATH DIAGRAMS

East facade



South facade



—●— Sun altitude in summer
—●— Sun altitude in winter

GMT Time (h)

—●— Blade angle in summer (June)
—●— Blade angle in winter (Dec)

Notes: 1. When blade angles $>90^\circ$ - facade is in the shade. 2. Normally the angle of the blade follows the VSA (vertical shadow angle). When shading is not required (i.e. when facade is in the shade or when the sky is overcast), the blades may be set for a maximum daylight entry or vision to the outside, or are closed for night security insulation.

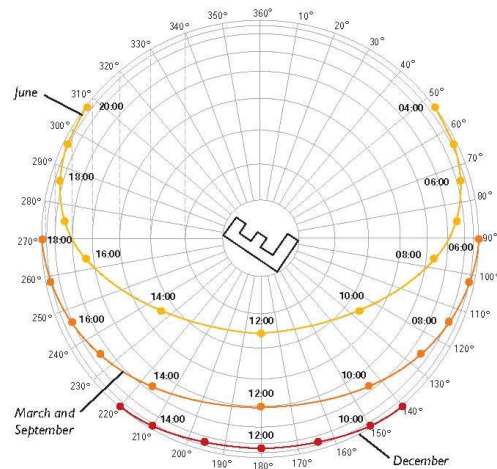
TOTAL CONTROL

Although fixed solar shading performs well on a South facing facade, performance is dramatically reduced on a East or West facing facade which receives a large amount of sunshine during the day.

A controllable shading system can best overcome this problem. Sun tracking blades follow the path of the sun, making sure the solar shading system always optimizes the amount of daylight entry.

On dull or overcast days the blades are controlled in such a way that if clouds pass over the building, the blades will automatically open to maximize daylight entry and then later revert back to their original position.

The Sun path diagram (right) for latitude 52°N shows the position of the sun throughout the day during the months of June, March/September and December.



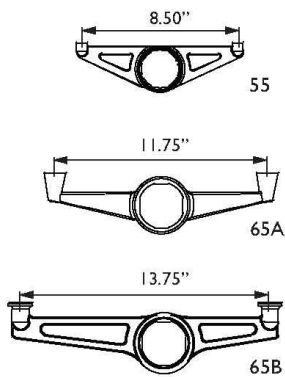
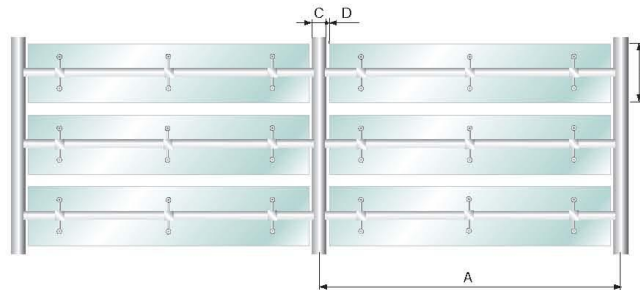
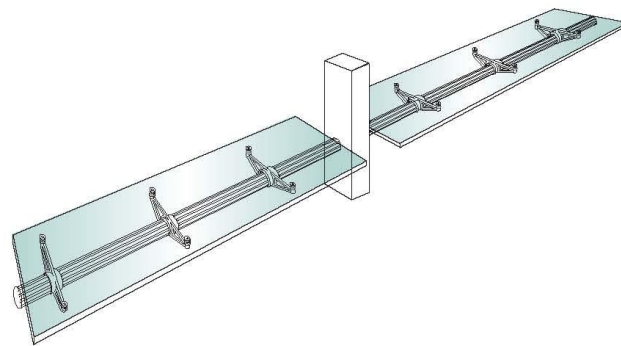
Carrier System I (LSI)

CARRIER SYSTEM I (LSI)

Intended for wider spans, Carrier System I incorporates a central aluminum torsion tube along the length of the blade, and is ideal for continuous facades, as well as for roofs.

For glass, cross sectional blade widths from 11.75" and up to 23.5" are available.

This carrier system is also suited for use with metal, fabric, wood, terracotta clay and translucent acrylic blades.



Glass Parameters Table

Dimensions	LSI - 55	LSI - 65A	LSI - 65B
A in. (max)	97.50	128.75	128.75
B in.	11.75 - 19.50	13.75 - 21.50	16.50 - 23.50
C in.	2.50	2.50	2.50
D in.	.50	.50	.50
Angle of rotation°	0 - 100	0 - 100	0 - 100
Torsion tube Ø in.	2.00	2.50	2.50

Note: Table to be used as a guide only. Allowable dimensions depend upon the specific requirements of the project.



Shadoglass

Shadoglass describes a fixed or controllable external solar shading system that incorporates glass blades. A Shadoglass shading system can reduce solar heat gain, lower air conditioning running costs, and lessen glare while maximizing the use of natural daylight. The glass blades are available in various colors, surface finishes and coatings to meet specific design requirements. This enables the designer to control the quality of light entering the building. Photovoltaic cells may be integrated into the glass so as to obtain further energy benefits.

Features and benefits

- Available as standard in widths of up to 23.50".
- Available in unsupported spans of up to 6.50 ft., supported spans of up to 13.00 ft. (depending on windloads and other criteria).
- Wide range of colors, surface finishes and coatings.
- All principal support components manufactured from corrosion-resistant extruded aluminum alloy with stainless steel fixings.
- Fixed or controllable.
- May permit the integration of photovoltaic cells.



Controls

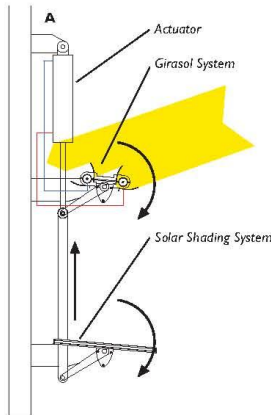
AWV Solar Shading systems may be controlled in three different ways:

- Hand control via lever or crank handle.
- Electrically operated via actuators, which require a controller such as ICS 4-Link, SolTronic or a client BMS.
- Self powered via a thermal hydraulic controller Colt Girasol. This operates autonomously and requires no additional source of power other than the sun.

GIRASOL

Girasol operates solar shading louvers without the need for electrical power or a sophisticated control system.

Absorber tubes, enclosed by mirrors, force a hydraulic cylinder to open or close the blades according to the position of the sun.



Tubes are filled with a special hydraulic fluid and as the sun moves over the building, there will be an imbalance of heat between the two tubes and the blades will open or close as appropriate.

ICS 4-LINK

ICS 4-Link is ideally suited to larger projects with more complex control requirements. It is a generic control system that can operate HVAC, smoke control and solar shading systems.

This product has a wide variety of operating modes, including sun tracking, daylighting optimization and PV illumination. It responds to timers and sensors to ensure that the building 'reacts' appropriately to the sun's position and to the weather.

Remote operation is available via an internal modem interface and a manual override is also possible.

SOLTRONIC

SolTronic is ideally suited for small to medium sized projects. It is a simplified version of ICS 4-Link and can control up to ten actuators in any single zone.

This product responds to external weather conditions, automatically calculating the position of the sun, and adjusts the position of the blades accordingly.





COMMISSIONING

Proper commissioning by experts is essential. We recommend that our specialist staff commission and certify the system.

MAINTENANCE & TESTING

AWV solar shading systems require virtually no maintenance.

All components of any system should be serviced at least once a year and tested monthly.



All AWV solar shade devices are licensed products of Colt International Ltd.



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Holland, OH 43528
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www.awv.com



Southeast Material Science Façade

Annual Savings kWh:

788.86

System Cost:

0.0

Energy Cost (per kWh):

0.08

Demand Charge (per kWh):

0.0

Peak Demand Time (0-24.0):

0.0

NOTE: All costs must be in the same units.

Savings Per Year:

63.1088

Daysim EconomicAnalysis for Southeast Material Science Student Study Area.

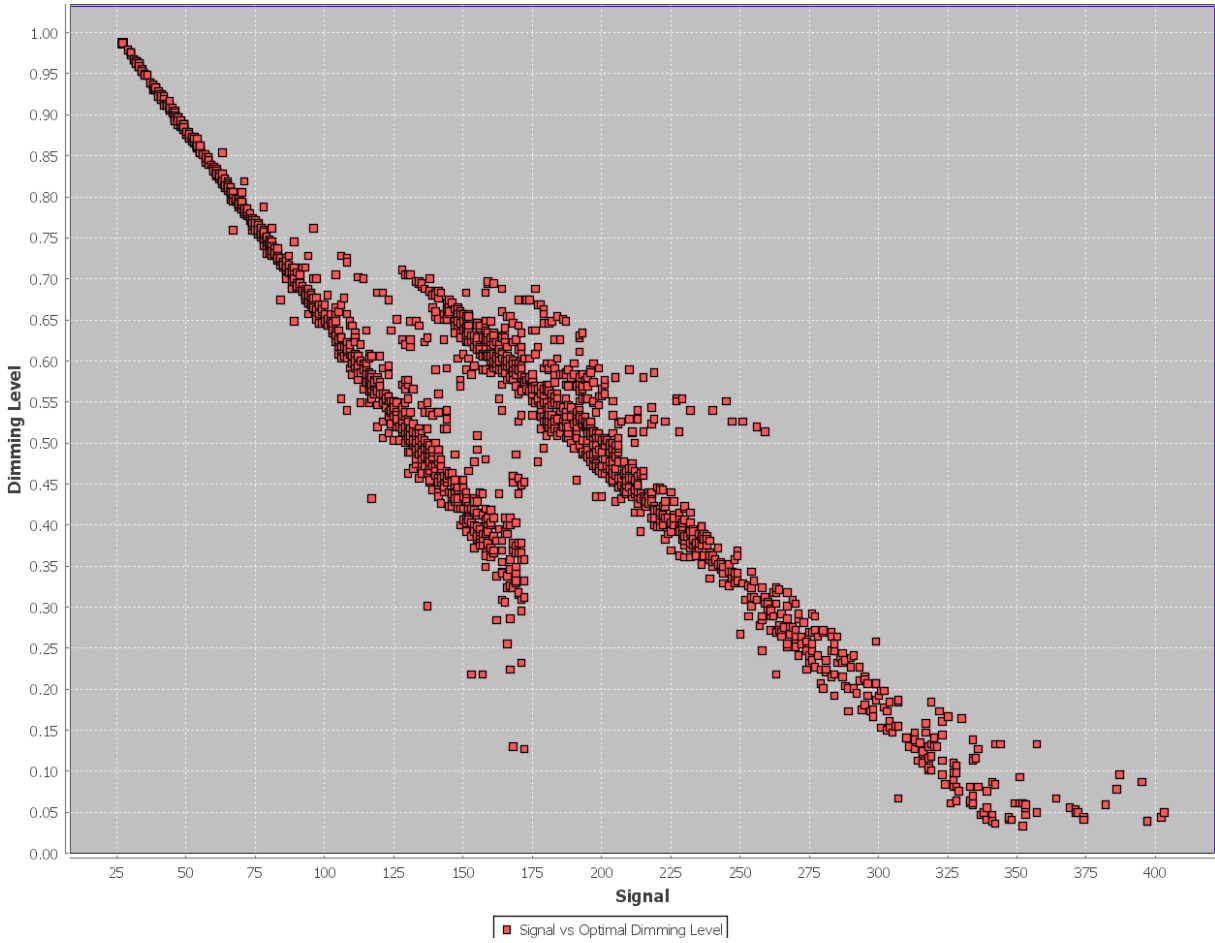
Controlled Zone: Grand Total		January	February	March	April	May	June	July	August	September	October	November	December	Total
Base		152.76	132.84	146.12	132.84	152.76	146.12	146.12	152.76	139.48	152.76	146.12	99.63	1700.35
Optimal		106.61	90.5	75.85	70.82	82.12	65.45	62.13	73.96	70.84	81.91	91.55	71.74	943.53
Algorithm		106.93	90.77	71.45	68.85	79.58	59.01	55.74	70.06	66.74	78.86	91.09	72.36	911.48
Savings		45.83	42.06	74.67	63.98	73.18	87.11	90.37	82.7	72.74	73.9	55.02	27.26	788.86

Daysim Controlled Zone Energy Table for Southeast Material Science Student Study Area.

Controlled Zone: Grand Total		January	February	March	April	May	June	July	August	September	October	November	December	Total
Base		229.71	199.75	219.72	199.75	229.71	219.72	219.72	229.71	209.73	229.71	219.72	149.81	2556.82
Optimal		183.56	157.41	149.45	137.73	159.07	139.05	135.74	150.91	141.1	158.86	165.16	121.92	1800.0
Algorithm		183.88	157.68	145.05	135.77	156.53	132.61	129.34	147.01	136.99	155.8	164.69	122.54	1767.95
Savings		45.83	42.06	74.67	63.98	73.18	87.11	90.37	82.7	72.74	73.9	55.02	27.26	788.86

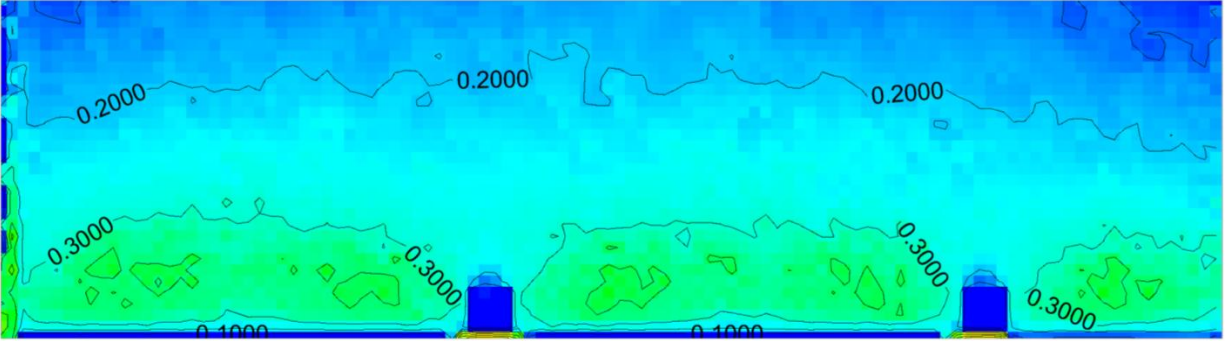
Daysim Controlled Zone Energy Table for Southeast Material Science Student Study Area.



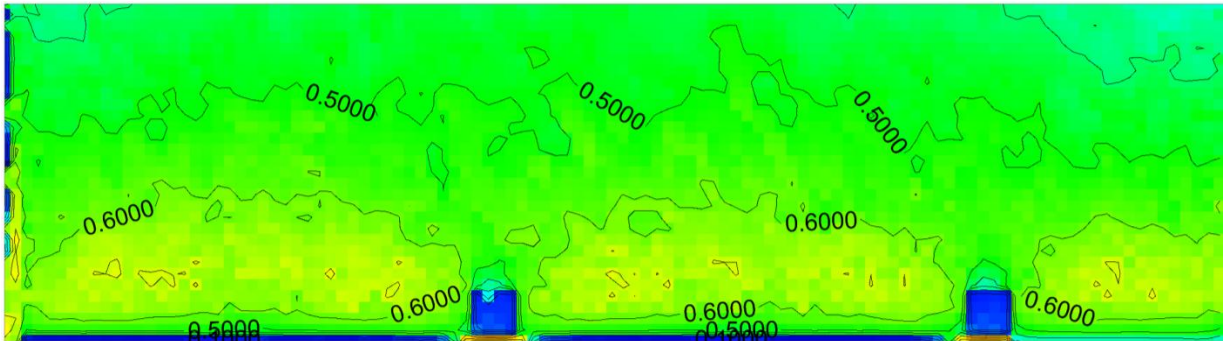


Dimming Level Vs. Photosensor Signal for Southeast Facing Material Science Student Study Area.

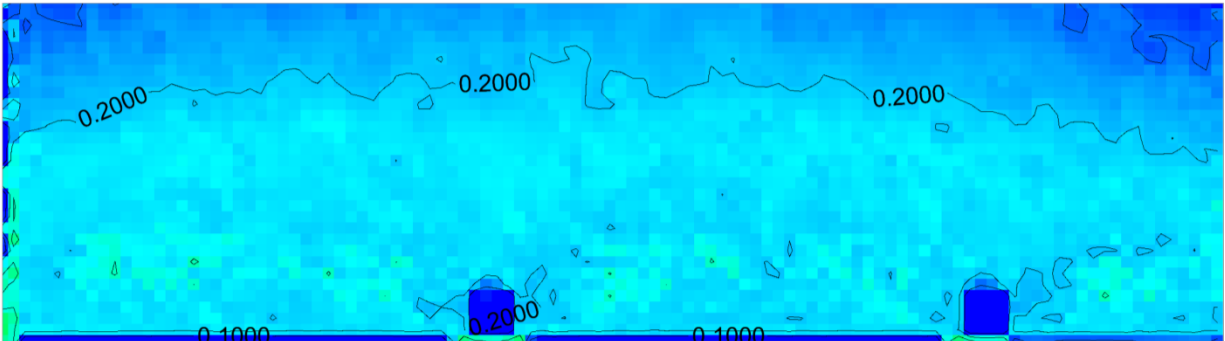




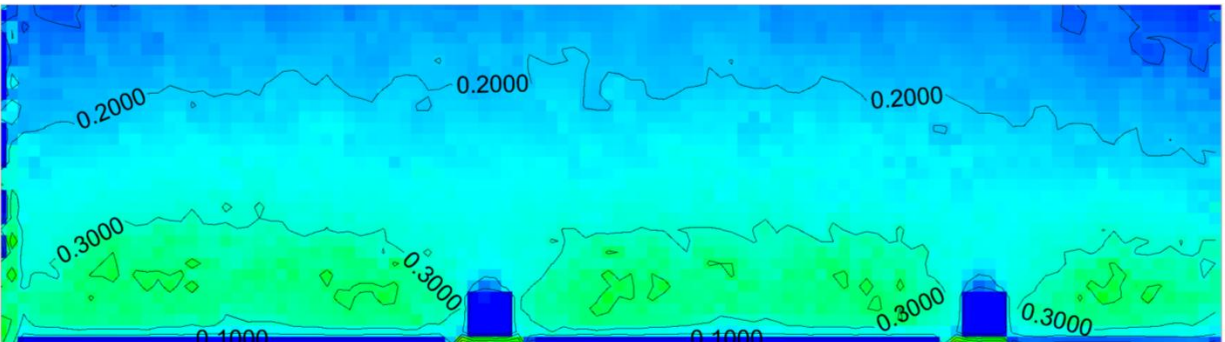
Daylight Autonomy for Southeast Facing Material Science Facade (322.8lux).



Continuous Daylight Autonomy for Southeast Facing Material Science Facade (322.8lux).



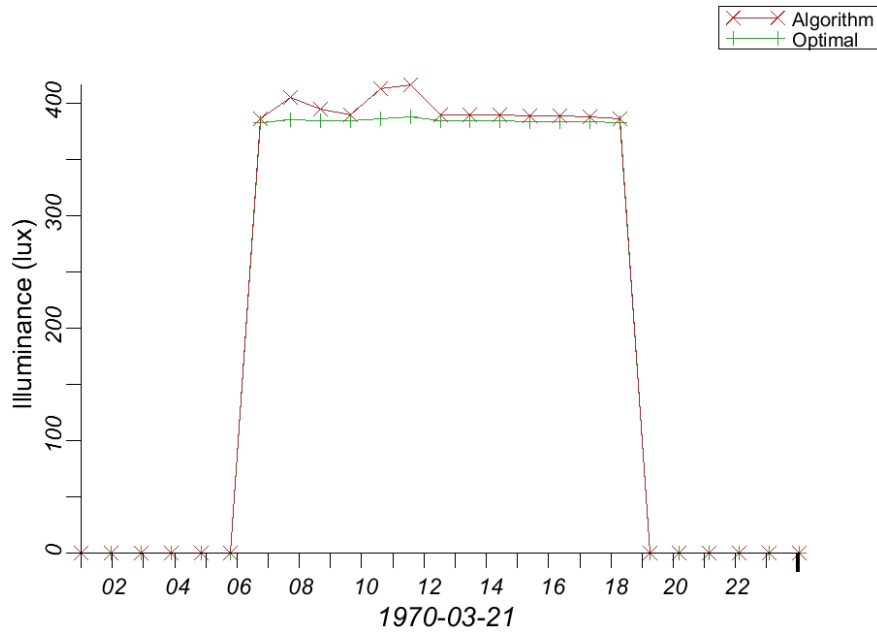
Daylight Illuminance for Southeast Facing Material Science Facade (322.8 to 1000lux).



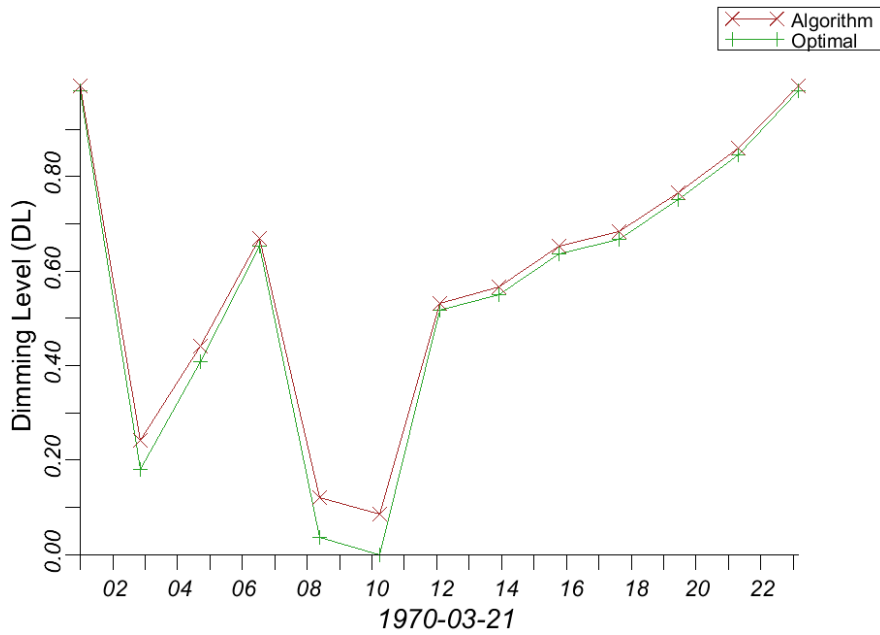
Useful Daylight Illuminance for Southeast Facing Material Science Facade (322.8 to 2000lux).



Fall & Spring Equinox: 7:00AM through 7:00PM

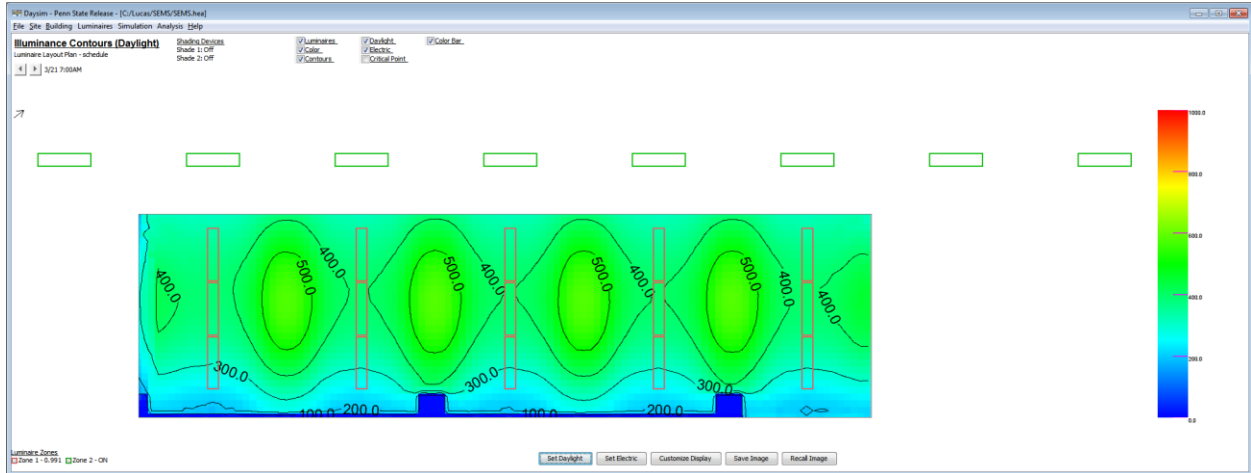


Daysim Illuminance Timeplot for Southeast Material Science Façade (Fall & Spring Equinox).

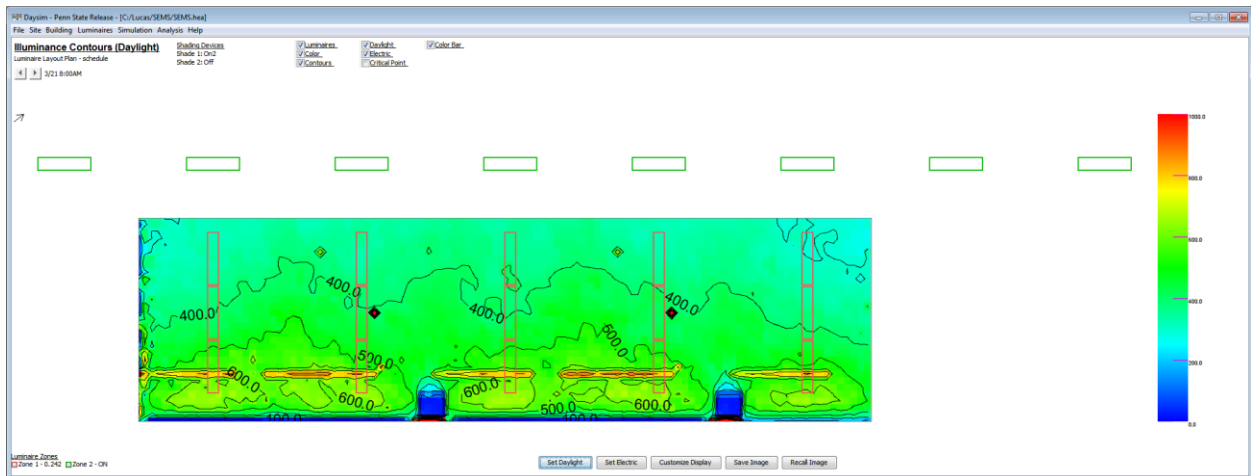


Daysim Dimming Timeplot for Southeast Material Science Façade (Fall & Spring Equinox).

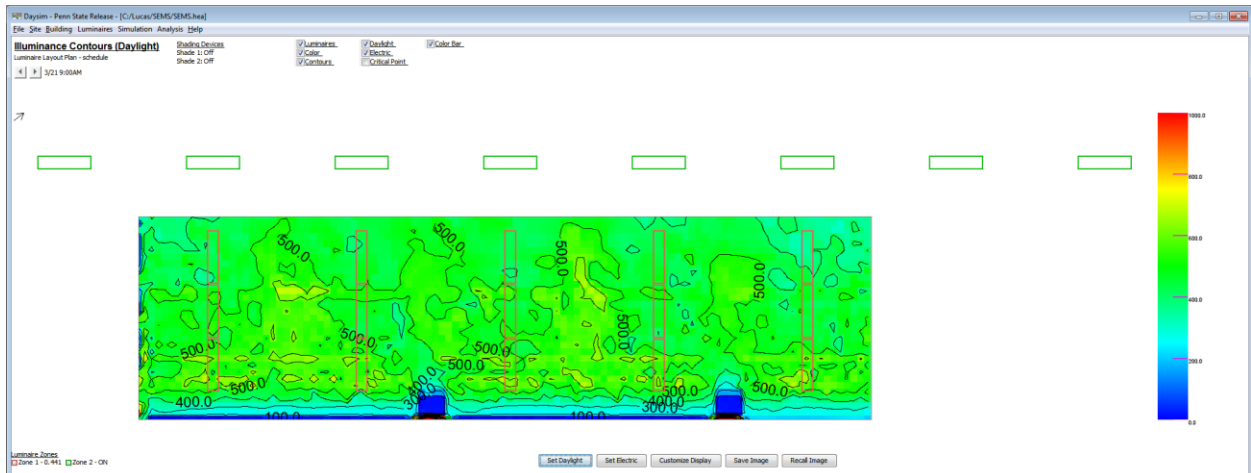




Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 7:00AM).

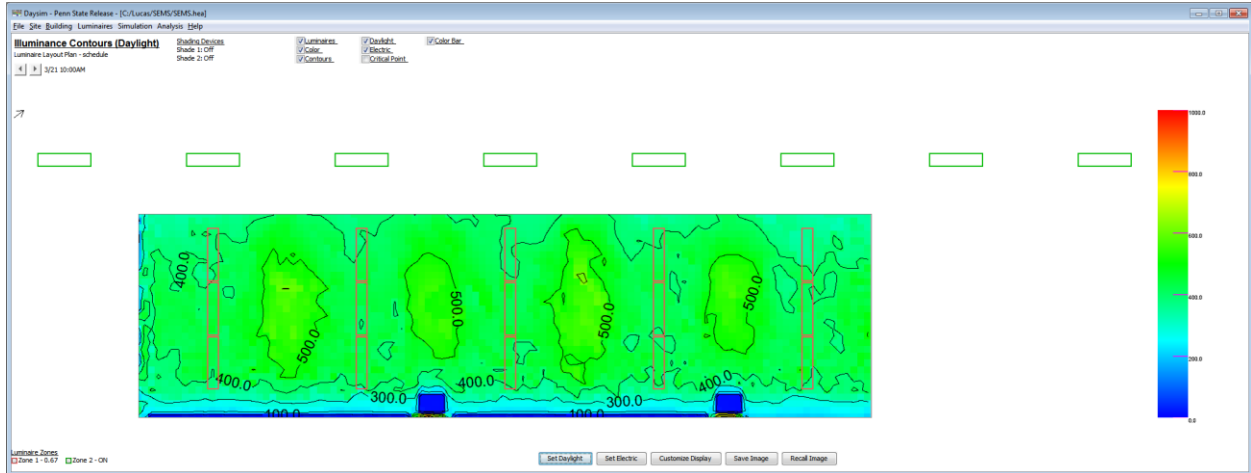


Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 8:00AM).

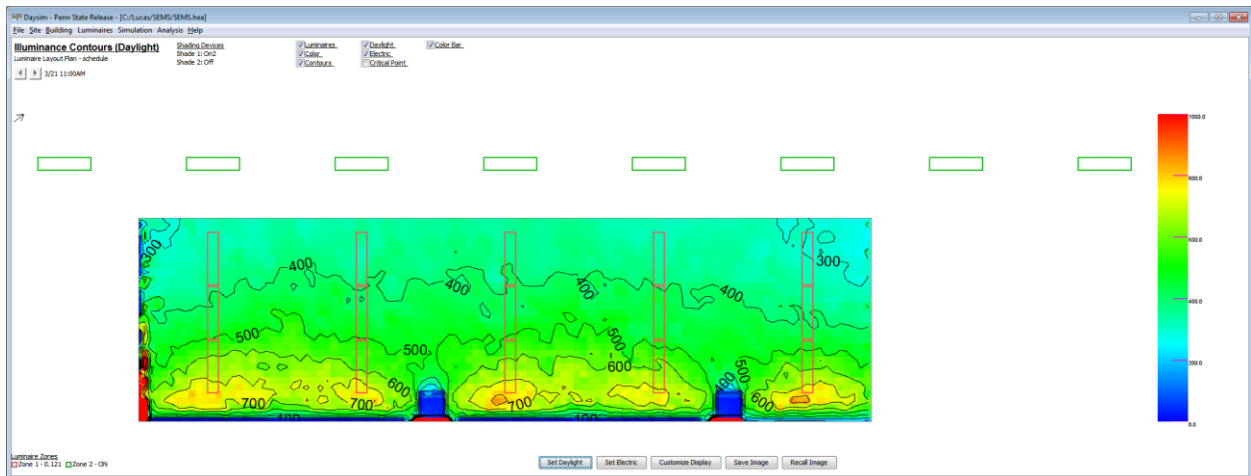


Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 9:00AM).

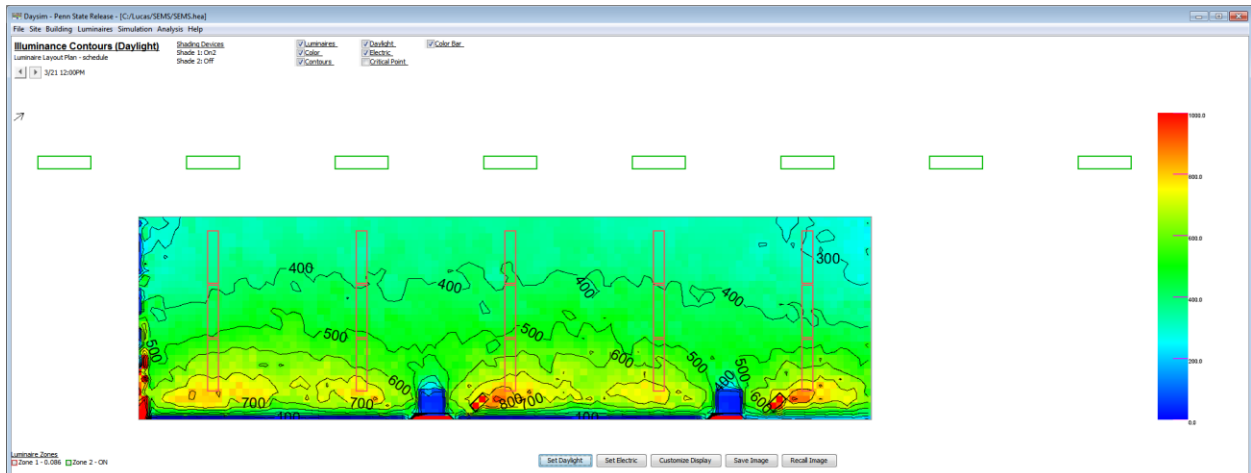




Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 10:00AM).

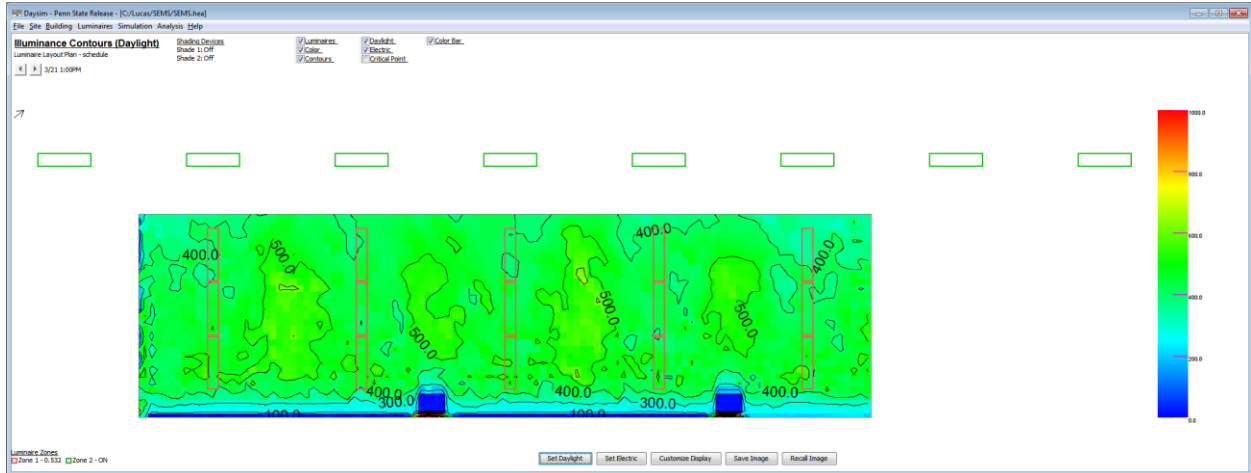


Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 11:00AM).

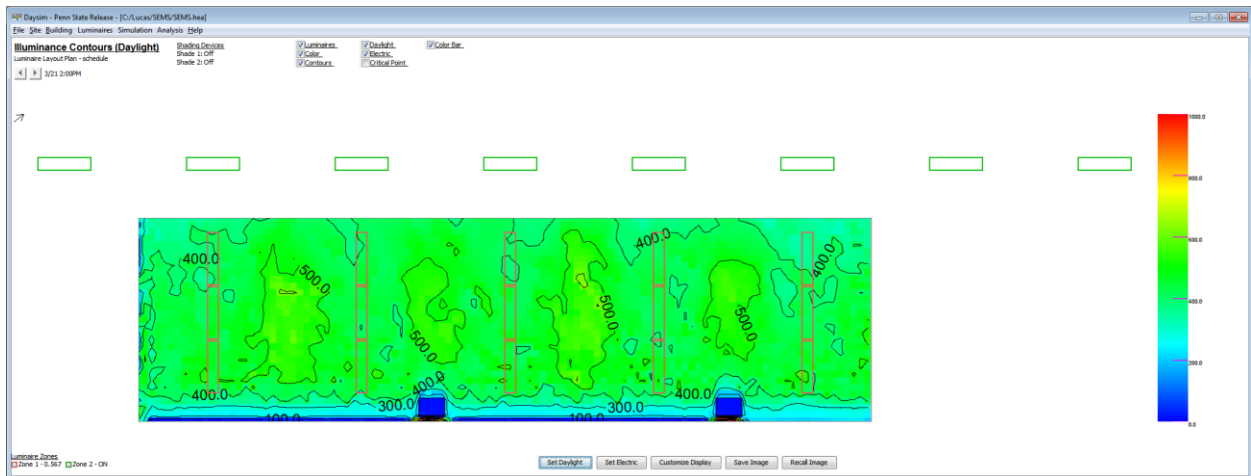


Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 12:00PM).

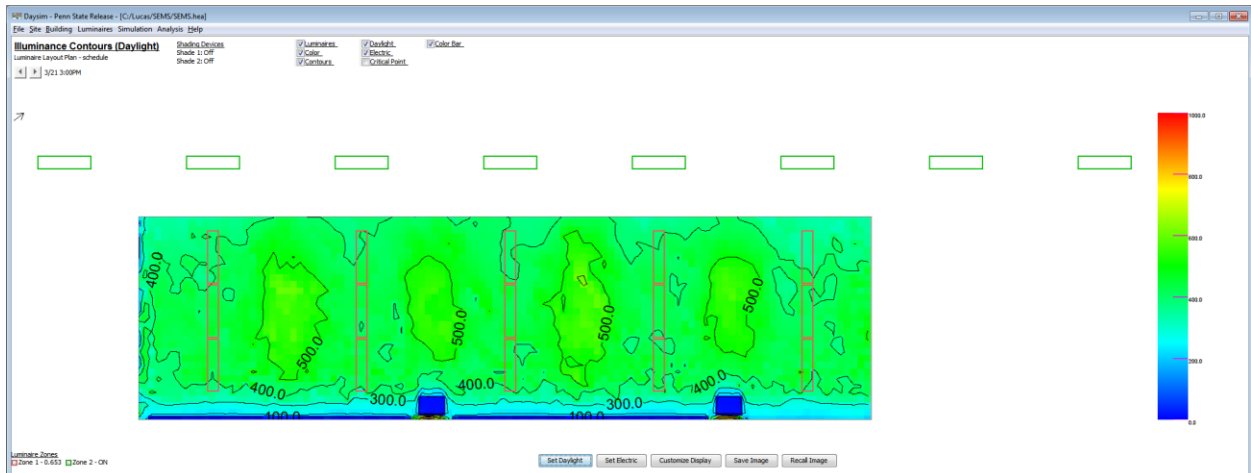




Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 1:00PM).

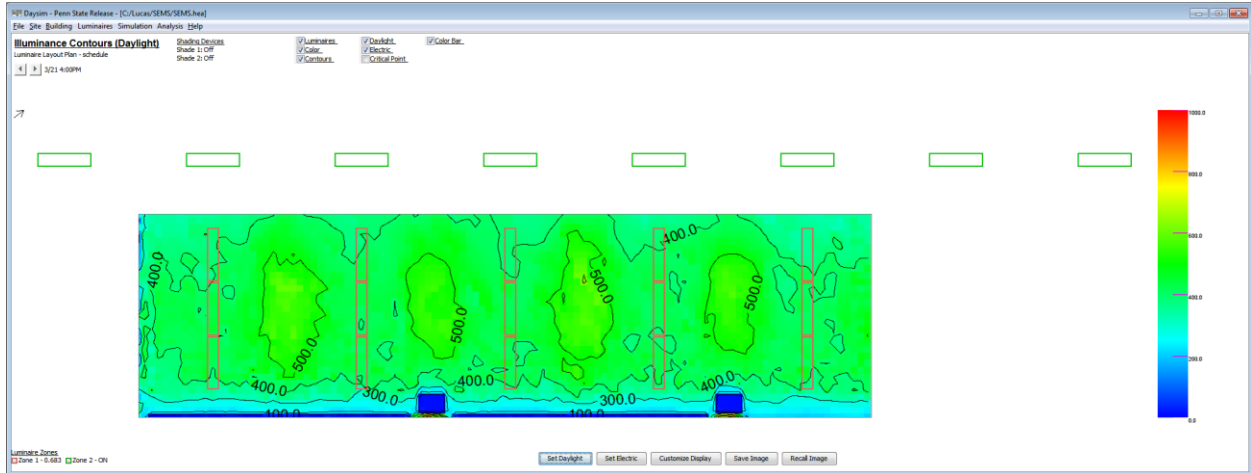


Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 2:00PM).

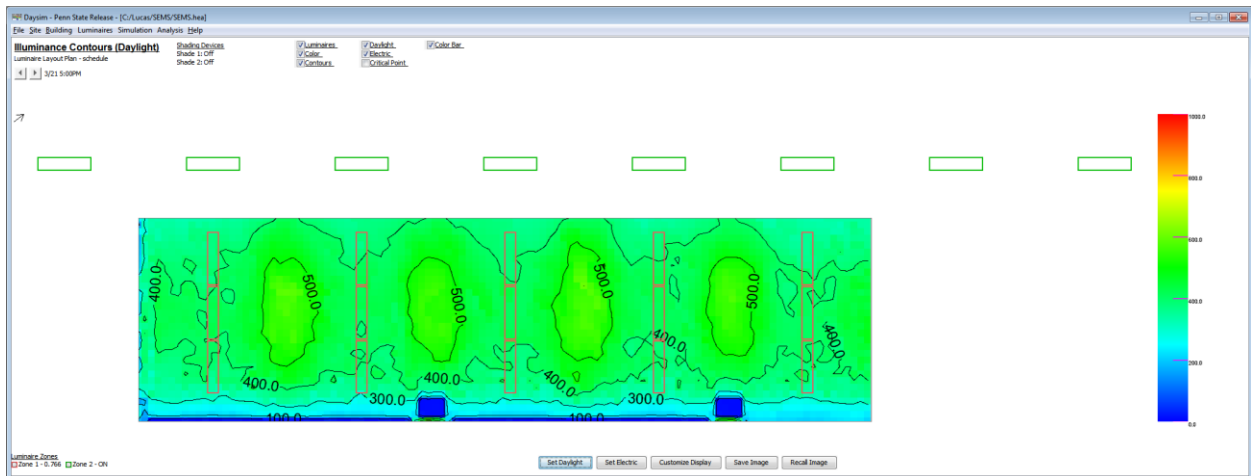


Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 3:00PM).

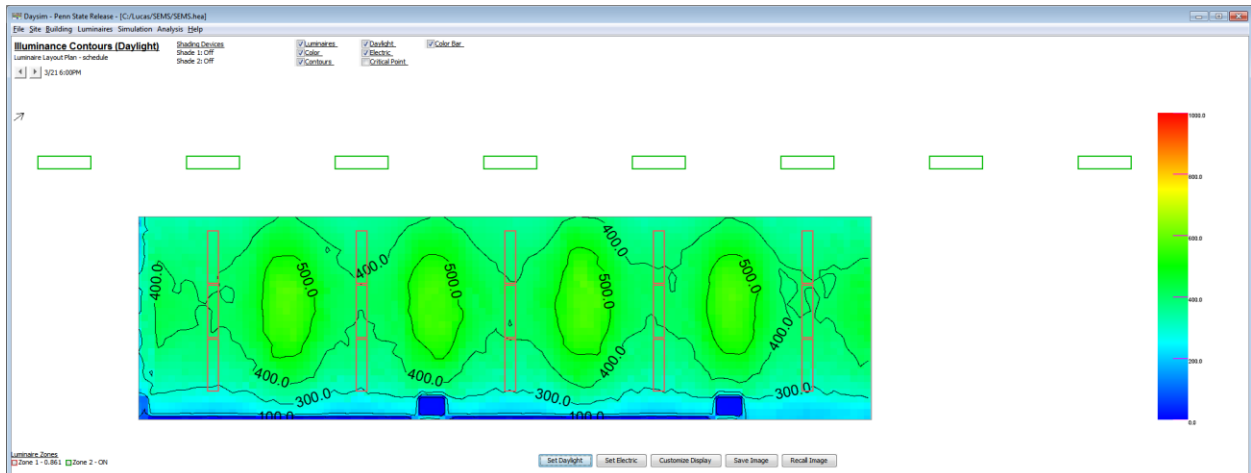




Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 4:00PM).

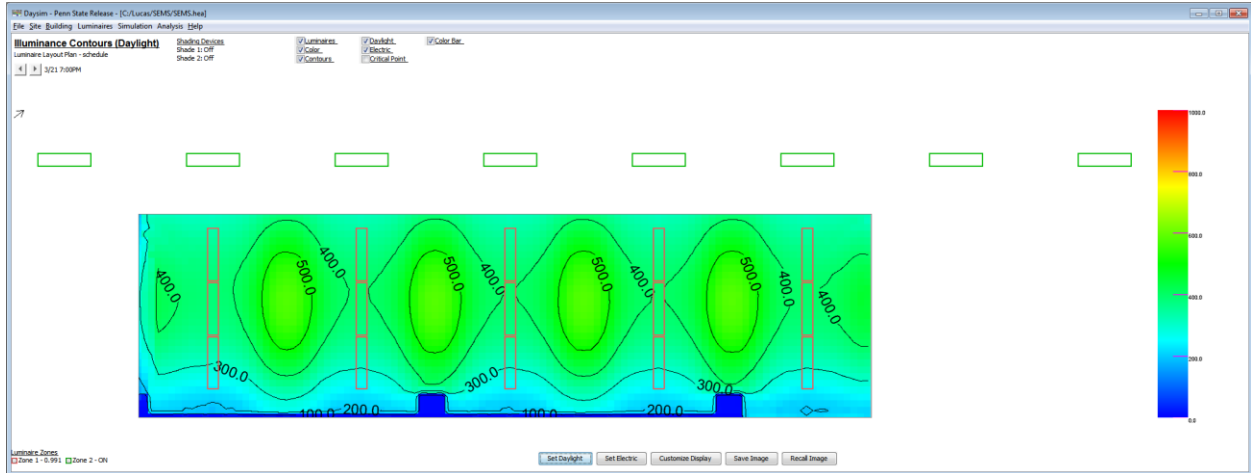


Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 5:00PM).



Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 6:00PM).

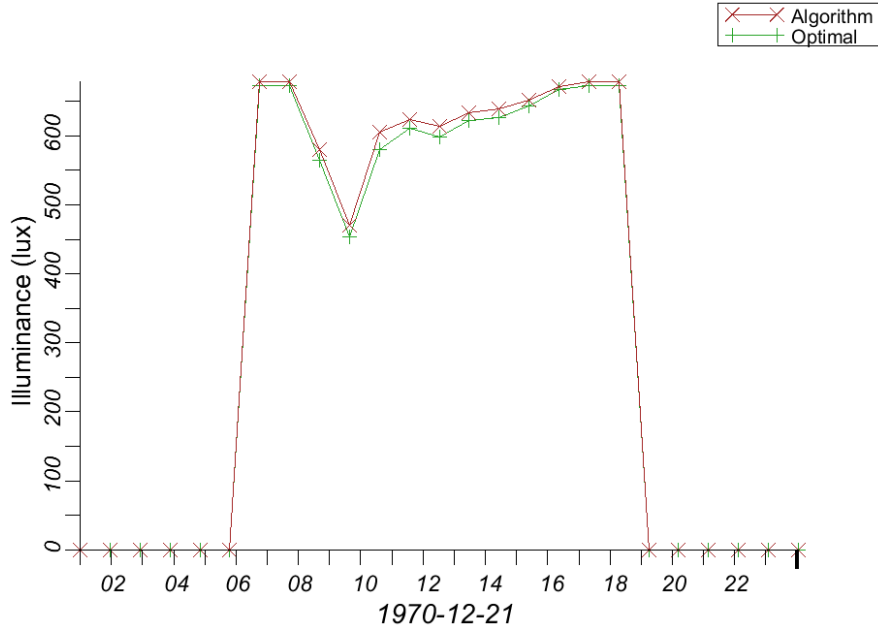




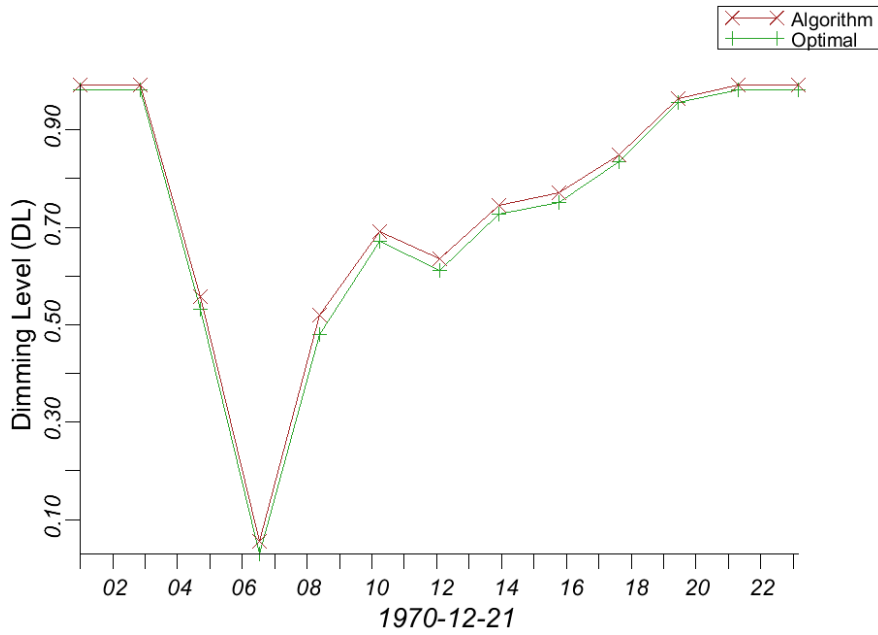
Illumination Contours for Southeast Facing Material Science Façade (3/21 & 9/21 – 7:00PM).



