MINNESOTA B3 GUIDELINES

New Buildings and Major Renovations

Version 3.0

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Print Version

Center for Sustainable Building Research
College of Design · University of Minnesota

Print Version Contents

Appendices: Templates and calculators not included in print version; additional templates to be added in late 2017

All SB 2030 Documents Available at b3mn.org/2030energystandard

Introduction and Background

Sustainable design is a means to reduce energy expenditures, enhance the health, wellbeing, and productivity of building occupants, and improve the quality of the natural environment. All of these contribute to high-performance buildings with lower life cycle costs.

In response to stakeholder feedback gathered from 2015 through 2017, the B3 Guidelines Team has revised its B3 Guidelines and its tracking and submission process. This document describes the new requirements in B3 Guidelines Version 3.0, also known as the Minnesota Sustainable Building Guidelines or MSBG, and is intended to provide and summarize information on guideline revisions.

History

Over the past several decades, many international, national, and regional organizations have developed guidelines to achieve sustainable design. In 1997, the Minnesota Sustainable Design Guide (MSDG) was initiated by Hennepin County with a grant from the Minnesota Office of Environmental Assistance (OEA) and was later maintained by the University of Minnesota.

In 2000, the Minnesota Legislature required the Departments of Administration and Commerce, with assistance from other agencies, to develop sustainable building design guidelines that would apply to all new buildings receiving funding from the State of Minnesota bond proceeds fund after January 1, 2004. In 2008, this legislation was expanded to apply to all major renovations receiving funding from the State's bond proceeds fund after January 1, 2009. The legislation defined "major renovations" as at least 10,000 square feet and including the replacement of the mechanical, ventilation, or cooling system of the building or a section of the building. According to the legislation, applicable New Buildings and Major Renovations must:

- Exceed the state energy code by at least 30%.
- Focus on achieving the lowest possible lifetime costs.
- Encourage continual energy conservation improvements.
- Include air quality and lighting standards.
- Create and maintain a healthy environment.
- Facilitate productivity improvements.
- Specify ways to reduce material costs.
- Consider the long-term operating costs of the building, including the use of renewable energy sources and distributed electric energy generation that uses a renewable source or natural gas or a fuel that is as clean or cleaner than natural gas.

Acknowledgements

The development of the B3 Guidelines has been a multiyear process in collaboration with many people and departments in the State. The team assembled to develop and run the B3 Guidelines program represents regional and national expertise. The B3 Guidelines Team would like to recognize the following individuals for their contributions:

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Prior Versions

The B3 Guidelines are required for projects funded directly or indirectly, in whole or in part, from Minnesota bond monies after January 1, 2004. The guidelines have been updated several times since the beginning of this program: Version 1.1 was the applicable version for new construction projects receiving bond money from 2004 to 2006. Version 2.0 followed for new construction projects receiving bond money prior to 2009. In 2009, Version 2.1 was released with the online B3 Guidelines Tracking Tool and the B3 Guidelines became mandatory for major renovation projects. After August 1, 2009, the Sustainable Buildings 2030 (SB 2030) Energy Standard became the energy efficiency requirement of the program. This standard included a focus on increasing efficiency requirements across a wide array of building types, and providing several paths to compliance.

In 2013, Version 2.2 was released, which included significant updates in the following areas:

- Site and water management
- Stormwater management
- Bird-safe building design
- Process requirements (commissioning)

In 2017 version 3.0 was released, please see pages 14-17 for a summary of changes.

The B3 Guidelines build on previous regional and national efforts to achieve its goals: They are designed to be compatible with other national guidelines and rating systems while maintaining regional values, priorities, and requirements. They are also designed to be clear, simple, and easily monitored with explicit documentation to record progress. The B3 Guidelines set up a process for quantifying the human, community, environmental, and life-cycle economic costs and benefits of new projects and help to fully account for the actual costs and benefits of sustainable building design.

Guidelines Organization

The guidelines are organized into the following topic categories:

- Performance Management
- Site and Water
- Energy and Atmosphere
- Indoor Environmental Quality
- Materials and Waste

In this document, the guidelines are discussed according to category. Each category begins with the intent of that topic. Guidelines are noted as required or recommended, and each guideline is presented with specific intent, the required and recommended performance criteria, guidance on meeting the guideline, required Tracking Tool submissions, and additional resources, such as glossaries. This document also includes a list of project information collected by the B3 Guidelines Tracking Tool that does not correspond to specific guidelines.

Applicability

With the expansion of the legislation in 2008 to include major renovations, the two main types of projects subject to B3 Guidelines are New Buildings and Major Renovations. Each has their own criteria for required use.

New Buildings Overall Applicability Criteria:

All new buildings funded in whole or part by Minnesota bond monies after January 1, 2004 must comply with B3 Guidelines. Additions are considered New Buildings that require compliance with B3 Guidelines if they have both of the following characteristics:

- If heated, the addition has its own heating plant(s) (e.g., boiler, etc.) whether or not its source of energy (e.g., fuel) is from an adjacent building.
- If cooled, the addition has its own cooling plant(s) (e.g., chiller, rooftop unit, etc.) whether or not its source of energy (e.g., electricity) is from an adjacent building.

Exceptions to compliance with the B3 Guidelines as a whole are *not* allowed based on size of building, number of utility connections, or whether a building is heated, cooled or electrically lit. However, some individual guideline criteria are adjusted based on these or other variations.

If an agency or design team feels certain guideline criteria do not apply to a particular building due to programmatic conflict, this is handled through a variance process facilitated through the B3 Guidelines Tracking Tool.

Major Renovations Overall Applicability Criteria:

All Major Renovation work funded in whole or part by Minnesota bond monies after January 1, 2009 must comply with the guidelines. Renovation work is considered under Major Renovations and requires compliance with the guidelines if it has both of the following characteristics:

- Renovated area includes 10,000 square feet or more.
- It encompasses at least the replacement of the mechanical, ventilation, or cooling system of the building, or a section of the building.

Exceptions to compliance with the B3 Guidelines as a whole are *not* allowed based on number of utility connections, or whether the renovated area is heated, cooled, or electrically lit. However, some individual guideline criteria are customized based on these or other project characteristics. If an agency or design team feels certain guideline criteria do not apply to a particular building, this is handled through a variance process facilitated through the B3 Guidelines Tracking Tool. Exceptions are permitted if a Major Renovations project has completed its Design Development Phase before February 23, 2009 (when the guidelines for Major Renovations were released), and subsequently received new or additional bond funding after January 1, 2009.

Not-Applicable versus Not Compliant Status:

Any construction project that receives bond funding after January 1, 2004 which is believed to not be subject to the B3 Guidelines should complete a Non-Applicability Request Form (available from the B3 Project Website). This form is *not needed* if a project is following the B3 Guidelines. This form is used to determine whether the B3 Guidelines apply to a project and thus whether the project needs to meet the guidelines as a whole. Projects that have been granted a Not Applicable designation after completing this form will be noted by the B3 Guidelines Team but would not need to further pursue the guidelines, barring any project changes. Projects that are not following the guidelines and have submitted a Non-Applicability Request Form but have not yet received a Not Applicable designation will be listed as "pending" until status can be determined. If the B3 Guidelines Team determines that the B3 Guidelines do apply to a

bond-fund receiving project but the project is not following B3 Guidelines, that project will be listed as Not Compliant on the B3 Case Studies Database and in reporting to the state.

Once the B3 Guidelines Team has determined that a project must comply with the overall B3 Guidelines, renovation projects may still request exemption from specific guidelines. This is permitted for guidelines pertaining to work outside the scope of the renovation.

The table below distinguishes requirements for New Buildings from requirements for Major Renovations, while allowing reference to a common master set of guidelines. The table also lists which guidelines are required for different types of renovations.

	Guideline	New Buildings	Major Renovations
	Performance Management		
P.1	Design and Construction Process	Required	Required
P.2	Operations Process	Required	Required
	Site and Water		
S.1	Identification and Avoidance of Critical Sites	Required	Documentation Required
S.2	Stormwater Management	Required	Required for Minimum Site Scope (See Guideline)
S.3	Soil Management	Required	Required for Minimum Site Scope (See Guideline)
S.4	Sustainable Vegetation Design	Required	Required for Minimum Site Scope (See Guideline)
S.5	Light Pollution Reduction	Required	Required for Exterior Lighting Scope
S.6	Erosion and Sedimentation Control during Construction	Required	Required for Any Site Scope
S.7	Landscape Water Efficiency	Required	Required for Minimum Site Scope (See Guideline)
S.8	Building Water Efficiency	Required	Required if Plumbing Scope (See Guideline)
S.9	Bird Safe Building	Required	Required if Glazing in Scope
S.10	Appropriate Location and Development Pattern	Recommended	Not Applicable
S.11	Brownfield Redevelopment	Recommended	Not Applicable
S.12	Heat Island Reduction	Recommended	Recommended if Roof or Site Scope
S.13	Transportation Impacts Reduction	Recommended	Recommended
S.14	Wastewater Management	Recommended	Recommended if Plumbing or Site Scope
	Energy and Atmosphere		
E.1	Energy Efficiency	Required	Required
E.2	Renewable Energy	Required	Recommended
E.3	Efficient Equipment and Appliances	Required	Required
E.4	Atmospheric Protection	Recommended	Recommended
	Indoor Environmental Quality		
I.1	Low-Emitting Materials	Required	Required for Newly Installed Materials
I.2	Moisture Control	Required	Required if Exterior Envelope is in Scope
I.3	Ventilation Design	Required	Required
I.4	Thermal Comfort	Required	Required
I.5	Quality Lighting	Required	Required if Lighting Replacement is in Scope
I.6	Effective Acoustics	Required	Required
I.7	Vibration Reduction	Required	Recommended if Structural is in Scope
I.8	Daylight	Required	Required (Partial - See Guideline)
I.9	View Space and Window Access	Recommended	Recommended
I.10	Personal Control of IEQ Conditions & Impacts	Recommended	Recommended
I.11	Promotion of Healthful Physical Activity	Recommended	Recommended
	Materials and Waste		
M.1	Life Cycle Assessment of Materials	Required	Required (Partial - See Guideline)
M.2	Environmentally Preferable Materials	Required	Required
M.3	Waste Reduction and Management	Required	Required
M.4	Health	Required	Required

Some guidelines are not be applicable to some Major Renovation projects. Detail is provided under those guidelines. Guidelines without further detail on applicability may be assumed to be required for all project types.

Process

Compliance with the B3 Guidelines involves the coordination of several project team members across several phases. The primary guideline management roles, the guideline management process and the variance process are outlined below. This process must be completed through the B3 Guidelines Tracking Tool (at trackingtool.b3mn.org).

Guideline Management Roles

Work Team: The work team is the team responsible for advancing a project through the B3 Guidelines during each particular phase. Depending on the phase, the work team may include the planning team, predesign team, design team, construction team, or operations team. This team works toward achieving the guideline performance criteria appropriate to their phase. The work team is also responsible for completing all required documentation in the B3 Guidelines Tracking Tool at the end of each phase (and annually during ongoing occupancy for 10 years).

Guideline Leader: The guideline leader coordinates the completion and documentation of tasks to comply with the sustainable building guidelines. Different people may fill the role of guideline leader for each phase. The guideline leader may work within the organization contractually responsible for a specific phase, or he or she may be a consultant hired by that organization. The guideline leader is the primary contact person for guideline compliance. If an agency does not designate this role, a representative from the work team fulfills the guideline leader's tasks.

The guideline leader's duties include:

- Coordinating and supporting the Guideline Management Process.
- Maintaining continuity as the guideline leader's position transfers across phases and responsible organizations.
- Supporting an interdisciplinary, participatory team approach.

The guideline leader should possess the following qualities:

- Be familiar with B3 Guidelines and with sustainable building practices in general.
- Have good facilitation and communications skills.

Appropriated Agency: The appropriated agency is the agency that received funding from the capital bond proceeds on behalf of the project and is responsible for compliance review. The agency contact role is the representative of the appropriated agency and includes the following responsibilities:

- The appropriated agency is responsible for reviewing (but not necessarily determining) compliance with B3 Guidelines according to the Compliance Review Process based on the extent of compliance documented in the B3 Guidelines Tracking Tool.
- The appropriated agency reviews and decides whether to accept variance applications according to the Variance Review Process.
- The appropriated agency may choose to cease involvement in project compliance monitoring after successful completion of one year of operation.

CSBR: The Center for Sustainable Building Research (CSBR) at the University of Minnesota acts as the B3 Guidelines Tracking Team. CSBR leads the B3 Guidelines Tracking Process and updates and maintains project information with required forms and optional guideline reports for each phase of project development and each year of operational data. This data may be posted on the B3 Guidelines Case Study Database. It may also be used for selected audits, to improve the usability and effectiveness of the B3 Guidelines, and to translate building performance into state economic, human, and environmental outcomes. CSBR tracks the B3 Guidelines on direction of the state.

Project Planning & Work:

- At the start of each phase (or year of operation), the guideline leader reviews the B3 Guidelines and required documentation, plans the tasks to be completed for that phase to meet the guidelines, and communicates this with the work team.
- If variances to the B3 Guidelines are sought, the guideline leader requests a variance from the appropriated agency before completion of the Design phase of the B3 Guidelines Tracking Tool. This variance request is made for individual guidelines using the B3 Guidelines Tracking Tool and reviewed by CSBR prior to agency approval).
- The work team for the responsible organization (planning team, design team, construction team, or operations team depending on phase) incorporates B3 Guidelines requirements into the work.

Documentation:

- The work team completes the appropriate documentation via the B3 Guideline Tracking at the end of each phase. The team should archive relevant documentation for that phase (or for one year) for future reference.
- The guideline leader submits online documentation to the appropriated agency for compliance review at the end of each phase (or annually during facility operation).

Review and Tracking:

- The appropriated agency reviews the level of compliance reported by the work team. The agency also reviews and decides whether to approve variance requests.
- CSBR tracks the status of compliance, variances, documentation, and performance outcomes and summarizes these for the state.

B3 Guidelines Tracking Tool

All project information is submitted through the online B3 Tracking Tool. The Tracking Tool is an online project file that helps to collect information at each phase of the guidelines from team members and manages the submission process. Each guideline is assigned to an individual role in the tool, the individual assigned to that role should then complete the required information to document compliance with the B3 Guidelines. Once all information has been submitted for a specific phase, the guideline leader submits the phase to be reviewed either by the agency contact or by the SB 2030 reviewer and the agency contact (the SB 2030 review takes place after the Design and Final Design submissions).

Variances

Variance requests are typically proposed by building designers. Due to the variability of submitted projects, some may require full or provisional variances. These variances should be requested during schematic design. Allowable justification for variances are limited to:

1. Programmatic conflicts. If the project‘s building program and the B3 Guidelines are in direct conflict with each other, the building program should be respected. If the building program cannot accommodate the guideline, a variance for a specific guideline should be requested (e.g., as the Department of Correction’s program requires a higher light level at the edge of their properties than is specified by B3 Guidelines. A variance to Guideline S.5: Light Pollution Reduction, S5A. Light trespass is regularly approved for Department of Corrections projects.)
2. Project type. Projects with limited scope may wish to request variances for specific guidelines outside the scope of their work.

The B3 Guidelines Team will review variance requests to ensure an appropriate justification for the variance has been identified, and adequate information has been provided. Approval authority for variances lies with the appropriated agency; for the B3 Guidelines, this person is the agency contact. The person charged with reviewing requests should be familiar with the intent of B3 Guidelines. If the agency contact does not feel comfortable with their understanding of the

intent of the guideline, the variance can be referred to the B3 Guidelines Team. Ultimately, variances can be granted, rejected, or amended. Through the variance process, guideline requirements can be provisionally or fully waived. A provisional variance may be considered first, and is requested when there is not enough information available at the current phase to determine if the guideline can be met successfully. A provisional variance is not available during the last required phase of a guideline.

Conditions Not Considered Grounds for a Variance

- Variances will not be considered if alternative design strategies have not been evaluated, including consideration of a creative solution that may maintain the intent of the B3 Guidelines.
- Variances will not be considered on the basis of monetary or convenience rationale.
- Variances will not be considered because compliance with the B3 Guidelines would alter the standard operating procedures of the design team.
- Variances will not be considered on the basis of a site's small or irregular shape or features.
- Note that the variance process is not required for recommended guidelines.
- No variances are available for the requirement to follow the SB 2030 program.

Required Elements of a Variance

A work team proposing a variance should:

- Explain the programmatic conflict necessitating modifications for the particular project.
- Identify a modified performance level and/or compliance method that comes as close to meeting the guideline as possible which will be pursued by the design team.

For example, if a thorough search and proactive conversation with local waste management services in rural Minnesota yield no service options for the required 75% construction waste recycling rate, the work team should identify the maximum waste recycling rate that is available in the region and support that modified performance threshold in the variance request.

Variance Review Process

The Variance Review Process defines the steps for reviewing a request to waive a portion of the guideline as written. This process is intended to be used sparingly, for issues such as non-applicability to a building type, location, or scale. The Variance Review Process is led by the appropriated agency and consists of the following key steps:

- The appropriated agency receives the variance request from the work team and guideline leader.
- After review, the appropriated agency either accepts or rejects the request for variance, or may specify a compromise equivalency or conditions for the variance.
- The appropriated agency documents variance approval or rejection using the B3 Guidelines Tracking Tool.

Compliance Review Process

The Compliance Review Process is designed to provide regular checkpoints for reviewing compliance with the guidelines from the project's initial phases through ongoing occupancy. The appropriated agency leads the Compliance Review Process, which consists of the following key components:

- The appropriated agency receives the Phase Summary Report from the guideline leader, submitted electronically using the B3 Guidelines Tracking Tool.
- The appropriated agency reviews the extent and nature of compliance as documented by the guideline leader and decides if the extent of compliance is acceptable. (The appropriated agency is not responsible for determining compliance, but may question if compliance is achieved.)
- The appropriated agency then either approves the extent of compliance for that phase, or directs the guideline leader to revisit compliance measures with the work team.
- After successful completion of the project, data from each year of occupancy will be reported through the B3 Guidelines Tracking Tool for the life of the building.

B3 Guidelines Tracking Process

The B3 Guidelines Tracking Process consists primarily of updating and maintaining the project information. Related activities may include posting data from the project on the B3 Case Studies Database, using project information to improve the usability and effectiveness of the B3 Guidelines, and translating reported building performance into economic, human, and environmental outcomes for use by the State of Minnesota. This process consists of the following elements:

- Agency completes required approval process for each phase using the B3 Guidelines Tracking Tool. Depending on the phase, outcome documentation may also call for attachment of commissioning or other reports. These attachments will be included in the online submission.
- CSBR receives compliance and outcome information from the agency, via the Tracking Tool.
- CSBR uses the information received to update and maintain project information.
- CSBR provides preliminary review of variances to ensure appropriate justification and information.
- CSBR uses project information at the direction of the State of Minnesota.

Version 3.0 Update Summary

From 2015 to 2017 the Center for Sustainable Building Research (CSBR) led an effort to review and update the B3 Guidelines. CSBR proposed updates to the guideline process as well as revisions to the Performance Management and Materials sections of the B3 Guidelines. A review of the low-emitting materials requirements previously under Guideline I.2 in the Indoor Air Quality section was also included in this process.

LHB and other user groups have worked with CSBR to review and test the market viability of proposed guideline revisions. In addition, LHB and CSBR have collaborated on a series of focus group meetings representing those involved with the design, construction and operation of public buildings in Minnesota. These stakeholders have provided valuable feedback on the B3 and SB 2030 program including how to improve the usability and performance of the programs in the future.

These guideline revisions are intended to:

- Bring the B3 system up to date with the latest national standards and green rating systems.
- Revise performance standards and requirements to reflect the current state of the building industry in Minnesota.
- Reduce the administrative burden for projects to the minimum level necessary to ensure compliance.
- Improve the sustainable performance of projects.

The following two sections contain substantial revisions:

- Process Management
- Material Selection (Guideline I-1 – Low VOC materials is included in this update as it pertains to material selection requirements)

The CSBR will carry out annual updates to the remaining sections of the B3 Guidelines on a rolling schedule. The anticipated review schedule is as follows:

- 2017: The B3 submission process and in-depth changes to Materials and Performance Management go into effect as B3v3.0.
- 2017: Site and Water guidelines updated, to go into effect in 2018 as B3v3.1.
- 2018: Indoor Environmental Quality guidelines updated, to go into effect in 2019 as B3v3.2.
- 2019: Energy and atmosphere guidelines updated, to go into effect in 2020 as B3v3.3.

Other individual guideline updates may be done outside the schedule listed above if it is determined that a guideline needs improvement due to changing technology or based on feedback from program participants. However, the majority of the B3 Guideline Team's efforts are expected to pursue advancement of the guidelines listed here.

SB 2030 has increasing standards embedded in its design. There are anticipated upcoming adjustments to the program not addressed in this revision. Most notable of these are an anticipated change from an evaluation based on site energy to an evaluation based on carbon emissions. The potential inclusion of offsite renewable energy generation and clarification of onsite generation requirements will also be addressed.

Changes to the B3 Guidelines Phases

The following is a comparison of the required submission phases between Version 2.2 and Version 3.0. The previous versions of the guidelines required eight submission phases and ten years of operational tracking. These have been replaced with four phases. Annual reporting in operations for a period of ten years is still required.

