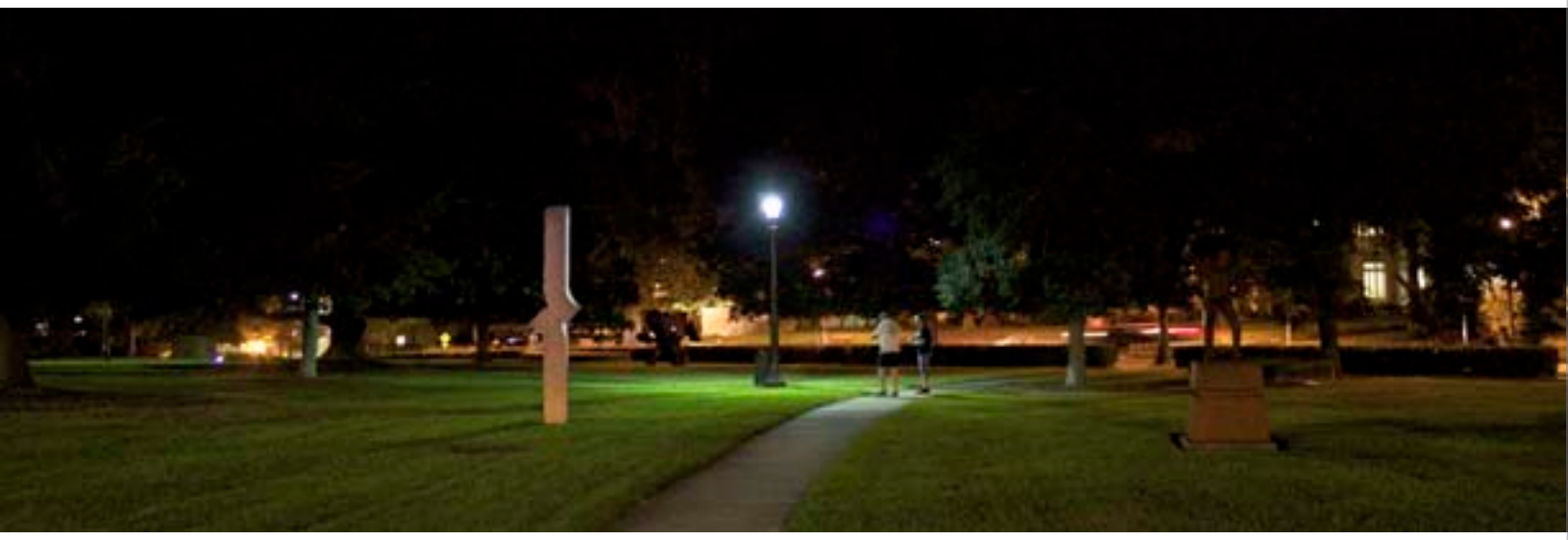
APPENDIX F - ECU EXTERIOR LIGHTING MASTER PLAN

INTRODUCTION



History

The lighting master plan was commissioned as a result of campus community concerns

- Safety and perceived security concerns raised in campus safety walks
- Maintenance concerns by campus staff given the variety of lighting equipment and consumables
- Sustainability concerns
- Aesthetic concerns by Board of Visitors and others about lighting fixtures selected for newer capital projects.

Process

Public work sessions:

A series of public work sessions were commissioned with stakeholders throughout the university. Discussions primarily centered around:

Public safety - areas of concern, times of concern, types of issues (quality of life, perceived security, actual endangerment).

Environmental - energy usage, dark skies, light trespass and glare

Maintenance - lamp/ballast life, luminaire life cycle, stocking, repair and retrofit

Aesthetics - luminaire styles, lamp color and color rendering.

Priorities – Areas of particular opportunity and concern

Goals:

Based on these discussions a number of goals were established:

Create a few standards for illuminance of new walking, parking, driving and assembling areas based on what is working now and recommended practice.