Winter Solstice: 7:00AM through 7:00PM

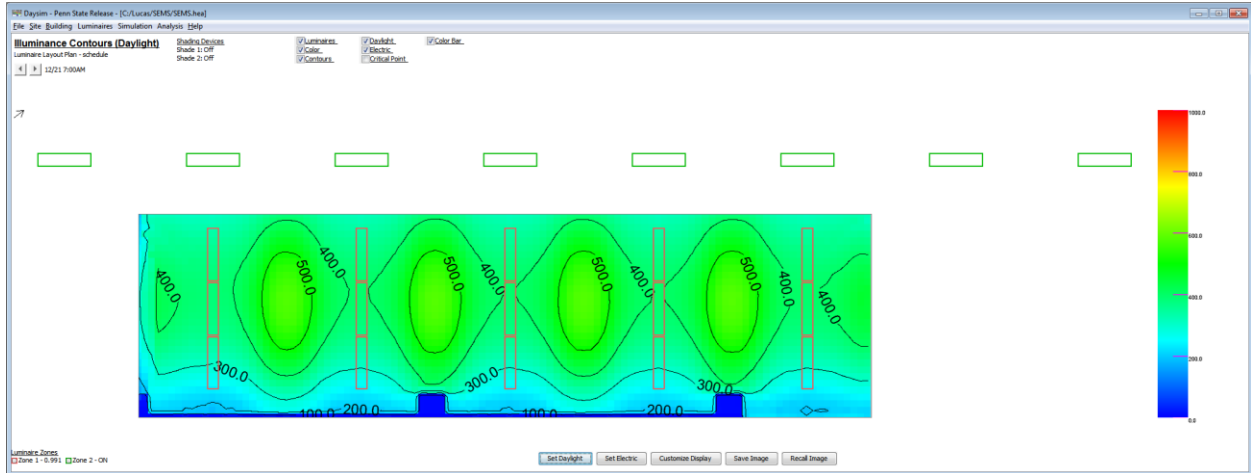


Daysim Illuminance Timeplot for Southeast Material Science Façade (Winter Solstice).

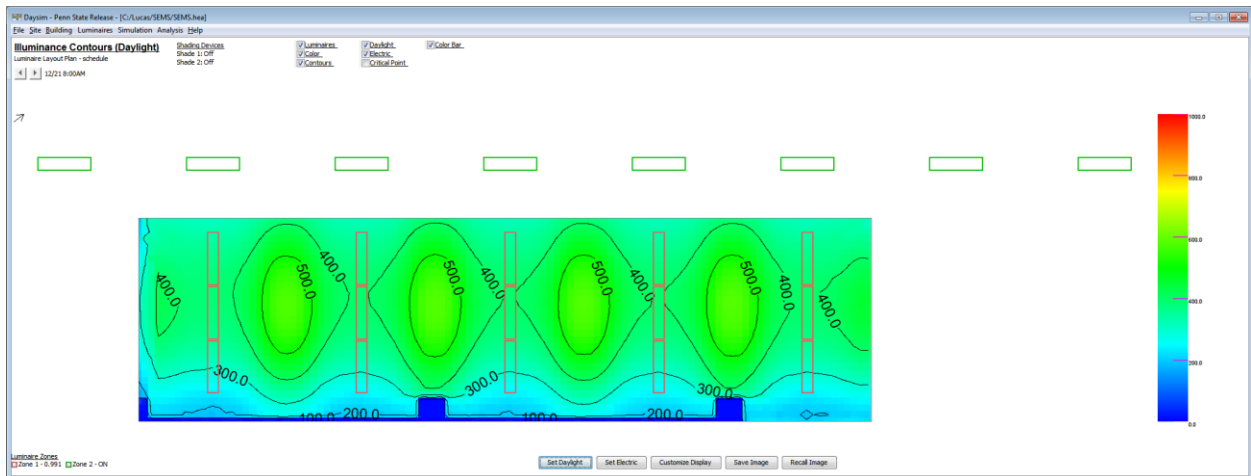


Daysim Dimming Level Timeplot for Southeast Material Science Façade (Winter Solstice).

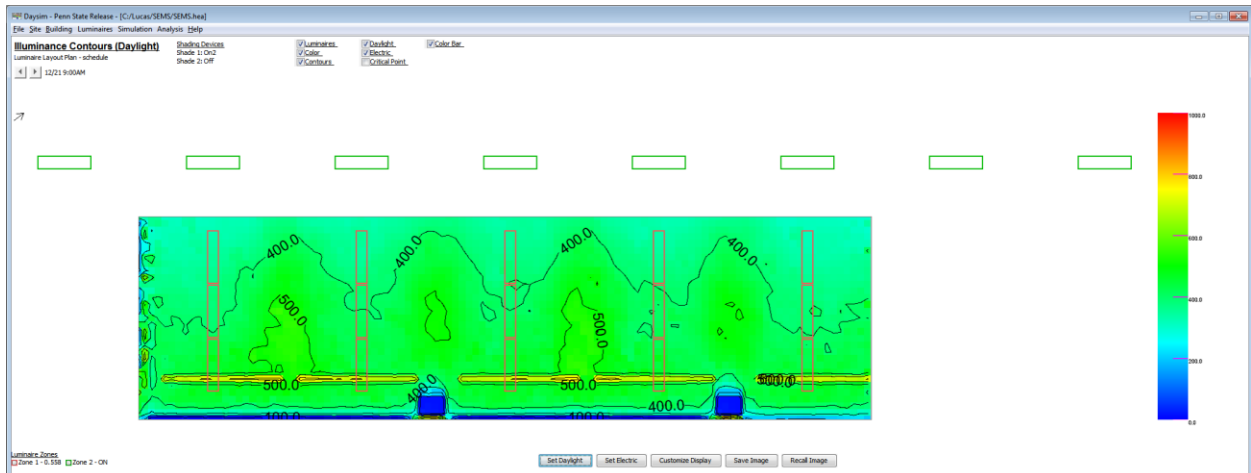




Illumination Contours for Southeast Facing Material Science Façade (12/21 – 7:00AM).

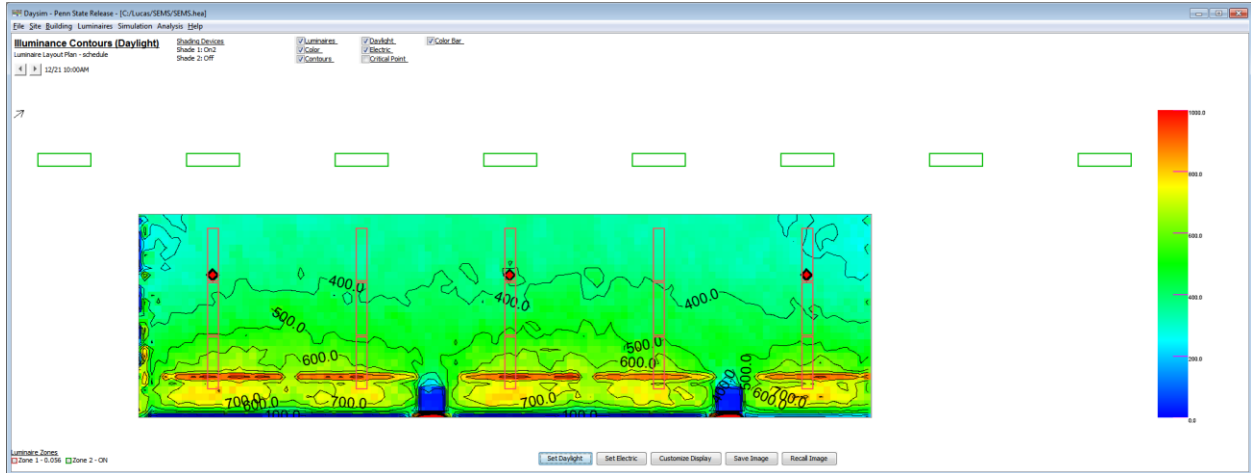


Illumination Contours for Southeast Facing Material Science Façade (12/21 – 8:00AM).

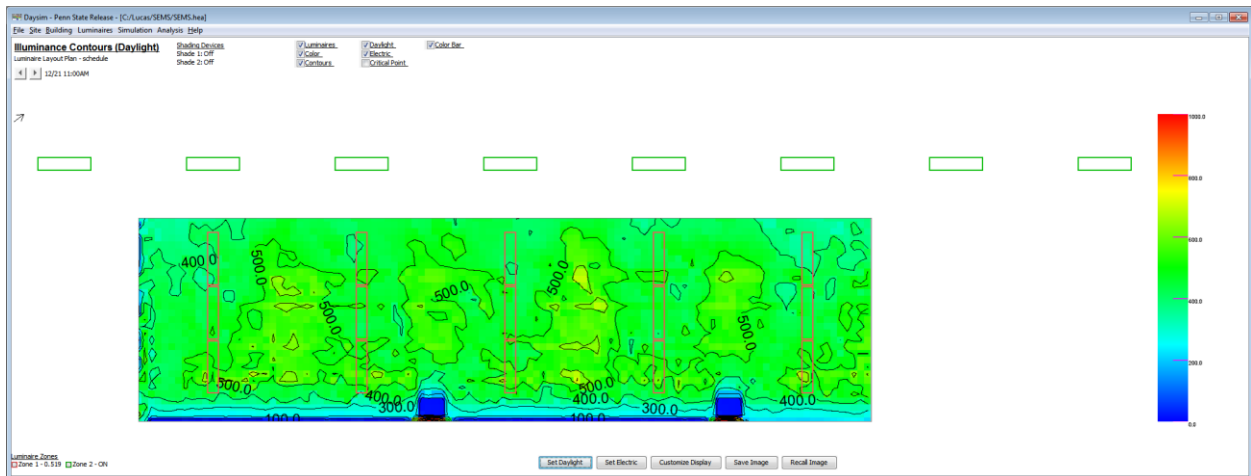


Illumination Contours for Southeast Facing Material Science Façade (12/21 – 9:00AM).

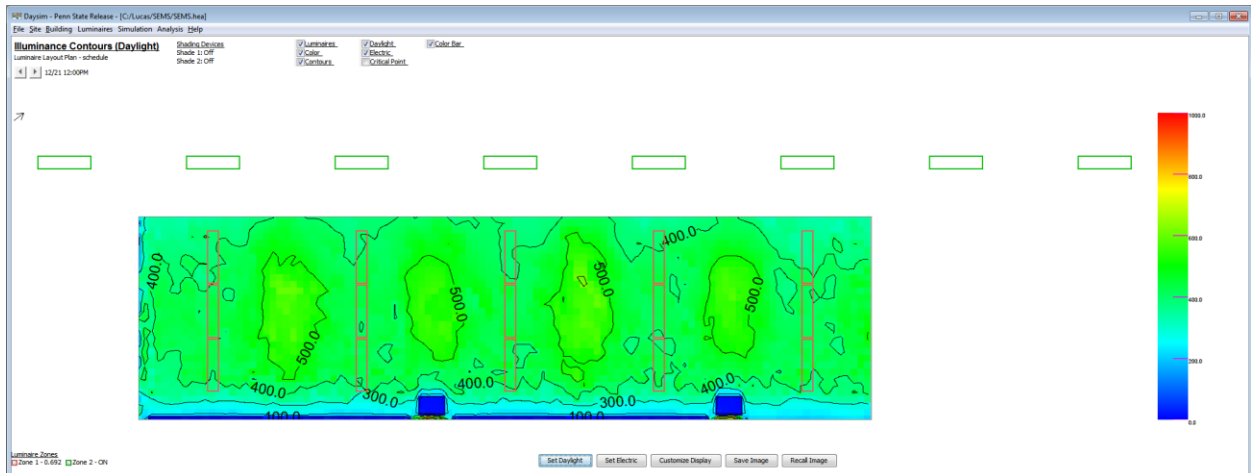




Illumination Contours for Southeast Facing Material Science Façade (12/21 – 10:00AM).

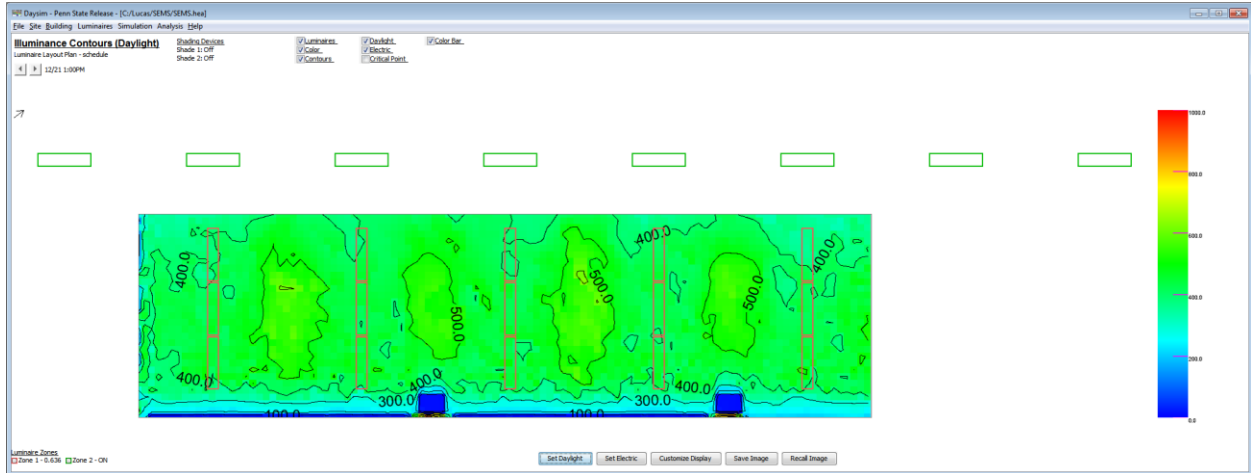


Illumination Contours for Southeast Facing Material Science Façade (12/21 – 11:00AM).

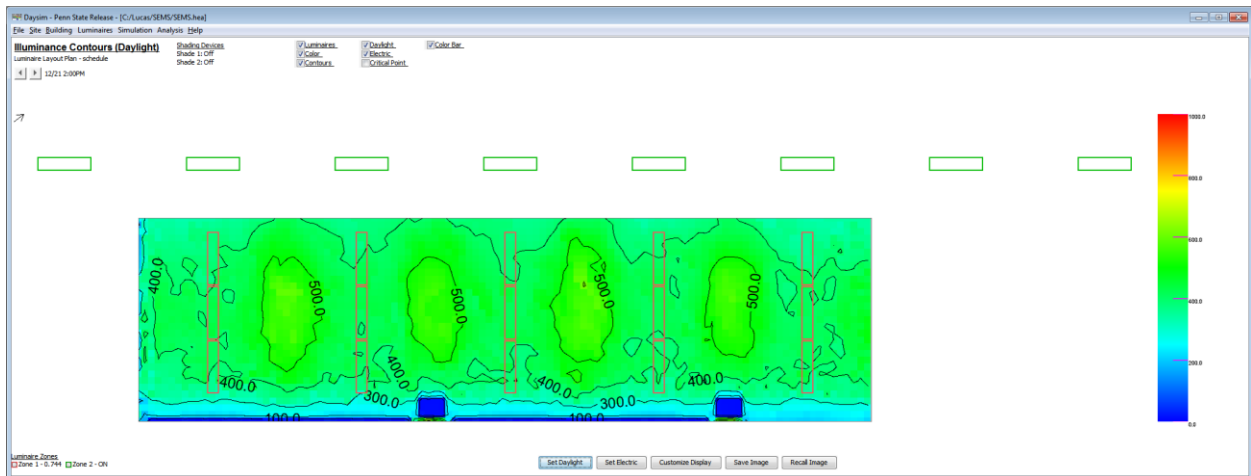


Illumination Contours for Southeast Facing Material Science Façade (12/21 – 12:00PM).

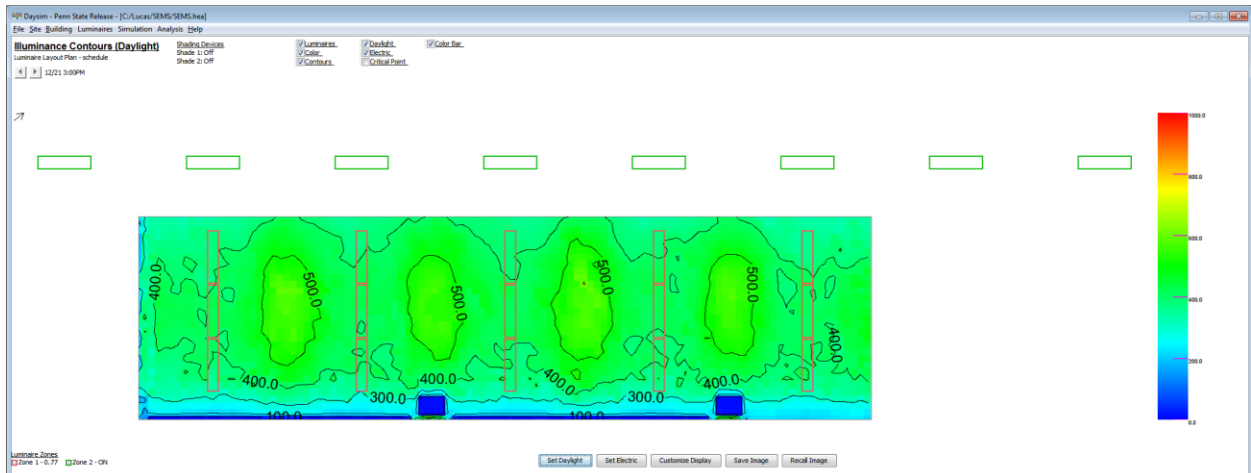




Illumination Contours for Southeast Facing Material Science Façade (12/21 – 1:00PM).

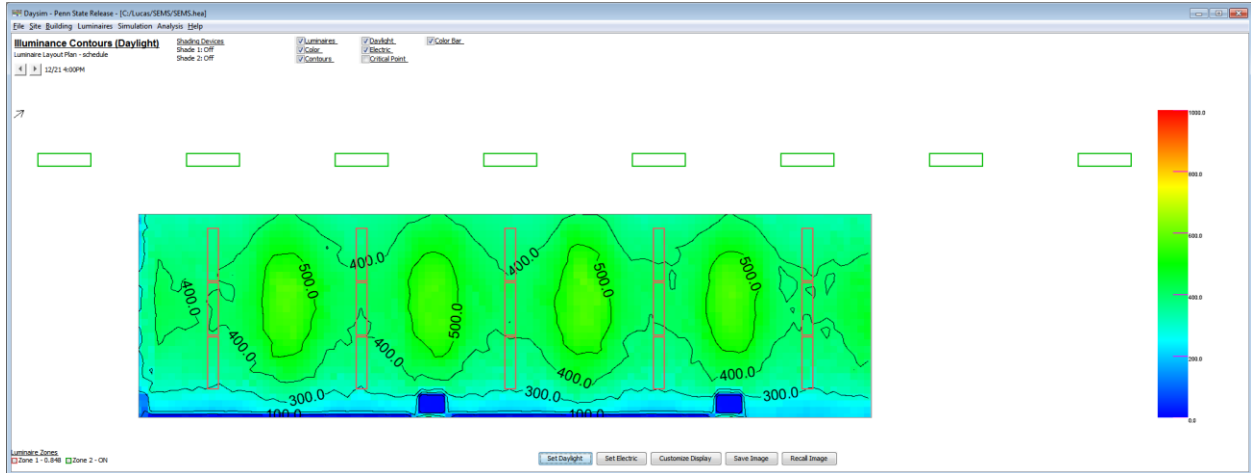


Illumination Contours for Southeast Facing Material Science Façade (12/21 – 2:00PM).

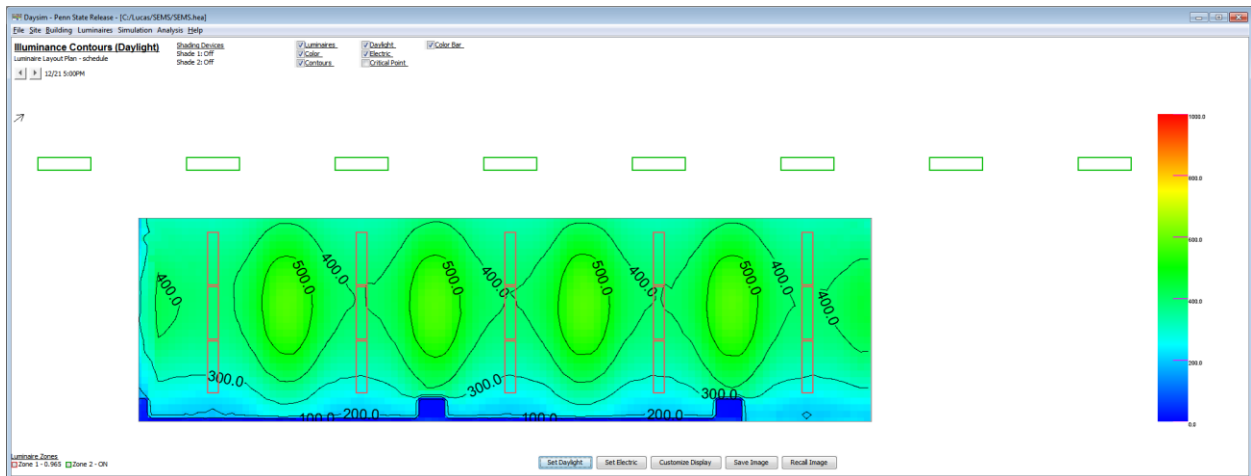


Illumination Contours for Southeast Facing Material Science Façade (12/21 – 3:00PM).

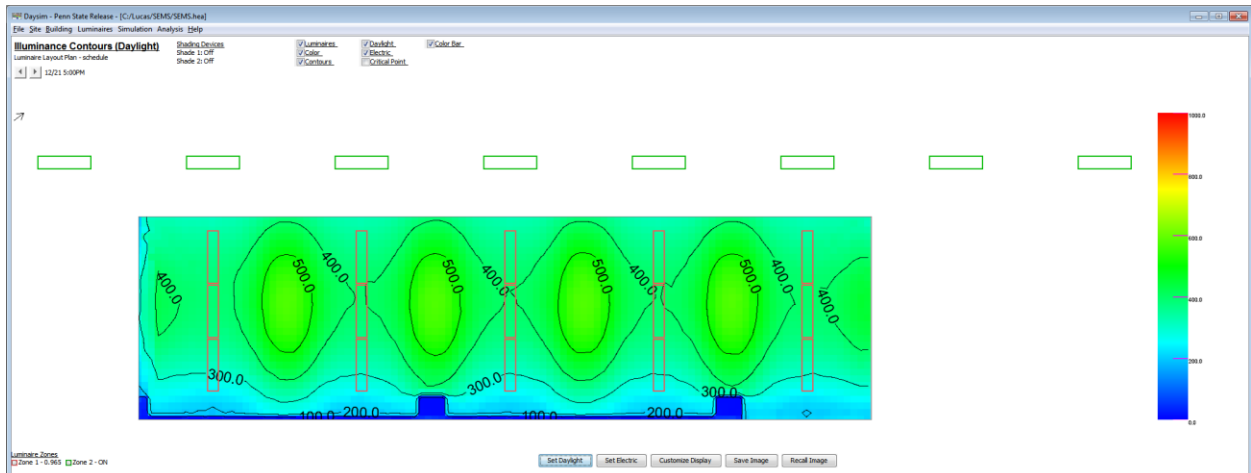




Illumination Contours for Southeast Facing Material Science Façade (12/21 – 4:00PM).

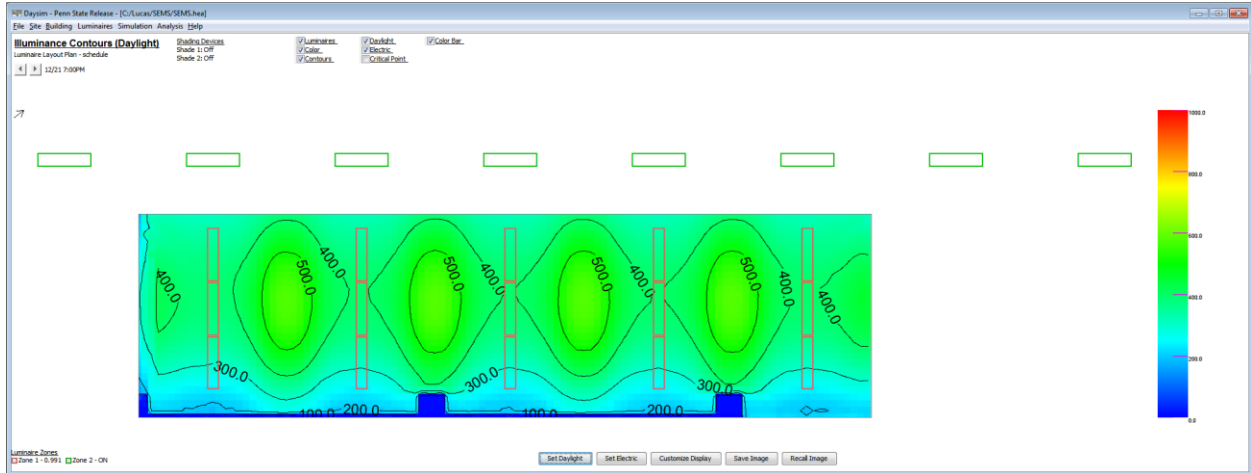


Illumination Contours for Southeast Facing Material Science Façade (12/21 – 5:00PM).



Illumination Contours for Southeast Facing Material Science Façade (12/21 – 6:00PM).

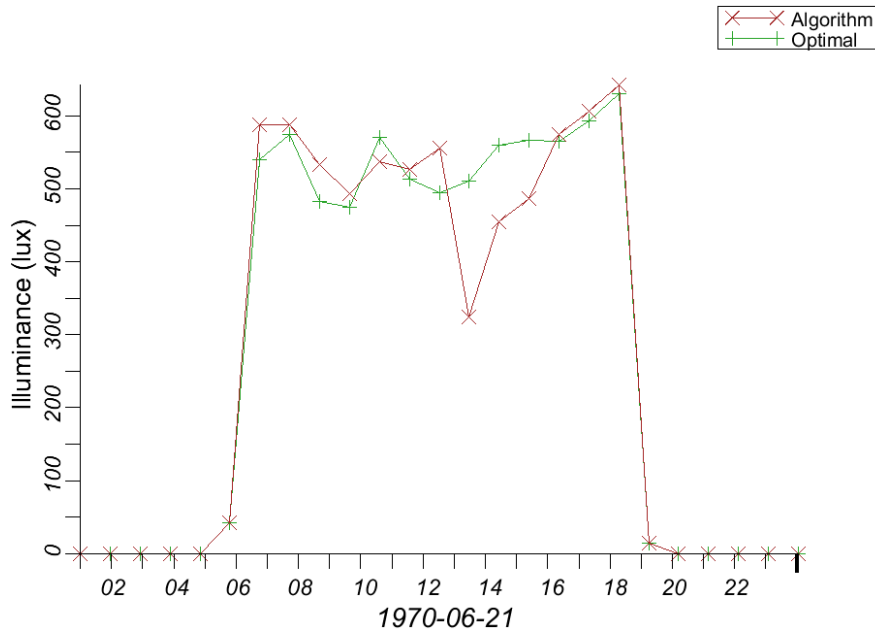




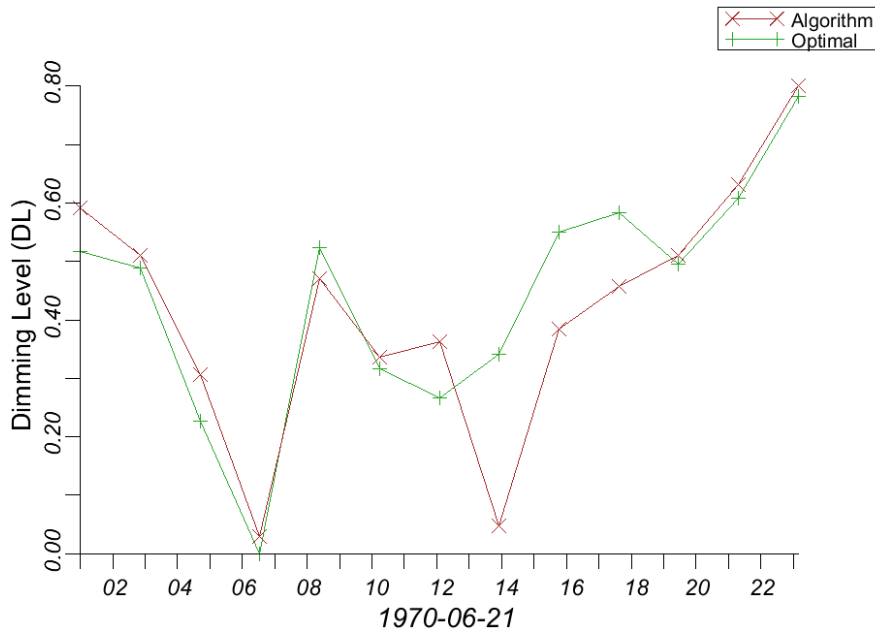
Illumination Contours for Southeast Facing Material Science Façade (12/21 – 7:00PM).



Summer Solstice: 7:00AM through 7:00PM

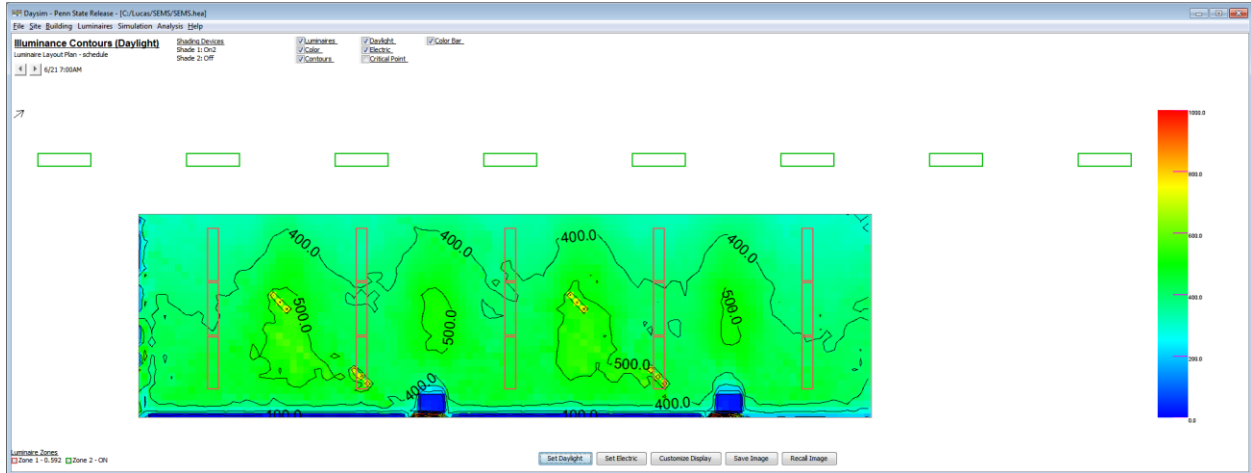


Daysim Illuminance Timeplot for Southeast Material Science Façade (Summer Solstice).

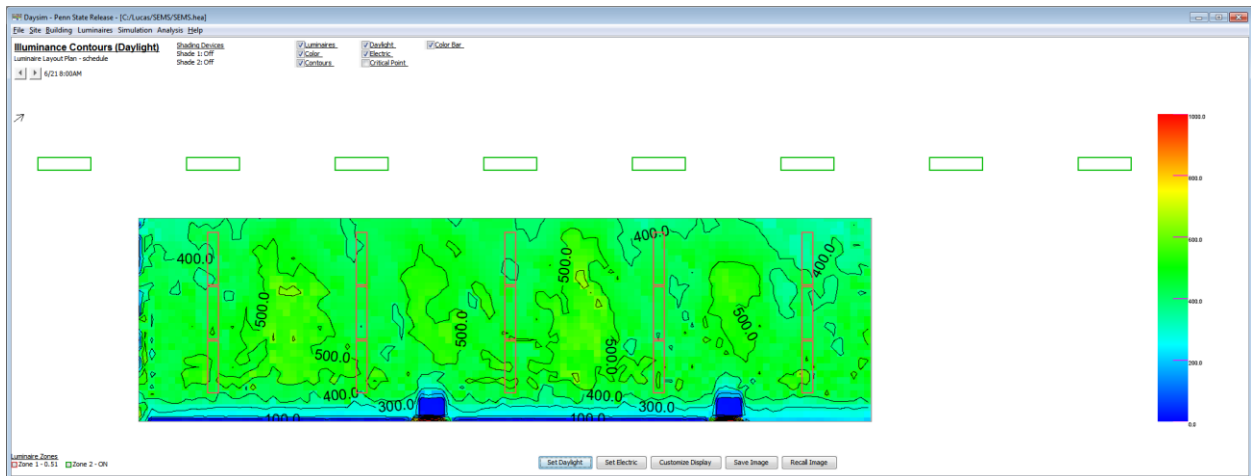


Daysim Dimming Timeplot for Southeast Material Science Façade (Summer Solstice).

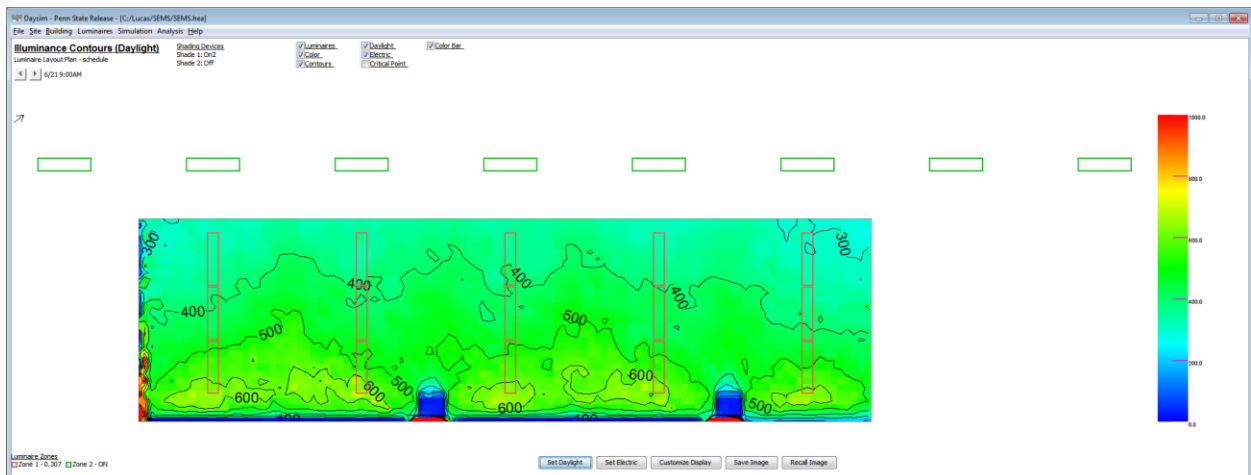




Illumination Contours for Southeast Facing Material Science Façade (6/21 – 7:00AM).

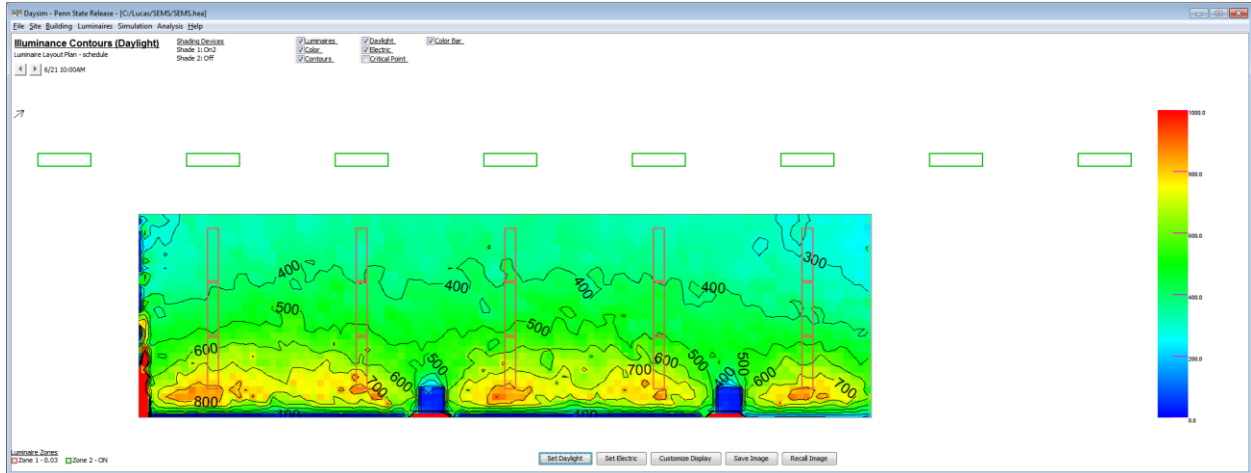


Illumination Contours for Southeast Facing Material Science Façade (6/21 – 8:00AM).

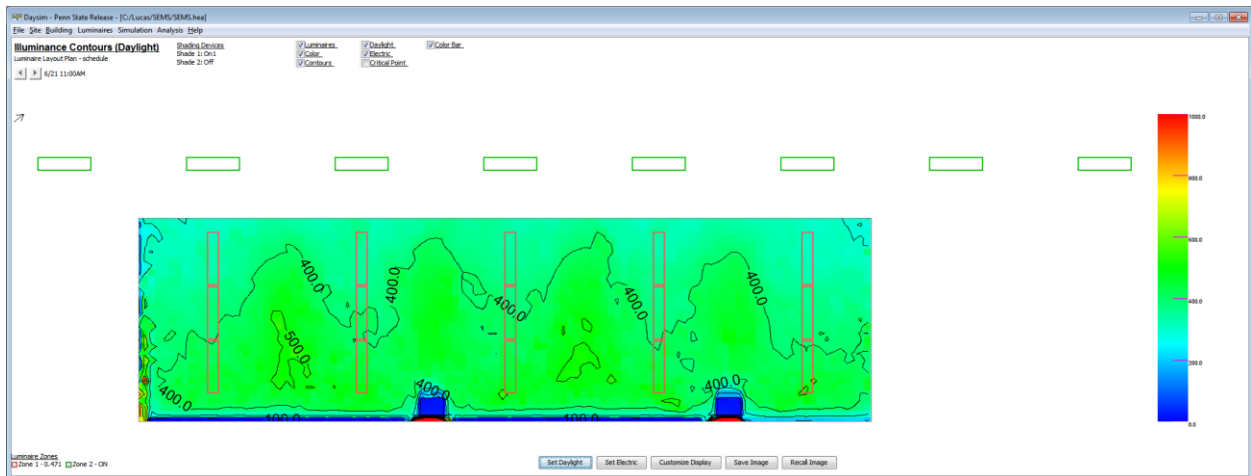


Illumination Contours for Southeast Facing Material Science Façade (6/21 – 9:00AM).

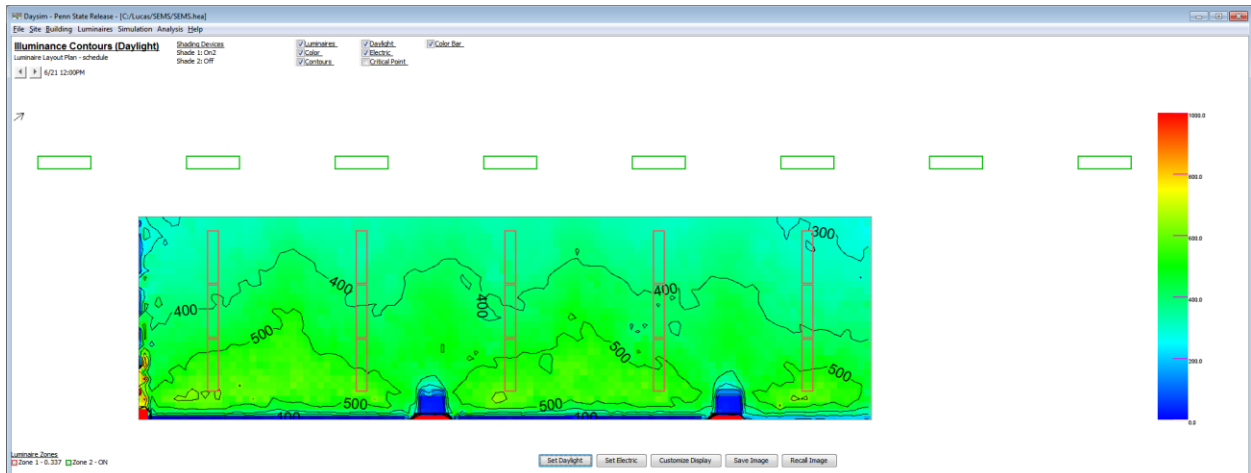




Illumination Contours for Southeast Facing Material Science Façade (6/21 – 10:00AM).

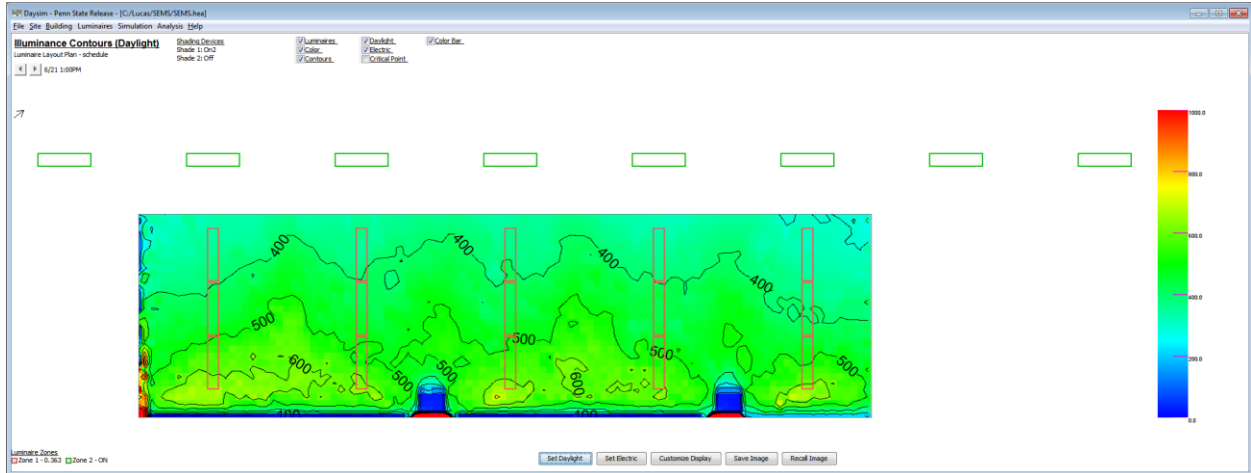


Illumination Contours for Southeast Facing Material Science Façade (6/21 – 11:00AM).

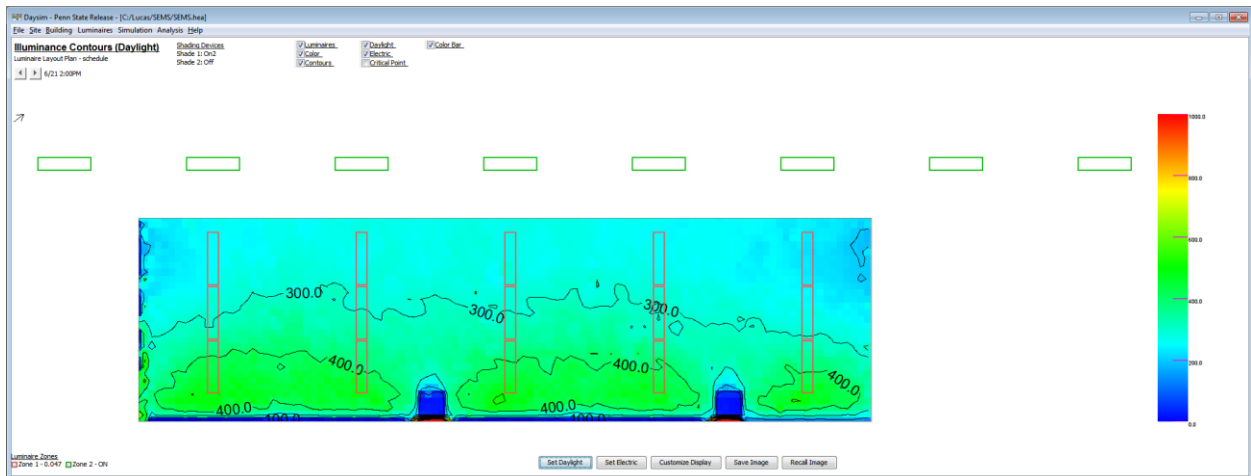


Illumination Contours for Southeast Facing Material Science Façade (6/21 – 12:00PM).

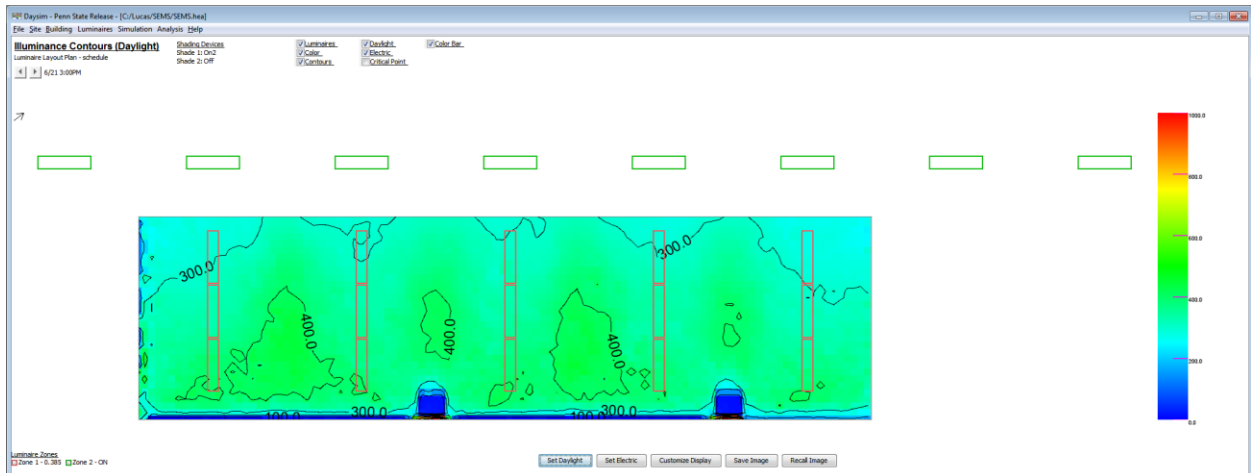




Illumination Contours for Southeast Facing Material Science Façade (6/21 – 1:00PM).

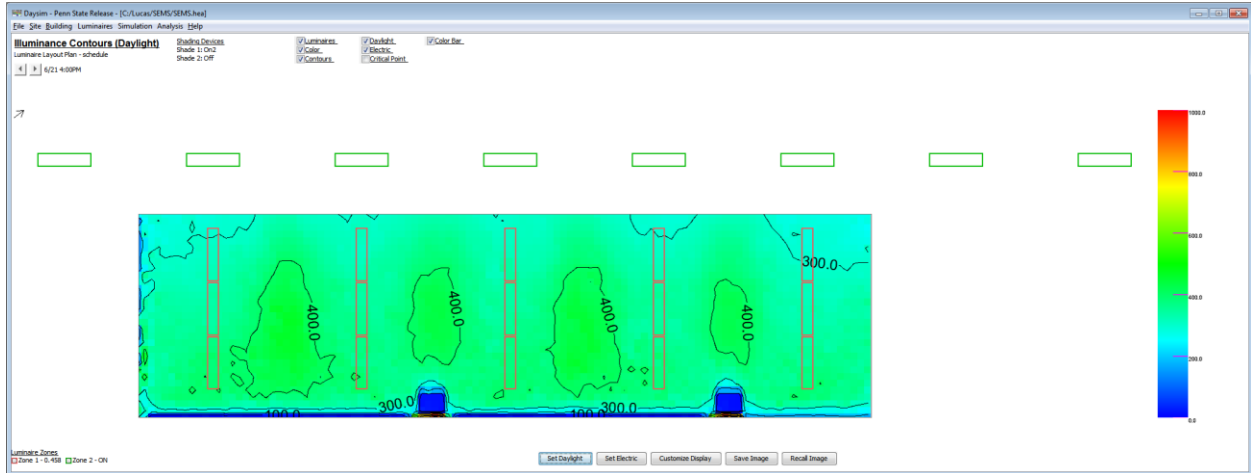


Illumination Contours for Southeast Facing Material Science Façade (6/21 – 2:00PM).

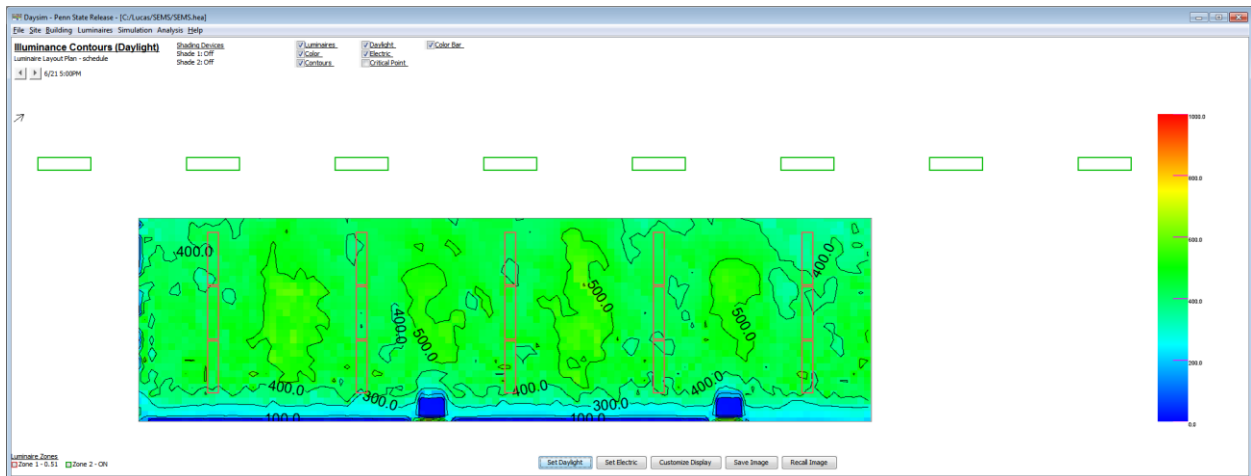


Illumination Contours for Southeast Facing Material Science Façade (6/21 – 3:00PM).