Version 2.2 Phases	Version 3.0 Phases	Description
Agency Planning Predesign – Programming Predesign – Site Selection	Predesign	Agency/owner is responsible for setting up project in Tracking Tool, establishing familiarity with B3 Guidelines (including calculating a preliminary SB 2030 Energy Standard), establishing a budget, and selecting a design team based on B3/SB 2030 requirements. Guideline leader, once selected, transitions to member of design team. An early Owner's Project Requirements (OPR) document should be drafted at this phase.
Schematic Design	Design	Check-in to make sure design is on track to meet B3/SB 2030 requirements.
Design Development Construction Documents	Final Design	Compliance check of bid/permit documents.
Construction/Construction Administration	Closeout	Verification that constructed building meets B3/SB 2030 requirements; Guideline leader role moves from design and construction team to owner and operations team once documentation of closeout is complete.
Correction Period	Occupancy – Year 1	Owner is responsible for compliance in occupancy.

These phases were selected to optimize the potential for impact on the final design while providing the documentation needed to determine B3/SB 2030 compliance (i.e., at Final Design and Project Closeout). Since version 3.0 eliminates the Design Development phase submittal, an additional SB 2030-only check-in may be required for submissions related to the SB 2030 Energy Standard. Additional differences between previous versions and the version 3.0 phase submission practices include:

- Agency performs project setup: Some B3 projects currently rely on the architect to set up a project in the Tracking Tool when hired (typically at the beginning of design). The architect then has to retroactively complete the planning and Predesign requirements. Version 3.0 requires the agency/owner to set up the project in the Tracking Tool and engage in the Predesign phase. The agency/owner is responsible for ensuring that the site, budget, and design team are selected based on a comprehensive understanding of the B3 Guidelines and SB 2030 Energy Standard.
- Timely phase submission and review: Project teams previously had a grace period of 60 days after a phase ends to complete the documentation requirements. This results in agency and SB 2030 feedback reported too late to cost-effectively inform design decisions. Version 3.0 requires complete guideline documentation be submitted

immediately upon completion of each phase. B3 Guidelines submissions should be integrated into other owner submission requirements (e.g., drawings and outline specifications at schematic design, construction documents coordinated with the B3 Final Design submission, etc.). The agency and SB 2030 review process would then occur in conjunction with the owner review of the documents.

Changes to the Variance Approval Process

Due to the variability of submitted projects, provisional or full variances may occasionally be necessary for specific B3 Guidelines. A description of these two types of variances follows:

Provisional Variance: A provisional variance is requested when there is not enough information available at the current phase to determine if the B3 Guideline can be met successfully. A provisional variance is not available during the last required phase of a guideline.

Full Variance: Full variances are intended for cases where guidelines are not applicable based on the nature and/or scope of the project. For instance, a prison may not be able to meet Guideline S.5A: Light Trespass, because of higher lighting levels demanded by security guidelines. Full variances must be identified and requested during the schematic design phase of the project, in the Design submission in the Tracking Tool.

In previous versions of the B3 Guidelines, variances were requested by the design team and approved or rejected by the agency contact using the Tracking Tool. This variance process has been used with varying degrees of rigor by agency contacts and necessitates validation. This will be done by a preliminary review of variances by the B3 Guidelines Team. The preliminary review will ensure that variances are pursued for appropriate reasons and that adequate data is provided in variance requests. The Version 3.0 variance process is still fundamentally similar to the variance process for earlier versions of the guidelines. However, variance requests will not move forward if they do not include adequate information or appropriate justification for granting a variance.

References to Other Guidelines and Rating Systems

Whenever possible the B3 Guidelines Version 3.0 was brought into alignment with other guidelines and rating systems. This includes some incorporation of guidelines from LEED v.4 and the International Green Construction Code (IGCC). There are several benefits to the alignment:

- It leverages others' work in guideline development.
- It provides projects seeking dual compliance a more straightforward documentation path.
- For those project teams that are familiar with other guideline submission requirements, compliance with the B3 Guidelines is more easily verified.

Compliance with a relevant portion of LEED or the IGCC does not impart compliance with any portion of the B3 Guidelines. Portions of the B3 Guidelines that are similar or use identical language to other guidelines and green building rating system have been noted in the footnotes. Key differences from the reference guideline are also noted.

Tracking Tool Changes

The B3 Guidelines Tracking Tool has been a useful tool to improve coordination between project team members. It has also improved the B3 Guideline Team's oversight of the program and facilitated agency contact and SB 2030 review. The current method of information collection and exchange through the Tracking Tool will continue, with many of the inputs required under Version 2.2 (B3v2.2) of the guidelines remaining under Version 3.0 (B3v3.0).

Changes under B3v3.0 include:

- Project information not corresponding to a specific guideline will be collected in a new portion of the Tracking Tool found at the beginning of each guideline section. Information collected in this section feeds into other guidelines, helping to avoid redundant information and to streamline completion of the guidelines.
- Variance requests will be subject to approval by the B3 Guidelines Team before moving to the agency contact for final approval.

Updates to Specific Guidelines

Guidelines Performance Management – Guidelines P.1 and P.2

Guidelines P.1 and P.2 replace B3v2.2 guidelines P.1 through P.6. The prior guidelines have been streamlined to better coordinate with industry standards and allow for design team flexibility when approaching integrated design.

Guideline P.1: Design and Construction Process now outlines the required design and construction process and documentation required for compliance with B3. These have been aligned to industry standards and require the completion of Owner's Project Requirements at an early phase.

Guideline P.2: Operations Process retains the requirement to evaluate buildings with a Sustainable Post Occupancy Evaluation. New under B3v3.0 is the requirement for some large buildings to set up an Energy Efficient Operations Manual to ensure that the project is operating efficiently. The recommendation for contingency to be set aside in case of non-compliance with SB 2030 in operation is also retained.

Guidelines Reordered and Eliminated

B3v2.2 Guideline S.14 has been moved to B3v3.0 Guideline S.9, with B3v2.2 Site and Water Guideline S.9 moving to B3v3.0 S.10, S.10 to S.11 and so on. B3v2.2 Guideline I.1 has been eliminated as it is prohibited smoking in and around buildings, which is now redundant with code. Guidelines I.2 through I.12 have been renumbered into Guidelines I.1 through I.11.

Material Guidelines

Guidelines related to the selection of building materials have undergone significant updates.

B3v2.2 Guideline I.2 has been updated and renumbered as B3v3.0 Guideline I.1 and reflects use of California CDPH standards in determining limits and methods for evaluating material emissions.

B3v3.0 M.1 includes an update and expansion of the Whole Building Life Cycle Assessment Guideline and improvement in building product disclosure requirements. M.2 updates the calculation method for environmentally preferable materials. Guideline M.3 incorporates updates in construction waste reduction planning while maintaining the 75% diversion requirement. M.4: Health was added in B3v3.0 to include provisions to limit building occupant and installer exposure to potentially toxic material.

Updates to Other Guidelines

All guidelines and supporting information have been edited as needed for clarity. Links and referenced standards have also been updated across the guidelines and supporting material has been reformatted. Guidance provided in appendices in prior versions of the guidelines has been included into the *Meeting the Guidelines* section.

Performance Management Guidelines

Intent

The following performance management guidelines assist project teams in gathering necessary information and coordinating the design, construction, and operations processes in order to ensure that each project successfully meets key performance criteria, including those of the B3 Guidelines. Successful implementation of appropriate processes, including integrative design, can minimize risk and improve outcomes.

General Performance Management and Project Information:

The following information is collected in the Performance Management section of the B3 Guidelines Tracking Tool, under Section P.0:

Predesign:

- Project schedule
- Project budget

Design:

- Updated project schedule
- Updated project budget
- Building information – occupancy, building gross square footage, number of stories

Final Design:

- Updated project schedule
- Updated project budget
- Updated building information – occupancy, building gross square footage, number of stories
- Performance strategies used, including narrative

Closeout:

- Updated project schedule
- Actual project cost
- Updated building information – occupancy, building gross square footage, number of stories
- Updated performance strategies used, including narrative

Occupancy – Submitted annually for ten years:

- Updated building information – occupancy, building gross square footage, number of stories

Guideline P.1: Design and Construction Process

Intent

To support the compliance and outcome tracking process by facilitating the creation and communication of relevant project goals and information.

Required Performance Criteria

A. Develop an Owner's Project Requirements (OPR) document, beginning at the predesign or equivalent phase. This document is developed in coordination between the owner, commissioning authority, architect, engineer and any other relevant stakeholders. A commissioning authority must be established at the predesign phase to complete the early-phase goal setting. The OPR includes:
   1. A list of the authors who developed the document and assisted in early team kickoff and goal setting meeting(s).
   2. All sections listed in Section 6, Appendix D of ASHRAE 202-2013.
   3. A preliminary SB 2030 Energy Standard, as created through the SB 2030 Energy Standard Tool.
   4. Regular updates and developments as the owner's requirements change and project details become available.
   5. The requirement that trend data is able to be saved for major equipment for a minimum of two months if a building automation system is requested in the OPR.

B. Develop a Commissioning Plan (Cx Plan) from the OPR with the assistance of the architect, engineer, commissioning authority and owner. The Cx Plan should follow section 7 and Appendix E in ASHRAE 202-2013.

C. Develop a Basis of Design document (BoD) from the OPR with the assistance of the architect, engineer, commissioning authority, and owner. The BoD should follow section 8 and Appendix F of ASHRAE 202-2013.

D. Develop a safety risk assessment of indoor air quality issues for projects that are attached to occupied buildings ("new building" additions or "major renovations" only).

E. Develop indoor air quality procedures according to a Construction Air Quality Management Plan and Warranty Period Air Quality Management Plan. The Construction Air Quality Management Plan and the Warranty Period Air Quality Management Plan must have at a minimum the sections outlined in Templates P1E-1 and P1E-2.

Recommended Performance Criteria

F. Assemble an appropriate stakeholder team that includes representation from every discipline involved in the project, including: the owner's decision-making team, users, occupants, operations and maintenance representatives, at least one representative from the community, and at least one agency "client" or visitor representative. An owner representative and commissioning agent must also be included, if applicable. Members must make a commitment through post-occupancy.
G. Facilitate planning/review workshops at key phases with all team members.
    1. In Predesign:
        i. Comprehensive planning workshop
        ii. Programming workshop
    2. In Design:
        i. Conduct facility performance workshop within the first 2–3 weeks of the design phase.
        ii. Convene a multidisciplinary team at least once per design phase for integrated progress review toward guidelines.
        iii. Convene a stakeholder team for regularly integrated progress reviews. Stakeholder team to meet a minimum of once per phase.
        iv. Convene general contractor and subcontractors for preconstruction kickoff meeting to review the B3 Guidelines goals and objectives.
        v. Discuss progress toward project outcomes during construction meetings.
    3. After occupancy:
        i. Convene facility operations manager, human resources manager, and others who offer cross-disciplinary points of view on facility operations for annual meetings to review operation practices, complaints, and building maintenance issues.

Meeting the Guidelines

Note that Guideline P.1 includes several sub-guidelines: P.1A, P.1B, and P.1C, which are typically performed by a commissioning agent. The remainder of the guidelines under P.1 are not typically within the scope of the commissioning agent and are instead usually assigned to the contractor because they relate to planning specific construction and warranty period air quality. Sub-guideline P.2A may fall under the scope of the commissioning agent, design mechanical engineer, or other team members, according to the owner’s needs. Sub-guideline P.2A involves capturing specific operation parameters essential to optimal building operation. Support for this process may be available from the SB 2030 Operations Team.

To meet the guidelines, an owner must engage a commissioning agent as early as a potential project is identified during the predesign of the project to assist the owner in developing the Owner’s Project Requirement (OPR) document. The creation of this document outlines the goals and requirements of the owner. It is useful to have the assistance of the commissioning agent in its creation, as they will be verifying the design and construction against these requirements. The OPR document lays out several key requirements of a building’s design and operation.

The OPR also creates a set of fundamental requirements that the commissioning agent can check the completed project against, rather than relying on the plans and specifications for validating the success of the design and construction process.

The Basis of Design document (BoD) is developed after the OPR and consists of information related to the specific design of the project in order to create a common understanding of how the OPR is being achieved by the design of the project. This document may also serve as a reference for owner input and approval of design decisions as needed.

The Commissioning Plan (Cx Plan) document provides an outline and documentation of measuring how the design, construction, and operation of the building meet the OPR.

Each of these documents should be edited and developed as the design and the project requirements evolve.

Submittal Requirements

Predesign:

- P.1A: Owners Project Requirements (OPR).
- P.1B: Commissioning scope and commissioning budget.
- P.1D: Safety risk assessment if work is to be done to an existing building (either a renovation or addition).

Design:

- P.1A: Updated OPR.
- P.1B: Draft Cx Plan.
- P.1C: Draft Basis of Design (BoD).
- P.1D: Updated Safety Risk Assessment.
- P.1F: Members of stakeholder team.
- P.1G: Meeting minutes of goal setting workshops.

Final Design:

- P.1A: Updated OPR.
- P.1B: Final Cx Plan.
- P.1C: Updated BoD.
- P.1D: Final Safety Risk Assessment.
- P.1E: Specifications Requiring Construction Air Quality Management Plan.
- P.1F: Updated members of stakeholder team.
- P.1G: Dates and attendees of planning and review workshops

Closeout:

- P.1B: Commissioning report, including system manual and training plan.
- P.1E: Construction Air Quality Management Plan.
- P.1E: Warranty Period Air Quality Management Plan.
- P.1F: Updated members of stakeholder team.
- P.1G: Updated meeting minutes of planning and review workshops.

Occupancy – Submitted annually for ten years:

- Cx Report (only for year 1 if not captured at closeout).

Additional Resources

ASHRAE Standard 202-2013: http://www.techstreet.com/standards/ashrae-202-2013?product_id=1862482

Federal Energy Management Program Building Program: energy.gov/eere/femp/federal-energy-management-program

LBNL Study *Building Commissioning: A Golden Opportunity for Reducing Energy Cost and Greenhouse Gas Emissions*: http://cx.lbl.gov/documents/2009-assessment/lbnl-cx-cost-benefit.pdf

Guideline P.2: Operations Process

Intent

To ensure that buildings perform optimally.

Required Performance Criteria

A. Develop and implement an SB 2030 Energy Efficient Operations Manual (EEOM). The EEOM defines tasks to ensure that each significant energy consuming device uses only as much energy as needed to serve its intended function. An EEOM is required for all projects meeting the following criteria, subject to the listed exclusions.
   1. Applicable buildings meet any of the following criteria:
      i. Over 100,000 gross square feet (gsf) in size.
      ii. Between 50,000 and 100,000 gsf with an EUI above 100 kBtu/sf.
      iii. Fails to meet SB 2030 target during their second year of operation.
   2. Exclusions:
      i. Buildings in which the EEOM program does not support the HVAC system types.
      ii. Buildings under 50,000 gsf that meet their SB 2030 target in their second and subsequent years of operation.
      iii. Buildings under 20,000 gsf.
      iv. Buildings operated by agencies or organizations with substantially similar or more robust energy management procedures to the EEOM. These plans and procedures must be reviewed and approved by the B3 Guidelines Operations Team. These procedures are not required to be building specific.

B. Conduct at least one post-occupancy evaluation of the project after the first 12 months of occupancy and before 24 months.
   1. The Scan-Level Post-Occupancy Evaluation is required for available space types present in the project. This process is supported by the B3 Post-Occupancy Evaluation (B3 POE) process.

C. Buildings without supported space types at six months post-occupancy are exempt from this requirement. Projects may also be exempt if they do not meet the minimum required number of occupants or residents; more details are available at the B3 POE website.

Recommended Performance Criteria

D. Reserve 0.25% of total construction cost for contingency in order to meet the SB 2030 Energy Standard in Operations. As compliance with the SB 2030 program is required through ten years of operation, 0.25% of total construction cost is required to be set aside for efforts related to evaluating and remediating non-compliance in SB 2030 projects. This budget includes professional services over and above the services originally contacted for and additional construction costs that may be incurred to meet the SB 2030 Energy Standard if the project fails to meet the SB 2030 standard after the first year.

Meeting the Guidelines

P.2A:

For more information on completing and using the EEOM please visit: http://www.b3mn.org/operations/. The B3 Operations Team may be able to facilitate the creation of the EEOM for projects subject to the requirement. This facilitation and support will require availability and coordination of design and operation team members. To ensure the

maximum available level of support is available to a project, please contact operations@b3mn.org no later than 60 days prior to the completion of construction.

P.2B:

There are three (3) levels of sustainable POE surveys (SPOES): Scan, Core, and Advanced. The required Scan survey is available for select building types and is free for state-funded projects adhering to B3 Guidelines. Complete details can be found at www.b3mn.org/poe/. Buildings with space types with no supported SPOES at 6 months post-occupancy are exempt from this requirement. Projects may also be exempt if they do not meet the minimum required number of occupants or residents. A contact will need to be established who will serve as the primary contact for the survey collection process will need to be established.

The goal of these evaluations is to standardize the methodology for studying a building's performance from the occupant's point-of-view, to provide feedback to the owners and operators, and to understand how the building performs in practice.

Submittal Requirements

Predesign:

- P.2C: Budget showing compliance with contingency.

Design:

- P.2C: Budget showing compliance with contingency.

Final Design:

- P.2C: Budget showing compliance with contingency.

Closeout:

- P.2A: Draft SB 2030 Energy Efficient Operations Manual.
- P.2C: Budget showing compliance with contingency.

Occupancy – Submitted Annually for ten years:

- P.2B: (One time during occupancy) Sustainable Post-Occupancy Evaluation report.

Additional Resources

ASHRAE Standard 100-2015:

https://www.ashrae.org/resources--publications/bookstore/standard-100

ASHRAE Guideline 4-2008:

http://www.techstreet.com/standards/guideline-4-2008-ra-2013-preparation-of-operating-and-maintenance-documentation-for-building-systems?product_id=1852923

SB 2030 Energy Efficient Operations: http://b3mn.org/operations/

B3 POE Site (including library of prior POE results): http://b3mn.org/poe/index.html

Site and Water Guidelines

Intent

Building construction transforms land that provides valuable ecological services. Society has only recently begun to understand that these services have a quantifiable economic value. For example, the City of Minneapolis has recently developed a stormwater management fee that better reflects the true costs of stormwater runoff and that provides more economic incentive for improved stormwater performance. Site selection and design affect transportation and energy use, which lead to ground-level ozone, acid rain, smog, and global climate change. Current development practices on the land can lead to uncontrolled stormwater runoff, degraded water and soil quality, depletion of water, soil, and valuable vegetated areas, and destruction of habitat. The B3 Guidelines seek to design and maintain sites that have soil and water quality capable of supporting healthy, biodiverse plant, animal, and human communities, which reduce water and energy consumption, improve the rate, quantity, and quality of stormwater runoff, and minimize pollutant contributions related to transportation requirements.

Objectives:

- To improve the ability of the soil to maintain its structure against adverse impacts.
- To restore/improve the hydrologic cycle of water on the site to avoid adverse impacts onsite and downstream.
- To reduce consumption of potable water.
- To improve the biodiversity of the site by introducing flora and fauna which will help contribute to the sustainability of the site over time.
- To reduce energy consumption and pollution contributions to air and water related to site location and associated transportation requirements.
- To restore/improve the outdoor environmental quality (OEQ) of the site to enhance occupant productivity, building performance, and community benefits.

General Site and Water Information:

The following information is collected in the Site and Water Section of the B3 Guidelines Tracking Tool, Section S.0:

Predesign:

- Site information – existing and proposed site areas of various conditions (e.g., wetland, building footprint, woodland).

Design:

- Updated site information – existing and proposed site areas of various conditions (e.g., wetland, building footprint, woodland).

Final Design:

- Updated site information – existing and proposed site areas of various conditions (e.g., wetland, building footprint, woodland).
- Site and water strategies used, including narrative.

Closeout:

- Updated site information – existing and proposed site areas of various conditions (e.g., wetland, building footprint, woodland)
- Updated Site and water strategies used, including narrative.

Guideline S.1: Identification and Avoidance of Critical Sites

Intent

To ensure that appropriate project sites are chosen, and to minimize the development footprint on portions of sites whose natural features and functions are particularly valuable to the larger community. To ensure that development is minimized on sites where soil, water, and flora/fauna indicators are in a fragile condition because of surrounding development or because of the site's natural state. Knowledge of critical site conditions help determine actions to be taken under S.4 Sustainable Vegetation Design.

Required Performance Criteria

Guidelines apply to all projects designated New Buildings.

Avoid selecting sites that meets any one of the following Critical Site Criteria:

A. Land of national, state, regional, or local natural resource and biological/ecological significance as identified in national, state, regional, or local natural resources inventories, assessments and biological surveys and land within 150 feet of this type of these areas that functions as a buffer zone.
B. Prime farmland and farmed wetland as defined by state statute rules and identified in County Soil Surveys and/or County/regional farmland and natural areas conservation/preservation programs.
C. Land with elevation lower than 5 feet above the elevation of the 100-year flood (as defined by the local watershed district, watershed management organization, or joint powers organization) and land that acts as a buffer zone within 50 feet of these areas.
D. Land that provides habitat for any animal or plant species on the federal or state threatened or endangered list, and/or land that provides habitat for any rare animal or plant species using the Minnesota County Biological Survey (CBS), and land that acts as a buffer zone within 300 feet of these areas. If rare, threatened, or endangered species are present on maps of a subject site, contact the CBS for exact coordinates of the said species.
E. Land that was public parkland prior to acquisition for a project, unless land of equal or greater value as parkland is accepted in trade by the public landowner (Park Authority projects are exempt).
F. Land under a conservation easement.

