

The University of British Columbia

# Okanagan Campus Design Guidelines



THE UNIVERSITY OF BRITISH COLUMBIA

# UBC OKANAGAN DESIGN GUIDELINES

JANUARY 2019

## **ACKNOWLEDGMENT**

We begin by acknowledging that UBC's Okanagan Campus is located on the territories of the Syilx (Okanagan) peoples, and that UBC's activities take place on Indigenous lands throughout British Columbia and beyond.

The Syilx Okanagan people have been here since time immemorial. In September 2005, the Okanagan Nation Alliance officially welcomed UBC to Okanagan territory in a ceremony, Knaqs npi'ismist, where UBC signed a Memorandum of Understanding with the Okanagan Nation Alliance. The university works with the Okanagan Nation in the pursuit of campus plans for UBC Okanagan in respectful acknowledgement of the Syilx Okanagan people's stewardship of their territory for thousands of years.

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# INTRODUCTION

## 1.1 PURPOSE

The *UBC Okanagan Design Guidelines* (the *Guidelines*) are a compulsory design reference tool to guide the design of all future facilities on the University of British Columbia (UBC) Okanagan Campus. The *Guidelines* supplement, and should be read in conjunction with, the [UBC Okanagan Campus Plan](#) (September 2015, and subsequent updates).

The *Guidelines* have also incorporated additional design ideas derived from consultation with the UBC Okanagan Campus community and technical staff. In addition, the *Guidelines* reinforce and supplement the [Whole Systems Infrastructure Plan](#) (May 2016), which establishes a 20-year framework for improving the overall campus performance and ensuring that it is resilient to future changes in growth, utility rates, and climate change.

The *Campus Plan* provides a significant amount of design direction to guide the evolution of the campus over the next 20 years and in keeping with the Campus Vision:

*The University of British Columbia's Okanagan Campus aspires to be a centre for learning and innovation that produces global citizens through transformative personal growth and collaboration. Its people, places, and activities are linked by a shared commitment to fostering community, and supporting social and ecological well-being. Deeply connected to the landscape, the campus is an accessible, intimate, and welcoming environment – a catalyst for positive change.*

## 1.2 CAMPUS PLAN CONTEXT

The 2015 *Campus Plan* provides a long-term campus planning framework for existing and future academic and research activities, student housing, and associated campus services and infrastructure for the next 20 years. The *Campus Plan* provides capacity for a potential doubling of the campus population and academic and residential facilities. It includes a framework for on-going campus development including: conceptual direction for investment in future buildings and infrastructure. It also provides conceptual frameworks for major campus elements including: landscapes and public realm, recreation, amenities and programming, circulation and transportation, parking and infrastructure. The *Campus Plan* supports coordination with private, government and community interests to deliver regional opportunities for research, economic development and community building.

The *Campus Plan* describes an overall design vision that weaves future facility requirements into a unique Okanagan landscape and between the existing built infrastructure components. Four Principles form the backbone of the *Campus Plan* and the *Guidelines*.

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- **A Welcoming and Connected Campus:** Through design, programming and partnerships, strengthen physical and social connections on campus and reach beyond to the surrounding community to create lasting and impactful relationships between people and places.
- **Celebrating Place:** Strengthen the intimacy and legibility of campus spaces and places, while celebrating the surrounding Okanagan landscape, to achieve a distinguished and compact campus within an indigenous landscape setting.
- **Campus Vitality:** Leverage campus growth to create a vibrant community, meeting the needs of all users and enabling students, staff, faculty and the broader community to connect, learn and linger.
- **Whole Systems Infrastructure:** Campus growth should be managed through a whole systems (environment, economic and social sustainability) lens to achieve net-positive impact on the well-being of the campus community and ecology.

The *Campus Plan* is further articulated through a series of eleven 'Places' connected by a series of 'Organizing Pedestrian Spines', each distinguished by unique features and supportive of the Principles. Through these Places and Pedestrian Spines, the *Campus Plan* strives to maintain and enhance the Okanagan Campus as a memorable place by establishing campus-wide strategies for urban design, landscape, views, universal accessibility and sustainability.

UBC completed its new strategic plan in 2018. *Shaping UBC's Next Century* sets out the university's collective vision and purpose, as well as goals and strategies for the years ahead. It also guides and informs the university's planning aims and efforts. As a core area of the strategic plan, People and Places strives to create vibrant, sustainable environments that enhance wellbeing and excellence for people at UBC and beyond. UBC seeks to promote and protect this positive and reciprocal interaction between people and places through its deep commitments to Indigenous peoples, sustainability and wellbeing. These commitments are, in turn, reflected and carried through in the *Guidelines*.

These *Guidelines* and complementary plans and guidelines, collectively, provide a bridge between the broader campus-wide strategies of the *Campus Plan* and the detailed project design decisions that would be required on a given project. New projects and Okanagan Campus development is to be reviewed for consistency with these *Guidelines* as well as other plans, policies and guidelines.

### **Innovation Precinct**

Subsequent to the 2015 *Campus Plan*, UBC Okanagan undertook the development of the *Innovation Precinct Structure Plan* (IPSP), for the approximately 30.9 gross hectares that occupies the northeast quadrant of the campus, identified in on page 11. The IPSP provides planning and design principles, a physical framework and urban design guidelines to guide the development of innovation and research

space and facilities on the University's Innovation Precinct lands over the next 20 years and beyond and that support its academic, financial, community and whole systems integration objectives as set out in the *Campus Plan*, the *Whole Systems Infrastructure Plan* and the [Integrated Rainwater Management Plan](#).

In addition to these *Guidelines*, the IPSP shall be consulted for planning and design principles and design guidelines for all projects within the Innovation Precinct. Where there are gaps within the IPSP (i.e., lighting, paving types), these *Guidelines* should be a reference for the development of design responses that are compatible with the goals and principles of the IPSP and *Campus Plan*.

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OKANAGAN MASTER PLAN



INNOVATION PRECINCT STRUCTURE PLAN



## 1.3

### ROLE AND INTENDED AUDIENCE

These *Guidelines* promote cohesion and consistency across the campus, while allowing enough flexibility to ensure design team creativity and innovation remain possible on each project. The *Guidelines* are for the use of:

- Consultants, as a guide to the design of building, landscape, and surface infrastructure projects within the Okanagan campus
- Staff undertaking in-house project design, or reviewing capital projects in the pre-application and permit application process
- Project sponsors, as part of project identification and Steering Committee review / oversight
- Members of the broader UBC community who are interested in understanding the long-term character objectives for the Okanagan campus

## 1.4

### HOW TO USE THE DESIGN GUIDELINES

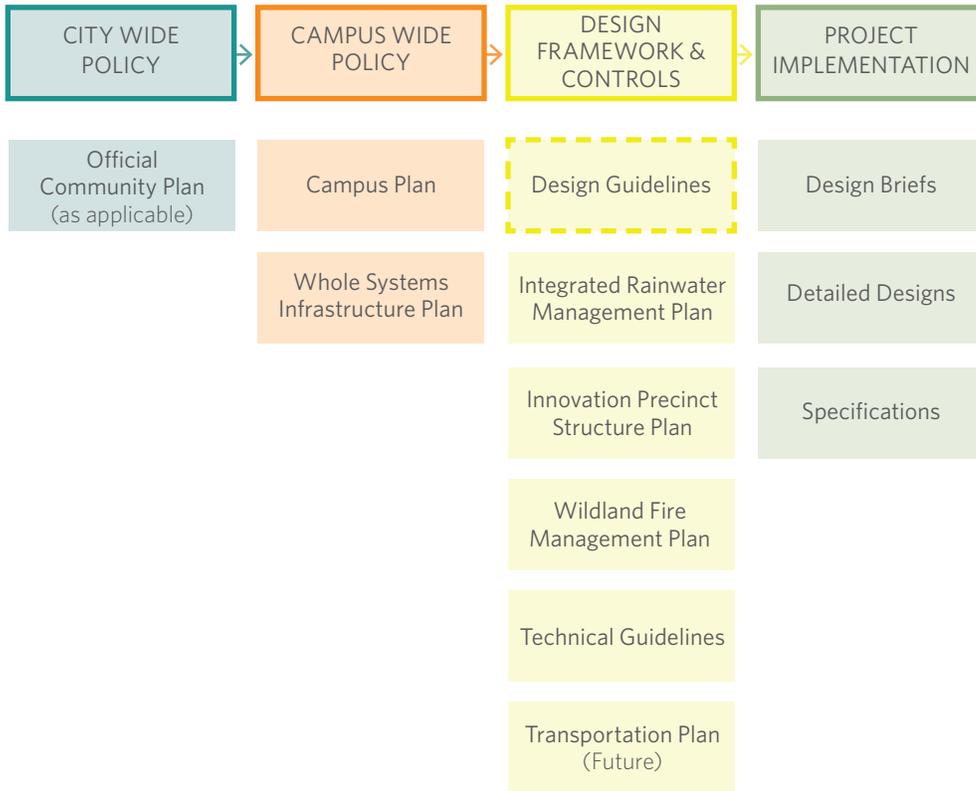
Section 6.1 of the *Campus Plan* outlines the project approval process for all capital projects on the Okanagan Campus. All new buildings, additions and significant exterior campus projects must submit plans for review by Campus Planning and Development, prior to Board of Governors consideration. Plans will be reviewed for consistency with these *Guidelines* and other approved policies, plans and guidelines (see figure 01).

Sponsors, project managers, designers and consultants are encouraged to contact UBC Okanagan Campus Planning and Development to initiate pre-application discussions about a project as early as possible in order to confirm a shared understanding of all policies, plans and guidelines applicable to their project. At its discretion, Campus Planning and Development may provide a more detailed Design Brief for some sites, which will set out high level design, sustainability and programmatic expectations. The Design Brief will be used in conjunction with the *Guidelines* and other campus policies throughout the project life-cycle.

Multi-disciplinary design teams for each project are expected to work collaboratively, such as through an integrated design process, from project inception through to project approval, to ensure all component systems work in harmony toward the functional, sustainable, and character objectives of the campus.

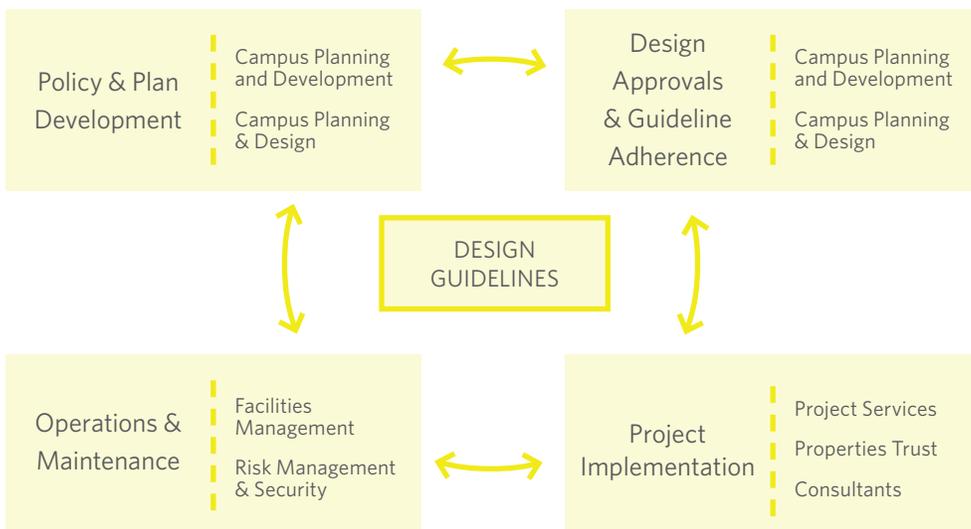
Variations and relaxations to the *Guidelines* for particular projects may be considered where justified, and resolved during the conceptual design and development permit stage.

FIGURE 01. RELATIONSHIP OF PLANS AND POLICIES



◀ The *Guidelines* provide a bridge between broader campus-wide strategies and detailed project design decisions.

FIGURE 02. ROLE OF THE GUIDELINES



◀ The *Guidelines* provide guidance to a variety of stakeholders at different stages of a project's development.

## Process Guide

The following process guide will help to ensure the *Guidelines* are properly applied:

- Involve all relevant campus planning and design disciplines in an interactive and integrative process throughout the project to establish and ensure support of project goals and objectives
- Adopt the [UBC Sustainability Process](#) for all building projects
- Engage widely with stakeholders and public interests per [UBC's Engagement Charter](#)
- Bring technical operations learning and knowledge to the front end of the design process and throughout capital project development
- Embed the *Guidelines* and related documents within the design process from the design brief development onwards

## Future Revisions

The Guidelines will be reviewed and amended from time to time, as experience is gained with implementing the guidelines and as new best practices emerge.

Endorsed future changes will be organized into *Appendix B: Future Revisions*. Project sponsors and consultants shall always check with UBC Okanagan Campus Planning and Development Staff to confirm they have an up-to-date version.

Project designers will find recommended standards for building interiors, indoor furnishings, and infrastructure not otherwise addressed by these guidelines, under separate cover in the [UBC Technical Guidelines](#).

## 1.5

### DOCUMENT ORGANIZATION

These Guidelines are organized into six major sections, including:

- **Introduction:** describes how to use the guidelines and explains their underlying context, rationale, role in the design process, and relationship to other documents and policies.
- **Public Realm:** provides guidance on campus-wide landscape treatments that reinforce the experience and character of public spaces.
- **Architecture:** provides goals and supporting strategies for creating a cohesive campus through context, sensitive building siting, massing and design.
- **Green Buildings:** provides goals, targets and guidelines for buildings to achieve a net-positive impact on the campus.
- **Colour:** provides a detailed framework for choosing colour and material when designing buildings and public spaces.
- **Lighting:** provides design and performance criteria for all exterior campus lighting.

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# 2

# PUBLIC REALM

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## PUBLIC REALM GOALS

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1. Instill pride and sense of place
2. Foster social sustainability and community
3. Maximize access, personal safety, comfort and security
4. Enhance education through informal learning
5. Support and nurture physical and mental wellbeing
6. Leverage whole systems landscapes

*The public realm guidelines are intended to “bridge” design intentions for campus transformation as articulated in the Campus Plan and Whole Systems Infrastructure Plan, and clarify more specific design and technical considerations to guide implementation, in support of the Campus Plan’s four guiding principles.*

## 2.1 INTRODUCTION AND GOALS

The public realm is critical to the university's identity, beauty and function. Building and landscape projects should support a distinguished expression of arrival and threshold along all formal campus approaches and destinations and achieve timelessness and dignity befitting a world class university. To achieve this vision all public realm projects should:

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- 1. Instill pride in UBC and foster a strong sense of place:** The Okanagan landscape is an integral and unique part of the campus experience and should be celebrated. The design of campus landscapes shall include materials, plants and colors that are unique to the natural environment, and appropriate to the climate and water concerns of the Okanagan Valley.
- 2. Foster social sustainability and community building by animating, invigorating and bringing life to campus:** Campus landscapes shall be designed to support and invite student and academic displays and installations that are consistent with the academic mission, and with careful and thoughtful consideration of open space configuration, design and programming.
- 3. Maximize access, personal safety, comfort and security:** All campus landscapes shall be designed for universal access in keeping with current codes and best practice standards. Personal safety is an essential concern and is addressed through Crime Prevention through Environmental Design (CPTED) strategies. Site furniture shall be designed or selected to maximize outdoor use in the fall, winter and spring, and enable students to undertake as many activities outside as would otherwise be undertaken inside.
- 4. Enhance the educational experience with informal learning opportunities:** Public realm spaces shall encourage social interaction, foster cross-discipline learning and, as appropriate, reflect indigenous culture and learning. Spaces should be flexible in their use and allow for creative expression by students and invite a variety of academic activities and learning interventions, both permanent and temporary. Landscape designs should incorporate pedagogical opportunities in botanical, ecological and indigenous learning through plant selection. Faculty and students of the university are strongly encouraged to consider the public realm as a canvas and platform for all types of class project and learning opportunities.
- 5. Support and nurture the physical and mental health of students, faculty and staff:** Spaces shall be well-designed, safe, ecologically and socially vibrant, and support a variety of activities and experiences - from quiet contemplation to ceremonial events, to active play and sport.
- 6. Leverage natural systems to support ecological health and reduces life-cycle costs:** The public realm shall maximize economic and environmental sustainability through designs, materials and operations that minimize maintenance, and maximize durability, resilience and life-cycle costs.<sup>1</sup>

<sup>1</sup>The [Whole Systems Infrastructure Plan \(WSIP\)](#) and [Integrated Rainwater Management Plan \(IRMP\)](#) should be reviewed for additional relevant guidelines to support this goal

UNIVERSITY WAY AND ALUMNI AVENUE  
GATEWAY



▲ Design of campus Gateways shall draw upon regional stone and native plantings to evoke the Okanagan landscape upon arrival.

ALTERNATIVE CAMPUS GATEWAYS



▲ Under the right circumstances, there may be opportunities for bolder expression of gateway and identity (e.g. silver "UBC" letters on the Vancouver Campus).

## 2.2 HARDSCAPE

### 2.2.1 Gateways

The campus arrival experience will evoke the natural Okanagan landscape and send a clear message that one has arrived at a place that is both environmentally and socially unique. Gateways announce a distinct threshold while respecting the integrity of the surrounding natural landscape that defines the university's sense of place and commitment to sustainability (particularly as viewed from Highway 97, Hollywood Road North and John Hindle Drive). This landscape is characterized by a foreground of sloping grassland and a backdrop of native pine woodland. The design of Gateways shall draw upon the established forms and materials of the existing gateway walls as well as regional stone and natural campus planting precedents.

- a. **Material:** Local limestone; alternative durable materials can be considered based on design and context.
- b. **Signage:** The University of British Columbia name and crest must be included on all gateway signs.
- c. **Inscriptions:** Text should be embedded in the wall and speak to aspirations of higher learning; inscriptions can be chosen through a consultation process or competition.
- d. **Planting:** Native grassland and trees.
- e. **Lighting:** Low level lighting should be added to illuminate wall and trees wall at each location.

### 2.2.2 Paving

Campus paving serves as a strong unifying element in the campus landscape. It also improves legibility of the campus circulation hierarchy. Judicious consideration of intended paving use will assist to inform the scale of paving and indeed, whether paving can be reduced with the goal of minimizing campus imperviousness.

#### Surfaces:

- a. Pedestrian paving shall have a permanent, firm, and slip-resistant surface (see trail exception). No sandblast finish paving is permitted.
- b. The paved surface of pedestrian areas shall not have gratings with openings that will permit the passage of a sphere more than 13mm (1/2") in diameter, and all elongated openings shall be oriented approximately perpendicular to the primary direction of travel.
- c. Wherever possible, paved areas should be designed to sheet drain into adjacent landscape areas that have been appropriately designed and graded to receive the water. Drainage structures in paved areas should be avoided if possible to reduce operational and maintenance demands.
- d. Utility access points that are located within the walking surface area must match the level of the sidewalk and possess a non-slip surface.

FIGURE 03. CAMPUS PAVING PLAN



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LEGEND

University Walk

University Way

International Mews & Research Road

East-West Promenade

GREEN CONNECTORS:

1 Mid-Campus Connector

2 Knowledge Lane

3 Discovery Avenue Greenway

CAMPUS TRAILS:

1 Pine Loop Trail

2 Old Pond Trail

Other Nature Trails

**Width:**

- a. Sidewalks and other necessary public realm walkways shall be at least 2m (6') in width for snow clearing devices and free of obstructions including furniture, trees, campus planters, and other vertical elements such as poles and fire hydrants.
- b. Sidewalks adjacent to roads shall be setback a minimum 1.2m (4') from the back of curb to provide a campus planting strip for lawn, shrubs or trees unless otherwise approved. This requirement may be relaxed if there are rainwater management or other functional opportunities that are otherwise better accomplished by reducing it.
- c. Walkways elsewhere in the public realm shall respond as much as possible to the natural paths of travel or 'desire lines' of pedestrians.
- d. Pedestrian areas must also be free from all obstructions for the full expanse of the paved surface to a height of no less than 2m (7'), except handrails, which are permitted to project no more than 100mm (4") from either or both sides into the clear area.

**Gradients:**

- a. Slopes in paved pedestrian areas shall not exceed a ratio of 1:20 (5%).
- b. Long continuous slopes of 1:20 (5%) are not permitted in pedestrian paving without landings, except where natural topography makes this impractical.
- c. Continuous gradients in excess of 5% shall be designed as ramps.
- d. A minimum 0.5% cross slope on any paved area must be provided to achieve positive drainage and may not exceed 2%.

**Changes in Grade:**

- a. When the vertical drop from a pedestrian area to an adjacent surface is more than 75mm (3"), a curb or other barrier no less than 75mm (3") must be provided. Care should be taken to ensure that any joints are as flush as possible, with a maximum tolerance of 6mm (1/4").

**Materials:**

- a. In principle, paving materials should be selected and laid out in a way that creates an intentionally designed transition between paving materials, patterns and colors.
- b. All new exterior pathways and upgrades to existing routes must employ paving as outlined in section 2.2.3 of this document.
- c. Where appropriate and without diminishing campus unity or dignity, consultants may propose the addition of secondary paving materials or patterns to add interest or contribute to sense of place (e.g. stone).
- d. Where paving is repaired, it must be done to match the material and pattern of existing paving. Where this is not possible or desirable, identify which area it falls within according to the Campus Paving Plan (Figure 03) and install paving that meets the criteria described in the following section (2.2.3).

### 2.2.3 Paving Type by Area

**University Walk (Type 1):** Designers are to apply precedent design standards to any further expansion of this walkway. At paving intersections or elsewhere where the paved area expands outside the typical width of University Walk, the material shall not be composed of pavers in order to convey a clear expression of dominant hierarchy to University Walk. It is anticipated that University Walk (Type 1) paving will be bisected by paving materials established in University Way in order to address material transition and spatial hierarchy. Likewise, it is anticipated that Type 1 paving will be modified at the Central Courtyard where Type 1 and Type 4 paving intersect. Designers are encouraged to explore possible solutions to reconcile materials and address spatial hierarchy. However, in principle, it is anticipated that Type 1 paving will be bisected at the courtyard with the introduction of a more simple plain of concrete paving.

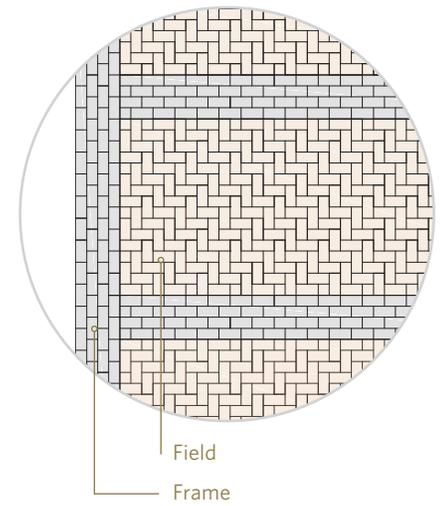
- a. **Material:** Standard concrete pavers.
- b. **Finish:** Sandblasted, unsealed.
- c. **Sizes:** 225mm long x 112.5mm wide x 80mm thick (8-7/8"L x 4-7/16"W x 3-1/8"T).
- d. **Walkway Width:** 6m (20') or as established.
- e. **Pattern (Field):** Interlocking herringbone laid parallel with walkway edge, fields to be +/- 1.8m (6' long) by width of walkway.
- f. **Pattern (Frame):** Fields to be separated by 4 course wide frame of pavers in running bond pattern, walkway edges to receive 4 course wide frame of pavers in running bond pattern.
- g. **Colour (Field):** Desert sand.
- h. **Colour (Frame):** Brown.
- i. **Jointing Sand:** Polymeric jointing sand or equivalent jointing materials in paving joints to inhibit organic residues and weed growth in paving joints.

**University Way (Type 2):** This walkway has not yet been built. Guidelines to be determined subject to final design and funding.

**International Mews and Research Road (Type 3):** This walkway is almost entirely complete with only the northern extension of International Mews to be finished. Designers are to apply precedent design standards to any further expansion of this walkway. At paving intersections or elsewhere where the paved area expands outside the typical width of International Mews / Research Road (Type 3), the material shall not be composed of pavers in order to convey a clear expression of dominant hierarchy to Type 3. Careful consideration will need to be given to the reconciliation of Type 3 paving where it intersects with paving in University Way.