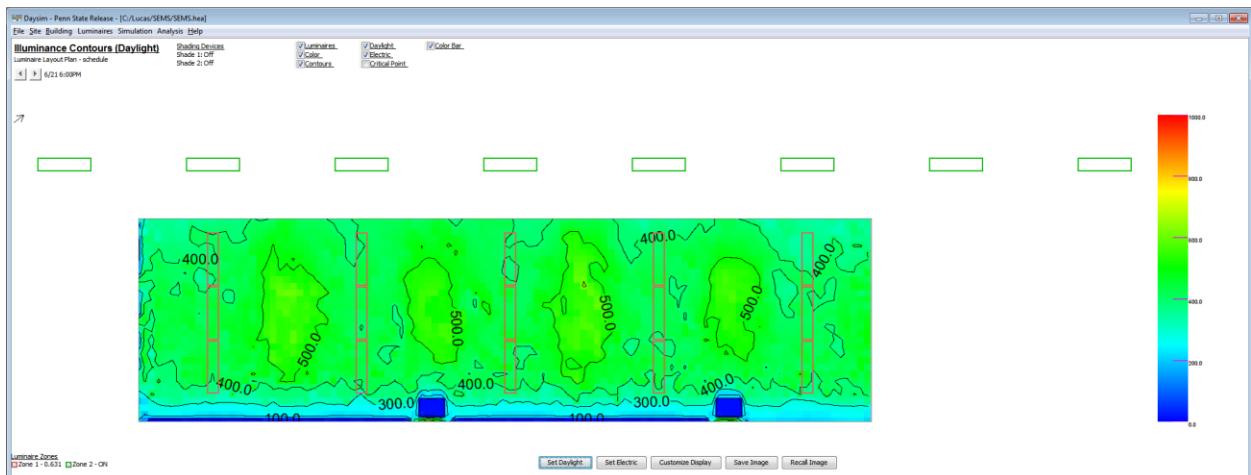




Illumination Contours for Southeast Facing Material Science Façade (6/21 – 4:00PM).

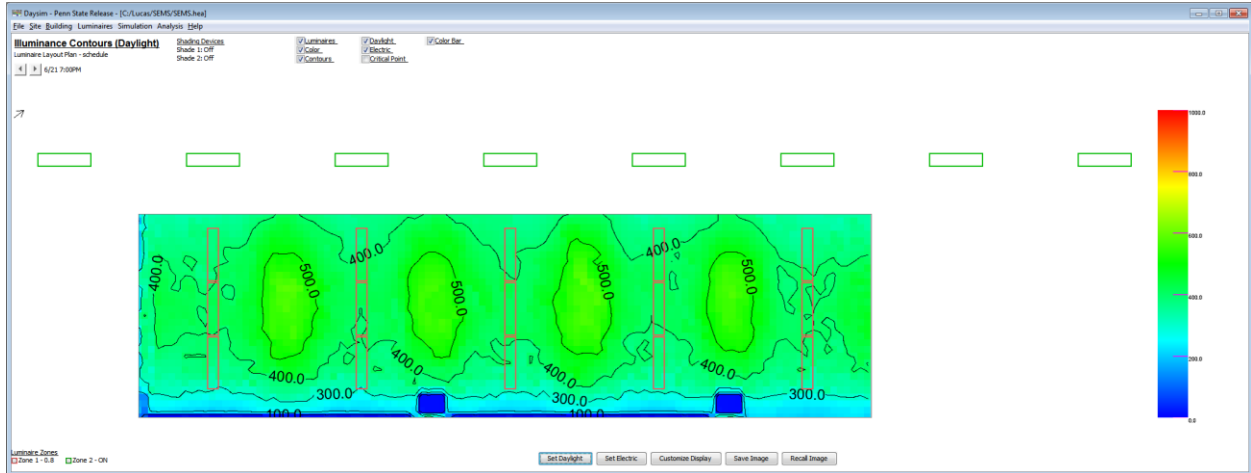


Illumination Contours for Southeast Facing Material Science Façade (6/21 – 5:00PM).



Illumination Contours for Southeast Facing Material Science Façade (6/21 – 6:00PM).





Illumination Contours for Southeast Facing Material Science Façade (6/21 – 7:00PM).



Northwest Material Science Façade

Annual Savings kWh:

776.12

System Cost:

0.0

Energy Cost (per kWh):

0.08

Demand Charge (per kWh):

0.0

Peak Demand Time (0-24.0):

0.0

NOTE: All costs must be in the same units.

Savings Per Year:

62.089600000000004

Daysim EconomicAnalysis for Northwest Material Science Student Study Area.

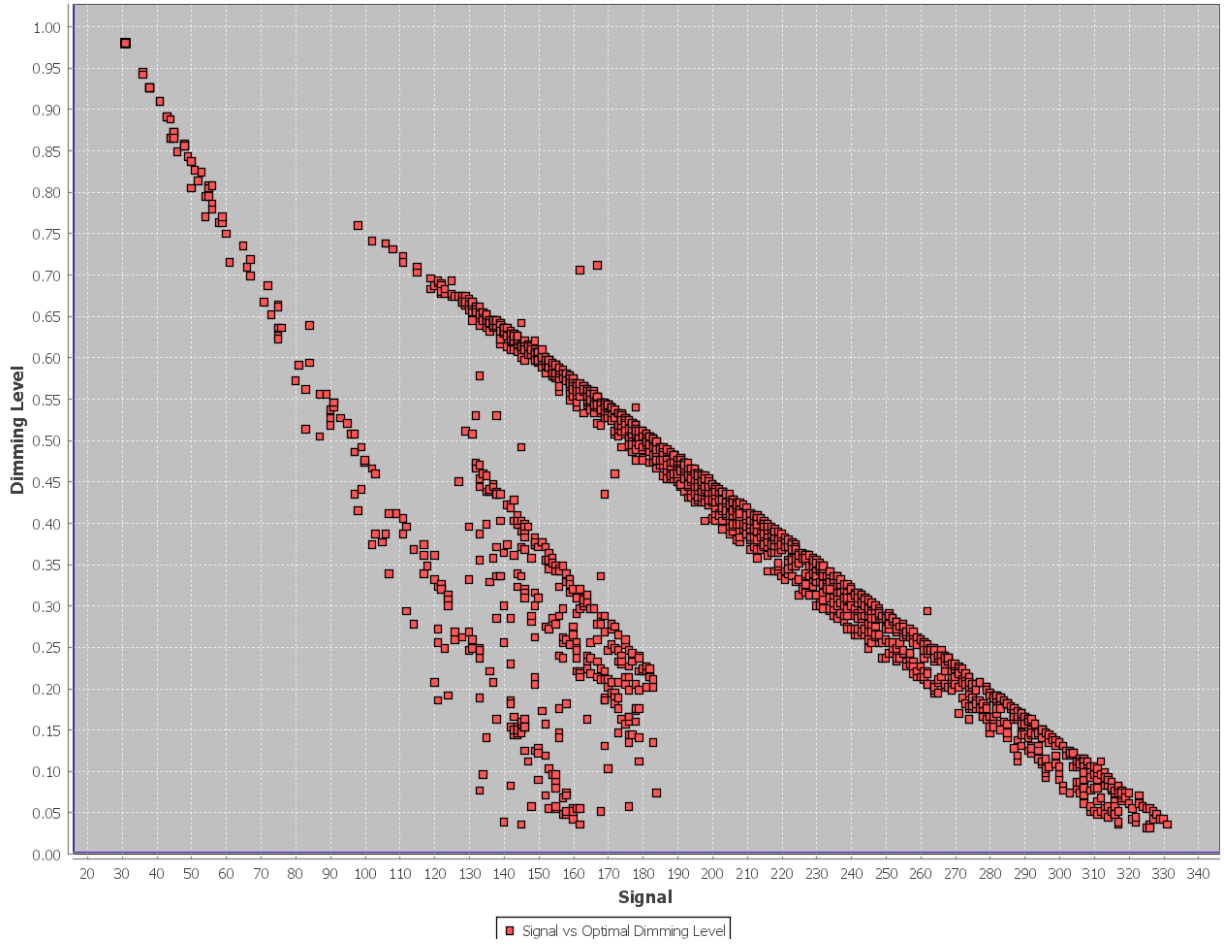
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	152.76	132.84	146.12	132.84	152.76	146.12	146.12	152.76	139.48	152.76	146.12	99.63	1700.35
Optimal	103.06	81.83	77.92	55.8	60.56	51.34	50.25	56.15	69.23	86.09	98.78	67.86	858.92
Algorithm	112.71	90.36	81.25	60.73	65.83	52.45	51.88	62.35	72.94	90.46	105.83	77.35	924.22
Savings	40.04	42.47	64.86	72.1	86.92	93.67	94.23	90.4	66.53	62.29	40.28	22.27	776.12

Daysim Controled Zone Energy Table for Northwest Material Science Student Study Area.

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	229.71	199.75	219.72	199.75	229.71	219.72	219.72	229.71	209.73	229.71	219.72	149.81	2556.82
Optimal	180.01	148.74	151.52	122.71	137.51	124.94	123.85	133.1	139.49	163.04	172.38	118.04	1715.39
Algorithm	189.66	157.27	154.85	127.65	142.78	126.05	125.49	139.3	143.2	167.41	179.44	127.53	1780.69
Savings	40.04	42.47	64.86	72.1	86.92	93.67	94.23	90.4	66.53	62.29	40.28	22.27	776.12

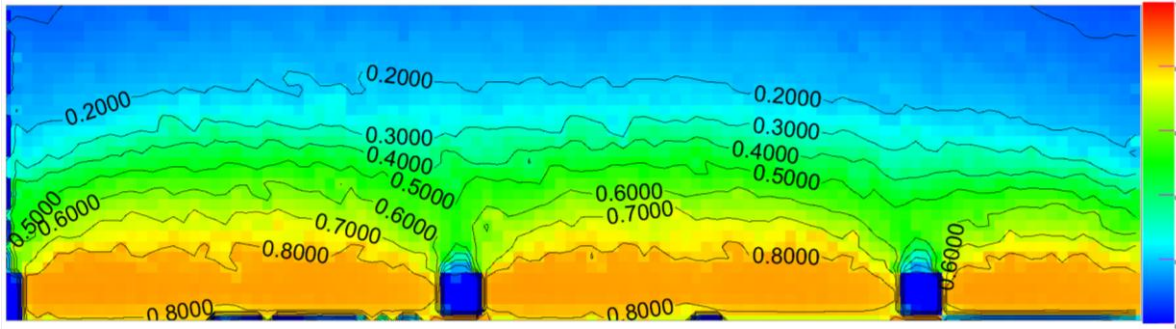
Daysim Controled Zone Energy Table for Northwest Material Science Student Study Area.



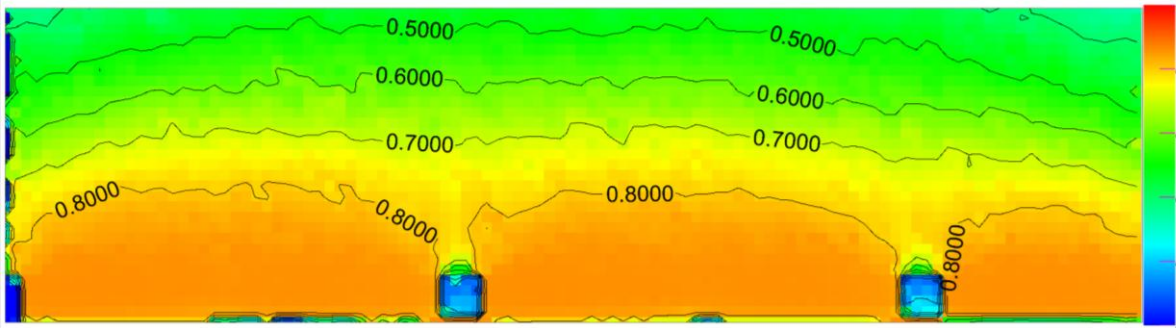


Dimming Level Vs. Photosensor Signal for Northwest Facing Material Science Student Study Area.

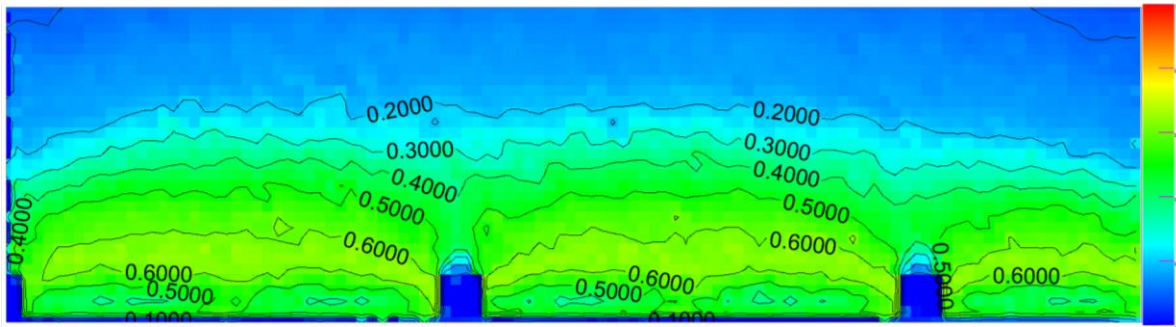




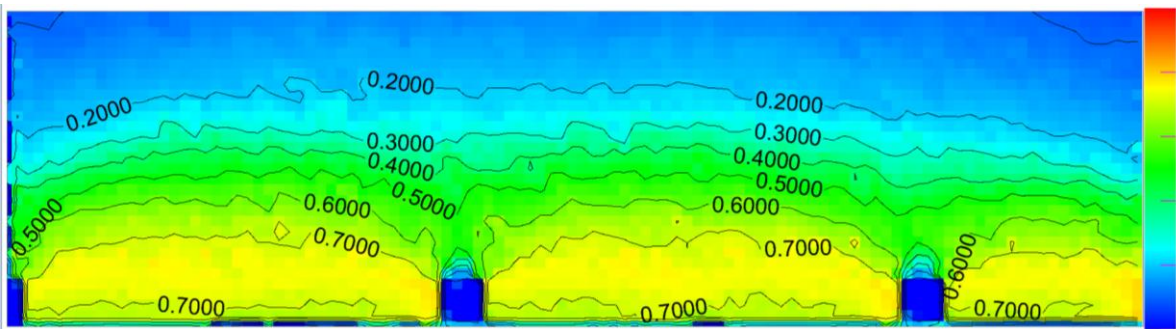
Daylight Autonomy for Northwest Facing Facade (322.8lux).



Continuous Daylight Autonomy for Northwest Facing Material Science Facade (322.8lux).



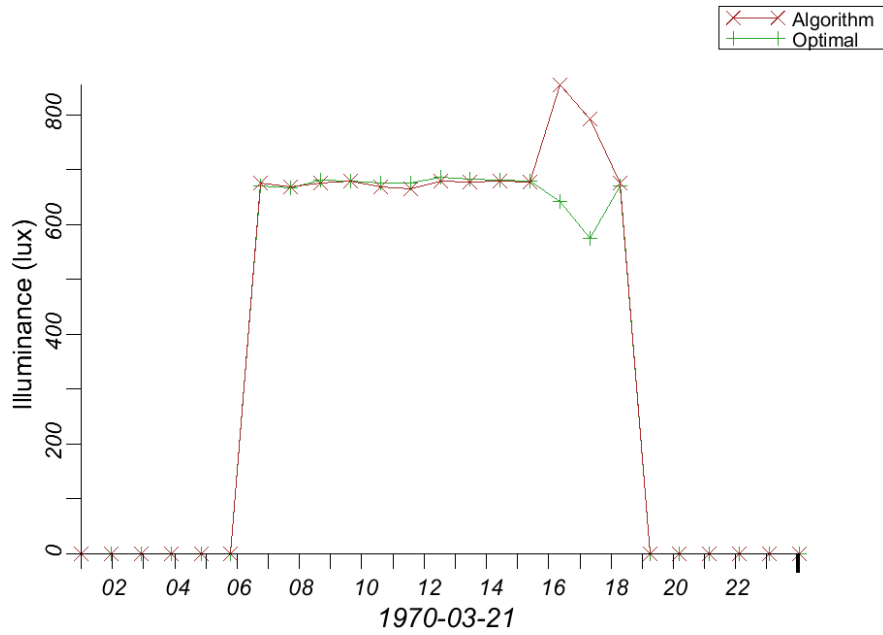
Daylight Illuminance for Northwest Facing Material Science Facade (322.8 to 1000lux).



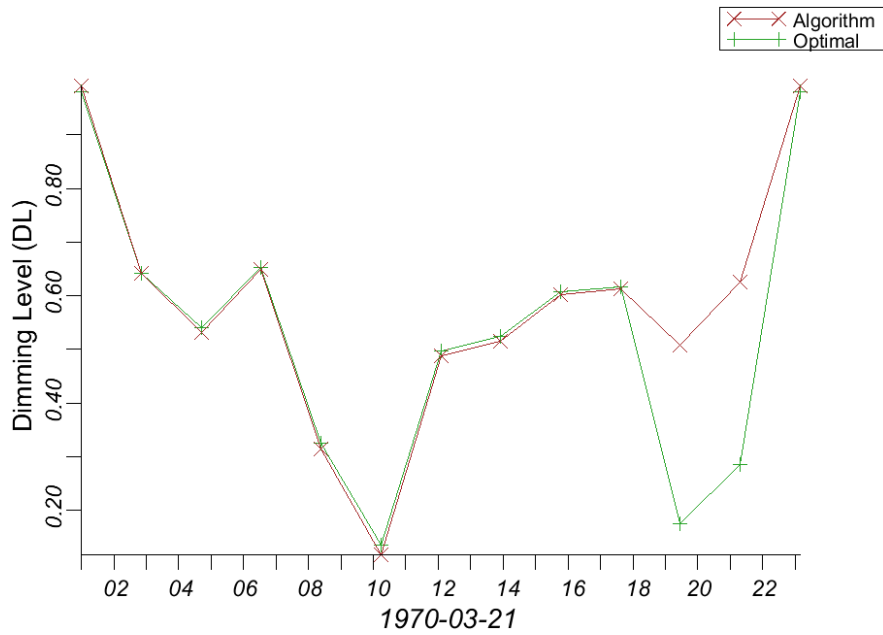
Useful Daylight Illuminance for Northwest Facing Material Science Facade (322.8 to 2000lux).



Fall & Spring Equinox: 7:00AM through 7:00PM

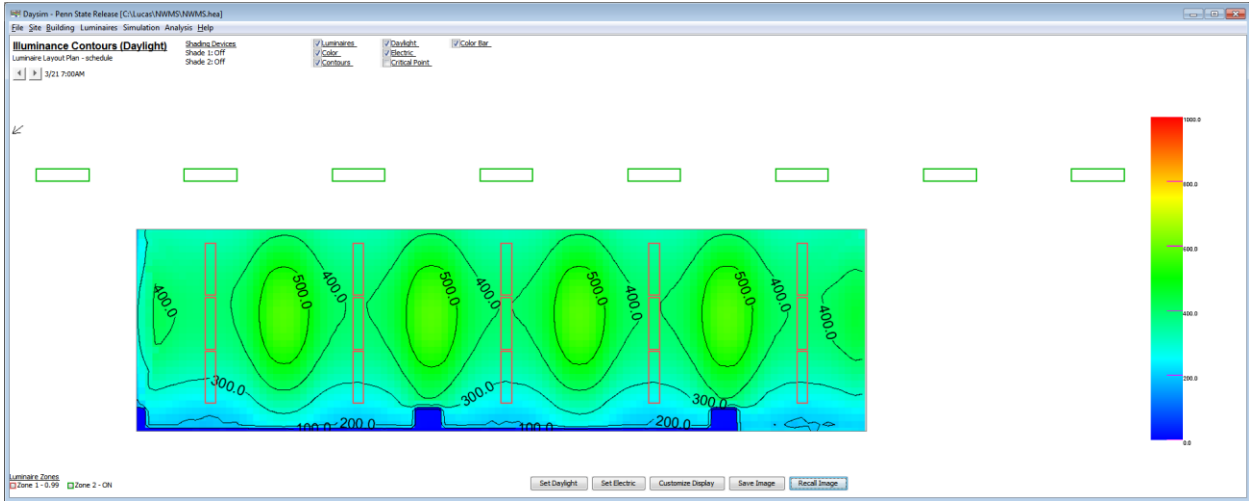


Daysim Illuminance Timeplot for Northwest Material Science Façade (Fall & Spring Equinox).

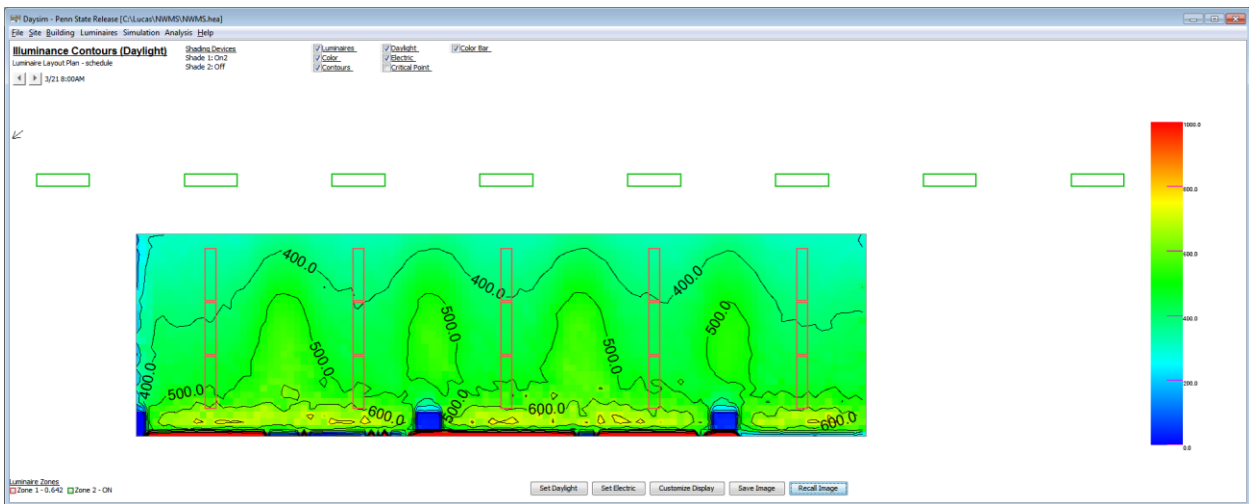


Daysim Dimming Timeplot for Northwest Material Science Façade (Fall & Spring Equinox).

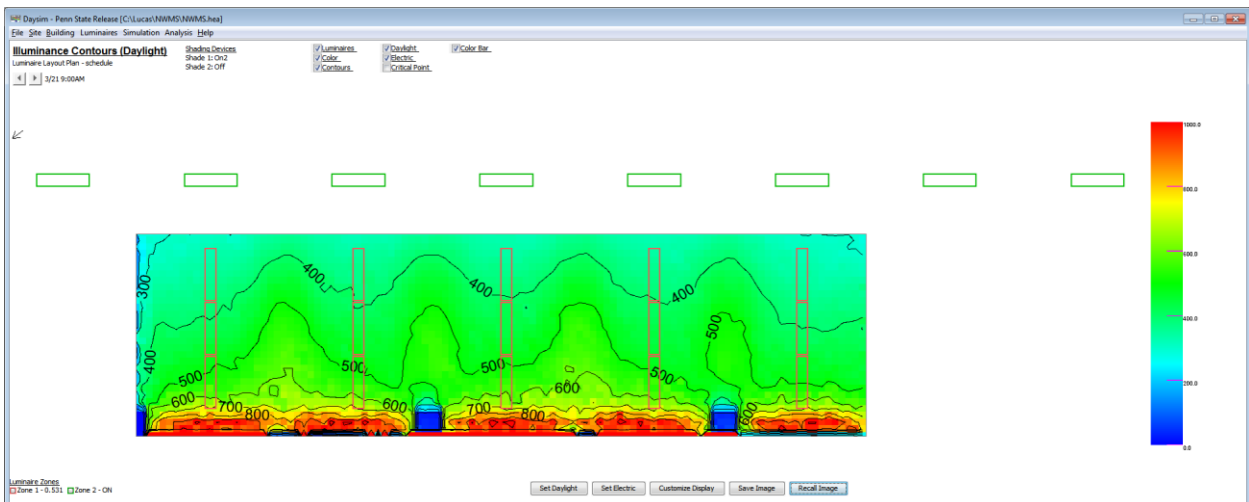




Illuminance Contours for Northwest Facing Material Science Façade (7am 3/21 & 9/21).

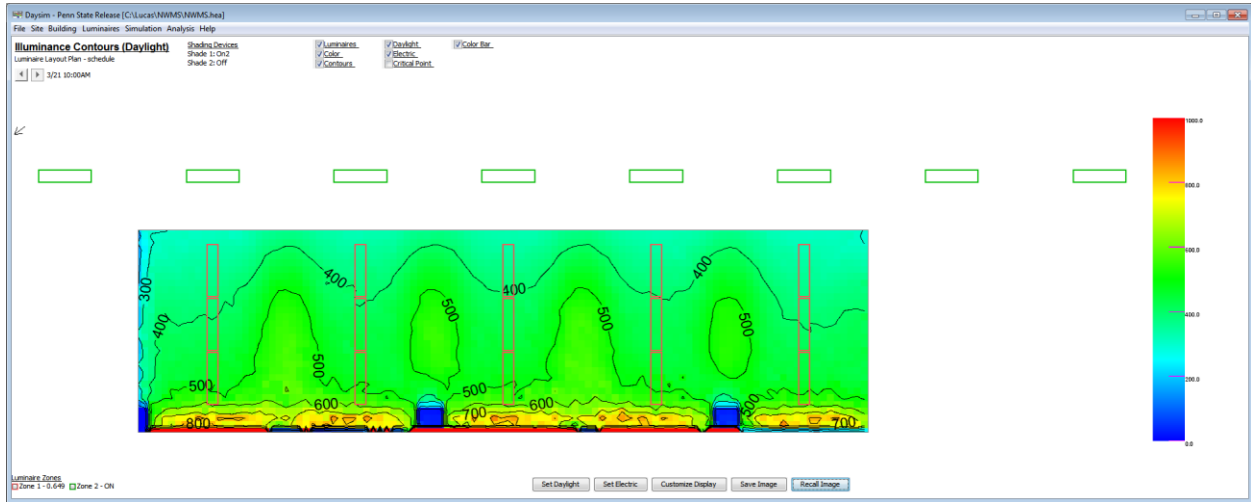


Illuminance Contours for Northwest Facing Material Science Façade (8am 3/21 & 9/21).

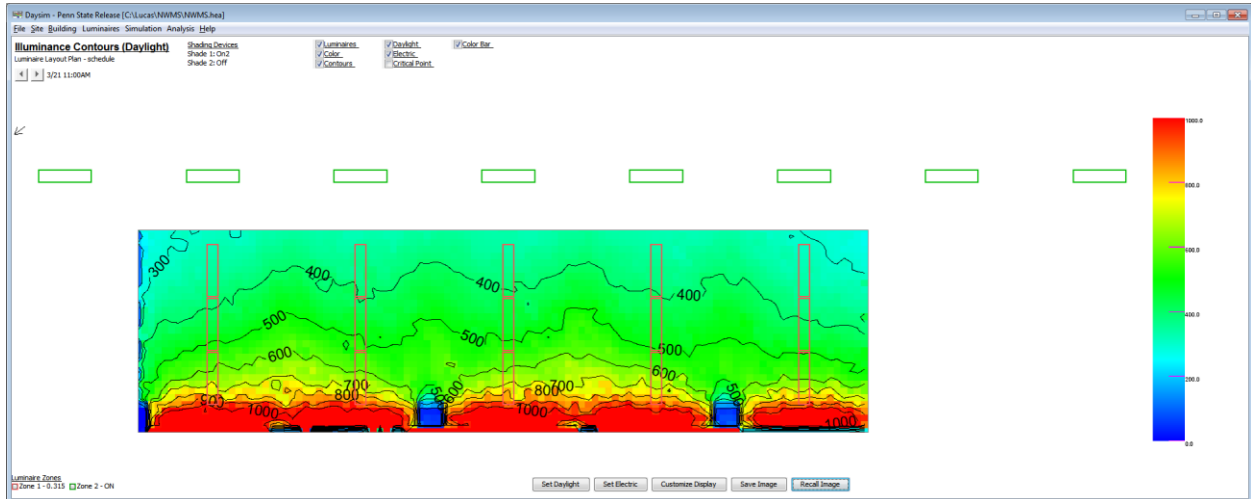


Illuminance Contours for Northwest Facing Material Science Façade (9am 3/21 & 9/21).



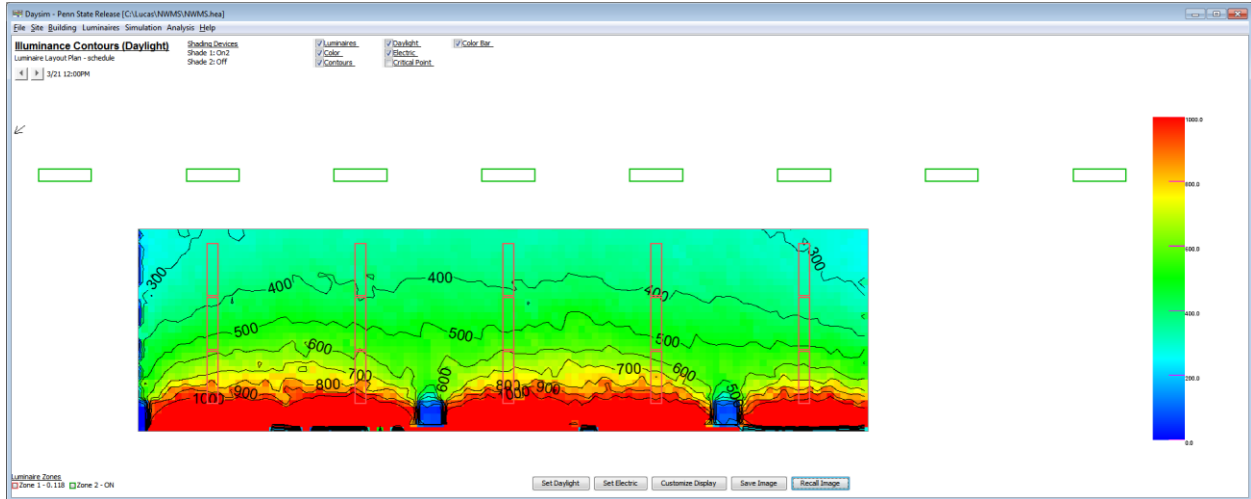


Illuminance Contours for Northwest Facing Material Science Façade (10am 3/21 & 9/21).

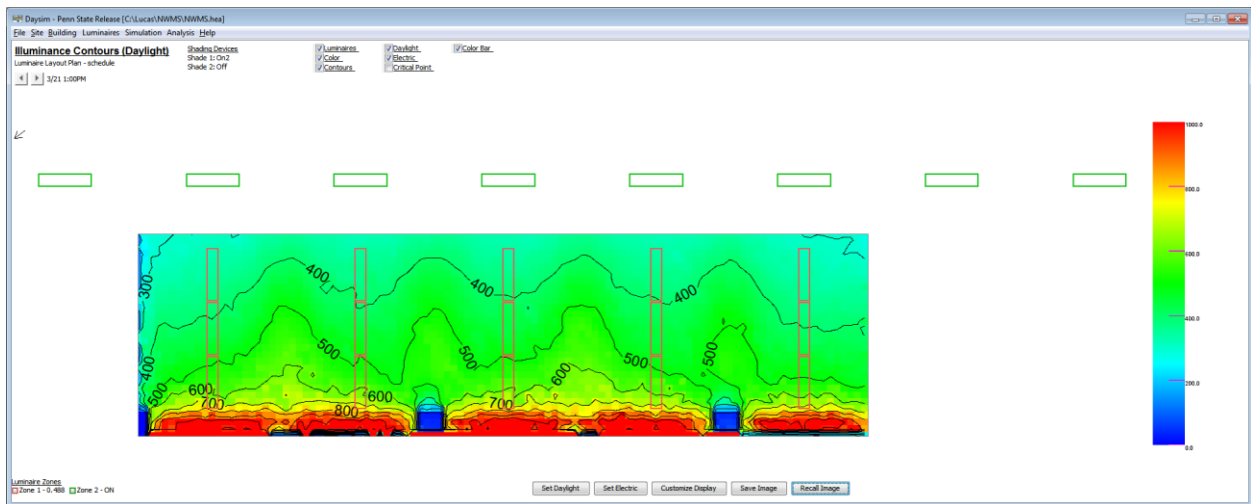


Illuminance Contours for Northwest Facing Material Science Façade (11am 3/21 & 9/21).

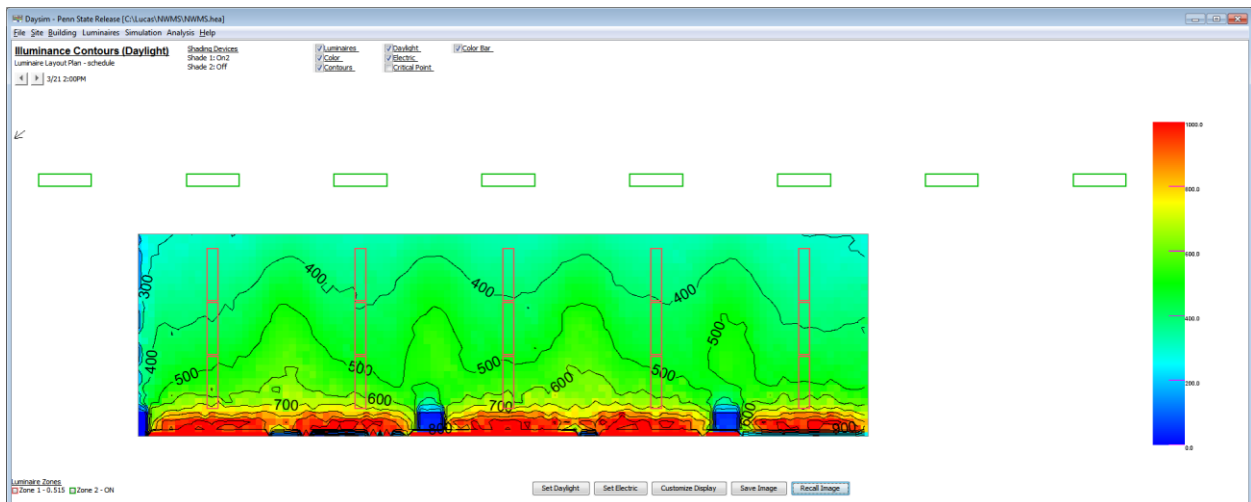




Illuminance Contours for Northwest Facing Material Science Façade (12pm 3/21 & 9/21).

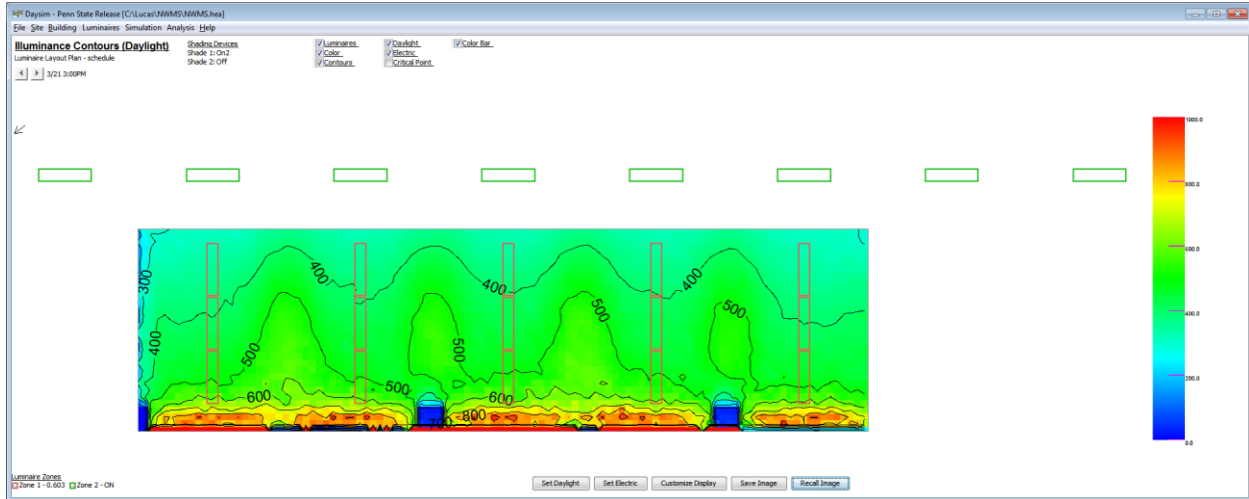


Illuminance Contours for Northwest Facing Material Science Façade (1pm 3/21 & 9/21).

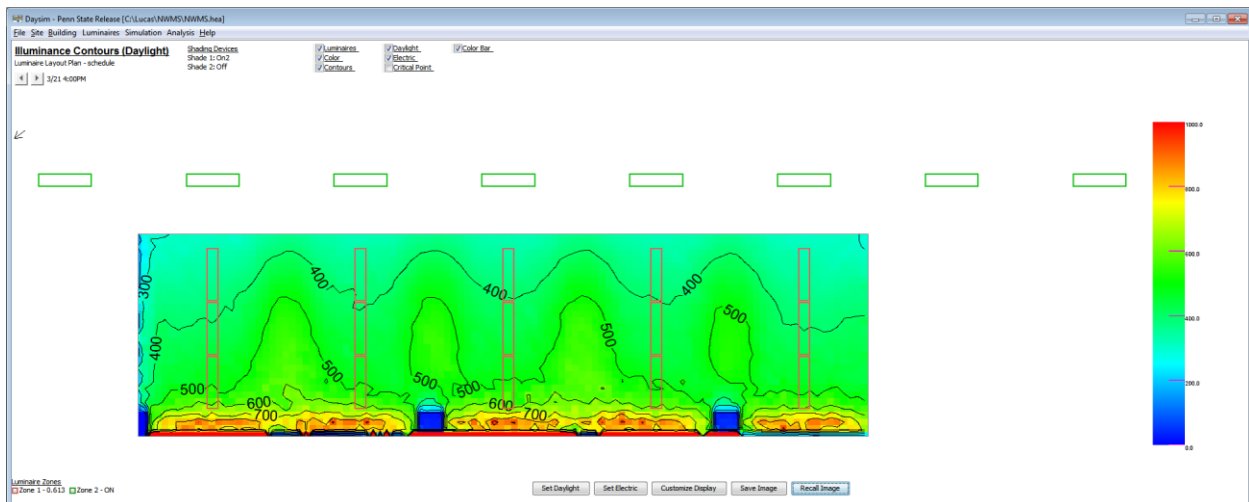


Illuminance Contours for Northwest Facing Material Science Façade (2pm 3/21 & 9/21).

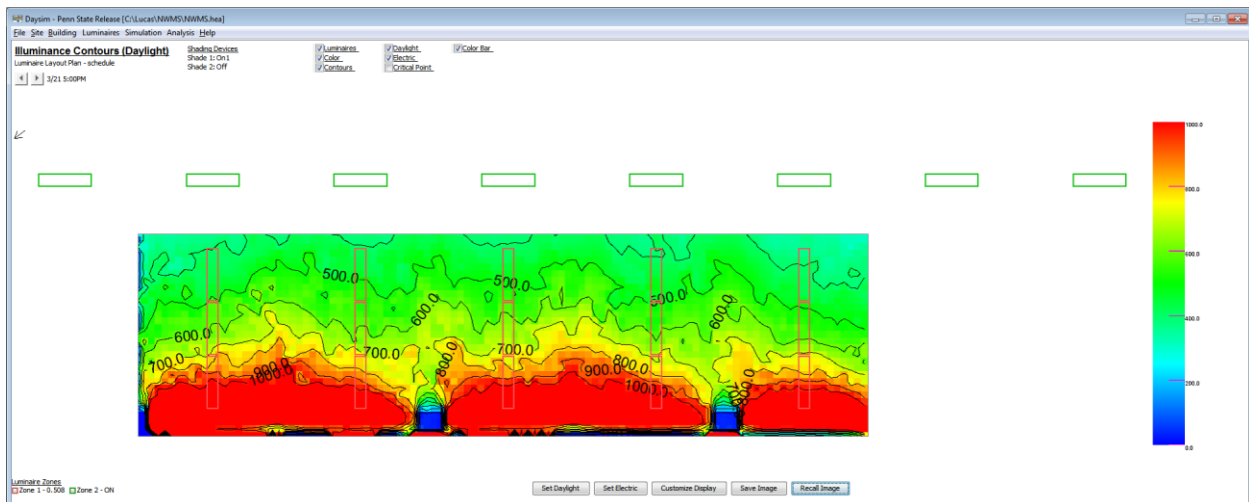




Illuminance Contours for Northwest Facing Material Science Façade (3pm 3/21 & 9/21).

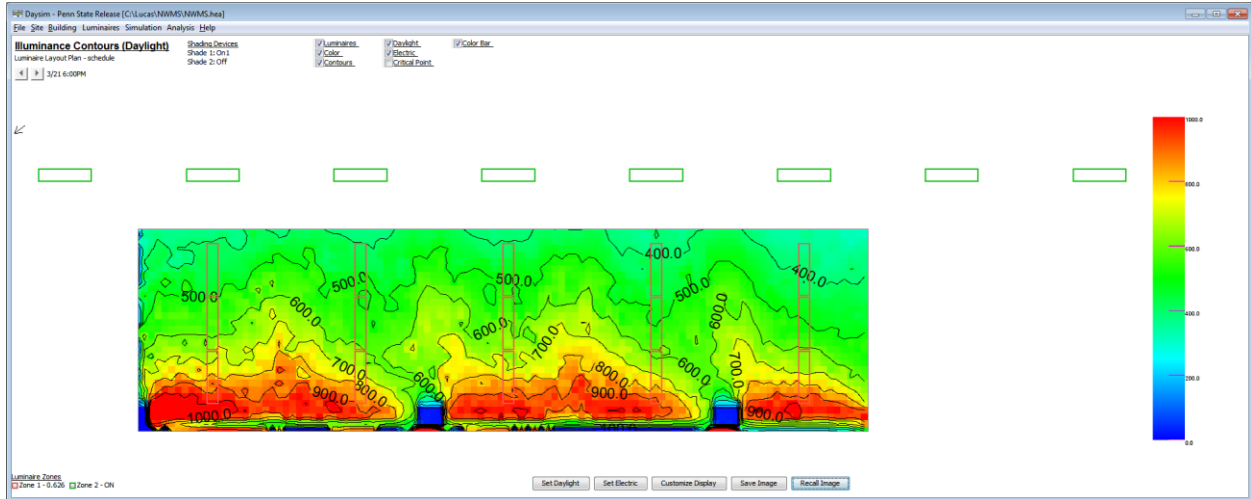


Illuminance Contours for Northwest Facing Material Science Façade (4pm 3/21 & 9/21).

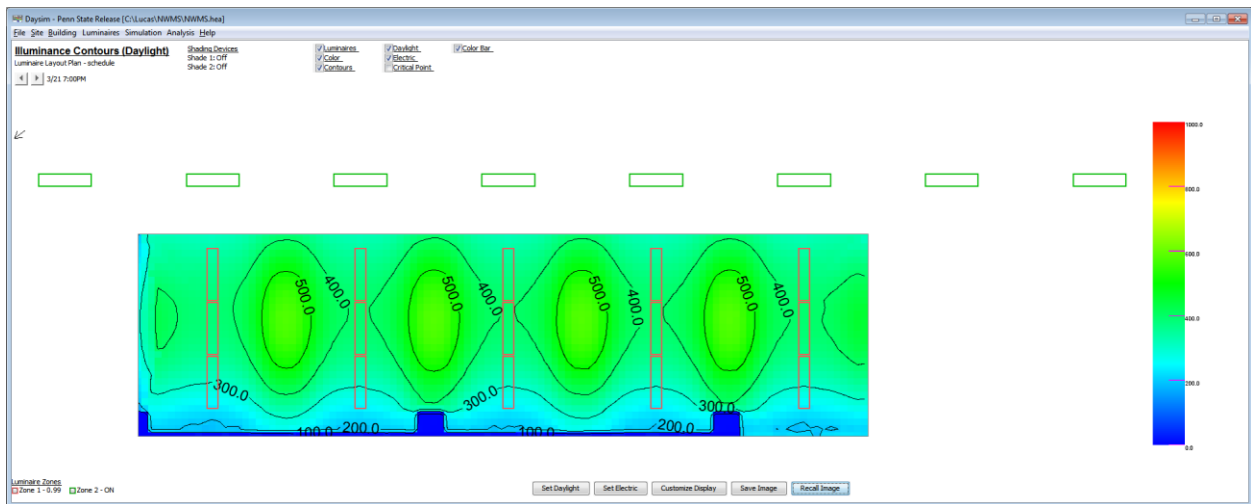


Illuminance Contours for Northwest Facing Material Science Façade (5pm 3/21 & 9/21).





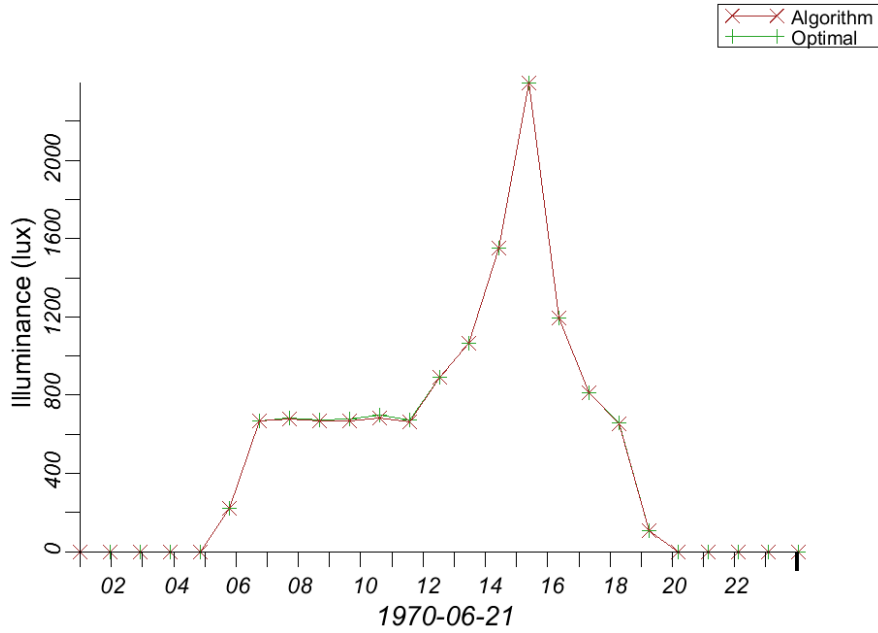
Illuminance Contours for Northwest Facing Material Science Façade (6pm 3/21 & 9/21).



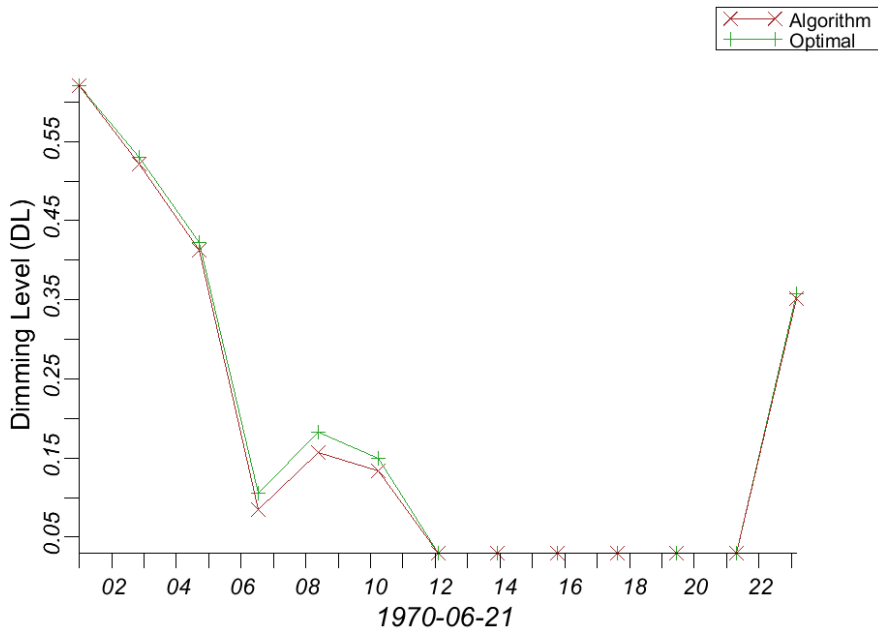
Illuminance Contours for Northwest Facing Material Science Façade (7pm 3/21 & 9/21).



Summer Solstice: 7:00AM through 7:00PM

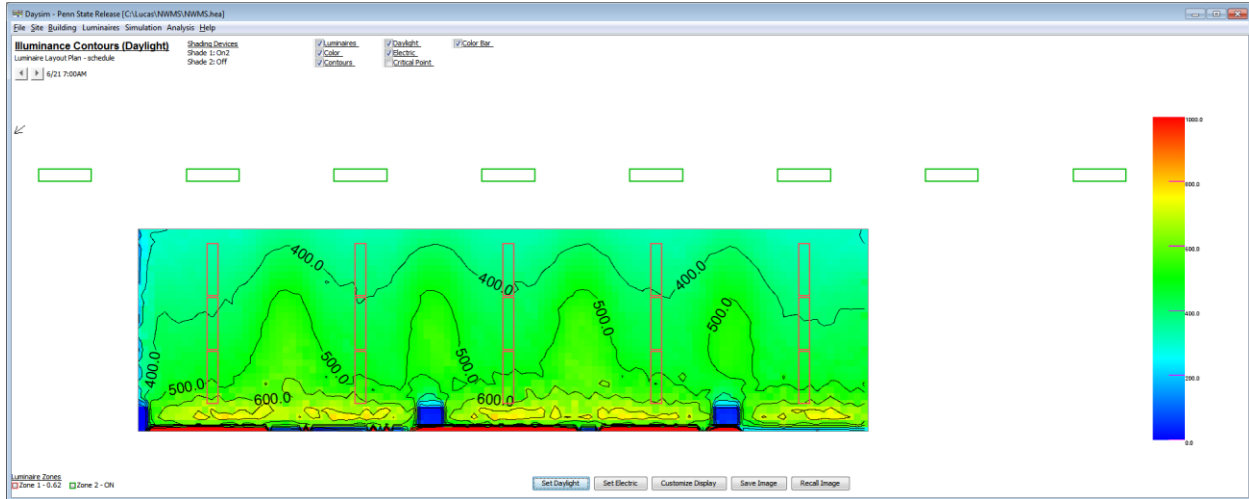


Daysim Timeplot Table for Northwest Material Science Façade (Summer Solstice).