If the site does not completely avoid the conditions in S.1A, S.1C, or S.1D, there are site management implications in S.4D, S.4E, and S.4F, respectively.

Meeting the Guidelines

Implementation in the Design Process:

In the predesign and early design of the project, determine ideal spatial needs for existing or new development. Identify critical sites for preservation or restoration on the project site as defined by the B3 Guidelines, and determine the type of buildings and related infrastructure that will be required for the developed areas and their spatial requirements. After a site has been selected, create potential spatial footprints that preserve any critical sites identified during the predesign phase

Through the design process, refine site plans and details that preserve, protect, and/or enhance critical sites within the project area.

In the construction documents, construction administration and buyout of the project hold a preconstruction meeting to identify requirements for protection/preservation of critical sites during and after the construction process. Consider easements for critical sites that will preserve those sites beyond the life of the project.

Comprehensive County "Critical Natural Resources" map and assessments such as Minnesota County Biological Surveys, DNR Natural Resources Inventory, and Assessment (NRI/A) (in 7 county Metro Area), local NRI/A's and other national, state, or county databases and maps not listed here may aid in identifying habitat with identified or potential threatened or endangered flora/fauna. A municipality's current Comprehensive Plan may help identifying areas designate as parkland.

Submittal Requirements

Predesign:

- S.1A through S.1F: Identification of any critical site conditions.

Design:

- S.1A through S.1F: Identification of any critical site conditions onsite and any impingement, existing, and proposed conditions for critical site concerns, including restored lands as applicable.

Final Design:

- S.1A through S.1F: Identification of any critical site conditions and impingement on critical site conditions, existing and updated proposed conditions for critical site concerns, including restored lands as applicable.

Additional Resources

Public Land Survey Notes are available at the University of Minnesota, Twin Cities Campus, Wilson Library – range, township, and section information is needed on the subject site.

Marshner's Land Cover Map of Minnesota: www.dnr.state.mn.us, http://www.mngeo.state.mn.us/chouse/land_use_historic.html

National Wetland Inventory: https://www.fws.gov/wetlands/

Farmland Information Center: http://www.farmlandinfo.org/state/minnesota

The Minnesota Board of Water and Soil Resource (BWSR): http://www.bwsr.state.mn.us/

Minnesota Land Trust http://www.mnland.org

Minnesota Rules referencing the Board of Soil and Water Resources, Chapters 8400-8420: https://www.revisor.mn.gov/rules

Soil and Water Conservation Society www.swcs.org

American Land Title Association/American Congress of Surveying and Mapping (ALTA) Survey: www.alta.org

Guideline S.2: Stormwater Management

Intent

To minimize the negative impacts of a project, both on- and offsite, by maintaining a more natural hydrologic cycle through infiltration, evapotranspiration, and reuse.

Required Performance Criteria

Guidelines apply to all projects designated New Buildings and Major Renovations with site work site scope that includes an area of site disturbance that is greater than 3,000 s.f. OR Area of imperviousness (footprint of building plus site impervious area) renovated that is greater than 2000 s.f

A. Runoff Rate and Volume:
    1. Control the rate of runoff from the post-development site to match the runoff rates for the native soil and vegetation conditions for the 2-year and 10-year, 24-hour design storms.
    2. Do not allow discharge from the site for 1.1 inches of runoff from all new or redeveloped impervious (non-vegetated) areas.
B. Runoff Quality:
    1. Provide treatment systems to remove 80% of the post-development Total Suspended Solids (TSS).
    2. Provide treatment systems to remove 60% of the post-development Total Phosphorus (TP).
C. Operations and Maintenance Manual:
    1. Stormwater Best Management Practices (BMPs) must have an Operations and Maintenance manual created that outlines maintenance requirements and schedules for completion. Operations and maintenance manuals must be recorded with the county registrar.

Meeting the Guidelines

Note that all governing rules and regulations for stormwater management apply to work covered by this section. The more stringent regulation takes precedence. Methods to achieve credits in this section must be consistent with those found in the most current edition of the Minnesota Pollution Control Agency's “Minnesota Stormwater Manual.”

Implementation in the Design Process:

In Predesign and other early design phases, seek direction from the local government unit or authority with jurisdiction over the project’s stormwater management. Applicable rules, regulations, and permitting requirements must be understood and applied.

Perform topographic, utility, boundary, and wetland surveys, as applicable. Identify onsite areas where the site conditions and topography will facilitate stormwater management. Identify onsite areas where site conditions do not allow for stormwater treatment or infiltration, such as groundwater recharge areas or karst topography. Perform geotechnical analysis of the site to determine soil types, infiltration rates, and areas best suited for stormwater management.

Through the design process, complete general calculations to estimate the volume of stormwater that will need to be treated onsite per B3 Guideline requirements. Identify stormwater management techniques that are appropriate for the amount and type of stormwater generated by the developed site.

In the construction documents phase of the project, finalize stormwater calculations to determine the volume of stormwater necessary for onsite treatment. Details and specifications for necessary stormwater management techniques must also be developed based on the stormwater calculations.

As the project moves into and through the construction administration phase, compliance submittals – with plans and details – will be monitored. Bidders must be made aware of specific requirements for stormwater management. A pre-construction meeting should be held to identify requirements for the construction of stormwater management areas and for protection during and after the construction process. Stormwater management features should be constructed in a sustainable manner, according to drawings and specifications.

An operations and maintenance manual should be developed for the ongoing care of stormwater management areas. Stormwater management areas must be maintained per the operations and maintenance manual. As-built records of stormwater systems must be maintained, stormwater management techniques must be monitored, and performance data must be recorded.

The most recent version of the "Minnesota Stormwater Manual" put out by the Minnesota Pollution Control Agency is a valuable resource, available as a wiki at stormwater.pca.state.mn.us/index.php/Main_Page.

Documentation:

The documentation required for the stormwater guideline includes the following:

- Pre-settlement, existing conditions and proposed runoff rate for the 10-year, 24-hour precipitation event and for 1.1 inches of runoff from impervious surfaces.
- Existing and proposed conditions for Total Suspended Solids (TSS) and Total Phosphorus Loads (TP) for a 2-year, 24-hour event.
- Operations and maintenance manual for the ongoing care of stormwater areas. There may also be requirements from local jurisdictions relating to O&M procedures and documentation.

Submittal Requirements

Predesign:

- S.2A: Pre-settlement and existing condition runoff rates for the 2-year, 24-hour precipitation event and the 10-year, 24-hour precipitation event. Pre-settlement runoff quantity for 1.1 inches of runoff from impervious areas.
- S.2B: Contaminant load of TSS and TP for a 2-year, 24-hour event before treatment.

Design:

- S.2A: Pre-settlement, existing condition, and proposed condition runoff rates for the 2-year, 24-hour precipitation event and the 10-year, 24-hour precipitation event. Pre-settlement and proposed condition runoff quantity for 1.1 inches of runoff from impervious areas.
- S.2B: Contaminant load of TSS and TP for a 2-year, 24-hour event before treatment and proposed contaminant load change.

Final Design:

- S.2A: Pre-settlement, existing condition, and proposed condition runoff rates for the 2-year, 24-hour precipitation event and the 10-year, 24-hour precipitation event. Pre-settlement and proposed condition runoff quantity for 1.1 inches of runoff from impervious areas.
- S.2B: Contaminant load of TSS and TP for a 2-year, 24-hour event before treatment and proposed contaminant load change.
- S.2C: Operational stormwater BMP manuals.

Closeout:

- S.2A: Pre-settlement, existing condition, and installed condition estimated runoff rates for the 2-year, 24-hour precipitation event and the 10-year, 24-hour precipitation event. Pre-settlement and installed condition estimated quantity for 1.1 inches of runoff from impervious areas.
- S.2B: Contaminant load of TSS and TP for a 2-year, 24-hour event before treatment and contaminant load change with installed measures, and verification that the site contractor understands the requirements and intent of this guideline.
- S.2C: Updated operational stormwater BMP manuals and verification that the site contractor understands the requirements and intent of this guideline.

Additional Resources

Minnesota Pollution Control Agency MIDS Calculator: https://stormwater.pca.state.mn.us/index.php/MIDS_calculator

National Resources Conservation Service, Standard Curve Numbers; https://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/

Environmental Protection Agency: www.epa.gov

Metropolitan Council Urban Small Sites BMP Manual Low-Impact Development Guidelines: https://metrocouncil.org/Wastewater-Water/Planning/Water-Resources-Management/Water-Quality-Management-Key-Roles.aspx

Minnesota Association of Watershed Districts: www.mnwatershed.org

Minnesota Pollution Control Agency: www.pca.state.mn.us

Stormwater Manual Best Management Practices Manual: https://www.pca.state.mn.us/water/stormwater-best-management-practices-manual

Center for Watershed Protection: www.cwp.org

Board of Water Quality and Soil Resources: www.bwsr.state.mn.us

International Stormwater Database: www.bmpdatabase.org

Minnesota Erosion Control Association: www.mnerosion.org

Stormwater Manager's Resource Center: www.stormwatercenter.net

Guideline S.3: Soil Management

Intent

To promote the maintenance of the permeable structure of the soil in order to optimize water infiltration/filtration capabilities and maintain the biological functions of the soil in order to optimize plant health and species richness.

Required Performance Criteria

Guidelines apply to all projects designated New Buildings and for all Major Renovations that include area of site disturbance that is greater than 3,000 square feet or area of imperviousness (footprint of building plus site impervious area) renovated that is greater than 2000 square feet.

A. Create soil management and erosion control plans to protect the soil profile of the site during and after construction.
B. The bulk density of all unpaved pervious surfaces intended for seeding and planting must have the following maximum bulk densities. Soils in these areas that exceed the stated bulk densities must be decompacted to 18 inches prior to planting or seeding by air spading, ripping, adding organic matter (see S.3F), or other decompaction method.
    1. Clay and Silt: less than 1.25 g/cm3.
    2. Loam: Less than 1.35 g/cm3.
    3. Sand: Less than 1.55 g/cm3.
C. Limit soil disturbance.
    1. Limit soil disturbance (defined as grading, compacting, piling, tilling, scraping, storing, and removal of soil) to 40 feet beyond the building perimeter; 15 feet beyond primary roadway curbs, main utility branch trenches, pervious areas, and stormwater management features; and 5 feet beyond walkways.
    2. Limit soil disturbance to no closer than 5 feet from tree driplines and/or the perimeter of site areas/features identified for protection. Trees must be protected as individuals or as groups (canopies < 10 feet apart) with tree protection fence located 5 feet beyond the drip line, prior to site activities.
D. Maintain, establish, or enhance a 75-foot vegetated buffer for delineated wetland boundaries.
E. Do not sell or export any topsoil from project site. Stockpile and protect existing site topsoil, or import topsoil for a respread of 12 inches in all proposed planting and seeding areas.
F. Build the site's natural mycorrhizae and microbial population and enhance the health of the soil by raising or maintaining the percentage of organic material content in the existing or imported site soil. Soil must have a minimum of 3% organic material by weight. Test the soil in planting and seeding areas and amend with organic material as needed to meet this requirement.
G. Where trees are surrounded by hard surfaces (e.g., sidewalks, patios, driveways, car parks, plazas, parking islands), use suspended pavement techniques, structural soils, or other comparable methods such as larger tree openings to provide adequate rootable soil volumes. Minimum volume of rootable soil volume per tree is:
    1. Small trees (e.g., serviceberry): 400 cubic feet
    2. Medium trees (e.g., ironwood): 800 cubic feet
    3. Large trees (e.g., hackberry): 1,200 cubic feet

    Note: If using structural soils, total soil volumes above need to be multiplied by 5 to obtain equivalent volume of soil useable by the tree.

If above soil volumes cannot be met, trees requiring smaller soil volumes should be selected. Where applicable, utilize suspended pavement or comparable methods to allow tree roots under hard surfaces access to adjacent open space.

Meeting the Guidelines

Implementation in the Design Process:

When the site is selected, a soil management plan must be drafted and updated to prevent erosion, maintain and protect topsoil, amend soil, and provide adequate soil rooting volume to grow large, healthy trees per the B3 Guideline requirements.

Submittals for compliance should be monitored to ensure that the B3 Guidelines will be met in the construction documents, construction administration, and project buyout to ensure that performance criteria are being met.

A preconstruction meeting should be held to identify requirements for protection, preservation, and enhancement of site soil during and after the construction process. Practices to meet performance criteria should be implemented according to the drawings and specifications and successful implementation of performance criteria should be confirmed when complete.

Documentation:

The documentation required for this guideline includes the following:

- Soil management and erosion control plans.
- Verification of language mandating compliance in construction documents and verification of meeting guideline requirements for maximum bulk densities, applicable wetland requirements, prohibition of topsoil removal from site, minimum organic content, and protection of trunk area.

Submittal Requirements

Final Design:

- S.3A: Soil management and erosion control plans.
- S.3B: Verification that the construction documents mandate compliance.
- S.3C: Verification of the site plan meeting guideline in construction documents.
- S.3D: Verification that if wetlands are on the site that the appropriate buffer has been established or maintained.
- S.3E: Verification of language mandating compliance in construction documents.
- S.3F: Verification of language mandating compliance in construction documents.
- S.3G: Verification of language mandating compliance in construction documents if trees are surrounded by hard surfaces.

Closeout:

- S.3B: Verification of meeting the guideline requirements.
- S.3C: Verification of the final site plan meeting guideline. Verification that the site contractor understands the requirements and intent of this guideline.
- S.3D: Verification that if wetlands are on the site that the appropriate buffer has been established.
- S.3E: Verification of language mandating compliance in construction documents as updated during construction and verification that the site contractor understands the requirements and intent of this guideline.
- S.3F: Verification of language mandating compliance in construction documents as updated during construction and verification that the site contractor understands the requirements and intent of this guideline.
- S.3G: Verification of language mandating compliance in construction documents and guidelines requirement compliance if trees are surrounded by hard surfaces.

Additional Resources

Philip J. Craul. Urban Soils: Applications and Practices. New York: John Wiley & Sons, 1999.

Bassuk, Nina; Grabosky, Jason; Trowbridge, Peter; Urban, James. "Structural Soil: An Innovative Medium Under Pavement that Improves Street Tree Vigor." Urban Horticulture Institute, University of Michigan. Web resource from: www.hort.cornell.edu/uhi/outreach/csc/article.html

University of Minnesota Extension: www.extension.umn.edu

Guideline S.4: Sustainable Vegetation Design

Intent

To restore natural areas and ensure the conservation of existing site features during planning and construction so the site can sustain its water, soil, and plant cover functions and promote biodiversity of both net and viable species populations.

Required Performance Criteria

Guidelines apply to all projects designated New Buildings and for all Major Renovations that include area of site disturbance that is greater than 3,000 square feet or area of imperviousness (footprint of building plus site impervious area) renovated that is greater than 2000 square feet.

A. On previously developed sites: maintain or improve natural site functions and biodiversity for 50% of site area (excluding building footprint) in accordance with existing conditions and surrounding site context.
B. On all sites: A minimum of 75% of total vegetated area on the site must be native to the local area. In addition, a minimum of 75% of all trees and shrubs, by quantity, are to be native material. Native is defined as a plant which originates from within a 200-mile radius of the site without human intervention. Cultivars may be used if they do not appear on the Minnesota Native Plant Society or University of Minnesota Extension Service “Invasive” or “Species of Concern” lists. Exception: Do not remove existing, non-invasive vegetation solely in order to achieve this threshold.
C. Maintain or supplement tree trunk area of site so that there is no net loss of tree trunk area (square inches) at diameter at breast height (dbh = 4.5 feet) (Reference: International Society of Arboriculture (ISA) measurement tree area ratio for translating dbh to caliper.) Pre-project tree trunk area may disregard existing trees less than 6 inches in diameter. Replaced tree trunk area may include trees of any diameter.
D. If the site selected did not completely avoid (per Guideline S.1A) land of national, state, regional, or local natural resource and biological/ecological significance as identified in national, state, regional, or local natural resources inventories, assessments, and biological surveys and an associated 150-foot buffer zone, then for the portions of this site that include this type of land, create and implement a protection and maintenance plan that follows Minnesota County Biological Survey (CBS) guidelines and with CBS staff input before any site work is done.
E. If the site selected did not completely avoid (per Guideline S.1C) land with elevation lower than 5 feet above the elevation of the 100-year flood as indicated by the local watershed district, watershed management organization, or joint powers organization and an associated 50-foot buffer zone, then for the portions of this site that include this type of land, create and implement a protection and maintenance plan that follows BWSR guidelines and with BWSR staff input before any site work is done.
F. If the site selected did not completely avoid (per Guideline S.1D) land (including a 300-foot buffer zone) which provides habitat for any animal or plant species on the federal or state threatened or endangered list, and/or if the site provides habitat for any rare animals or plant species, using the Minnesota County Biological Survey (CBS), then create and implement a protection and maintenance plan that follows CBS guidelines and with CBS staff input before any site work is done.
G. Determine if the vegetation on site includes invasive species using the Invasive Species County Weed Guideline. If the site does contain invasive species, create or implement a mitigation and maintenance plan as defined by the Minnesota Department of Agriculture.
H. Promote pollinator health. Do not select neonicotinoid-applied plants. Include in specifications of site establishment, maintenance and operations the requirement of non-use of neonicotinoid pesticide products. Select plantings that are pollinator friendly as listed in the resources below.

Recommended Performance Criteria

I. On previously developed sites: Maintain or improve natural site functions and biodiversity for 90% of site area in accordance with existing conditions and surrounding site context.

Meeting the Guidelines

Implementation in the Design Process:

Select a site where the proposed building and infrastructure will have minimal disturbance on the existing vegetation and the supporting soil and hydrologic conditions that support it. Identify areas of vegetation or high quality areas for restoration that will be protected or restored during the design and construction process.

Through the design process, integrate techniques that minimize negative impacts on soil, water, and vegetation on the site and adjacent sites that are to be preserved or restored. Develop details and specifications that support the use of native plantings, maintain existing biodiversity, and promote enhancement of site conditions per the B3 Guidelines.

Hold a preconstruction meeting to identify requirements for protection/preservation of vegetation during and after the construction process. Monitor submittals for compliance with plans and details. Make bidders aware of specific responsibilities for integrating the onsite vegetation management with connections to vegetation on adjacent sites. Ensure that existing plants and trees indicated to remain are protected, and maintain or improve soil and water conditions to promote and improve vegetation growth.

Create an operation and maintenance manual to protect and maintain onsite vegetation. Document the existing conditions of the vegetation, the reason why it was preserved or enhanced, and its ability to function in its current capacity. Note what enhancements, and what enlargements or reductions in spatial area, would be needed to accommodate a different building type in the future.

Pollinator friendly planting list:

Select pollinator friendly planting from the list below for compliance with S.4H:

DNR Pollinator Best Management Practices and Habitat Restoration Guidelines:
http://files.dnr.state.mn.us/natural_resources/npc/2014_draft_pollinator_bmp_guidelines.pdf

University of Minnesota Bee Lab “Plants for Minnesota Bees”
https://www.beelab.umn.edu/sites/beelab.umn.edu/files/plants_mn_bees.pdf

Calculations:

S.4: 90% of the 30-year maturity-level area may be used if and only if the following two conditions are met:

- Condition 1 – Minimum soil volume – 1,000 cubic feet per tree is provided for trees individually planted, or 600 cubic feet per tree for trees in shared soil. For structural soils this volume must be multiplied by a factor of 5.
- Condition 2 – Minimum area of catchment sloped to tree soil – 1,000 square feet of impervious surface or 3,000 square feet of turf (or similar); this area can be prorated for partially impervious areas.

Submittal Requirements

Design:

- S.4A: Amount of non-building site area with natural site functions and biodiversity pre-project.
- S.4B: Amount of non-building site area with native species pre-project.

- S.4C: Amount of tree-trunk area and percent site area of tree canopy pre-project.
- S.4D: Verification of implementation of protection plan (if Guideline S.1A is not met).
- S.4E: Verification of implementation of protection plan (if Guideline S.1C is not met).
- S.4F: Verification of implementation of protection plan (if Guideline S.1D is not met).
- S.4G: Identification if invasive species are present onsite.
- S.4H: Verification of selection of pollinator friendly plantings.
- S.4I: Amount of non-building site area with natural site functions and biodiversity pre-project.

Final Design:

- S.4A: Verification that the amount of site area with natural site functions and biodiversity pre- and post-project meets 50% threshold.
- S.4B: Amount of non-building site area with native species pre and post-project meeting 75% threshold.
- S.4C: Amount of tree-trunk area and percent site area of tree canopy pre and post-project demonstrating no loss in tree trunk area or canopy.
- S.4D: Verification of implementation of protection plan (if Guideline S.1A is not met).
- S.4E: Verification of implementation of protection plan (if Guideline S.1C is not met).
- S.4F: Verification of implementation of protection plan (if Guideline S.1D is not met).
- S.4G: Verification of implementation of mitigation plan if invasive species are present onsite.
- S.4H: Verification of selection of pollinator friendly plantings.
- S.4I: Amount of site area with natural site functions and biodiversity pre and post-project meeting 90% threshold.