Develop a family of lighting fixtures that are flexible, appropriate and unique to the areas of campus, that allows the facilities department to stock fewer parts and pieces

Prioritize problem areas and areas of opportunity

Provide safe places for recreation

Identify areas of visual interest that can be highlighted at night

Campus lighting survey

As a part of this study, the lighting consultant surveyed the existing lighting conditions around the main campus.

Fixture types - Over 28 different exterior lighting fixture styles exist on the main campus and College Hill

Exterior electric light levels in some places that exceeded 25FC, well above normal exterior levels

Extreme non-uniformity of illuminance in many places

Disability glare from non-cutoff wallpacks, floodlights, unshielded bollards and canopy lights

Light Levels / uniformity – some areas that are working well. Especially the West End Residential District and newer projects at College Hill

Areas of concern – Several areas exist where visibility is low, including the Historic Mall

Culture and lifestyle – Students cluster densely in areas with adequate lighting and avoid the central areas of campus that are inappropriately lighted.

Campus character - During the day several areas of open space are used for recreation and activities that might be better utilized at night

Illustrated guide and priority list

Based on the goals and findings, a two-step draft review process was commissioned for this campus lighting masterplan.

Updating university design guidelines

Based on this master plan, the existing campus guidelines will be updated to provide future designers clear direction on implementation of these strategies

Design considerations as a part of overall master plan (Summary)

This master plan is intended to support and provide specificity to the Overall Campus Master Plan developed concurrently by the Smith Group

References

IESNA RP-33-98 - Guidance on illuminance minimums and contrast maximums horizontal and vertical

IDA/IESNA Model Lighting Ordinance (60% Public Review Draft)

IESNA TM -15-07 Addendum A

International CPTED Association - CPTED AND LIGHTING: REDUCING CRIME, IMPROVING SECURITY - Guide Books for Design Professionals Number 2

NCSU campus master plan and lighting standards

Ohio State University campus lighting standards

Lighting Master Plan

Guiding Principles

Visibility – For reasons of safety, security and campus image, night time visibility is to be facilitated.

Safety - Lighting along paths and crossings shall allow easy navigation by pedestrians. This is created by having proper horizontal illuminance at grade.

Security – While lighting can not directly make areas more secure, it shall increase the perceived security by providing managed vertical illuminance on faces.

Natural surveillance – So that pedestrians are not intimidated by potential loiterers, lighting shall be judiciously designed to afford surveillance of areas near buildings and in tucked-away areas from a comfortable distance. This does not mean lighting every area, but rather using architecturally sound lighting to provide natural views of concealed areas. It also means lighting paths and vertical surfaces so that loiterers in off-path areas are seen in silhouette (at least), so they do not surprise pedestrians at close proximity.

Disposition awareness - At close proximity, soft vertical lighting of good color quality shall allow pedestrians to see clothing and faces accurately and also, in case of an incident, allow for proper identification of subjects

Contrast ratios – In order to increase visual acuity without using excess energy, careful control of uniformity and maximum illuminances shall be adhered to in future projects. Because pedestrians' visual systems are highly adaptable, increasing uniformity and eliminating excessive brightness will increase perceived brightness.

Glare control – In order to control contrast ratios, fixture glare must be controlled. All lighting equipment shall be evaluated for its glare potential.

Light pollution (uplight) – Light that does not contact surfaces and people is wasted. In order to minimize this waste and the impact of lighting on the night sky, all lighting equipment shall be evaluated for its uplight component. Special attention shall be taken to eliminate light emitted between 90° and 160° above nadir that contributes principally to light pollution.