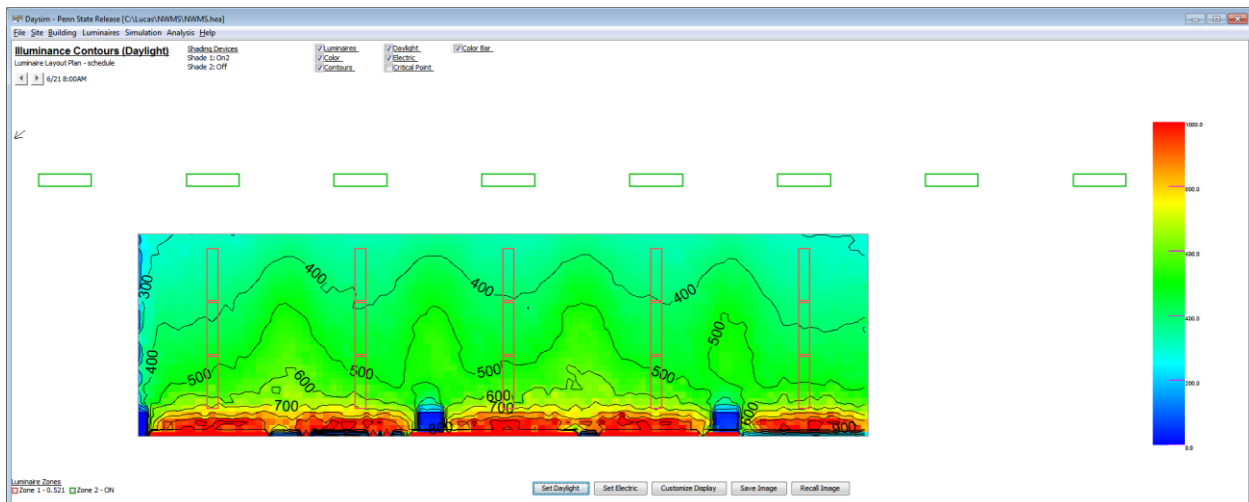


Daysim Dimming Timeplot Table for Northwest Material Science Façade (Summer Solstice).

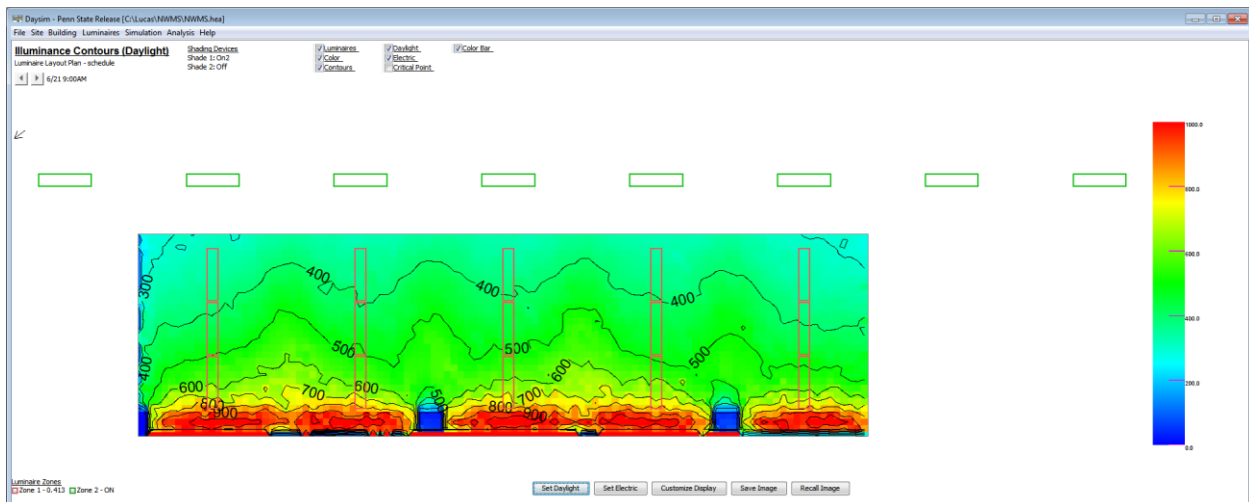




Illuminance Contours for Northwest Facing Material Science Façade (7am 6/21).

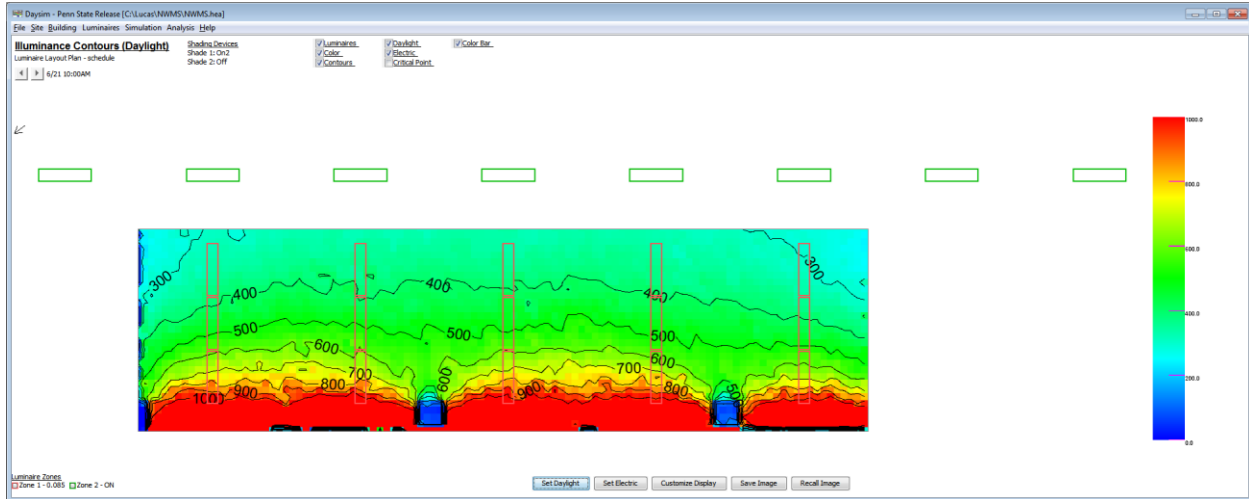


Illuminance Contours for Northwest Facing Material Science Façade (8am 6/21).

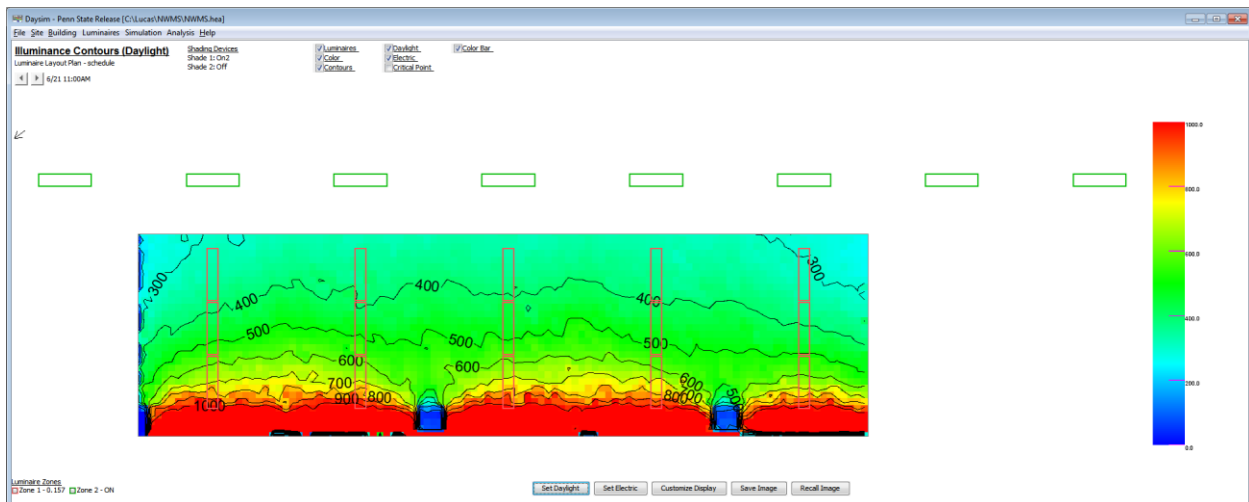


Illuminance Contours for Northwest Facing Material Science Façade (9am 6/21).

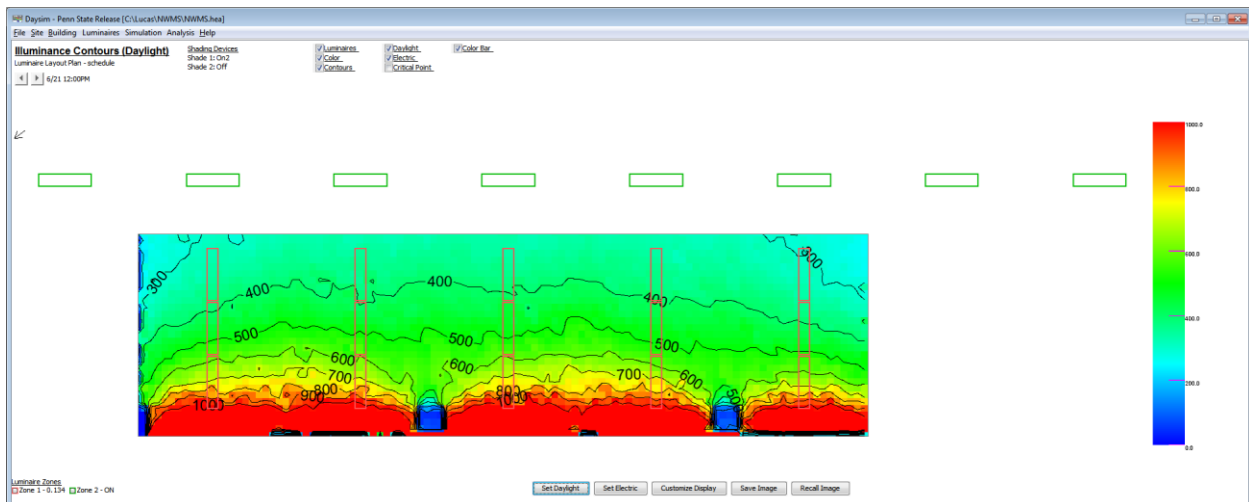




Illuminance Contours for Northwest Facing Material Science Façade (10am 6/21).

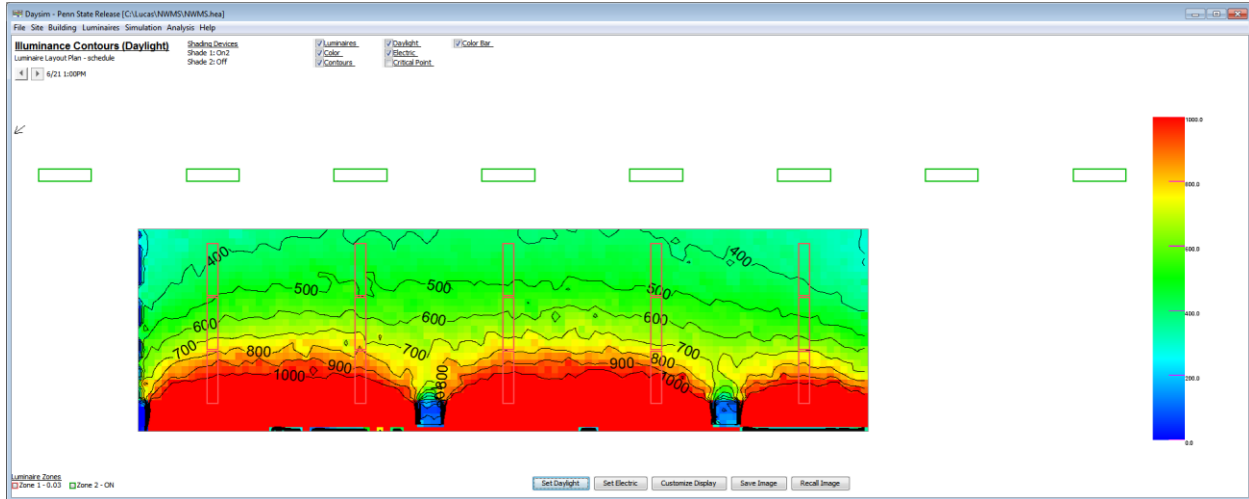


Illuminance Contours for Northwest Facing Material Science Façade (11am 6/21).

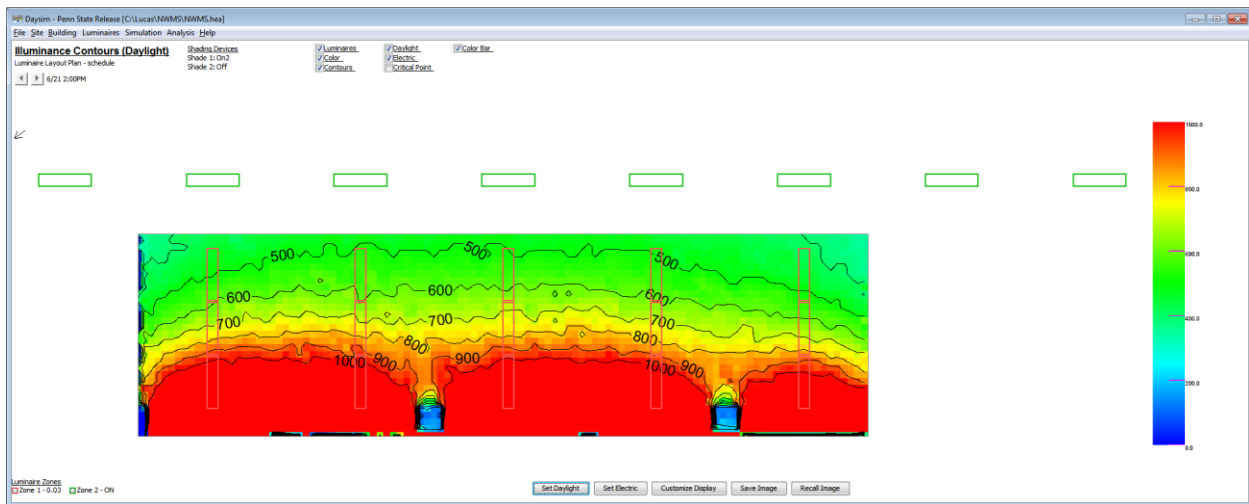


Illuminance Contours for Northwest Facing Material Science Façade (12pm 6/21).

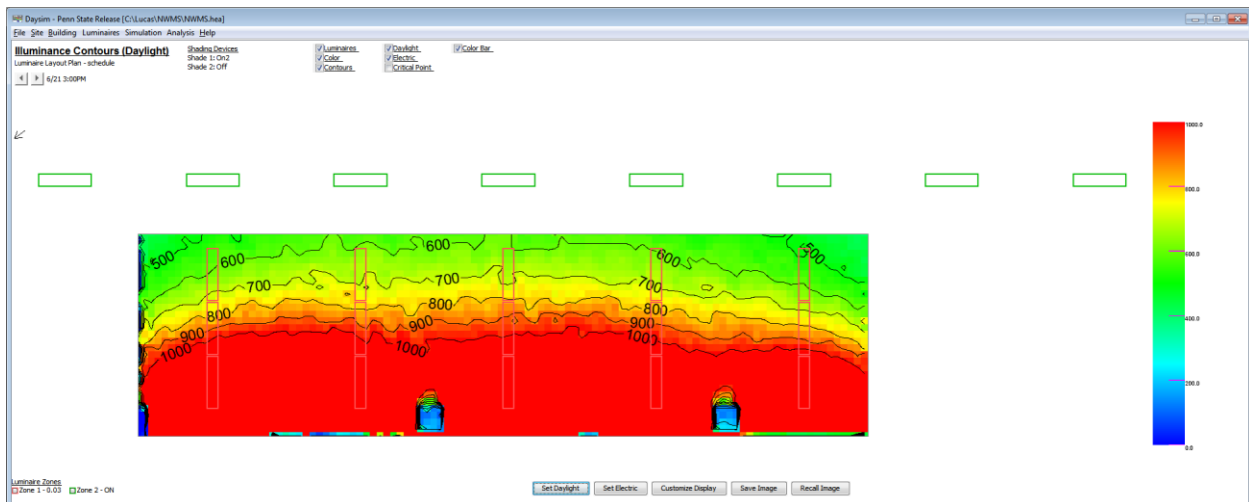




Illuminance Contours for Northwest Facing Material Science Façade (1pm 6/21).

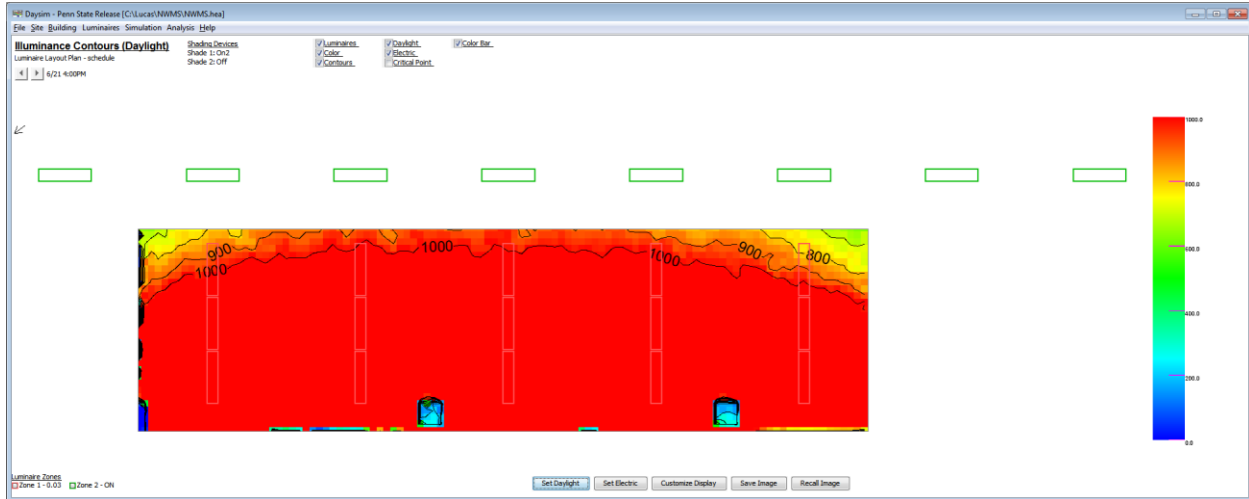


Illuminance Contours for Northwest Facing Material Science Façade (2pm 6/21).

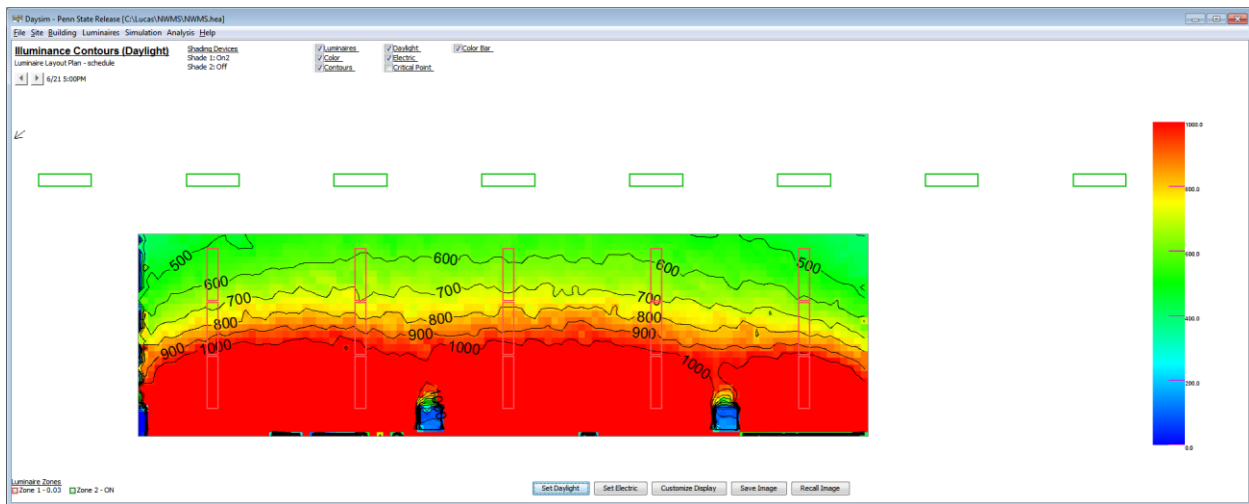


Illuminance Contours for Northwest Facing Material Science Façade (3pm 6/21).

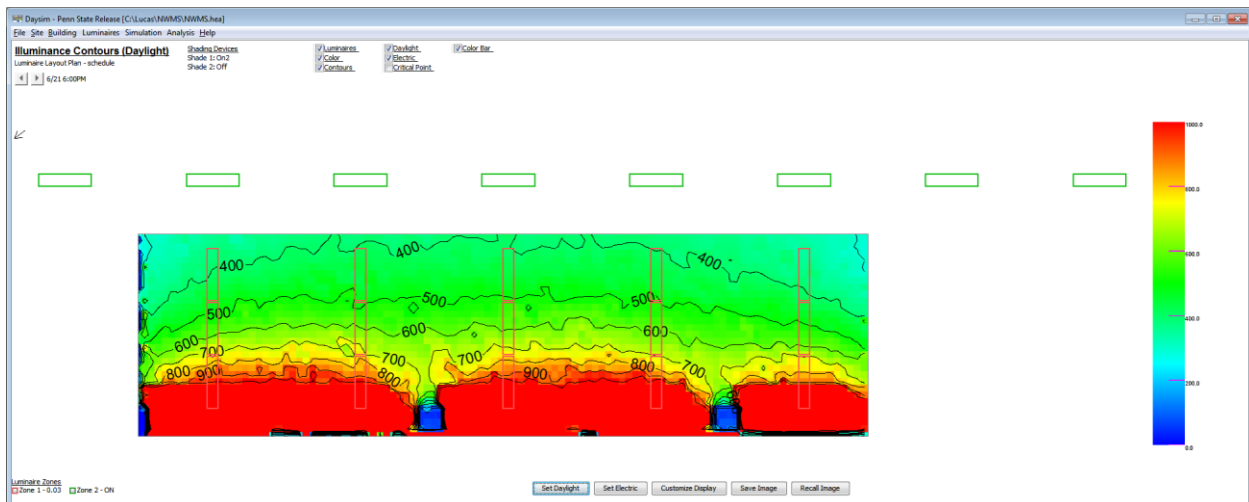




Illuminance Contours for Northwest Facing Material Science Façade (4pm 6/21).

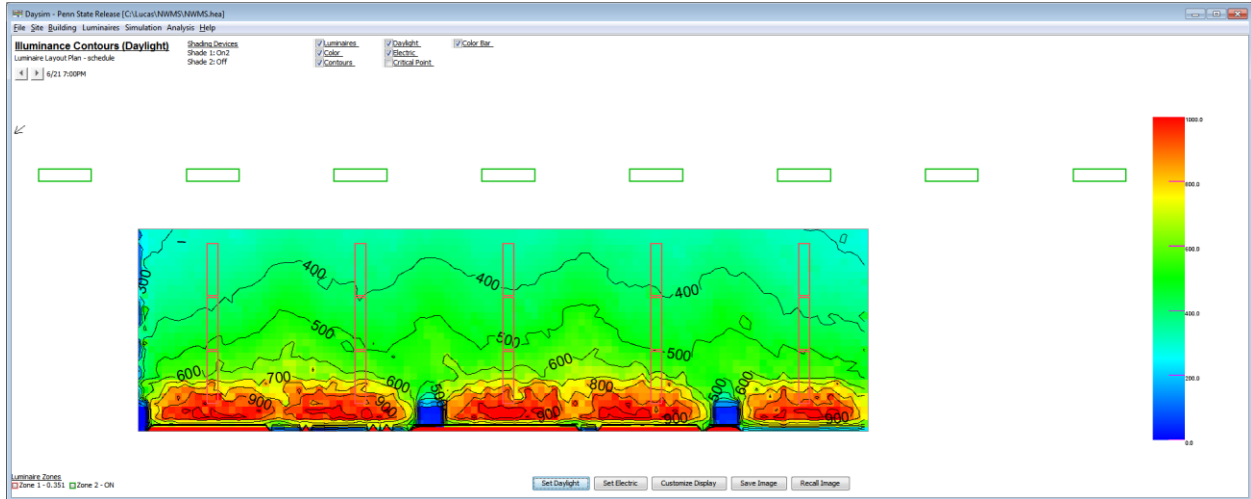


Illuminance Contours for Northwest Facing Material Science Façade (5pm 6/21).



Illuminance Contours for Northwest Facing Material Science Façade (6pm 6/21).

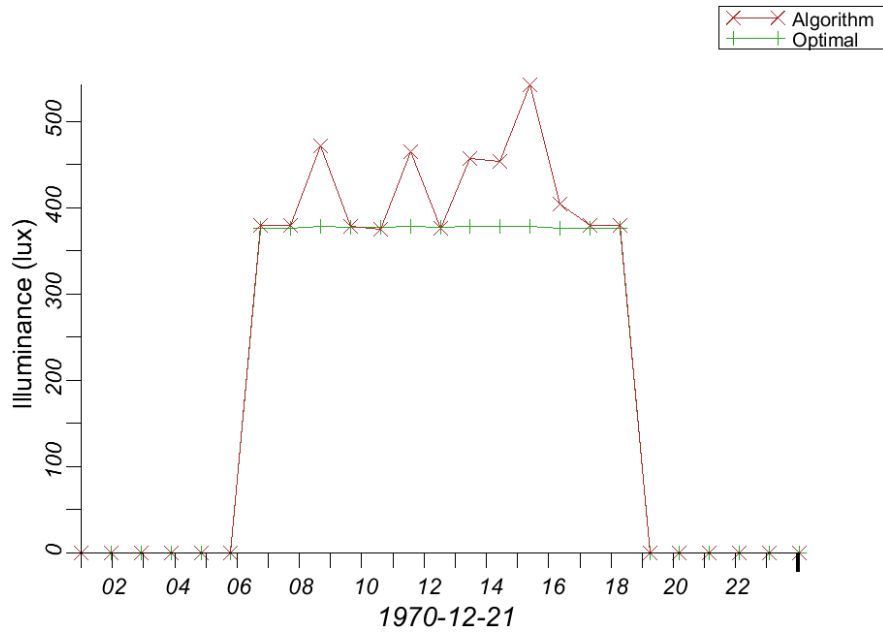




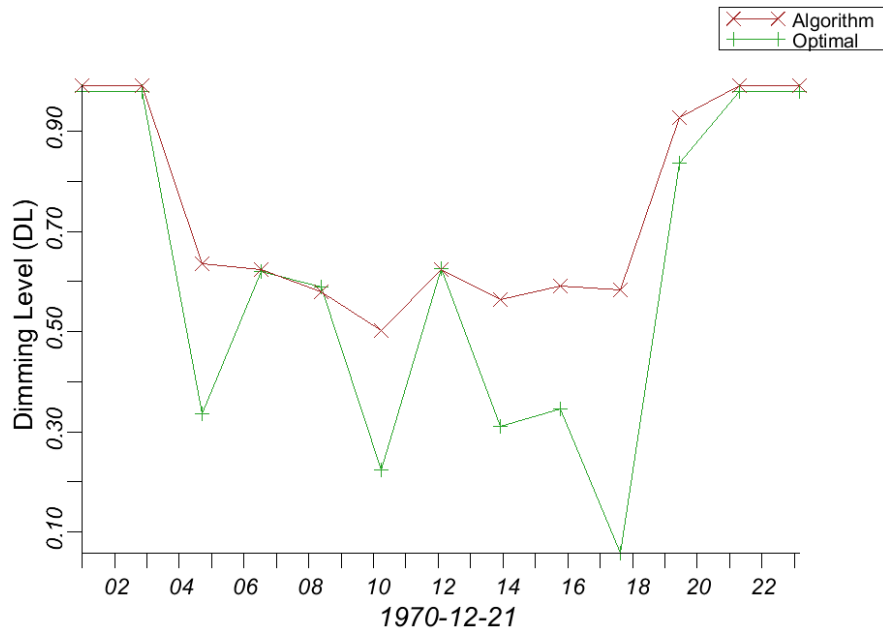
Illuminance Contours for Northwest Facing Material Science Façade (7pm 6/21).



Winter Solstice: 7:00AM through 7:00PM

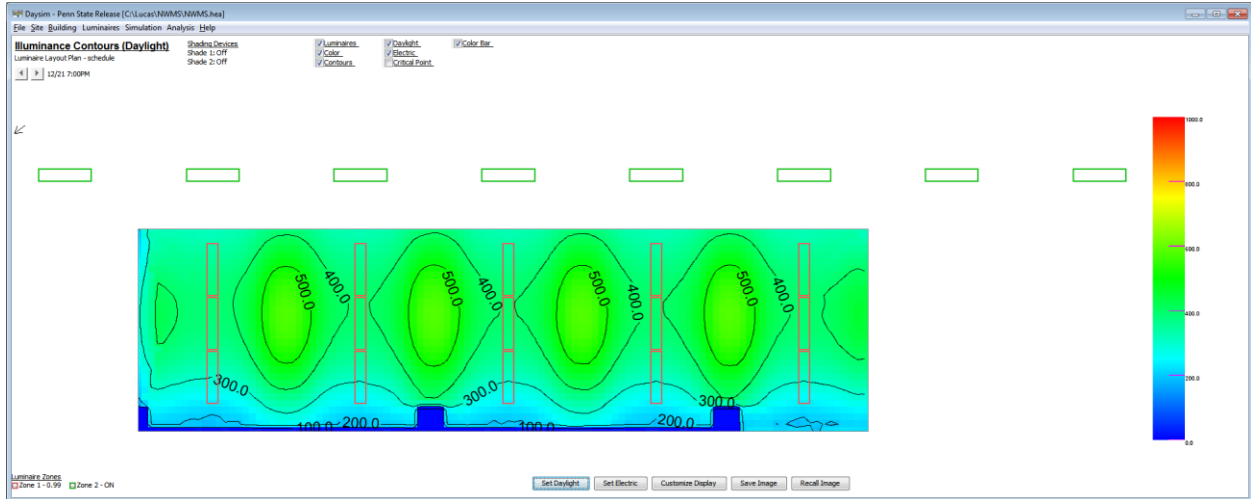


Daysim Illuminance Timeplot Table for Northwest Material Science Façade (Winter Solstice).

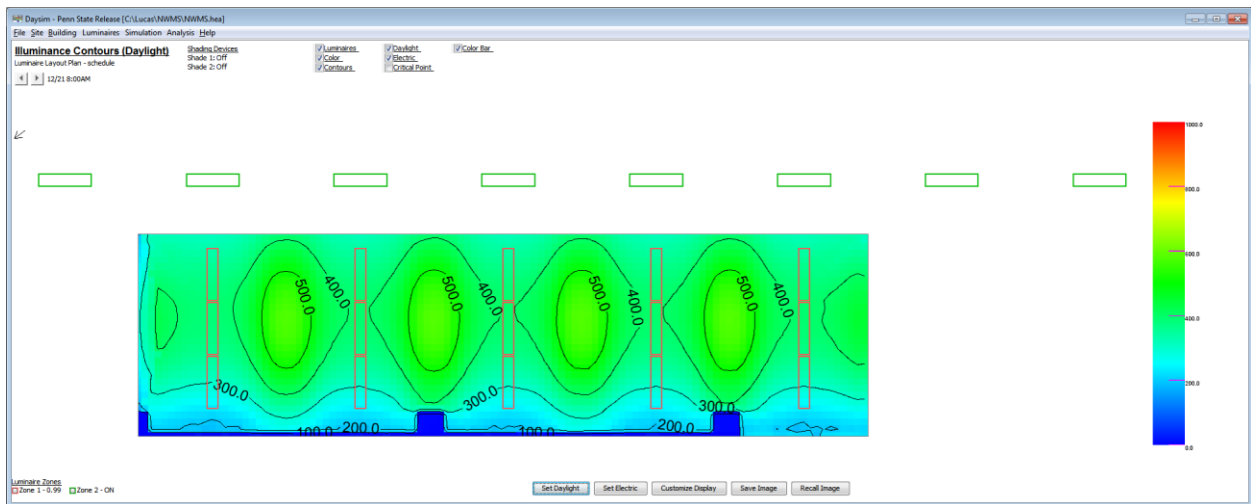


Daysim Dimming Timeplot Table for Northwest Material Science Façade (Winter Solstice).

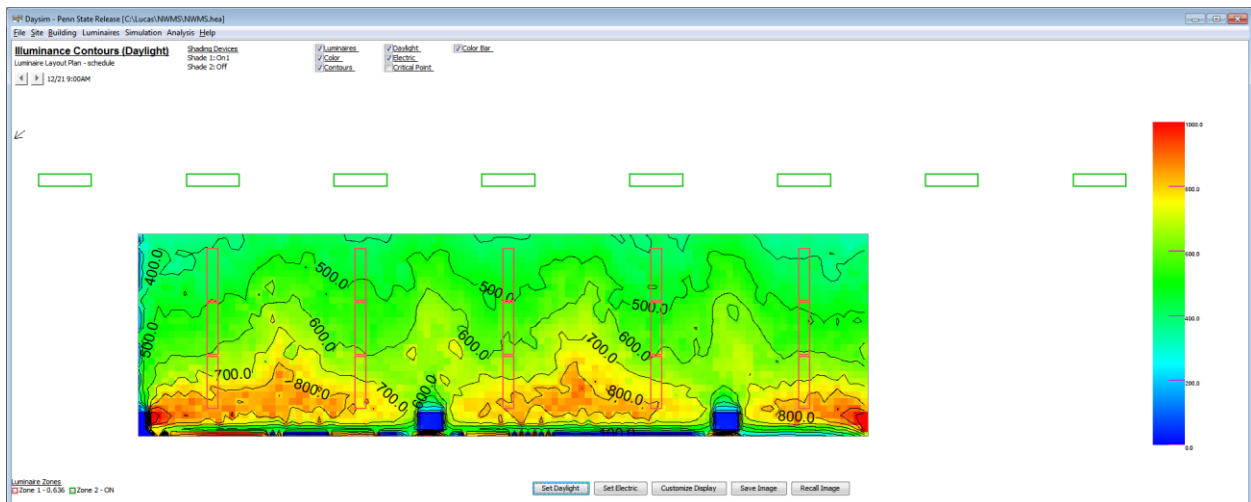




Illuminance Contours for Northwest Facing Material Science Façade (7am 12/21).

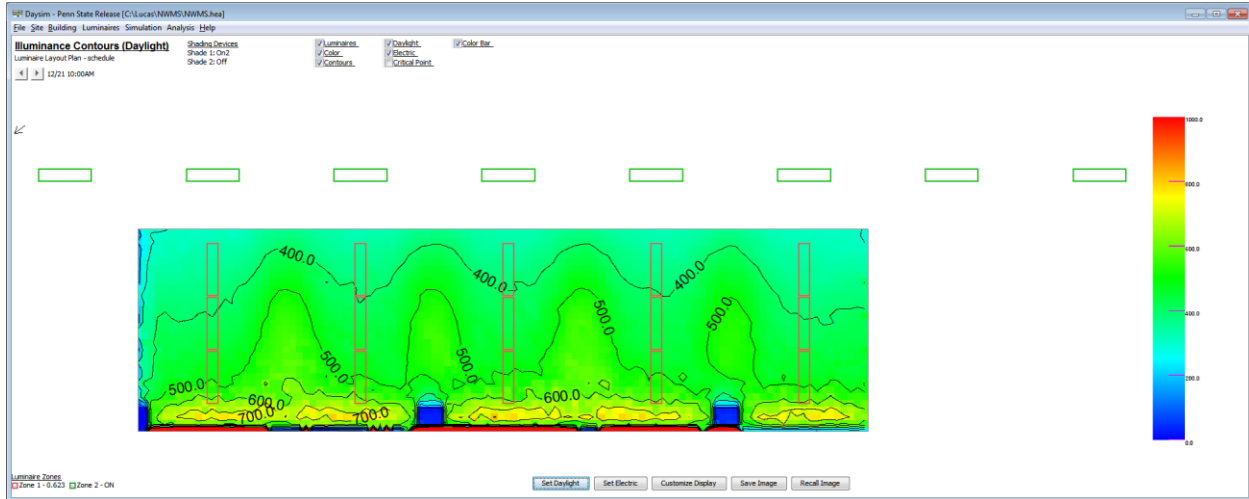


Illuminance Contours for Northwest Facing Material Science Façade (8am 12/21).

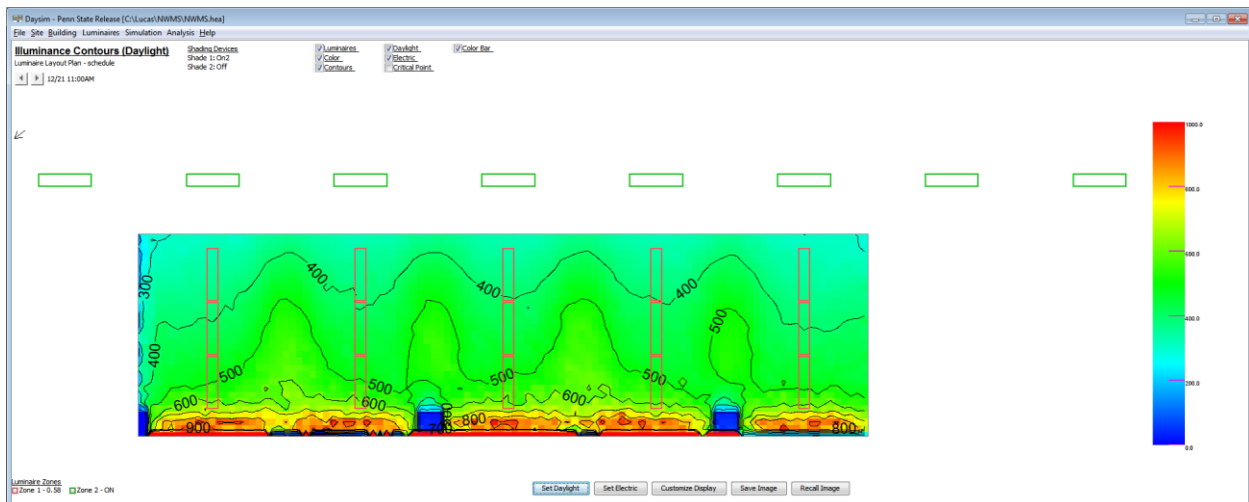


Illuminance Contours for Northwest Facing Material Science Façade (9am 12/21).

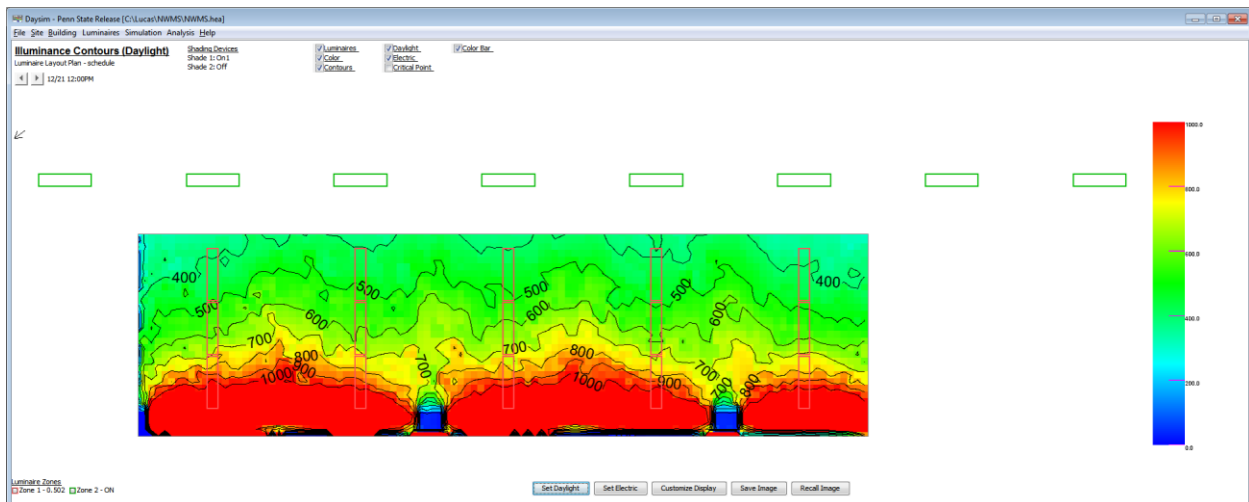




Illuminance Contours for Northwest Facing Material Science Façade (10am 12/21).

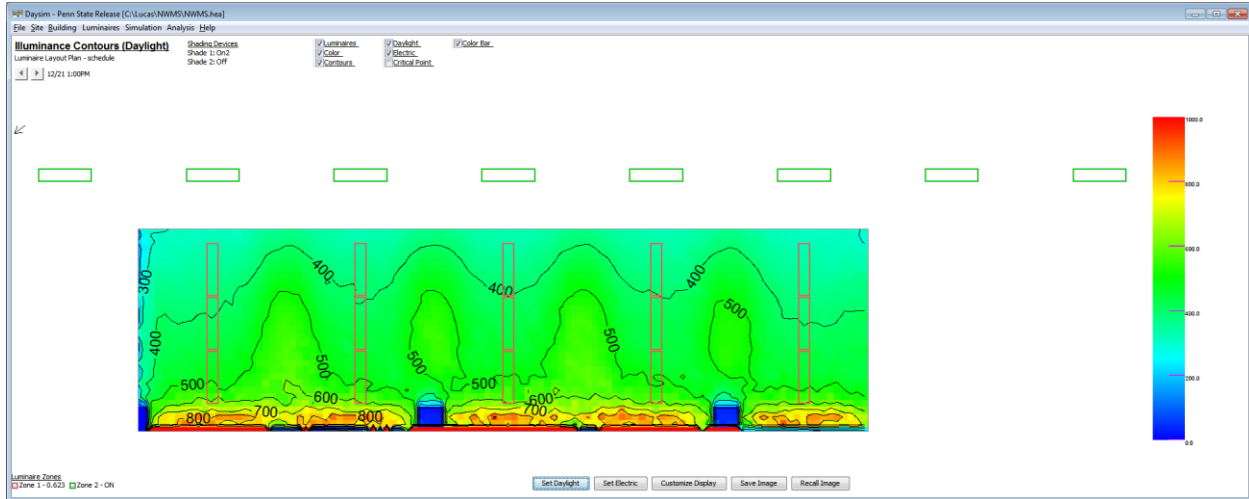


Illuminance Contours for Northwest Facing Material Science Façade (11am 12/21).

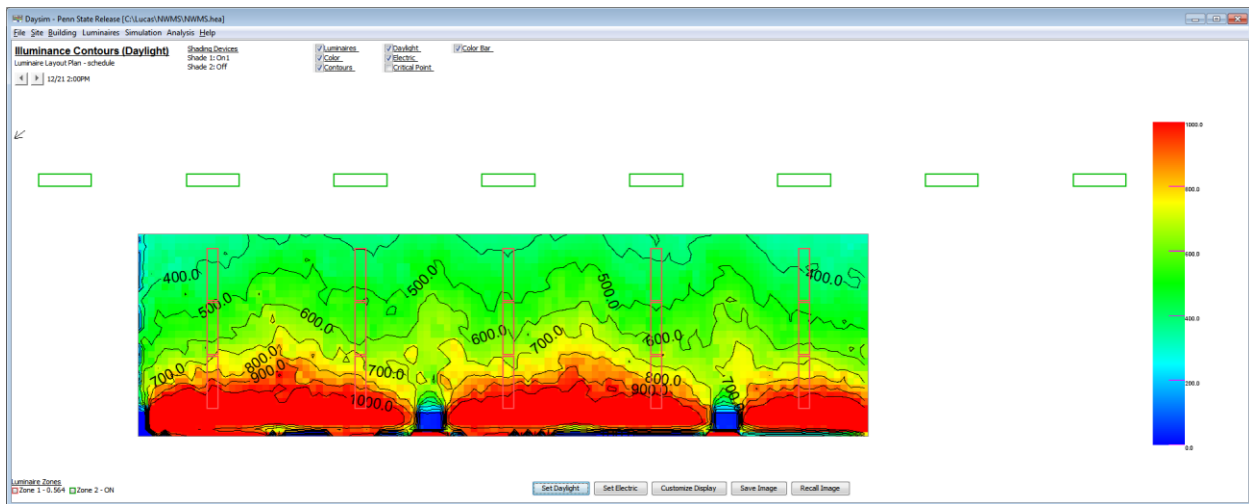


Illuminance Contours for Northwest Facing Material Science Façade (12pm 12/21).

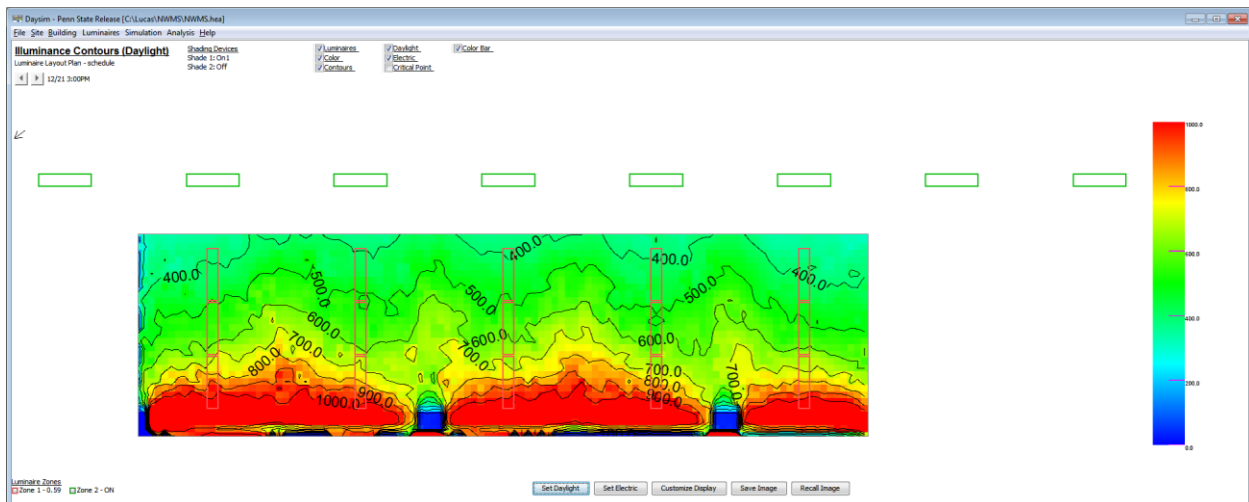




Illuminance Contours for Northwest Facing Material Science Façade (1pm 12/21).

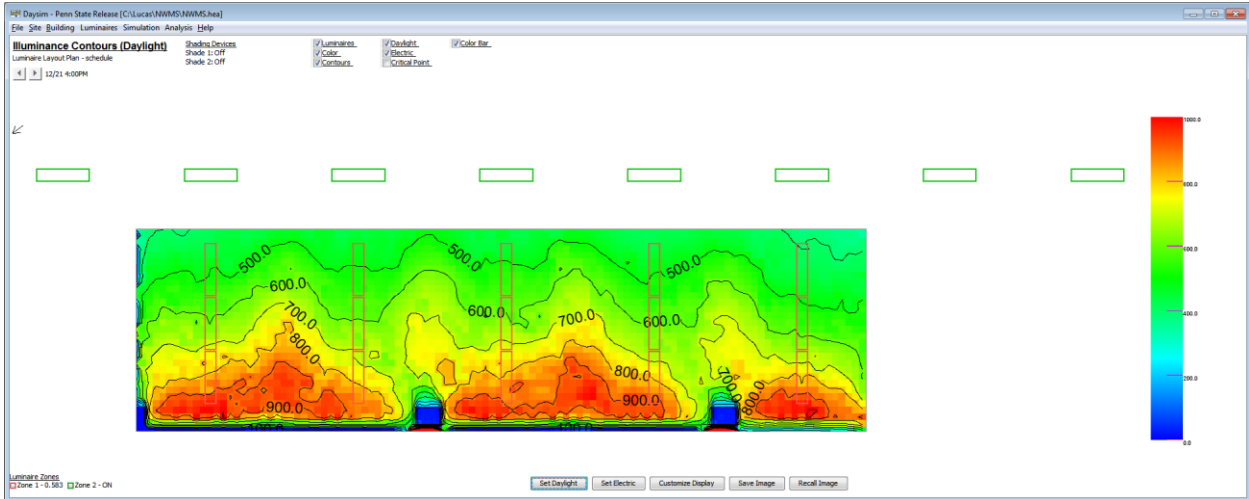


Illuminance Contours for Northwest Facing Material Science Façade (2pm 12/21).

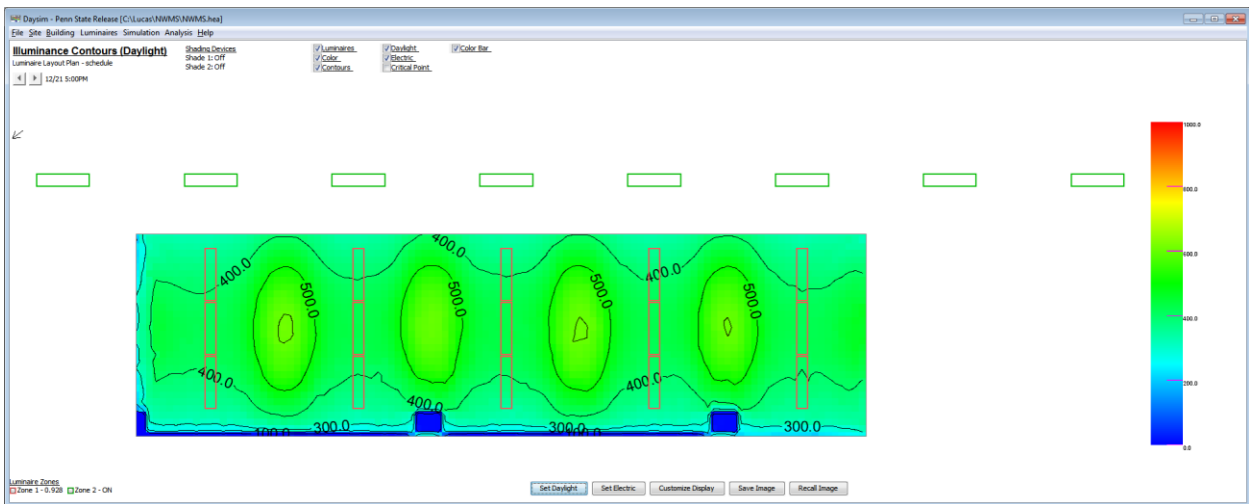


Illuminance Contours for Northwest Facing Material Science Façade (3pm 12/21).