Closeout:

- S.4A: Verification of final construction site area with natural site functions and biodiversity pre- and post-project meeting 50% threshold and verification that the site contractor understands the requirements and intent of this guideline
- S.4B: Verification of final construction non-building site area with native species pre- and post-project meeting 75% threshold and verification that the site contractor understands the requirements and intent of this guideline
- S.4C: Verification of final construction tree-trunk area and percent site area of tree canopy pre- and post-project demonstrating no loss in tree trunk area or canopy and verification that the site contractor understands the requirements and intent of this guideline.
- S.4D: Verification of implementation of protection plan (if Guideline S.1A is not met) and verification that the site contractor understands the intent of this guideline.
- S.4E: Verification of implementation of protection plan (if Guideline S.1C is not met) and verification that the site contractor understands the intent of this guideline.
- S.4F: Verification of implementation of protection plan (if Guideline S.1D is not met) and verification that the site contractor understands the intent of this guideline.
- S.4G: Verification of implementation of mitigation plan if invasive species are present onsite and verification that the site contractor understands the intent of this guideline.
- S.4H: Verification of planting of pollinator friendly plantings and verification that the site contractor understands the intent of this guideline.
- S.4I Verification of final construction site area with natural site functions and biodiversity meeting 90% threshold and verification that the site contractor understands the requirements and intent of this guideline.

Additional Resources

USDA Electronic Field office Technical Guide (eFOTG): www.nrcs.usda.gov/technical/

Seeding Manual – Latest Edition, Mn/DOT Office of Environmental Services, Turf Establishment & Erosion Control Unit http://www.dot.state.mn.us/environment/erosion/pdf/seedingmanual.pdf

The Minnesota County Biological Survey: www.dnr.state.mn.us/mbs/index.html

United States Dept. of Agriculture, Natural Resources Conservation Service, Engineering Field Handbook: https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=21429

Xerces Society Pollinator Conservation: http://xerces.org/pollinator-conservation/

DNR Pollinator Best Management Practices and Habitat Restoration Guidelines: http://files.dnr.state.mn.us/natural_resources/npc/2014_draft_pollinator_bmp_guidelines.pdf

University of Minnesota Bee Lab "Plants for Minnesota Bees": https://www.beelab.umn.edu/sites/beelab.umn.edu/files/plants_mn_bees.pdf

Minnesota Department of Agriculture, Invasive Species: https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=21429

Minnesota Department of Agriculture Conservation Funding Guide: http://www.mda.state.mn.us/protecting/conservation/practices/invasivemgmt.aspx

International Society of Arboriculture: www.isa-arbor.com/publications/tree-ord/ordprt3d.aspx

Board of Water and Soil Resources: www.bwsr.state.mn.us/index.html

Guideline S.5: Light Pollution Reduction

Intent

To eliminate light trespass from the site, improve night sky access, and reduce development impact on nocturnal environments.

Required Performance Criteria

Guidelines apply to all projects designated New Buildings and for all new exterior lighting scope within Major Renovations.

A. Do not exceed the following nighttime (sunset to sunrise) vertical illuminance values for each of the four exterior lighting zone types defined below. The illuminance measurement must be at 5 feet above ground level, along the site property line and facing into the site, perpendicular to the site property line. Vertical illuminance solely from site lighting fixtures may be used; light reflectance off of site surfaces may be ignored in meeting this criteria.

Environmental Lighting Zone	Description	Maximum Vertical Illuminance Levels [fc] at Property Line
E1: Intrinsically Dark	Parks and residential areas where controlling light pollution is a high priority	0.1
E2: Low Ambient Brightness	Outer urban and rural residential areas	0.1
E3: Medium Ambient Brightness	Urban residential areas	0.2
E4: High Ambient Brightness	Urban areas having both residential and commercial use and experiencing high levels of nighttime activity	0.6

Note: This table was adapted from Illuminating Engineering Society of North America (IESNA) RP-33-99, using "post curfew" recommendations for all values to ensure that light trespass is minimized for each environmental zone. In situations where the property line is very close to the area of development (commonly referred to as "zero property line"), and where lighting is required for emergency egress purposes, it may not be possible to meet these recommendations, and an exception may be made for lighting within 10 feet of these areas. Carefully explain and document these conditions.

Recommended Performance Criteria

B. Reduce upward emissions to reduce light pollution or sky glow.
   1. For the environmental lighting zones as defined above for light trespass, achieve the following light distribution characteristics:

      For parking lot and security lighting areas:

      i. Zone E1: Use luminaires with light distribution that meets IESNA's Full Cutoff Fixtures.
      ii. Zone E2: Use luminaires with light distribution that meets IESNA's Cutoff Fixtures.
      iii. Zone E3: Use luminaires with light distribution that meets IESNA's Semi-Cutoff Fixtures.
      iv. Zone E4: Use luminaires with light distribution that meets IESNA's Cutoff Fixtures.

      For facade, display, sculptural, and sign lighting:

      v. For luminaires of 3500 or more lumens, light objects from above.
      vi. For luminaires of less than 3500 lumens, objects may be lit from below. Make an effort to minimize non-target light (maximize the percentage of uplight that falls on the target).

C. Create lighting control zones and provide lighting control devices for parking lot, security, and decorative and façade lighting so that each type of lighting can be controlled independently and can be turned off or reduced in response to reduced lighting needs during low use or non-use periods.
   Note: The principles for sky glow criteria S.5 B-C are adapted from principles outlined in IESNA RP33-99, Lighting for Exterior Environments.

D. Use lamps with a minimum CRI of 65 in areas of safety/security (i.e., main walking routes through large parking lots, isolated areas), at building entrances, and locations where identification of objects or individuals is essential.

Meeting the Guidelines

Implementation in the Design Process:

During the design process, define zones that require high, medium, and low levels of lighting based on safety, security, and environmental concerns. Take into consideration existing nighttime ambient lighting levels. Develop coverage patterns of lighting and design of light fixtures in relation to the scale of the development and the need for light or safety. Focus on enhancing way-finding, increasing safety, and minimizing glare and light trespass. At site periphery, increase wayfinding and minimize light trespass.

In the construction documents and construction administration and buyout of the project, develop site lighting that adds and directs light only where it is required, is efficient in its use of energy, maximizes safety, and minimizes light trespass.

During construction, monitor submittals for compliance with plans and details and make bidders aware that plans are diagrammatic and that adjustments will need to be made when installing lighting. When installed, ensure that lighting is installed upright and plumb with correct luminaires, bulbs, and attachments. Remedy pattern and color rendition if needed.

During occupancy, monitor and maintain vegetation around lighting to keep it from obscuring light coverage pattern, and clean or replace light lenses at regular intervals.

Submittal Requirements

Design:

- S.5A: Vertical illuminance allowed at property line.
- S.5B: Verification of use of cutoff fixtures.
- S.5C: Verification of creation of outdoor lighting control zone, use of control devices.
- S.5D: Verification of use of lamps with CRI within guideline limits.

Final Design:

- S.5A: Vertical illuminance allowed at property line, vertical illuminance as designed.
- S.5B: Verification of use of cutoff fixtures.
- S.5C: Verification of creation of outdoor lighting control zone, use of control devices.
- S.5D: Verification of use of lamps with CRI within guideline limits.

Closeout:

- S.5A: Vertical illuminance as installed and verification that the site contractor understands the requirements and intent of this guideline.
- S.5B: Verification of use of cutoff fixtures and verification that the site contractor understands the requirements and intent of this guideline.
- S.5C: Verification of outdoor lighting control zone, use of control devices and verification that the site contractor understands the requirements and intent of this guideline.
- S.5D: Verification of use of lamps with a CRI above 65 and verification that the site contractor understands the requirements and intent of this guideline.

Additional Resources

Illuminating Engineering Society of North America (IESNA) Recommended Practice (RP-33-14) Lighting for Exterior Environments: http://www.techstreet.com/standards/ies-rp-33-14?product_id=1888389

Illuminating Engineering Society of North America (IESNA) Technical Memorandum TM-10-00, Addressing Obtrusive Light (Urban Sky Glow and Light Trespass) In Conjunction with Roadway Lighting: https://www.ies.org/store/technical-memoranda/addressing-obtrusive-light-urban-sky-glow-and-light-trespass-in-conjunction-with-roadway-lighting/

Illuminating Engineering Society of North America (IESNA) Technical Memorandum TM-11-00, Light Trespass: Research, Results and Recommendations: https://www.ies.org/store/technical-memoranda/light-trespass-research-results-and-recommendations-reaffirmed-2011/

International Dark-Sky Association: www.darksky.org

Guideline S.6: Erosion and Sedimentation Control during Construction

Intent

To ensure the reduction of erosion and sedimentation during construction.

Required Performance Criteria

Plan for and implement erosion control management during construction per National Pollutant Discharge Elimination System (NPDES) site permit limits, including provisions:

A. Ensure that no soil is left open for more than 48 hours (use blankets, fences, and slope interceptions instead).
B. Inspect, repair and cover erosion-damaged areas within 6 hours of every 24-hour storm event that is greater than or equal to 0.75 inches.
C. Create a Storm Water Pollution Prevention Plan (SWPPP) and submit it to MPCA and the local watershed authority 4 days prior to any and all site disturbances.
D. Identify and protecting all downstream Total Maximum Daily Load (TMDL) impaired waters from identified impacts (examples include mercury, lead, calcium, chromium, copper, chloride, Total Suspended Solids (TSS), phosphorus, biota).
E. Limit sediment discharge to the most stringent of the following scenarios:
F. 5 tons per acre per year using the Revised Universal Soil Loss Equation (RUSLE) method or other generally accepted soil runoff calculation;
G. Where applicable, meet the sediment discharge requirements of the watershed district, watershed maintenance organization, joint powers association, or other local governing unit.
H. Maintain temporary erosion control until the site is vegetated and stormwater infrastructure is fully functional.

Meeting the Guidelines

Implementation in the Design Process:

In predesign and early design, seek direction from the local government unit or authority with jurisdiction over the project's erosion and sedimentation control. Understand applicable rules, regulations, and permitting requirements. Determine soil type, soil structure, and limitations of soil, by performing a detailed geotechnical analysis.

Through the design process, evaluate what types of erosion and sedimentation control measures are appropriate for the specific types of soils and slopes present onsite, and develop drawings and specifications that protect soil, water, and utilities form erosion and sedimentation.

Hold a preconstruction meeting to identify requirements for sediment control during and after the construction process. Monitor project submittals for compliance with plans and details. Coordinate as necessary with contractors to ensure correct application of erosion and sedimentation controls and necessary modifications. Maintain temporary erosion control until the site is fully vegetated and stabilized and the stormwater management techniques are fully functional and online.

Create an operations and management manual that requires, at a minimum, inspections and necessary maintenance of the site and stormwater management areas for erosion and sedimentation and ensures that operations staff is familiar with site maintenance.

Submittal Requirements

Design:

- S.6D: Identification of downstream TMDL impaired waters,

Final Design:

- S.6A: Verification of language mandating compliance in construction documents.
- S.6B: Verification of language mandating compliance in construction documents.
- S.6C: Verification of language mandating compliance in construction documents.
- S.6D: Identification of downstream TMDL impaired waters, verification of site design mitigating downstream TMDL impact.
- S.6E: Tons of sediment discharge and reduction percentage, additional threshold if requirements are present from other organizations and verification that the more stringent limits are met.
- S.6F: Verification of language mandating verification in construction documents.

Closeout:

- S.6A: Verification of installed soil cover measures and verification that the site contractor understands the requirements and intent of this guideline.
- S.6B: Verification that the site contractor understands the requirements and intent of this guideline.
- S.6C: Verification that the site contractor understands the requirements and intent of this guideline.
- S.6D: Verification that the site contractor understands the requirements and intent of this guideline
- S.6E: Verification that methods of limiting sediment discharge were implemented and verification that the site contractor understands the requirements and intent of this guideline.
- S.6F Verification that temporary erosion control was implemented and verification that the site contractor understands the requirements and intent of this guideline.

Additional Resources

Best management practices for erosion and sedimentation control by the Environmental Protection Agency (EPA), Minnesota Pollution Control Agency (MPCA), MetCouncil, or Local Governing Unit (LGU)

MetCouncil Small Sites BMP Manual: https://metrocouncil.org/Wastewater-Water/Planning/Water-Resources-Management/Water-Quality-Management-Key-Roles.aspx

RUSLE Method (NRCS): www.ars.usda.gov/Research/docs.htm?docid=5971

Minnesota Pollution Control Agency SWPPP Guidelines: https://www.pca.state.mn.us/water/construction-stormwater

Minnesota Pollution Control Agency Publication: Minnesota's Impaired Waters: https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list

Stormwater Best Management Practices Manual: www.pca.state.mn.us/index.php/water/water-types-and-programs/stormwater/stormwater-management/stormwater-best-management-practices-manual.html

Erosion Control & Stormwater Management: www.dot.state.mn.us/environment/erosion/index.html

Guideline S.7: Landscape Water Efficiency

Intent

To limit or eliminate demand for municipal potable water or harvested groundwater (well water) used for maintaining a building's plants and lawn areas.

Required Performance Criteria

Required and Recommended Performance Criteria apply to all projects designated New Buildings and for all Major Renovations that include area of site disturbance that is greater than 3,000 square feet or area of imperviousness (footprint of building plus site impervious area) renovated that is greater than 2000 square feet.

A. Design and maintain landscape so that after a 2-year establishment period, the landscape uses 50% less municipal potable water or harvested ground water for irrigation than a base-case landscape design. (Exception: annuals are exempt.) Any amount of site-harvested rainwater, stormwater, or gray or waste water treated onsite to tertiary standards may be used. The criteria may be met by any combination of the following: selection of native or low water-use plants, use of alternatively sourced irrigation water as described, use of high efficiency irrigation systems, or other strategies. In order to verify compliance with this guideline during building operation, it is necessary to sub-meter irrigation separately from indoor water consumption.

Recommended Performance Criteria

B. Design and maintain landscape so that after a 1–2 year establishment period, the landscape uses no (100% less) municipal potable water or harvested ground water than a base-case landscape design. (Exception: annuals are exempt.) Any amount of site-harvested rainwater, stormwater, or gray or waste water treated onsite to tertiary standards may be used. The criteria may be met by any combination of the following: selection of native or low water-use plants, use of alternatively sourced irrigation water as described, use of high efficiency irrigation systems, no irrigation systems, or other strategies.

Meeting the Guidelines

Implementation in the Design Process:

Evaluate the site for existing natural features for water capture and vegetated areas that require low water input. Define areas of different plant communities based on water input requirements. Identify opportunities for water harvest and reuse. Perform general calculations for water consumption and identify available sources for the water.

As the design continues, update calculations and select native and water-efficient plant communities based on the community's location, slope, soil, and hydrologic regime. Develop and finalize details and specifications for irrigation, water harvest, and water reuse systems.

Hold a preconstruction meeting to identify requirements for landscape water efficiency and maintenance requirements. Monitor submittals for compliance with plans and details as the project moves toward completion. Make bidders aware of specific requirements for landscape water efficiency and maintenance requirements.

Create an operation and maintenance manual to protect and maintain the plant material and the irrigation from potable and non-potable sources used onsite. Consider requiring a first- and second-year maintenance program to ensure

establishment of plant communities, which will enable them to continue to perform, once established, with the designed level of water and chemical inputs.

Calculations and Base Case:

Calculations used for this guideline include determination of the base-case and design-case irrigation consumption.

The base and design cases water consumption may be calculated using the Interactive Water Budget Tool from EPA Water Sense: https://www3.epa.gov/watersense/water_budget/application.html or by a manual calculation using the landscape coefficient method The base-case water consumption should be calculated using a typical mix of turf grass, building-adjacent shrubs, and other typical vegetation.

Submittal Requirements

Design:

- S.7A: Base-case irrigation water consumption.

Final Design:

- S.7A and S.7B: Base and design case irrigation water consumption, alternatively sourced irrigation water used, and annotated plan showing vegetated areas and plant selections.

Closeout:

- S.7A and S.7B: Updated base and design case irrigation water consumption, alternatively sourced irrigation water used, and verification that site contractor understands the requirements and intents of this guideline.

Occupancy – Submitted annually for ten years:

- S.7A and S.7B: Water consumption used for irrigation.

Additional Resources

LEED v.4 Irrigation Calculator: http://www.usgbc.org/resources/outdoor-water-use-reduction-calculator

Interactive Water Budget Tool from EPA Water Sense (note that this outputs peak monthly consumption): https://www3.epa.gov/watersense/water_budget/application.html

Guideline S.8: Building Water Efficiency

Intent

To minimize municipal potable water or harvested groundwater (well water) use in buildings to conserve water resources and minimize water and wastewater treatment infrastructure impacts and cost.

Required Performance Criteria

A. Reduce municipal potable water or harvested groundwater use in building by 30% compared to code (1992 Energy Policy Act requirements) for any fixture types referenced by those requirements. The criteria may be met by any combination of the following: selection of low or no flow fixtures, use of alternatively sourced water, or other strategies. Major Renovation projects may limit performance criteria application to the number of fixtures included in the renovation scope, however, even if no fixture replacement was planned in the renovations scope, for any plumbing fixtures within the renovated area: faucets in the renovated area must be upgraded with low-flow faucet aerators, and showerheads must be upgraded with low-flow showerheads. In order to verify compliance with this guideline during building operation, it is necessary to sub-meter indoor water consumption separately from irrigation.

Recommended Performance Criteria

B. Reduce municipal potable water or harvested groundwater use in building by 50% compared to code (1992 Energy Policy Act requirements) for any fixture types referenced by those requirements. The criteria may be met by any combination of: selection of low or no flow fixtures, use of alternatively sourced water, or other strategies. Major Renovation projects may limit performance criteria application to the number of fixtures included in the renovation scope.

Meeting the Guidelines

Use Worksheet S-8 Building Water Calculator to calculate building water use for base and design. This also shows EPA required flow and flush fixture rates, and example fixture performance values.

Implementation in the Design Process:

In Predesign and early design, develop a water efficiency improvement goal meeting or exceeding the guideline requirements.

Through the design process adapt the water efficiency goal, document it in the program, and communicate the water efficiency goal to all design team members. The water efficiency goal should also be documented in the specifications for the project.

Provide annual water use calculations showing the reduction in water use compared to code. Use the total daily water requirements from the Minnesota Plumbing Code and the Energy Policy Act as the basis of the calculations.

In the project's construction documents confirm or revise calculations from the design development phase and specify compliant appropriate fixtures. Clearly indicate the water efficiency goal. Review submittals and verify compliance with specifications and confirm installation onsite.

Documentation

Documentation required for this guideline includes a completed Appendix S8 – Building Water Calculator. This evaluates the reduction from a base-case water scenario for regulated fixtures.

Submittal requirements

Design:

- S.8A: Base-case indoor water consumption.

Final Design:

- S.8A: Base and design case indoor water consumption, and alternatively sourced indoor water used, and completed Building Water Calculator documenting 30% reduction from base case.
- S.8B: Calculations from S.8A documenting 50% reduction from base case.

Closeout:

- S.8A: Updated base and design case indoor water consumption, and alternatively sourced indoor water used, updated completed Building Water Calculator documenting 30% reduction from base case, and verification that site contractor understands the requirements and intents of this guideline.
- S.8B: Calculations from S.8A documenting 50% reduction from base case.

Occupancy – Submitted annually for ten years:

- S.8A and S.8B: Indoor water consumption (collected through B3 Benchmarking) and verification that the building operator understands the intent of this guideline.

Additional Resources

Appendix S8: Building Water Calculator

Guideline S.9: Bird-Safe Building

Intent

Sustainable design can create environments that are attractive to birds, and this benefits both occupants and wildlife. Any built environment, but especially those attractive to birds, can pose a risk for bird-building collisions, which kill hundreds of millions of birds per year. The intent of this guideline is to limit the risk of built environments to birds, with special attention to the highest risk conditions. Some other B3 Guidelines also affect bird-safe building, such as S.1 Avoidance of Critical Sites, S.4 Sustainable Vegetation Design, and S.5 Light Pollution Reduction recommended criteria S.5B and S.5C.

Required Performance Criteria

Guidelines apply to all New Construction projects and all Major Renovations which include replacement of glazing. For Major Renovations without new or replacement glazing scope, only S.9E (Follow the "Lights Out" light management program) is required.

A. Traps cannot include any glazing with a threat factor (TF) greater than 25: The following conditions are considered traps:
   1. Glass/Plexiglas (transparent) railings (all surfaces exposed to exterior).
   2. Glass/Plexiglas-sided walkways (e.g., skyways, covered walks with glass on two sides).
   3. Any glazed surface that offers a see-through situation that is 20 feet or less across, such as a small atrium, or glass corners.

B. High Risk Surfaces are limited to 15% of surface area with TF 75 or more. No more than 15% of the area of a high risk surface can have a threat factor greater than or equal to TF 75. A high risk surface is defined as:
   1. A surface within 50 feet or less of attractants such as trees, shrubs, prairie, grassland, or open water (including green roofs with this type of vegetation).
   2. A surface in a see-through situation greater than 20 feet across (such as atriums, gathering spaces/lobbies, etc.)

C. The Whole Building Threat Factor (WBTF) must be less than or equal to WBTF 45, or WBTF 15 for critical sites. Use the B3 Guidelines Bird-Safe Design Calculator (Appendix S-9a) to determine WBTF. The calculator will also document and help to meet requirements for S.9A , S.9B, and S.9D. Use Guideline S.1 criteria to determine if the project is on a critical site to determine the appropriate WBTF threshold.

D. The Non-Enclosure Threat Factor (NETF) must be less than or equal to NETF 45. Use the B3 Guidelines Bird-Safe Design Calculator to determine NETF for non-enclosure surfaces.