FIGURE 4A. TYPE 1 PAVING PATTERN

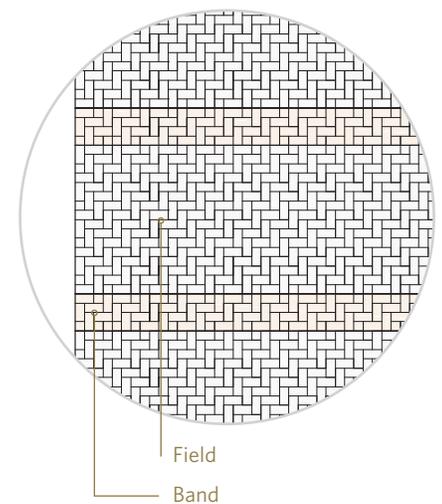
University Walk



This graphic is a sample window of the paving pattern and does not show the paving area in its entirety.

FIGURE 4B. TYPE 3 PAVING PATTERN

International Mews & Research Road

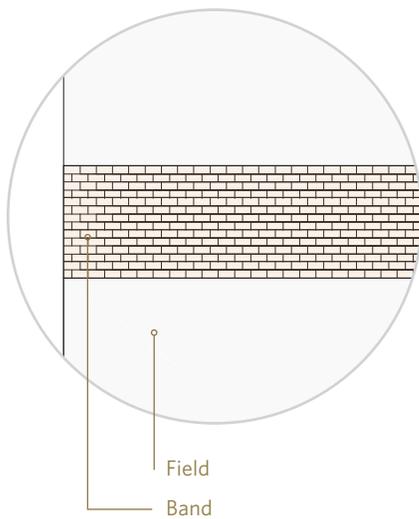


This graphic is a sample window of the paving pattern and does not show the paving area in its entirety.

- a. **Material:** Standard concrete pavers.
- b. **Finish:** Sandblasted, unsealed.
- c. **Sizes:** 225mm long x 112.5mm wide x 80mm thick (8-7/8" L x 4-7/16" W x 3-1/8" T).
- d. **Walkway Width:** 6m (20') or as established.
- e. **Pattern (Field):** Interlocking herringbone laid parallel with walkway edge. Fields to be +/- 1.8m (6') long by width of walkway.
- f. **Pattern (Band):** Fields to be separated by 450mm (18") wide band of pavers in interlocking herringbone pattern; walkway edges at lawn or concrete pavers to framed by 150mm (6") wide band of cast in place concrete flush with surface of pavers; no concrete band is required to frame walkway edge when it abuts adjacent concrete paving.
- g. **Colour (Field):** Natural.
- h. **Colour (Band):** Brown.
- i. **Jointing Sand:** Polymeric jointing sand or equivalent jointing materials in paving joints to inhibit organic residues and weed growth in paving joints.

FIGURE 4C. TYPE 4 PAVING PATTERN

East-West Promenade



▲ This graphic is a sample window of the paving pattern and does not show the paving area in its entirety.

**East-West Promenade (Paving Type 4):** The segment from the foot of the stairs up to the Central Courtyard to the Gathering Circle is complete and should be considered the standard precedent for ongoing design development of the Promenade across the courtyard up to Research Road. At paving intersections (cross-paths), the material of the intersecting paving shall 'protrude' into or 'overlay' East-West Promenade (Type 4) paving. In situations where the paved area expands outside the typical width of the East-West Promenade, the material of the adjacent paving must provide a contrast such that the East-West Promenade is clear and legible. It is anticipated that Type 4 paving will be bisected by paving materials in a redeveloped Central Courtyard in order to address material transition and spatial hierarchy. Designers are encouraged to explore possible solutions to reconcile materials and address spatial hierarchy. However, in principle, it is anticipated that Type 4 paving will be bisected at the courtyard with the introduction of a more simple plain of concrete paving.

- a. **Material:** Cast in place concrete with standard concrete paver banding.
- b. **Finish (concrete):** Medium broom finish; brush strokes to be perpendicular to primary direction of travel; brush strokes to be consistent and parallel with joints and edges; tooled or saw cut joints; broom away trowel lines or "window frames".
- c. **Finish (concrete paver):** Sandblasted, unsealed.
- d. **Paver sizes:** 225mm long x 112.5mm wide x 80mm thick (8-7/8" L x 4-7/16" W x 3-1/8" T).
- e. **Walkway width:** 6m (20') wide or as established.
- f. **Pattern (Field):** Fields to be +/- 7.0m (24') long; joints in concrete to be based on established onsite precedents.

- g. **Pattern (Band):** Fields to be separated by a band composed of 14 courses of concrete pavers laid out in running bond pattern.
- h. **Colour (Concrete):** Natural Grey.
- i. **Colour (Paver band):** Brown.
- j. **Jointing Sand:** Polymeric jointing sand or equivalent jointing materials in paving joints to inhibit organic residues and weed growth in paving joints.

**Mid-Campus Connector (Paving Type 5):** The character of this pathway varies depending on its context. A portion of the proposed pathway alignment runs perpendicular with the East-West Promenade and along the edge of the Transit Exchange. The section between Kalamalka Residence and Monashee Residence is comprised of existing stairs. The overarching goal of this corridor should be to create a more legible, organic and informal character over its entire length as identified in the Campus Paving Plan (Figure 03). Where Type 1 and Type 3 paving intersect with Type 5 paving, designers may consider bisecting Type 5 paving in order to make it more legible and an animating feature of the campus.

- a. **Material:** Cast in place concrete; other materials (e.g. stone) may be considered in place of or in addition to concrete as a means of enhancing the juxtaposition of the built campus and its natural edge.
- b. **Finish:** Medium broom finish; brush strokes to be perpendicular to primary direction of travel; brush strokes to be consistent and parallel with joints and edges; tooled or saw cut joints; broom away trowel lines or “window frames”; other finishes to concrete or alternative materials may be considered as a means of enhancing the juxtaposition of the built campus and its natural edge.
- c. **Walkway Width:** Minimum of 2m (6’) wide anywhere along its length. However, width is to be guided by the programmatic and space needs of adjacent uses.
- d. **Pattern:** Rectangular grid; Dimensions as appropriate; Pattern varies for alternate approved materials.
- e. **Colour:** Natural grey, colour varies for alternate approved materials.

**Knowledge Lane (Type 6):** Like the Mid-Campus Connector, the character of this pathway is more serpentine and informal than the East-West Promenade. In addition to serving as a primary east-west pedestrian corridor, this pathway also accommodates service vehicle access. Where possible, the existing road should be redesigned without a curb to convey a message of pedestrian priority. Paving should be flush with adjacent landscape. Bollards or other means of defining the pathway are required.

- a. **Material:** Cast in place concrete.
- b. **Finish:** Medium broom finish; Brush strokes to be perpendicular to primary direction of travel; brush strokes to be consistent and parallel with joints and edges; tooled or saw cut joints; broom away trowel lines or “window frames”.

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- c. **Walkway Width:** 6m (20') wide anywhere along its length.
- d. **Pattern:** Rectangular grid, dimensions as appropriate.
- e. **Colour:** Natural Grey.

**Discovery Avenue Greenway (Type 7):** The most serpentine of the major north-south pedestrian ways varies in contextual character and must address some significant grade changes.

- a. **Material:** Cast in place concrete
- b. **Finish:** Medium broom finish; brush strokes to be perpendicular to primary direction of travel; brush strokes to be consistent and parallel with joints and edges; tooled or saw cut joints; broom away trowel lines or "window frames".
- c. **Walkway Width:** to be determined subject to final design and project funding.
- d. **Pattern:** Rectangular grid, dimensions as appropriate.
- e. **Colour:** Natural grey.

**All other paved areas (Type 8):** Unless otherwise specified follow these specifications:

- a. **Material:** Cast in place concrete.
- b. **Finish:** Medium broom finish; brush strokes to be perpendicular to primary direction of travel; brush strokes to be consistent and parallel with joints and edges; tooled or saw cut joints; broom away trowel lines or "window frames".
- c. **Walkway Width:** Minimum 2m (6') wide free of any obstructions.
- d. **Pattern:** Rectangular grid, dimensions as appropriate.
- e. **Colour:** Natural grey.

**Pine Loop and Old Pond Trail (Type 9):** Informal trails will be allowed to permit jogging, walking and other passive activities in campus natural areas except where such trails pose a safety hazard or otherwise harm the viability of existing flora and fauna. Trail heads should be clearly marked with a map and a distance. Trails are not to be lit at night in order to discourage use. Connections to community trails should be clearly marked as part of the campus wayfinding system. UBC should work together with the City of Kelowna and private property owners/ developers to ensure that these connections are realized.

Adherence to the WSIP's vision to provide an ecologically rich and diverse campus environment is critical in the development and maintenance of trails. Existing ecological assessment and reports on species at risk should be referenced to ensure adherence to best management practices.

*Pine Loop Trail / Old Pond Trail (North-East Section):*

- a. **Material:** Compact aggregate (e.g. 25mm (1") diameter crush rock to depth

of 8cm (3"); topped with 2cm (3/4") of clean crusher chips) with a granular base; avoid mulch for trail systems due to fire risk.

- b. **Width:** 2m (6') with unobstructed clear width of 0.5m (1'-12") on each side of the trail for maintenance service access with a clear height of 2.4m (8').

*Old Pond Trail (South/West Section) and other Nature Trails:*

- a. **Material:** Compact native soil with compact aggregate where appropriate; avoid mulch for trail systems due to fire risk.
- b. **Width:** 0.5 to 1m (1'-12" to 3') with unobstructed clear width of 0.5m (1'-12") on each side of the trail for maintenance service access with a clear height of 2.4m (8').

Refer to Kelowna [Linear Parks Master Plan](#) 'Class 6: Nature Trails'

### 2.2.3 Screening, Utility Structures and Generators

There are no specific locations where the placement of enclosures are identified. Implementation will happen on an as needed basis to enclose things that are not meant to be seen, such as trash bins.

- a. **Screening:** to be provided around storage areas, trash/recycling collection bins, and mechanical structures; height shall be sufficient to fully conceal the objects that are to be screened, to be diamond-pattern vinyl-coated chain link with slats woven vertically through the grid; all component parts, including strapping, to be vinyl-coated black. Solid cedar wood board fences may also be considered where they are compatible with the architecture and the profile of the surrounding public realm (e.g. 'back of house' or high visibility 'front of house'). Any environmentally superior alternatives to vinyl-coated chain link fencing and associated components will be considered if they can achieve a similar aesthetic goal.
- b. **Utility Structures and Generators:** Utility structures and generators are to be painted Utility Grey or provided with a decorative wrap as appropriate and/or as permitted by the utility company. The graphic shall be an image associated with the adjacent planting in order to provide as much camouflage to the structure as possible. Any environmentally superior alternatives to decorative vinyl-based wraps will be considered if they can achieve a similar aesthetic goal.

### 2.2.4 Surface Parking Lots

Given the extensive area devoted to parking, surface parking can have a significant aesthetic and environmental impact. The primary objectives of parking design guidelines are to:

- Support the university's Sustainability and IRMP requirements
- Mitigate and reduce the urban heat island effect
- Integrate with the existing or planned campus context
- Enhance and/or maintain green spaces
- Improve public realm safety, appearance, comfort, and connectivity
- Manage and reduce rainwater runoff in compliance with the IRMP

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The design of surface parking lots are to follow these standards (in addition to satisfying any requirements of the City of Kelowna):

- a. A ratio of one tree per five parking spaces is required for aesthetics and to reduce heat island effects. In order to make snow clearing efficient, trees may be arranged singly, in groups in parking islands, or around the periphery of parking areas.
- b. Trees should be planted in at least 30 cubic meters at 0.9 m depth (1,060 cubic feet at 3ft depth) of good quality soil.
- c. Slope surfaces to direct rainwater toward landscaping, rain gardens or other water collection areas, as identified on the site with suitable salt, drought, flooding and pollution-tolerant plant species.
- d. Snow storage areas should be located away from streets and other areas where sight lines and streetscape quality are a priority. Recommended locations for snow storage include bio-retention areas (where provided) and parking over-flow areas. Development Plans must indicate location of snow storage areas.
- e. Parking lots are large impermeable areas that should be used to capture rainwater - incorporate on-site rainwater management in compliance with the IRMP's minimum retention requirements.
- f. Foster pedestrian safety by making pedestrian routes distinct and legible with painted pedestrian routes or separate sidewalks.

### 2.2.5 Anti-Skate Hardware

It is imperative that hard landscape steps, furniture, walls and railings are designed to be resistant to skateboarding damage. Design strategies can include incorporation of air gaps, notching, and offsets in seat walls, uneven surfaces, uneven adjacent paved surfaces that preclude skateboarding, and other creative alignments and articulation of surfaces, walls, steps and railings.

Metal breaks and studs installed on the surface of target areas are sometimes subject to tampering and vandalism and should be designed to be as durable and vandal resistant as possible where this approach is employed.

Metal breaks and studs must not be located more than 45cm (18") from ends of any target feature. Spacing between metal surface protrusions shall be approximately 90cm (36").

*Anti-Skate Surface Mount:*

- a. **Manufacturer:** Skate Stoppers (phone: (619) 447-6374; website: [www.skatestoppers.com](http://www.skatestoppers.com)).
- b. **Model:** FA 902.5.
- c. **Material:** 6061-T6 aluminum.
- d. **Finish:** Hard tumbled to remove all machined and/or cut edges. Aluminum finish options include Type II Clear Anodize or Hard Anodize.

- e. **Corner Radius:** For corner with 15mm (1/2") radius.
- f. **Outside Dimensions:** 50mm (2") wide x 100mm (4") deep x 60mm (2-3/8") tall.
- g. **Anchoring:** Anchored with two offset through holes for SMART PINS PLUS anchors. Use anchors in conjunction with two-part epoxy.
- h. **Spacing:** 450mm (18") from end of planters/walls and approximately 900mm (36") centers. Do not apply at grout joints.

Alternative manufacturers/suppliers may be considered if they meet performance specifications. Any alternatives must be approved by Campus Planning and Development.

### 2.2.6 Planter and Seat Walls

- a. **Cast in place concrete:** Parged and sandblasted with right angle corners. No beveled corners on horizontal or vertical surfaces.
- b. **Brick:** Acceptable where materiality is an extension of building architecture.
- c. **Stone:** Local limestone. Other stone is acceptable where materiality is an extension of building architecture.
- d. **Guard rail:** to be provided if landscape walls exceed 2ft in height.

## 2.3

### SOFTSCAPE

#### 2.3.1 Planting

Campus planting design presents an opportunity to strengthen the intimacy and legibility of campus spaces and places, while celebrating the surrounding Okanagan landscape, to achieve a distinguished and compact campus within an indigenous landscape setting.

In general, designers should default to a style that is more informal and naturalistic rather than linear and formal. Naturalized drifts of related campus plants are generally preferred over monocultural mass plantings. Native plants are preferred over non-native as an aesthetic, environmental approach and learning opportunity.

Designers should seek to select plants and create planting that look good in four seasons but particularly in the fall, winter and spring when the campus population is at its peak. To this end designers must give thoughtful consideration to foliage colour, bark, branching pattern, seed heads, berries, persistence into fall, and overall presence during their dormant period.

Unless otherwise specified in these guidelines, all campus landscapes should conform to the methods and materials specified in the *Canadian Landscape Standard*.

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- a. **Selection:** Select hardy, vigorous, drought tolerant plants that can resist being overwhelmed by weed growth. Select pest and disease resistant trees and plant material.

Plants should be selected that do not contain toxic substances or produce dusts, exudates or odours that cause irritation, chemical burns, poisoning or allergic reactions. Check authoritative references. See also, [WorkSafe BC, Toxic Plant Warnings](#).

- b. **Discouraged Plants:** No plants identified by [The Okanagan and Similkameen Invasive Species Society](#) (OASISS) will be used. Case-specific exceptions may be considered subject to approval by Campus Planning and Development.

Avoid plant species that are known to have a high susceptibility to insect and disease infestations. Select plant species that are known to exhibit a high degree of pest and disease resistance.

Avoid plant species that spread into thickets with underground rhizomes. Where variances to this guideline may have been granted by reviewers, plantings with these characteristics must be contained with enclosed root barrier of the required depth to prohibit root migration into adjacent plantings, structures, buildings, ponds, irrigation or drainage systems.

- c. **Arrangement:** "Simplicity of Scale" — At the campus wide level, all new and replacement plantings are to be designed with an institutional scale characterized by simple palettes of plants arranged in broad layers of massed plantings. Give careful consideration to the need for planting areas and avoid where possible to reduce maintenance.
- d. **Green Infrastructure:** Softscape that is intended to provide a rainwater management function should reference design specifications provided in the [IRMP Part 2: Maintenance Manual](#).

### 2.3.2 Soils

Specifying soils and growing media that are guaranteed free of pernicious weeds and seeds plays a critical role in fulfilling UBC's policy of avoiding the use of toxic chemical pesticides and herbicides on campus grounds. Adhere to *British Columbia Landscape Standards*. Testing shall be performed on all soils.

Soil depths are to be as follows: Trees - 600mm (24"), Shrubs - 450mm (18"), Lawns - 200mm (8")

### 2.3.3 Irrigation

Refer to [UBC Okanagan Irrigation Specifications](#). Wherever possible, sub surface drip irrigation systems are to be provided.

### 2.3.4 Landscape Edges

- a. No edging is to be used to separate plant beds or tree pits from lawn areas. Manually cut edges of plant beds and tree wells.

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- b. Edging is to be used to separate areas of gravel. Bender boards (recycling plastic wood-like products) to be used to separate gravel areas from lawn or plant beds. Metal (aluminum) may be considered and approved with written support by Campus Planning and Development. Permaloc “cleanline” mill finish. 5mm (1/5”) thick x 100mm (4”) depth.

### 2.3.5 Lawns

- a. Provide "Eco Blue Blend" - A local source, eco-friendly Kentucky bluegrass blend available as seed or sod (website: [www.ecoturffarms.com/products/turf/eco-blue-blend.html](http://www.ecoturffarms.com/products/turf/eco-blue-blend.html); phone: (250) 765-9429).

### 2.3.6 Meadows

- a. Apply hydroseeding, especially for sloped or non-irrigated areas. This should only be performed during the early spring or mid fall.
- b. **Seed Mix:** Agronomic Dry Land Mix (50kg/HA)
 

Crested Wheatgrass ( <i>Agropyron cristatum</i> ):	25%
Slender Wheatgrass ( <i>Elymus trachycaulus</i> ):	25%
Rough Fescue ( <i>Festuca campestris</i> ):	24%
Annual Rye ( <i>Lolium multiflorum</i> ):	20%
Perennial Rye ( <i>Lolium perenne</i> ):	5%
Canada Blue Grass ( <i>Poa compressa</i> ):	1%
Long Leaved Aster ( <i>Symphotrichum ascendens</i> ):	<1%
Douglas Aster ( <i>Symphotrichum subspicatum</i> ):	<1%
- c. **Supplier:** Premier Pacific Seeds Ltd. can do custom mixtures (website: [www.premierpacificseeds.com](http://www.premierpacificseeds.com); phone: 1 (800) 433-5153).

### 2.3.7 Mulch

- a. Provide “Nature’s Gold” or equivalent to a depth of 75mm (3”) (website: [www.naturesgold.ca/products/mulches/](http://www.naturesgold.ca/products/mulches/); phone: (250) 862-6476).
- b. No bark is permitted to be used on campus due to fire hazards.

### 2.3.8 Grading

Whether lawn, groundcover or shrubs, careful consideration must be given to gradients, adjacent surface materials and slopes, ease of maintenance, and safety of grounds staff. Lawns and grass areas must be graded at slopes safe for mowing by maintenance crews and safe for all other campus users.

- a. Maximum allowable slope for lawns is 5:1. Slopes over 5:1 are only permitted where pre-approved by the Campus Landscape Architect in consultation with the Manager, Landscape and Contract Services.
- b. Grades of lawns and plantings shall comply with best management practices related to site drainage, and be kept within safe, stable and maintainable limits using appropriate slope retention design and construction methods.

- c. Site specific design strategies should be used to avoid excessive, inaccessible or unsafe slopes (lawns or plantings). Such strategies may include, but not be limited to: terraced landscapes, retaining walls, enclosed planters, access ramps, pathways and stairs.
- d. Sloped landscapes must be graded appropriately in relationship to buildings, hardscape and other site elements such that mowers, excavators or other equipment used for maintenance or renovation purposes are not at risk of losing traction, slipping, and rolling downslope causing injury to operators, bystanders, or damage to property.
- e. Balancing cut and fill and aesthetic grading considerations should not result in excessive mounding of soils such as to create knolls, hummocks or slopes that cannot be negotiated safely by landscape maintenance staff (either on foot or with power equipment).
- f. Grade at toe of steeper mown slopes must be graded to avoid mower-rollover or slippage due to abrupt grade discontinuities into top of retaining walls, or adjacent flat surfaces such as roads and walkways.
- g. Avoid planting trees within steep sections near toe of slopes unless conditions stated above have been met.
- h. Sloped landscapes must be structurally stable, and be resistant to surficial erosion or shifting of under-bearing soils, plants, trees or geotextile. Landscape maintenance staff must be able to access and negotiate sloped landscapes on foot or with equipment as needed without undue ergonomic stress, potential injury, loss of footing, or loss of equipment control.
- i. For specialized circumstances, such as planted slopes for rainwater detention ponds, or stream bank stabilization, variance from the above criteria may be granted subject to pre-approval by the Campus Landscape Architect in consultation with the Manager of Landscape and Contract Services. Nonetheless, erosion control technologies such as matting, geo-grids, geo-synthetic bags etc. must be used to ensure stability of soils, mulches and the proper establishment of slope plantings as discussed above.
- j. Under no circumstances should rough or finished grades of lawn, planting or paving result in the burying or otherwise obscuring of existing utility service covers, valve-boxes, manholes, catchbasins, or the like. Should a circumstance arise where a service will fall below proposed finish grades, contractor must halt work and contact the owner immediately before proceeding

### 2.3.9 Campus Trees

- a. **Street Trees:** These will, over time, bring beauty and coherence to the campus while still allowing a wide range of seasonal colour, scale, and biodiversity. Gateways, special places and routes are accentuated. The decision to apply consistency or diversity of species to any particular campus streetscape will be dependent on the extent to which a precedent has already been established, or where there are unique aesthetic or ecological goals that need to be met. Any deviation from existing precedent will be selected based on best practice for street tree selection and enhancement of campus biodiversity. Tree locations and species should be carefully considered for their potential to minimize heat island effects and to influence the heating and cooling of buildings. Unless directed otherwise by Campus Planning and Development, street trees shall be consistent with others on the street.

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- b. **Tree Retention/Protection:** Existing healthy trees over 10cm (4") caliper (diameter at breast height) on a project site shall be retained in any new proposal where possible, or conserved through relocation on campus. During construction, tree protection fencing is required around all trees identified for retention in the review process by Campus Planning and Design in order to protect their root zones and branches. Refer to the [Tree and Shrub Preservation Technical Guidelines](#) for more information on best practice.
- c. **Arborist Advice:** Where existing trees over 10cm (4") in diameter are impacted by development, detailed recommendations for retention and protection during construction must be obtained from a certified arborist, to the satisfaction of Campus Planning and Development.
- d. **Special Trees:** Every reasonable effort shall be made to protect the following special trees in particular: Class and commemorative trees (locations of all new trees to be approved by Campus Planning and Development).

### 2.3.10 Food Gardens and/or Learning Gardens

Food growing gardens sponsored by student, staff, or faculty may be considered on a case by case basis in discussion with Campus Planning and Development. Under no circumstances will the establishment, operation and maintenance of any approved food garden fall to the maintenance and operational responsibilities of Facilities Management.

## 2.4 SITE FURNITURE

The selection of site furnishings shall support use of the public realm in all seasons of the year and enable students to do outside as much as possible of what they might otherwise be doing inside. Accordingly, furnishings should manage sun and wind to maximize human comfort. The selection and location of site furnishings should create campus cohesion, and the desired institutional character of a world-class campus and support use of the public realm for academic purposes, for sharing of ideas and for interaction. Criteria for design and selection of site furnishings should include consideration of sustainable, resilient and low maintenance materials. All site furniture selections, designs and arrangements should provide for equitable use and universal access.

### 2.4.1 Tables and Seating

**Custom Table/Seating Design:** Site furniture is encouraged to be built *in situ* as integrated architectural landscape elements. Designers are invited to be creative in terms of design, function and configuration of site furniture. Seating elements typically should include bench tops or other material surfaces to add thermal comfort and usability during the shoulder seasons and winter months. Designs are subject to approval by Campus Planning and Development.