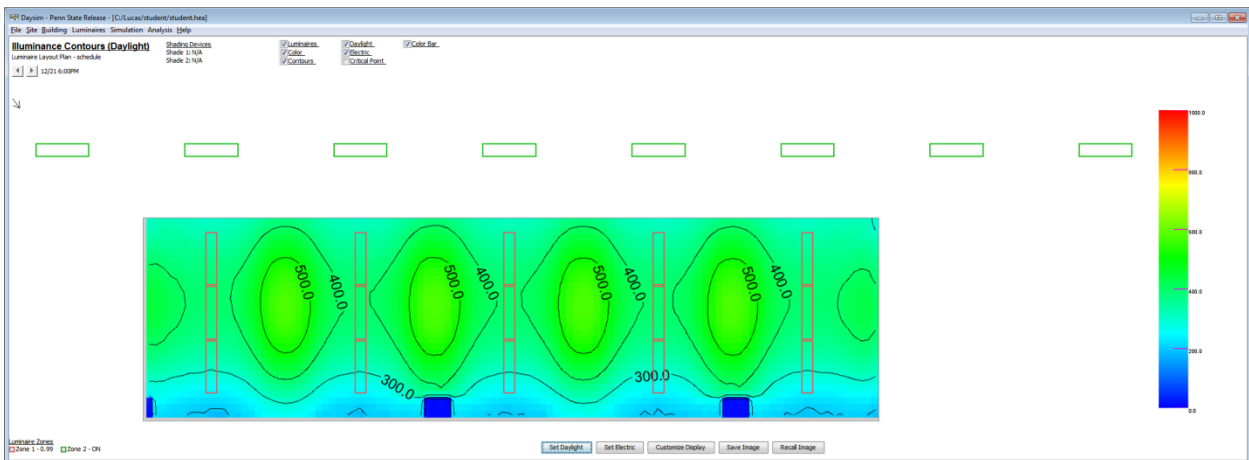




Illuminance Contours for Northwest Facing Material Science Façade (4pm 12/21).

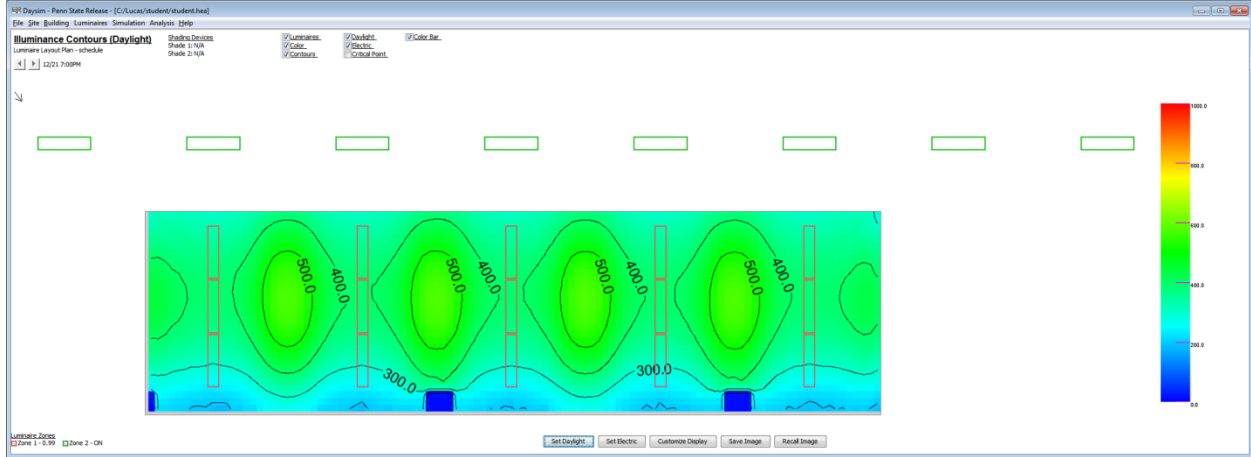


Illuminance Contours for Northwest Facing Material Science Façade (5pm 12/21).



Illuminance Contours for Northwest Facing Material Science Façade (6pm 12/21).





Illuminance Contours for Northwest Facing Material Science Façade (7pm 12/21).



Northeast Life Science Facade

Annual Savings kWh:

861.05

System Cost:

0.0

Energy Cost (per kWh):

0.08

Demand Charge (per kWh):

0.0

Peak Demand Time (0-24.0):

0.0

NOTE: All costs must be in the same units.

Savings Per Year:

68.884

Daysim Annual Energy Savings for Northeast Facing Life Science Façade Student Study Area.

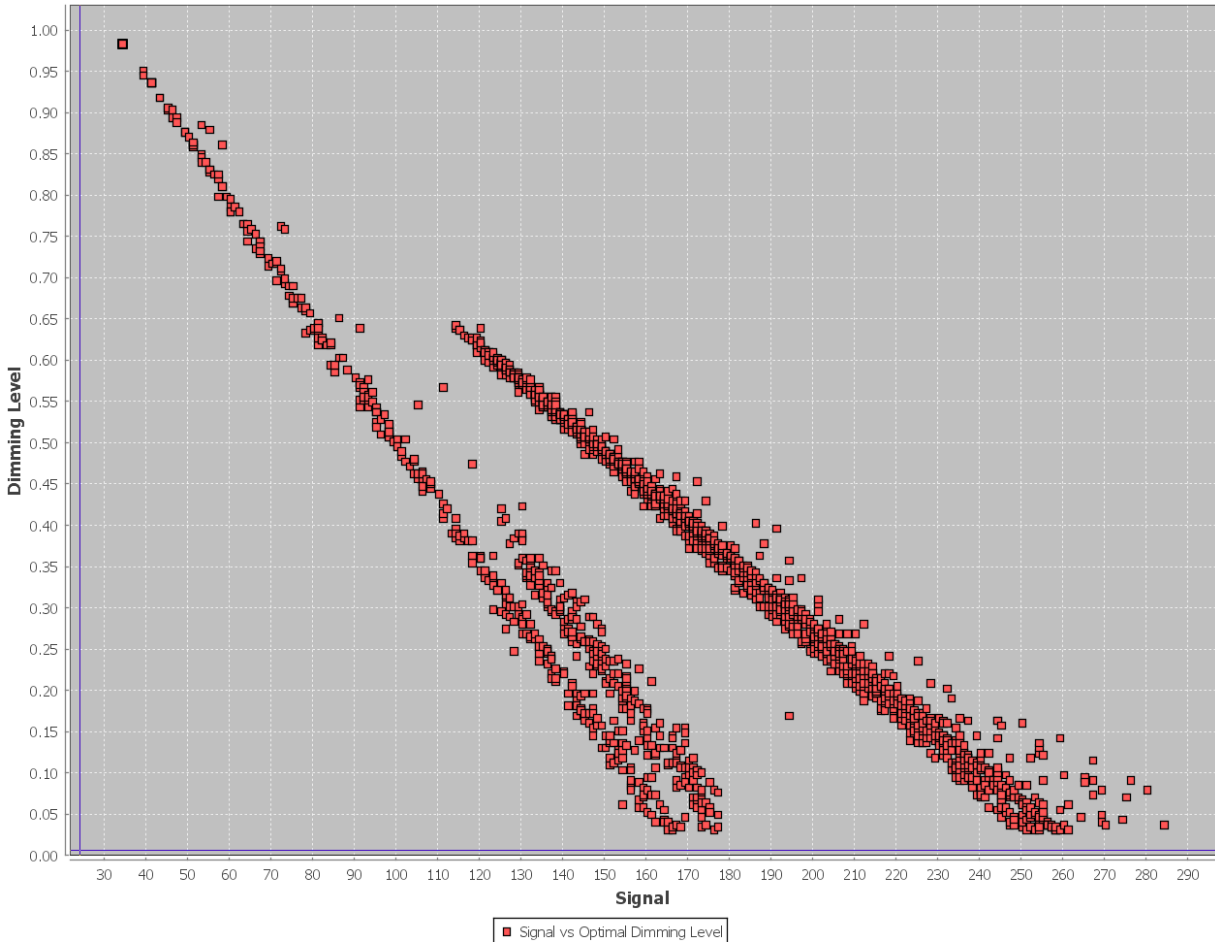
Controlled Zone	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	152.76	132.84	146.12	132.84	152.76	146.12	146.12	152.76	139.48	152.76	146.12	99.63	1700.35
Optimal	100.52	79.53	70.73	47.01	44.91	33.23	31.1	44.02	60.6	82.85	97.22	66.7	758.46
Algorithm	110.82	88.81	76.38	52.64	52.29	37.32	35.58	50.16	66.23	88.38	105.14	75.49	839.29
Savings	41.94	44.02	69.74	80.19	100.46	108.79	110.53	102.6	73.25	64.38	40.97	24.13	861.05

Daysim Controlled Zone Energy Table for Northeast Facing Life Science Façade Student Study Area.

Controlled Zone	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	229.71	199.75	219.72	199.75	229.71	219.72	219.72	229.71	209.73	229.71	219.72	149.81	2556.82
Optimal	177.47	146.44	144.33	113.92	121.85	106.83	104.7	120.97	130.86	159.8	170.82	116.88	1614.93
Algorithm	187.77	155.73	149.98	119.55	129.24	110.92	109.18	127.11	136.48	165.32	178.75	125.68	1695.77
Savings	41.94	44.02	69.74	80.19	100.46	108.79	110.53	102.6	73.25	64.38	40.97	24.13	861.05

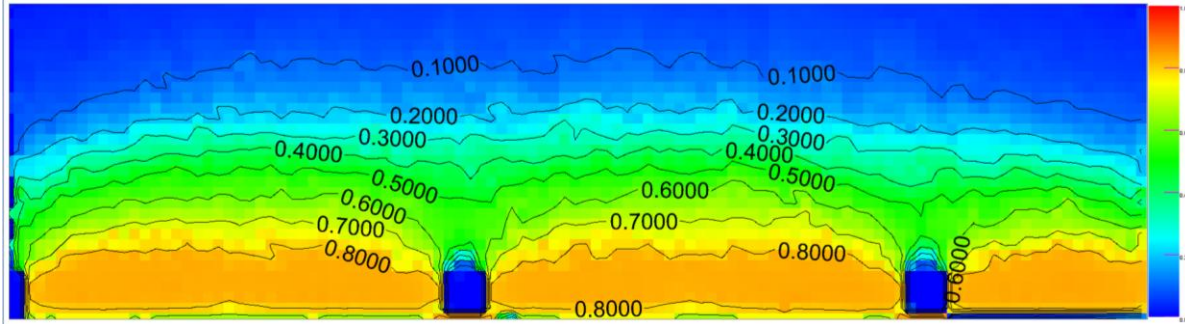
Daysim Controlled Zone & Corridor Energy Table for Northeast Facing Life Science Façade Student Study Area.



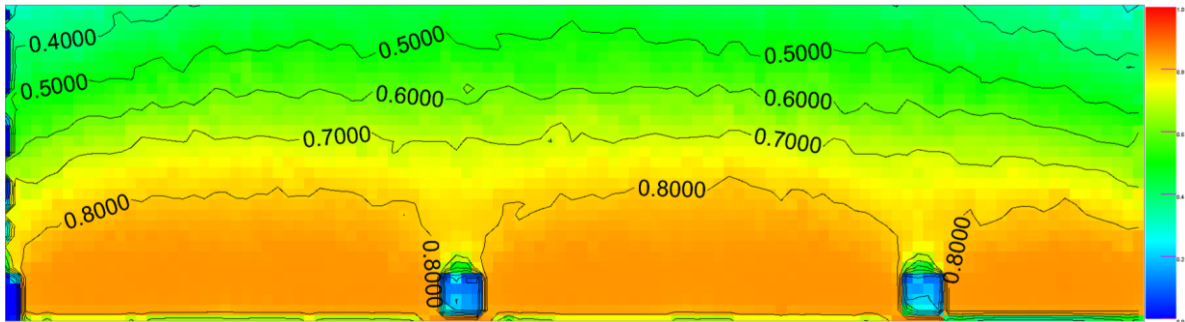


Daysim Photosensor Signal Vs. Dimming Level for Northeast Facing Life Science Student Study Area.

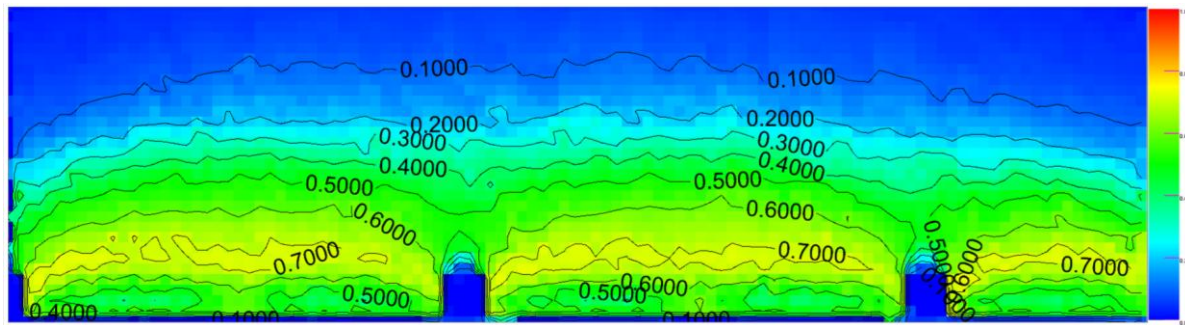




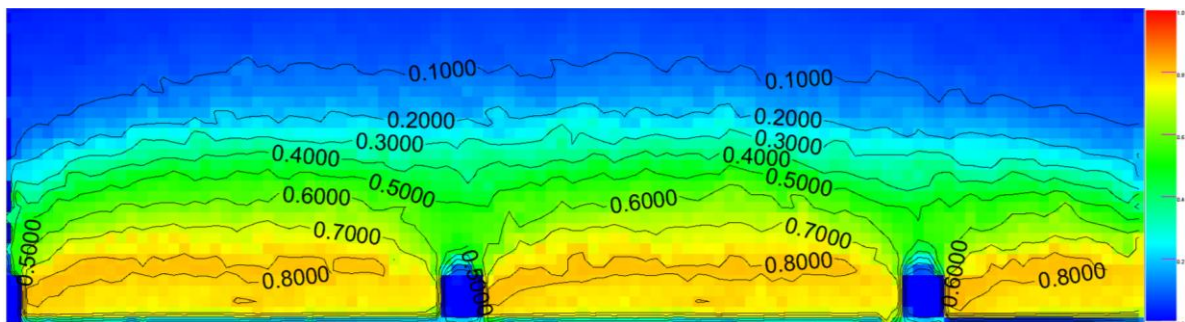
Daylight Autonomy for Northeast Facing Life Science Façade (322.8lux).



Continuous Daylight Autonomy for Northeast Facing Life Science Façade (322.8lux).



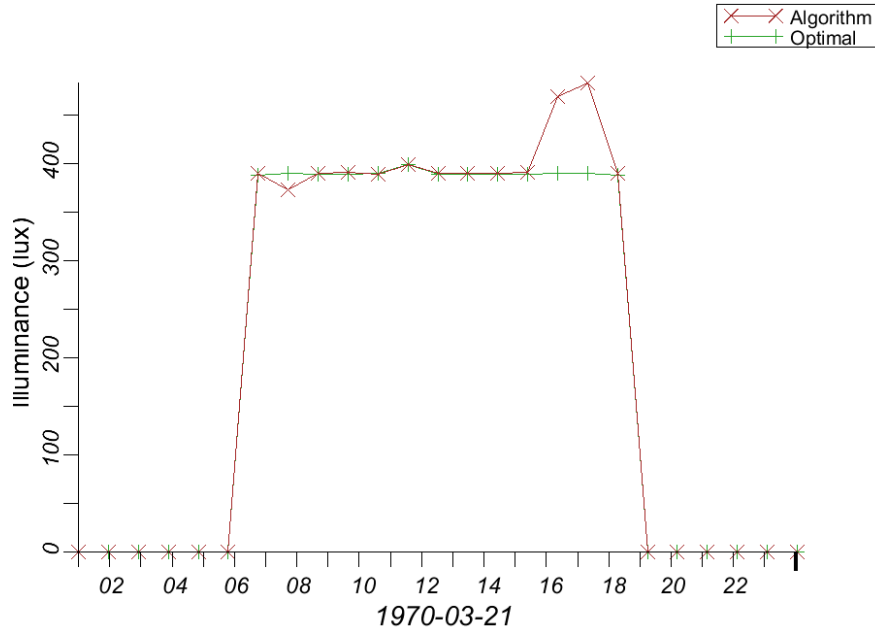
Useful Daylight Illuminance for Northeast Facing Life Science Façade (322.8 to 1000lux).



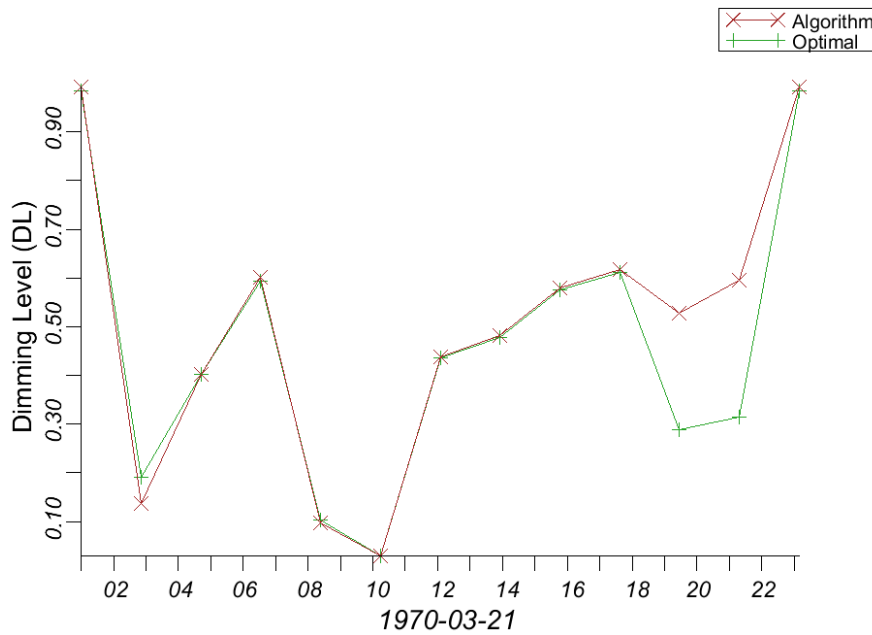
Useful Daylight Illuminance for Northeast Facing Life Science Façade (322.8 to 2000lux).



Fall & Spring Equinox: 7:00AM through 7:00PM

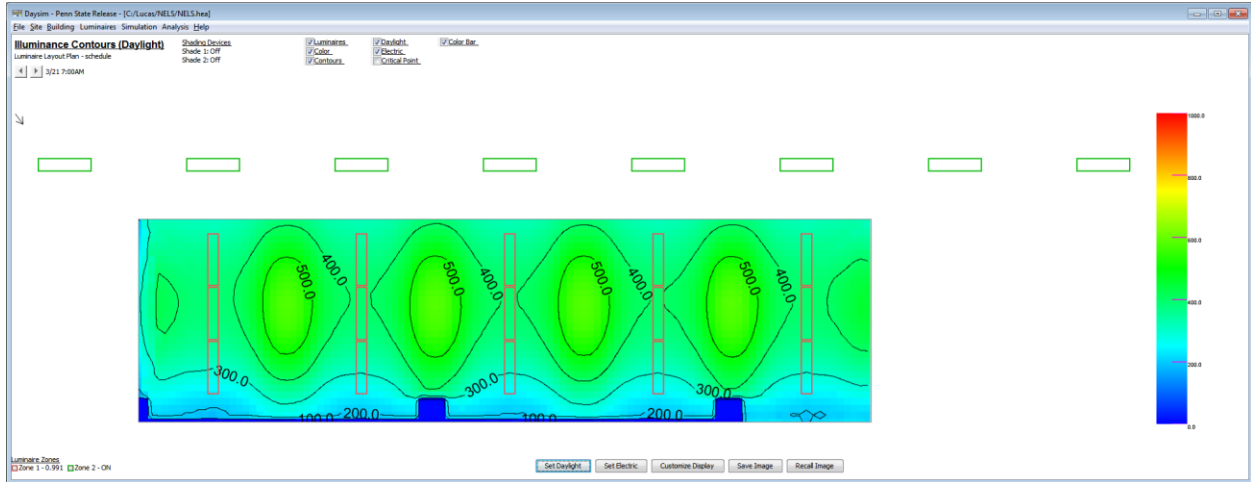


Daysim Illuminance Timeplot for Northeast Life Science Façade (Fall & Spring Equinox).

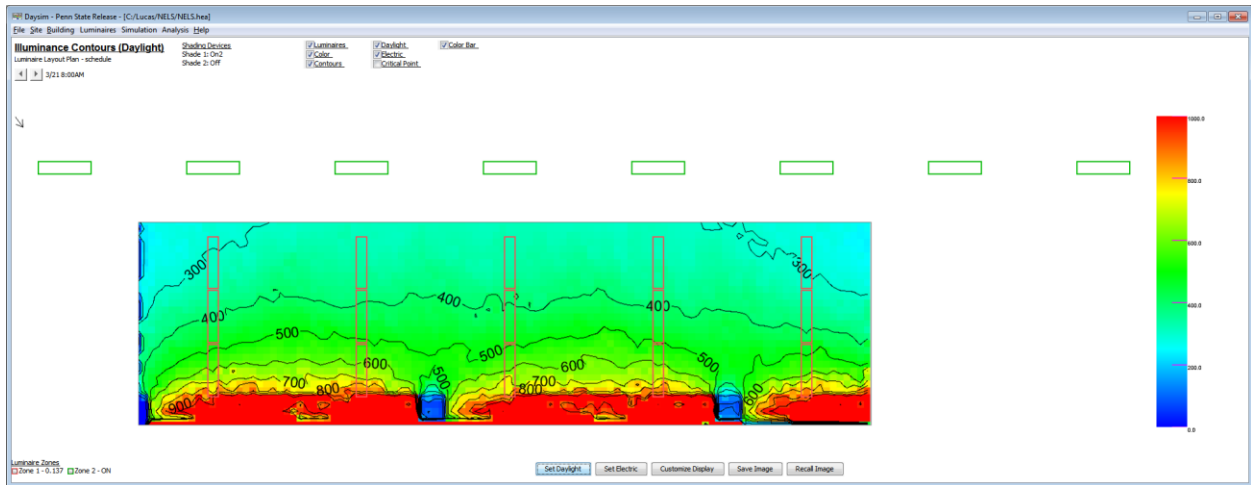


Daysim Dimming Timeplot for Northeast Life Science Façade (Fall & Spring Equinox).

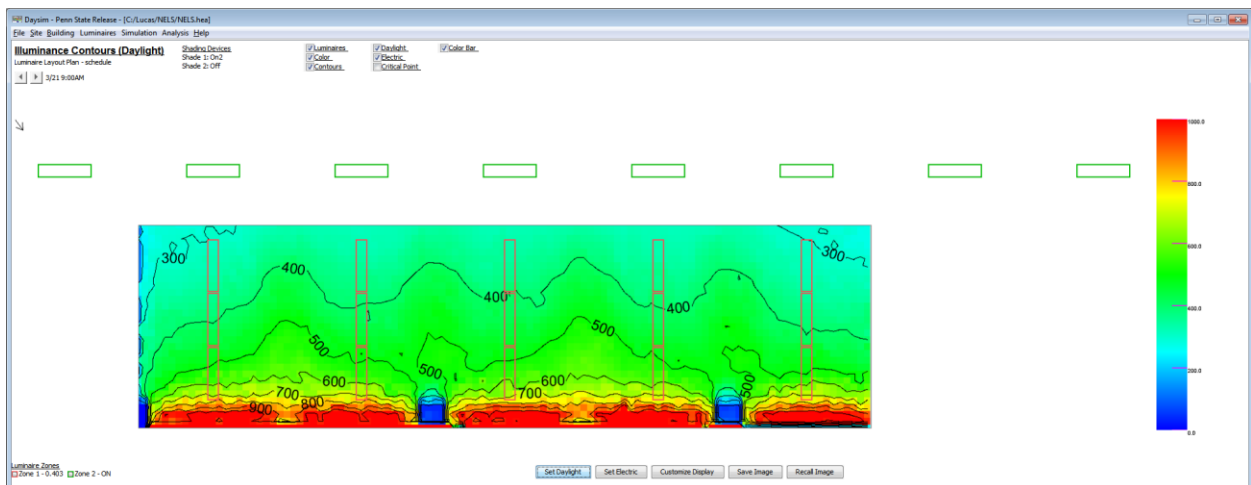




Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 7:00AM).

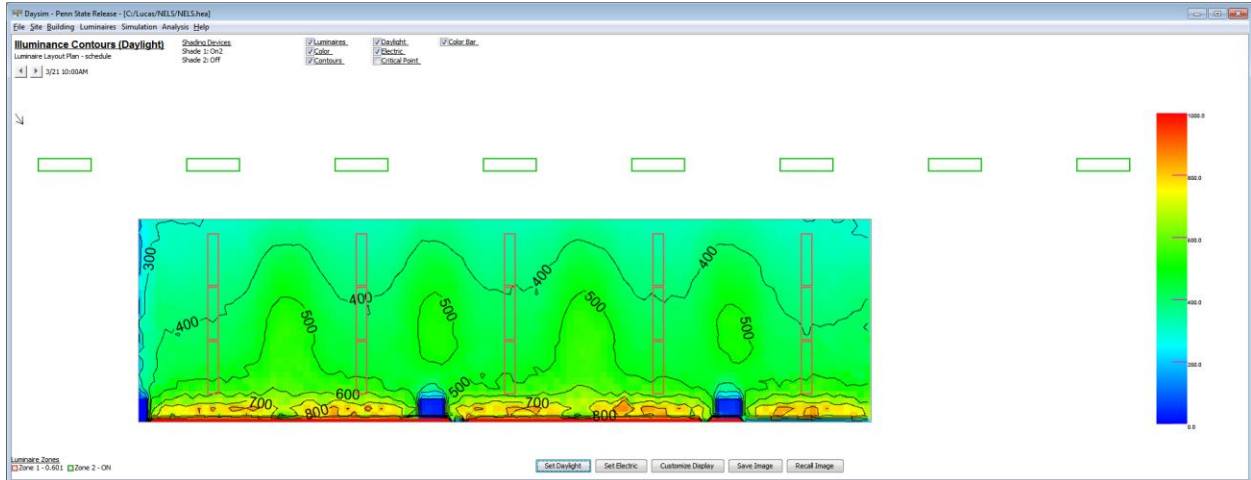


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 8:00AM).

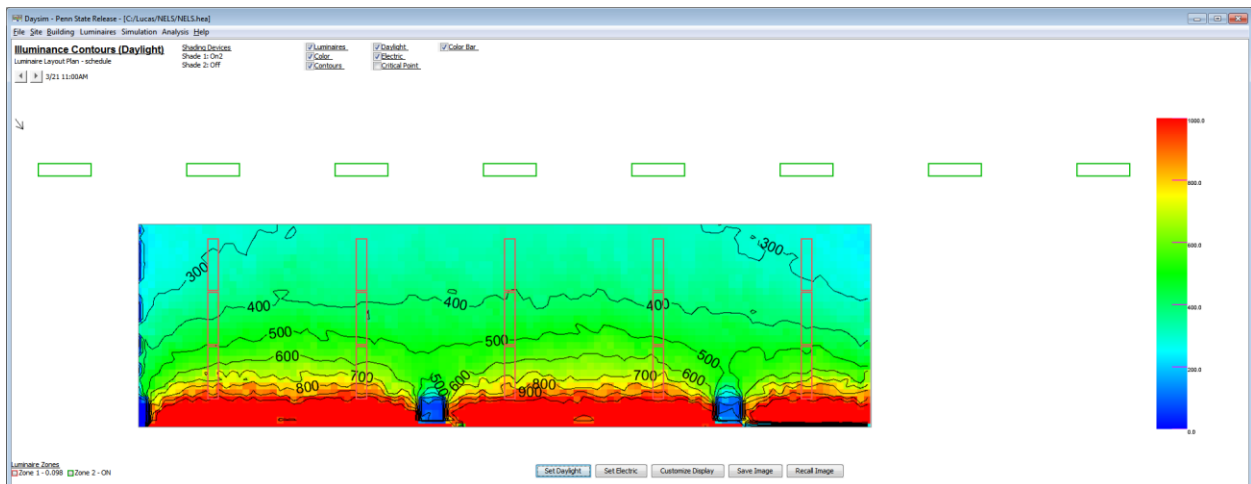


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 9:00AM).

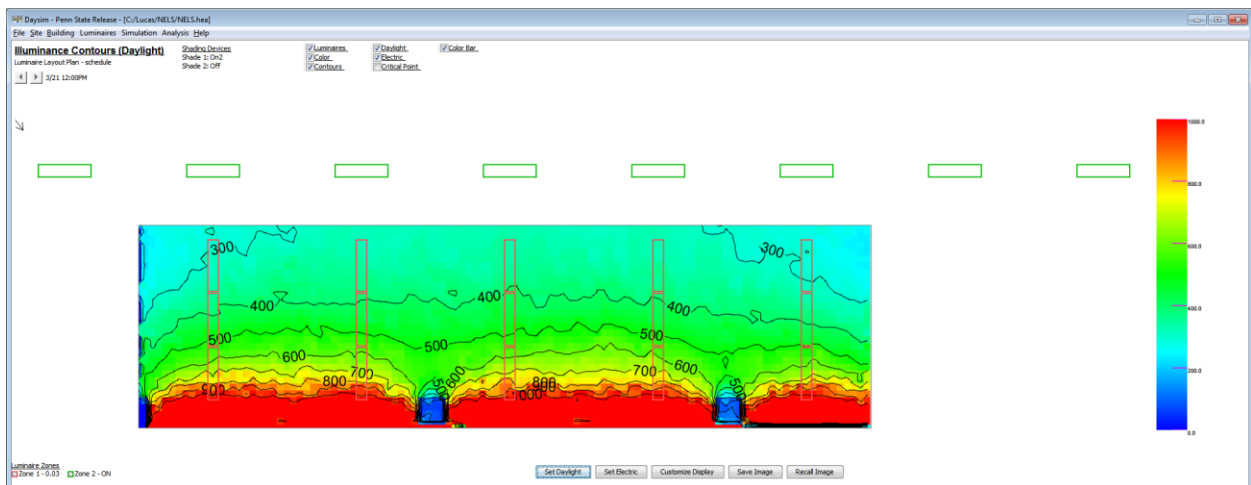




Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 10:00AM).

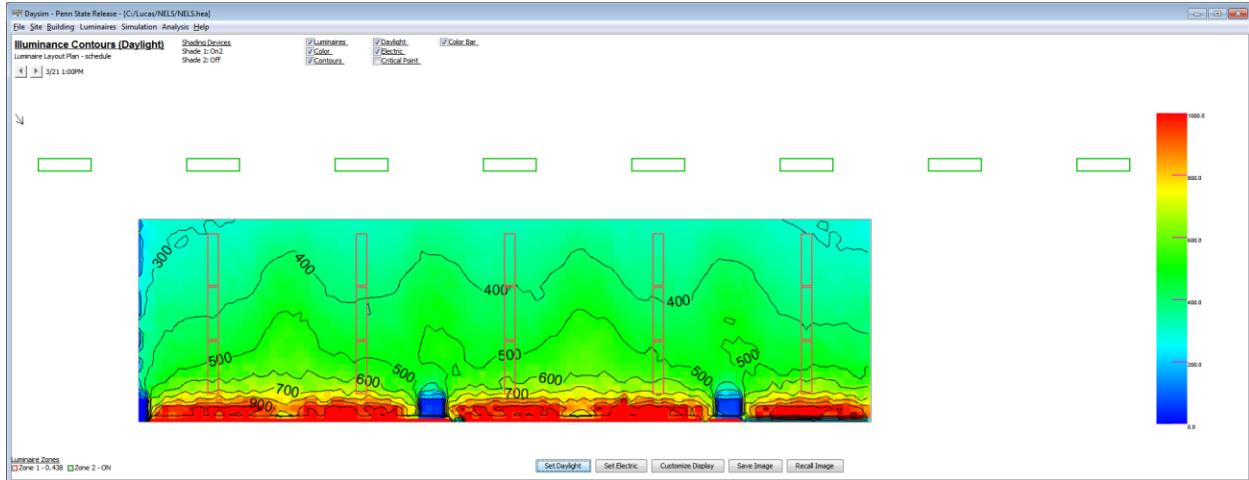


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 11:00AM).

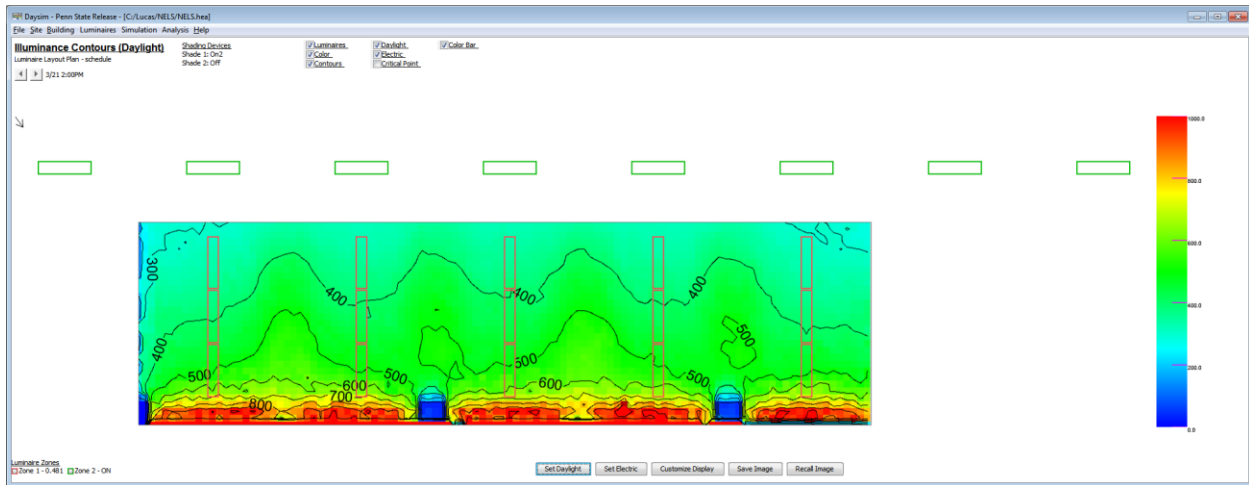


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 12:00PM).

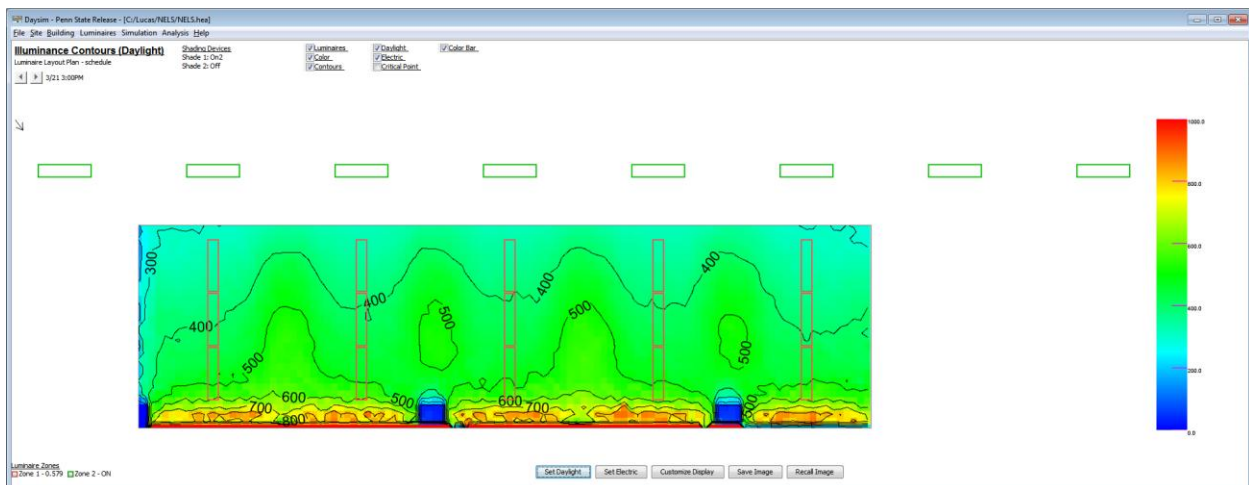




Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 1:00PM).

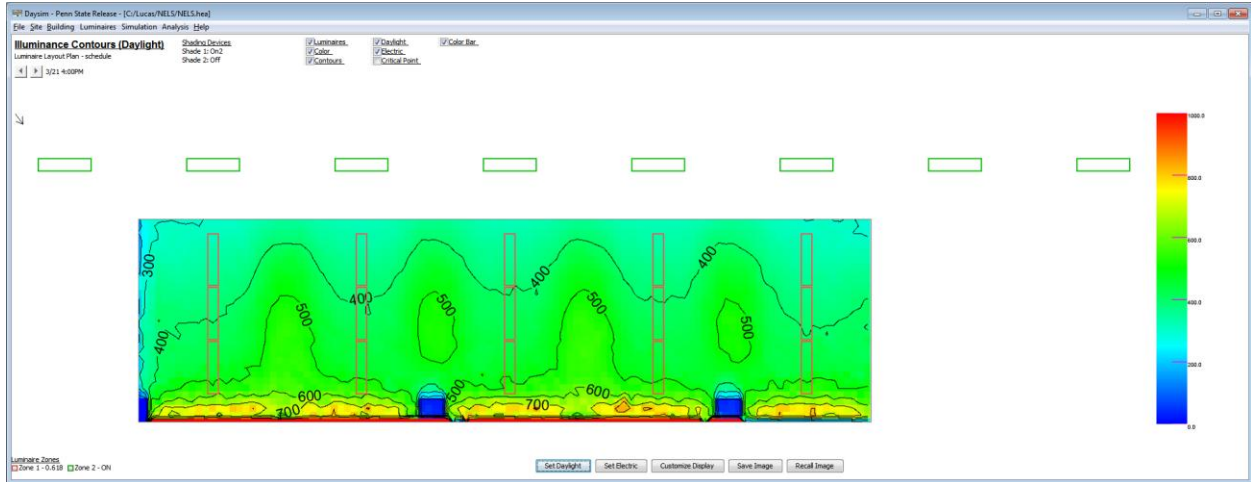


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 2:00PM).

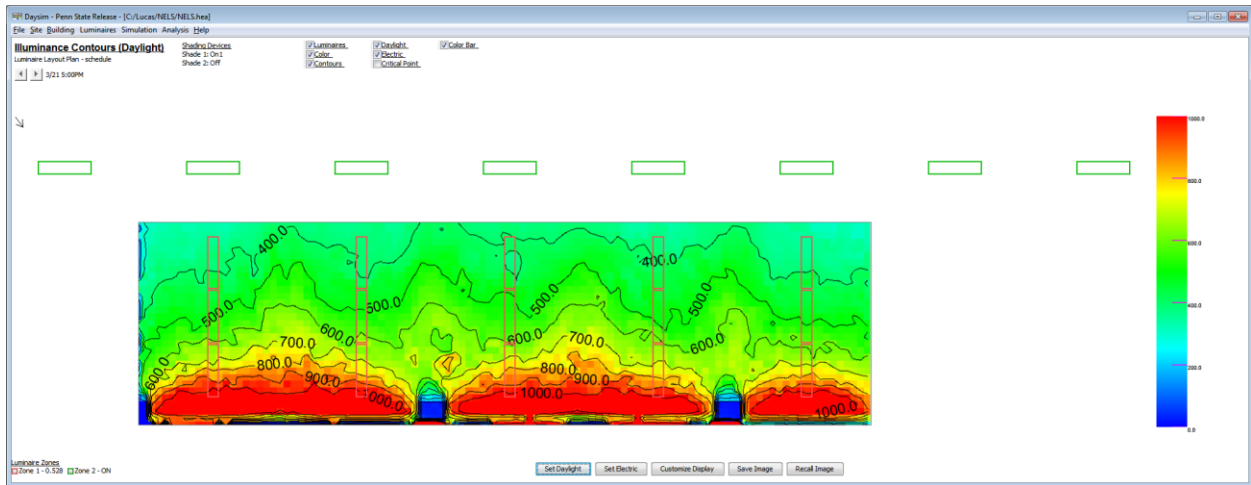


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 3:00PM).

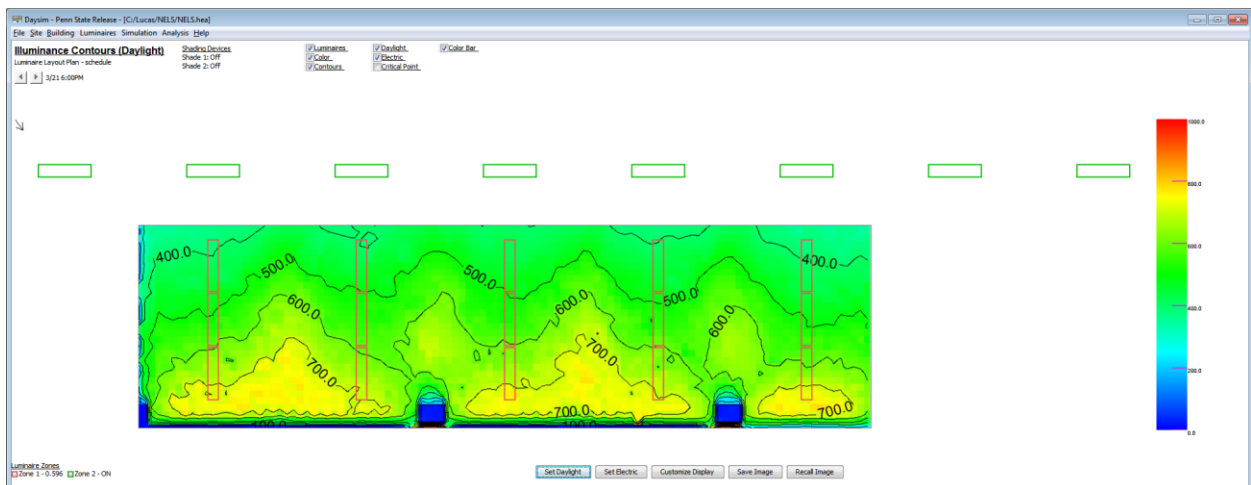




Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 4:00PM).

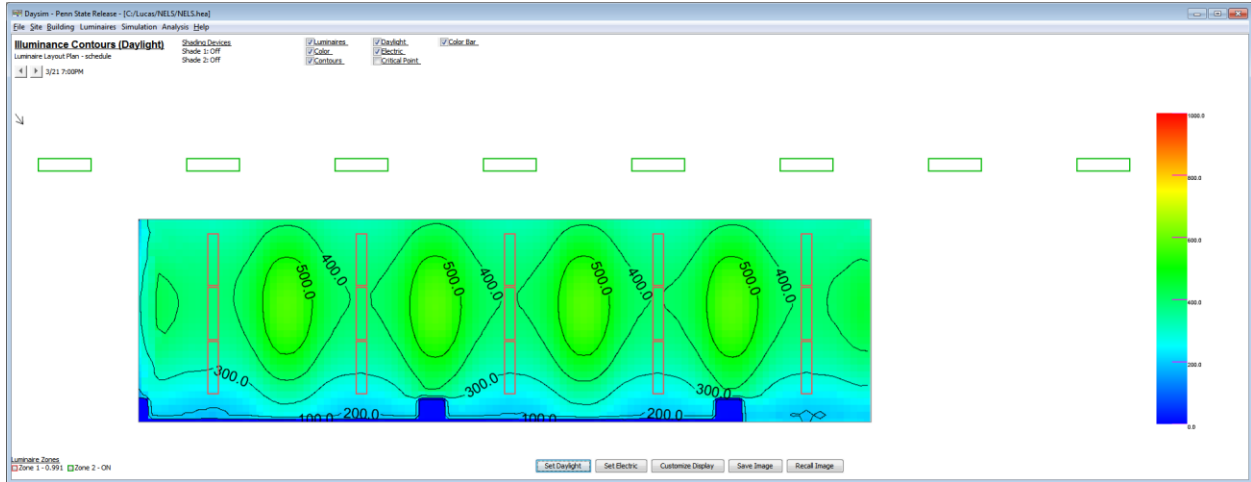


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 5:00PM).



Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 6:00PM).

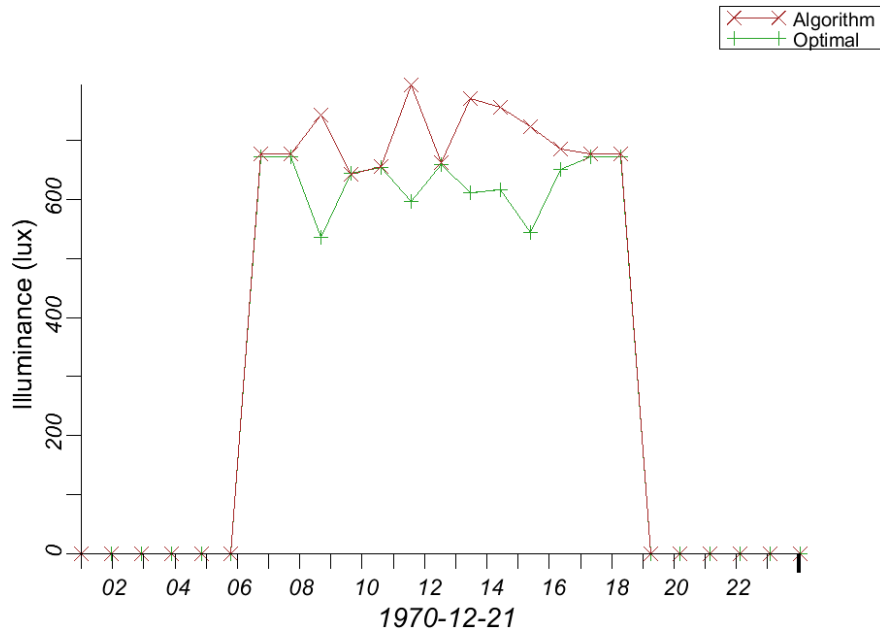




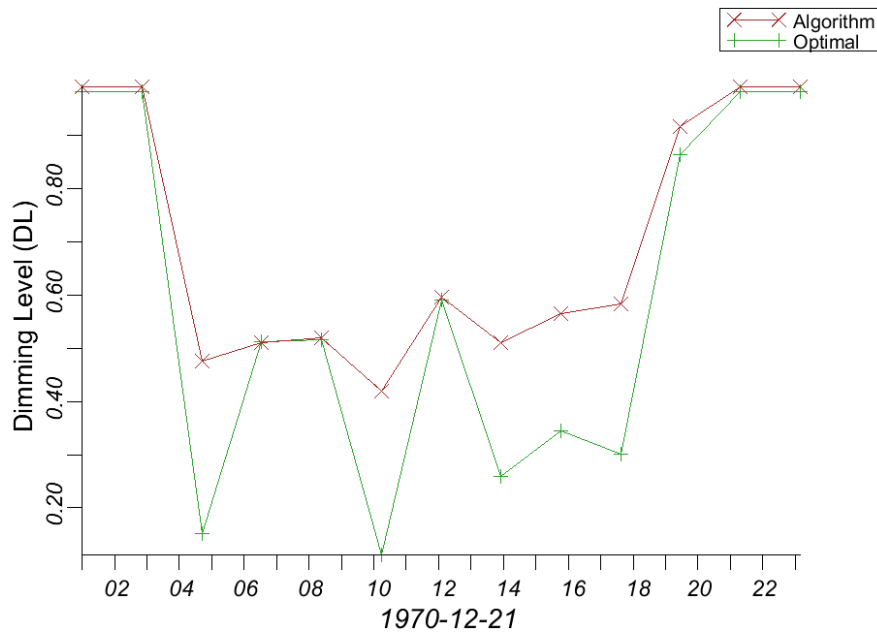
Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 7:00PM).



Winter Solstice: 7:00AM through 7:00PM

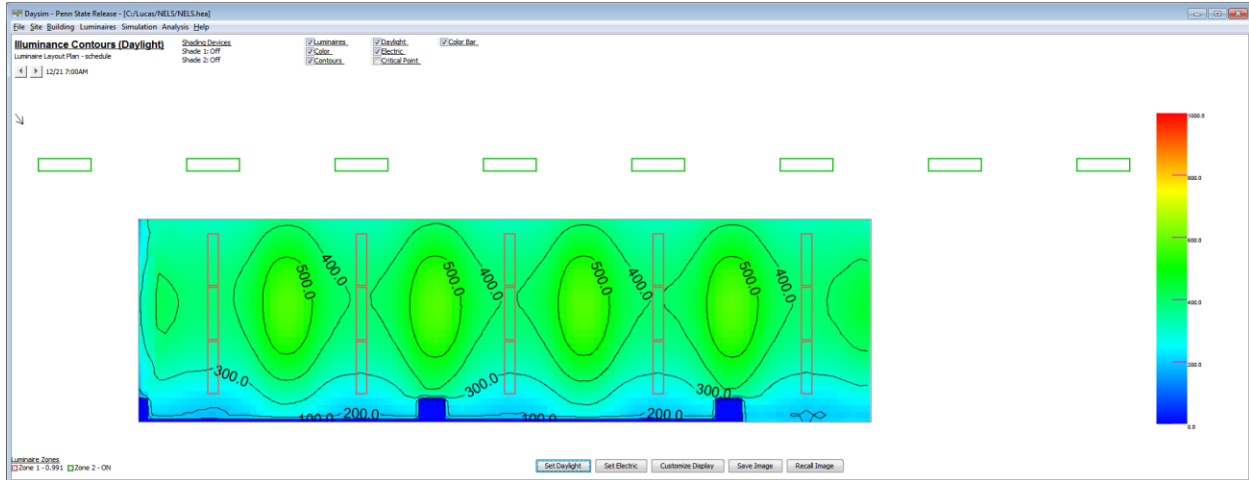


Daysim Illuminance Timeplot for Northeast Life Science Façade (Winter Solstice).

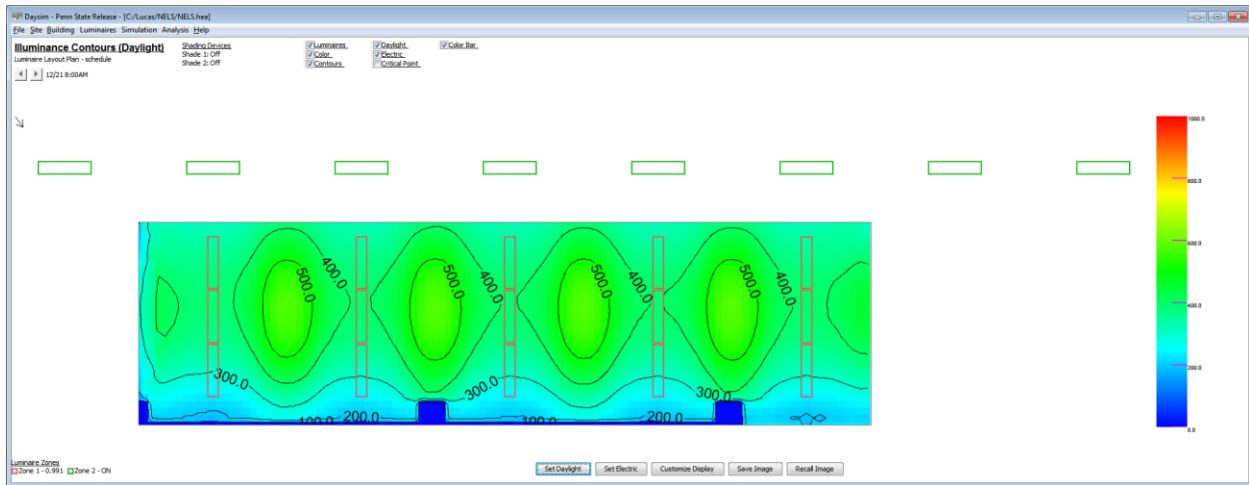


Daysim Dimming Timeplot for Northeast Life Science Façade (Winter Solstice).