E. Follow the Lights Out light management program, which addresses operation of lights at night for specified times and dates of bird migrations. In addition to the B3 Guidelines requirement, note that this is also required by law for state owned and managed buildings.
   1. Dates: Between March 15 and May 31 and between August 15 and October 31 each year.
   2. Times: Between midnight and dawn.
   3. Lighting: Turn off building lighting including but not limited to: architectural lighting at top of building; up-lighting; interior lighting, especially on upper floors; and lobby or atrium lighting. Exception: Where lights are documented as necessary between midnight and dawn for normal use of the building, they may be operated.

F. Correction period monitoring – for one year after construction/occupancy, walk the perimeter of the building(s) and all accessible setbacks and roof areas at least two times per week. Document survey activity and findings as required in Appendix S-9b Bird Safe Monitoring Worksheets.

Recommended Performance Criteria

G. Meet the Whole Building Threat Factor (WBTF) of less than or equal to 15
   Use the B3 Guidelines Bird-Safe Design Calculator (Appendix S-9a) to determine WBTF
H. Practice enhanced bird-safe building monitoring. In addition to S.9F (First-Year Building Monitoring) above:
   1. Continue the first year monitoring format for one or more additional years (shifting to a January–December calendar year basis in ongoing operations phases of the Tracking Tool).
   2. AND/OR conduct more surveys per week for the first or more years.
   3. AND/OR work with an organization such as Audubon Minnesota to collect and catalog birds found.
I. Bird-safe building narrative: Complete a Bird-Safe Case Study Narrative Report to document and share bird-safe efforts. Use Appendix S-9c Bird-Safe Building Narrative Template or include a write up with similar content.
J. Bird-safe lighting design: Comply with recommended lighting guidelines S.5B and S.5C and document bird-safe features of lighting including for S.5C; identify how control zones relate to the Lights Out program.

Meeting the Guidelines

Implementation in the Design Process:

In Predesign and early design, consider the impact of glazing percentage. If the building use is likely to be associated with large glazed areas, consider increased risk/adjustments needed on highly vegetated sites. Additionally, consider an ecological assessment of the site that includes an evaluation of bird species, habitat, and migration patterns.

Through the design process identify attractant areas for birds on the site, plan deterrents for facades adjacent to attractants, and keep glazed areas of buildings greater than 50 feet away from them. Configure building to minimize bird collision “traps.” Traps can include clear barriers, transparent railings, or other glazed see-through conditions. See guideline for complete conditions deemed to be traps.

Evaluate early designs through the Bird-Safe Calculator (Appendix S-9a), and inform and adjust designs to meet bird-safe criteria. Check design against bird-safe criteria and update the WBTF in the Bird-Safe Building Calculator to confirm it continues to comply.

As the construction documents are developed, confirm continued compliance with all required and pursued recommended bird-safe criteria, adjusting documentation and design as needed.

Confirm that contract documents include those features needed for bird-safe compliance, as calculated using the Bird-Safe Calculator (Appendix S-9a). Make bidders aware of specific requirements for sustainable construction according to the B3 Guidelines. Watch for substitutions that would change the bird-safe performance of the building, and ensure that any material substitutions meet bird-safe performance criteria.

Confirm correct implementation of features affecting bird-safe performance according to drawings and specifications.

Incorporate bird-safe first year monitoring and Lights Out program criteria into the project documentation. Coordinate with lighting engineer regarding controls for lights to accommodate Lights Out program compliance.

Comply with Lights Out management program during relevant seasons according to the guidelines.

Perform required first-year bird-safe monitoring and any recommended ongoing monitoring that was pursued, using appendix S14A for First-Year Building Monitoring.

If pursuing Bird-Safe Case Study Narrative, coordinate with lighting engineer on documentation of lighting benefits anticipated from Lights Out program.

If pursuing S.5 B and S.5 C under S.5 Light Pollution, consider documentation of bird-safe features for S.9 J Bird-Safe Lighting Design

Submittal Requirements

Design:

- S.9A: Traps Threat Factor (as calculated by Appendix S9), and upload of preliminary version of Appendix S9.
- S.9B: If the project includes new "high risk surface," and the area of that surface with a TF greater than 75.
- S.9C: Verification that the Whole Building Threat Factor is under 45 (or 15 for critical sites).
- S.9D: Indication of whether the project includes new glazing and, if so, verification that the Non-Enclosure Building Threat Factor is under 45.
- S.9G: Whole Building Threat Factor under 45.

Final Design:

- S.9A: Traps Threat Factor (as calculated by Appendix S9), and upload of final design version of Appendix S9.
- S.9B: If the project includes new "high risk surface," and the area of that surface with a TF greater than 75.
- S.9C: Verification that the Whole Building Threat Factor is under 45 (or 15 for critical sites).
- S.9D: Indication of whether the project includes new glazing and, if so, verification that the Non-Enclosure Building Threat Factor is under 45.
- S.9G: Verification that the designed Whole Building Threat Factor is under 45.

Closeout:

- S.9A: Traps Threat Factor of installed condition (as calculated by Appendix S9), and upload of final version of Appendix S9.
- S.9B: If the project includes new "high risk surface," the installed area of that surface with a TF greater than 75.
- S.9C: Verification that the installed Whole Building Threat Factor is under 45 (or 15 for critical sites).
- S.9D: Verification that the installed Non-Enclosure Building Threat Factor is under 45.
- S.9E: Verification of a Lights Out management program in place.
- S.9F: Verification that the facility operations team is aware of first year monitoring requirements.
- S.9G: Verification that the Installed Whole Building Threat Factor is under 45.

Occupancy – Submitted annually for ten years:

- S.9E: Verification of adherence to Lights Out management program
- S.9F (Year one only): Verification of first year monitoring

Additional Resources

Bird Safe Building Guidelines by Audubon Minnesota and Project Birdsafe:
http://mn.audubon.org/conservation/birdsafe-buildings

Sheppard, C. 2011. Bird-Friendly Building Design. American Bird Conservancy, The Plains, VA:
http://collisions.abcbirds.org/

State of Minnesota Lights-Out management program:
http://www.revisor.leg.state.mn.us/laws/?id=101&doctype=Chapter&year=2009&type=0 w

Glossary

Threat Factor

Threat Factor, a property of a building material related to likelihood of bird collision, found in the Threat Factor Table (See Appendix S-9). Consult the B3 Guidelines Team if you have questions on what Threat Factor should be used for a material.

Traps

Traps are glazed conditions that are particularly likely to produce bird strikes. These are defined in the B3 Guidelines as any of the following: Transparent exterior railings (e.g. a glass or plexiglass panel in an exterior railing system), transparent sided walkways (e.g., skyways with both sides glazed, covered walks with glazing on both sides), or any other condition where multiple transparent or translucent surfaces on the exterior of the project are separated by 20 feet or less which and which can be seen through simultaneously (e.g. a small atrium, or glazed corners).

High Risk Surfaces

High risk surfaces are those surfaces within 50 feet or less of attractants such as trees, shrubs, prairie, grassland, or open water, or any other condition where multiple transparent or translucent surfaces on the exterior of the project are separated by 20 feet or more which and which can be seen through simultaneously (e.g. a small atrium, or glazed corners).

Guideline S.10: Appropriate Location and Development Pattern

Intent

To direct development, where appropriate, to existing urban, suburban, or rural areas with in-place infrastructure to reduce development pressure on undeveloped land or greenfield sites; to conserve natural resources, reduce energy use and pollution contributions related to transportation requirements; and to promote a sense of increased community interaction. To encourage development of the site to support existing patterns and goals for local density, open space, and land use.

Recommended Performance Criteria

Guidelines apply to all projects designated New Buildings.

Site Selection:

A. Select a site, considering the associated building concept, which presents the most comprehensively positive impact for environmental, economic, community, and human benefits.
    1. For urban and suburban locations: Select sites that reuse existing urban/suburban and industrial sites; are located near mass transit and public amenities to encourage walking to services instead of driving; and can utilize existing infrastructure such as utilities, roadways, services, etc. Select sites that support regional development strategies and local comprehensive plans. Favor sites where the project will disrupt the smallest number of ecologically preferable land uses.
    2. For rural locations: Avoid greenfield sites that might not meet the threshold for a potentially critical site under Guideline S.1 , but that negatively impact green space and soil and water conditions. Favor sites on which the project will disrupt the smallest number of ecologically preferable land uses.

Context and Planning Compatible Development:

B. Land Use: Maintain or improve upon site land use type and condition.
C. Density: Urban and suburban locations: Maintain or increase localized density to conform to existing or desired density goals as listed in Minnesota's Community-Based Planning Act.
D. Open Space: Maintain or increase open space compared to local or prevailing standards for the site.
E. Green Corridors: Maintain or increase green corridors compared to local or prevailing standards for the site.

Meeting the Guidelines

Implementation in the Design Process:

In Predesign and early design, seek out and evaluate opportunities to locate development in areas where existing infrastructure will support increased densities and where additional development can improve site use. Work with local government units and community representatives to inventory potential sites that will enhance environmental and economic performance for communities and agencies alike.

Consider choosing to develop a site where community revitalization is occurring, provided the required development density is achieved by the project's completion. Integrate community feedback into density development proposals, working closely with municipalities to coordinate development efforts. Document these development density goals.

Through the design process maximize use of existing infrastructure and target maximum development densities appropriate to the site.

In the construction documents, construction administration, and project buyout, make bidders aware of specific requirements for sustainable development.

Submittal Requirements

Predesign:

- S.10A: A narrative of the qualities of the site selected and a comparative evaluation against at least two alternate sites.

Design:

- S.10B: Verification of compliance is done from information collected under S.0: General Site and Water sections documenting improved site land use and condition.
- S.10C: Baseline localized density goals based on the Minnesota Community-Based Planning Act.
- S.10D: Local prevailing standard for open space.
- S.10E: Local prevailing standard for green corridors.

Final Design:

- S.10B: Information collected in S.0: General Site and Water sections documenting improved site land use and condition.
- S.10C: Baseline localized density goals based on the Minnesota Community-Based Planning Act and project density as designed.
- S.10D: Local prevailing standard for open space and quantity of open space as designed.
- S.10E: Local prevailing standard for green corridors and quantity of green corridors as designed.

Additional Resources

Green Corridors: Minnesota DNR Natural Resource Planning: www.dnr.state.mn.us/nrplanning/index.html

National Recreation and Park Association: www.nrpa.org

Minnesota Association of Development Organizations: www.mnado.org

Minnesota Community-Based Planning Act: https://www.revisor.mn.gov/statutes/?id=462.3535

Resource Materials, Planning Guides, “Under Construction: Tools and Techniques for Local Planning”: http://www.mnplan.state.mn.us/pdf/2002/UnderConstruction.pdf

Guideline S.11: Brownfield Redevelopment

Intent

To promote the redevelopment of damaged or contaminated sites to reduce development pressure on undeveloped land and utilize existing investments in infrastructure, conserve natural resources, and promote a new sense of community renewal, identity, and revitalization.

Recommended Performance Criteria

Guidelines apply to all projects designated New Buildings.

A. Redevelop brownfield sites to support Minnesota's Community-Based Planning Act.
B. Provide remediation as required for EPA's Sustainable Redevelopment of Brownfields Program and enroll site in the Minnesota Pollution Control Agency's Voluntary Investigation and Cleanup Program.
C. Develop a site classified as a brownfield into a greenspace (a process known as B2-G), for park or open space connected to building development.

Meeting the Guidelines

Implementation in the Design Process:

During site selection, Predesign, and other early design phases, seek direction from the local government unit or authority with jurisdiction over the project's brownfield redevelopment. In planning for facilities not yet located, include a brownfield redevelopment option that meets expectations of key locations, appropriate size, and sufficient infrastructure to support planning goals within the applicable rules, regulations, and permitting requirements. Select a building approach that is adaptable to brownfield redevelopment. Preferably, select a site that is eligible for the EPA's Brownfield Redevelopment Program. County Brownfield maps may be useful in listing contamination source and degree of contamination.

Submittal Requirements

Predesign:

- S.11A: Area of brownfield redeveloped.
- S.11B: Area of brownfield remediated.
- S.11C: Area of brownfield redeveloped into parkland.

Final Design:

- S.11A: Area of brownfield redeveloped.
- S.11B: Area of brownfield remediated.
- S.11C: Area of brownfield redeveloped into parkland.

Additional Resources

Minnesota Community-Based Planning Act: https://www.revisor.mn.gov/statutes/?id=462.3535

Resource Materials, Planning Guides, "Under Construction: Tools and Techniques for Local Planning": http://www.mnplan.state.mn.us/pdf/2002/UnderConstruction.pdf

EPA Sustainable Redevelopment of Brownfields: www.epa.gov/brownfields

Minnesota Pollution Control Agency's Voluntary Investigation and Cleanup Program: https://www.pca.state.mn.us/waste/brownfields

Minnesota Department of Employment and Economic Development Contamination Cleanup and Investigation Grants Program: https://mn.gov/deed/government/financial-assistance/cleanup/contamination.jsp

Guideline S.12: Heat Island Reduction

Intent

To help reduce heat islands (thermal gradient differences between developed and undeveloped areas) to minimize impact on microclimate and human and wildlife habitat.

Recommended Performance Criteria

Guidelines apply to all projects designated New Buildings and Major Renovations with roof or impervious surface replacement.

A. Reduce heat islands on non-roof site surfaces:
   Meet one of the paths below:
   1. Path 1: Provide any combination of the following characteristics for 50% of the site hardscape:
      i. Surface composed of light colored/high albedo (reflectance is 0.30 or greater).
      ii. Surface composed of an open-grid pavement system (less than 50% impervious).
      iii. 50% of non-parking surfaces shaded within five years.
      iv. 50% of parking surfaces shaded within ten years.
   2. Path 2: provide 100% of non-circulation parking surface shaded within ten years.
   3. Path 3: A minimum of 50% of parking spaces placed underground or in a structured parking facility.

B. Reduce heat islands on roof surfaces:
   Meet one of the paths below:
   1. Path 1: Use ENERGY STAR roof-compliant, high-reflectance, AND high emissivity roofing (initial reflectance of at least 0.65 and 3-year-aged reflectance of at least 0.5 when tested in accordance with ASTM #903 and emissivity of at least 0.9 when tested in accordance with ASTM 408) for a minimum of 75% of the roof surface.
   2. Path 2: Install a "green" (vegetated) roof for at least 50% of the roof area.
   3. Path 3: The two paths above can be combined by the following formula: (high albedo roof Area/0.75) + (green roof area/0.5), the project is compliant if this area is greater than or equal to total roof area.

Meeting the Guidelines

Implementation in the Design Process:

During site selection, consider sites where existing vegetation or site features provide shading that can be integrated into the built area. Also evaluate effects of maturing plantings or changing uses on future heat island effects. Consider sharing building space or amenities, such as parking, to minimize the development footprint and surfaces that promote the heat island effect.

Through the design process preserve or propose landscape features that provide shade for surfaces that contribute to the heat island effect. Orient the building and pavement surfaces that maximize shade for surfaces that contribute to the heat island effect. Minimize building and pavement surfaces that are exposed to the sun. Consider replacing impervious surfaces (i.e., roofs, sidewalks, roads, driving lanes, etc.) with open-grid paving or high albedo materials. Consider replacing roofing surfaces with high albedo materials or vegetated surfaces.

Monitor submittals for compliance with plans and details. Make bidders aware of specific requirements for heat island reduction.

During occupancy, monitor and maintain vegetation around site to preserve its beneficial effects and mitigate negative developments.

Submittal Requirements

Final Design:

- S.12A: Site area of hardscape, high albedo hardscape, open-grid pavement area, non-parking hardscape areas shaded at five and ten years and underground parking areas.
- S.12B: Total roof area, green roof areas, and high albedo roof area.

Additional Resources

Green Roofs for Healthy Cities: www.greenroofs.org

Guideline S.13: Transportation Impacts Reduction

Intent

To reduce negative land development impacts on energy and to reduce pollution caused by transportation. To reduce automobile dependence, reduce the amount of pavement impacting natural systems, and allow for more ecologically responsive approaches to the site.

Recommended Performance Criteria

A. Locate the building within 0.25 mile of one or more bus lines OR a light rail/bus station, AND within .25 mile of retail and public services.
B. Locate project within 0.25 mile of restaurants and service facilities.
C. Provide means for securing bicycles, with convenient changing/shower facilities for use by cyclists, for 5% or more of building fulltime equivalent (FTE) occupants OR according to local bicycle parking guidelines OR zoning requirements, whichever is more stringent.
D. Install alternative-fuel refueling or plug-in electric vehicle charging station(s) for 3% of the total vehicle parking capacity of the site.
E. Limit parking area by sizing parking capacity not to exceed minimum local zoning requirements, encouraging shared parking with adjacent uses, and adding no new parking for rehabilitation projects.
F. Provide preferred parking for hybrid vehicle owners, carpools, or vanpools capable of serving 5% of the building occupants.
G. Locate preferred parking, bicycle parking, pick-up areas, and covered waiting spaces within close proximity of the main building entrances, with markings clearly designating these areas.

Operations Policies

H. Offer work pattern alternatives such as telecommuting and teleconferencing facilities that reduce vehicle and air travel time.
I. Set a company policy to buy carbon emission offsets for business air travel.
J. Support mass transit riders by offering free or discounted bus or train passes for those who commit to not driving in at least 3 days per week. Make company cars (preferably alternatively fueled) readily available for daytime business travel for those who do not drive in.
K. Manage transportation impacts: Track commuting and business travel contributions to pollution impacts and include in annual environmental reporting. Evaluate the effectiveness of transportation policies and facilities and set goals for continual improvement in travel emissions performance.

Meeting the Guidelines

Implementation in the Design Process:

Perform a transportation survey of future building occupants to identify transportation opportunities and needs. Determine in the survey the number of vehicle trips per square foot of building and equate that to the amount of CO2 produced or that could be “reduced” over a 1-year life cycle through alternative transportation methods. Monitor use.

Seek location accessible to two or more bus lines or a light rail station and within walking distance of retail and public services. Also consider sites that offer the possibility of sharing transportation facilities such as parking lots and refueling stations with neighboring developments.

In Predesign and other early design phases, include dedicated space for transportation amenities such as bicycle racks and showering/changing facilities and alternative-fuel refueling stations in the building and site program.

Through the design process, size parking capacity not to exceed minimum local zoning requirements. Add no new parking for rehabilitation projects. Provide preferred parking for carpools, vanpools, plug-in electric or hybrid vehicles. Design to encourage use by occupants with clearly marked carpool parking, pick-up areas, and covered waiting spaces within close proximity of the building entrance.

Develop specifications and drawings to support bicyclists, pedestrians, and mass transit/carpool members. Design means for securing bicycles, with convenient changing/shower facilities for use by cyclists. Ensure potentially hazardous fueling facilities are separately ventilated or located outdoors. Enhance the design hybrid/carpool/vanpool parking to encourage its use by occupants. Create and conveniently locate plug-in electric charging stations conveniently to encourage its use by occupants.

Submittal Requirements

Predesign:

- S.13A: Determination if the project site complies with the guideline.
- S.13B: Determination if the project site complies with the guideline.
- S.13H: Verification of work pattern alternatives offered.
- S.13I: Verification of carbon offset policy.
- S.13J: Verification of free or discounted bus or train travel.
- S.13K: Verification of policy to track travel pollutants annually.

Design:

- S.13C: Verification of inclusion of bicycle storage and changing/shower facilities.
- S.13D: Verification of inclusion of alternative-fuel refueling stations.
- S.13E: Verification of limitation of parking area.
- S.13F: Verification of preferred parking for hybrid vehicles, carpools or vanpools.
- S.13G: Verification of the location of preferred parking, bicycle parking, near building entrances.

Final Design:

- S.13C: Verification of inclusion of bicycle storage and changing/shower facilities.
- S.13D: Verification of inclusion of alternative-fuel refueling stations.
- S.13E: Verification of limitation of parking area.
- S.13F: Verification of preferred parking for hybrid vehicles, carpools or vanpools.
- S.13G: Verification of the location of preferred parking, bicycle parking, near building entrances.

Additional Resources

Metropolitan Council: www.metrocouncil.org

Guideline S.14: Wastewater Reduction and Management

Intent

To reduce wastewater generated for conventional treatment.

Recommended Performance Criteria

A. Reduce the volume of the subject site's wastewater flow entering the municipal wastewater system or an onsite conventional septic system by 50%. Alternatives that can contribute to this guideline include, but are not limited to the following: peat moss drain fields, constructed wetlands, aerobic treatment systems, solar aquatic waste systems and composting or ecologically-based toilets or urinals. Reduction of building water and sewer discharge also contributes to reduced wastewater generated without negatively impacting adjacent municipal water well heads. Reduction of building water consumption also contributes to reduced wastewater.

Meeting the Guidelines

Implementation in the Design Process:

Seek direction from the local government unit or authority having jurisdiction on which water utility districts in the local community are stressed and will be impacted by the development. Engage this water authority about alternative proposals for graywater treatment in order to streamline the approval process. In areas not served by a public waste treatment facility, a site should be selected that can accommodate approved exterior biological waste treatment systems such as peat moss, drain fields, treatment wetlands, etc.

In the early design process consider ways to reduce wastewater going to the municipal wastewater system or onsite conventional septic system. Note that reduction of building water consumption also contributes to reduced wastewater. Also consider ways to use graywater for non-potable water uses such as irrigation, toilets, vehicle washing, sewage transport, HVAC/process make-up water, etc. Determine whether graywater or biological wastewater treatment systems are appropriate based on program and activities within the building and on the site. If so, develop goals and objectives for graywater reclamation or biological treatment.