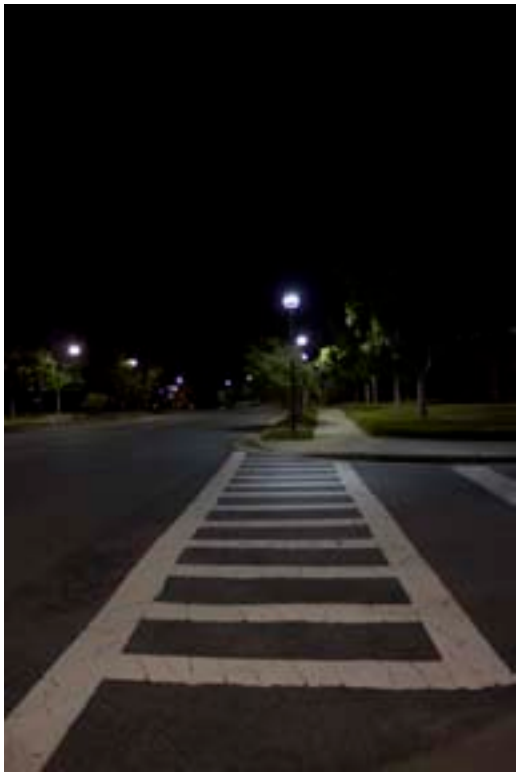
Light trespass – Lighting that impacts adjacent properties unintentionally should be eliminated. Special attention should be given to potential trespass of lighting into dormitory rooms as it may impact sleep cycles of occupants.

An energetic campus – Lighting shall emphasize what makes the campus an interesting, compelling and energetic place after dark. Areas of focus, gathering and visual interest shall be addressed so that campus has lighting that matches its vibrancy.

Vision

Light and night visibility

The human visual system is highly adaptive. We can see during the peak of summer sunlight and in very low light levels. This adaptation occurs over time. If we exit a dark theater into daylight, our system is shocked because we do not have time to adapt comfortably. Given time, the visual system can adapt to luminances ranging from daylight to starlight. In most after-dark environments, we are adapted somewhere in between. This state of vision is known as mesoptic, where the low end of the cone photoreceptors and high end of the rod photoreceptors are stimulated. In this range, the key to visual acuity is not actually the absolute level of luminance, but rather the proper sequence of lighting levels and uniformity. It is important that members of the campus community not experience very high light levels adjacent to very low light levels. By keeping luminance uniform, we eliminate the need for excessively high light levels; saving energy and reducing light pollution and trespass.



Sequencing

(See Table 02-01 for referenced illuminance guidelines)

Consider a student leaving class in Howell Science after dusk when the lighting plan has been implemented. By limiting light levels in the corridors to 15FC average, the student has time to transition from interior task lighting levels that are typically around 45FC. This is a comfortable adaptation of 3:1 (45FC:15FC). By the time the student has adapted to the 15FC, she is leaving the building. If the building entrance/exit is illuminated to an average of 5FC, then she again experiences a comfortable 3:1 adaptation. This exit transitions to a primary path that has an average of over 2.6FC (extrapolated from 0.75FC min. 6:1 uniformity). When she arrives at White Hall she has a similar adaptation back to interior levels.

Likewise consider a theater patron arriving from 5th Street via automobile. The street lighting level averages about 0.5 FC. In the parking lot north of Messick,

the average illuminance is 1.6FC (0.25FC min. 12:1 uniformity extrapolated). He adapts to the building entrance of 5FC average before entering the theater lobby at about 15FC average. Vertical lighting of the facade and interior elements reinforce wayfinding; guiding him toward the building.

Vertical lighting

Because horizontal lighting is reduced, it becomes even more critical that lighting on vertical surfaces is carefully considered. Low-glare vertical light on faces is crucial to perceived security. Also vertical light on objects of interest, facades and from inside buildings provides visual interest and rhythm to the campus experience.

Focal elements

Successful facade lighting at Whichard Building and Joyner Library are examples of lighting that provides focus and visual rhythm to the campus. There are a number of other opportunities for similar explorations of architectural detail in new and existing projects on campus. The judicious use of facade lighting is encouraged. Discrete facade lighting reinforces major architectural forms and features without floodlighting large portions of the building or surrounds

Building exidence

Light exiting through building glazing must also be considered as a part of the facade. Excess brightness from interior lighting is not allowed. Interior fixtures near fenestration, light transmittance of glazing and interior lighting strategies must be carefully considered.