- a. **Minimum Length:** 1.8m (6') long.
- b. **Material:** Resysta.

- c. **Material Size:** 1 x 3's on edge.
- d. **Colour:** FVG - C14 Siam sealed with Resysta 2k sealer.
- e. **Spacing between slats:** 30mm (1").
- f. **Spacers:** At distance sufficient to avoid warping.
- g. **Fastening and anti-skate hardware:** Galvanized or stainless steel.

**Standard Catalogue Bench:** Where built-in-place benches are not appropriate, the following catalogue bench is to be used:

- a. **Manufacturer:** landscapeforms (phone: toll free (800) 521-2546; website: [www.landscapeforms.com](http://www.landscapeforms.com)).
- b. **Model:** Neoliviano bench with back and arms.
- c. **Length:** 175 m (69").
- d. **Height:** 79 cm (31").
- e. **Depth:** 68 cm (27").
- f. **Frame:** Cast aluminum.
- g. **Back and seat:** Jarrah wood.
- h. **Mounting:** Surface.
- i. **Frame Finish:** Polyester powder coat finish baked at high temperature sufficient to produce a mar-resistant finish.
- j. **Frame Colour:** Utility Grey (GP 3979A or RAL 7043).
- k. **Wood species:** The specified timber shall be Forest Stewardship Council (FSC) Canada - Certified, dimensionally stable, fungus resistant and of hardness equivalent to Ipe.
- l. **Dimensions:** 1.8 m (6') length.

Alternative manufacturers/suppliers may be considered if they meet performance specifications. Any alternatives must be approved by Campus Planning and Development.

**Picnic Tables:** to be considered on a case-by-case basis.

**Movable Seating:** Movable seating is welcomed on the campus where there is a champion who will account for and maintain it. Chair styles are subject to approval by Campus Planning and Development. Refer to section 4.4 *Unique Use Palettes* for information on colour specifications.

## 2.4.2 Bike Racks and Lockers

### Exterior Bike Racks:

- a. **Manufacturer:** Urban Racks (phone: 1 (888) 717-8881; website: [www.urbanracks.com](http://www.urbanracks.com)).
- b. **Model:** Urban Staple - UB-1000-STD.
- c. **Material:** Hot dipped galvanized steel or stainless steel.

- d. **Mounting:** Inverted U racks to be mounted on concrete in a row shall be placed on a minimum of 800mm (32") centres and maximum 900mm (36") centers. This allows enough room for two bicycles to be secured to each rack. Spacing to be selected to maximize bike racks - spacing closer to 900mm (36") is desired to maximize user experience.
- e. **Placement:** Parking stand area depth shall be 2440mm (96") to ensure bikes do not encroach into circulation space or into landscaping.

The minimum distance from a wall or landscaped edge to the base of the bicycle rack is 610mm (24"). This will provide sufficient space for a bike to be parked at the centre of the rack and not overhang a concrete pad into landscaping.

Provide a standard aisle measurement of 1525mm (60") (can be narrowed in certain instances with approval).

**Exterior Bike Lockers:** Lockers are managed by UBCO Parking, and locker locations are determined and approved by Campus Planning and Development.

- a. **Manufacturer:** Urban Racks (phone: 1 (888) 717-8881; website: [www.urbanracks.com](http://www.urbanracks.com)).
- b. **Model:** Urban Bike Locker - UBL-2000-STD.
- c. **Material:** Powder coated.
- d. **Locking Mechanism:** SALTO key-less electronic system ([www.saltosystems.com](http://www.saltosystems.com)).
- e. **Colour:** to match other lockers on campus.

### 2.4.3 Tree Grates

Based on the experience of UBC Facilities Management, the planting of trees in grates is strongly discouraged as the growth potential of trees is diminished and snow clearance is made more difficult. They may only be considered for use when space is so limited that sufficient pedestrian space cannot otherwise be provided. Allowance is subject to approval by Campus Planning and Development.

### 2.4.4 Bollards

No illuminated bollards are permitted for use on the campus. The following specifications are to be used where free-standing bollards are required.

#### Stationary Bollard:

- a. **Manufacturer:** Frances Andrew Site Furnishings Ltd. (phone: (800) 565-6579; website: [www.francesandrew.com](http://www.francesandrew.com)).
- b. **Model:** Series 32 SB32-P1-UBC Small Radius.
- c. **Material:** Steel tube housing.
- d. **Mounting:** 150mm (6") schedule 40 steel pipe, in-ground 610mm (24") deep on concrete base only.

#### EXTERIOR BIKE RACKS



▲  
Bike racks are to be installed on a concrete pad.

- e. **Finish:** Utility Grey (General Paints #GP 422-7 or International Standard #RAL 7043).
- f. **Height:** 915mm (36").
- g. **Diameter:** 150mm (6").
- h. **Spacing:** 2.2m (7') on centre to accommodate small vehicles.

Alternative manufacturers/suppliers may be considered if they meet performance specifications. Any alternatives must be approved by Campus Planning and Development.

**Collapsible Bollard:** the following specification is to be used where freestanding removable bollards are required.

- a. **Manufacturer:** MaxiForce (phone: (410) 552-9888; website: [www.maxiforcebollards.com](http://www.maxiforcebollards.com)).
- b. **Model:** MaxiForce Collapsible Bollard with wrench operated hinge.
- c. **Material:** Steel tube housing.
- d. **Mounting:** Complete with 200mm (8") deep footing.
- e. **Finish:** Power coated Utility Grey (General Paints #GP 422-7 or International Standard #RAL 7043).
- f. **Height:** 810mm (32").
- g. **Width:** 1500mm x 750mm (6" x 3").
- h. **Spacing:** 2.2m (7') on centre to accommodate small vehicles.

Alternative manufacturers/suppliers may be considered if they meet performance specifications. Any alternatives must be approved by Campus Planning and Development.

#### 2.4.5 Trash and Recycling Receptacles

- a. **Manufacturer:** Big Belly Waste and Recycling (phone: 1 (888) 820-0300; website: [www.bigbelly.com/platform/](http://www.bigbelly.com/platform/)).
- b. **Model:** High Capacity Double Station (HC5/HC5) Smart, Solar-Powered Compacting Model (150 Gal/570 L). Contact Facilities Management to confirm latest model.

#### 2.4.6 News and 3rd Party Distribution Boxes

News and other 3rd party distribution boxes are not to be installed in the public realm.

### 2.4.7 Electrical Outlets

Electrical power outlets are to be incorporated into the design of seat walls and custom designed seating and table structures to support usage of the furniture for study and social activities. Outlets must not protrude from the face of the surface on which they are located.

### 2.4.8 Commemorative Signage

See section 4.10 of [UBC Signage Standards and Guidelines](#) for requirements for commemorative signage.

### 2.4.9 Special Initiatives and Installations

Campus Planning and Development will consider student and faculty led initiatives and installations on a case by case basis. The introduction of new initiatives and/or installations within the campus public realm must be thoughtfully considered. The approval process will seek proposals that enhance learning and animation.

### 2.4.10 Public Art

Proposals for public art installations are to reviewed and approved by the UBC Okanagan Public Art Collection Curator. Siting of approved projects for outdoor spaces is determined by Campus Planning and Development.

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## 2.5

### ACCESSIBILITY

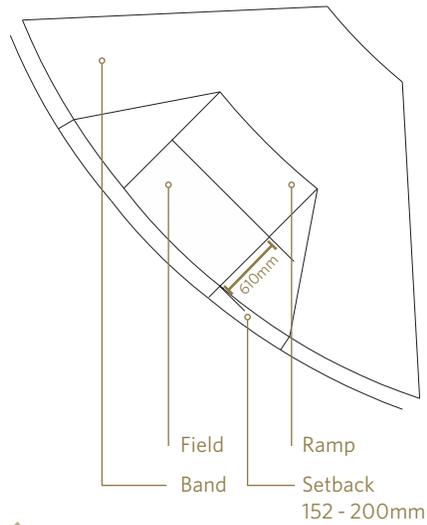
The design of all spaces shall be barrier free, welcome all users and facilitate effective access to people of all ability levels. Every public realm design intervention must be conceived to support the university's goal of a barrier free campus and to ensure equal participation by people of all ages and abilities.

UBC is committed over time to providing dignified, welcoming, and effective access to people of all ability levels, to all buildings and public realm areas where people are expected to engage in the life of the university. In addition to meeting the accessibility provisions of the BC Building Code and associated *Building Access Handbook* (2009 - or updated version if available), all new public realm designs must address equitable use. In other words, designers shall wherever possible design spaces to create the same means of access for all users, or integrate them in such a way as to avoid segregation of users by physical abilities.

- a. **Stairs:** The introduction of stairs shall be avoided where grades are sufficient to provide graded accessibility. Where stairs are required, no fewer than 3 risers shall be included in any set of stairs in order to avoid creating a trip hazard.
- b. **Ramps:** Ramps with slopes not exceeding a 1:12 ratio (8.3%) may be used to provide access between level paved areas and landings. The length of any single ramp segment of an accessible pathway is to be coordinated with its gradient so that for every vertical climb of 75cm (2'-6") there is a level landing to give the user a brief respite. Standards for acceptable height, width, guards, length, landings and handrails must be provided as described in the *BC Building Access Handbook*. Curved ramps should be avoided unless the radius is extremely large.
- c. **Handrails:** Must be included on all stairs including those with less than 4 risers in accordance with *BC Building Access Handbook* requirements. Handrails must be continuous through landings of contiguous flights of stairs. Anti-skate hardware or design must be included without any reduction in usability. Pathways with slopes less than a 1:20 ratio (5%) do not require a handrail. A slope up to a 1:16 ratio (6%) requires one handrail. Slopes between 1:16 (6%) and 1:12 (8%) require 2 handrails.
- d. **Curb ramps:** Where a pedestrian path crosses a road or service lane, a tactile warning pad shall be provided to alert pedestrians. A 600mm (24") long tactile warning surface shall be embedded into the entire width of a curb ramp or pedestrian crossing area. The tactile warning surface shall be comprised of vitrified polymer composite (VPC) tiles. Color: pearl white.
- e. **Raised crosswalks:** Where a pedestrian path crosses a road or service lane, and is level with a vehicular right of way, the paving material of the pedestrian corridor shall extend across the road in order to convey pedestrian priority,

and a tactile warning pad shall be provided to alert pedestrians. A 600mm (24") long tactile warning surface shall be embedded into the entire width of a pedestrian crossing area. The tactile warning surface shall be comprised of vitrified polymer composite (VPC) tiles. Color: pearl white.

FIGURE 05. CURB RAMP DIAGRAM



▲ This graphic is a sample of a curb ramp and does not show the area in its entirety.

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# 3

# ARCHITECTURE

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## ARCHITECTURE GOALS

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1. Support user groups and campus vitality
2. Maximize compactness and flexibility
3. Contribute to campus cohesion
4. Integrate with topography
5. Maintain valley views

*The Okanagan Campus is envisioned as a community of buildings that work together to create a cohesive whole. At the same time, each building is encouraged to express its unique personality and respond to its particular position and role within the campus framework.*

## 3.1 INTRODUCTION AND GOALS

The UBC Okanagan Campus is envisioned as a community of buildings that work together to create a cohesive whole. Design campus buildings to respond to the service they provide, and to meet the following goals:

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### 3.1.1 Support user groups and campus vitality:

- Develop room configurations and building layouts to support the learning and research objectives and transformations sought by user groups.
- Contribute to the aesthetics and vitality of adjacent outdoor public spaces. Locate active uses of the building program on the ground floor, fronting outdoor social spaces and pedestrian corridors. Design for these ground floor active uses to anticipate flexibility and change over time.
- Site and arrange building massing to maximize sunlight access to outdoor social spaces (see *Figure 26, Build-to Map* and the *Places* section of the [Campus Plan](#)).
- Express towards the exterior public realm the culture and activities of user groups. Ground floor uses fronting the public realm should use transparent, non-tinted “low e” glazing to showcase the active uses within.
- Promote physical activity and wellbeing by locating stairwells in central locations and designing them as external beacons of vibrancy at night.
- Minimize the impact of parking and vehicle loading on campus walkability and pedestrian experience. Design loading storage enclosures as an aesthetically integrated part of the building architecture.
- Pursue opportunities to expand the amount of informal learning spaces with new development.

### 3.1.2 Maximize compactness and flexibility for change:

- Maximize the compactness of new buildings to make wise use of the limited campus land, enhance energy efficiency and contribute to a vibrant campus. Building programs should be located on appropriately sized sites or combined with other programs to achieve a minimum of 4 storeys for academic buildings and 6 storeys for residential.
- Design flexible buildings and spaces to accommodate a range of academic and research activities.

### 3.1.3 Contribute to campus cohesion:

- Place new buildings to frame open spaces and to heighten the experience and views of the surrounding landscape.
- In the campus core, align building footprints with the campus grid (see *Figure 26, Build-to map* in the *Campus Plan*). Outside the campus core, align building

footprints in response to both the dominant landscape contours and passive design objectives.

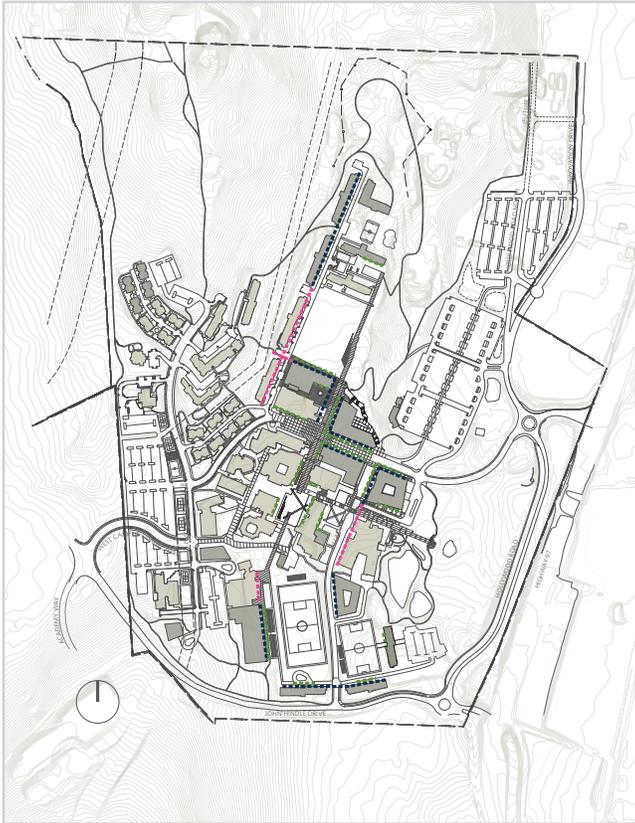
- Emphasize horizontal building proportions and expression to reflect the horizontality of the rolling Okanagan landscape.
- Design buildings to build campus cohesion. Start the design process with a contextual analysis of the adjacent buildings and landscape. Prioritize campus colour and material harmony consistent with the *Colour Guidelines* (see section 5). The only deviation to this visual cohesion requirement is reserved for buildings with uses of the highest academic status (such as the campus Teaching and Learning Centre). These ‘signature’ buildings are to balance contextual fit with one or two distinguishing design or massing qualities.
- Use durable exterior materials that minimize both the impact on the environment and total cost of ownership. The character and quality of the materials are to adhere to the *Colour Guidelines* (Section 5) and correspond to the hierarchy of the façade they are located on. Façades facing primary corridors and outdoor spaces are to use a higher quality material palette to communicate ‘permanence’ and ‘university’. Tertiary façades and exteriors of large research facilities in the Innovation Precinct may use a more moderate material palette to achieve an elegant utilitarian expression.

#### **3.1.4 Integrate buildings with topography:**

- Visually ground buildings within the landscape through massing that responds to topography and interior layouts that allow indoor activities to extend outward into landscape elements (e.g. patios, seating retaining walls, planters etc.). The building and the topography should read as being in dialogue.
- Reduce the impact of sloped topography for the mobility challenged by providing weather protection along primary pedestrian routes and creating elevator assisted routes through buildings that mediate major grade changes.

#### **3.1.5 Maintain key views:**

- Site and arrange building massing to maintain key views out into the valley (see *Figure 28, Key Views Map* in the *Campus Plan*).
- Roofs that can be viewed from above are to incorporate methods to improve their appearance. Selection of membrane and ballast colours must be compatible with the natural Okanagan landscape, per the *Colour Guidelines* (section 5).



◀ **BUILD-TO-LINES**  
Active Edges and Weather Protection, Figure 26, Okanagan Campus Plan

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◀ **KEY VIEWS**  
Figure 28, Okanagan Campus Plan

# 4

# GREEN BUILDINGS

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## GREEN BUILDINGS GOALS

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1. Achieve net positive performance
2. Support a low carbon future
3. Optimize water quality, supply and security
4. Enhance and/or restore ecology
5. Strive for full waste recovery
6. Divert 100% of rainwater from municipal systems
7. Support human health and wellbeing

*Green buildings reduce energy use, reduce greenhouse gas emissions and improve occupant health and well being.*

## 4.1 INTRODUCTION AND GOALS

The [Whole Systems Infrastructure Plan](#) (WSIP) defines and supports a long term vision for creating a sustainable campus using a whole systems approach that incorporates environmental, economic and social sustainability outcomes to achieve a net positive<sup>1</sup> impact on the wellbeing of the campus community and ecology. The WSIP provides an implementation framework for how this will be achieved, including recommendations for the Design Guidelines as well performance goals, both of which have been used in the development of guidance provided in this section.

As part of the whole systems approach, individual campus buildings need to contribute to the overall ambitious vision of a net positive campus articulated in the WSIP. To achieve this, building designs need to meet incrementally improved performance goals on the building scale and consider of impacts beyond the site boundary that are beneficial for the entire campus. For example, individual buildings should connect to one of the District Energy Systems in order to reduce reliance on traditional heating and cooling systems and associated higher greenhouse gas emissions.

The following goals inform the application of the guidelines:<sup>2</sup>

- 1. Achieve a net positive performance in operational energy and carbon:** Buildings need to be designed to incrementally use less energy and emit less GHG's over time in order to reach a net positive goal for energy and carbon by 2050.
- 2. Implement a framework that supports low embodied carbon in future development:** UBC seeks to promote building designs that minimize embodied carbon and other environmental and social impacts associated with the extraction, manufacturing, construction and operations.
- 3. Optimize water quality, supply and security:** Given the Okanagan's arid drought prone climate together with population growth, water conservation is an important imperative in the design of new buildings and landscapes.
- 4. Enhance and/or restore the ecology:** Including natural systems that can enhance habitat on campus as well as create a visual expression of biodiversity that can improve mental health, spark interest and provide educational experiences.
- 5. 100% diversion of rainwater from municipal systems:** Rainwater management is required at each development site to reduce the downstream impact and help achieve 100% diversion for the campus as a whole.

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<sup>1</sup>Net positive: a mode of development that contributes to human and ecological systems more than it takes. This approach focuses on generating mutual benefits to humans and the environment as opposed to only attaining net zero or negative impacts.

<sup>2</sup>All goals are taken from WSIP except goal 6.

- 6. **Strive toward full waste recovery reuse:** UBC seeks to reduce consumer waste through management programs and waste from all demolition, construction and renovation projects by optimizing material use, reducing waste generated, and increasing waste diversion.
- 7. **Support human health and wellbeing in building design:** From design and construction, to inhabitation, to demolition - human health and wellbeing must be considered at all stages of a building's life-cycle.

## 4.2 GREEN BUILDING CERTIFICATION (LEED)

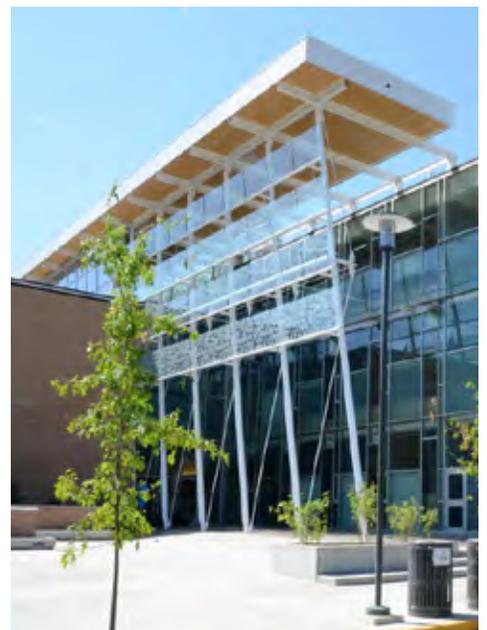
UBC's baseline policy is that all major institutional projects are to be LEED Gold certified, however other pre-approved certifications may be used (for example certification by: Living Building Challenge, Passive House or the WELL Building Standard). Note some certifications are focused on specific aspects of building design (e.g. Passive House focuses on Energy use) and projects will be subject to additional design requirements (e.g. water use reduction requirements)

New construction and major renovation projects targeting LEED certification should reference the UBC LEED Implementation Guide (version 4). This Guide was developed for the Vancouver campus and is intended to provide project teams with UBC specific guidance on LEED credits for the campus, as well as clearly identify credits that should be mandatory because they align with UBC policies. Specific parameters for UBC Okanagan projects will dictate individual approaches to LEED certification but the Guide will provide a useful starting point.

Purcell Residence is built to LEED Gold equivalent for student residences, and Reichwald Health Sciences Centre is LEED Gold Certified.



Purcell Residence



Reichwald Health Sciences Centre

## 4.3

### INTEGRATIVE PROCESS

UBC supports an integrated design process for buildings and retrofits to ensure more consistent integration of sustainability measures and to ensure key design disciplines are brought together to achieve a high level of sustainability performance in a streamlined manner. Integrated design is critical for the success of a whole systems approach (recommended in the WSIP) for the campus and needs to start early in the design process.

The [UBC Sustainability Process](#) brings building stakeholders together right from the start of the design process to look for synergies between systems and components. The benefits of integrated design are many: achieving higher levels of building performance and occupant comfort, reduced environmental impacts and - with the input of the building operators and end users - improved building lifecycle management and user satisfaction.

UBC actively promotes processes that encourage integrated design. To this end, UBC requires that design teams follow the UBC Sustainability Process which provides guidance.

The first step in the UBC Sustainability Process is the development of a Project Design Brief. UBC stakeholder workshops are held to identify each project's social, economic and environmental sustainability goals prior to the engagement of the design team. The goals reflect UBC's WSIP implementation objectives and emerging priorities.

UBC has found that three workshops with the design team and university stakeholders are needed in order to fully explore and integrate the sustainability goals into the project design. The first workshop (3A) takes place during schematic design and provides early focus on building massing, orientation and sustainable energy and water systems. The second workshop (3B) investigates design strategy synergies that will meet the goals set out in the Design Brief. The final workshop (3C) takes place during design development and uses interactive energy modeling to evaluate the trade-offs between energy performance, lifecycle cost and system complexity.

The final step in the Process is to facilitate a feedback loop and officially report on the project's sustainability outcomes and performance to the UBC Board of Governors. This feedback step is crucial in transferring lessons learned from one project to the next.

#### 4.3.1 Existing Buildings

In order to clearly identify policy and process requirements associated with new buildings, renovations, fit-outs and retrofits a classification system has been developed.