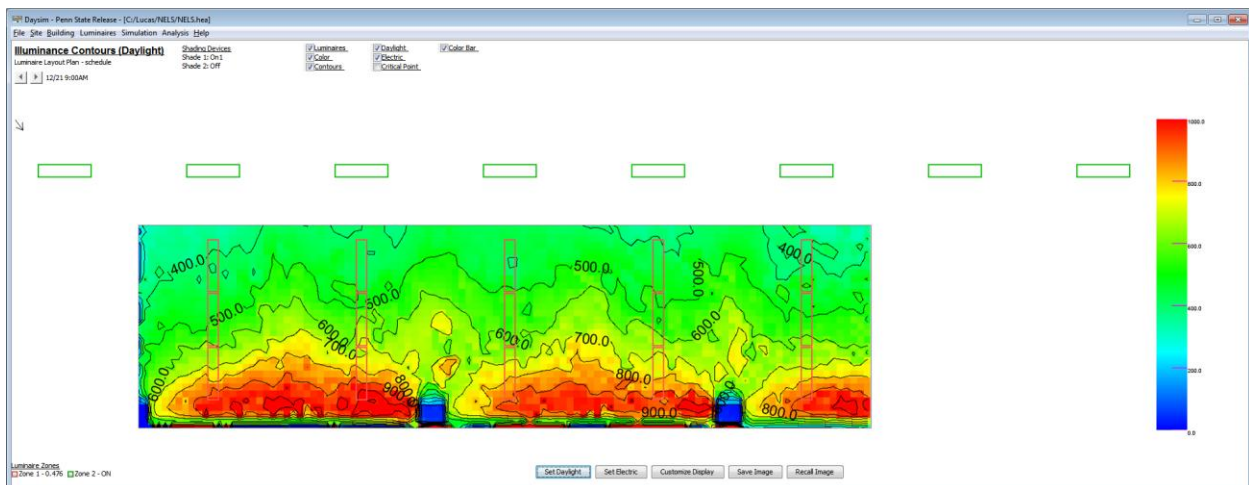




Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 7:00AM).

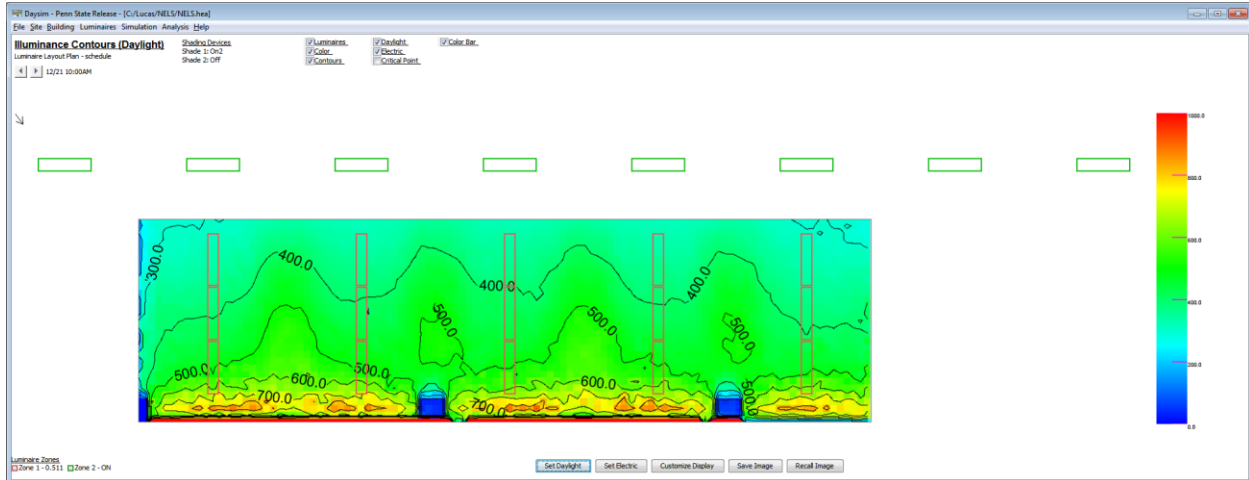


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 8:00AM).

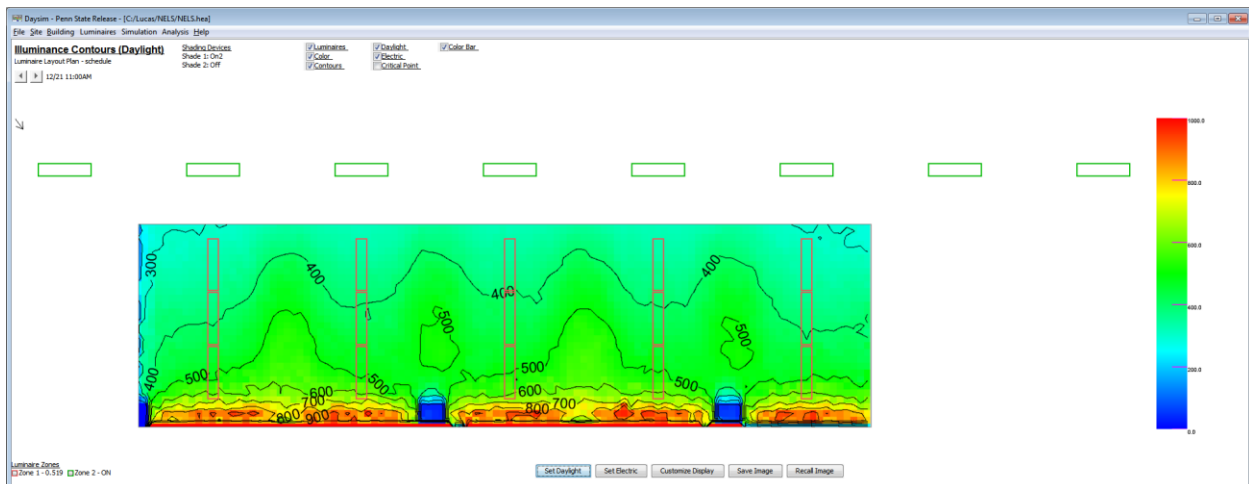


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 9:00AM).

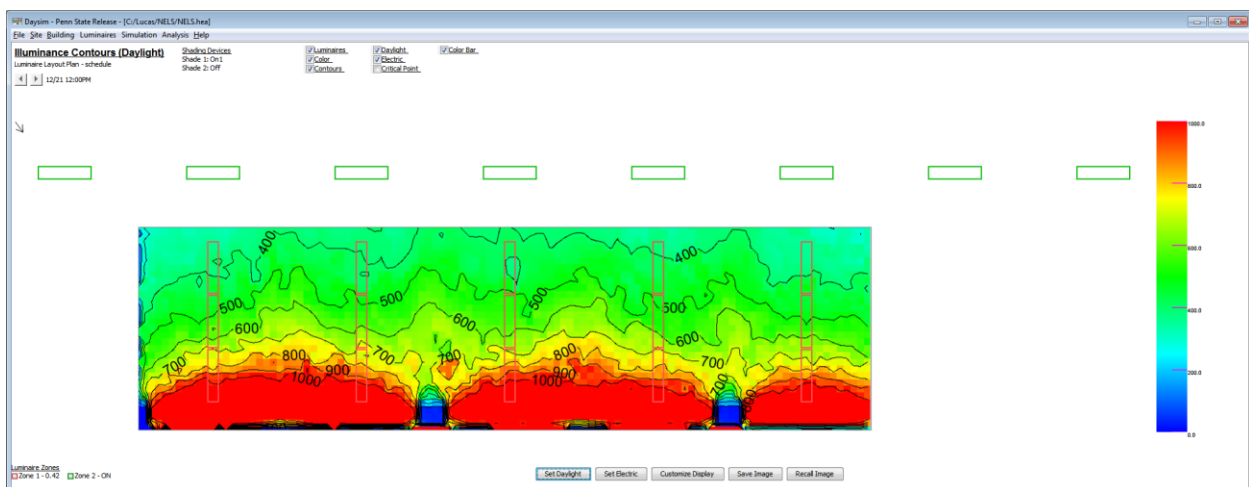




Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 10:00AM).

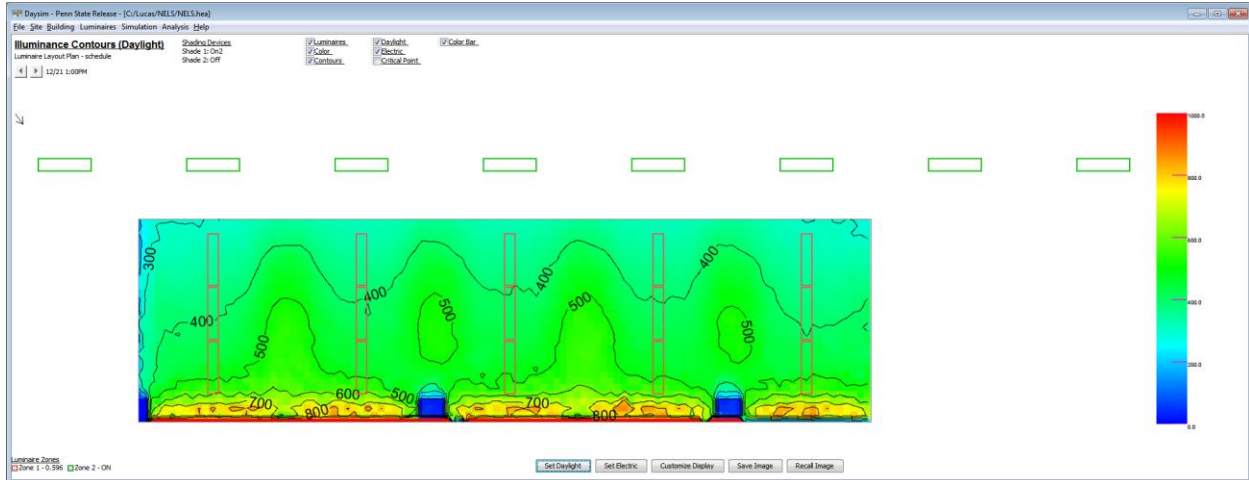


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 11:00AM).

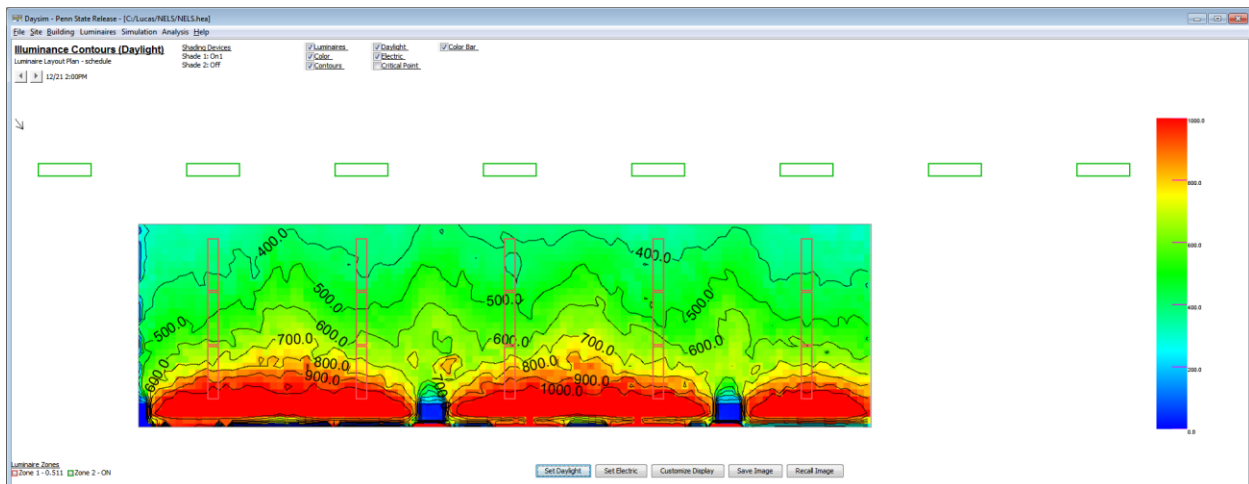


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 12:00PM).

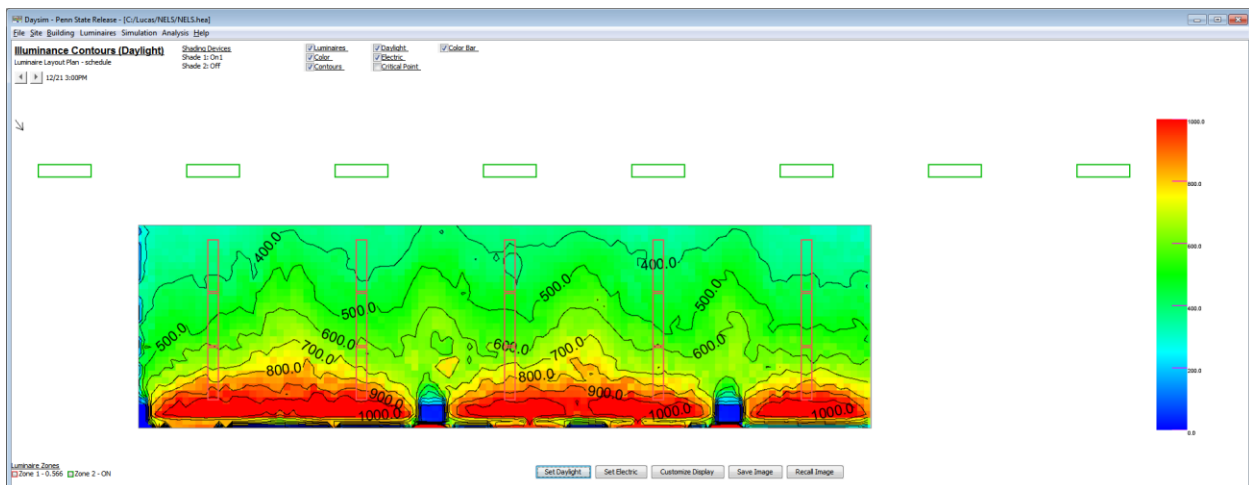




Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 1:00PM).

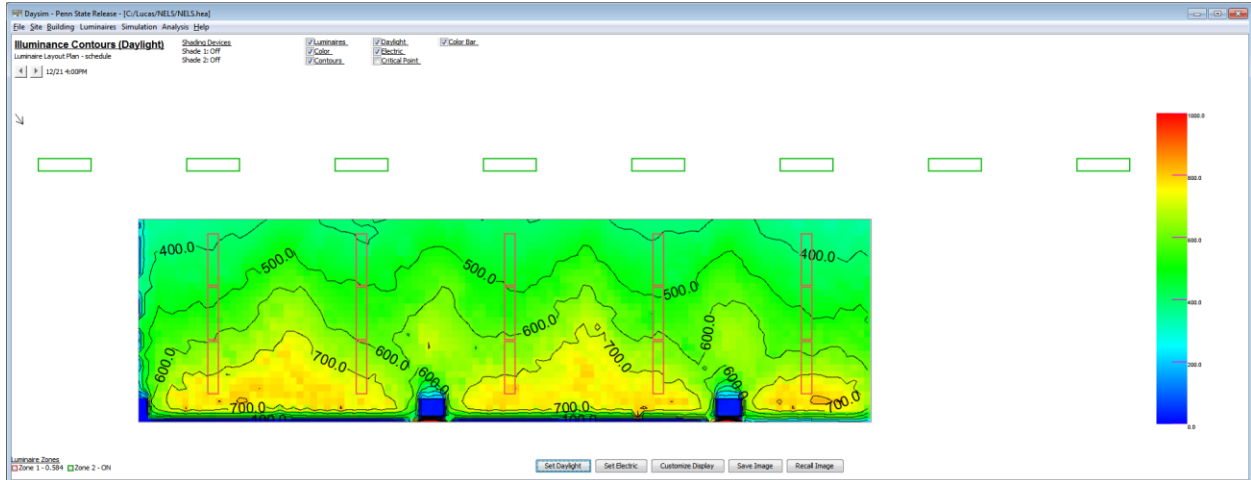


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 2:00PM).

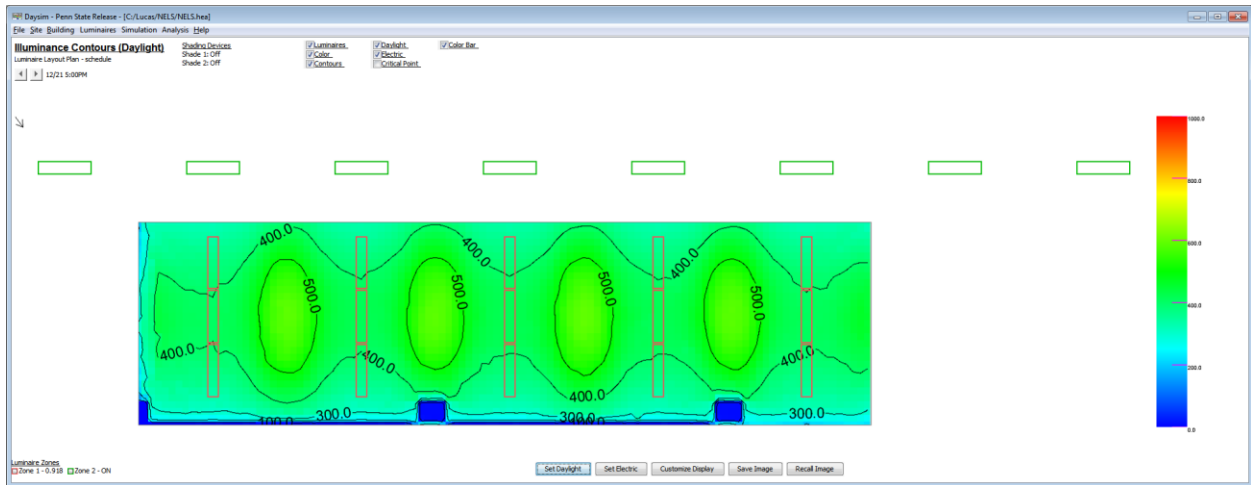


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 3:00PM).

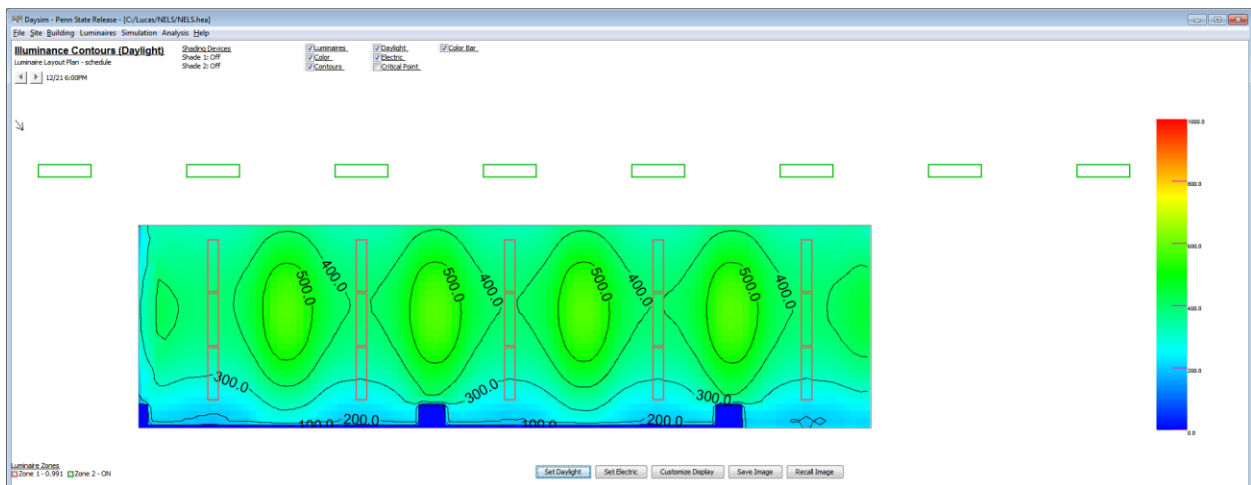




Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 4:00PM).

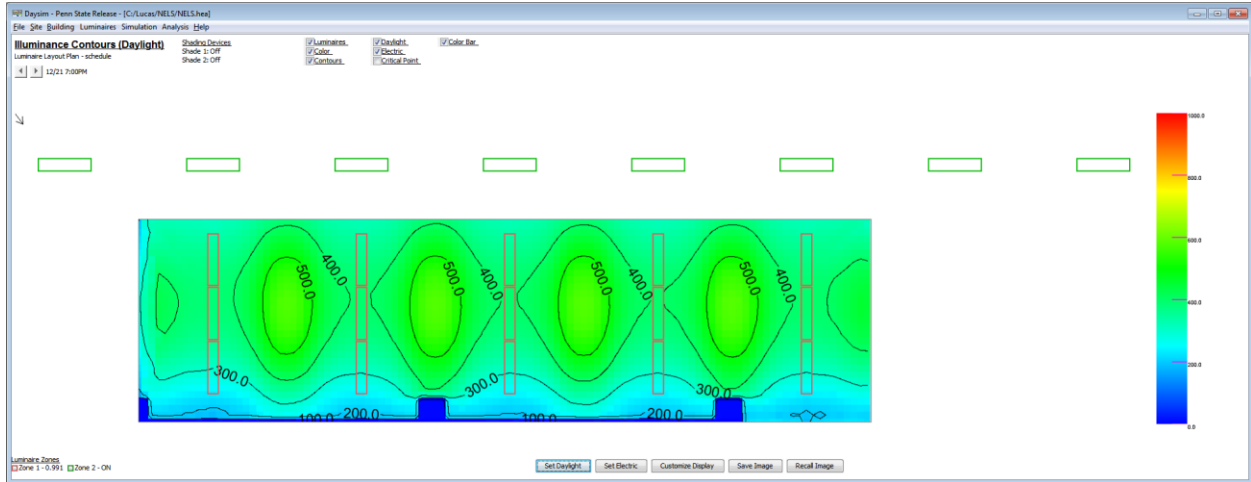


Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 5:00PM).



Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 6:00PM).

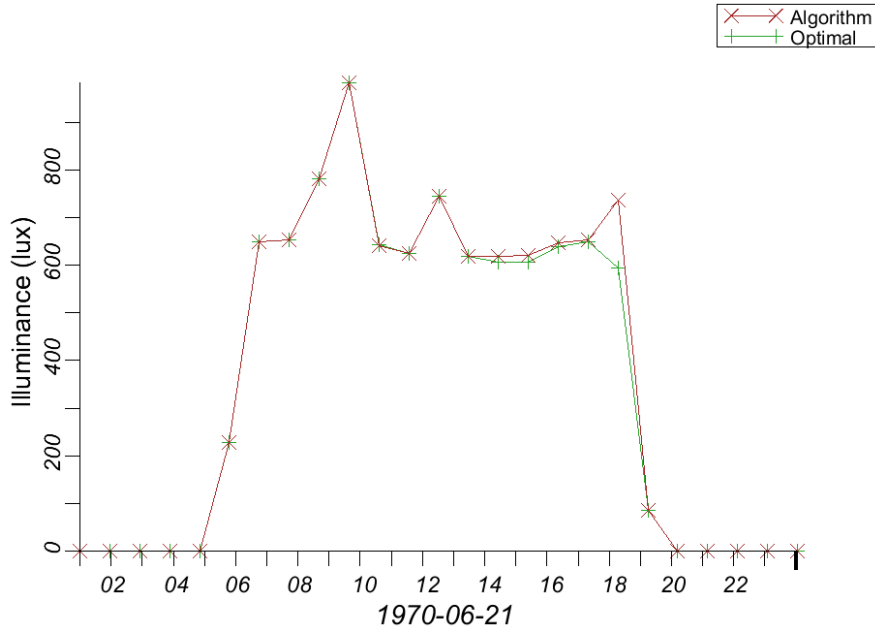




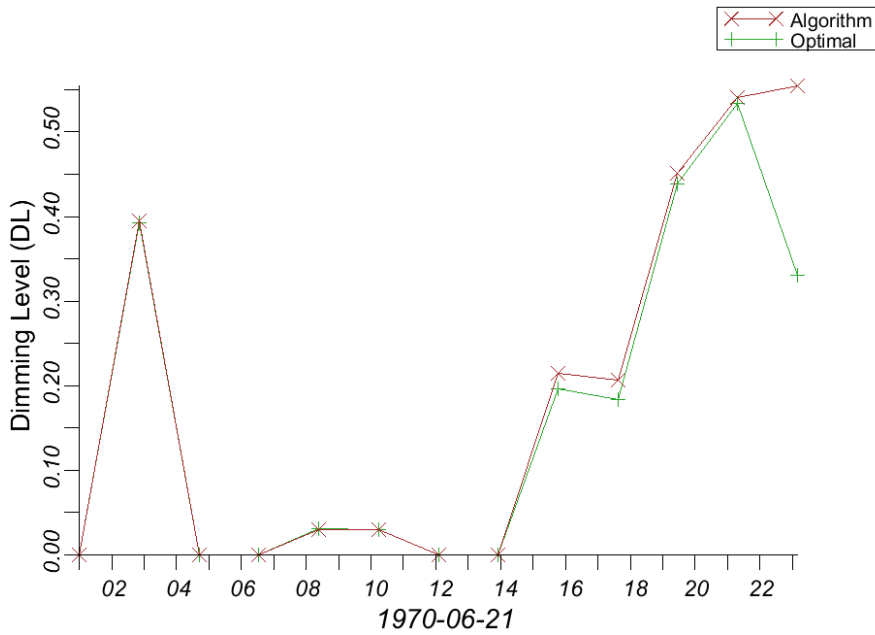
Illumination Contours for Northeast Facing Life Science Façade (3/21 & 9/21 – 7:00PM).



Summer Solstice: 7:00AM through 7:00PM

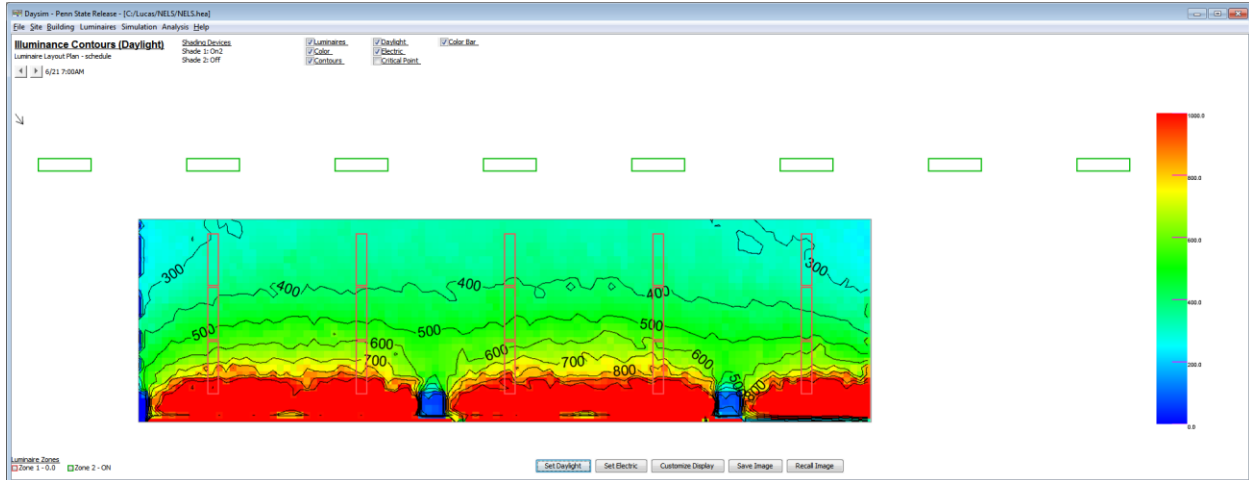


Daysim Illuminance Timeplot for Northeast Life Science Façade (Summer Solstice).

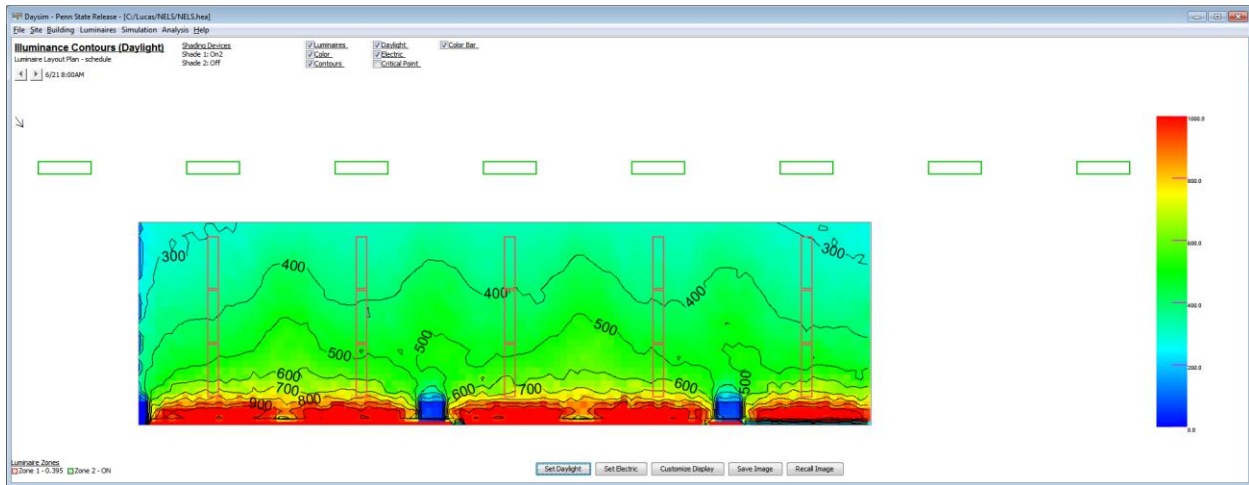


Daysim Illuminance Timeplot for Northeast Life Science Façade (Sumemr Solstice).

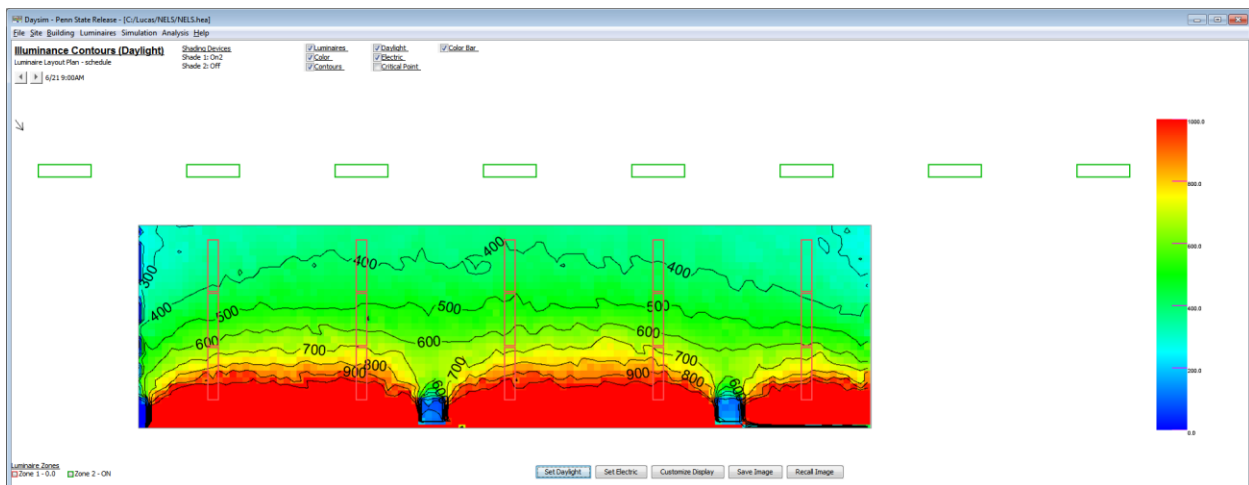




Illumination Contours for Northeast Facing Life Science Façade (6/21 – 7:00AM).

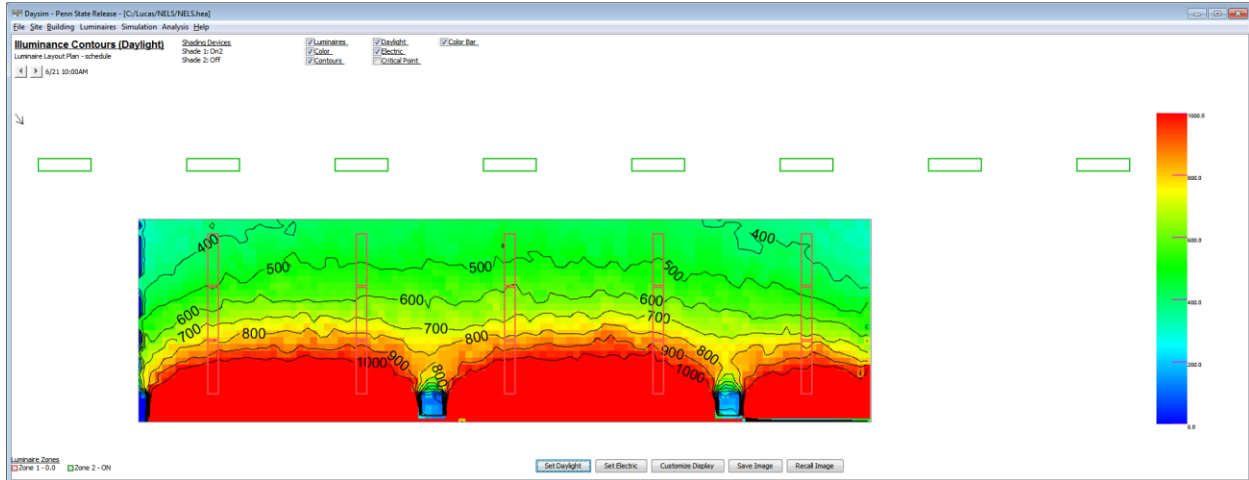


Illumination Contours for Northeast Facing Life Science Façade (6/21 – 8:00AM).

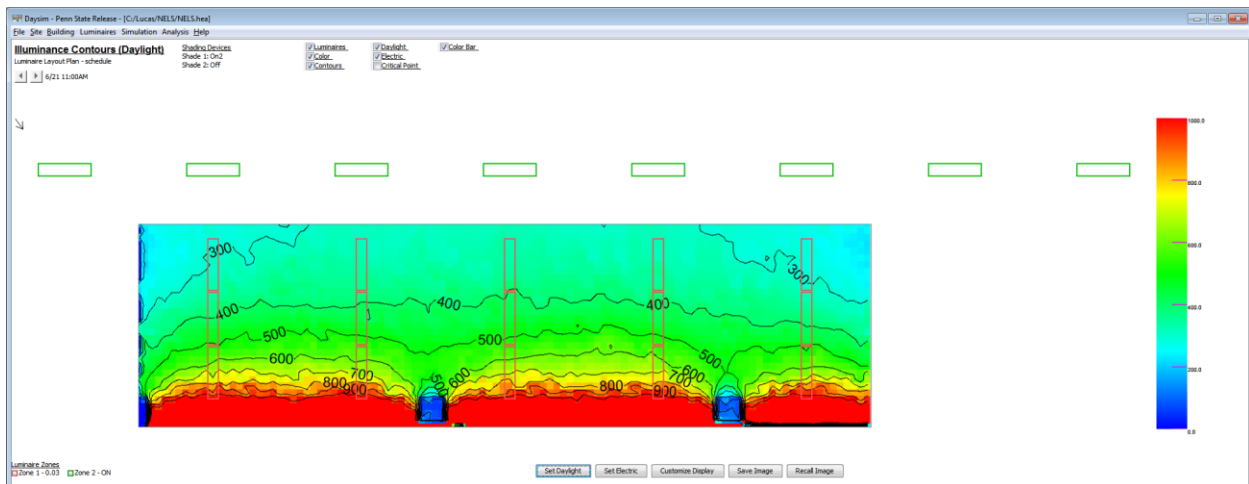


Illumination Contours for Northeast Facing Life Science Façade (6/21 – 9:00AM).

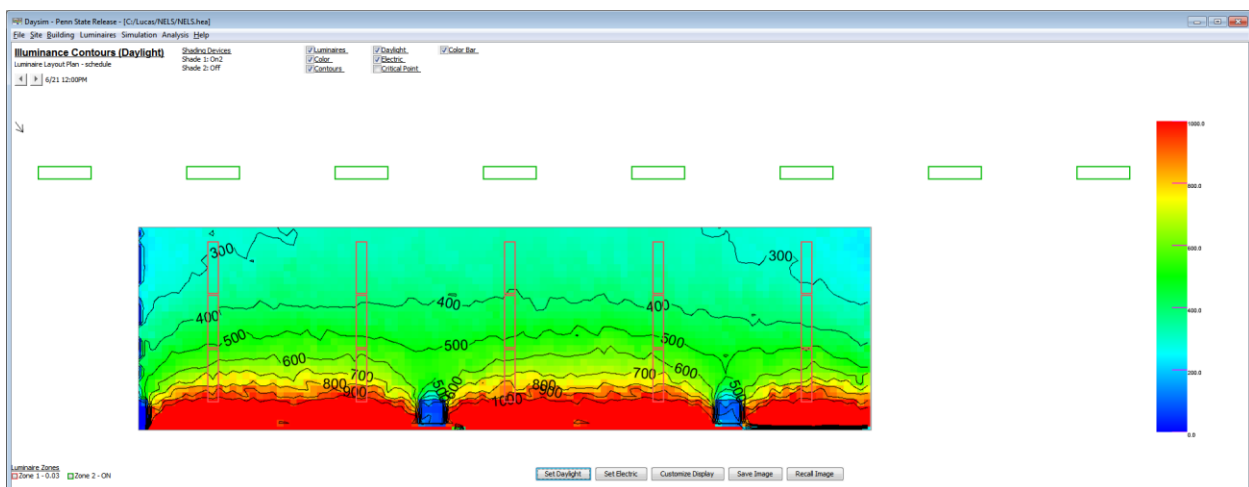




Illumination Contours for Northeast Facing Life Science Façade (6/21 – 10:00AM).

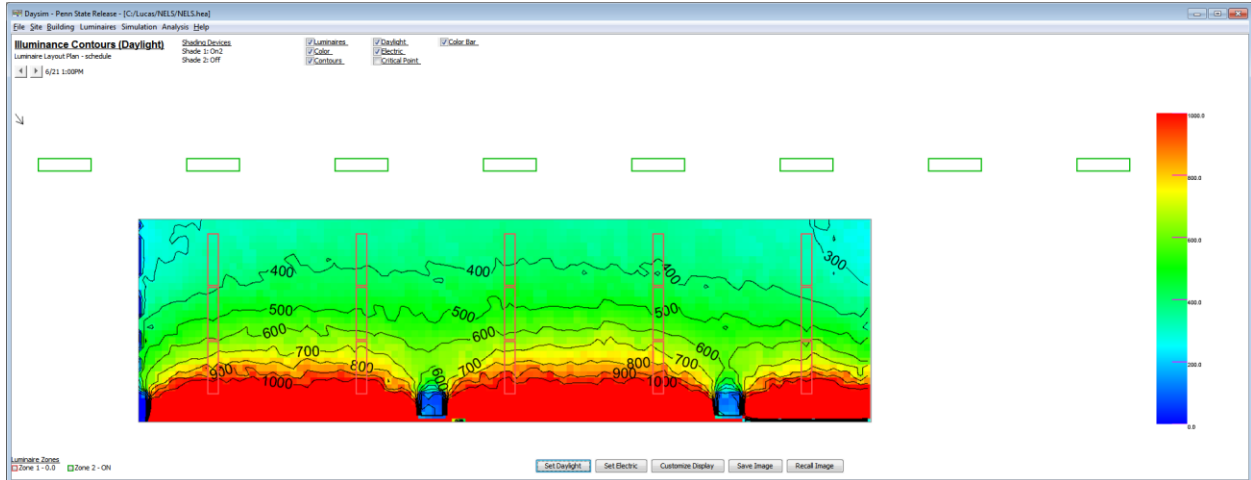


Illumination Contours for Northeast Facing Life Science Façade (6/21 – 11:00AM).

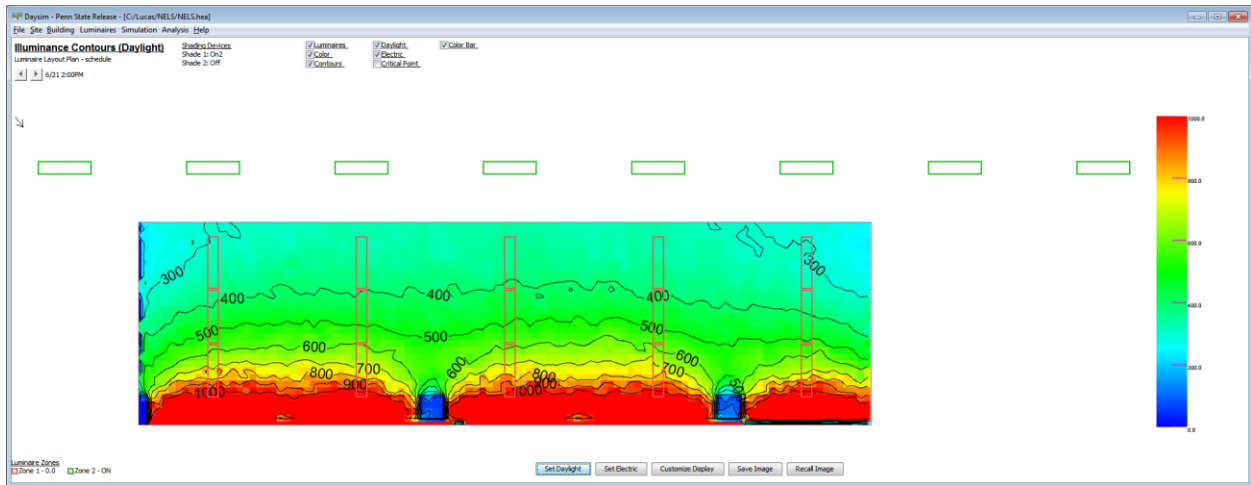


Illumination Contours for Northeast Facing Life Science Façade (6/21 – 12:00PM).

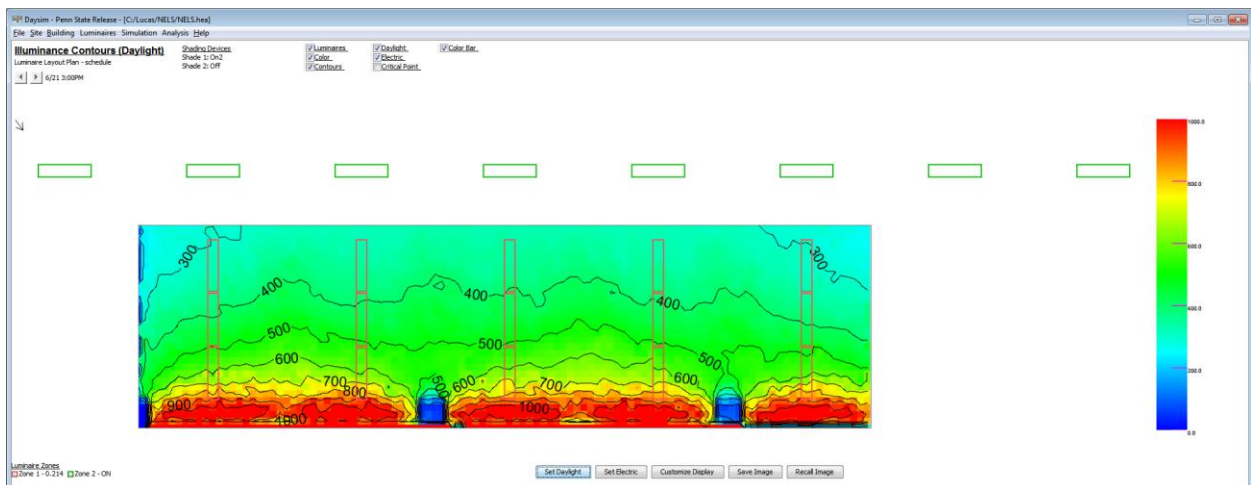




Illumination Contours for Northeast Facing Life Science Façade (6/21 – 1:00PM).

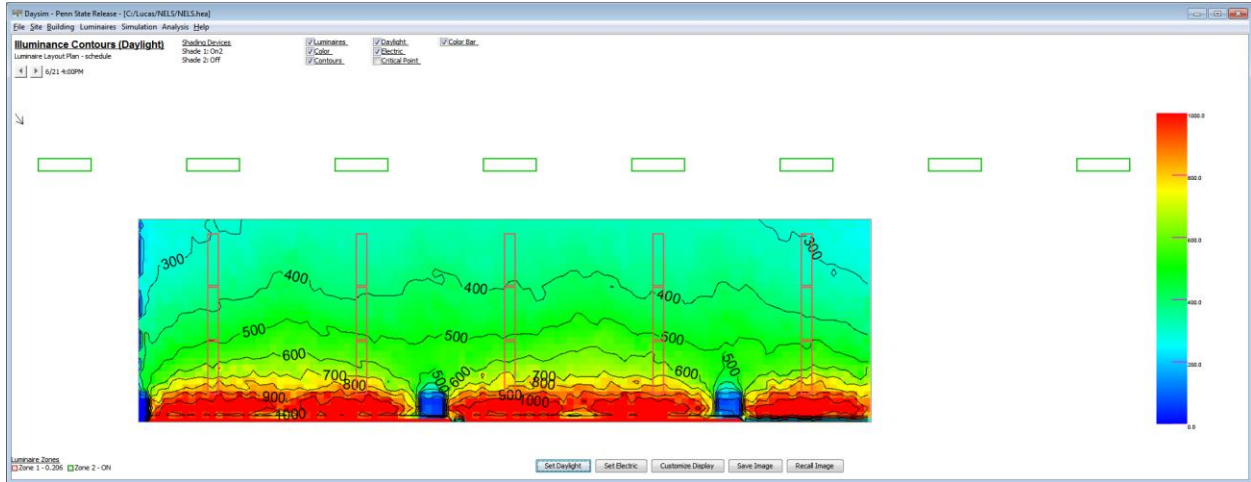


Illumination Contours for Northeast Facing Life Science Façade (6/21 – 2:00PM).

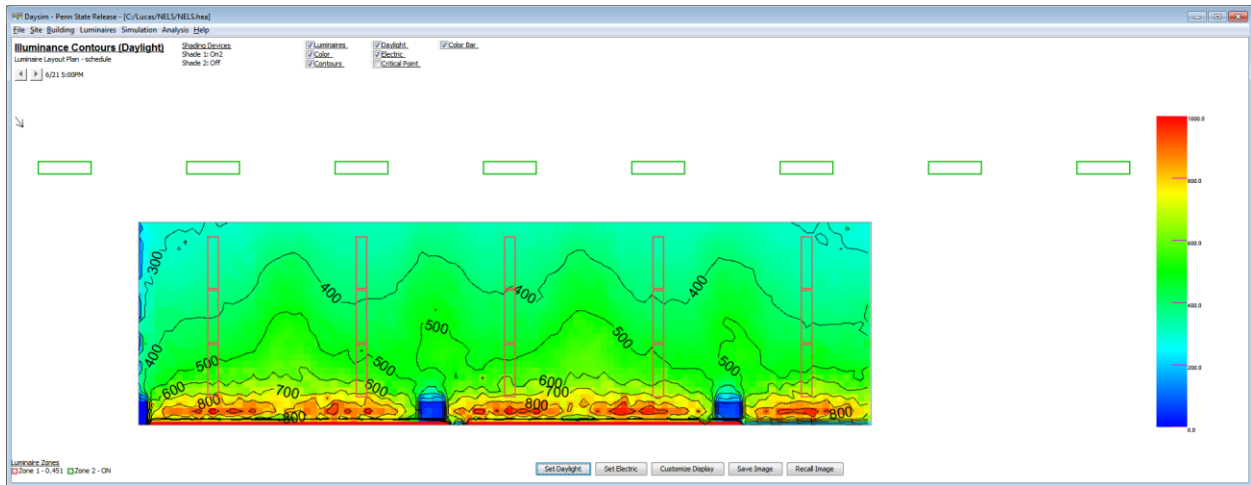


Illumination Contours for Northeast Facing Life Science Façade (6/21 – 3:00PM).

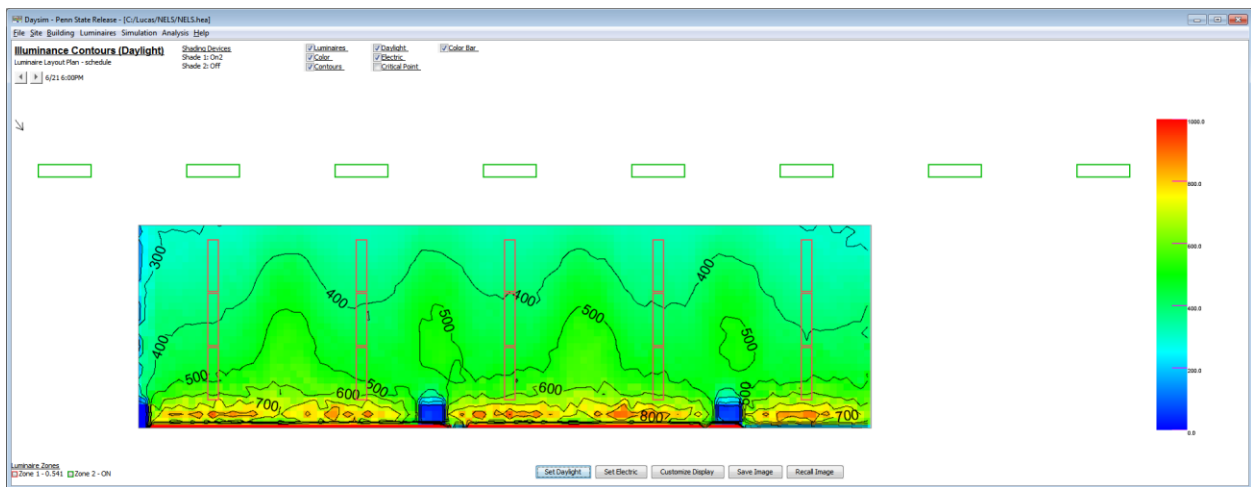




Illumination Contours for Northeast Facing Life Science Façade (6/21 – 4:00PM).