Lighting for permanent works of art

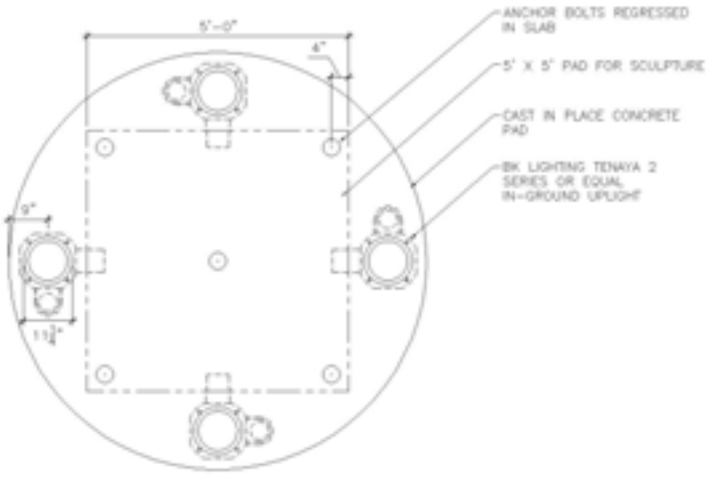
Works of art, particularly sculpture is found throughout campus with a concentration along the perimeter of the Historic Mall. Works of art considered permanent by the university should be treated with lighting specifically designed for the works. A combination of pole mounted, on-grade and in-grade key and fill lights should be employed to emphasise form, material and meaning of the work.

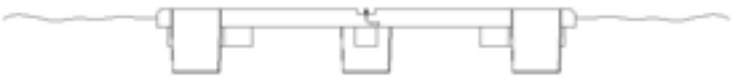
Proposed design for rotating art locations

Because the University has a vibrant visual arts program, several pieces of art are displayed on a temporary basis around campus. If the university provides set locations for these pieces, it would help organize the visual experience, help maintenance crews by removing art from lawn areas and provide a better showcase for the works. It is proposed that concrete pads be provided with integral anchor points and lighting to encourage the organized presentation of temporary art installations and to provide additional visual interest at night.

Lighting for landscape features

Lighting for important landscape elements will also add to the after-dark character of the campus. Specimen trees and other important elements at hubs and axis of campus paths should be illuminated with on-grade or in-grade fixtures as appropriate





PROPOSED ART ONGRADE PEDESTAL WITH INTEGRATED LIGHTING

Tiered Paths

Parking and play areas shall follow IESNA RP-33-98, provide adequate light for visual acuity and safe transit and occupation

Secondary paths shall be lighted to IESNA standard levels for enhanced security

Primary path routes shall be lighted with greater uniformity to clearly define them as arteries and encourage connectivity and traffic flow