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Existing buildings renovations and retrofits offer a significant impact in terms of achieving the campus sustainability goals because of the extent of the existing building stock. The tier system clarifies performance targets and expectations for the renovation and retrofits of existing buildings as well as new builds:

TABLE 01. TIER SYSTEM FOR INSTITUTIONAL BUILDING PROJECTS

TIER	DESCRIPTION	AREA/BUDGET	GREEN BUILDING REQTS.
TIER 1	New Buildings - Large	> 1000 m <sup>2</sup> , > \$5M	<ul style="list-style-type: none"> <li>Green building certification</li> <li>Energy target*</li> <li>UBC Technical Guidelines</li> <li>Life cycle costing focus</li> <li>Sustainability Process</li> <li>Design Brief</li> <li>Owner's Project Reqts.</li> <li>DE Strategy*</li> </ul>
TIER 2	New Buildings - Small	< 1000 m <sup>2</sup> , > \$5M	<ul style="list-style-type: none"> <li>Energy target</li> <li>UBC Technical Guidelines</li> <li>Life cycle costing focus</li> <li>Sustainability Process</li> <li>Design Brief</li> <li>Owner's Project Reqts.</li> </ul>
TIER 3	Major Project Renovations	> \$5M	<ul style="list-style-type: none"> <li>Green building certification (consider)</li> <li>Energy target*</li> <li>UBC Technical Guidelines</li> <li>Life cycle costing focus</li> <li>Abbreviated Sustainability Process</li> <li>Abbreviated Design Brief</li> <li>Owner's Project Reqts.</li> </ul>
	a. Renewal (includes envelope and mechanical system upgrade)		<ul style="list-style-type: none"> <li>UBC Technical Guidelines</li> <li>Life cycle costing focus</li> <li>Meeting with Project Services, Energy Team, Sustainability CP&amp;D</li> <li>Owner's Project Reqts.</li> </ul>
TIER 4	Partial Fit-outs	\$1M - \$5M	<ul style="list-style-type: none"> <li>UBC Technical Guidelines</li> <li>Life cycle costing focus</li> <li>Meeting with Project Services, Energy Team, Sustainability CP&amp;D</li> <li>Owner's Project Reqts.</li> </ul>
TIER 5	System Upgrades (e.g., chiller replacement, controls)	N/A	<ul style="list-style-type: none"> <li>UBC Technical Guidelines</li> <li>Life cycle costing focus</li> </ul>

in progress\*

## 4.4

### NET POSITIVE DESIGN

#### 4.4.1 Passive Design

Passive design strategies developed early in the building design process, using modeling to understand the impacts of design decisions, have significant potential to reduce energy use, reduce greenhouse gas emissions and improve occupant comfort while allowing full compatibility with the campus district energy systems in a cost effective manner. The following passive design considerations are:

- Design high performance envelopes that are air tight, minimize thermal bridging and provide a high level of thermal comfort for occupants.
- Harness solar radiation and to take advantage of internal heat loads through well-insulated envelopes and orientation that maximizes solar gain in winter and minimizes solar gain in summer.
- Prevent unwanted solar gain with shading, storing heat in thermal mass, and using outdoor cool air for passive ventilation.
- Optimize daylight and views to the outdoors for occupants while controlling unwanted solar gain and glare and maximizing envelope performance.
- Through orientation and massing, maximize the effectiveness of naturally occurring air flow patterns to facilitate passive ventilation and minimize the use of mechanical ventilation.

#### 4.4.2 Building Orientation and Massing

Optimizing building orientation is a fundamental and effective way to design comfortable buildings which use less energy. Building shape and massing can also significantly affect the energy performance of buildings.

- Use the appropriate glazing response according to façade orientation and design specific solar shading appropriate to each façade orientation.
- On south and west elevations, minimize unshaded windows, particularly the west elevation which contributes to significant undesirable afternoon and evening solar gain.
- On existing buildings with extensive glazing on south, west or east elevations, consider strategies such as shading devices or buffer spaces to improve thermal comfort and to reduce energy use associated with glazing.
- Design compact buildings to achieve a lower envelope to volume ratio. Where possible, include atriums to facilitate natural ventilation, day-lighting and passive cooling.

#### 4.4.3 Space Planning

Matching program requirements with appropriate orientation, massing, and other passive design strategies can reduce energy use and play a role in occupant comfort.

THE HANGER FITNESS AND WELLNESS CENTRE



▲ Cross laminated timber construction achieves a high performance building envelope and reduces embodied energy.

ARTS AND SCIENCES II



▲ The building incorporates passive design strategies including natural/wind driven ventilation, high thermal mass and heat recovery.

- a. Where possible locate spaces in the building so that particular thermal requirements can be met with minimal active building systems.
- b. If possible, locate spaces with wider comfort ranges or that require heating in the more difficult orientations such as south and west. Program areas with large internal gains are ideally located on the north orientation to minimize cooling.
- c. In challenging thermal comfort situations, projects can incorporate buffer spaces to act as a thermal buffer.
- d. Consider zone control for heating and ventilation that can be used to capture energy costs savings. Zone design should incorporate current uses and future potential building use consolidation or change of use and layout.
- e. Include vestibules at all major entranceways to reduce air infiltration by having only one set of doors open at any given time.
- f. Building systems should be designed to be easily and efficiently reconfigurable.

#### 4.4.4 Building Envelope

Buildings shall have institutional quality building envelopes that are well-insulated and airtight in order to reduce energy use, provide a comfortable environment for building occupants and protect the university’s assets. Projects shall review the UBC Technical Guidelines early in the design process.

- a. Insulation values shall be greater than the prescriptive code values. See the UBC Technical Guidelines (TG’s) 07 21 00 Thermal Insulation.
- b. Airtightness shall be tested according to ASTM E799 or USACE Version 3 standard, as required by the BC Energy Step Code.
- c. Recommended cladding materials are: brick, stone, precast concrete, metal panels and cement composite panels. Wood (with coating) and architectural (poured in place) concrete are only permitted in protected locations under overhangs.
- d. EIFS, stucco and exposed glulam elements are not permitted. See TG’s Section 07 40 00 Cladding.
- e. Subgrade waterproofing shall be provided for occupied spaces using a torch on membrane. See TG’s section 07 10 00 Damp proofing and Waterproofing.
- f. Roofing shall typically be two ply SBS at flat roof locations with a five year RCABC warranty. The level of leak detection and monitoring shall be determined according to risk. See TG’s section 07 50 00 Membrane Roofing, 07 55 00 Vegetated Protected Membrane Roofing; 07 61 00 Sheet Metal Roofing and 07 62 00 Sheet Metal Flashing and Trim.
- g. Exterior doors are to be protected by overhangs. See TG’s section 08 00 10 Openings - General Requirements.

NICOLA STUDENT RESIDENCES



▲  
The building uses of high efficiency wall and roof insulation and high efficiency windows.

Building orientation and strategic use of glazing and shading minimize solar gain and heat loss.



UNIVERSITY CENTRE

#### 4.4.5 Windows and Glazing

Windows provide necessary views, daylight and ventilation, but are the weakest thermal elements in the building envelope. Careful consideration of the location,

size and performance of windows can significantly improve thermal comfort and reduce energy use in buildings.

- a. To conserve energy, windows and associated exterior solar shading are to allow beneficial solar gain in the winter and block it in the summer. Overall each project shall minimize the heat loss due to the poor thermal performance of windows. See TG's section 08 80 00 Glazing.
- b. Projects are to have high performance windows: thermally broken, double or triple pane window assemblies designed for a cool climate. Glazing units are to incorporate low-e coatings and have low solar heat gain coefficient. See TG's section 08 00 10 Openings-General.
- c. Fiberglass windows are encouraged in lieu of metal windows where code allows due to their superior performance. PVC windows will be permitted in non-academic, low rise buildings only. See TG's section 08 50 00 Windows.
- d. Curtain wall is preferred, storefront is permitted in protected locations only. See TG's section 08 44 13 Glazed Aluminum Curtain Walls and 08 41 13 Aluminum-Framed Entrances & Storefronts.
- e. Where operable windows are utilized, insect screens and HVAC interlocks must be provided unless otherwise approved. For areas without a defined single occupant, automated windows are preferred over manual.

#### 4.4.6 Building Energy Efficiency

Incorporating energy efficiency in new buildings should conceptually first be tackled by reducing loads, then selecting efficient systems to meet the load and finally by looking at renewable electricity or carbon neutral district energy to meet the load.

Energy targets, including energy use intensity (EUI) targets and thermal energy demand intensity (TEDI), will be set by UBC for all new projects and major retrofits. Energy targets will be based on considerations in other policy documents including the WSIP, the District Energy Strategy, the Climate Action Plan and alignment with the evolving BC Step Code. Energy efficiency measures to achieve targets are to be selected for building designs based on cost efficiency over the lifecycle.

The targets, expressed in kWhr/m<sup>2</sup>/yr, will be identified during the Design Brief phase, based on the building use. The design team will be given an opportunity to review and discuss the targets and its implication for building design; after final agreement on the target the project shall be designed to meet the EUI. In addition to the EUI target, buildings may have a LEED EAc1 requirement and will need to achieve a minimum of 11 points for this credit, see the LEED Implementation Guide for details.

#### 4.4.7 District Energy

All academic and residence buildings shall connect to the campus district energy systems for heating, cooling and domestic hot water wherever possible to prepare for a successful transition to a zero carbon campus. Buildings for

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This facility uses low carbon energy supply to heat and cool campus buildings.



GEO-EXCHANGE FACILITY

which connection to the low temperature district energy system is not practical (for example, due to high elevation) must apply for a variance, and instead must achieve GHG reductions through providing all space heating and domestic hot water from the efficient use of electricity.

#### **4.4.8 Building Systems and Equipment**

Building systems and equipment should be designed to be as simple as possible while meeting the functional requirements. Components, finishes, equipment and systems are to be selected that require minimal maintenance and exhibit a high level of maintainability and long-term reliability. Equipment shall be readily accessible for maintenance and replacement. Parts and service for all equipment should be readily available locally.

#### **4.4.9 Metering and Controls**

Understanding UBC's energy use helps to reduce campus energy and emissions. In order to measure energy use, all buildings are to have building meters for electricity, gas, water and district energy. Secondary side BMS meters are required in all buildings over 2,500m<sup>2</sup> for the following uses: interior lighting , exterior lighting , space heating, space cooling, domestic hot water, fans and pumps, receptacle loads and water for irrigation. The measurement devices shall have the capability to automatically communicate the energy consumption data to a data acquisition system.

Refer to UBC- OKanagan 01 92 00 Monitoring Based Commissioning TG for detailed requirements.

#### **4.4.10 Heating, Ventilating and Air Conditioning**

All systems should be compatible with UBC's ambient temperature DES system, without the need for packaged boilers for peak heating during winter. Mechanical cooling should be provided as required for thermal comfort, but should be optimized by the use of night setbacks, demand control ventilation and passive design strategies. Consideration should be given to future climate predictions see 4.7.10 Climate Adaptive Design. The following systems are recommended:

- 4 pipe heating/cooling system
- Ventilation heat recovery systems are generally required
- Displacement ventilation
- Dedicated outdoor air systems
- Natural ventilation( typically combination with mechanical ventilation)
- Sewage heat recovery (recommended in residences)

#### 4.4.11 Lighting and Power

Building lighting shall incorporate efficient LED fixtures capable of dimming and lighting controls. Plug load controls in the form of occupancy sensor should be considered for office spaces and other locations where loads can be reduced without impacting research and other important functions. For the residences vacancy control sensors could be considered for the rooms. To reduce peak electrical loads from summer air conditioning and winter heating, major projects shall have a demand response plan that includes the capability to reduce a building's peak demand by 10% by automated or semi-automated means.

#### 4.4.12 Lab Ventilation Control

Laboratories must meet all ventilation requirements and guarantee safe operation while reducing air changes per hour (ACH) where possible to save energy. The baseline rate is 8 ACH with a night setback when unoccupied of 4 ACH. Fume hoods should be specified at the lower end of acceptable WorkSafeBC velocity range. See TG's section 23 05 00 HVAC - General Requirements and 23 38 16 Fume Hood Exhaust Systems.

#### 4.4.13 Solar PV Readiness

New buildings must be ready to receive a future PV system on open roof areas. Building designs must indicate allocated space, capacity and pathways for infrastructure including rough-in and cable.

#### 4.4.14 Commissioning

All major projects should be commissioned by a third party commissioning provider using monitoring based commissioning. The Owners Project Requirements are to be developed early in the design process in conjunction with UBC stakeholders. Facility operating staff shall be part of the commissioning team as well as transition team which will help UBC as buildings transition from the construction phase to the occupancy phase. Appropriate demonstration and training shall be provided to facilities as part of projects scopes.

See TG's section 01 91 00 Commissioning and 01 92 00 Monitoring Based Commissioning.

### 4.5

## LOW EMBODIED CARBON FUTURE

#### 4.5.1 Materials Selection

Wood has the potential to be a low carbon, local building material which has been used in innovative ways successfully at UBC. The choice of a wood structural system is recommended to be used where there is a good fit with the use of the building (for example residences and some academic uses). Wood cladding as a secondary cladding material or as an interior finish materials is also encouraged.

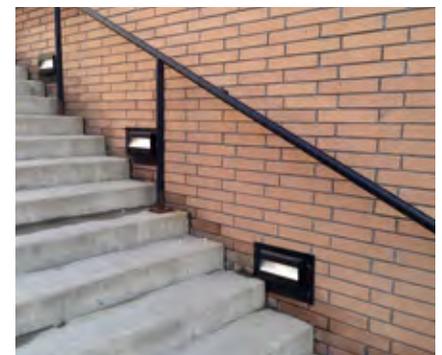
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The south atrium collects and heats air for heat recovery.



UNIVERSITY CENTRE

Locally sourced, high-recycled content materials including low embodied energy high fly-ash concrete are used on the exterior.



UNIVERSITY CENTRE EXTERIOR

### 4.5.2 Durability

Buildings (tiers 1 to 5) and their systems are to be designed to optimize the university’s total cost of ownership while meeting the functional requirements of building users. During design of major building systems or replacement of equipment, options should be compared that allow the university to choose the optimum total cost of ownership.

Durable materials should be selected that minimize the need for new resources and their operation and maintenance expenditures over the building’s lifetime. Components, finishes, equipment and systems are to be selected that require minimal maintenance and exhibit a high level of maintainability and long-term reliability. Equipment shall be readily accessible for maintenance and replacement.

The target design service life for key building systems are to be as follows:

- 100 years for structure
- 100 years for the exterior envelope (based on a service life *Campus Plan* which may include *Campus Planned* replacements)
- 25 years for roof systems
- 30 years for mechanical and electrical systems
- 25 years for interior components and systems

## 4.6

### WATER QUALITY, SUPPLY AND SECURITY

#### 4.6.1 Water Conservation

UBC is currently undergoing a campus wide monitoring strategy and water metering program to establish a baseline for campus operations. All new buildings and renovations should work with building users early in the design process to reduce process water use and install water efficient plumbing fixtures. For reduction in exterior water use, drip irrigation is required where possible and native planting requirements will reduce watering requirements. A non-potable water system is being considered for the campus and buildings may be part of a pilot program for purple pipe plumbing system installation.

#### 4.6.2 High Efficiency Plumbing Fixtures

New and existing buildings should install high efficiency plumbing fixtures as a water conservation measure.

- |                |                  |
|----------------|------------------|
| • Fixture type | Flush/Flow rate  |
| • Toilets      | 4.8 LPF 1.26 GPF |
| • Urinals      | 1.9 LPF 0.5 GPF  |

- Lavatory faucets 1.9 LPM 0.5 GPM
- Kitchen faucets 5.7 LPM 1.5 GPM
- Showers 5.7 LPM 1.5 GPM

## 4.7

### ECOLOGY

#### 4.7.1 Biodiversity and Building Design

Naturalized systems should be integrated into new construction and landscape where possible. For buildings, green infrastructure such as living walls and green roofs should be considered where appropriate. Sustainable drainage should be considered in building design and tie into campus wide rainwater management goals and public realm design. Trees of an appropriate species should be planted wherever possible to contribute to increased biodiversity and provide shade for buildings.

#### 4.7.2 Green Infrastructure

Green infrastructure such as living walls or green roofs may be considered in some locations, despite their cost premium, as they offer many social and environmental benefits that tie into WSIP goals.

Living walls can provide shade for buildings and offer psychological benefit to building occupants by creating a closeness to nature. Living wall design should allow for ease of maintenance and irrigation and should be planted either in the ground or in horizontal containers.

Plant selection should be suitable to the climate, drying out in the summer drought and re-growing with the rain in the fall and spring. Native or adaptive plants should be selected where possible to enhance habitat for pollinators, butterflies and some birds.

#### 4.7.3 Bird-Friendly Building Design Strategies

Birds are important for biodiversity because they provide essential ecosystem services in the form of pest control, pollination, and seed dispersal. In addition to this, the high visibility and audibility of birds creates a valuable experiential link between people and local wildlife in urban settings.

Glass is currently one of the largest sources of anthropogenic bird mortality in North America. Birds are unable to perceive glass as a solid object and building collisions occur when they try to fly into the sky or vegetation they see through or reflected by glass. If glass is sensitively incorporated into the built environment, these pitfalls can be avoided and we can continue to enjoy the benefits this material offers. For further information, see *UBC's Bird Friendly Design Guidelines*.

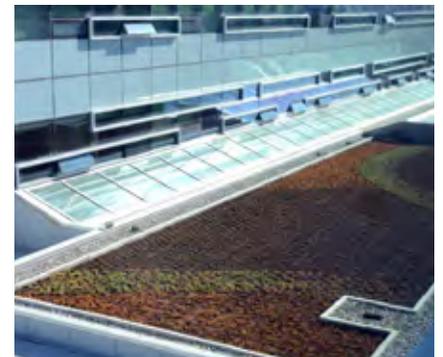
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ENGINEERING MANAGEMENT AND  
EDUCATION LANDSCAPE



▲ The naturalized landscape adjacent to storm water retention pond supports campus ecology and biodiversity.

ENGINEERING MANAGEMENT AND  
EDUCATION BUILDING GREEN ROOF



▲ The use of native and adaptive plants for the green roof captures rainwater for irrigation.

## 4.8 RAINWATER

### 4.8.1 Rainwater Management

All rainwater will be managed on campus in compliance with the Integrated Rainwater Management Plan, 2017 (IRMP). Individual projects must achieve minimum on-site retention<sup>3</sup> storage requirements which accommodate volume changes from the predevelopment state in order to reduce downstream effects on infrastructure. Site control can be achieved through Low Impact Development (LID) techniques such as rain gardens and lineal vegetated swales, designed to slow down, infiltrate, evaporate and treat submittals<sup>4</sup> to support the minimum retention requirements. In addition to meeting the IRMP's requirements, all LEED Certified projects are required to manage the 95th percentile of regional or local rainfall events.

<sup>3</sup>Retention is as: complete containment on-site for disposal through infiltration or evaporation. (Detention is defined as temporarily holding and releasing of water (e.g., using a tank or orifice, but the volume still runs off) and does not meet the IRMP requirements.)

<sup>4</sup>Submittals: design, calculated added volume rates for the 100 year storm event and description of how overland water will be directed off the site.

## 4.9 WASTE RECOVERY AND REUSE

### 4.9.1 Construction and Demolition Waste

UBC seeks to reduce waste from all demolition, construction and renovation projects by optimizing material use, reducing waste generated, and increasing waste diversion.

A minimum waste diversion requirement for all projects (including renovation projects and minor projects) is to divert at least 75% of construction and demolition waste from disposal. This is easily achievable in most projects and can often have economic benefits. LEED projects should follow the additional requirements as described in the LEED Implementation Guide.

All projects need to track the amount of waste and diversion achieved via project submittals. See TG's Construction and Demolition Waste for templates and more information.

### 4.9.2 Waste Separation Guidelines

To allow conformance with UBC's waste management programs and regional waste disposal bylaws, UBC buildings must make provisions for indoor recycling stations, rather than stand-alone garbage receptacles, in addition to providing the necessary facilities for storage and loading of waste and recycling. Refer to TG's 10 20 00 Interior Specialties (section 5.0 Recycling and Water Management) and 11 82 00 Waste Handling Equipment.

Recycling stations are configured to collect waste in the following streams:

- Blue Bins – Recyclable Items

- Green Bins – Refundable Items
- Grey Bins – Waste
- Yellow Bins – Organic Materials (only located in lobbies of academic and administrative buildings as well as in lunchrooms across campus)

On average, each recycling station can service about 1,000m<sup>2</sup> of gross building floor space. The number of stations may need to be adjusted up or down depending on the number of users and the size of the stations. High traffic areas should use full sized stations and low traffic areas will more easily accommodate small stations). Stations should be located such that the front of the station, and therefore signage, is facing the majority of users. Typical placement is against a wall. (See the *Recycling Infrastructure Guidelines* for more details).

In lobbies, recycling stations should be situated such that most building visitors will be able to see at least one full-size station when entering or leaving the building through the main entrances.

Recycling stations should be located with 5m of the door to large classrooms or lecture halls and 10m of the door to smaller classrooms. Stations are typically located in hallways and not inside classrooms.

In lunch rooms and kitchenettes, recycling stations should be located in the same room or within 3m of the food preparation area and must include an organic materials stream. Constrained spaces may use a 3-bin station with the paper bin omitted provided there is a paper recycling bin/station nearby.

Individual offices should have desk-side recycling units, which consist of a blue recycling bin and black garbage bin attachment, typically emptied by occupants. Recycling stations should be within 25m of all offices and on the same level. Organic materials and recyclable/refundable items may be omitted from an office station provided these streams are provided at another station within 25 m (e.g., at a lunch room).

## 4.10

### HUMAN HEALTH AND WELLBEING

#### 4.10.1 Healthy Materials

To promote optimal material selection, UBC is committed to working towards content transparency for all products used on campus. Project teams should choose building materials that have demonstrated content when possible, for example materials for which the manufacturer has developed Environmental Product Declarations and Health Product Declarations. Building materials choices should be optimized to minimize impacts on human health over their life cycle.

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### 4.10.2 Environmental Quality

Projects are to consider the impacts of their design on the health and well-being of the campus community. Specifically, projects are to consider how air quality, lighting levels, noise levels, thermal comfort, and design for a healthy lifestyle can benefit students, staff, faculty, and visitors.

### 4.10.3 Air Quality

Projects are to ensure a healthy, steady and adequate flow of fresh air in order to enhance the users' sense of comfort and well-being. Refer to TG's UBC Okanagan Section 23 05 00 HVAC - General Requirements. Buildings should also have provisions to mitigate the impact of poor outdoor air quality by filtering outside air. Natural ventilation, displacement ventilation and dedicated outdoor air systems are all encouraged. Interior building products should be chosen to optimize air quality and particularly minimize the emission of VOC's. Building entrance systems should be installed at each major entrance to reduce the tracking of harmful contaminants indoors.

### 4.10.4 Lighting Levels

Good lighting design is required to achieve the lighting level and quality required for the functional requirements of each space. Natural lighting is a priority as it promotes circadian health and minimizes electricity use. All lighting is to be LED and occupancy and daylight sensors are required in appropriate locations. See TG's section 26 51 00 Interior Building Lighting.

### 4.10.5 Acoustics

Built environments can harbour sounds that are distracting and disruptive. To promote a good environment for learning, social interaction, satisfaction and productivity, thoughtful acoustic design is essential for UBC buildings. An acoustic consultant is required for projects with extensive or large learning spaces. Design strategies which often accompany green building design (such as increased airflow between spaces and a reduction in interior finish materials) are particular sound control challenges that need to be mitigated.

For acoustical requirements of classrooms see TG's 10 00 10 Special Room Requirements.

For acoustic requirements of finishes see TG's Division 9.

### 4.10.6 Thermal Comfort

Thermal comfort design plays a role in the way users experience places where they live and work. Contributing factors are: air speed, temperature, radiant temperature and humidity. Spaces should be designed to have thermal conditions acceptable to a majority of occupants. Extensive glazing should be avoided to avoid impact on thermal comfort of occupants. Radiant systems, displacement

ventilation and dedicated outdoor air systems are recommended as they are more energy efficient and increase thermal comfort.

For Thermal Comfort Requirements see TG's 20 00 30 Indoor Thermal Environment.

#### 4.10.7 Climate Adaptive Design

The impacts associated with climate change are becoming more pressing with long term warming, more extreme weather events and changing precipitation patterns. Climate adaptive design is now recognized as an important direction for green buildings at UBC. Building modeling should include climate projections for temperatures and rainfall in 2030 and 2050, using current and developing best practices, to understand and plan for adaptation over the building's service life.

#### 4.10.8 Healthy Lifestyle Design

One key design consideration is to locate stairs close to the building entrances so that they provide a convenient way to incorporate short periods of physical activity for building users. Such stairs can additionally include elements of aesthetic appeal and/or daylighting.

See the [Active Design Guidelines](#) for strategies for creating healthier buildings and urban spaces base on the latest research and best practices.

#### 4.10.9 Celebrating Whole Systems

The celebration of the university's whole systems based approach to development is encouraged. Visual expression and educational elements can contribute to raising awareness regarding natural cycles and the science of sustainability. Some designs may appropriately include interactive elements and artistic expression. Celebrating rainwater management, sustainable drainage, enhanced ecology, district energy, building energy efficiency measures and waste recovery can contribute to expressing UBC's whole systems goals to the campus community and the outside world.