Through the design process evaluate availability of potential storage and treatment areas on the site. Where biological wastewater treatment systems are under consideration, evaluate savings incurred from minimized amount of piping required because of reduced volume of wastewater.

Research and analyze systems early in the design process to ensure successful and effective design solutions and evaluate requirements for permits and/or variances. Develop appropriate design strategies and select appropriate systems based on program, occupants, occupant schedule and site. Research and implement best available alternative waste treatment fixtures and technologies.

If considering constructed wetland systems, identify design requirements based on users, capacity, pollutants to be removed from water, area, and detention time necessary for thorough treatment, vegetation and aquatic life survival requirements, and aesthetics. Select, design, and specify appropriate treatment system or multiple systems based on site and building determinants. Specify the type of storage area that is most applicable for the project.

Monitor submittals for compliance with plans and details and perform appropriate testing when complete.

Create an operations and management manual that requires inspections and necessary maintenance of the wastewater systems and ensures that operations staff is familiar with biological wastewater treatment strategies and systems present onsite.

Submittal Requirements

Final Design:

- S.14A: Amount of wastewater treated in an alternative treatment system.

Additional Resources

EPA Constructed Wetlands: https://www.epa.gov/wetlands/constructed-wetlands

Energy & Atmosphere Guidelines

Intent

Goal

To promote energy efficient buildings and renovations that reduce the state's expenditures on imported fuel and power and have the lowest reasonable environmental impacts resulting from energy generation and the use of refrigerants harmful to the atmosphere. A parallel goal is to support and enhance the state's building benchmarking activities for ongoing operations performance.

Overview

Energy consumption for building operations represents approximately one third of the total energy use in the State of Minnesota. This section of the B3 Guidelines provides guidance on mitigating both the cost of energy and associated ecological impacts that affect the state's economy. For each building, there are multiple paths to conservation. To further reduce impacts on the environment and to promote community economic development, this guide requires a minimal baseline of onsite wind or solar renewable energy and recommends the investigation of renewable and distributed forms of power generation using wind, solar, and biomass technologies as well as other cleaner forms of hydrogen or hydrocarbon-based power generators. Combined Heat and Power (CHP) systems may be an appropriate solution for individual buildings or groups of state facilities.

Objectives

- Design New Buildings and Major Renovations subject to SB 2030 to meet the energy benchmarks of the SB 2030 program.
- Provide building performance data for benchmarking activities.
- Reduce plug loads and process energy through energy-smart purchasing practices.
- Design New Buildings and Major Renovations to source at least 2% of their SB 2030 target or better final energy use from onsite renewable sources.
- Encourage the consideration of additional power usage from renewable energy and cleaner generation systems whether generated onsite or purchased from offsite “green power” generated in Minnesota.
- Encourage the installation of onsite renewable energy systems to provide 2% of total building energy use, in accordance with Minnesota legislation.
- Encourage the balanced consideration of global warming potential, ozone depletion potential, and atmospheric lifetime in selecting refrigerants.
- Help assure that long-term operations meet or exceed original design operating parameters.

General Energy and Atmosphere Information:

The following information is collected in the Energy and Atmosphere Section of the B3 Guidelines Tracking Tool, under Section E.0:

Final Design:

- Energy and atmosphere strategies used, including narrative.

Closeout:

- Updated energy and atmosphere strategies used, including narrative.

Guideline E.1: Energy Efficiency

Intent

To meet energy-efficiency performance standards for buildings to significantly reduce carbon dioxide emissions by lowering energy use.

Required Performance Criteria

A. Meet MN SB 2030 Energy Standards, information on which can be found at www.b3mn.org/2030energystandard. Results and compliance are tracked in the B3 Guidelines Tracking Tool.
B. Document predicted and actual energy use by type. For all New Buildings and Major Renovations, document predicted and actual energy use by type in the B3 Guidelines Tracking Tool, including recording modeled plug loads and sub-metered actual plug loads separately from other electrical loads in the built project.

Meeting the Guidelines

Please refer to the SB 2030 project website, at http://www.b3mn.org/2030energystandard for more guidance on SB 2030 compliance, including submittal requirements.

Guideline E.2: Renewable Energy

Intent

To require a minimal use of onsite renewable energy and to encourage the broader consideration and use of renewable energy sources and cleaner forms of energy to reduce atmospheric pollution. This can provide a stimulus to the state's economy through investments in local jobs and materials while reducing the state's expenditures on imported fuel and power. The language of this guideline is intended to align with Minnesota legislation, which requires an economic analysis of onsite solar-and-wind-derived renewable energy systems sufficient to offset 2% of predicted energy demand (MN Statute §16B.32, Subd 1a). This legislation requires the installation of such systems unless explicit reasons are provided that rule out installation.

Required Performance Criteria

Guidelines apply to all projects designated New Buildings and are recommended for Major Renovations.

A. Provide 2% of energy needs with onsite solar or wind renewable sources:
   Eligible wind and solar renewable sources may include:
   1. Photovoltaic solar panels which convert sunlight directly into electricity.
   2. Wind turbines that capture wind to turn rotors, which turns a generator and creates electricity.
   3. Transpired solar collectors that use sunlight to preheat air for heating purposes.
   4. Solar thermal systems that use the sun to heat water for heating or domestic hot water uses.

   Analyze at least two scenarios that include the environmental and economic impacts of supplying 2% of the building's anticipated total energy use with onsite renewable generation systems. This is coordinated with Minnesota Statute §16B.326, which states:

   > "a new building must consider meeting at least 2% of the energy needs of the building from renewable sources located on the building site. For purposes of this subdivision, 'renewable sources' are limited to wind and the sun. The Predesign must include an explicit cost and price analysis of complying with the 2% requirement compared with the present and future costs of energy supplied by a public utility from a location away from the building site and the present and future costs of controlling carbon emissions. If the analysis concludes that the building should not meet at least 2% of its energy needs from renewable sources located on the building site, the analysis must provide explicit reasons why not."[1]

   Evaluation of the feasibility of the 2% systems for projects shall be done using the B3 Levelized Cost of Energy (LCOE) Calculator to determine if the levelized cost of wind or solar is less than the combined price of grid energy and carbon. The tool includes several generic values for costs at the predesign phase to streamline evaluation which are refined at later phases. Installation of a system meeting 2% of the anticipated energy need of the project is required if the evaluation determines that the levelized cost of energy from a proposed system is less than the combined price of grid energy and carbon.
B. Design project to be solar-ready to facilitate future solar design retrofits or expansion of installed systems.
   Solar-ready considerations include planning for the location of solar systems in building orientation and massing, structure to support solar systems, electrical or plumbing chases, dedicated mechanical space, and planning for maintenance access to allow straightforward installation and operation.

[1] Minnesota Statute §16B.32, Subd. 1a. www.revisor.mn.gov/statutes/?id=16B.32

Recommended Performance Criteria

C. Provide 10% of energy needs with renewable and cleaner distributed generation systems.
Consider the inclusion of all renewable and cleaner distributed generation approaches to meet 10% or more of the buildings energy needs. This goal may be achieved through the construction budget by paying for the design and installation of a renewable or cleaner distributed generation system or through the operating budget through a contract to purchase renewable or cleaner distributed generation.

D. Provide 100% or more of energy needs with renewable and cleaner distributed generation systems.
Consider the inclusion of all renewable and cleaner distributed generation approaches to meet 100% or more of the buildings energy needs. This goal may be achieved through the construction budget by paying for the design and installation of a renewable or cleaner distributed generation system or through the operating budget through a contract to purchase renewable or cleaner distributed generation.

Meeting the Guidelines

Implementation in the Design Process:

Identify the potential investment value of onsite generation to offset 2% of predicted energy use during Predesign and site selection. Evaluate and adjust building geometry and orientation for solar-based energy solutions, and investigate the viability and potential of other onsite renewable and distributed energy options. Also evaluate the proximity to nearby renewable distributed energy generation sources and the transmission potential to the site and/or the investment potential for the project.

Two options must be investigated using the LCOE calculator to achieve compliance with E.2 Renewable Energy: a solar photovoltaic (PV) option, and either a solar hot water or small wind option. Transpired solar thermal collectors may be evaluated as an second option but are not supported by the LCOE calculator. If the design team wishes to pursue this option the B3 Guidelines Team may be consulted to assist in calculating levelized cost. Each of these three technologies has its own tab in the LCOE tool. Note that ground source (geothermal) heat pumps, air source heat pumps, and passive solar energy may be desirable for the project, but do not qualify to meet the requirements of E.2.

During the Predesign phase the LCOE calculator requires a small number of inputs to perform the levelized cost of energy calculation. These inputs typically include the required yearly energy production (>/= 2% of predicted total building energy use as determined by the SB 2030 Energy Standard Tool (E.1.c)) and the yearly average fuel/electricity costs at the site (including any demand charges, delivery charges, surcharges, and fees). All other necessary inputs are generally either provided as defaults or assumptions built into the calculation cells. Input cells with default values should not be adjusted unless there is reason to adjust them. Calculation cells are locked so users cannot adjust them.

During the Design phase, locate renewable and distributed energy installation areas on plans, elevations and sections as appropriate. Investigate spatial and loading impact on site, architectural, mechanical and electrical systems and develop preliminary performance specifications for the selected technology(s). The Design and Final Design versions of the LCOE calculator require more detailed information than the predesign version, and should correspond to contractor refined performance characteristics, energy production, and cost. Outputs of the refined assumptions are uploaded in the B3 Guidelines Tracking Tool at the Design phase and updated with final estimates for Final Design phase. Identification of which system was installed will be verified at project Closeout.

Related Legislation:

There may be implications resulting from Minnesota Statute §16B.323, which states in part that the project may, “after the completion of a cost-benefit analysis, may include installation of “Made in Minnesota” solar energy systems of 40

kilowatts capacity on, adjacent, or in proximity to the state-funded building." Additionally "The capacity of a solar system must be less than 40 kilowatts to the extent necessary to match the electrical load of the building or to the extent necessary to keep the costs for the installation below the five percent maximum…" Note that this limits the cost of "Made in Minnesota" solar that can be installed on site to no more than 5 percent of the appropriation.

Minnesota Statute §16B.326 states that "when practicable, geothermal and solar thermal heating and cooling systems must be considered when designing, planning, or letting bids for necessary replacement or initial installation of cooling or heating systems in new or existing buildings that are constructed or maintained with state funds. The Predesign review must include a written plan for compliance with this section from a project proposer. For the purposes of this section, "solar thermal" means a flat plate or evacuated tube with a fixed orientation that collects the sun's radiant energy and transfers it to a storage medium for distribution as energy for heating and cooling."

This section does not provide a comprehensive list of potentially relevant legislation or the full text of those statues cited. Please reference the Revisor of Statues of the State of Minnesota for full legislation text.

Submittal Requirements

Predesign:

- E.2A: Predesign plan for projects using state predesign process, Predesign LCOE calculator documenting two systems evaluated (including at least one PV) for meeting 2% of annual energy demand.

Design:

- E.2A: Design LCOE calculator documenting two systems evaluated for meeting 2% of annual energy demand including contractor estimates of performance, energy production and cost.
- E.2B: Verification of solar-ready design features included in project.
- E.2C: Detail and verification of system meeting 10% of annual energy need.
- E.2D: Detail and verification of system meeting 100% of annual energy need.

Final Design:

- E.2A: Updated LCOE calculator documenting two systems evaluated for meeting 2% of annual energy demand, including updated contractor estimates of performance, energy production and cost, and selection of which system planned for installation.
- E.2B: Verification of solar-ready design features included in project.
- E.2C: Detail and verification of system meeting 10% of annual energy need.
- E.2D: Detail and verification of system meeting 100% of annual energy need.

Closeout:

- E.2A: Updated LCOE calculator documenting two systems evaluated for meeting 2% of annual energy demand, including updated contractor estimates of performance, energy production and cost, and selection of which system installed.
- E.2B: Verification of installed solar-ready design features included in project.
- E.2C: Detail and verification of system installed meeting 10% of annual energy need.
- E.2D: Detail and verification of system installed meeting 100% of annual energy need.

Additional Resources

Minnesota renewable legislation: MN Statute §16B.32, Subd 1a: www.revisor.mn.gov/statutes/?id=16B.32

Minnesota Legislation: Solar Energy in State Buildings: §16B.323 Solar Energy In State Buildings: www.revisor.mn.gov/statutes/?id=16B.323

Minnesota Legislation: Geothermal Energy in State Buildings: §16B.326 Heating And Cooling Systems; State-Funded Buildings: www.revisor.mn.gov/statutes/?id=16B.326

The Database of State Incentives for Renewable Energy (DSIRE):. http://www.dsireusa.org/

RETScreen software: www.retscreen.net

The Minnesota Department of Commerce guidance documents and model solar-ready specifications: http://mn.gov/commerce-stat/pdfs/solar-ready-building.pdf

Guideline E.3: Efficient Equipment and Appliances

Intent

To reduce energy use associated with plug loads and process loads in buildings. These strategies may also contribute to meeting the SB 2030 Energy Standard if using a performance approach (documenting design energy use with a simulation).

Required Performance Criteria

A. Select new equipment and appliances that meet Energy Star criteria.

Meeting the Guidelines

Implementation in the Design Process:

Budget for energy efficient (Energy Star) equipment and appliances in early planning phases.

During construction documents, provide drawings, cut sheets, and specifications highlighting compliance of equipment and appliances with Energy Star requirements. Document efficiency ratings of motors and drives, water service equipment, and other electrical load components. During construction administration, review shop drawings to assure compliance with energy efficient equipment specifications.

Submittal Requirements

Final Design:

- E.3A: Verification of specification of Energy Star appliances for available appliance types.

Closeout:

- E.3A: Verification of selection of Energy Star appliances for available appliance types.

Additional Resources

DOE ENERGY STAR Program: www.energystar.gov

Guideline E.4: Atmospheric Protection

Intent

To encourage the investigation and evaluation of refrigerants to reduce environmental impacts harmful to the atmosphere. Energy conservation should be achieved with the lowest reasonable environmental impacts.

Recommended Performance Criteria

Guidelines apply to all projects designated New Buildings and are recommended for Major Renovations.

There are no required levels for atmospheric pollution from refrigerants at this time except for CFC reduction, which is required in the MN State Building Code. Meet the following criteria refrigerants:

A. Achieve an Atmospheric Lifetime (AtL) < 33. Atmospheric Lifetime is a measure of the average persistence of the refrigerant if released. A longer lifetime has worse environmental effects.
B. Achieve an Ozone Depletion Potential (ODP) < 0.034. Ozone Depletion Potential is a normalized indicator based on the ability of a refrigerant to destroy atmospheric ozone, where CFC-11 = 1.00. A higher ODP has worse environmental effects.
C. Achieve a Global Warming Potential (GWP) < 3500. Global Warming Potential is an indicator of the potency of the refrigerant to warm the planet by action as a greenhouse gas. A higher GWP has worse environmental effects.
D. Design, maintain, and operate the mechanical equipment to reduce refrigerant leakage over the life of the building.

Meeting the Guidelines

Refrigerant Climate Data[2]

Refrigerant	Atmospheric Lifetime in Years	Ozone Depletion Potential	Global Warming Potential
HFC-152a	1.4	0	120
HCFC-123	1.4	0.012	120
HCFC-21	2	0.01	210
HFC-32	5	0	550
HCFC-124	6.1	0.026	620
HFC-245fa	7.2	0	950
HFC-134a	13.8	0	1300
HCFC-22	11.9	0.034	1700
HFC-125	29	0	3400
HFC-227ea	33	0	3500

CFCs generally have high Ozone Depletion Potential and Global Warming Potential with long Atmospheric Lifetimes. CFCs are therefore not allowed by these guidelines and prohibited by MN state law. Halons have a higher Ozone Depletion Potential though a lower Global Warming Potential but a much longer Atmospheric Lifetime. Halons should be avoided if possible. HCFCs such as R-123, which other guides put in the same class as Halons, can have an Ozone

[2] James M. Calm, "Refrigerant Data Summary," *Engineered Systems Magazine* November 2001.

Depletion Potential, a Global Warming Potential and an Atmospheric Lifetime two orders of magnitude less than CFCs and Halons. HFCs offer near zero Ozone Depletion Potential, but some have high Global Warming Potential. For example, R-134 has an Ozone Depletion Potential of 0.0 but a Global Warming Potential and an Atmospheric Lifetime approximately ten times greater than R-123, an HCFC alternative. Substituting an HFC, which tends to be less energy efficient than an HCFC, may result in the use of more energy, resulting in a further increase in global warming.

Implementation in the Design Process:

In Predesign and early design determine onsite fire suppression requirements. Plan and organize building to minimize the need for the use of Halon fire suppression systems

Using the tables above and other information as may be available at the time of design, identify candidate refrigerants that have a low Global Warming Potential, short Atmospheric Lifetime, and a low Ozone Depletion Potential.

Use one of the weighted evaluation metrics provided to evaluate the refrigerants, and prioritize the list in the order given. Evaluate the economic and community impacts of the prioritized list and adjust priorities pursuant to the analysis.

In construction documents based on this analysis, develop specifications based on adjusted priorities. Verify shop drawings to assure compliance.

Submittal Requirements

Final Design:

- E.4A: Verification of atmospheric lifetime limits met for refrigerants.
- E.4B: Verification of ozone depletion limits met for refrigerants.
- E.4C: Verification of global warming potential limits met for refrigerants.
- E.4D: Verification of design intended to reduce refrigerant leakage.

Closeout:

- E.4A: Verification of atmospheric lifetime limits met for refrigerants.
- E.4B: Verification of ozone depletion limits met for refrigerants.
- E.4C: Verification of global warming potential limits met for refrigerants.
- E.4D: Verification of design intended to reduce refrigerant leakage.

Additional Resources

EPA Significant New Alternatives Policy, Reducing Hydrofluorocarbon Use and Emissions in the Federal Sector: https://www.epa.gov/snap/reducing-hydrofluorocarbon-hfc-use-and-emissions-federal-sector

Indoor Environmental Quality Guidelines

Intent

The goal of the guidelines in this section is to provide exemplary indoor air quality and other interior environmental conditions to promote occupant health, wellbeing, and productivity. Here, health is more than the absence of disease, and wellbeing includes provision of physical comfort and psychological satisfaction with the physical work environment.

The provision of indoor environmental quality at levels that support productive human habitation both complements and supports the environmental and economic goals for sustainable building. Appropriate indoor environmental qualities of air, temperature, sound, light, and visible and physical space, and occupants' ability to personally control these are the building's contributions to the biological bases of occupant comfort, health, and wellbeing. Harmful effects on occupants of poor indoor environmental quality are well documented in laboratory and field studies. Similarly, enhanced indoor environmental quality helps occupants feel and perform at their best, with subsequent health, wellbeing, and productivity benefits for themselves and their work organizations. These indoor environmental quality guidelines are constructed to first and foremost help prevent harm coming to occupants, then to optimize environmental quality conditions to correspond with human physiological processes, and finally to fine tune environmental conditions to work activities in a way that further enhances personal and organizational productivity.

Objectives:

- Provide a clean building that will minimize pollutant sources in the structure and its occupants.
- Provide a dry building to minimize structural and health problems associated with water intrusion and accumulation.
- Provide a well-ventilated building to dilute pollutants and bioeffluents emitted by the building materials, the occupants and their activities.
- Provide for occupant thermal comfort.
- Provide daylight for general ambient illumination.
- Provide interior view space or views to the exterior.
- Provide lighting solutions of high quality for visual tasks and preferred interior rendering.
- Provide interior conditions that avoid harmful vibration and noise effects and produce a positive acoustic environment acceptable to occupants and appropriate to their tasks.
- Provide for local occupant control of localized indoor environmental conditions in order to quickly correct harmful conditions and to better support work performance.
- Provide an interior spatial arrangement that encourages healthy human interaction and movement

General Indoor Environmental Quality information:

The following information is collected in the Indoor Environmental Quality section of the B3 Guidelines Tracking Tool, under section P.0:

Final Design:

- Indoor environmental quality strategies used, including narrative

Closeout:

- Updated Indoor environmental quality strategies used, including narrative

Guideline I.1 Low Emitting Materials

Intent

To minimize occupant exposure to volatile organic compounds.

Required Performance Criteria

A. All newly installed interior materials must comply with California Department of Public Health (CDPH) Standard Method v1.1–2010. Interior materials are defined as all materials and finishes interior to the enclosure's least vapor-permeable and continually air-sealed barrier system. This includes but is not limited to flooring adhesives, sealants, carpets, resilient flooring, paints, acoustical insulation products, gypsum board, acoustical ceilings, acoustic wall panels, casework, composite wood subflooring, and furnishings. [3]

1. Exceptions:
    i. Inherently non-emitting sources: Products that are inherently non-emitting sources of volatile organic compounds (VOCs) (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, clay brick, and unfinished or untreated solid wood flooring) are considered fully compliant without any VOC emissions testing if they do not include integral organic-based surface coatings, binders, or sealants.
    ii. Salvaged and reused architectural millwork more than one year old at the time of occupancy is considered compliant, provided it meets the requirements for any site-applied paints, coatings, adhesives, and sealants. Newly installed finishes and components are not exempt from I.2A or I.2B.
    iii. Product types with two or fewer compliant manufacturers available from the combination of all databases listed below at the point of product selection are exempt from this requirement.[4]
    iv. Structural building products as excluded from CDPH Standard Method v1.1 under part 1.1.4.
    v. Composite wood products covered under Guideline I.2C.
    vi. Furnishings covered under Guideline I.2D. Onsite applied furniture coatings are not exempt from the requirements of I.2A.
2. Approved databases of materials recognized as compliant with the most current CDHP standard:
    i. Collaborative for High Performance Schools (CHPS) Low Emitting Materials (which includes several of the other third-party certifications below).
    ii. Carpet and Rug Institute (CRI) Green Label Plus™ Certification (for carpet, cushion, and adhesive products).
    iii. Scientific Certification Systems (SCS) Indoor Advantage Gold™ Certification.
    iv. Resilient Flooring Institute (RFI) FloorScore™ Certification.
    v. Underwriters Laboratory (UL) GREENGUARD Gold™.
    vi. Intertek ETL Environmental™ VOC+.
    vii. Materials Analytical Services, LLC (MAS) Certified Green™ (for Building Materials).
    viii. NSF/ANSI 332 (for Resilient Floor Coverings).
    ix. Berkeley Analytical Associates ClearChem (for Interior Building Products).
    x. Coatings Research Group, Incorporated (CRGI) Green Wise Gold (for Paints).