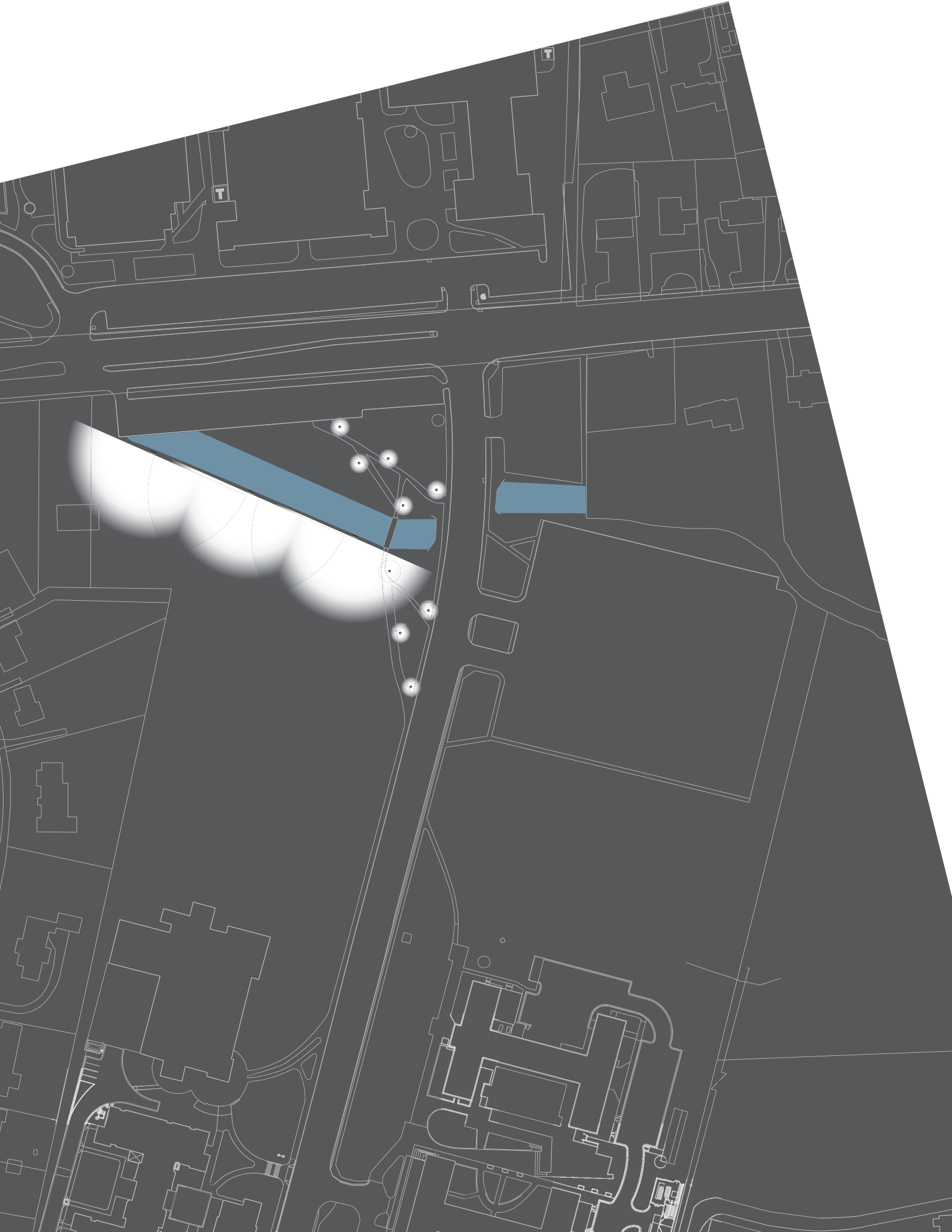
Gathering Places

Activity Areas

Areas near recreation zones and student centers shall have additional lighting to support activity. Lighting shall be controlled by astronomic timeclock and be on during normal operating hours and off or at reduced levels when closed.

Areas for Play

Additional lighting for areas near residential zones shall be provided during select hours and for special events. Lighting shall be controlled by electronic timer with integral astronomic time clock and shall either be turned on manually by students or by University Staff and shall turn off automatically after a prescribed period or at an established curfew whichever occurs first.



Focal Objects and Campus Character

A rhythm of focal objects exist clustered at central campus. The lighting at the Cupola, the Fountain, and Whichard and Joyner facades are the starting point for a campus full of interesting vertical items that should be highlighted at night.

As additional pieces of sculptural, landscape and architectural interest are added, focal lighting should reflect a radial pattern emanating from the Historic Mall and extending to the outer points of campus

Luminare Families

Refer to District Boundaries in Overall University Master Plan

West end and College Hill Residential Districts

- This fixture matches existing lighting fixtures in residential districts. Fixture generally controls glare well and provides good uniformity.
- Type: CL1
- Basis of Design: **Hadco "Small Techtra" Series**
- Lamp: **Philips MHC150/C/U/3K/ALTO**
- Luminaire mounting height: **12'**