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# 5

# COLOUR

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## COLOUR GOALS

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1. Strengthen the unique campus character
2. Establish an integrated UBC Okanagan colour system
3. Provide visual cohesion
4. Promote innovation in design and materiality
5. Create a unified campus user experience

*The UBC Okanagan colour system provides an overarching framework to deliver visual cohesion across a unified yet contextual campus experience.*

## 5.1 INTRODUCTION AND GOALS

The colour guidelines provide a framework to contribute to visual cohesion across a unified yet contextual Okanagan Campus experience. The foundation of the guidelines is an integrated colour system that informs recommendations for the selection of building materials, landscape, and site furniture related to all development projects on the campus.

The following principles inform the application of the guidelines:

1. **Strengthen the unique character of the UBC Okanagan Campus and engender “pride of place”:** The colour guidelines respect and complement the natural elements and environment – air, water, ground, flora and fauna – and addresses the contrast between the bright Okanagan spring and summer seasons and the dark late fall and winter months that largely define the academic year. It also acknowledges and celebrates UBC’s connection with the Okanagan Nation and the larger community by demonstrating inclusion through ethical and cultural relevance.
2. **Integrate colour holistically into design:** The colour guidelines facilitate close alignment among the colours used for building exteriors, transparent interiors and hardscapes. When integrated within the overall project design, colour can provide maximum impact with minimum application. A unified colour system enhances the value of individual projects through close and early collaboration among project architects, landscape architects and allied design professionals including: interior designers, environmental designers and communication designers.
3. **Provide visual cohesion that connects legacy and contemporary buildings:** The colour guidelines include both legacy and contemporary building colours in order to provide a visual and material connection among the legacy brick buildings, current and future projects, and to create greater visual integration among all aspects of campus development projects.
4. **Use colour to activate innovative building design and materiality:** The colour guidelines are an open-ended yet highly rigorous system for change. It is designed not only to accommodate changes in style, function and materials but to encourage the advancement of design that is responsive to these changes.
5. **Create a positive and unified user experience for students, faculty, staff, visitors and the broader community:** Colour extends the campus welcome and supports ease of access, navigation and safety. Colour adds to the aesthetic beauty of the architecture, landscape and surrounding environment. An inspired application of colour will ensure that the campus remains fresh and relevant to all audiences. The colour guidelines encourage restraint while allowing punctuations of colour to provide impact.

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## 5.2 PRIMARY COLOUR PALETTE

The Primary Colour Palette will challenge designers to find expression through diverse materiality and technologies. The Palette establishes a base colour range of three colours that unify campus architecture while advancing design innovation. The Palette shall inform both exteriors and interiors and encourage innovation and expression through the application of diverse materiality within each Primary Colour range. The primary colours shall be used to advance the appearance of buildings and surfaces towards lighter rather than darker colour values. Inspired by nature, the colour palette recognizes the Okanagan Campus within its local and regional context through the use of the following three colours:

- Grassland
- Ochre
- Earth

### Grassland

- **Appearance:** Tan/desaturated yellow
- **Use:** Building façades
- **Example materials:** Brick, wood, pre-finished metal and glass panels

### Ochre

- **Appearance:** Red/brown ochre
- **Use:** Contrast, strong statements and visual focus or façade features, soffits, screens and shade louvers, landscape walls
- **Example materials:** Brick, wood, corten steel, pre-finished metal panels

### Earth

- **Appearance:** Near neutrals/grey
- **Use:** Neutral backgrounds, transitions, soffits, trim, hardware, window framing, hand rails, landscape walls, paving, façade features
- **Example materials:** Concrete, brick, zinc, silver or grey anodized aluminum alucabond, stainless steel

### Transitional

- **Appearance:** Multi-coloured /variegated near neutrals and ochre
- **Use:** Visual connection between Grassland, Ochre and Earth on building façades, landscape walls
- **Example materials:** Dacite panels (full range of finishes as appropriate)

### Black and White

- **Use:** For definition, articulation, and architectural features only

FIGURE 06. COLOUR SYSTEM BASICS  
Primary Palette (Exteriors and Interiors)

Grassland



Ochre



Earth

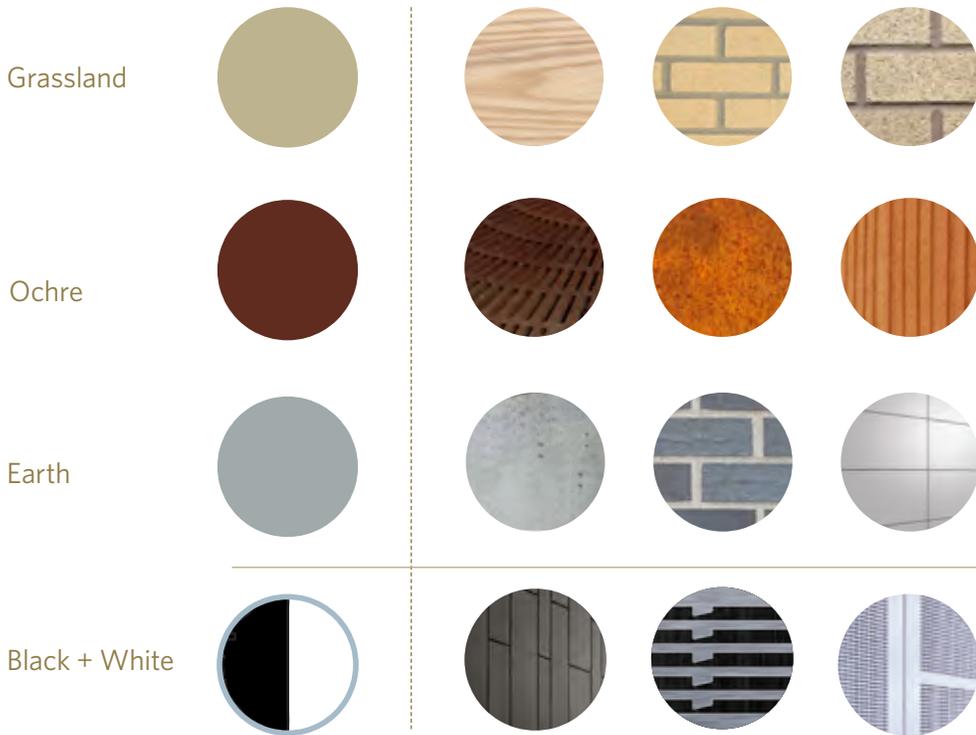


Transitional



Black and White





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◀ Architectural design reflects diverse materiality where Primary Colours are re-imagined through design elements such as pattern, texture, contrast and scale.

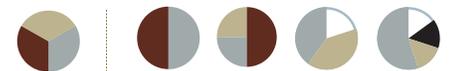
FIGURE 07. MATERIAL STRATEGY



Cornelius Vermuyden School, Canvey Island, UK. Nicholas Hare Architects.

◀ All three colours from the Primary Palette come together here, with punctuations of black, to exemplify how they might be used in material application.

FIGURE 08. COLOUR INTEGRATION



▲ While it is not necessary to use all three colours in the Primary Palette for the design of each individual project or building, it is anticipated that most projects will include at least two of the Primary Colours. Black and White may be used to extend the palette.

## 5.3 SECONDARY COLOUR PALETTE

The use of secondary colour, primarily for interiors, complements the Primary Colour Palette and is defined by concept, context and program, rather than a specific hue. Secondary colour will be used judiciously so that applications are engaging and stay relevant.

The Secondary Colour Palette is drawn from nature: (i.e., air, water, earth, flora). Secondary colour also has conceptual significance, references and sources drawn from the specificity of the campus setting (i.e., nature, narratives, history, research and stories).

Without compromising building energy performance, areas of high transparency, such as ground level elevations and vertical circulation can showcase big, intentional views of interiors spaces and broadcast energy, excitement and places of high animation. Interior application of secondary colour can enhance the building architecture, function and aesthetics and visually integrate the transition of user experience from the outside to the inside. General design considerations that should inform secondary colour choice include:

- Interior lighting solutions should reveal and/or create colour
- In general, dark colours should be avoided in order to keep the interiors brighter, especially during the fall/winter months
- Views to the interior should not be compromised by structural forms obfuscated by built-ins or objects placed near or directly against the windows
- The physical maintenance of visible interiors is a critical factor in ensuring colour solutions retain their visual integrity
- Interior views should be kept clear of ad hoc furniture assemblages such as tables, chairs, cabinets, waste and recycling containers, portable carrels, etc., as well as any accumulations of ephemera such as posters and handbills

FIGURE 09. SELECTING SECONDARY COLOURS

Inspired by authentic sources, selected Secondary Colours are used primarily on a building's interior and are meant to compliment the Primary Palette. The colours shown provide just a few examples of the possible hues that can be drawn from nature.

- ▶ Secondary Palette
- Air
- Water
- Ground
- Flora
- Fauna



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Almelo IISPA, The Netherlands. Koppert + Koenis Architecten.

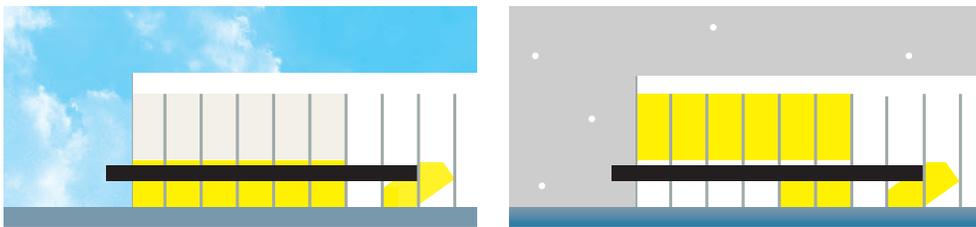
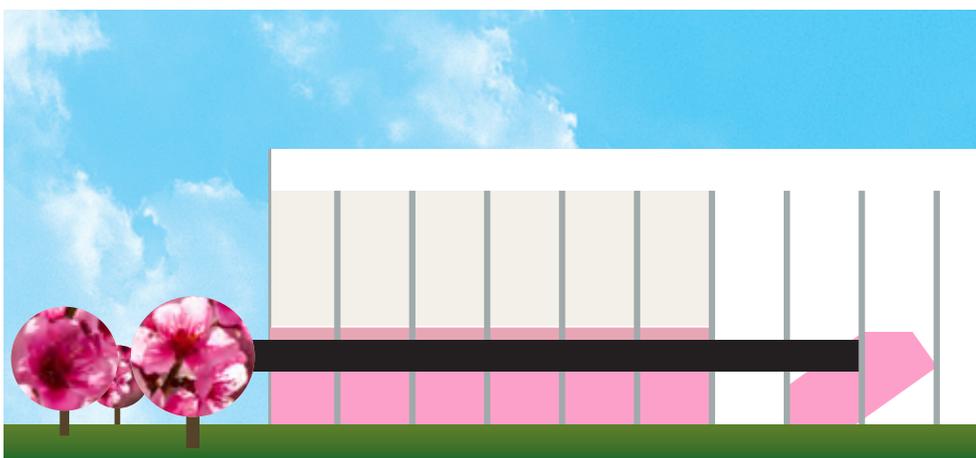


FIGURE 10. ANIMATED INTERIORS DIAGRAM

◀ Bright interiors can broadcast energy and excitement, and signal places of high animation. Dark colours are avoided in order to keep interiors brighter, especially during the long fall and winter months.

FIGURE 11. CULTURAL INTERIORS DIAGRAM



◀ Nature can be captured indoors with colours that reflect contextual significance.

## 5.4 UNIQUE USE PALETTES

The Unique Use Palettes are intended for limited and specific applications, of which will be managed by UBC Campus Planning and Development.

### Seasonal Palette

The Seasonal Palette is a two-colour institutional palette that supports seasonal strategies to increase campus vitality during two distinct seasons: spring/summer and fall/winter. The Seasonal Palette colours are drawn from nature and celebrate the UBC Okanagan Campus.

- Spring/Summer Color: Verbena Green
- Fall/Winter Colour: UBC Sky

The Palette activates seasonal strategies by signaling discrete design and programming applications for temporary features such as promotions, art installations, moveable tables chairs, seasonal furniture and campus plantings

### Spring/Summer Palette – Verbena Green

**Appearance:** Yellow green

An arresting yellow green references several wild and cultivated campus plants that share this radiant colour range. First among them is the Arrowleaf Balsamroot. A familiar sight on campus in spring, the “Okanagan Sunflower” is Kelowna’s official flower.

**Intent:** Signals and celebrates the return to sunny and warm weather

**Seasonal Applications:** Seasonal bistro chairs and tables, banners, installations and environmental graphics

### Fall/Winter Palette – UBC Sky

**Appearance:** Sky blue

The big, blue sky represents both UBC Campuses. In the colder months of fall and winter the expansive blue sky dominates against the more muted background of dormant foliage, and earthy landscape and architectural palettes.

**Intent:** Signals the presence of the big blue sky during fall and winter months

**Seasonal Applications:** Seasonal bistro chairs and tables, banners, installations and environmental graphics

Spring / Summer  
Verbena Green



Fall / Winter  
UBC Sky



### UBC Sustainability Green

While the use of green is discouraged for architectural features and is generally reserved for landscaping and views of the surrounding hills and agriculturally cultivated land, there are special cases that could potentially inspire the use of green. Rather than introducing an additional range of green, it is anticipated that UBC Sustainability Green can be used as a foundation for these situations.

**Use:** Installations, exhibits, infographics that highlight sustainability/green features

Sustainability  
Green



### UBC Wayfinding Signage Palette

The *UBC Wayfinding - Exterior Sign Standards and Guidelines* provide policy for the limited and specific use of a colour palette for permanent features and additions to the system, including updates and extensions to the maps, icon library, directories and markers.

Wayfinding  
UBC Sky



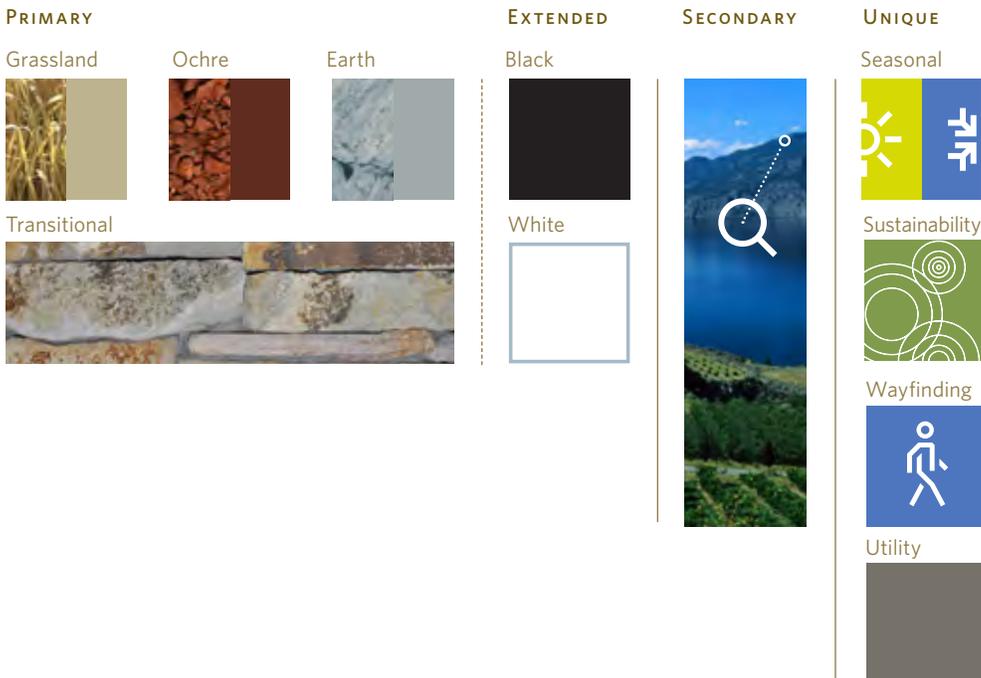
### UBC Utility Grey

UBC Utility Grey is to be used for any infrastructure in the campus landscape that is metal such as generators, light posts and elements of site furniture.

Infrastructure  
UBC Utility Grey



FIGURE 12. COMPLETE COLOUR SYSTEM



◀ The colour system seeks to enhance project value through the close and early collaboration among administrators, architects, landscape architects and allied design professionals, including: interior, environmental and communication designers.

# 6

# LIGHTING

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## LIGHTING GOALS

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1. Facilitate the active use of campus
2. Align lighting systems with Campus Plan design principles
3. Reduce operating expenses
4. Improve safety
5. Minimize environmental impact

*UBC Okanagan lighting guidelines are designed to ensure a welcoming, comfortable and safe experience for Campus users while minimizing environmental impacts and improving energy efficiency.*

## 6.1

# INTRODUCTION AND GOALS

The lighting guidelines establish strategies to achieve high quality lighting within the Okanagan Campus through improved performance requirements for all new and retrofit projects. Existing lighting fixtures will be phased out and a new family of fixtures will be introduced that meet the lighting hierarchy, scale, pattern and performance criteria outlined here. Consistent application of these strategies within the future campus development and lighting maintenance programs will result in a safe, comfortable and attractive campus. The following principles support the guidelines:

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### 1. Facilitate the active use of campus at night through improved lighting

**design:** A clear, well-organized and legible vehicular and pedestrian pathway lighting system enables students and faculty to safely access the campus at night. Good lighting quality is prioritized to achieve comfort and visibility. Light fixtures should illuminate people's faces to enable easy recognition and encourage interaction. Student commons, plazas, and significant public spaces (i.e. University Way and the Transit Exchange) are brightly illuminated to create a clear sense of destination and arrival.

### 2. Align lighting systems with the campus in terms of hierarchy, scale, pattern and detail:

The intensity, type, and scale of the light fixtures establish the order and significance of both vehicular and pedestrian routes. Highlighting campus gateways and important building façades of prominent buildings creates a hierarchy of places within the campus. Light is focused to communicate key campus features.

### 3. Reduce operating expenses through increased energy efficiency and durability:

The evolution of improved lighting technology allows for significant future energy and maintenance savings with better color and environmental performance. The lighting guidelines encourage adoption of new technology with improved performance.

### 4. Improve safety through better visibility at critical locations:

All crosswalks, roadway intersections, stairs and public gathering spaces are well illuminated to provide safety. All pathways and streets are illuminated above the minimum safe illuminance values. Higher illuminance is applied for major places and hubs, and primary circulation paths. Minimum values apply to emergency egress areas, and after hours building entrances.

### 5. Minimize environmental impact through shielding and minimizing light trespass into natural habitat:

All lighting is fully shielded, [Dark Sky](#) compliant, and will minimize light trespass onto surrounding natural habitat or other sensitive use sites. All projects should conform to best practices, such as those recommended by *LEED Sustainable Sites* requirements (see *Appendix A* for details).

## 6.2

### LIGHTING HIERARCHY

The lighting guidelines define a comprehensive lighting plan and stipulate the minimum design and operational standards for development and maintenance. The following sections are organized by hierarchy into four Site Types:

- Campus Streets
- Pedestrian Circulation
- Building Access and Egress
- Outdoor Places

Each section identifies standards for light intensity (illuminance), scale (height) and fixture aesthetic according to location and role on campus.

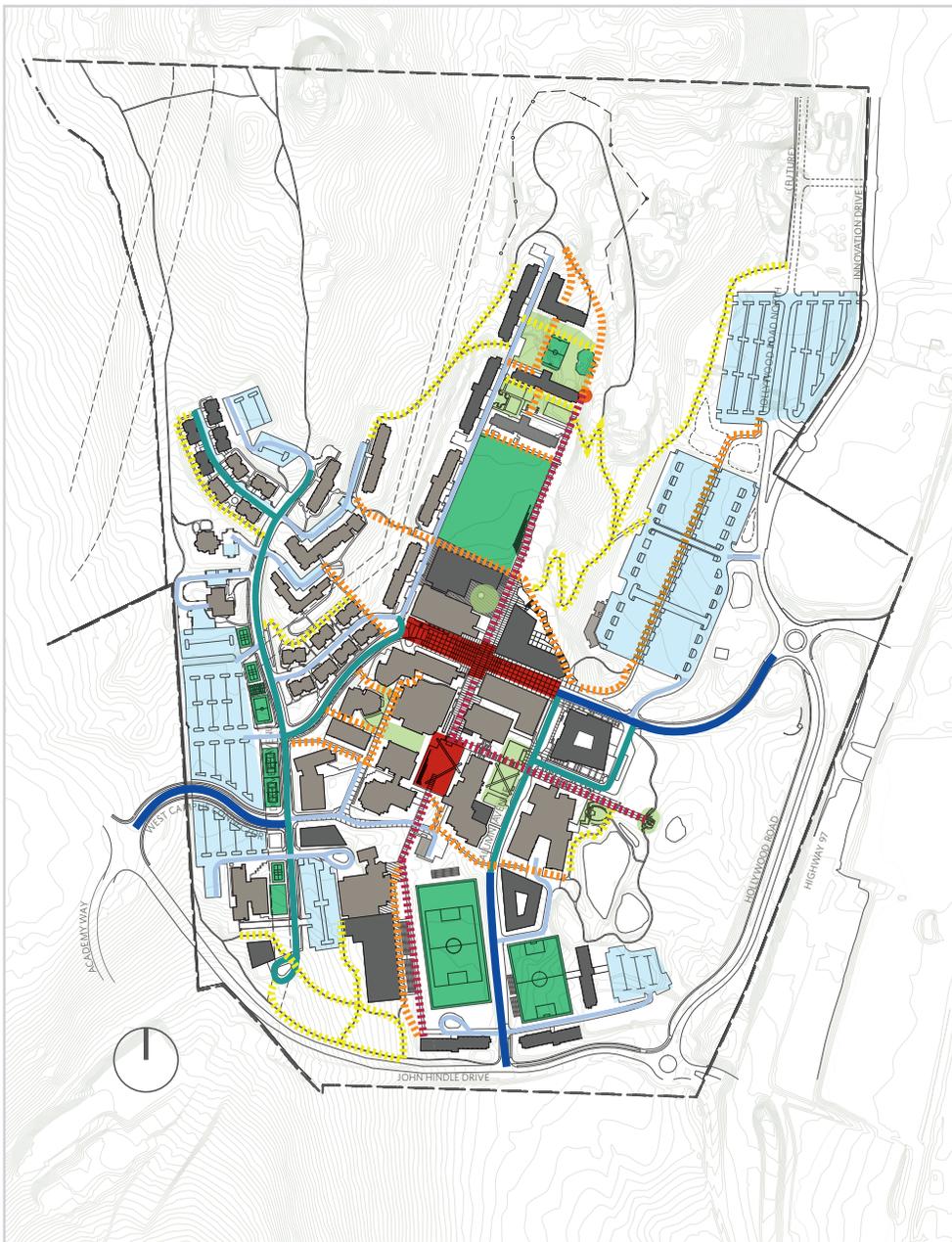
Criteria for lighting performance includes context, illuminance (lux), colour and pole spacing. Context values vary to create clear distinction within the overall campus; higher illuminance values are applied to larger scale spaces and pathways to establish prominence; color temperature and color rendering are stipulated to align better color performance with pedestrian use locations; pole spacing is specified to ensure even and consistent lighting levels.

Each luminaire and associated lumen output, watts, and pole height and spacing must be confirmed and configured to meet the illuminance requirements as outlined in the Lighting Performance Criteria Tables for each Site Type.

Retrofits of existing street lights, where full replacement is not achievable, should supply light of similar quality, color and illuminance to the requirements of the lighting plan. Where streetlights are to be added in between the existing lights, the new luminaires shall be adjusted to ensure that appropriate light levels are achieved.

When existing non-compliant light fixtures are identified for repair and/or replacement, it is expected the appropriate selected fixture be installed unless there are many obsolete lights in a row that need replacement. In this case the obsolete light would be used until there is funding to replace the entire row to the new standard.