[3] This guideline is aligned with the USGBC, "Indoor Environmental Quality Credit: Low-Emitting Materials," *LEED Building Design and Construction v.4*, though with a different definition of interior materials and a different threshold for compliance.
[4] Allowable exclusions differs from LEED v.4.

B. Wet-applied materials: All onsite wet-applied materials must meet the applicable requirements below. Interior onsite wet-applied materials also must meet the general requirements for VOC emissions under I2A.
   1. All paints and coatings wet-applied onsite must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.
   2. All adhesives and sealants wet-applied onsite must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168.
   3. Paints, coatings, adhesives and sealants wet-applied onsite may not include any intentionally added methylene chloride or perchloroethylene.

C. Composite Wood Products: Newly installed composite wood must meet the California Air Resources Board ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.

D. New furniture and furnishing items not tested under I.2A must be tested in accordance with ANSI/BIFMA Standard Method M7.1–2014. Comply with ANSI/BIFMA e3-2014 Furniture Sustainability Standard, Section 7.6.1 or 7.6.2.
   1. Furniture listed in the following databases or providing the following certifications are considered compliant with this guideline:[5]
      i. Scientific Certification Systems (SCS) Indoor Advantage (furniture)
      ii. Scientific Certification Systems (SCS) Indoor Advantage Gold (furniture)
      iii. Underwriter Laboratories (UL) Greenguard Certified
      iv. Underwriter Laboratories (UL) Greenguard Gold Certified
      v. Intertek ETL Environmental VOC (furniture)
      vi. Intertek ETL Environmental VOC+ (furniture)
      vii. Materials Analytical Services, LLC (MAS) Certified Green

Recommended Performance Criteria

E. After construction and before occupancy, conduct air-testing to ensure that the contaminant levels listed in the USGBC document “Maximum Concentration Levels, by Contaminant and Testing Method” are not exceeded using the test methods listed in that document. If excessive levels of contaminants are found in the building, develop a mitigation plan to reduce these and retest until acceptable thresholds are reached. Conduct testing in spaces representing typical airflow conditions and interior finishes.

Meeting the Guidelines

During Predesign and early design, identify all applicable product types to be used in the project. All interior materials on interior assemblies must be included (though some materials in these may be subject to the listed exclusions). For exterior assemblies this is done by determining which continuously sealed material or set of materials is least vapor-permeable and including all materials interior of that boundary. Note that there may be materials (such as metal cladding) that are the least vapor-permeable layer but which are not continually sealed, and should not be considered as the boundary of interior materials.

The recommended method for tracking this guideline is for an assigned team member or members to keep a running list of products and their VOC content compliance information, complete with manufacturer's documentation. If a product category has been identified but a complaint product has not yet been selected, products may be found in the list of

[5] Allowed furnishings differ from LEED v.4.

approved databases in the guideline requirements. Communication with manufacturers and product representatives may aid in the discovery of compliant products.

Through the design process, compile required documentation and maintain and update the list of materials. Review project documents to identify all applicable products and specify them as low- or non-emitting. Track and report all interior materials in the B3 Guidelines Tracking Tool, even those that are excluded from VOC content requirements.

For bid and construction documents preparation, verify continued selection of compliant interior materials and products to reflect guideline requirements. Provide contractor with detailed specifications to ensure that the team has the information needed to meet the B3 Guideline requirements. The design team should specifically call out compliant products and only specify allowable substitutions that also meet the guideline requirements.

Input compliant products into the B3 Tracking Tool by uploading a list of all interior materials used in the product and their method of achieving compliance or qualifying for an exemption. Note that compliance with I.2B may be documented through a Certificate of CARB Compliance from the Hardwood Plywood and Veneer Association or the Composite Panel Association. The absence of added methylene chloride and perchloroethylene may be determined from the MSDS for a material.

Coordinate reviews of the construction submittals to ensure that selected products meet the guideline requirements and do not exceed the allocated VOC emissions limits. All review submittals, substitution requests and changes to the construction contract should be carefully reviewed by the design team and contractor for compliance with guideline requirements.

Because meeting these guideline requirements is not typical for all construction teams and suppliers, conducting a B3 Guideline-specific preconstruction meeting to review the requirements in detail and stress their importance will aid in successful product procurement.

A Note for Suppliers, Contractors, and Subcontractors:

During construction, interior paints and coatings applied onsite represent the largest source of VOC emissions. Awareness of VOC levels in paints and coatings is a key step in ensuring the building project is sustainable, and selecting an approved paint, primer or stain is as easy as finding a compliant certification mark as listed in the guideline text. Similarly, awareness of interior adhesives and sealants applied onsite (including flooring adhesives) is also a key factor in compliance.

Carpet installation requires that the carpet, carpet cushion, and carpet adhesive all be compliant with this guideline. Installation of other floorings such as tile, masonry, cut stone, concrete, and wood require that any the flooring product and any finishes or sealers meet the same requirements as paints.

During closeout, monitor submittals and construction site to ensure that materials, products, and systems are being correctly installed to preserve project goals and objectives. Review substitutions based on performance criteria to ensure consistency and compliance with goals as represented in the drawings and specifications.

Document changes to requirements for construction that occur that may impact the provision or installation of materials, products, or components that were intended to ensure indoor air quality standards are achieved.

It is also recommended to use low- or noVOC emitting materials for products including cleaning supplies, pest management applications, minor remodeling, and maintenance associated with “churn” or standard product replacement of furnishings and finishes and to see the full benefit of lowered VOC emissions.

Retain final product compliance documentation as part of the B3 records.

Submittal Requirements

Design:

- I.1A: List the material categories needed to meet the guideline.

Final Design:

- I.1A: List all interior materials specified to meet the guideline in the required material categories, including method of compliance, compliant specifications.
- I.1B: List all wet-applied products specified in the project including method of compliance and relevant specifications.
- I.1C: List all composite wood products specified including method of compliance, compliant specifications, and product documentation.
- I.1D: List all furniture specified including method of compliance, compliant specifications, and product documentation.

Closeout:

- I.1A: List all interior materials installed in the required material categories, including method of compliance.
- I.1B: List all wet-applied products installed in the project including method of compliance.
- I.1C: List all composite wood products installed in the project including method of compliance.
- I.1D: List all furniture installed including method of compliance.
- I.1E: List testing protocols used in the project and results of testing, including levels of listed contaminants and locations tested.

Occupancy – Submitted annually for ten years:

- I.1E: Submit any testing results, whether remediation was necessary and performed remediation methods (if any).

Additional Resources

California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," Version 1.1, February 2010: http://www.cdph.ca.gov/programs/IAQ/Documents/cdph-iaq_standardmethod_v1_1_2010%20new1110.pdf updated method available here: https://www.cdph.ca.gov/programs/IAQ/Pages/VolatileOrganicCompounds.aspx

AQMD Rule 1113: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/r1113.pdf?sfvrsn=17

OEHHA Acute, 8-hour and Chronic Reference Exposure Level (REL) Summary: https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary and chRELs as of June 2016: http://oehha.ca.gov/air/allrels.html

Collaborative for High Performance Schools (CHPS) High Performance Products Database: http://www.chps.net/dev/Drupal/node/445

Carpet and Rug Institute (CRI) Green Label Plus Certification for carpet, cushion, and adhesive products: http://www.carpet-rug.org/CRI-Testing-Programs/Green-Label-Plus.aspx

EPA Indoor air PLUS: https://www.epa.gov/indoorairplus

UL SPOT: https://spot.ulprospector.com/en/na/BuiltEnvironment

LEED v.4 EQ Credit Low-Emitting Materials Third Party Certification and Labels: http://www.usgbc.org/resources/low-emitting-materials-third-party-certification-table

Low-Emitting Materials Calculator LEED v.4: http://www.usgbc.org/resources/low-emitting-materials-calculator

South Coast Air Quality Management District Rule 1168 - Adhesive and Sealant Applications: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1168.pdf

Glossary

Interior Materials

Interior materials and finishes are defined as all materials interior to the enclosure's least vapor-permeable and continually air-sealed barrier system. For most enclosure systems this definition will encompass all materials interior and exclusive of the vapor barrier/retarder, though for some assemblies with several systems providing vapor impermeability a further determination will need to be made.

Continually Air-Sealed Barrier System

A continually air-sealed barrier system refers to the set of air-sealed building materials that is intended to prevent air-flow through a wall assembly. This may consist of a continually sealed vapor barrier or a set of materials that when combined provide the least vapor-permeable system. Note that some materials have low vapor permeability but may not be part of a continually sealed system and should not be considered as the boundary of the building's interior.

Volatile Organic Compounds (VOCs)

Volatile organic compounds (VOC) refers to any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, that participates in atmospheric photochemical reactions, except those designated by EPA as having negligible photochemical reactivity. VOCs are organic chemical compounds the composition of which makes it possible for them to evaporate under normal indoor atmospheric conditions of temperature and pressure.[6]

Sealants

A sealant has adhesive properties and is formulated primarily to fill, seal, or waterproof gaps or joints between two surfaces. Sealants include sealant primers and caulks.[7] Sealants are used on wood, fabric paper, corrugated paperboard, plastic foam, and other materials with tiny openings, often microscopic, that may absorb or discharge gas or fluid.

Composite Wood Products:

Composite wood products includes hardwood plywood, particleboard, and medium density fiberboard. Composite wood excludes hardboard, structural plywood, structural composite, oriented strand board, glued laminated timber, prefabricated wood I-joists, and finger-jointed lumber.[8]

[6] United States Environmental Protection Agency, "Technical Overview of Volatile Organic Compounds," March 17, 2016.
[7] South Coast Air Quality Management District Rule 1168.
[8] Definition based on California Air Resource Board rules, www.arb.ca.gov.

Guideline I.2: Moisture Control

Intent

To ensure the prevention of exterior water intrusion, leakage from interior water sources, or other uncontrolled accumulation of water.

Required Performance Criteria

Guidelines apply to all projects designated New Buildings and for Major Renovations with exterior envelope included in project scope.

A. Design the building envelope to resist moisture penetration. Since all buildings have potential for moisture penetration, and since Minnesota is a heating dominated climate, provide drainage planes to the exterior.
B. During the coldest portion (99.5% cold temperature design value) of the heating season, keep the indoor dew point below 35°F (2°C).
C. Specify maximum moisture content of materials used in construction to assure that subsurface layers are dry enough to prevent moisture trapping by surface finish materials.

Meeting the Guidelines

Implementation in the Design Process:

In the program document, note any unusual water uses in the building for this occupancy class. As the site is selected, note any potential water intrusion potential associated with the site(s).

As the project proceeds through design, incorporate building envelope and mechanical systems to meet the performance criteria for I.2. Calculate dew points for interior surfaces of all exterior wall elements according to winter-day design conditions.

In bid documents, describe how materials at construction site are to be stored for protection against moisture damage during construction. Describe procedures to be followed to remove moisture-damaged materials from the construction site.

During construction, store materials appropriately to prevent water damage. Do not accept moisture sensitive materials with evidence of moisture damage, including stains. Remove them from the site and dispose of properly. Replace any moldy materials with new, undamaged materials. Sequence drying of construction materials appropriately during the construction process to prevent future problems.

During occupancy regular inspections should be conducted to ensure there are no visible signs of moisture intrusion or accumulation and to conduct regular testing of exterior wall construction to detect moisture in the exterior wall system. Remediation of identified exterior water intrusion should be corrected as soon as it is identified to lower the likelihood of mold growth.

Submittal Requirements

Final Design:

- I.2A: Verification of design of building envelope to resist moisture penetration.
- I.2B: Verification of indoor dew point within guideline limits.
- I.2C: Verification of specifications requiring maximum moisture content of materials within guideline limits.

Additional Resources

Lstiburek, J, and J Carmody (1993) Moisture Control Handbook, New York, Van Nostrand.

Lstiburek, J. (2002) “Moisture Control for Buildings.” ASHRAE Journal 44(2): 36–41.

Lstiburek, J. (2006) ”Understanding Drainage Planes.” ASHRAE Journal 48(2): 30–35.

Harriman, L. I., G. Brundrett, et al. (2001.) Humidity Control Design Guide for Commercial & Institutional Buildings. Atlanta

ASHRAE Standards 62.1 and 62.2: https://www.ashrae.org/resources--publications/bookstore/standards-62-1--62-2

Minnesota Department of Commerce Guide for Managing Indoor Air Quality: https://mn.gov/admin/assets/Minnesota_Guide_for_Managing_Indoor_Air_Quality_tcm36-207630.pdf

Guideline I.3: Ventilation Design

Intent

To promote good indoor air quality by requiring a ventilation baseline based on the general procedures and information contained in the latest approved version of ASHRAE Standard 62.1. To encourage better indoor air quality by recommending that ventilation design intent be demonstrated on a regular basis to building owners and operators. To encourage best indoor air quality by further recommending adjusting ventilation requirements upward from the baseline based on setting target CO2 concentration maxima.

Required Performance Criteria

A. Radon is best controlled using source prevention techniques rather than ventilation. For New Buildings, if construction is to occur in one of the 68 Minnesota counties considered Zone 1 by the US EPA, guidance contained in the EPA document, "Radon Prevention in the Design and Construction of Schools and Other Large Buildings," must be followed. Major Renovations must test for the presence of radon and execute mitigation if radon concentrations are found to be at or above 4pCi/L under typical conditions.
B. Ventilation Baseline: Meet current ASHRAE Ventilation Standard 62 for commercial and institutional buildings.

Recommended Performance Criteria

C. Ventilation Performance Validation: In addition to required ventilation baseline criteria above, design the ventilation system so that CO2 concentrations can be monitored continuously in all continuously occupied spaces. Continuously occupied spaces are those intended for human occupancy, excluding spaces intended for other purposes such as storage rooms or equipment rooms. Compare the expected values of CO2 concentrations found in high-occupancy spaces* in the building with those expected from the building design using ASHRAE 62.1. This should be done at 3-month intervals during the initial year of occupancy and annually thereafter.
D. Carbon Dioxide Limits on Ventilation: In addition to the required and recommended criteria described above, design the ventilation system so that the CO2 concentration in continuously occupied breathing zones (defined as the volume between 3 and 72 inches above the floor and 2 feet or greater distance from walls) cannot exceed 450 parts per million (ppm) above outdoor concentrations. Compare the expected values of CO2 concentrations found in high-occupancy spaces* in the building with those expected from the building design using ASHRAE 62.1 supplemented by the more rigorous CO2 concentration limit of this guideline (I.4D). Do this at 3-month intervals during the initial year of occupancy and annually thereafter.
   *Note: For this guideline, "high-occupancy spaces" are defined as spaces in the building with normal occupancy densities higher than the average density for the entire building.

Meeting the Guidelines

Select which guideline is relevant for the project. ASHRAE 62.2 should be used for low-rise residential buildings, ASHRAE 62.1 should be used for all others. The relevant most recent version is referred to as ASHRAE 62 below.

Implementation in the Design Process:

In Predesign and early design, determine the ASHRAE 62 requirements pertinent to the design, including applicable addenda. Work with the owner to identify high occupancy areas in the building. Determine design occupancy levels to

calculate design CO2 emissions in occupied zones. Use estimated design occupancy levels or ASHRAE design occupancy levels by space type.

During Design, incorporate the requirements of ASHRAE 62 into the design process as appropriate for the phase. When the initial ventilation design is completed using ASHRAE 62, compute the expected steady-state CO2 concentrations in high occupancy areas of the building.

Determine the ventilation rate per person needed to limit CO2 concentrations to 450 parts per million (ppm) above the outdoor concentrations in all occupied zones. Use CO2 generation rates based on the activity level of occupants. See Appendix A of the ASHRAE 62 User's Manual or other source of metabolic rates of building occupants.

Compare these ventilation rates with those calculated in ASHRAE Standard 62.1. The B3 Guideline design ventilation rate for each space is the larger of the value required from the ASHRAE Standard 62.1 or the CO2 concentration requirement above.

Coordinate with the energy analysis process, so that actual design ventilation rates are the same in both ventilation and energy design processes. The design team should consider using strategies that provide the opportunity to reduce energy use associated with ventilation. The list of recommendations includes but is not limited to:

- CO2 or other occupancy control to reduce ventilation in the building when it is unoccupied.
- Use of ventilation strategies that increase ventilation efficiency such as displacement ventilation.
- Use of economizer cycles where possible.
- Use of heat recovery strategies in the ventilation design chosen.

Through the design process ensure that the requirements of ASHRAE 62 are incorporated into the design process as appropriate for this phase. Specify appropriate instrumentation to monitor CO2 continuously in high occupancy areas of the building.

Update the design ventilation rate as any changes are made to the design occupancy levels planned for the building. Communicate these changes to the parties evaluating energy performance, so that significant changes in ventilation rate can be taken into account in energy calculations and strategies that address minimizing energy use in the building.

In the construction documents and construction administration and buyout of the project, follow a Construction IAQ Management Plan to prevent problems that will adversely affect IAQ when the building is occupied. At a minimum, utilize the requirements found in Section 7 of ASHRAE Standard 62.1 for construction and startup phases of the building. Compare the expected values of CO2 concentrations found in high-occupancy spaces in the building with those expected from the building design using ASHRAE 62. Comparisons should be conducted at 3-month intervals during the initial year of occupancy and annually thereafter.

Submittal Requirements

Design:

- I.3A: Verification that radon control prevention techniques were incorporated into early design of project.

Final Design:

- I.3A: Verification that radon control prevention techniques were incorporated into final design of project.
- I.3B: Verification of compliance with ASHRAE Standard 62 designed airflow rates.
- I.3C and I.3D: List CO2 designed limits by space.

Closeout:

- I.3A: Verification that radon control prevention techniques were incorporated into project.
- I.3B: Verification of compliance with ASHRAE Standard 62 designed airflow rates.
- I.3C and I.3D: List maximum CO2 commissioned limits by space.

Occupancy – Submitted annually for ten years:

- I.3C: List maximum monitored CO2 levels by space.

Additional Resources

EPA Radon: https://www.epa.gov/radon

EPA Radon Resistant Construction: https://www.epa.gov/radon/radon-resistant-construction-basics-and-techniques#rrct

EPA Indoor Air Quality: https://www.epa.gov/indoor-air-quality-iaq

For I4A: US EPA, Radon Zone Map: https://www.epa.gov/radon/epa-map-radon-zones

ASHRAE Standards 62.1 and 62.2: https://www.ashrae.org/resources--publications/bookstore/standards-62-1--62-2

US EPA, “Radon Prevention in the Design and Construction of Schools and Other Large Buildings,” EPA document 625-R-92-016, June 1994. http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=30004KZ6.txt

Guideline I.4: Thermal Comfort

Intent

To promote occupant thermal comfort through ambient temperature and operative temperature control, which includes wet bulb, dry bulb, and globe temperatures, relative humidity (RH), mean radiant temperature (MRT), and air velocity.

Required Performance Criteria

A. Maintain continuous indoor exposure to ambient temperature in continuously occupied spaces less than 80°F and greater than 64°F. For transition spaces (entries, hallways, exterior walls) temperatures may fall outside the limits for continuously occupied spaces to save energy.
B. In continuously occupied spaces where MRT asymmetry could be a problem (e.g., spaces such as glass atria, rooms adjacent to boiler rooms, and areas under an exposed roof structure), maintain the wall, floor, and ceiling surface temperatures within 20°F when taken from all continuously occupied positions, OR maintain no continuous indoor exposure to greater than 0.30 asymmetry in MRT across three body plane hemispheres (front-back, side-side, top-bottom).
C. Design air velocity greater than or equal to 10 feet per minute (fpm) for continuously occupied spaces. Exception: Spaces with natural ventilation or mixed-mode ventilation are exempt from I.5C during the times that they are operating in a natural or mixed-mode ventilation mode.
D. Design interior relative humidity (RH) within most recent version of ASHRAE Standard 55 for continuously occupied spaces. Exception: Spaces with natural ventilation or mixed-mode ventilation are exempt from I.5D during the times they are operating in a natural or mixed-mode ventilation mode.

Recommended Performance Criteria

E. Vary Dry Bulb Temperature (DBT) via building control system to avoid thermal boredom. Produce ramped drifts of up to + 2.0°F/hour in peak-to-peak variation around neutral temperature. Note: Operative Temperature (OT) is also known as Wet Bulb Globe Temperature, (OT or WBGT = 0.7 Natural Wet Bulb Temperature + 0.3 Globe Temperature).