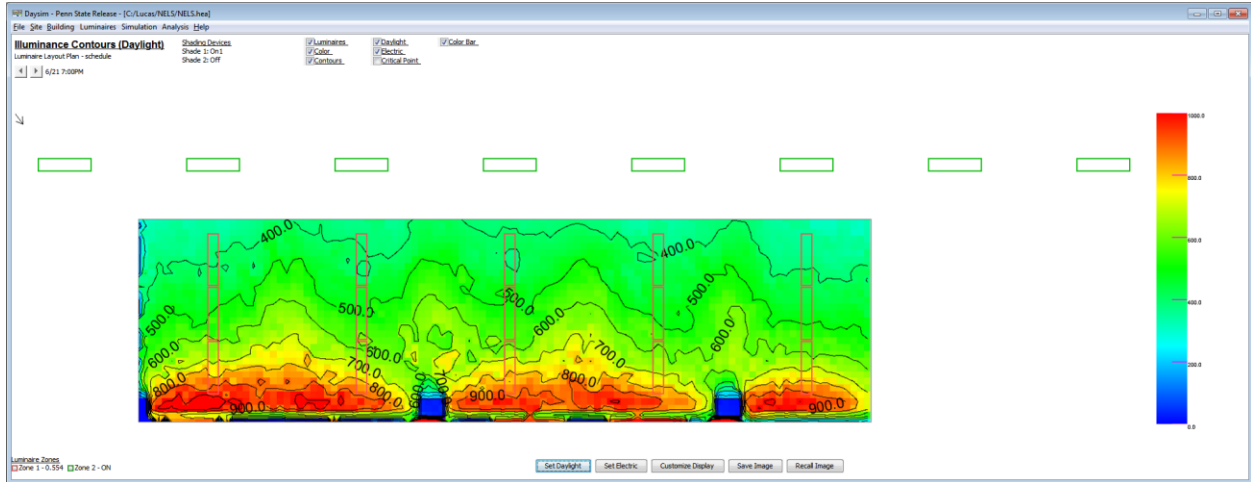


Illumination Contours for Northeast Facing Life Science Façade (6/21 – 5:00PM).



Illumination Contours for Northeast Facing Life Science Façade (6/21 – 6:00PM).





Illumination Contours for Northeast Facing Life Science Façade (6/21 –7:00PM).



Southwest Life Science Façade

Annual Savings kWh:

703.35

System Cost:

0.0

Energy Cost (per kWh):

0.08

Demand Charge (per kWh):

0.0

Peak Demand Time (0-24.0):

0.0

NOTE: All costs must be in the same units.

Savings Per Year:

56.268

Daysim Annual Energy Savings for the Southwest Life Science Student Study Area.

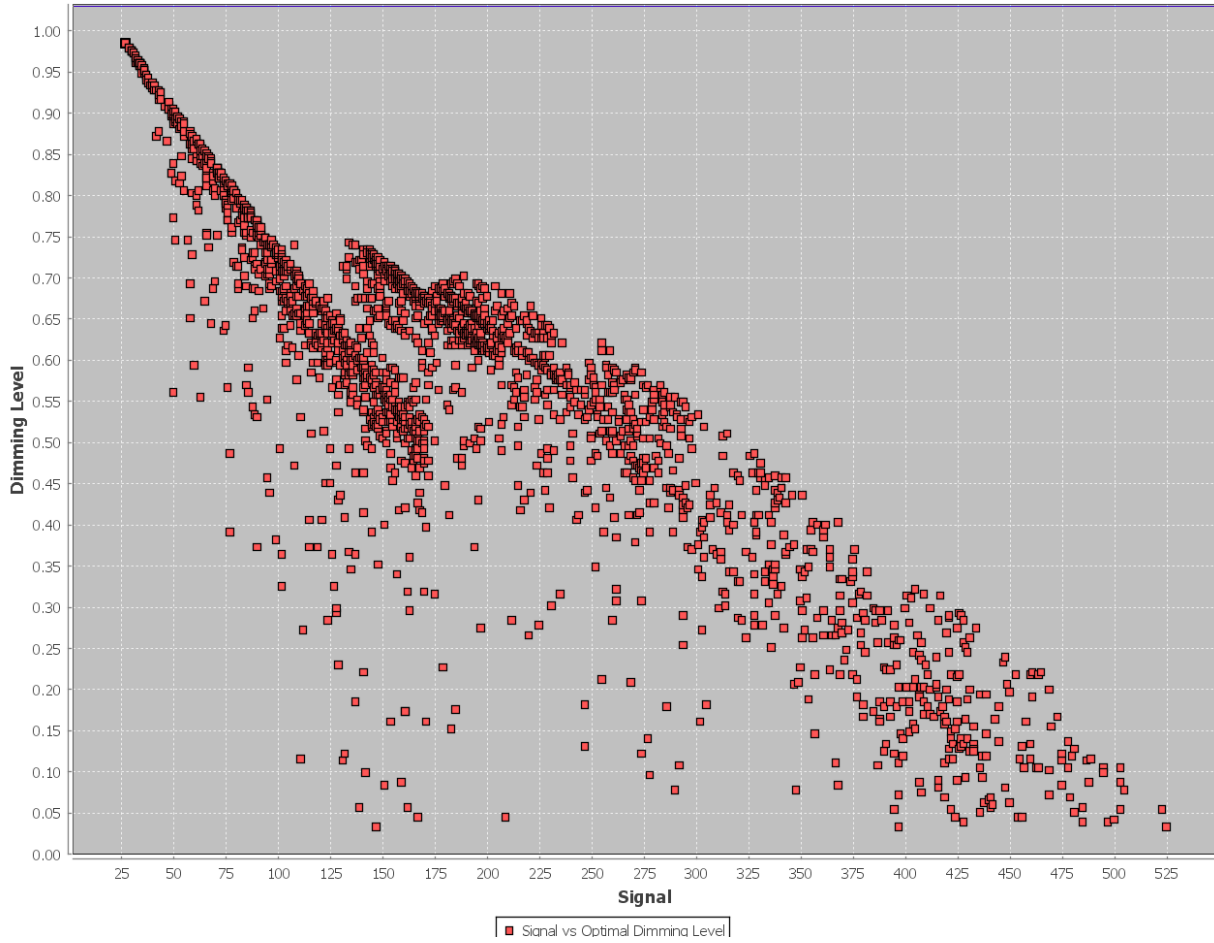
Controlled Zone		Grand Total											
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	152.76	132.84	146.12	132.84	152.76	146.12	146.12	152.76	139.48	152.76	146.12	99.63	1700.35
Optimal	101.74	89.5	73.45	79.16	95.38	76.92	73.47	79.07	71.43	80.89	88.49	72.56	982.12
Algorithm	107.81	95.12	78.33	79.77	93.56	70.01	67.52	76.66	76.21	83.54	92.5	75.9	996.99
Savings	44.94	37.71	67.78	53.06	59.19	76.11	78.59	76.1	63.26	69.22	53.61	23.72	703.35

Daysim Controlled Zone Energy Table for the Southwest Life Science Student Study Area.

Controlled Zone		Grand Total											
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Base	229.71	199.75	219.72	199.75	229.71	219.72	219.72	229.71	209.73	229.71	219.72	149.81	2556.82
Optimal	178.69	156.41	147.05	146.07	172.33	150.52	147.07	156.02	141.69	157.84	162.09	122.75	1838.59
Algorithm	184.76	162.03	151.94	146.68	170.51	143.61	141.12	153.61	146.47	160.49	166.1	126.09	1853.46
Savings	44.94	37.71	67.78	53.06	59.19	76.11	78.59	76.1	63.26	69.22	53.61	23.72	703.35

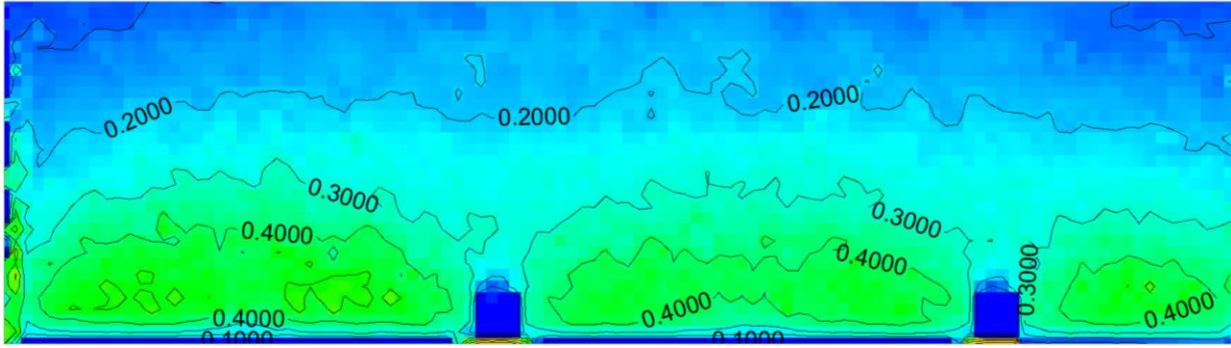
Daysim Controlled Zone & Corridor Energy Table for the Southwest Life Science Student Study Area.



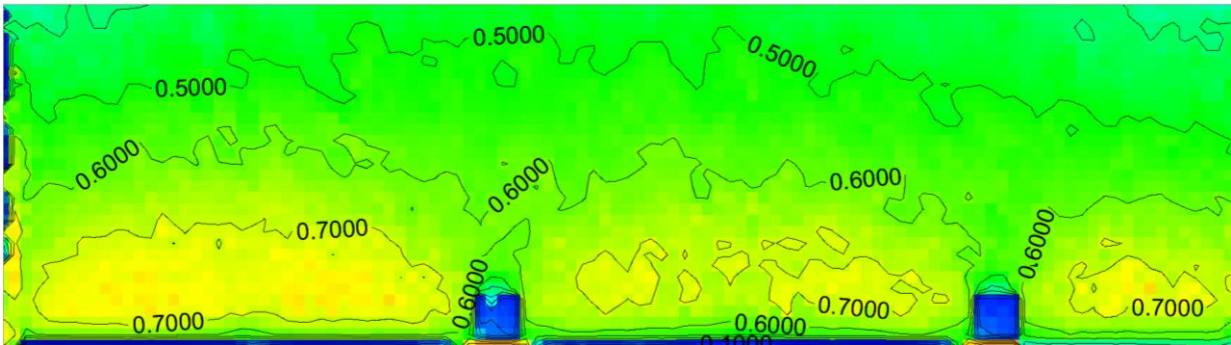


Daysim Photosensor Signal Vs. Dimming Level for the Southwest Life Science Student Study Area.

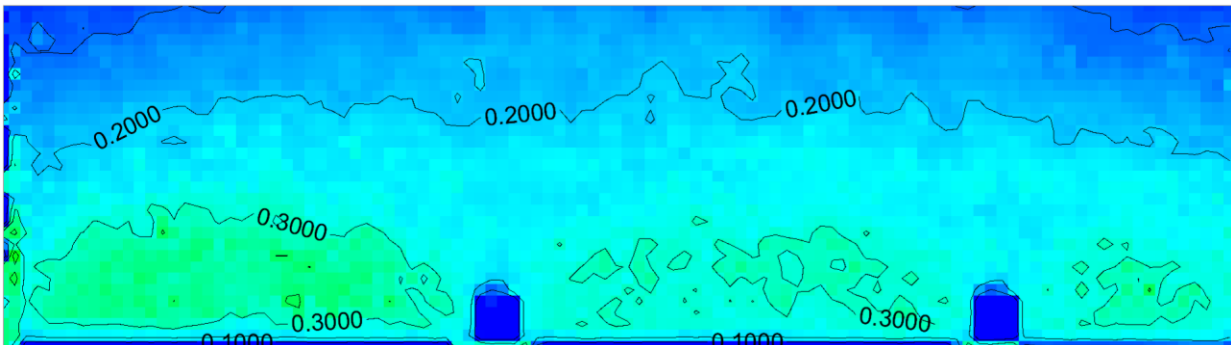




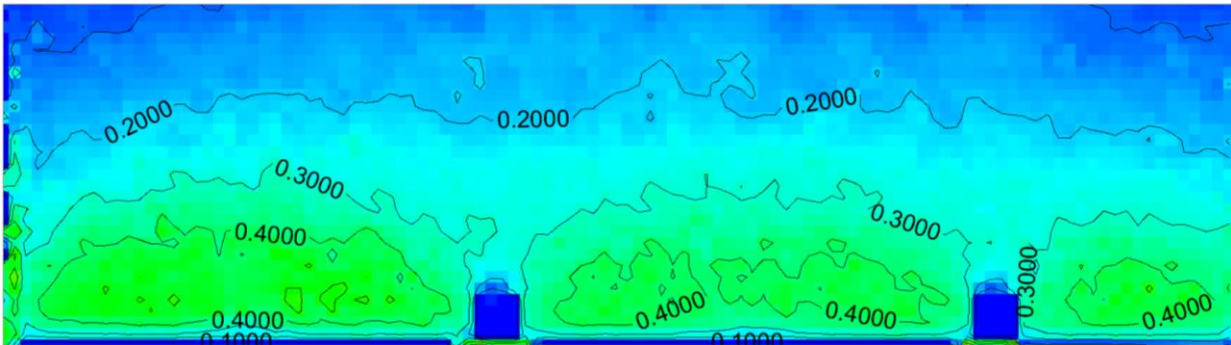
Daylight Autonomy for Southwest Facing Life Science Facade (322.8lux).



Continuous Daylight Autonomy for Southwest Facing Life Science Facade (322.8lux).



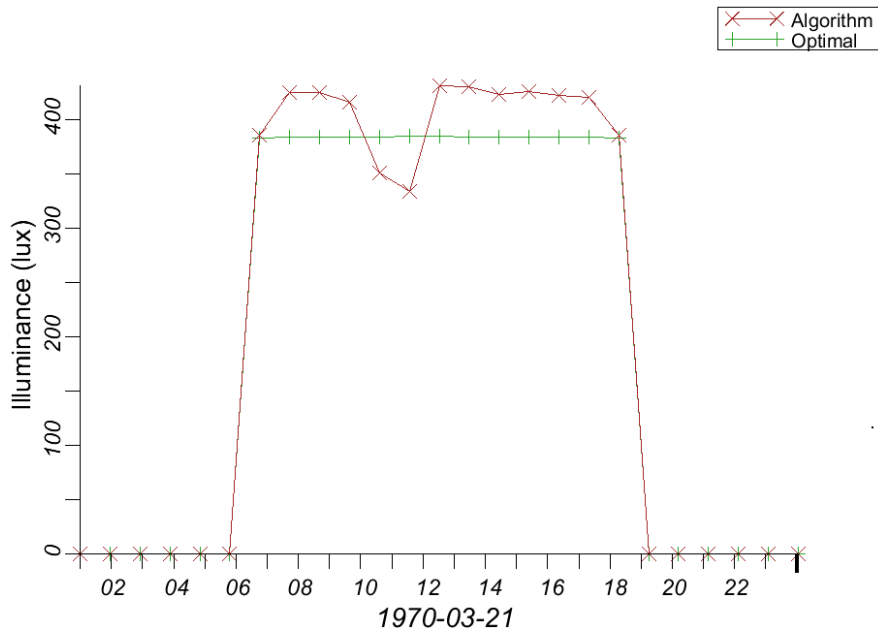
Useful Daylight Illuminance for Southwest Facing Life Science Facade (322.8 to 1000lux).



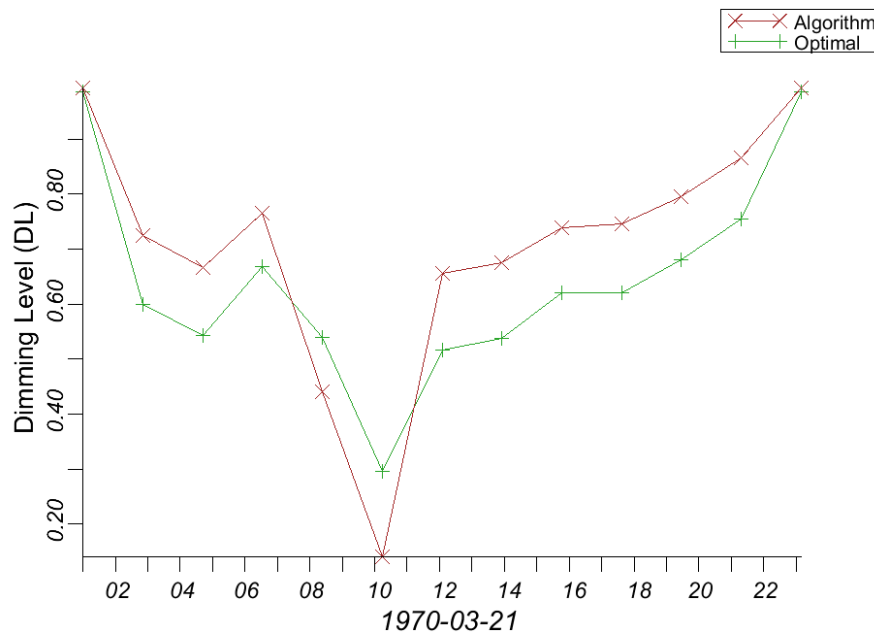
Useful Daylight Illuminance for Southwest Facing Life Science Facade (322.8 to 2000lux).



Fall & Spring Equinox: 7:00AM through 7:00PM

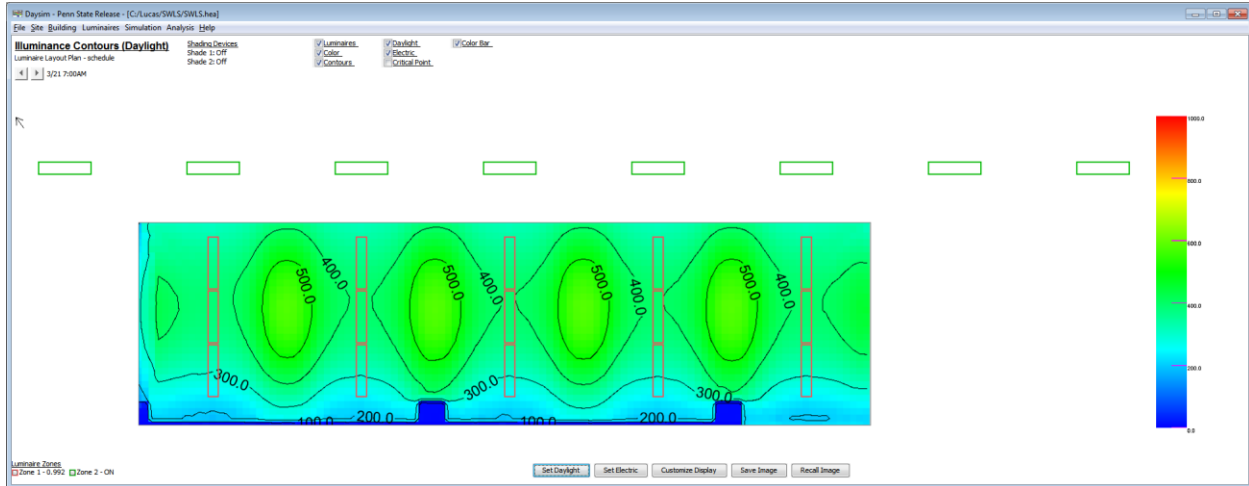


Daysim Illuminance Timeplot for Southwest Life Science Façade (Fall & Spring Equinox).

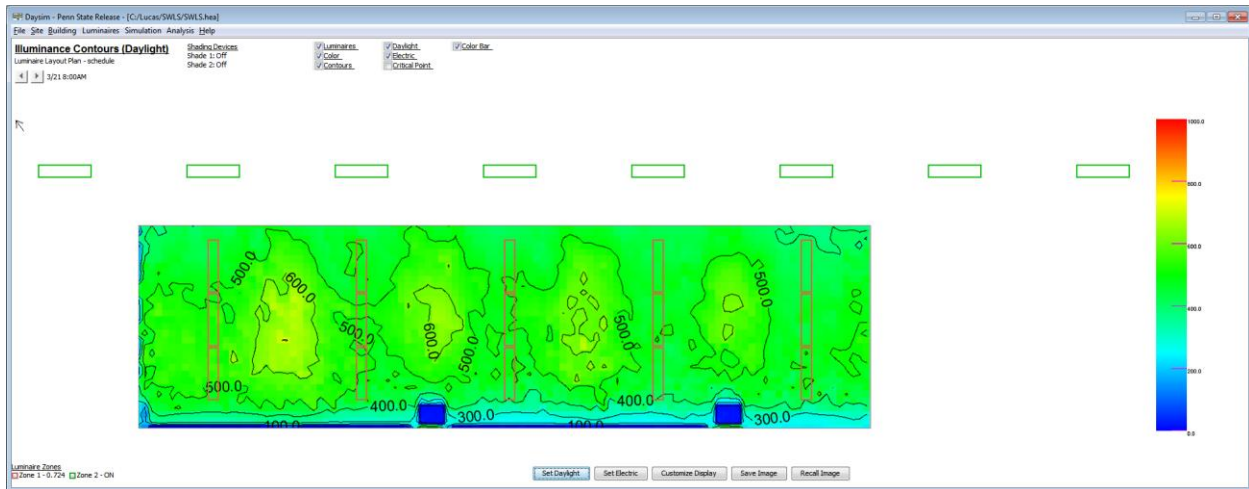


Daysim Dimming Timeplot for Southwest Life Science Façade (Fall & Spring Equinox).

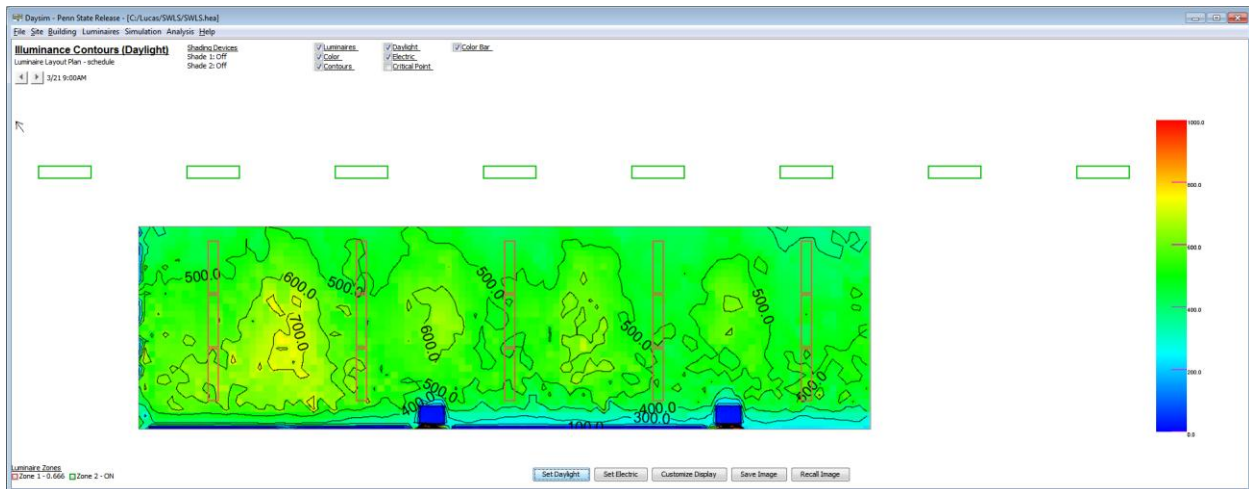




Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 7:00AM).

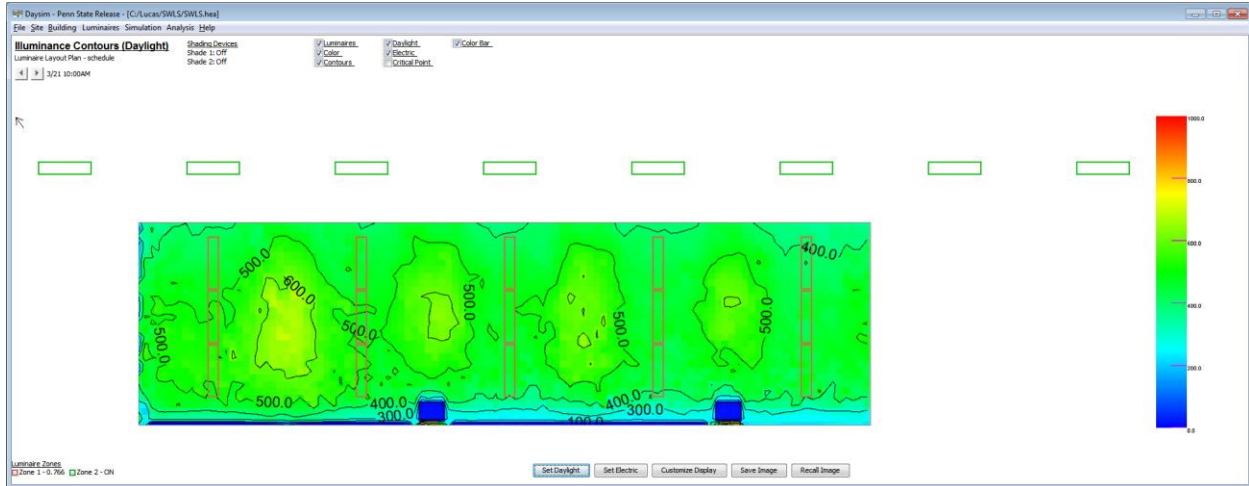


Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 8:00AM).

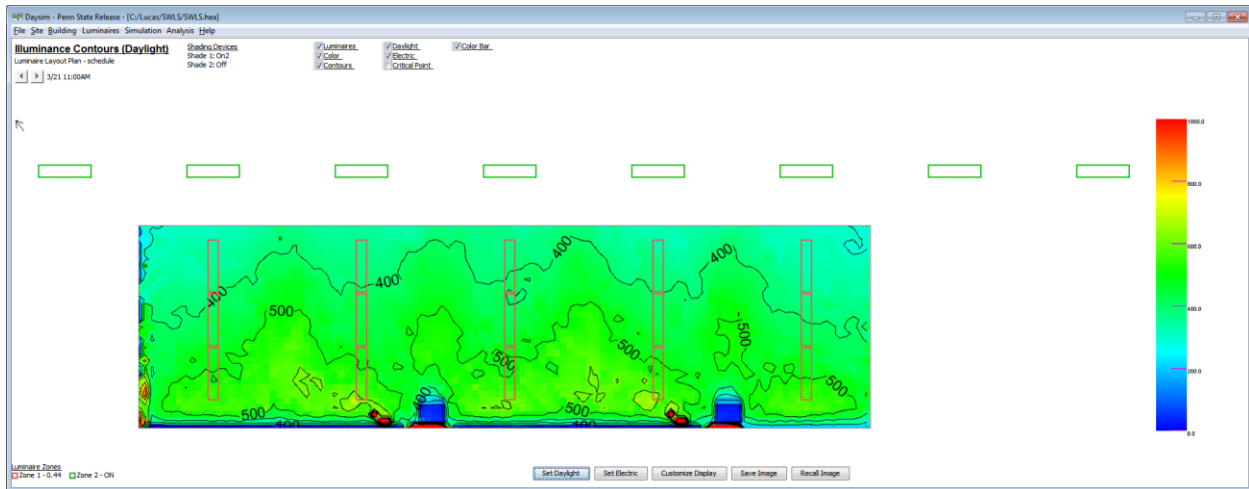


Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 9:00AM).

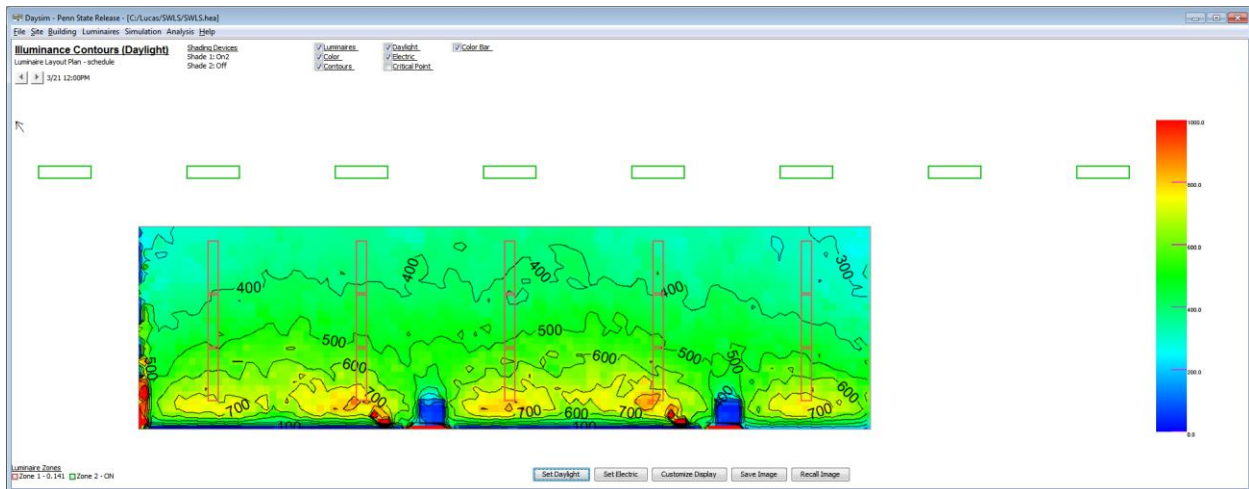




Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 10:00AM).

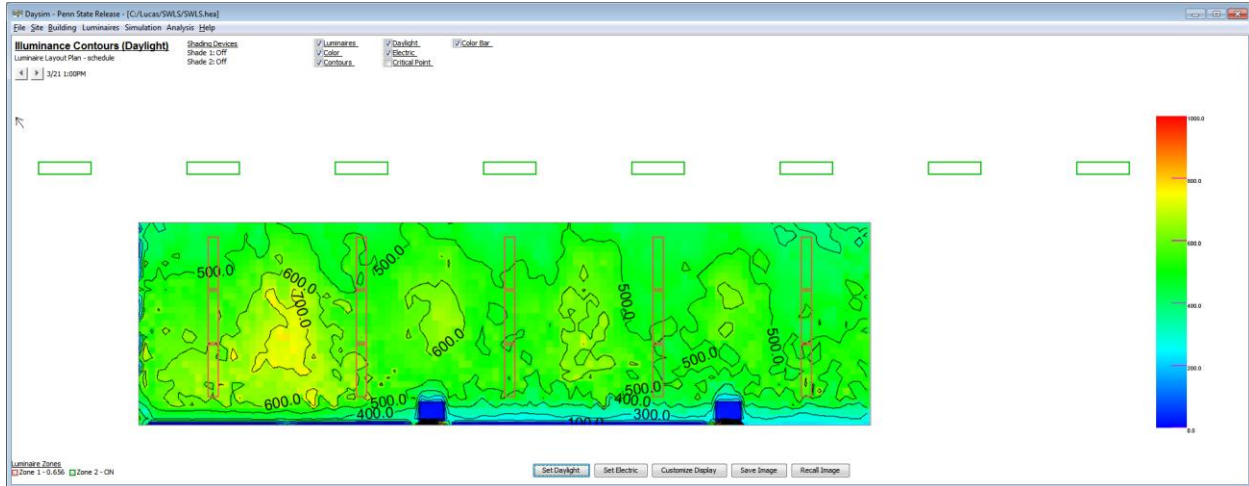


Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 11:00AM).

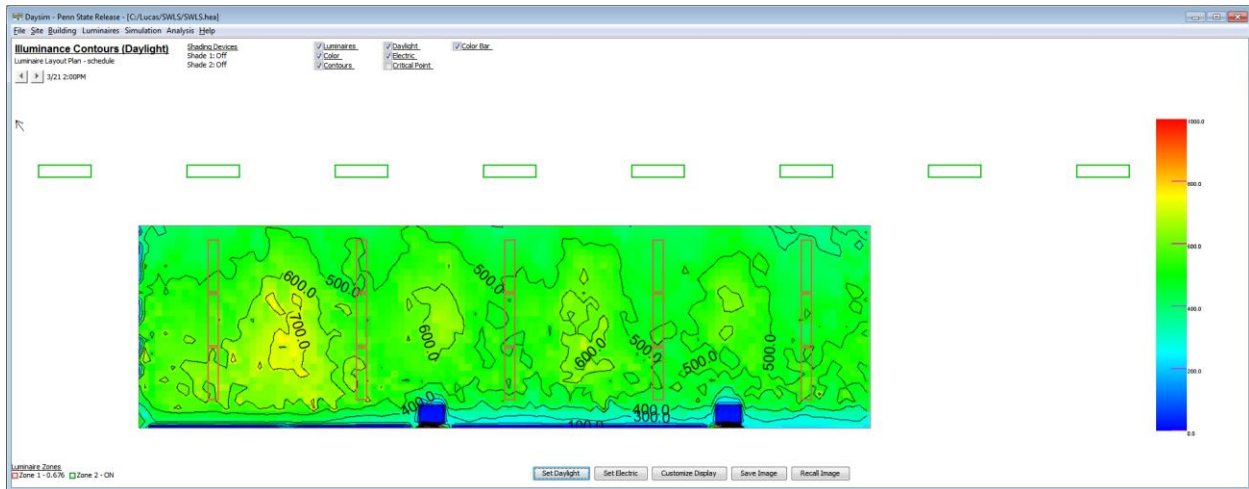


Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 12:00PM).

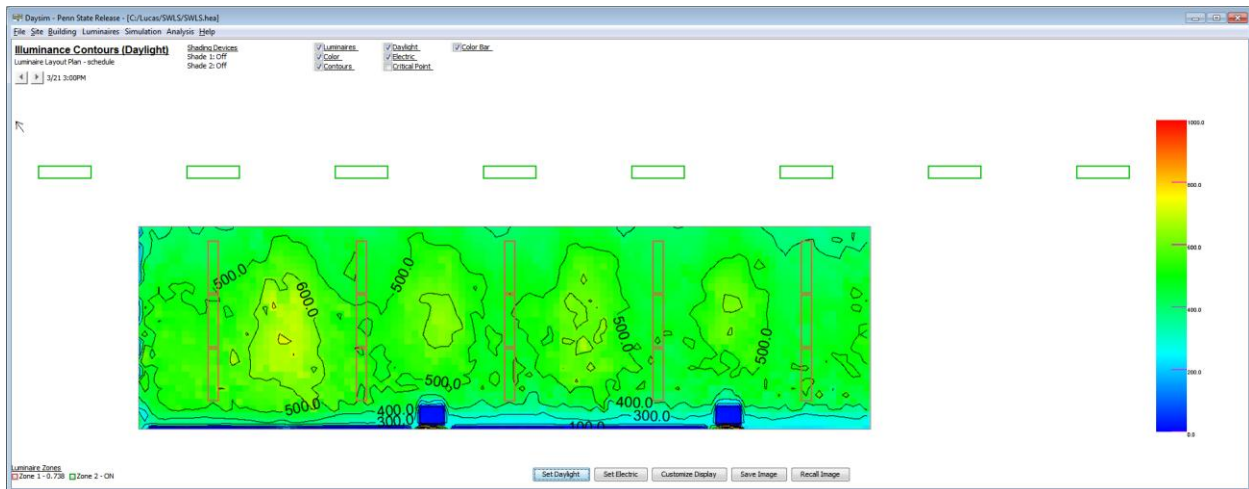




Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 1:00PM).

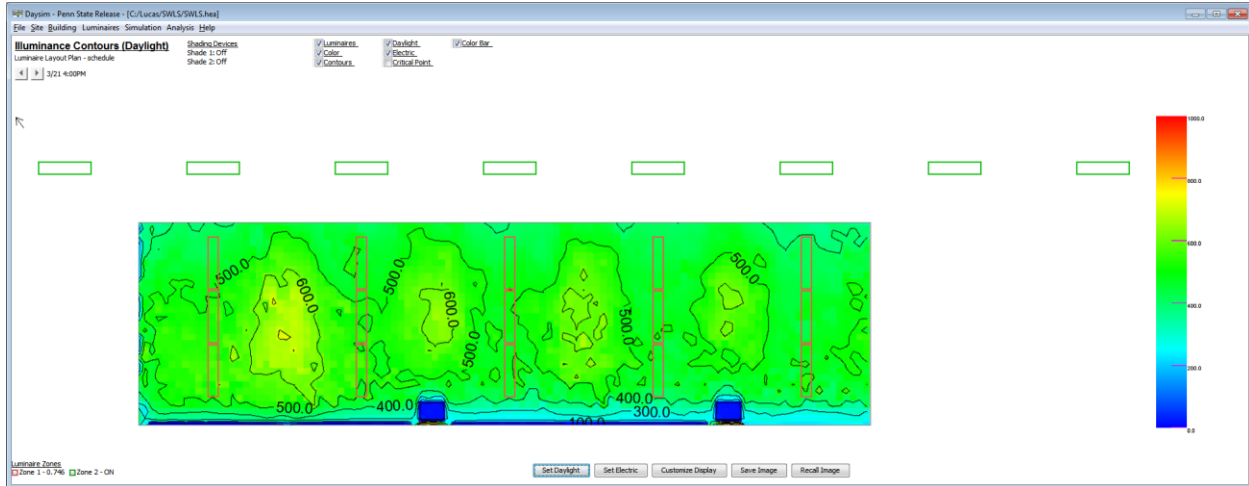


Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 2:00PM).

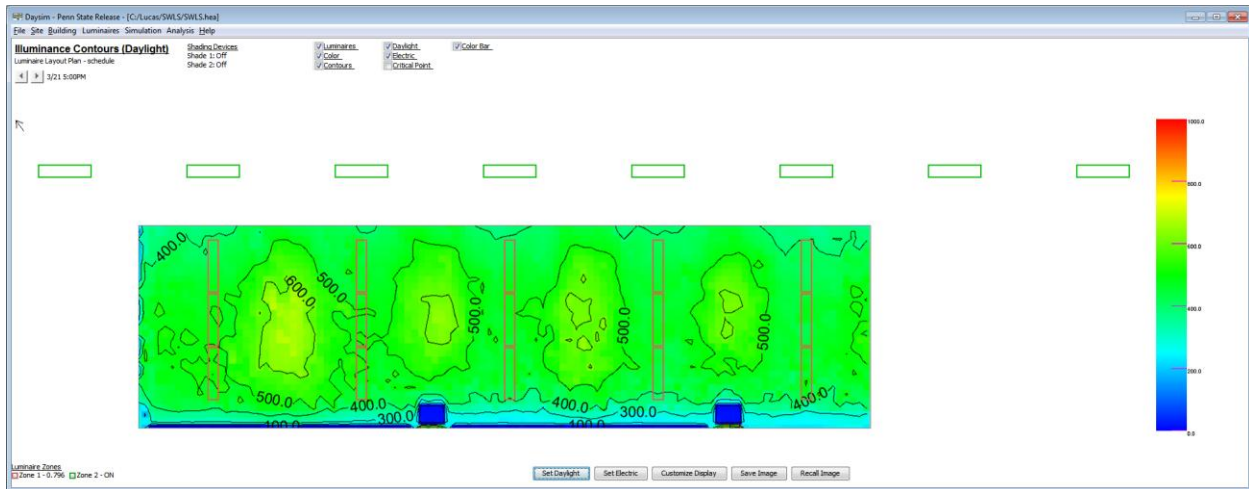


Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 3:00PM).

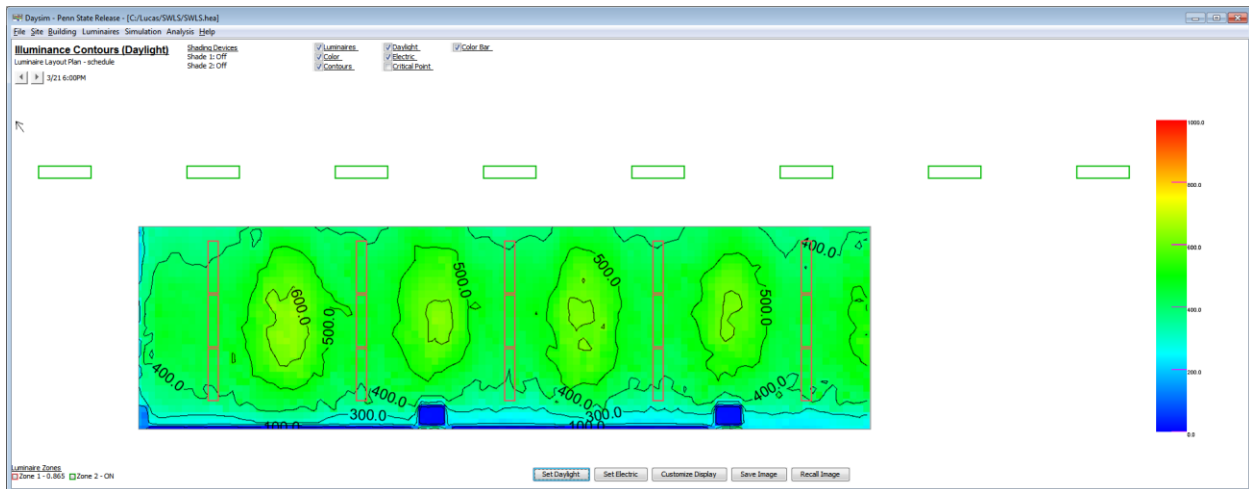




Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 4:00PM).

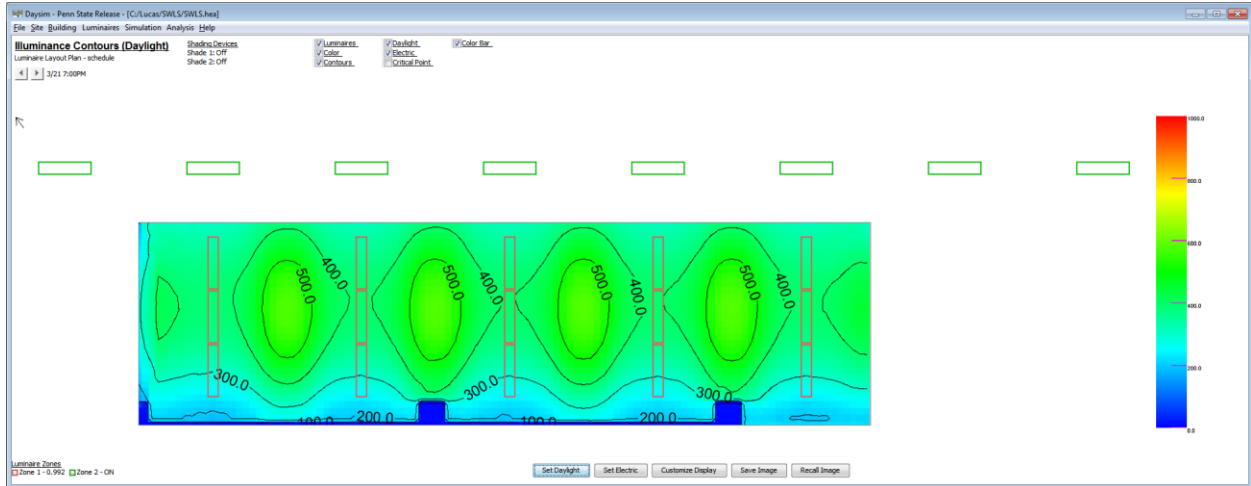


Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 5:00PM).



Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 6:00PM).

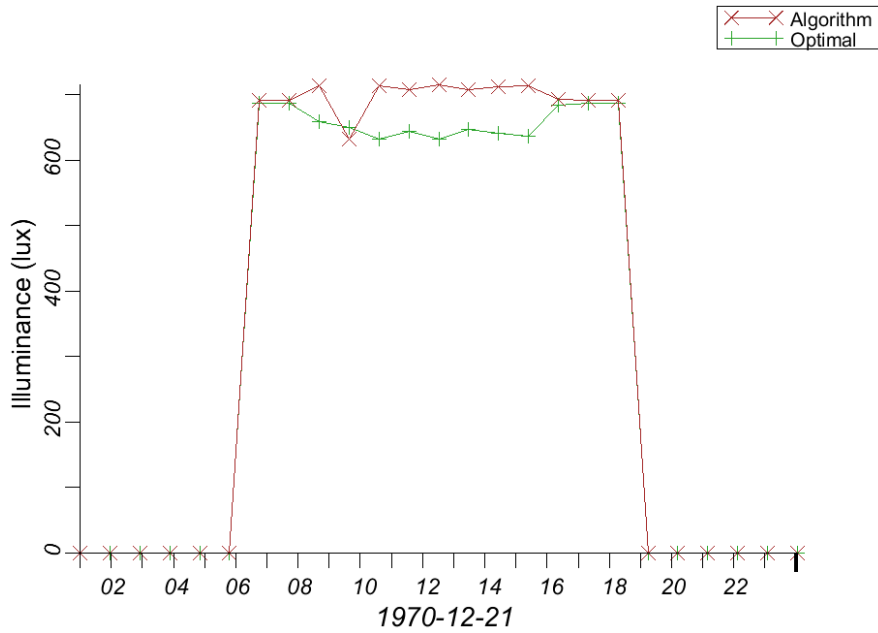




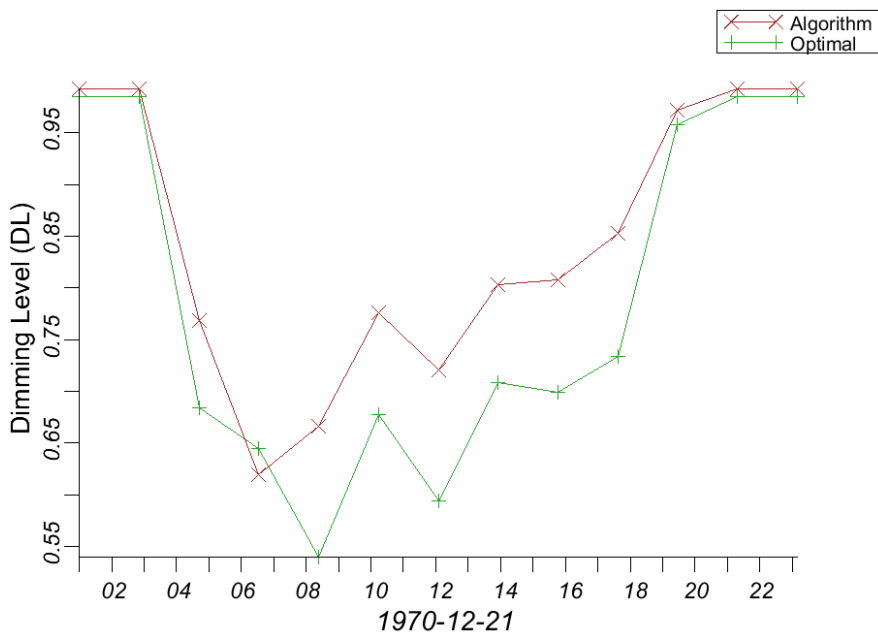
Illumination Contours for the Southwest Facing Life Science Façade (3/21 & 9/21 – 7:00PM).



Winter Solstice: 7:00AM through 7:00PM

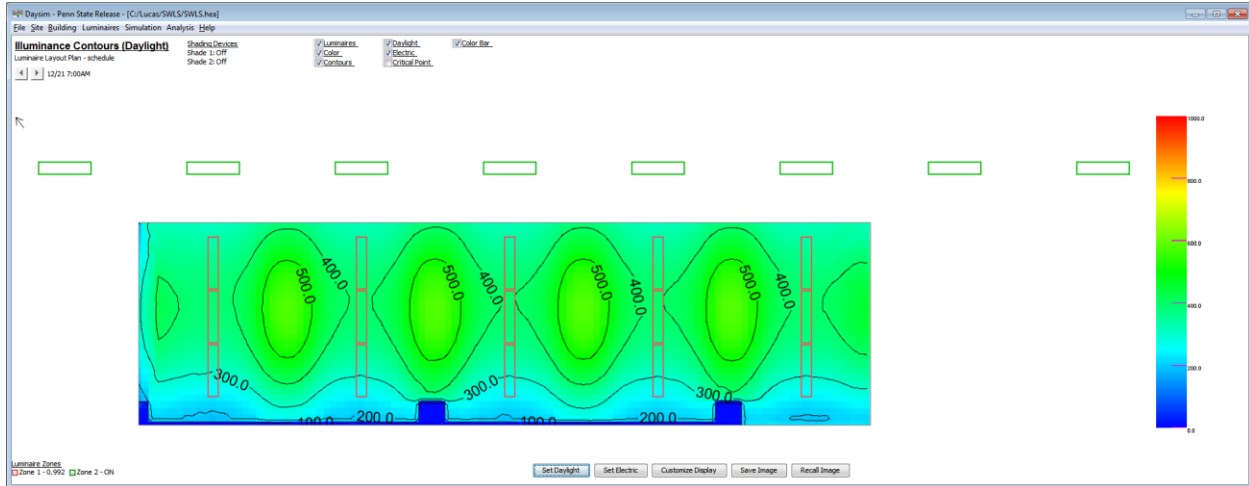


Daysim Illuminance Timeplot for Southwest Life Science Façade (Winter Solstice).

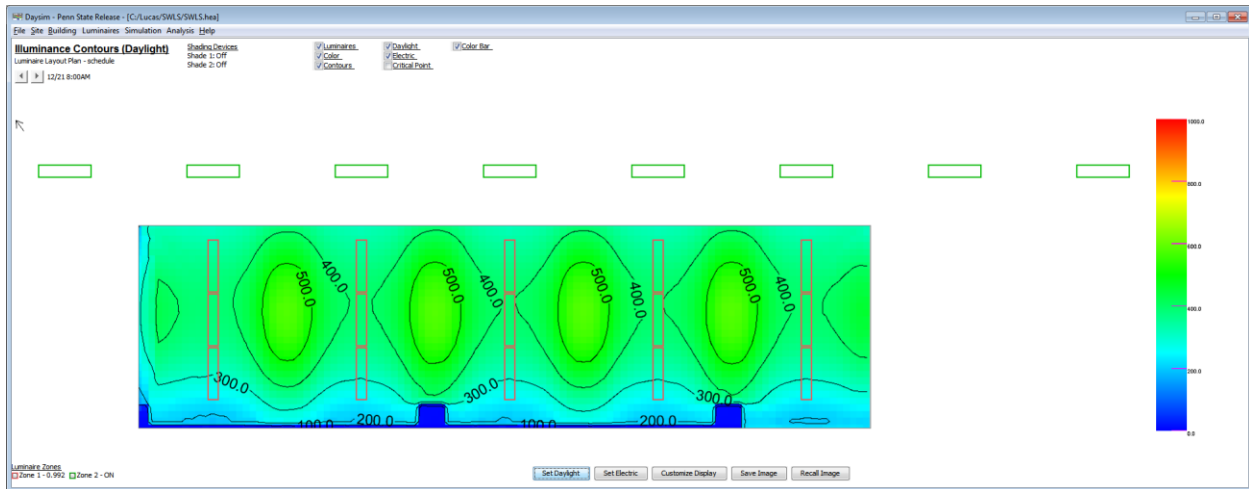


Daysim Dimming Timeplot for Southwest Life Science Façade (Winter Solstice).