FIGURE 13. MASTER LIGHTING PLAN



LEGEND

- |  |  |   |
|--|--|---|
|  Campus Entries                    |  Primary Campus Place |  Existing Building |
|  Campus Streets with Sidewalks     |  Parking              |  New Building      |
|  Shared Pedestrian + Service Lanes |  Green Event Space    |   |
|  Primary Ceremonial Routes         |  Green Sports Space   |   |
|  Secondary Pedestrian Routes       |  |   |
|  Tertiary Pedestrian Routes        |  |   |

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FIXTURE PALETTE



Schreder Piano



Selux Saturn Cutoff LED

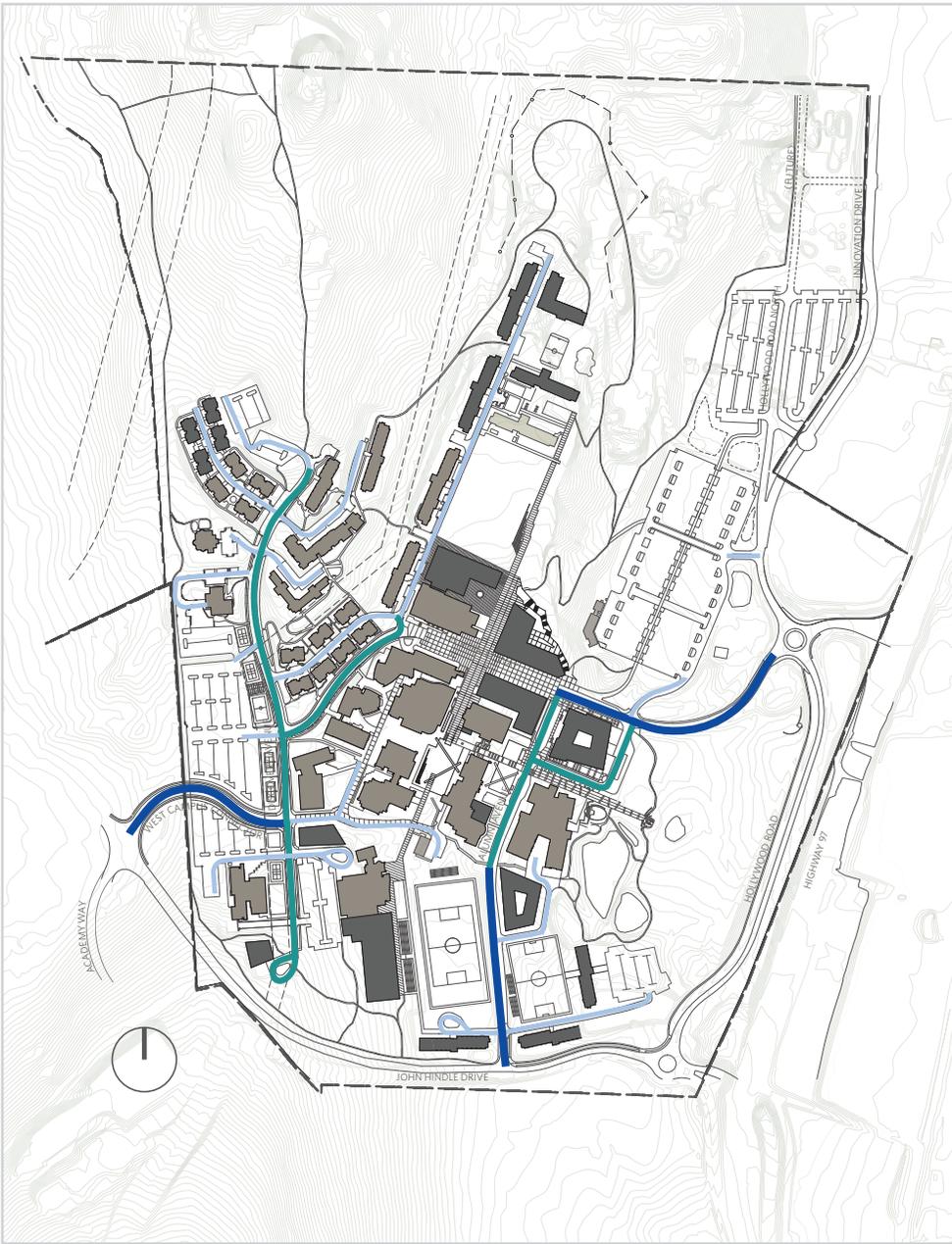
## 6.3 CAMPUS STREETS

Lighting standards for campus vehicular circulation is differentiated by traffic volume, street scale, pedestrian presence, and speed. Campus Entries are illuminated to the highest values in response to traffic volume and speed, and to denote a ceremonial campus arrival zone. Internal streets utilize a safe, mid range illuminance to allow more prominence to Pedestrian Circulation lighting. Where residence buildings are located, lower height fixtures with lower illuminance are used to minimize light trespass and impacts on residences.

Campus Street light poles are to be aligned with crosswalks at intersections and at mid-block locations to maximize light levels at these locations for improved visibility. For streets with adjacent pedestrian sidewalks additional lighting of the sidewalk may be required based on photometric design, in which case, include a secondary light fixture at 4.9m high over the sidewalk side of the 9m pole. Some Campus Streets require banner arms; please see section 5.8 for details.

At left are the selected fixture types. These fixtures were selected based on an evaluation of overall quality, performance, aesthetic, life span and cost. Suitable alternatives may be approved provided they meet the desired technical, aesthetic and design performance requirements outlined in this document.

FIGURE 14. CAMPUS STREETS LIGHTING PLAN



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TABLE 02. CAMPUS STREETS LIGHTING PERFORMANCE CRITERIA

CAMPUS STREETS	Context	Horizontal (lux)		Vertical (lux)	Colour (*K / CRI)	Controls	Spacing (oc)	
		AVG	UNIFORMITY	AVG			4.9m h	9m h
<b>Campus Entries</b>	High Luminance, Medium Contrast	30	6:1	N.A.	3000K / 70+	Photocell	N.A.	20m
<b>Campus Streets with Sidewalks</b>	High Luminance, Low contrast	20	6:1			Photocell	N.A.	30m
<b>Shared Pedestrian + Service Lanes</b>	Low Luminance, Low contrast	10	8:1			Photocell / Occupancy Sensor	20m	N.A.

FIXTURE PALETTE



Selux Saturn Cutoff LED

## 6.4 PEDESTRIAN CIRCULATION

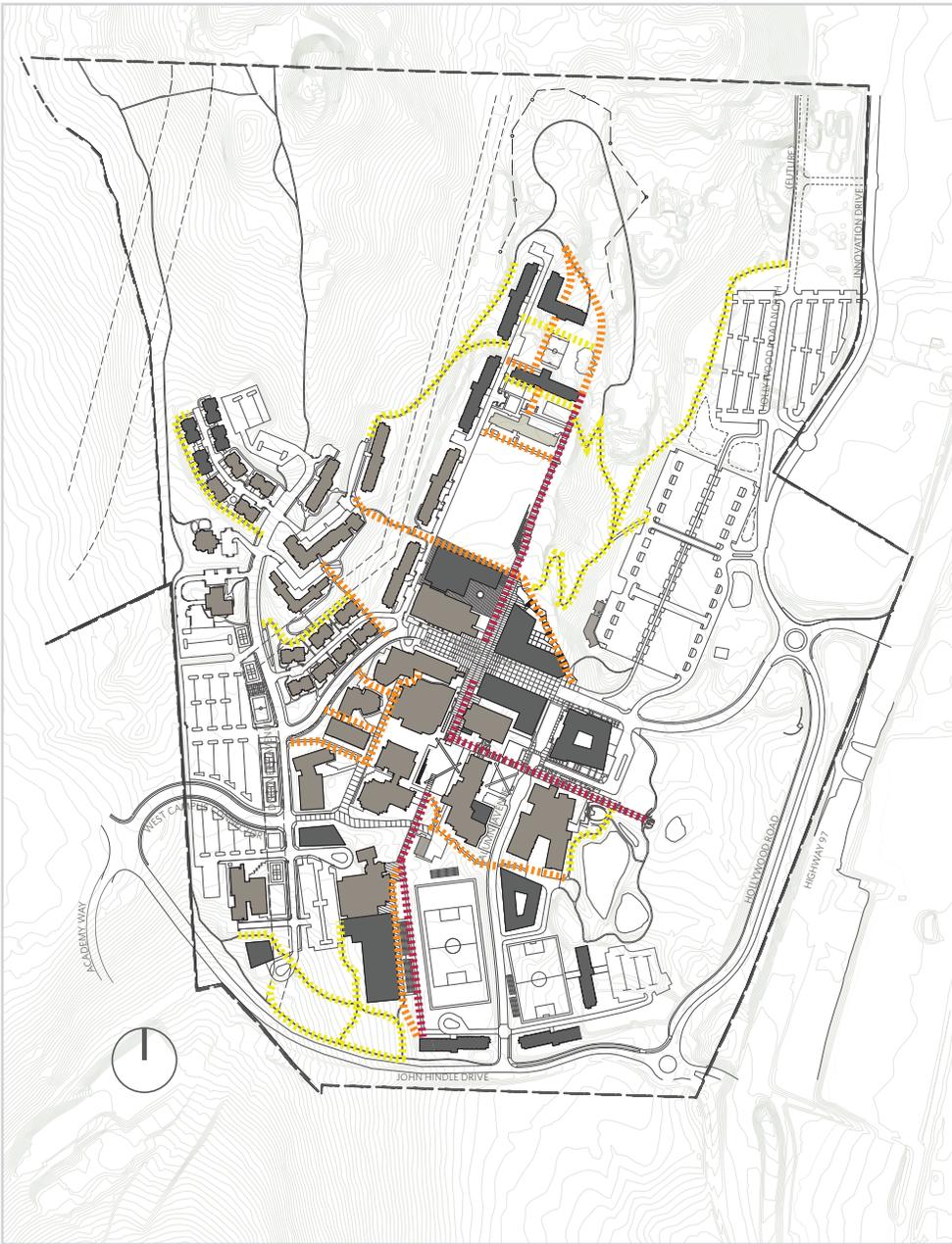
The three Pedestrian Circulation route types are as follows:

- Primary Ceremonial Routes are well established links within the campus core connecting University Way to adjacent academic areas, the Transit Exchange, and residence area to the north.
- Secondary Pedestrian Routes link academic buildings to streets, parking and neighborhoods.
- Tertiary Pedestrian Routes link to parking areas and neighborhoods and include green connectors and paths adjacent to natural habitats.

Pedestrian pathways are illuminated with varying illuminance (lux) corresponding to the type and scale of the pathway. All three Pedestrian Circulation route types utilize 4.9m high poles, spaced as required to achieve the illuminance values noted in the Lighting Performance Criteria table, with optimized light distribution and uniformity. Tertiary Pedestrian Routes lights are to conform to LEED criteria for LZ 1 (Light Zone rating per IESNA standards) and meet the Backlight, Uplight, and Glare (B.U.G.) ratings based on proximity to natural habitat lighting boundary (see *Appendix A* for details).

At left is the selected fixture type. This fixture has previously been used extensively on campus with a sodium lamp and is now replaced with the same style using an LED lamp. Suitable alternatives may be approved provided they meet the desired technical, aesthetic and design performance requirements outlined in this document.

FIGURE 15. PEDESTRIAN CIRCULATION LIGHTING PLAN



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TABLE 03. PEDESTRIAN CIRCULATION LIGHTING PERFORMANCE CRITERIA

PEDESTRIAN CIRCULATION	Context	Horizontal (lux)		Vertical (lux)	Colour (*K / CRI)	Controls	Spacing (oc)	
		AVG	UNIFORMITY	AVG			4.9m h	9m h
<b>Primary Ceremonial Routes</b>	High Luminance, Medium contrast	30	4:1	10	3000K / 80+	Photocell	10m	N.A.
<b>Secondary Pedestrian Routes</b>	Medium Luminance, medium contrast	20	4:1	5		Photocell	15m	N.A.
<b>Tertiary Pedestrian Routes</b>	Low Luminance, Low contrast	10	6:1	2		Photocell/ Occupancy Sensor	20m	N.A.

## 6.5

### **BUILDING ACCESS AND EGRESS**

On-site building lighting differentiates between primary, secondary and tertiary building access points. Lighting is used to emphasize building entrances, canopies and façades. Emergency egress lighting includes code required exit only doors, service equipment doors, and loading docks. Adjacent façade lighting or internal lighting is a part of each of these elements.

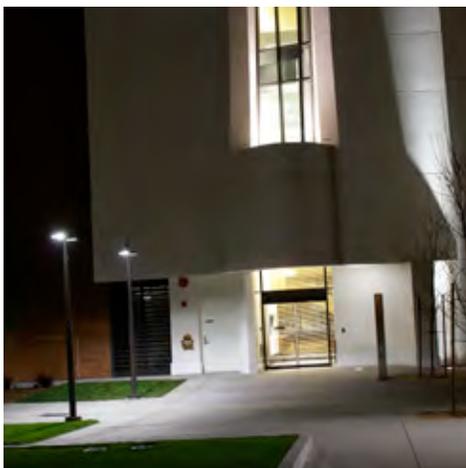
Lighting for access to campus buildings will be achieved using the same pole type as the adjacent pedestrian pathways. These poles will be spaced to optimize distribution and uniformity to create a clear, bright illuminated pathway to the building main entrance. Building mounted lighting should be shielded to limit glare, directed down to the walking surface or up onto covered canopies or eaves. Uplighting should be avoided to prevent glare. Principal lighting for the entrances of a building should be provided by the building as part of the architect's design. Lighting from the interior of the building shall be considered as part of the contributing light levels that may be required adjacent to the building.

Fixture options to satisfy on-site illumination requirements will be differentiated by nightly visitor access. Primary building entrances will be illuminated to the highest illuminance values and utilize quality lighting to promote wayfinding and ceremonial destinations from primary axes. Secondary Building entrances will be lit with high illuminances though differentiated from primary points of entry. Emergency Egress Pathways and Entrances will be lit to satisfy all safety illumination requirements.

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◀ A building's interior lighting can contribute to exterior lighting requirements, and add to the prominence and emphasis of primary entrances.



◀ More subtle down lighting clearly indicates secondary and tertiary building access points without overpowering key entries and public spaces.

TABLE 04. BUILDING ACCESS AND EGRESS LIGHTING PERFORMANCE

BUILDING ACCESS & EGRESS	Context	Horizontal (lux)		Vertical (lux)	Colour (*K / CRI)	Controls	Spacing (oc)	
		AVG	UNIFORMITY	AVG			4.9m h	9m h
<b>Primary Building Entrances</b>	High Luminance, High contrast	20	10:1	8	3000K / 80+	Photocell	N.A.	N.A.
<b>Secondary Building Entrances</b>	High Luminance, Medium contrast	15	6:1	5		Bi-level Dim w. ON/OFF / Occupancy Sensor ON	N.A.	N.A.
<b>Emergency Egress Pathway and Entrances</b> <sup>1</sup>	High Luminance, Low contrast	10	4:1	3		Photocell	N.A.	N.A.

<sup>1</sup> In loading and service areas, lighting controls to be user activated with timeclock off to provide minimum light levels required by WorkBC Legislation.

FIXTURE PALETTE



Selux Saturn Cutoff LED



Technilum Structure K



Schreder Piano

## 6.6 OUTDOOR PLACES

The [Campus Plan](#) identifies several places as key public realm spaces that will define the identify of the Okanagan Campus and become destinations for important events. These spaces also mark significant intersections of the campus circulation system. Lighting quality, scale, intensity, detail, and color emphasize the significance of these places at night, and differentiate these areas from their surroundings. Lighting equipment will support the multi-use nature of these spaces.

Lighting for Outdoor Places may include tall light poles with adjustable down lights or pedestrian scale light poles. Tall light poles with adjustable and color programmable light sources provide flexibility to aim light to highlight key event spaces with efficiency and flexibility. Pedestrian scale poles provide walkway illumination and visual connections to the campus path structure. Some poles require banner arms; please see section 5.8 for details.

The variety of activities conducted at campus nodes must be addressed through functional lighting solutions. Illuminance should vary to accommodate a variety of events and functions, from circulation to activity or task lighting, and to provide a more interesting pattern within the open space.

At left are the selected fixture types. The fixture palette supports the proper enjoyment of event plazas, academic commons, and recreational fields and courts. These fixtures were selected based on an evaluation of overall quality, performance, aesthetic, life span and cost. Suitable alternatives may be approved provided they meet the desired technical, aesthetic and design performance requirements outlined in this document. Sports field lighting shall be specified at the time of project design to meet the needs of the facility. Fixtures shall not have any light trespass into adjacent residential uses.

FIGURE 16. OUTDOOR PLACES LIGHTING PLAN



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TABLE 05. OUTDOOR PLACES LIGHTING PERFORMANCE CRITERIA

OUTDOOR PLACES	Context	Horizontal (lux)		Vertical (lux)	Colour (°K / CRI)	Controls	Spacing (m)	
		AVG	UNIFORMITY	AVG			4.9m h	9-18m h
<b>Primary Campus Place</b> University Way & Central Courtyard	High Luminance, Medium contrast	50-100	4:1	1/3 hor.	3000K / 80+	Photocell	10m	40m
<b>Green Event Spaces</b>	Low Luminance, Low contrast	10-20	8:1	1/3 hor.		Photocell ON / Time Clock OFF	15-20m	N.A.
<b>Green Sports Spaces</b>	High Luminance, High contrast	100-500	4:1	1/3 hor.		Photocell ON / Time Clock OFF	N.A.	As req.
<b>Parking</b>	High Luminance, Low contrast	10-30	4:1	1/3 hor.		Bi-level Dim w. ON/OFF / Occupancy Sensor ON	N.A.	20 - 30m

## 6.6.1 Primary Campus Places

### University Way and Central Courtyard

University Way and the Central Courtyard are identified as Primary Campus Places. These are prominent gathering spaces for the campus where lighting should emphasize the ceremonial aspects of the place and contribute to the identity and dignity of the campus.

Well crafted light elements at a large scale will define the space and create a comfortable atmosphere at night. The light fixtures within UBC's University Way and Central Courtyard may utilize a wide range of pole heights from 4.9m to 18m high. In conjunction with ornamental light columns, exterior building façades and landscape lighting, the light poles must correlate to hardscape and landscape design. Tall poles allow wide spacing and provide more unobstructed space on University Way; aiming angles should be limited to a maximum of 45 degrees above vertical. All University Way light poles shall include power outlets at the base. Lighting elements within Primary Campus Places will provide 50-100 lux, highlighting the prominence of these core campus locations.

## 6.6.2 Green Gathering/Event Spaces

These green spaces are landmark public gathering and event spaces. The landscape lighting design will highlight key landscape features and provide a warm and well-illuminated space for users. Pedestrian scale poles are used in conjunction with a variety of supplemental fixtures to define both pathways and landscape elements. Provide 5 to 20 lux, encouraging use by students at night.

## 6.6.3 Green Sports Spaces

Green Sports Spaces will be lighted to support the type of activities within Sports and recreational areas will be brightly lit to accommodate athletic competition and practice. Competition spaces provide required illuminance by sport type. Practice spaces and intramural sports spaces provide 30 to 100 lux.

Sports and recreational spaces form a significant part of the campus lighting plan at night. Sports field and court illumination is provided for practice, competition, and recreational use. Lighting will be shielded and focused to the playing surface to limit light spill and up light. Sports lighting fixtures are pole mounted, with time clock and user scheduling controls to limit use after occupants vacate the area.

### 6.6.4 Parking

Many people will travel to the campus by car, therefore the quality of the light within the car park lots influence their first and last experience at the campus. Good quality lighting provides for safety and security, and also aids wayfinding to accent main circulatory routes, entries, and exits.

At new car park surface lots utilize 9m-high poles spaced 30m on center. The efficiency of LED light fixtures will accommodate wide distances between poles. Integrate pedestrian poles at pathways leading to parking.

At existing car park lots, utilize new light fixtures on existing light pole foundations and add new light poles at similar height at intermediate aisles or at perimeter. Uniformity values may be adjusted lower at existing lots where necessary.

Use additional fixtures such as building-integrated façade lighting, directional area flood lighting and landscape lighting to increase brightness at the perimeter of the parking area to improve visibility and security.

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## 6.7 FIXTURE SCALE VARIETY

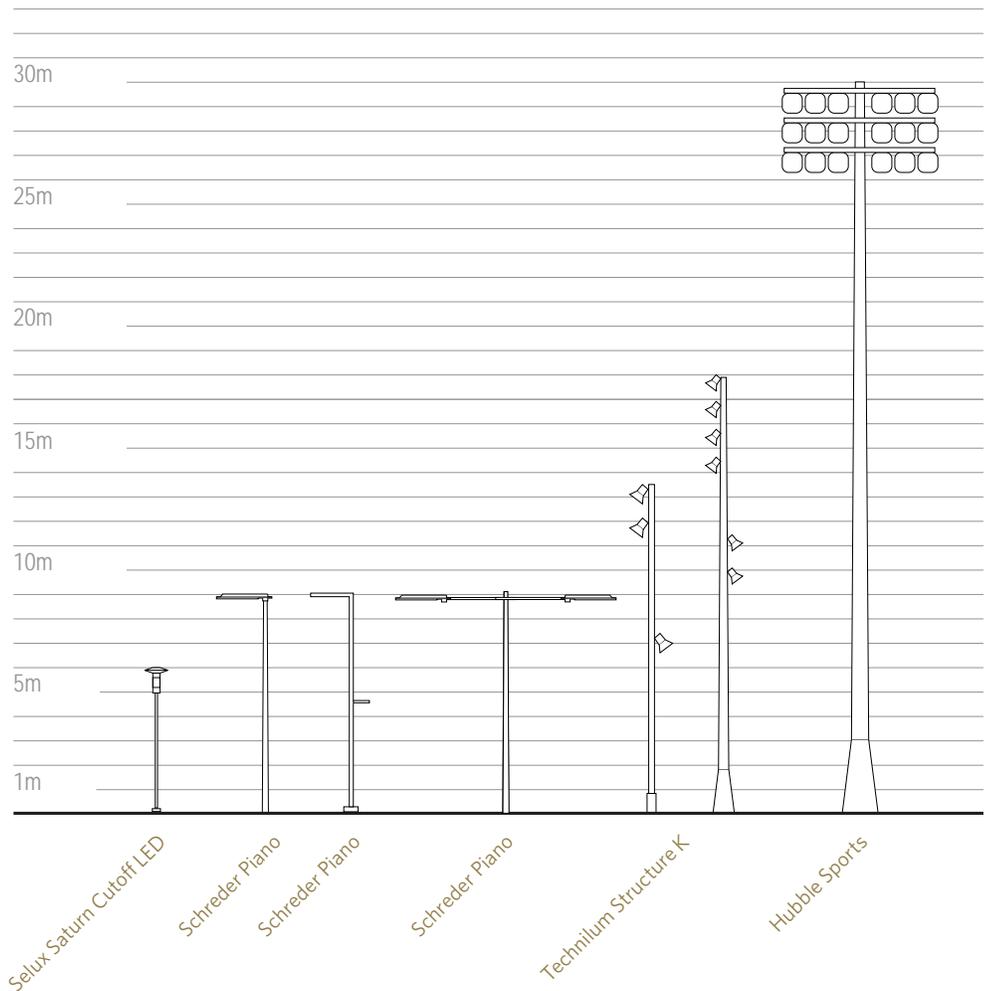
Lighting fixture systems reinforce the character of a space and support the architectural and landscape design. The lighting fixture’s appearance, scale and arrangement provide visual cues for functions within an area of the campus.

Light fixtures should express a modern and timeless design aesthetic through the use of durable materials that will maintain a high quality appearance over many years of use. The fixtures illustrated below are examples of well designed products that provide the appropriate image for the campus. Suitable alternatives may be approved provided they meet the desired technical, aesthetic and design performance requirements outlined in this document.

Selected light fixtures should be consistently applied within the campus to provide a unified approach to the illuminance, height and spacing of the lights, and the fixture and light pole aesthetics.

FIGURE 17. FIXTURE SCALE VARIETY

The scale of the selected fixture types have been chosen to promote a consistent campus lighting strategy that clearly differentiates hierarchy and context. The diagram plots the selected fixtures, and their relationship to each other.