Historic Mall

- This fixture speaks to classic lines around campus. This fixture is architecturally appropriate for pastural areas. The fixtures for the Mall area will have a slightly more ornate pole and fitter as appropriate for green space and is indicative of early 20th century lamp-posts
- Type CL2A
- Basis of Design: Sentry Electric "SWB-NS Estate" Series
- Lamp: Philips MHC150/C/U/3K/ALTO
  Luminaire mounting height: 12'
- Existing original gas fixtures to be removed and saved for possible use at piers and campus entrances and areas immediately adjacent to Fifth Street

Central Campus

- This fixture matches that of the historic mall, but is less ornate and, thus less expensive. Simplified pole and fitter fits with more architectural styles
- Type CL2B
- Basis of Design: Sentry Electric "SWB-NS Estate" Series
- Lamp: Philips MHC150/C/U/3K/ALTO
- Luminaire mounting height: 12'

Driveways and parking adjacent to buildings

- Matches outlying parking fixtures in smaller scale
- Type CL3 Series
- Basis of Design: Hadco PA31 Series
- Other acceptable models: Kim "Archetype" Series or LITHIONIA "AERIS" Series
- Lamp: Philips MHC150/C/U/3K/ALTO. Equivalent l.e.d. sources are encouraged where life-cycle cost analysis prove payback over the system life
- Luminaire mounting height: 20'. Fixtures on poles over 12' may only be located in areas easily accessible by bucket truck or scissor-lift for maintenance

Outlying parking areas

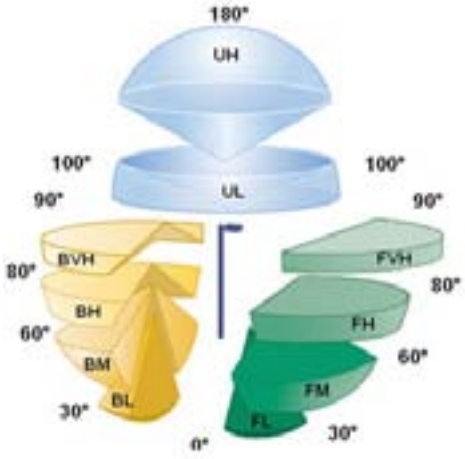


ILLUSTRATION OF ANGLES CONSIDERED IN BUG RATING SYSTEM

- Simple softened shoebox type fixtures that perform well and are unobtrusive in the landscape
- Type CL4 Series
- Basis of Design: Hadco PA31 Series
- Other acceptable models: Kim "Archetype" Series or LITHIONIA "AERIS" Series
- Lamp: Philips MS400/C/U/PS. Equivalent l.e.d. sources are encouraged where life-cycle cost analysis prove payback over the system life.
- Luminaire mounting height: 30'. Fixtures on poles over 12' may only be located in areas easily accessible by bucket truck or scissor-lift for maintenance
- Where fixtures must be located within paved sections of parking areas, they shall be located at the intersection of striped patterns and include no less that a 30" tall concrete base extending above the grade.

South driveways (Ninth Street extension) and parking

- Type CL5 Series
- Basis of Design: Kim "Curvature" Series

Existing fixtures to be maintained until end of useful system life.

Design Guidelines and Standards:

Table 1: Illuminance guidelines after dusk

Area Type	Measured	Target maintained illuminance at night	Uniformity not to exceed	Notes
Interior corridors and lobbies at night	Horizontal at floor	10-15FC Average	Varies based on building design	
Varies base on building design	Horizontal at grade	5FC Average	4:1	
	Vertical at 6' above grade	5FC Average		
Primary Pedestrian Paths	Horizontal at grade	**0.75 FC Minimum**	**6:1**	**Revised down slightly from NCSU path standard due to darker surrounds at ECU; similar to current West End path uniformity**
	Vertical at 6' above grade	2FC Average		
Secondary Pedestrian Paths	Horizontal at grade	0.5FC Minimum	8:1	Meets IES RP-33-98 standards for "enhanced security" walking paths
	Vertical at 6' above grade	2FC Average		
Parking Areas and Driveways	Horizontal	0.25FC Minimum at perimeter 0.5FC Minimum otherwise	12:1	Similar to current Rec. Center / Mendenhall Parking
	Vertical	2FC Average at pedestrian crossings		
Maximum illuminance on paths or parking areas at night	Horizontal	10 FC Max		
Parking Decks	Horizontal	0.5 Min	8:1	
	Vertical	2 FC Average		
Maximum trespass outside perimeter of parking decks	Horizontal	0.5FC		
Maximum illuminance on focal objects such as art or featured landscape objects	Vertical	20 FC Max		
Illuminance on building facades	Vertical	20 FC Max 2 FC Maximum Average Illuminance on lighted surfaces		Designs shall comply with latest ASHRAE 90.1 Stanards for facade power density