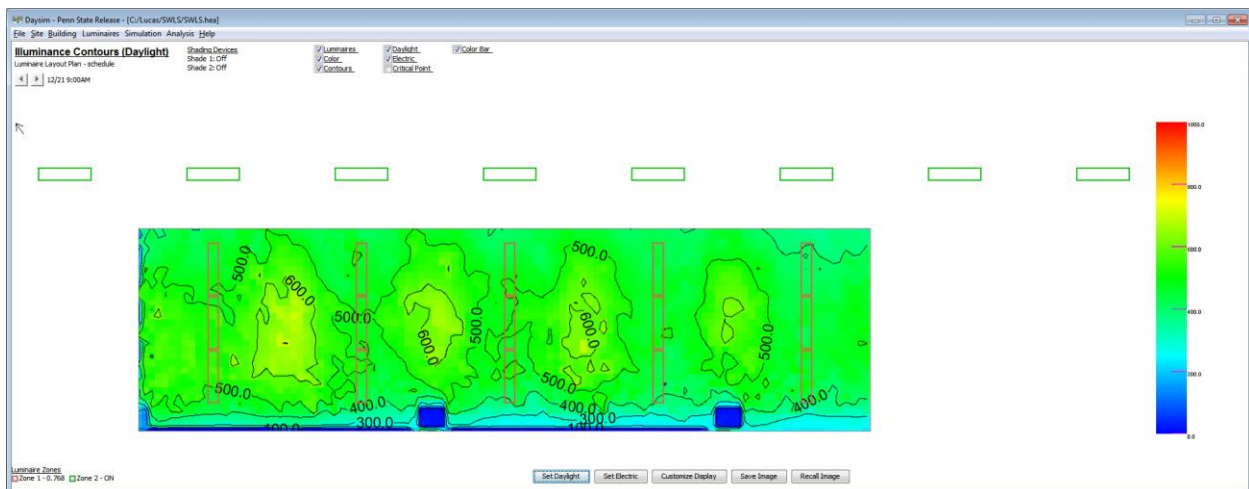




Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 7:00AM).



Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 8:00AM).

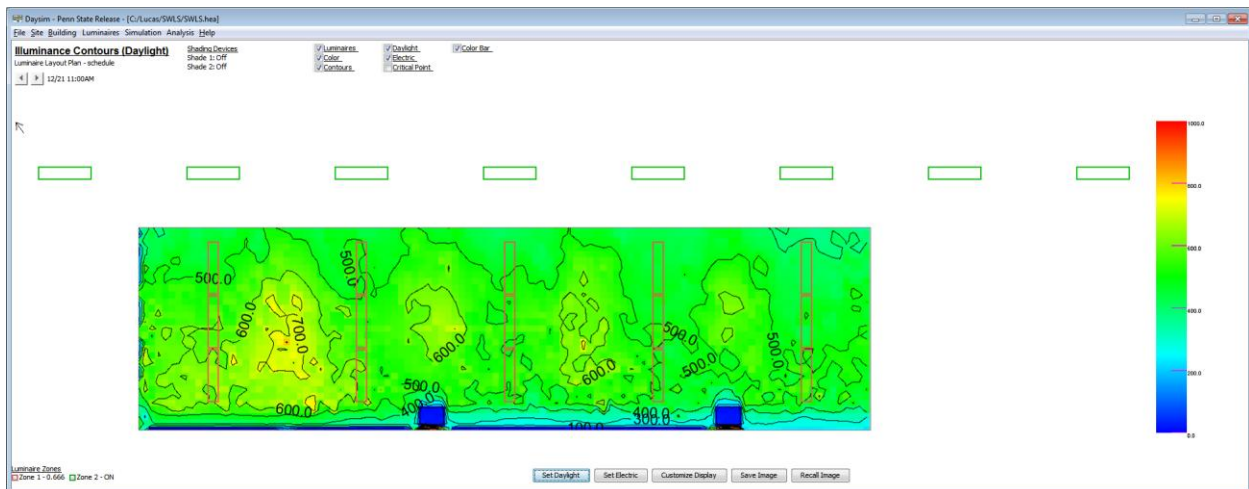


Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 9:00AM).

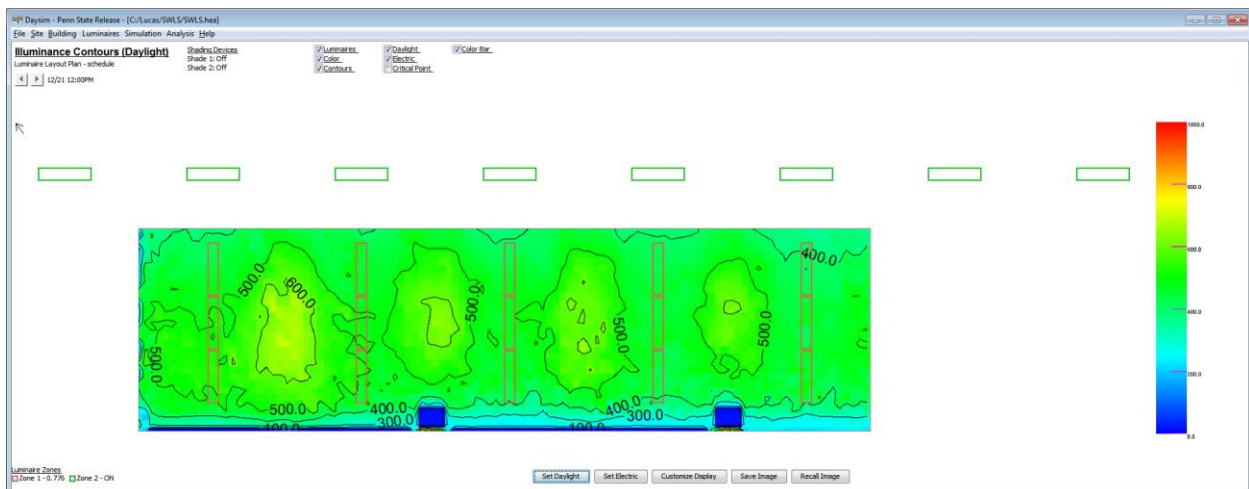




Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 10:00AM).

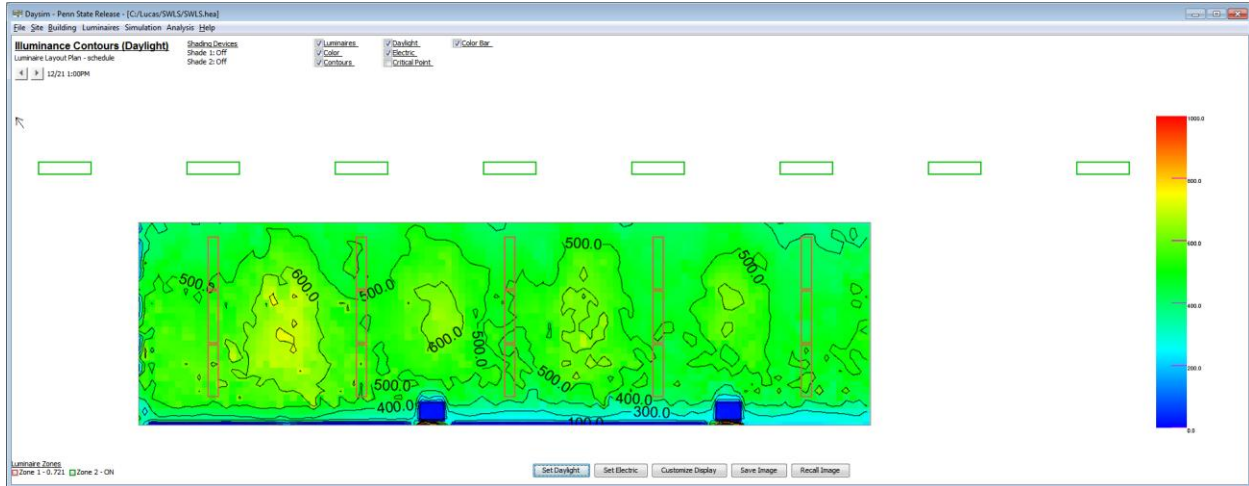


Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 11:00AM).

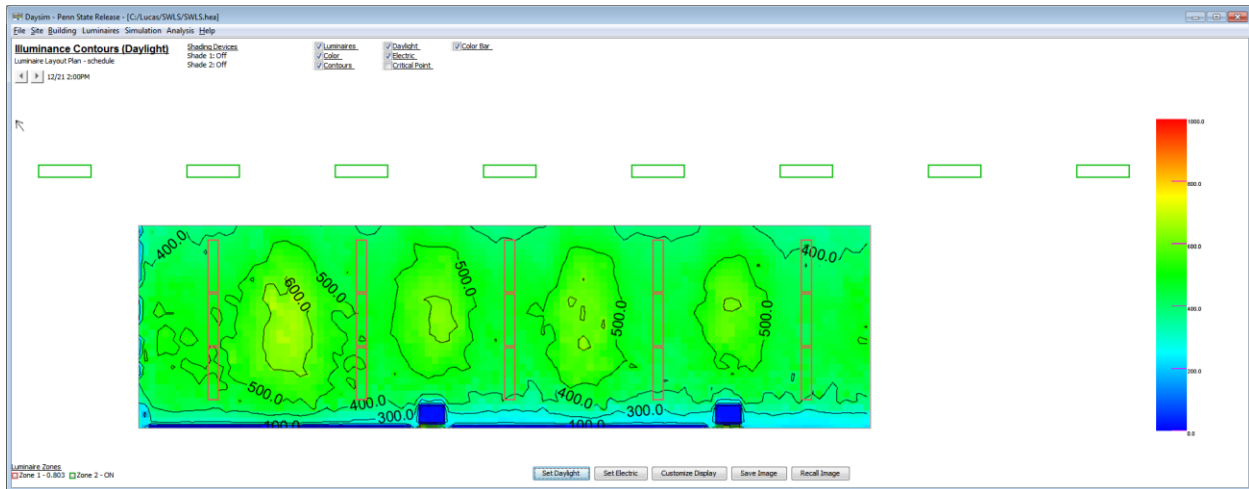


Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 12:00PM).

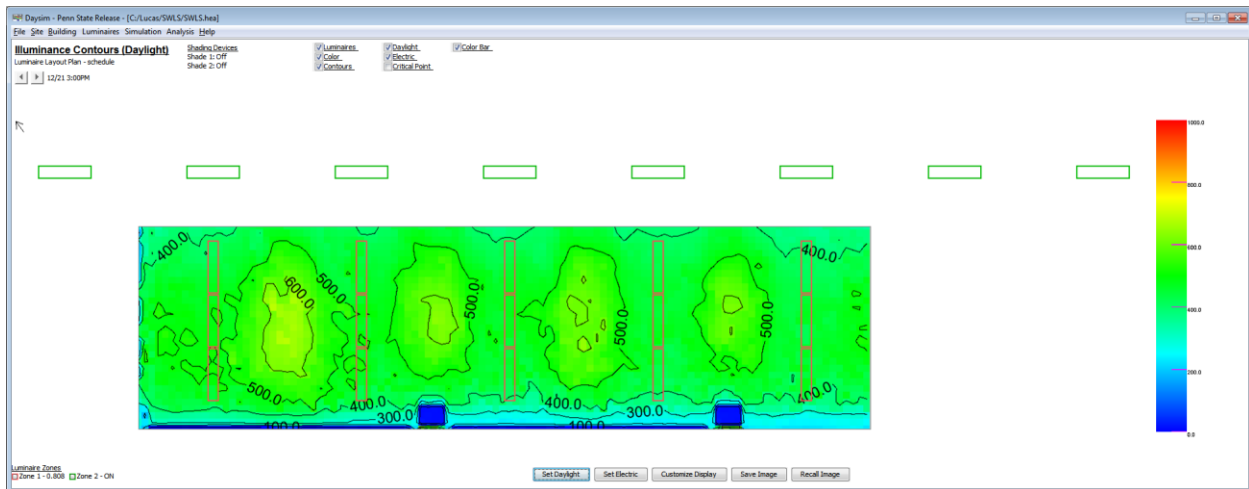




Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 1:00PM).

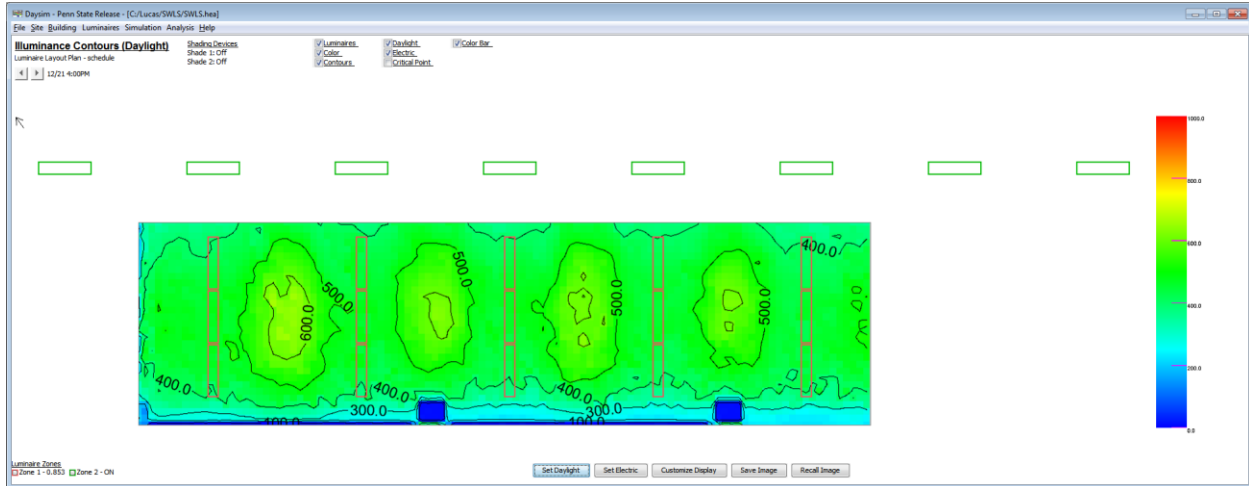


Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 2:00PM).

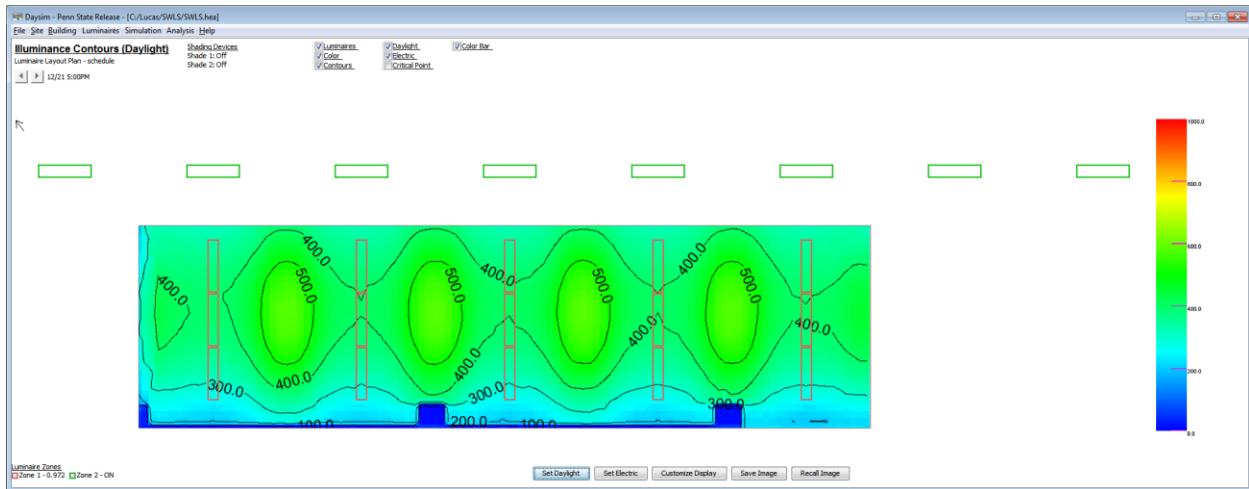


Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 3:00PM).

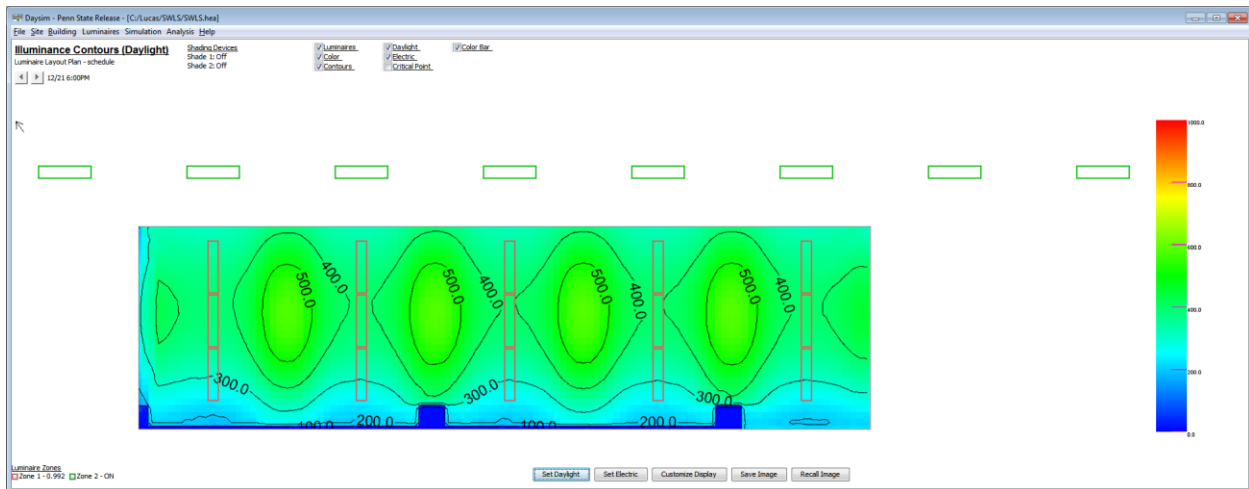




Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 4:00PM).

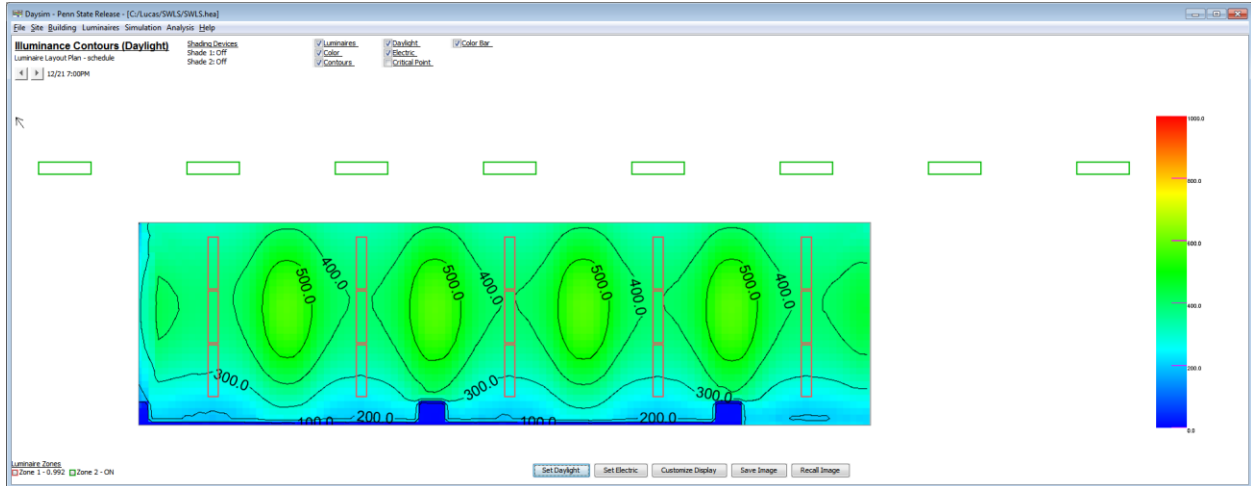


Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 5:00PM).



Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 6:00PM).

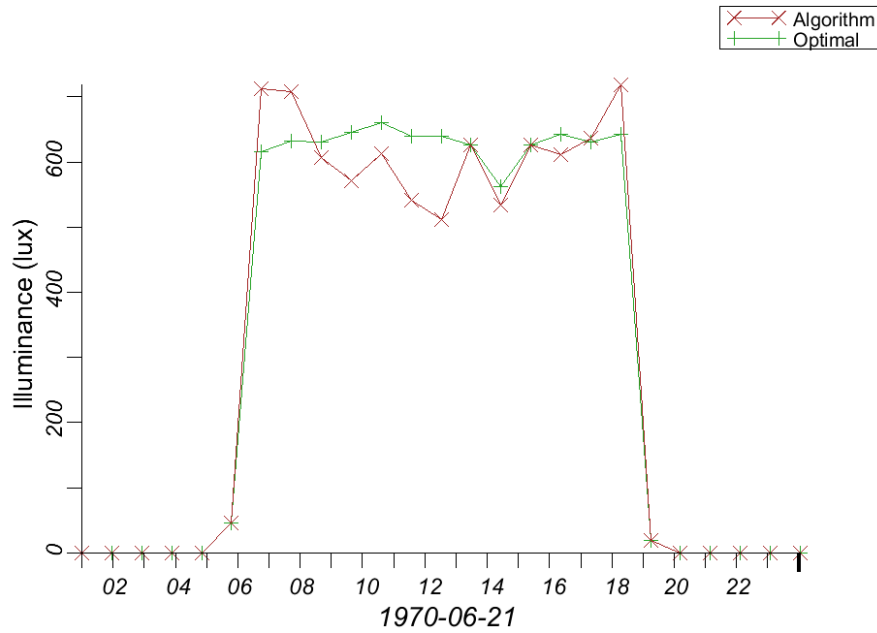




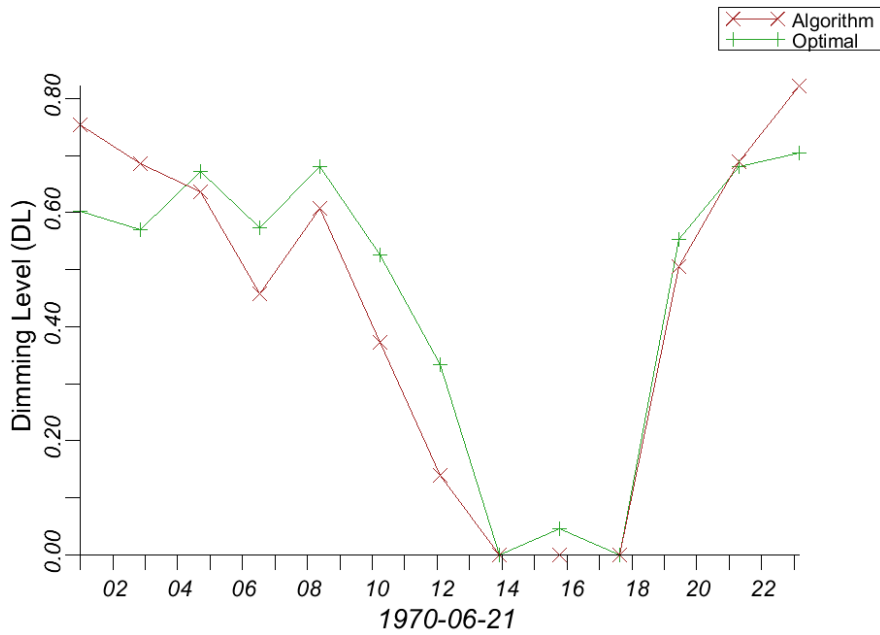
Illumination Contours for the Southwest Facing Life Science Façade (12/21 – 7:00PM).



Summer Solstice: 7:00AM through 7:00PM

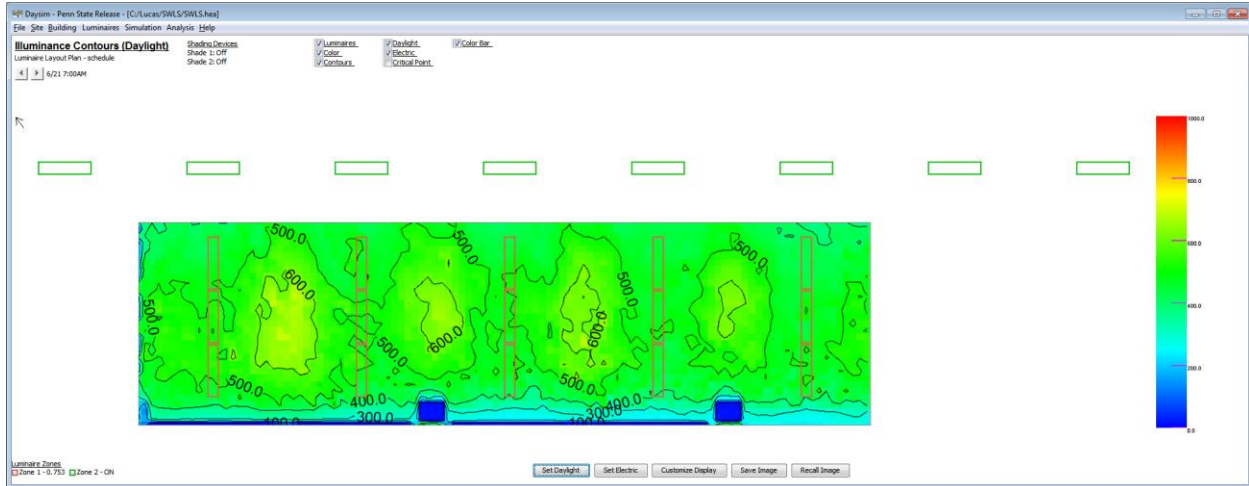


Daysim Illuminance Timeplot for Southwest Life Science Façade (Summer Solstice).

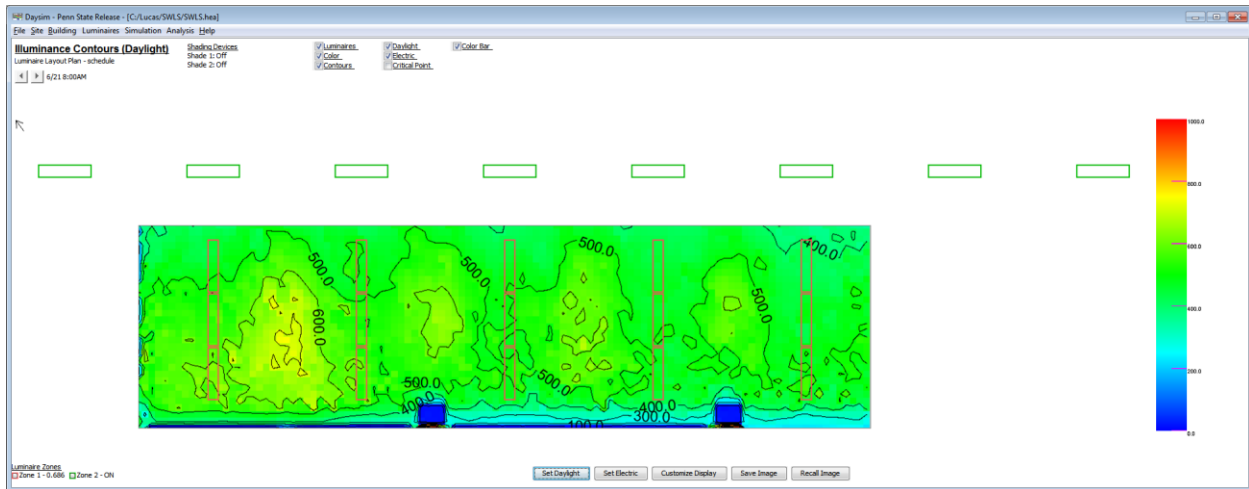


Daysim Dimming Timeplot for Southwest Life Science Façade (Summer Solstice).

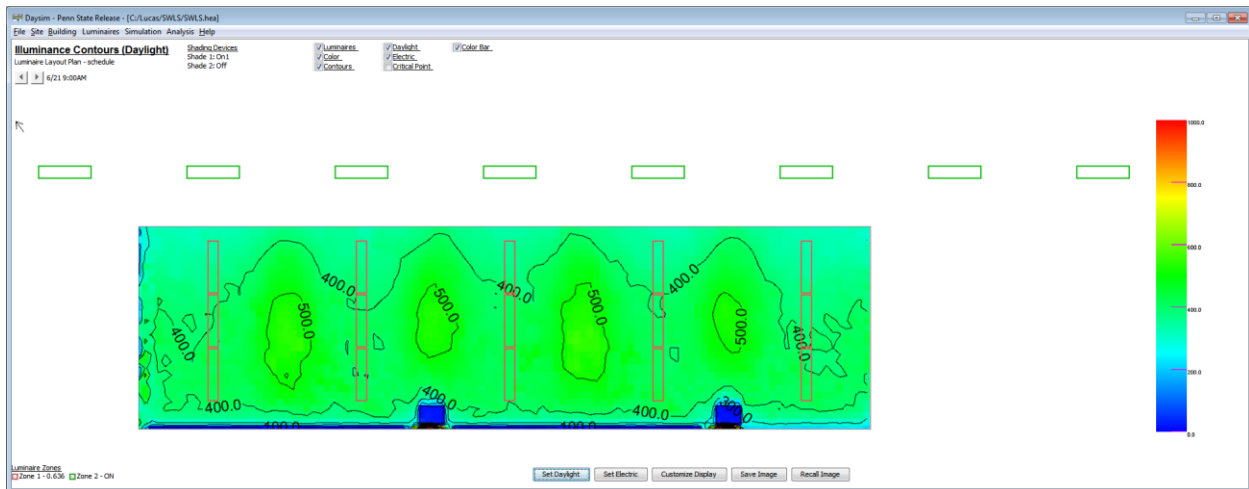




Illumination Contours for the Southwest Facing Life Science Façade (6/21– 7:00AM).

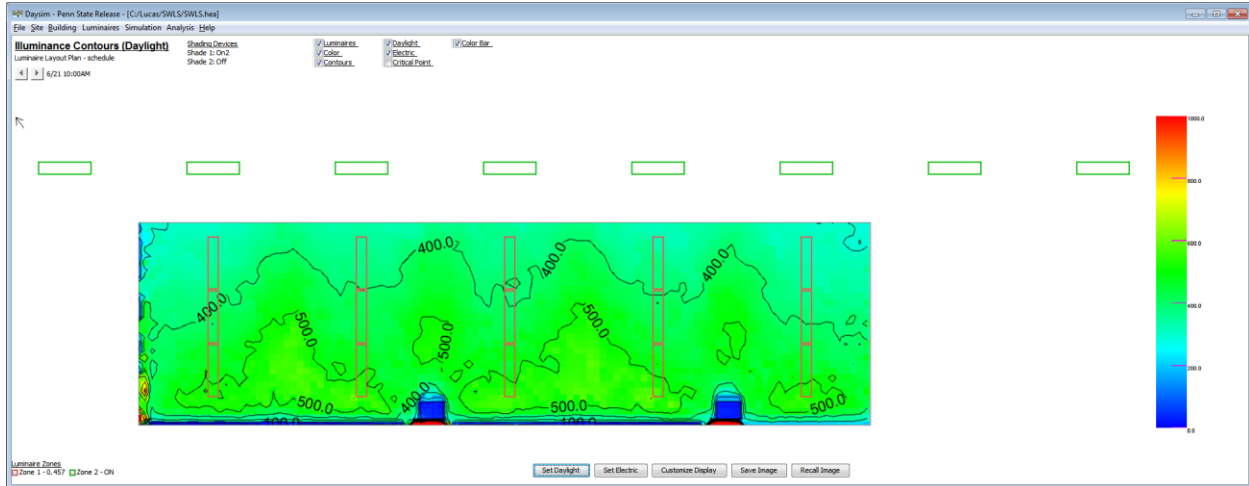


Illumination Contours for the Southwest Facing Life Science Façade (6/21– 8:00AM).

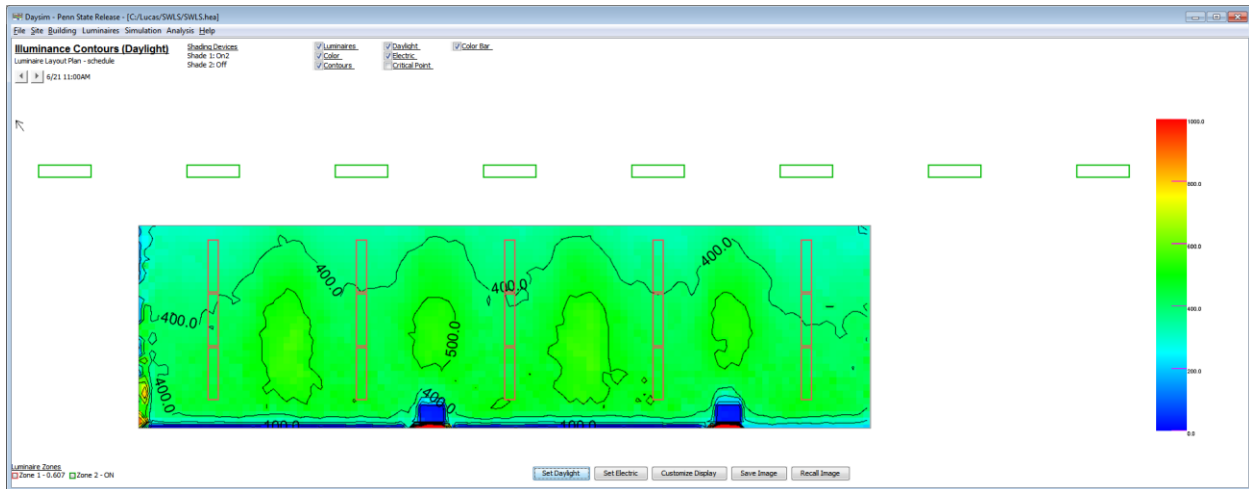


Illumination Contours for the Southwest Facing Life Science Façade (6/21– 9:00AM).

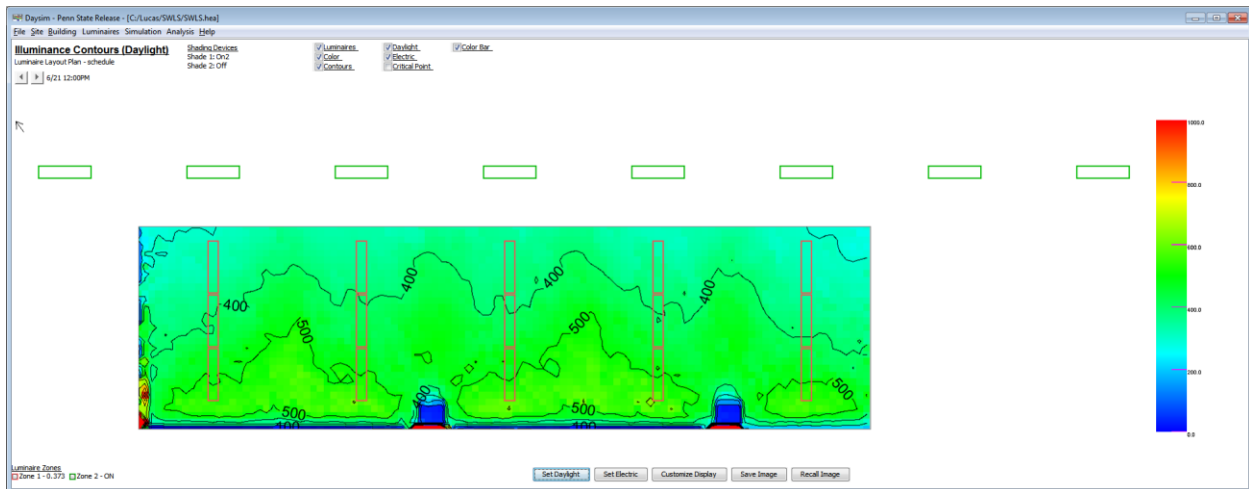




Illumination Contours for the Southwest Facing Life Science Façade (6/21– 10:00AM).

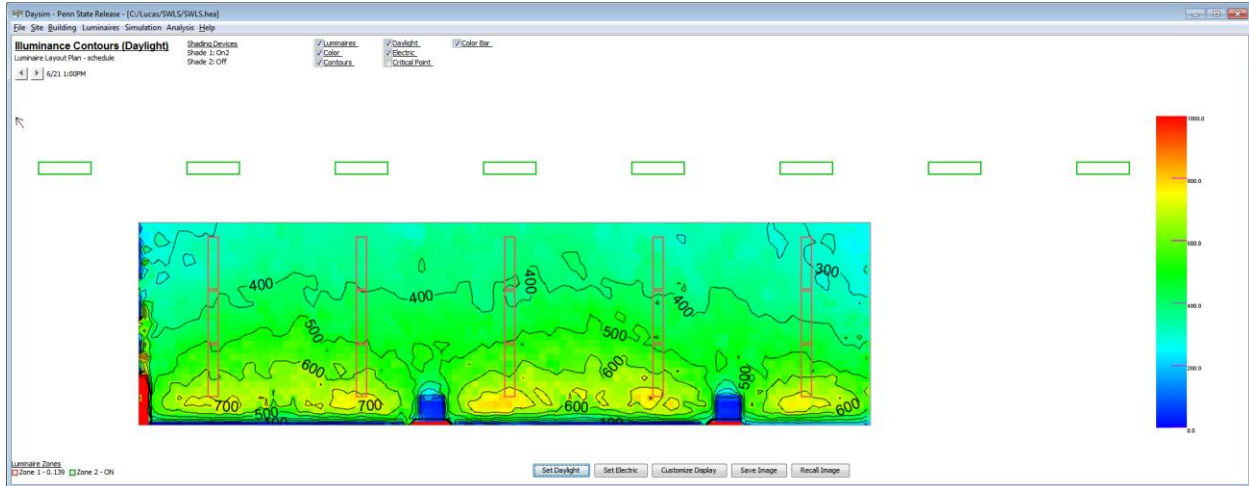


Illumination Contours for the Southwest Facing Life Science Façade (6/21– 11:00AM).

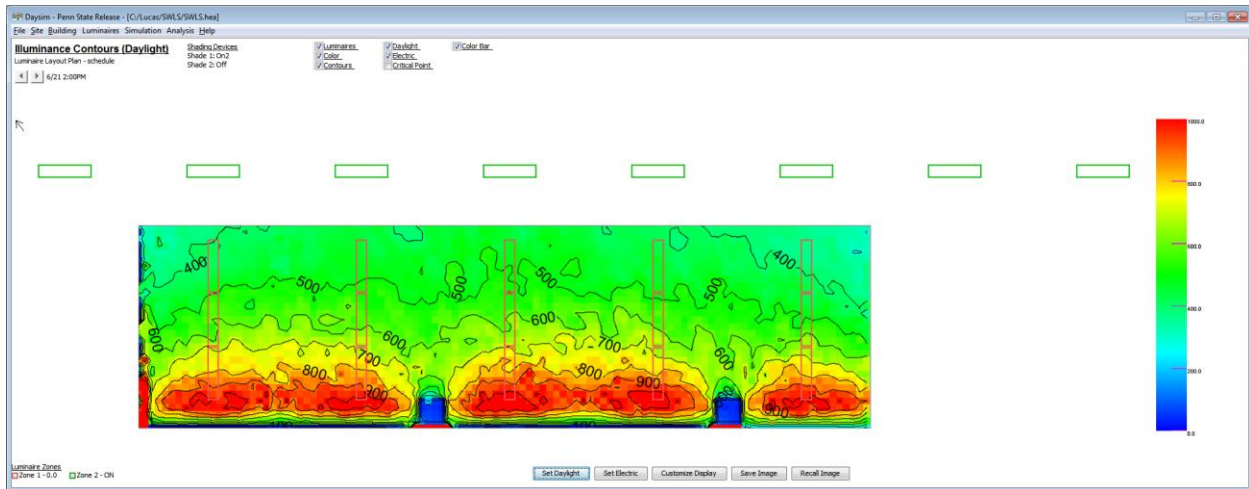


Illumination Contours for the Southwest Facing Life Science Façade (6/21– 12:00PM).

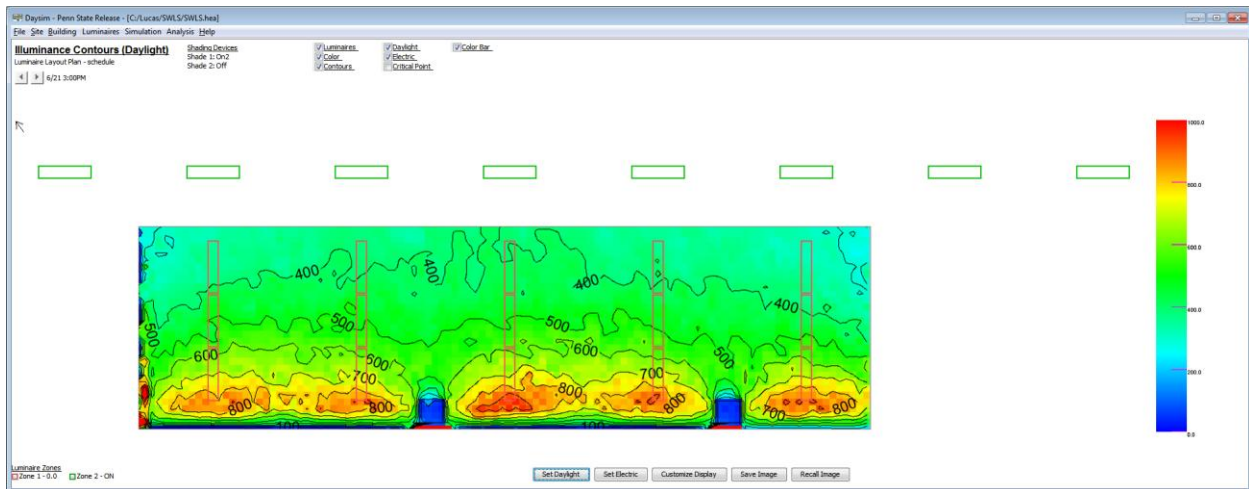




Illumination Contours for the Southwest Facing Life Science Façade (6/21- 1:00PM).

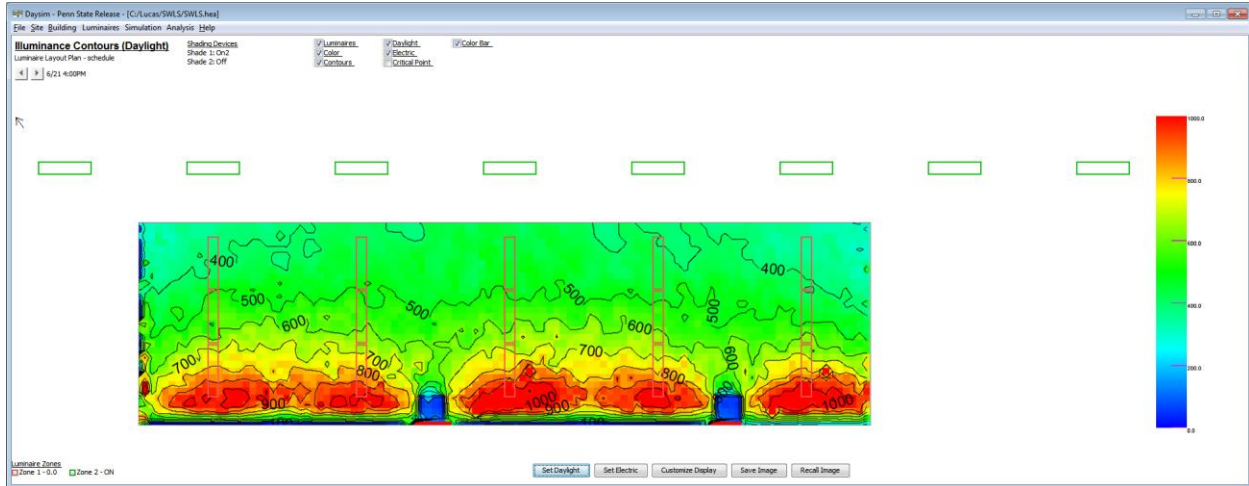


Illumination Contours for the Southwest Facing Life Science Façade (6/21- 2:00PM).

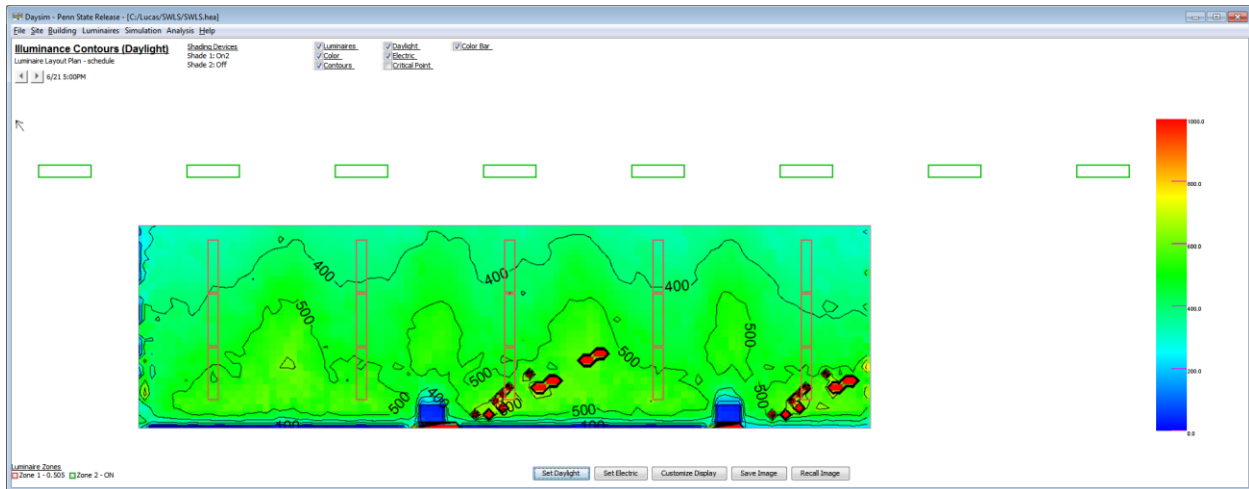


Illumination Contours for the Southwest Facing Life Science Façade (6/21- 3:00PM).

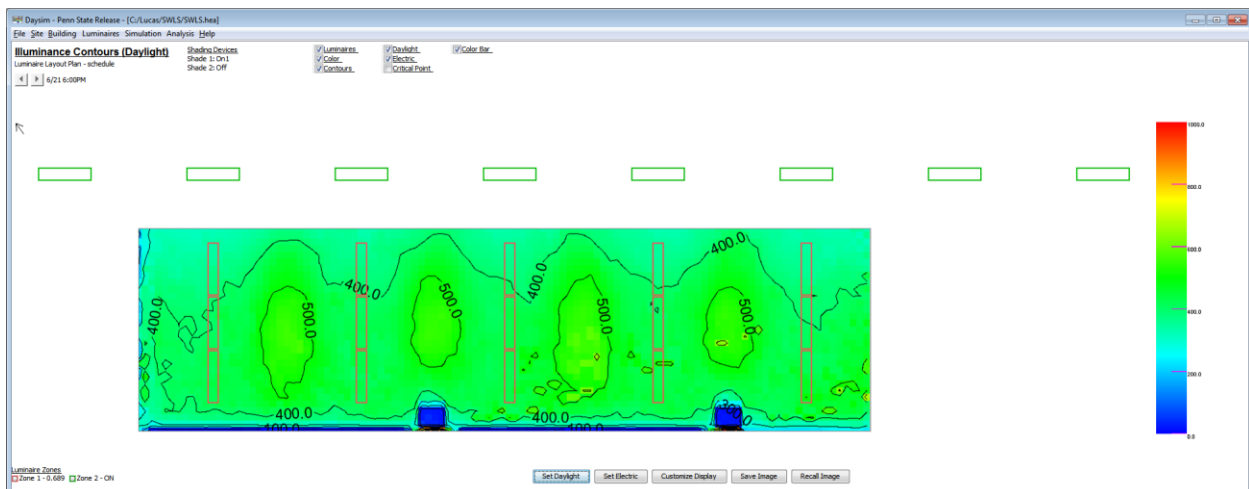




Illumination Contours for the Southwest Facing Life Science Façade (6/21– 4:00PM).

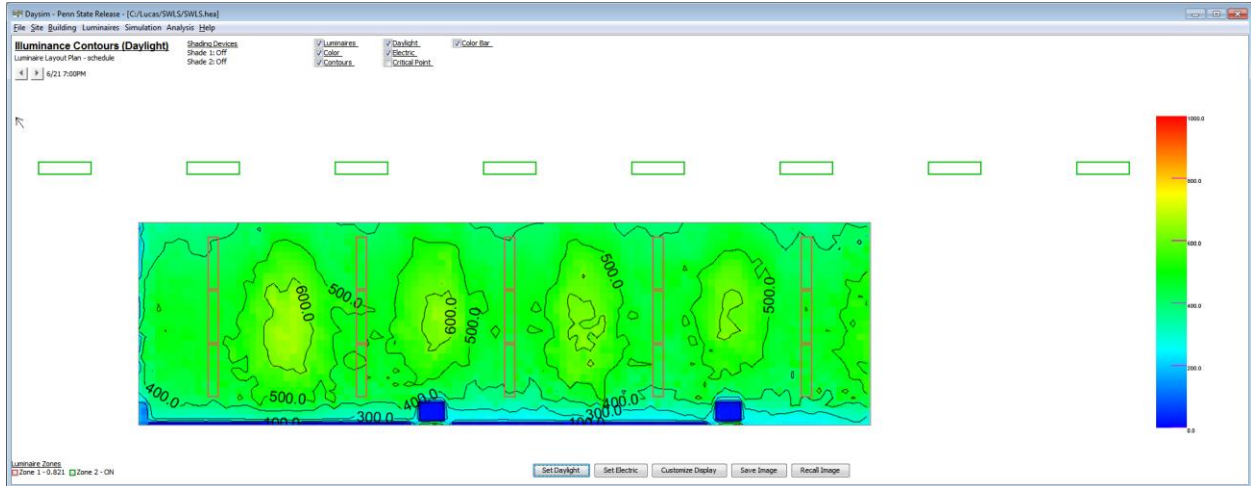


Illumination Contours for the Southwest Facing Life Science Façade (6/21– 5:00PM).



Illumination Contours for the Southwest Facing Life Science Façade (6/21– 6:00PM).





Illumination Contours for the Southwest Facing Life Science Façade (6/21– 7:00PM).