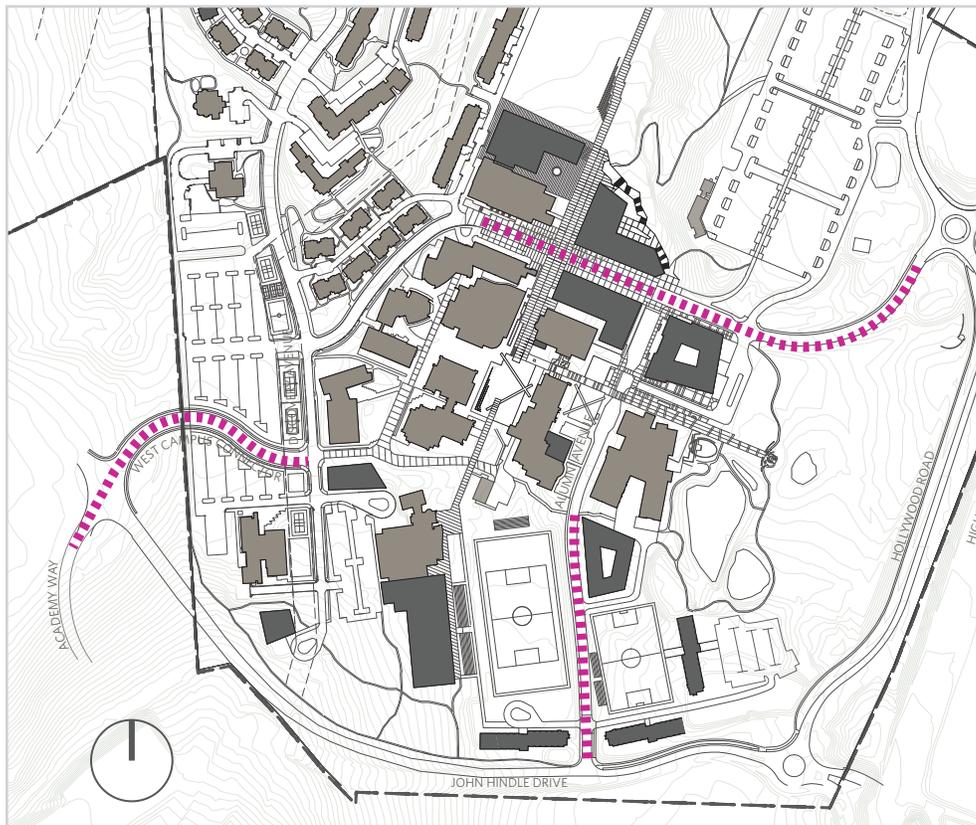
## 6.8 POLES AND BANNERS

Campus banners may be incorporated to announce entry or promote campus events. These are the guiding principles:

- Only faculties and administrative units of UBC may utilize the banner poles
- Priority will be given to enterprise-wide messages and initiatives (e.g. UBC brand, Graduation)
- Banner messages and designs must be of a high standard as befitting UBC's status and reputation
- Commercial content such as corporate logos, messages or offers are prohibited

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FIGURE 18. BANNER POLE LOCATION PLAN



### LEGEND

■■■■■■ Banner Pole Locations

## 6.9 PERFORMANCE SPECIFICATIONS

### Lighting Criteria

Project submissions must demonstrate the amount light energy (luminous flux) incident at a specific point on a surface over a standard area (lux, lumens per square meter). Lux measures light intensity on a surface. The *Guidelines* establish values to support the overall hierarchical plan illustrated in Figure 13.

Acceptable contrast ratios are established to allow key campus features to gain more prominence. Lower contrast ratios are defined for secondary components and to create large contiguous areas or circulation zones.

### Sustainable design requirements

Lighting should support the overall local and global environmental concerns or issues, by utilizing environmentally friendly solutions which limit light pollution, or the disposal of harmful waste, utilize solutions that integrate ease of maintenance and use of durable, reliable systems that anticipate future technologies. All pole mounted lights over 4.5 meters (15 feet) will meet LEED cut-off requirements per applicable Lighting Zone 2 (LZ2), see definitions below.

The lighting system will consider minimized lighting impacts of: light trespass, light pollution, and glare. The lighting system shall be in compliance with the following Lighting Zone Definitions:

- LZ1 - Dark (developed areas within national parks, forest land and rural areas)
- LZ2 - moderate ambient lighting (primary residential zones, neighborhood business districts, light industrial areas with limited nighttime use and residential mixed-use areas)
- LZ3 - moderately ambient lighting (all other areas not included in LZ1, LZ2, or LZ4, such as commercial / industrial, and high-density residential)
- LZ4 - high ambient lighting (high activity commercial districts in major metropolitan areas)

### Design requirements

Lighting plans and specifications must conform to the Master Lighting Plan (figure 13).

All Lighting Fixture specifications must comply with the following minimum performance criteria:

- a. **Lighting system efficiency** - 75% or higher.
- b. **Initial lamp efficacy** - 100 lumens per watt or higher.

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- c. **LED module lumen depreciation** - LM 70 > 50,000 hours.
- d. **Color Rendering Index** - 70 or greater.
- e. **Color Temperature** - 3000K.
- f. **Primary Voltage** - 120 volts.
- g. **Durability** - system and components must meet local and national electric code, IP 65 waterproof, rated for outdoor use, and higher thermal heat dissipation properties. Cooling system shall consist of a heat sink with no fans, pumps, or liquids, and shall not allow debris building up that may impair heat dissipation performance.
- h. **Ease of Maintenance** - submit samples for review and approval by UBC Okanagan Facilities Management to confirm access to all service components.
- i. **Luminaire optical design** - luminaire design shall incorporate appropriate shielding to limit view to direct lamp images, luminaire optical design shall meet the luminaire classification system of three composite (BUG) ratings of Backlight, Uplight, and Glare (<10% to frontlight very high FVH, <10% to backlight very high BVH, and 0% uplight high UH).
- j. **Light Poles** - aluminum, 150mm, round, straight, warm grey - (AZKO 900 (Europe) or RAL 7039 (North America)).

## Controls

New lighting systems will incorporate digital control systems, electronic power sources, and digital control sensors. Photocell, time-clock, and centralized lighting controls to monitor and manage light energy consumption are required. Local use of photocells and time-clocks may reduce lighting use to when occupied, and this is an effective approach for areas not frequently occupied at night.

Step down dimming technology dims lighting for reduce power consumption over the life of the lamp and at time of lower occupancy use, after midnight. Step dimming requires occupancy sensors to activate at full intensity when occupied.

A campus-wide lighting management system is recommended for monitoring lamp life and lighting system efficiency for improved maintenance and energy management.



# APPENDIX

# APPENDIX A: LIGHTING

## A.1 GLOSSARY

Discussions of lighting issues should include precise descriptions or terminology of the specific lighting technical parameters. The following glossary summarizes explanations of the technical lighting terms utilized within the report and the related practice standards to facilitate discussion of these issues. The following technical terms are presented in this report.

**Brightness:** The magnitude of sensation that results from viewing surfaces from which light comes to the eye. This sensation is determined partly by the measurable luminance of the source and partly by the conditions of observation (Context), such as the state of adaptation of the eye. For example, very bright lamps at night appear dim during the day, because the eye adapts to the higher brightness of daylight.

**BUG Rating:** A luminaire classification system established in IES TM-15-07, BUG Ratings Addendum that provides for uniform assessment of the directional characteristics of illumination for exterior area lighting. BUG is an acronym composed of Backlight, Uplight, and Glare. BUG ratings are based on a zonal lumen calculations for secondary solid angles defined in IES TM-15-07.

**Candela:** Measure of light energy from a source at a specific standard angle and distance. Candela (cd) is a convenient measure to evaluate output of light from a lamp or light fixture in terms of both the intensity of light and the direction of travel of the light energy away from the source.

**Contrast:** Calculated evaluation of high, medium and low contrast of visible light sources or surfaces within the Project Site by a ratio of luminance values. Contrast is the ratio of one surface luminance to a second surface luminance or to the field of view. Contrast values exceeding 30 to 1 are usually deemed uncomfortable; 10 to 1 are clearly visible; and less than 3 to 1 appear to be of equal value.

**Fully Shielded:** A lighting fixture constructed in such a manner that all light emitted by the fixture, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any part of the Luminaire, is projected below the horizontal as determined by photometric test or certified by the manufacturer. Any structural part of the light fixture providing this shielding must be permanently affixed. In other words, no light shines above the horizontal from any part of the fixture.

**Glare:** Glare is visual discomfort experienced from high contrast. For exterior environments at night, glare occurs when the range of luminance in a visual field is too large. The light energy incident at a point is measured by a scale of footcandles or lux, and is described in the technical term Illuminance. This

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incident light is not visible to the eye until it is reflected from a surface, such as pavement, wall, dust in the atmosphere or the surface of a light bulb. The visible brightness of a surface is measured in footLamberts (or metric equivalent candelas per square meter) and is described by the term Luminance.

The human eye processes brightness variations across a very broad spectrum of intensities. The ratio of brightness values generated by direct noon sun versus a moonlight evening is over 5000 to 1. Human eyes are capable of accommodating to this range of intensities given adequate time to adjust. However, the eye cannot process brightness ratios of more than 30 to 1 within a view without discomfort.

For the purpose of this analysis, brightness of light sources may be described subjectively by the following criteria:

**High Contrast Conditions:** View of light fixture emitting surface, such as a lens, reflector, or lamp, where brightness contrast ratio exceeds 30 to 1 (source Luminance to background Luminance ratio in footLamberts).

**Medium Contrast Conditions:** Brightly lighted surfaces where contrast ratio exceeds 10 to 1, but is less than 30 to 1 (lighted surface Luminance to background Luminance ratio in footLamberts).

**Low Contrast Conditions:** Illuminated surfaces where contrast ratio exceeds 3 to 1, but less than 10 to 1 (source Luminance to background Luminance ratio in footLamberts).

**Illuminance:** Illuminance is the means of evaluating the density of Luminous Flux. Illuminance indicates the amount of Luminous Flux from a light source falling on a given area. Illuminance is measured in footcandle (fc) which is the lumens per square foot, or Lux (lumens per square meter). Illuminance need not necessarily be related to a real surface since it may be measured at any point within a space. Illuminance is determined from the Luminous intensity of the light source. Illuminance decreases with the square of the distance from the light source (Inverse Square Law).

**Horizontal Illuminance:** Illuminance incident upon a horizontal plane. The orientation of the illuminance meter or calculation point will be 180° from Nadir.

**Vertical Illuminance:** Illuminance incident upon a vertical plane. The orientation of the illuminance meter or calculation point will be 90° from Nadir.

**Light Output Direction:** Luminaires for general lighting are classified in accordance with the percentages of total luminaire output emitted above and below horizontal. The light distribution curves may take many forms within the limits of upward and downward distribution, depending upon the type of light and the design of the luminaire.

**Lighting Array:** An installation of multiple light sources or lamps where the distance between each lamp or light source within the Lighting Array is less than 5

feet on center in any direction from any other source.

**Light Source:** Device which emits light energy from an electric power source.

**Light Trespass:** Electric light from subject property incident onto adjacent properties, measured in footcandles or lux, usually analyzed by measurement at or near the adjacent property line.

**Lighting Zone:** Defined by IESNA and summarized in Table 26.4 in the 10th Edition.

**Lighting Zone LZ2:** Outdoor areas of human activity where the vision of human residents and users is adapted to moderate light levels. Lighting is not uniform or consistent. Lighting is generally desired for safety, security and/or convenience.

**Lighting Zone LZ3:** Outdoor areas of human activity where the vision of human residents and users is adapted to moderately high light levels. Lighting is generally desired for safety, security and/or convenience.

**Lighting Zone LZ4:** Outdoor areas of human activity where the vision of human residents and users is adapted to high light levels. Lighting is generally desired for safety, security and/or convenience.

**Luminaire:** A complete lighting unit consisting of a lamp or lamps and ballast(s) (when applicable) together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply. Also referred to as a Light Fixture.

**Luminaire Cutoff:** A classification system created by the IESNA to describe light distribution from exterior luminaires.

**Full cutoff:** A Luminaire light distribution where zero Candela intensity occurs at or above an angle of 90° above Nadir. Additionally, the Candela per 1,000 lamp lumens does not numerically exceed 100 (10 percent) at or above a vertical angle of 80° above Nadir. This applies to all lateral angles around the luminaire.

**Cutoff:** A luminaire light distribution where the candela per 1,000 lamp lumens does not numerically exceed 25 (2.5 percent) at or above an angle of 90° above Nadir, and 100 (10 percent) at or above vertical angle 80° above Nadir. This applies to all lateral angles around the Luminaire.

**Semi-cutoff:** A luminaire light distribution where the candela per 1,000 lamp lumens does not numerically exceed 50 (5 percent) at or above an angle of 90° above Nadir, and 200 (20 percent) at or above vertical angle 80° above Nadir. This applies to all lateral angles around the Luminaire.

**Non-cutoff:** A luminaire light distribution where there is no Candela limitation in the zone above maximum Candela.

**Luminance:** Luminance is a measure of emissive or reflected light from a specific surface in a specific direction over a standard area. Luminance is measured in

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footLamberts (fL) (Candela per square foot) or cd/m<sup>2</sup> (Candela per square meter). 1fL = 3.43 cd/m<sup>2</sup>.

Whereas Illuminance indicates the amount of Luminous Flux falling on a given surface, Luminance describes the brightness of an illuminated or luminous surface. Luminance is defined as the ratio of luminous intensity of a surface (Candela) to the projected area of this surface (m<sup>2</sup> or ft<sup>2</sup>).

**Luminous Flux:** Mean value of total Candelas produced by a light source. Luminous Flux describes the total amount of light emitted by a light source. The unit for measuring Luminous Flux is Lumen (lm).

This radiation could basically be measured or expressed in watts. This does not, however, describe the optical effect of a light source adequately, since the varying spectral sensitivity of the eye is not taken into account. To include the spectral sensitivity of the eye the Luminous Flux is measured in lumen. Radiant Flux or 1 W emitted at the peak of the spectral sensitivity (in the photopic range at 555 nanometers produces a Luminous Flux of 683 lumen). The unit of lumen does not define direction.

**Skyglow:** Skyglow is the description of luminous atmospheric background and results from both natural and human made conditions. Natural causes of skyglow include sunlight reflected from the surface of the earth and moon, sunlight illuminating the upper atmosphere, and visible illumination from other interplanetary sources. Human made causes of skyglow include electric light that is emitted directly upward into the sky (Uplight), or reflected off of the ground. Such light illuminates the aerosol particles within the atmosphere and results in a luminous background.

**Uplight:** Uplight is the primary cause of skyglow and can be differentiated into two zones, (1) Lower Uplight and (2) Upper Uplight. Lower uplight describes light between 90° and 100° above nadir. Most skyglow is caused by Lower Uplight. Upper Uplight results primarily in energy waste.

## A.2 IESNA STANDARDS

The Illumination Engineering Society of North America (IESNA) defines professional best practices for the design and implementation of lighting systems. Many national, provincial, and local lighting codes are based upon the IESNA recommended practices, including illuminance design criteria. The Illuminance criteria within this Guideline above are, for the most part, greater than the IESNA Recommendations. A brief summary of relevant IESNA recommendations are listed below:

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DESCRIPTION		Horizontal Illuminance LUX (FC)			Vertical Illuminance LUX (FC)			Luminance			Source
		Average	Min	Uniformity Ratio	Average	Min	Uniformity Ratio	Uniformity Ratio			
<b>PEDESTRIAN ZONES AND PATHWAYS</b>	EM Egress	10	1.1								
	Mixed Vehicle Pedestrian	20		4 :1	10.8					IESNA RP-08-00 Table 5	
	Pedestrian Only (High Conflict)	10		4 :1	5.4					IESNA RP-08-00 Table 5	
	Ped Areas	5		4 :1	2.2					IESNA RP-08-00 Table 6	
	Medium Density Residential	4		4 :1	1.1					IESNA RP-08-00 Table 7	
<b>ROADWAY INTERSECTIONS</b>	Roadway - Major (High Ped Conflict)	35		3 :1						IESNA RP-08-00 Table 9	
	Roadway - Major (Med Ped Conflict)	28		3 :1						IESNA RP-08-00 Table 9	
	Roadway - Collector (High Ped Conflict)	25.0		4 :1						IESNA RP-08-00 Table 9	
	Roadway - Collector (Med Ped Conflict)	12.0		4 :1						IESNA RP-08-00 Table 9	
	Roadway - Local (High Ped Conflict)	20.0		6 :1						IESNA RP-08-00 Table 9	
	Roadway - Local (Med Ped Conflict)	15.0		6 :1						IESNA RP-08-00 Table 9	
	Roadway - Local (Low Ped Conflict)	8.0		6 :1						IESNA RP-08-00 Table 9	

DESCRIPTION		Horizontal Illuminance LUX (FC)			Vertical Illuminance LUX (FC)			Luminance		Source
		Average	Min	Uniformity Ratio	Average	Min	Uniformity Ratio	Uniformity Ratio		
<b>ROADWAYS</b>	Roadway - Major (High Ped Conflict)	15.0		3 : 1						IESNA RP-08-00 Table 2
	Roadway - Major (Med Ped Conflict)	12.0		3 : 1						IESNA RP-08-00 Table 2
	Roadway - Collector (High Ped Conflict)	10.0		4 : 1						IESNA RP-08-00 Table 2
	Roadway - Collector (Med Ped Conflict)	8.0		4 : 1						IESNA RP-08-00 Table 2
	Roadway - Local (High Ped Conflict)	8.0		6 : 1						IESNA RP-08-00 Table 2
	Roadway - Local (Med Ped Conflict)	6.0		6 : 1						IESNA RP-08-00 Table 2
	Roadway - Local (Low Ped Conflict)	4.0		6 : 1						IESNA RP-08-00 Table 2
<b>FAÇADE &amp; MONUMENT</b>	Bright Surroundings Light Surface				55					IESNA_RP-33-99 Table 2
	Bright Surroundings Medium Light Surface				75					IESNA_RP-33-99 Table 2
	Bright Surroundings Dark Surface				110					IESNA_RP-33-99 Table 2
	Dark Surroundings Light Surface				25					IESNA_RP-33-99 Table 2
	Dark Surroundings Medium Light Surface				35					IESNA_RP-33-99 Table 2
	Dark Surroundings Medium Dark Surface				45					IESNA_RP-33-99 Table 2
	Dark Surroundings Dark Surface				53.8 (5.0)					IESNA_RP-33-99 Table 2
	Site Contrast Blend in w/ surroundings								1 : 2	IESNA_Lighting Handbook_22-Fig 22-1
	Site Contrast Soft Accent								1 : 3	IESNA_Lighting Handbook_22-Fig 22-2
	Site Contrast Accented								1 : 5	IESNA_Lighting Handbook_22-Fig 22-3
	Site Contrast Strong Accent								1 : 10	IESNA_Lighting Handbook_22-Fig 22-4

## A.3 LIGHTING FACTORS IN THE VISUAL SYSTEM

The visual system perceives the luminance of an object, or the amount of light emitted or reflected off of a surface, measured in candelas per meter squared (cd/m<sup>2</sup>). Luminance is the luminous flux per unit of projected area (A<sub>∅</sub>) per unit solid angle (dw) leaving a given point in a given direction. The subjective evaluation of luminance is commonly known as brightness.

Luminance ratios are dependent on surface reflectance values and the resultant illuminance (incident light) that reach surfaces. Luminance for LED displays is typically measured with the luminous term called nit. A Nit is a candela per square meter (cd/m<sup>2</sup>). For the purposes of this impact report and for the sake of using typical lighting terminology, the impact of this LED façade design is evaluated in units of Foot-lamberts in the following analysis and the various lighting calculations found within. The relationship of a Nit to a Footlambert is:

$$1 \text{ fL} = (1/\pi) (\text{cd}/\text{ft}^2) = 3.426 (\text{cd}/\text{m}^2) = 3.426 \text{ nit}$$

The more common measurement of lighting is illuminance, which is the measure of light energy (luminous flux) incident at a specific point on a surface over a standard area (foot-candles (fc), lumens per square foot or lux, 1fc = 10 lux). This term describes light intensity on a surface.

In regards to visual perception, the human eye can perceive an illuminance range from a limited range of about three orders of magnitude. For example, the eye can successfully see from about 1 lux-1000 lux, or 100 lux-100,000 lux. On a moonlit night, the illuminance may range from .01Fc - 1Fc, meanwhile a bright sunlight day will have between 5000Fc-10,000Fc.

Adaptation allows a range of illuminance to be perceived and involves an eye's response to increase or decrease in light levels that occurs within a fraction of a second. The pupil of an eye constricts in response to increase of light levels about five times faster than it can dilate in response to a drop in light levels. Therefore, a person can adapt more quickly from darker environment to a brighter environment than vice versa. The aging eyes of older people are slower to adapt, thus will be more sensitive to changes in light levels.

The eye can so readily adapt to different light levels, that it is generally not a good judge of absolute illuminance levels, than rather the levels measured from a light meter. Human perception tends to compare relative brightness between the darkest and brightest areas within the field of view. As a result, a person adapted to a dimly lit environment will perceive a lit environment as very bright, and moments later, once moved into a darker environment, the same person will perceive the environment very dark. In the case of a night environment, people adapted to bright interior light levels may be temporarily "night blind" when they step into the dark exterior.

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## 1. Visual Size

The visual size of an object is one of the most important factors in how one perceives an object. The larger the object is relative to our visual field, the easier it is to see. Thus, as things are closer to our eye, they appear larger, and we are able to discern smaller details. In addition, the higher the light levels, the more precisely we can see detail. Lastly, humans can perceive smaller objects if they stand out against a contrasting background such as dark sky, just as a star is perceived against a black sky and a speck of dirt is visible against a clean white piece of paper. Size and visual acuity is relative to the distance of an object to our eyes as well as contrast levels are important factors in perception.

## 2. Contrast

Contrast is one of the most fundamental elements of vision; lack of contrast can reduce visibility to nil. Increasing the contrast between an object and its surrounding increases the visibility of the object, and reduces the need for additional illumination. In cases of signage and retail design, increasing the brightness contrast is the overall objective, increasing visibility while lowering general illumination requirements.

Increasing the luminance of the façade increases the visibility of the project, however in relation to existing adjacent backgrounds; the brightness contrast will be minimized due to the fact that the project building façade will have an added luminance that will be the midpoint value between the highest and lowest values. This conclusion is based on the illuminance and luminance measurements of the existing conditions.

## 3. Motion

The human eye, constantly in motion, scans fields of view for standard vision. When a moving object becomes the subject, the general scanning process is disrupted. Focusing on moving objects requires concentration and interferes with the general scanning process. The slower and more predictable the motion of an object, the easier it is to perceive. Thus, when focusing on moving objects, our peripheral vision of a moving object becomes blurred. The faster an object is moving the less detail can be distinguished. In addition, the increase of object size and contrast between the object and its background will increase visibility and perception of the human eye.

Motion in the field of view attracts our visual attention. In the case of nighttime driving, an object detected in the periphery of vision often causes the driver's visual attention to be momentarily diverted from the road to the object. Motion as well as, flashes and flicker (changes in illumination) will draw a driver's attention away from the road.

An eye can adapt to an illuminance range of about three orders of magnitude. Within a fraction of a second the eye can adapt to a significant change in

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illumination, an increase or decrease. If it is assumed that the maximum speed limit for drivers along a typical vehicular street is 40 mph and the distance from the first point of view to project site location is (Dist) then this relationship of time and distance is described below in which the total time it takes to typically reach a closer view of a project site is approximately 22.95 sec, well within the time required for light adaptation:

$$T = (\text{Dist}) * (1 \text{ hr} / 40 \text{ miles}) * (60 \text{ min} / 1 \text{ hour}) * (60 \text{ sec} / 1 \text{ min})$$

T = Time allowed to adapt to the luminance level of the project façade

Dist = .25 mi shortest distance from first point along street, line of sight to project site

$$T = (.25\text{mi}) * (1\text{hr}/40\text{mi}) * (60\text{min}/1\text{hr}) * (60\text{sec}/1\text{min}) = 22.95 \text{ sec}$$

In consideration of the above equation, the increase in sight distance from the project increases driver safety as a result of the adequate stopping distances presented within the project, where:

Stopping distance, SD = reaction distance, RD + braking distance, BD

Reaction distance is defined as:

$$RD = \text{reaction time} \times \text{velocity (ft/sec)}$$

The figure below shows the critical relationship between the reaction time and the velocity of the vehicle to the reaction distance and the table on the right shows the reaction distance as a function of reaction time at a given 55mph.