Equipment guidelines

- Pedestrian scale post-top luminaires are to be provided by the university to projects at a cost to the project. The type of decorative luminare is determined by the district in which the project is constructed.
- Bollards are strongly discouraged for path lighting due to potential for glare, lack of usable vertical light on faces and difficulty of maintenance. Where illluminated bollards must be used as a part of a building design, they shall not be the principal means of path illuminance.
- Acceptible lamps: Philips CMH35/ T6/830, PL-T32W/830. Equivalent l.e.d. or induction sources encouraged where life-cycle costs analysis prove payback over the system life.
- Use of ingrade fixtures is discouraged. Any considered must be equivalent of IP67 and aimed at objects in a manner that reduces spill light and glare. In-grade fixtures may only be used in hardscape or lawns where mulch and other planting materials will not impede the operation and maintenance of the fixtures. They shall be no more than (within 1/2") above grade to avoid creating a tripping hazards. They shall not be installed at the low-point of adjacent grades where they may become de facto drains. All conduit entry points must be sealed properly with RTV silicone or similar and installed and drained properly according to the manufacturer's recommendations. Basis of Design: BK Tenya, HP2 or CO2 Series
- Ongrade landscape lighting may be used in planting beds, but not in or near lawns or pathways where they may cause a tripping hazard and complicated lawn maintenance. For durability , on-grade fixtures shall be machined from a solid billet of copper-free aluminum, brass or stainless steel and be IP66 rated or higher and be anchored to remain rigid and watertight when kicked or similarly impacted. Basis of Design: BK Artistar Series
- Judicious façade lighting is encouraged. Use ASHRAE 90.1.2004 for guidance on maximum lighting power density. Acceptible lamps: Philips CMH35/T6/830, CMH70/T6/830, CMH150/T6/830, MHC150/C/U/3K/ALTO , PL-T32W/830. Equivalent l.e.d. or induction sources encouraged where life-cycle costs analysis prove payback over the system life. All fixtures shall be IP66 Rated or better.
- Non-cutoff wall-packs may NOT be used unless lamp is cutoff by a physical structure in a manner that
- prevents view from normal angles
- Unsheilded canopy lights my NOT be used. Lights at buildings shall reduce glare by shielding light source from view from pedestrian paths by baffle or other means of control. All building mounted lighting shall be easily accessible for maintenance
- Where ever possible, ballasts matching campus stock shall be specified
- Catenary type pedestrian scale lighting may be used if approved as a part of the building design
- **BUG (Backlight, Uplight, Glare) Rating** as defined by IESNA TM-15-07 Addendum A shall not exceed B2-U2-G2 except when mounted near residence halls or perimter of campus when B0 is required

Implementation

Finalization and procurement strategies for new campus standard lighting fixtures

As a part of Lighitng Project 2 the relighting of Historic Mall. Samples of each fixture being considered for Type CL2A shall be purchased and installed. Feedback will be solicited from the university community before final selection is made. The final selection for project shall be considered the campus standard CL2A fixture and this document updated to reflect the selection

In order to allow the universtiy to create a standard family of lighting fixtures, yet still allow open competition. Fixtures shall be considered the university's preferred brand for the purposed of bidding future projects.