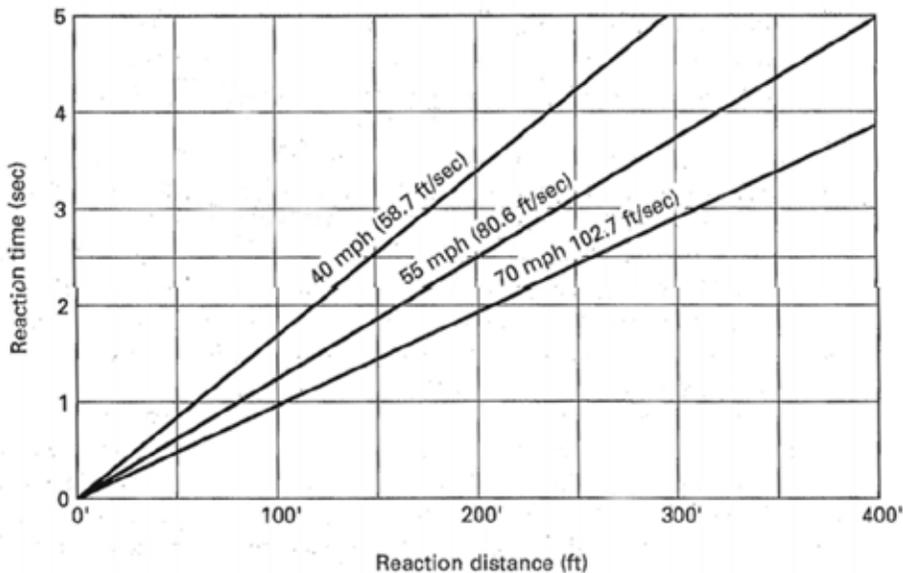


Figure: Reaction Distance

**Reaction Distance as a  
Function of Reaction Time at 55 mph**

Reaction Distance	
Reaction Time (sec)	Reaction Distance (feet)
1	80.7
2	161.3
3	242.8
4	322.7
5	403.3

*Table: Reaction distance as a function of reaction time*

The table shows that for a given velocity (55 mph), the longer the reaction time, the greater the reaction distance; hence the longer the stopping distance.

#### **4. Light Pollution**

Light pollution is any adverse effect artificial light including sky glow, glare, light trespass, light clutter, and decreased visibility.

##### **a. Glare Impacts**

Substantial light or glare impacts adversely affect day or nighttime views in the area. The magnitude of the sensation of glare depends on such factors as the size, position, and luminance of a source; the number of sources; and the luminance to which the eyes are adapted.

Glare is defined as visual discomfort experienced from high contrast. Each visible luminaire source (LED) or surface relative to the surrounding background (sky, hills, and foreground) has the potential to result in “glare”. There are two types of glare: 1) Disability Glare, which is glare that reduces the ability to see or identify objects, and 2) Discomfort Glare, which is glare that produces ocular discomfort, but does not reduce the ability to see. Glare is measured by a contrast ratio, which defines a luminance ratio between the foreground of luminaries to the background of dark sky. A significant glare impact is defined quantitatively as a luminance ratio of 30:1 or more.

The quality of illumination has a direct bearing on the safety, efficiency, and appearance of the proposed lighting once the functional needs of the project. As mentioned above, quality is dependent upon transient adaptation as well as glare control. Glare is caused by an excessively bright source directly within view. Such sources of glare can be especially distracting, and thus annoying, as it is very difficult to avoid directing one’s attention to a bright light source. Typically, people are looking toward the horizon, low angle sources of glare can be particularly troublesome, and difficult to avoid visually. Therefore preventive measures to avoid views into bright sources of light below the horizontal line should be implemented.

## b. Site Line Studies

Several areas or site line studies have been identified and are analyzed within this report as potential sources of visual discomfort or light intrusion based on general observation. Seeing is a function of the light leaving a surface referred to as luminance (L). Within the visual field of view, comfort and visibility are dependent upon the inherent luminance patterns. Comfort is dependent on the variation in luminance in the visual field (luminance ratios). Visibility is affected by the adaptation state, quality of luminance patterns, and clutter within the visual field. Clutter can create an overload of the visual system due to excessive luminance ratios.

The two contributing factors to determining luminance are the surface reflectance and the illuminance incident on a surface as defined by the Illuminating Engineering Society:

$$E = p * L$$

E = Illuminance (incident light energy arriving at an object)

p = Reflectance of surface

L = Luminance (reflected light energy from the surface)

The above relationship will be developed further in Section 4.0 Methodology.

## c. Views

As stated in Lighting Issues, the potentially obtrusive visual impact of disability glare is the effect of stray light in the eye whereby visibility and visual performance are reduced or producing a measurable amount of stray light in the eye. This potential visual impact or disability glare is only possible in the line of sight to the project site. However, the directional view of observers is variable and not fixed; the lighting points are not necessarily positioned in regular line arrays. Thus, the line of sight is defined as an imaginary straight line from the eye to a perceived object. The line of sight and field of views encompass the maximum viewing angle that a person may perceive of the project site. Together with these two factors, lighting impacts of glare and visual performance can be evaluated.

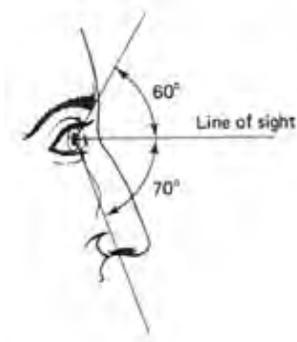


Figure: Vertical Limits of the Field of View

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The figure on the left indicates the maximum vertical limits of the field of view as 60° above and 70° below the line of sight. Normal line of sight is horizontal, which contends a normal field of vision. Glare, potentially occurs when a pedestrian has the ability to view into a luminaire directly, beyond the normal line of sight (beyond 60° above horizontal). Figure below depicts the relationship related to controlling light distribution angles to minimize glare.

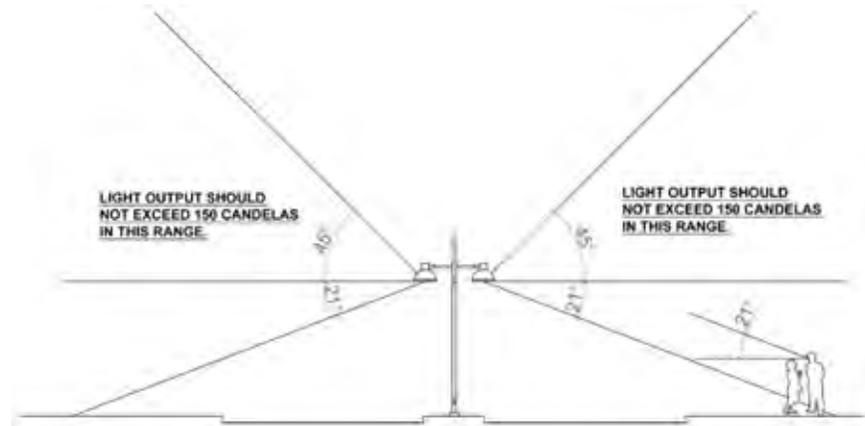


Figure: Direct Glare

#### d. Light Trespass

Light trespass is considered an undesirable condition in which spill light (light that falls outside of the area intended to be lighted) is cast. By limiting the exterior lighting originating on a property to a maximum of 0.5 horizontal foot candles (HFC) at a distance of 25 feet beyond the property lines, will greatly alleviate many complaints and will certainly improve the quality and effectiveness of most all outdoor area lighting applications.

This specification will allow the controlled placement of luminaires adjacent to the property lines. With many outdoor luminaires, it is difficult to comply with low-level foot-candle requirements at the property line. Height and placement of luminaires are strategic in preventing this contentious aspect of outdoor lighting.

## A.4 LEED LIGHTING POLLUTION STANDARDS

### Section 6: Site Design—Human Health + Well-Being

## Credit 6.8: Reduce light pollution

### 4 points

#### INTENT

Minimize negative effects on nocturnal environments and human health and functioning, reduce sky-glow, and increase nighttime visibility by reducing light trespass on site.

#### REQUIREMENTS

In order to reduce light pollution:

- Meet uplight and light trespass requirements for all exterior luminaires located inside the project boundary (except those listed under “Exemptions”) using one of the two methods below, based on:
  - The photometric characteristics of each luminaire when mounted in the same orientation and tilt as specified in the project design
  - The lighting zone of the project property (at the time construction begins). Classify the project under one lighting zone using the definitions provided in the Illuminating Engineering Society and International Dark Sky Association (IES/IDA) Model Lighting Ordinance (MLO) User Guide.

*Note:* Projects may use different methods for uplight and light trespass (backlight and glare).

- For internally illuminated exterior signage within the project boundary:
  - Do not exceed a luminance of 200 candelas per square meter (nits) during nighttime hours and 2,000 candelas per square meter (nits) during daytime hours. Illumination for front-lighted signage is considered façade or landscape lighting and must comply with uplight and light trespass lighting requirements.

#### Method 1: BUG rating method

Do not exceed the luminaire backlight, uplight, and glare (BUG) ratings (see Tables 6.8-A through C) for the project’s MLO lighting zone, based on the specific light source installed in the luminaire. Backlight and glare ratings are also based on the mounting location and distance from the lighting boundary. For guidance on determining ratings for luminaires, refer to the Documentation guidance section below.

The lighting boundary is the SITES project boundary. The lighting boundary can be modified under the following conditions:

- When the lighting boundary abuts a public area that is a walkway, bikeway, plaza, or parking lot, the lighting boundary may be moved to five feet (1.5 meters) beyond the property line.
- When the lighting boundary abuts a public roadway or public transit corridor, the lighting boundary may be moved to the center line of that roadway or corridor.
- The lighting boundary may be expanded to include additional properties contiguous to the SITES project if the additional property is owned by the same entity and has the same or higher MLO lighting zone designation.

Orient all luminaires located at a distance that is less than two mounting heights from the lighting boundary such that the backlight points toward the nearest lighting boundary line. The backlight rating requirement excludes building-mounted luminaires with the backlight oriented toward the building.

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## Section 6: Site Design—Human Health + Well-Being

### Backlight ratings

Table 6.8-A

MLO lighting zone	Allowed BACKLIGHT ratings for luminaire mountings			
	> 2 mounting heights from lighting boundary	1 to 2 mounting heights from lighting boundary and properly oriented	0.5 to 1 mounting height to lighting boundary and properly oriented	< 0.5 mounting height to lighting boundary and properly oriented
LZ0	B1	B1	B0	B0
LZ1	B3	B2	B1	B0
LZ2	B4	B3	B2	B0
LZ3	B5	B4	B3	B1
LZ4	B5	B4	B3	B2

Refer to Table 6.8-G to determine lumen requirements for backlight ratings B0—B5.

### Uplight ratings

Table 6.8-B

MLO lighting zone	Luminaire UPLIGHT rating
LZ0	U0
LZ1	U1
LZ2	U2
LZ3	U3
LZ4	U4

Refer to Table 6.8-H to determine lumen requirements for uplight ratings U0—U4.

### Glare ratings

Table 6.8-C

MLO lighting zone	Allowed GLARE ratings for luminaire mountings				
	Building-mounted > 2 mounting heights from any lighting boundary	Building-mounted 1–2 mounting heights from any lighting boundary	Building-mounted 0.5 to 1 mounting heights from any lighting boundary	Building-mounted < 0.5 mounting heights from any lighting boundary	All other luminaires
LZ0	G0	G0	G0	G0	G0
LZ1	G1	G0	G0	G0	G1
LZ2	G2	G1	G0	G0	G2
LZ3	G3	G1	G1	G0	G3
LZ4	G4	G2	G1	G1	G4

Refer to Table 6.8-I and Table 6.8-J to determine lumen requirements for glare ratings G0—G5.

## Section 6: Site Design—Human Health + Well-Being

### Method 2: Calculation method

#### Uplight

Do not exceed the following percentages of total lumens emitted above horizontal:

Table 6.8-D

MLO lighting zone	Maximum allowed percentage of total luminaire lumens emitted above horizontal
LZ0	0%
LZ1	0%
LZ2	1.50%
LZ3	3%
LZ4	6%

#### Light trespass (backlight and glare)

Do not exceed the following vertical illuminances at the lighting boundary. (Use the definition of lighting boundary in Method 1). Calculation points may be no more than five feet (1.5 meters) apart. Calculate the vertical illuminance on vertical planes running parallel to the lighting boundary. The normal to each plane should be oriented toward the property and perpendicular to the lighting boundary, extending from grade level to 33 feet (10 meters) above the height of the highest luminaire.

Table 6.8-E

MLO lighting zone	Maximum vertical illuminance at the lighting boundary
LZ0	0.05 footcandles
LZ1	0.05 footcandles
LZ2	0.10 footcandles
LZ3	0.20 footcandles
LZ4	0.60 footcandles

#### Exemptions from uplight and light trespass requirements

The following exterior lighting is exempt from the requirements, provided it is controlled separately from the nonexempt lighting:

- Specialized signal, directional, and marker lighting for transportation
- Lighting that is used solely for façade and landscape lighting in MLO lighting zones 3 and 4, and is automatically turned off from midnight until 6 a.m.
- Lighting that is integral to other equipment or instrumentation that has been installed by the equipment or instrumentation manufacturer
- Lighting for theatrical purposes for stage, film, and video performances
- Government-mandated roadway lighting
- Hospital emergency departments, including associated helipads
- Lighting for the national flag in MLO lighting zones 2, 3, or 4
- Internally illuminated signage

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## Section 6: Site Design—Human Health + Well-Being

### SUBMITTAL DOCUMENTATION

#### Method 1: BUG rating method

- MLO lighting zone classification for the site
- Exterior lighting plan and fixture schedule documenting the locations, time of use, and type of fixtures installed
- Photometric testing data for each type of luminaire or product cut sheets with photometric data broken out by the solid secondary angle
- Calculations demonstrating compliance with BUG rating requirements for the site's MLO lighting zone

#### Method 2: Calculation method

- MLO lighting zone classification for the site
- Exterior lighting plan and fixture schedule documenting the locations, time of use, and type of fixtures installed
- Photometric testing data for each type of luminaire or product cut sheets with photometric data
- Completed table for the site lumen calculations. The following data will be required to complete the calculation:
  - Luminaire type
  - Quantity installed
  - Initial fixture lumens per luminaire

### DOCUMENTATION GUIDANCE

#### Method 1: BUG rating method

Figure 6.8-F describes the zones to be measured for each luminaire in order to determine the BUG ratings for Method 1. Zones are based on the spherical secondary solid angles created by light emitted from the luminaire. Determine the rating for each zone using Tables 6.8-G through J. The overall rating is then determined by taking the maximum rating obtained for that table. For example, if the BH zone is rated B1, the BM zone is rated B2, and the BL zone is rated B1, then the backlight rating for the luminaire is B2.

Section 6: Site Design—Human Health + Well-Being

Figure 6.8-F

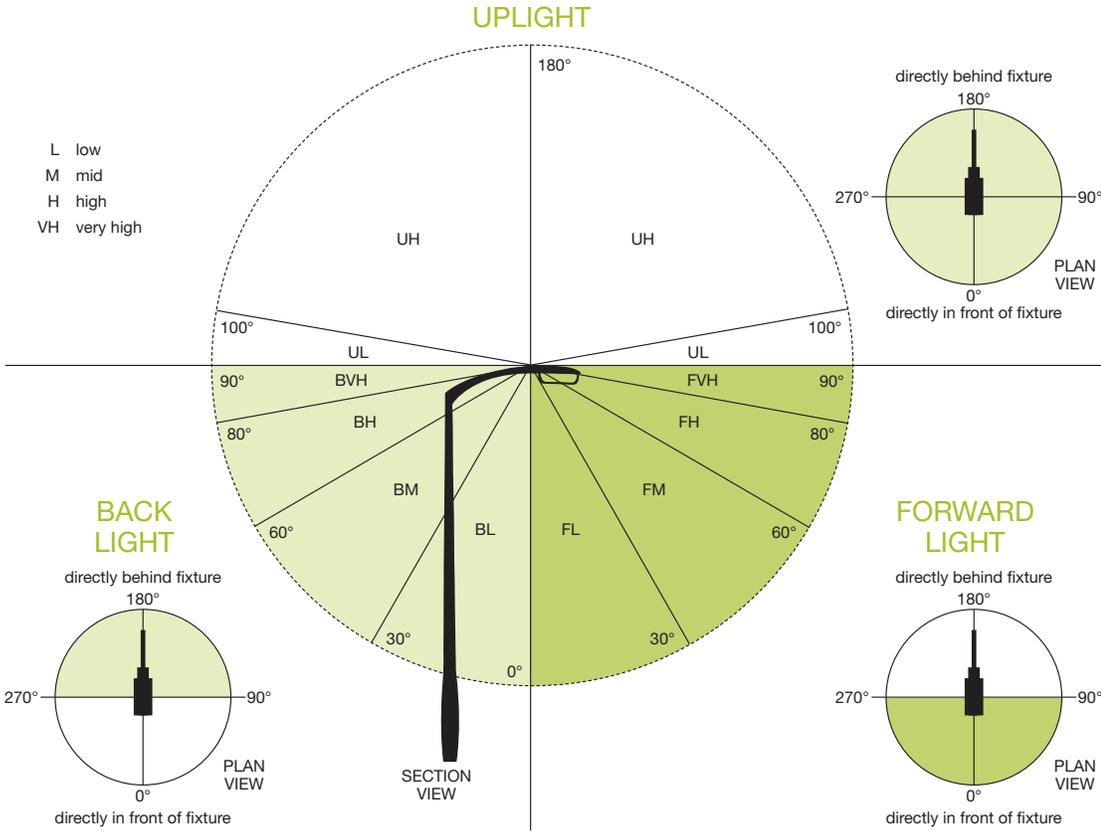


Table 6.8-G

Zone	BACKLIGHT ratings (maximum zonal lumens)					
	B0	B1	B2	B3	B4	B5
BH	110	500	1000	2500	5000	>5000
BM	220	1000	2500	5000	8500	>8500
BL	110	500	1000	2500	5000	>5000

Table 6.8-H

Zone	UPLIGHT ratings (maximum zonal lumens)					
	U0	U1	U2	U3	U4	U5
UH	0	10	50	500	1000	>1000
UL	0	10	50	500	1000	>1000

## Section 6: Site Design—Human Health + Well-Being

Table 6.8-I

Zone	GLARE ratings for asymmetrical luminaire types (type I, type II, type III, type IV)					
	G0	G1	G2	G3	G4	G5
FVH	10	100	225	500	750	>750
BVH	10	100	225	500	750	>750
FH	660	1800	5000	7500	12000	>12000
BH	110	500	1000	2500	5000	>5000

Table 6.8-J

Zone	GLARE ratings for quadrilateral symmetrical luminaire types (type V and type V square)					
	G0	G1	G2	G3	G4	G5
FVH	10	100	225	500	750	>750
BVH	10	100	225	500	750	>750
FH	660	1800	5000	7500	12000	>12000
BH	660	1800	5000	7500	12000	>12000

### RECOMMENDED STRATEGIES

- Adopt site lighting criteria to maintain safe light levels while avoiding off-site lighting and night sky pollution.
- Control the direction and spread of light by choosing the correct type of light fixtures. Consider using Illuminating Engineering Society (IES) “full cut off” or “fully shielded” designated fixtures, which means that no light is visible above the lowest light emitting part of the fixture.
- The Dark Sky Society recommends “Top-mounted sign lighting...with RLM (dish) type shields, provided that the light falls entirely on the sign and is positioned so that the light source (bulb) is not visible from any point off the property or into the roadway.”
- Consider hiring a professional lighting designer to strategically place lighting over 15,000 lumens or accent and wayfinding lighting.

### ECONOMIC AND SOCIAL BENEFITS

Light pollution can disrupt circadian rhythms and melatonin production, which has been linked to serious health concerns.<sup>1</sup> Reasonable use of outdoor lighting restores dark night skies and preserves the ambiance of the night. In addition, whether artificial outdoor light is directly adjacent to a species habitat or located at some distance, as through sky glow, it disturbs balances in competition and predation among vast numbers of nocturnal species and has the potential to disrupt the functioning of entire ecosystems.<sup>2</sup> Excessive night lighting of buildings kills thousands of migrating birds annually.<sup>3</sup>

1. RG Stevens, “Artificial Lighting in the Industrialized World: Circadian Disruption and Breast Cancer,” *Cancer Causes and Control* 17 (2006): pp. 501–507.  
 2. International Dark-Sky Association, “Frequently Asked Questions,” [www.darksky.org/about-ida/faqs](http://www.darksky.org/about-ida/faqs) (accessed March 24, 2013).  
 3. City of Chicago Mayor’s Office and Department of Environment, *Chicago’s Bird Agenda 2006* (Chicago: City of Chicago, 2006).

## Section 6: Site Design—Human Health + Well-Being

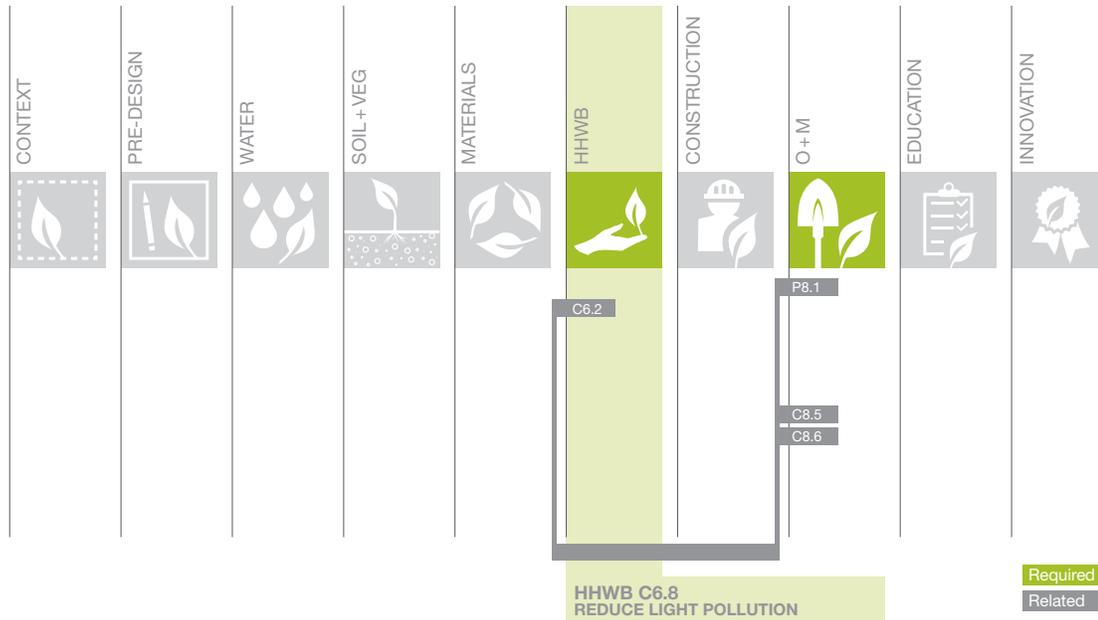
### DEFINITIONS

- **Light pollution** is any adverse effect of artificial light, including sky glow, glare, light trespass, light clutter, decreased visibility at night, and energy waste. (International Dark-Sky Association.)

### RESOURCES

- Components of this credit were adapted from the U.S. Green Building Council’s LEED credit: LEED BD+C v4 SS Credit 6: *Light pollution reduction*.
- For definitions for lighting zones and explanations and diagrams for BUG from a light source, see the Illuminating Engineering Society (IES) and International Dark Sky Association (IDA) “Model Lighting Ordinance (MLO) User Guide,” [www.ies.org/PDF/MLO/MLO\\_FINAL\\_June2011.pdf](http://www.ies.org/PDF/MLO/MLO_FINAL_June2011.pdf).
- For more information about BUG rating lumens requirements and limits, see IES TM-15-11 (“Luminaire Classification System for Outdoor Luminaires”) Addendum A, [www.ies.org/PDF/Erratas/TM-15-11BUGRatingsAddendum.pdf](http://www.ies.org/PDF/Erratas/TM-15-11BUGRatingsAddendum.pdf).
- For more guidelines and recommendations to minimize light pollution, consult these resources:
  - Dark Sky Society “Guidelines for Good Exterior Lighting Plan,” [www.darksky.org/handouts/LightingPlanGuidelines.pdf](http://www.darksky.org/handouts/LightingPlanGuidelines.pdf)
  - Dark Sky Society “Recommendations for Effective Outdoor Lighting,” [www.darksky.org/assets/documents/is012.pdf](http://www.darksky.org/assets/documents/is012.pdf)
  - International Dark Sky Association, “Simple Guidelines for Lighting Regulations for Small Communities, Urban Neighborhoods, and Subdivisions,” [www.sustainablecitiesinstitute.org/view/page.basic/report/feature.report/Guide\\_Simp\\_Guide\\_Ltng\\_Reg](http://www.sustainablecitiesinstitute.org/view/page.basic/report/feature.report/Guide_Simp_Guide_Ltng_Reg)

### LINKS TO OTHER SITES PREREQUISITES AND CREDITS



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