Priorities

Many of the presciptions included in this plan are meant to implemented as a part of capital projects over time. However, there are a several areas that need to be addressed as specific lighting projects due to safety concerns, scope that would not be included in capital projects, and/or problems that are fairly serious that need to be addressed

Maintainance projects as systems are replaced

- Glare control of existing fixtures
- Replace non-cutoff wallpacks with full-cutoff verisons
- Use shields or replace canopy lights
- Remove building mounted area lights that emit light over 45 degrees above nadir (straight down) and replace with appropriate site lighting
- Upgrade light sources to 3000K ceramic metal halide, led or fluorescent as appropriate per fixture usage and life-cycle cost analysis.

Proposed Projects

Lighting Project	Import	Cost	Difficulty	Priority	Suggestions	Role players
1 - Driveway and Parking at Ninth Street Extension	1	3	3	1	Extend type CL5 fixtures along driveway and parking area; remove exisiting utility light and add lighting at unlit lot	University, electrical engineer, electrical contractor
2 - Historic Mall Lighitng	1	9	6	2	Redesign and replace pedestrian scale lighting at heart of campus	University, lighting designer, electical and civil engineers, landscape architect, arborist, general, electrical and landscape contractors
3 - Signage Lighting at 5th Street and Downtown	4	2	1	3	Study new ongrade lighting for existing grand campus sign	University, lighting designer, electrical enginer, electrical contractor
4 - Campus Gateways	4	4	4	4	Phase 1: Redesign for campus gateway piers along 5th Street Phase 2: New campus gateways along 10th Street	University, lighting designer, electrical, civil and structural engineers, architect, landscape architect, general, electrical, masonry and landscape contractors
5 - 10th Street College Hill Transition and Recreation Zone	3	8	5	5	Create an active zone at the foot of College Hill that provides an active and interesting connection to central campus; include park area south of Science and Technolgy	University, lighting designer, electrical, civil and structural engineers, architect, landscape architect, general, electrical and landscape contractors
6 - Central Campus Northwest Site and Building Lighting	4	4	5	6	Improve lighting between Projects 2 and 4 on northwest side of Central Campus including Garrett, Art, Jarvis, Fleming, Cotton and Spilman	University, lighting designer, electrical, civil, architect, landscape architect, general, electrical and landscape contractors
7 - Central Campus South Site and Building Lighting	5	4	6	7	Improve site lighting in the areas between Projects 2 and 4 on the south side of Central Campus including Student Health Flanagan, Slay, Umstead and Grounds	University, lighting designer, electrical, civil, architect, landscape architect, general, electrical and landscape contractors

Lighting project	Import	Cost	Difficulty	Priority	Suggestions	Role players
8 - Central Campus Southeast Site and Building Lighting Improvements	7	5	6	7	Improve site lighting in the areas between Projects 2 and 5 on the southeast side of Central Campus including Graham, Bate, Rawls, Howell, Science and Technology, Christenbury, Brewster and Music	University, lighting designer, electrical, civil, architect, landscape architect, general, electrical and landscape contractors
9 - Central Campus Southwest Site and Building Lighting	7	5	6	8	Improve site lighting in the areas between Projects 2 and 4 on the southwest side of Central Campus including GJoyner, Mendenhall, Student Recreation, Ringgold, Greene, Bloxton and Erwin.	University, lighting designer, electrical, civil, architect, landscape architect, general, electrical and landscape contractors
10 - Central Campus Northeast Site and Building Lighting Improvements	6	4	6	8	Improve site lighting in the areas between Projects 2 and 4 on the northeast side of Central Campus including Wright, McGinnis, Drama, Speight, Austin and Rivers	University, lighting designer, electrical, civil, architect, landscape architect, general, electrical and landscape contractors
11 - College Hill Perimeter Parking Lighting improvements	9	5	4	9	Improve uniformity, glare control and energy efficiency in parking areas surrounding campus	University, lighting designer, electrical, civil, landscape architect, general, electrical and landscape and paving contractors
12 - Central Campus Perimeter Parking Lighting Improvements	9	5	4	9	Improve uniformity, glare control and energy efficiency in parking areas surrounding campus	University, lighting designer, electrical, civil, landscape architect, general, electrical and landscape and paving contractors