Meeting the Guidelines

Calculate or simulate thermal comfort using guideline performance criteria and other appropriate thermal comfort indices. Operative Temperature is determined by DBT, relative humidity, and mean radiant temperature (DBT, RH, MRT), and air velocity. Calculation can also include the effects of Clo value (the insulation value of clothing), physical activity, and time. See especially the most recent version of ASHRAE Standard 55 and the Human Factors and Ergonomics Design Handbook for explanation of conditions and measures to provide for thermal comfort. See other references, particularly Engineering Data Compendium and NASA MSIS for handling special condition problems. See Handbook of Environmental Psychology for discussion of thermal issues for particular settings (e.g., offices, industrial environments) and for perceived control of thermal variables.

Implementation in the Design Process:

During Predesign, determine special thermal comfort requirements or problems that may be encountered in the building due to work activities or siting or design considerations.

Review conditions that affect thermal comfort using the most recent version of ASHRAE Standard 55 or Human Factors and Ergonomics Design Handbook. Perform any baseline studies on thermal problems or issues that may exist in current facilities if the project involves a move or remodel.

During Design, estimate thermal comfort performance measures using ASHRAE Standard 62 occupancy limits for spaces and comfort zone and other thermal conditions in ASHRAE Standard 55. Ensure that no major design characteristic of the building required by these guidelines will push these variables outside general comfort ranges as defined by the guidelines.

As the Design phase progresses, consider additional calculations of thermal comfort indices as appropriate to specific project conditions. Additional measures may include operative temperature, new effective temperature (which combines air temperature and relative humidity,) or Wet Bulb Globe Temperature (which combines dry bulb, wet bulb, and globe temperature measures.) The latter is the effective index under potential heat stress conditions.

During construction administration, verify the project is achieving thermal comfort as designed and required by this guideline.

Submittal Requirements

Final Design:

- I.4A: Verification of designed temperature range within guideline limits.
- I.4B: Verification of mean radiant temperature asymmetry within guideline limits.
- I.4C: Verification of designed relative humidity within guideline limits.
- I.4D: Verification of thermal variables within limits set forth in the most recent version of ASHRAE Standard 55.
- I.4EF: Verification of variation of DBT included in building system operation specifications.

Additional Resources

ASHRAE Standard 55-2013: https://www.ashrae.org/resources--publications/bookstore/standard-55-and-user-s-manual
University of California Berkeley CBE Comfort Tool: http://comfort.cbe.berkeley.edu/

Tillman, Barry. 2016. Human Factors and Ergonomics Design Handbook, Third Edition, Barry Tillman. McGraw-Hill, NY.

Guideline I.5: Quality Lighting

Intent

Electric lighting should be designed to supplement and support the use of daylight as the primary source of light for visual tasks. This is vitally important to achieving environmental, health and economic goals. The integrated design of artificial and natural light must also maintain these lighting quality characteristics and effects: tolerable glare, natural color rendering, and attractive illumination of people for social exchanges.

Required Performance Criteria

Guidelines apply to all projects designated New Buildings and for Major Renovations with lighting replacement in the project scope.

A. Newly installed electric lighting must be operable in multiple modes and responsive to both daylight zones and differentiated uses within a given space, such as separating controls for media projection areas from general task areas within a space.

Recommended Performance Criteria

B. For general illumination in most space types, attain an average electrical illumination at the work plane of 35 to 50 foot-candles. A minimum of 25 foot-candles is recommended at any point 3 feet or more from a wall.
C. Consult the current version of the Illuminating Engineering Society of North America (IESNA) handbook for other recommended light levels.
D. Keep contrast ratios in the field of view within the space as seen from the task areas to no greater than 10:1
E. Achieve a Color Rendering Index (CRI) for each space type based on recommendations in the current version of the IESNA handbook.
F. At a minimum, conduct a point-by-point analysis of horizontal illumination levels at the work plane in each lighting mode for each space.
G. Perform computer simulation of the performance characteristics of the electric lighting system in each primary space type. Illumination levels on vertical planes should be evaluated when they have been defined as a task or work area.

Meeting the Guidelines

Implementation in the Design Process:

Incorporate performance criteria into lighting design criteria in program document. Develop additional quality lighting criteria as needed for special facility issues. For example, security or anti-vandalism lighting may need to be incorporated into lighting considerations.

The design may be closer to the minimum recommended handbook illumination values to reduce the connected load and conserve energy; note that if this is the case the contrast ratios in become even more important to maintain, and the overall volumetric luminance should be considered.

Conduct a first order check during Design for design constraints on lighting design. Ensure that general daylighting schemes and lighting plans are not in conflict with achieving lighting quality and any additional lighting criteria.

During early design, as fixtures types and fixtures are being selected complete a lighting analysis and develop the lighting design in conformance with performance criteria. Perform any lighting modeling studies as needed to confirm or substitute for calculations.

During construction observe and verify that the room, window, finish, and lighting variables (upon which estimated compliance was based) are proceeding according to goals as reflected in drawings and specifications.

Conduct onsite measurements once all lighting is operational during construction administration.

Submittal Requirements

Final Design:

- I.5A: Verification that the lighting system designed with multiple modes.
- I.5B: Verification that the work plane illumination is within guideline limits.
- I.5C: Verification that the illumination levels within guideline limits.
- I.5D: Verification that the contrast ratios levels within guideline limits.
- I.5E: Verification that the CRI provided by lighting within guideline limits.
- I.5F: Verification of analysis of horizontal illumination levels.
- I.5G: Verification of modeled determination of illumination levels.

Additional Resources

Rea, M. S., ed. IESNA Lighting Handbook, Tenth Edition. New York: Illuminating Engineering Society of North America, 2011: https://www.ies.org/store/lighting-handbooks/lighting-handbook-10th-edition/

Tillman, Barry. 2016. Human Factors and Ergonomics Design Handbook, Third Edition, Barry Tillman. McGraw-Hill, NY.

Guideline I.6: Effective Acoustics

Intent

To promote interior conditions that avoid harmful noise effects and produce a basis for a positive soundscape acceptable to occupants and appropriate to their tasks. The benefits are avoiding exposure to unhealthy noise levels, the elevated stress which accompanies higher background noise levels, and noise distraction impacts on mental work. Effective acoustics enable effective speech communications at normal speaking voice while providing for local speech privacy.

Required Performance Criteria

A. Recurrent background noise from external and internal sources cannot not exceed 70 A-weighted decibels (dBA).
B. All continuously occupied office space must meet a Noise Curve (NC) of no greater than NC-50. (See recommended levels below.)
C. All classroom space must meet an NC of no greater than NC-45.(See recommended levels below.)
D. Reverberation time for all continuously occupied space must be no less than 0.2 seconds and no greater than 0.8 seconds. Reverberation time must be evaluated on the 500 Hz octave band, and must be appropriate to the uses of the space. (See recommended levels below.) Note that this requirement would not apply to concert halls or other music performance auditoria.

Recommended Performance Criteria

E. Articulation Index must be less than 0.20 for open offices, where a low level of speech intelligibility is required (speech privacy is desired), and greater than 0.70 for enclosed offices where a high level of speech intelligibility is required.

Promote Positive Acoustics Appropriate to Tasks:

F. Reduce NC criterion to NC 45 or lower for continuously occupied spaces.
G. NC can be no greater than NC 40 for intermittently occupied meeting spaces like conference rooms and classrooms. (Note that this is less stringent than the ANSI S12.60 standard for classrooms.)
H. Provide reverberation times optimal for space use based on professional acoustic judgment. General Guidelines are as follows:
    1. Open Office: 0.2–0.5 seconds
    2. Enclosed offices: 0.2–0.4 seconds
    3. Classrooms 0.2–0.7 seconds
    4. For other space types, such as gymnasiums and auditoriums, use acoustic professional judgment and advice.

Meeting the Guidelines:

There are several US university programs focused on architectural acoustics and many sources of room acoustics modeling software that are commercially available. There are also free acoustics modeling and analysis software available from some universities and companies. These programs provide calculated estimates of quantities like reverberation time and sound pressure levels given certain parameters that account for room size, shape, surface absorption, and activity types.

Implementation in the Design Process:

Include performance criteria in programming document. Develop any additional special acoustical performance requirements to support functional programming of building (e.g., sources of recurrent noise that need to be controlled, special user populations which may have distinct auditory performance limitations, multiple uses of building spaces which may have different acoustic criteria. Investigate and choose appropriate acoustics modeling software for the project. (See Additional Resources below.)

Consider performance in building layout and form. Ensure that there are no inherent acoustic conflicts or limits to meeting performance criteria at schematic design. Perform preliminary software simulations to ensure that general acoustics parameters are met. Through Design Development demonstrate complete compliance with acoustical performance criteria via updated calculations or more detailed simulation modeling.

Address explicit performance criteria in design and materials selection and specification. Check to ensure materials selection meets necessary criteria for acoustical controls.

Submittal Requirements

Final Design:

- I.6A: Verification that expected background noise is within guideline limits.
- I.6B: Verification that expected office background noise NC is within guideline limits.
- I.6C: Verification that expected office background noise NC is within guideline limits.
- I.6D: Verification that expected reverberation time is within guideline limits.
- I.6E: Verification that expected articulation index is within guideline limits.
- I.6F: Verification that continually occupied space expected background noise NC within guideline limits.
- I.6G: Verification that intermittently occupied space expected background noise NC within guideline limits.
- I.6H: Verification that expected reverberation time is within limits specified in guideline.

Closeout:

- I.6A: Verification that expected background noise of installed condition is within guideline limits.
- I.6B: Verification that office expected background noise of installed condition NC is within guideline limits.
- I.6C: Verification that office expected background noise of installed condition NC is within guideline limits.
- I.6D: Verification that expected reverberation time of installed condition is within guideline limits.
- I.6E: Verification that expected articulation index of installed condition is within guideline limits.
- I.6F: Verification that occupied space expected background noise NC of installed condition is within guideline limits.
- I.6G: Verification that intermittently occupied space expected background noise NC of installed condition is within guideline limits.
- I.6H: Verification that expected reverberation time of installed condition is within guideline limits.

Additional Resources

The Engineering Toolbox architectural acoustic calculator: http://www.engineeringtoolbox.com/room-absorption-sound-d_69.html

IRCAM (a French research project with many useful publications and free software): www.ircam.fr

ODEON distributes room acoustics modeling software: www.odeon.dk

SARA – A Spatial Audio & Room Acoustics Project from the Academy of Finland: www.acoustics.hut.fi/~vpv/projects/sara.htm

Guideline I.7: Vibration Reduction

Intent

To promote interior conditions that avoid harmful vibration effects produced by wind sway, transmitted outdoor sources, indoor machinery (especially HVAC), and foot traffic. This will avoid prolonged exposure to unhealthy vibration levels and enable prolonged comfortable work at a workstation. It will also diminish anxiety and stress due to wind sway on upper floors as well as maintain the value of the building.

Required Performance Criteria

Guidelines apply to all projects designated New Buildings and are recommended for Major Renovations that include structural changes.

A. For steel structures, control vibrations in accordance with AISC Design Guide 11.
B. For steel joists, control vibrations in accordance with SJI Technical Digest #5: Vibration of Steel Joist-Concrete Slab Floors.
C. For wood or concrete construction, control deflection as follows:
    1. Live Load Deflection: L/480
    2. Total Deflection: L/360

Recommended Performance Criteria

D. To better control vibration, do not construct floors using bar joists

The following recommendations for improved vibration control comes from Human Factors Research on the effects of vibration on health and wellbeing of occupants:

E. Return period of greater than 0.5% g horizontal acceleration in top third of a high rise (7 stories or greater) building shall not be less than 6 years.
F. Floor vibration must be kept above Splittgerber Minimum Complaint Level (approximately 0.001 Root Mean Square Acceleration (G_{rms}) across 4–8 hertz (Hz) resonant with human body components) or 8 hour reduced comfort level (approximately 0.15m/sec^2 across 4–8 Hz resonant with human body components) for all continuously occupied spaces, restrooms, and meeting rooms.
G. Apply floor vibration criterion to all intermittently occupied spaces except storage areas.

Meeting the Guidelines

Implementation in the Design Process:

Include performance criteria in programming document. Identify any potential sources of unusual vibration conditions within building (e.g., heavy equipment or machinery operations, inclusion of windpower generators, etc.).

Consider performance criteria in placement of machinery and in general building form and layout. Confirm isolation of vibration sources in early design, or tag for special treatment in design development. Demonstrate compliance via structural calculations or table citation during design development through construction documentation.

Submittal Requirements

Design:

- I.7D: Verification that the design does not incorporate use of bar joists for floor assemblies.

Final Design:

- I.7A: Verification that the design complies with AISC Design Guide 11.
- I.7B: Verification that vibrations controlled according to SJI Technical Digest #5: Vibration of Steel Joist-Concrete Slab Floors
- I.7C: Verification that the deflection limits comply with listed limits.
- I.7D: Verification that the design does not incorporate use of bar joists for floor assemblies.
- I.7E: Verification that the return period is within the guideline limits.
- I.7F: Verification that floor vibration is within guideline limits for continuously occupied spaces.
- I.7G: Verification that floor vibration is within guideline limits for all intermittently occupied spaces.

Additional Resources

The American Institute of Steel Construction, Inc. (AISC) AISC Design Guide 11: https://www.aisc.org/Design-Guide-11-Vibrations-of-Steel-Framed-Structural-Systems-Due-to-Human-Activity-Second-Edition#.WPV-6aLavIU

Steel Joist Institute (SJI) SJI Technical Digest #5: Vibration of Steel Joist-Concrete Slab: https://steeljoist.org/product-category/publications/

Guideline I.8: Daylight

Intent

To promote daylight for ambient illumination at levels and conditions known to produce physiological and psychological benefits. Daylight contributes to a perception of a “bright and cheery” workplace through provision of volumetric brightness (also called “room-surface brightness”). The important qualities of daylight are its inherent variation, power spectrum (color), and the predominantly horizontal component of its illumination vector (direction of illumination). Some studies have also shown a correlation between daylighting and improved productivity and test scores.

Required Performance Criteria

Guidelines apply to all projects designated New Buildings and for Major Renovations with glazing redesign included in project scope.

A. In New Buildings, at least 75% of the floor area of continuously occupied spaces in the building must have a minimum daylight factor of 1% when measured without furniture and at 2 feet 6 inches above the floor. This may be demonstrated using the Daylight Factor Calculator provided in the B3 Guidelines, through daylight simulation, or physical daylight modeling. (This is recommended for Major Renovations where applicable.)
B. In New Buildings, in every continuously occupied space with daylight, not more than 15% of the floor area shall exceed a uniformity ratio of 10:1 when measured without furniture and at 2 feet 6 inches above the floor. (This is recommended for Major Renovations where applicable.)
C. Control direct solar penetration with fixed or operable shading devices to prevent direct sunlight from falling on the work plane beyond 4 feet from the exterior walls during the majority of operating hours.
D. Employ automatic controls to turn off or dim the electric lights when daylighting is available. For spaces with daylight, the Window to Floor Area Ratio (WFAR) should not need to exceed 25% in order to meet daylighting criteria listed here. Note that exceeding this WFAR may introduce excess energy use and possibly glare.

A continuously occupied space is defined as a space that is occupied by one or more persons for more than one hour during days the building is in use.

Excluded from calculation of continuously occupied spaces are:

- Spaces with uses that only require minimal lighting and in which the primary activity intended for the space would be harmed by daylight (this exclusion does not apply to spaces with ultraviolet light concerns).
- Spaces that do not meet the minimum occupancy outlined above during daylight hours.

Meeting the Guidelines

Several different software environments can calculate daylight factor and other daylighting metrics, these include:

Velux Daylight Visualizer, a simple-to-use daylight and rendering modeling environment that can be used to evaluate daylight factor and other lighting measures for complicated spaces and that works with 3D models from Autocad, Revit, Sketchup, Archicad, and others.

Diva for Rhino is a plug-in used in conjunction with the Rhinoceros NURBS modeler. It allows complex evaluations of daylight in buildings, including analysis of their surrounding environments.

DAYSIM is an analysis software that uses the Radiance engine and allows for 3D model inputs and evaluation in Rhinoceros, Sketchup, and Ecotect.

Implementation in the Design Process:

While programming the space use and arrangement of the project, identify and list continuously occupied spaces without security, hazard, or other conditions that would prevent the use of windows.

Using the Daylight Factor Calculator or other daylight simulation to establish room proportions, window area, and surface properties that satisfy the required performance criteria for each of the prototype spaces characteristic of the project's design.

During early design use the Daylighting Factor Calculator or other daylight simulation to establish room proportions, window area, and surface properties that satisfy the required performance criteria, if this has not already been completed. Begin organizing the building volume and fenestration so as to maintain the required performance criteria. Use the output from the daylight models to check the performance periodically as the design evolves.

For each of the main prototype spaces, test and determine the implications for orientation, room proportion, window area, and finishes that achieve the performance criteria.

As the project design progresses demonstrate compliance using the Daylighting Factor Calculator, computer simulation, or physical modeling, whichever tool is appropriate. For each of the main prototype spaces, show a summary of calculations and quantitative results indicating conformance with performance criteria.

During construction observe and verify that the room, window, finishes (upon which estimated compliance was based) are proceeding according to goals and are reflected in drawings and specifications.

Measure performance criteria onsite. Develop a sampling plan to confirm daylighting performance over the first three years of occupancy. Compare performance at specific test times to what would be expected under the same conditions in the model. For example, if the onsite lighting measurements are taken at noon, on September 21, compare to the modeled condition at noon on September 21. Demonstrate that performance criteria are maintained via a sampling plan of daylighting performance over varying conditions during the first three years of occupancy.

Documentation

A Simple Daylighting Factor Calculator available in Appendix I-8 is designed to identify the physical attributes for room dimensions, surfaces, and fenestration in order to just meet the performance criteria for standard CIE overcast sky conditions. It does not currently take into account light shelves, partitions, non-orthogonal planes, significant exterior obstructions, or exterior reflecting surfaces. For such parameters that go beyond the current capability of the Daylighting Factor Calculator, physical models or computer simulations are necessary to refine the volumetric and surface attributes of the final design in order to assure compliance with the Required and Recommended Performance Criteria.

For more advanced and refined analysis, computer analysis and simulation should be used to evaluate options and create a daylighting solution. Some widely available programs are noted below. Usually, three-dimensional digital models are constructed using computer-aided design software (CAD), which is then imported into the daylighting analysis software. Such programs usually require the user to define location, sky conditions, and date and time and interior surface characteristics. Note that some programs that produce photorealistic renderings of the design do not necessarily provide accurate quantitative results.

Submittal Requirements

Design:

- I.8A: Verification and documentation that 75% of continuously occupied space has a daylight factor of 1% or greater.
- I.8B: Verification that design does not exceed 10:1 in more than 15% of floor area.
- I.8C: Verification that daylight penetration is controllable more than 4 feet from exterior walls during operational hours.

Final Design:

- I.8A: Verification and documentation that 75% of continuously occupied space has a daylight factor of 1% or greater.
- I.8B: Verification that design does not exceed 10:1 in more than 15% of floor area.
- I.8C: Verification that daylight penetration is controllable more than 4 feet from exterior walls during operational hours.

Additional Resources

Velux Daylight Visualizer: http://www.velux.com/article/2016/daylight-visualizer

Efficient Windows Collaborative contains references, resources and simulation tools for window design and selection for daylighting: www.efficientwindows.org

Windows for High Performance Buildings contains references, resources and simulation tools for window design and selection for daylighting: www.commercialwindows.org

Radiance lighting engine: radiance-online.org

DOE Buildings Program: Daylighting http://energy.gov/eere/energybasics/articles/daylighting-basics

Building Energy Software Tools Directory: the DOE lists several hundred types of building analysis tools available to the designer, with a section on lighting, many of which include daylighting capabilities: http://buildingenergysoftwaretools.com/

Guideline I.9: View Space and Window Access

Intent

To promote interior view space or views to the exterior. The benefits of providing this visual access are the ability for focal rest to avoid eyestrain and access to visual information about changing outside conditions. A view amenity also aids varying attention cycles and relieves the stress of mental work.

Recommended Performance Criteria

Guidelines apply to all projects designated New Buildings and for Major Renovations.

A. From every continuously occupied position in spaces there must be visual access to an external window view that is at least 10 degrees in horizontal and vertical visual angle at no greater than the 50th percentile standing at an average eye height of 64 inches.
B. From every assigned and continuously occupied workstation position at seated eye height of 48 inches there must be visual access to a view space that is at least 20 feet away. The view space must be at least a continuous 20 degrees horizontal angle beginning at not more than 10 degrees from the centerline of sight. The view space must also be at least a continuous 15 degrees vertical view angle beginning at not more than 10 degrees from the horizontal centerline of sight and shall be above that horizontal centerline. As an alternate to the 20 degree horizontal by 15 degree vertical dimensions of the line of sight, the table Allowable View Space Aperture found under the Meeting the Guidelines section below, which approximates a 20 degree horizontal by 15 degree vertical view angle section below may be used.
C. Higher performance is achievable if views are provided to horizon lines, clouds, tree lines and clusters, and natural waterscapes.

Meeting the Guidelines

Include performance criteria in the programming document. Develop any special view and window requirements during functional programming of activities for the building (e.g., presence of an amenity view space, special security concerns for windows in certain locations of the building).

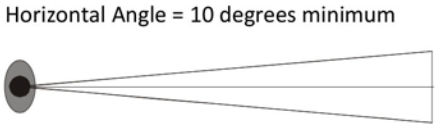
Determine implications of performance criteria for space planning and incorporate into early design. Perform first order estimates of view access given projected uses within building and initial sizing and placement of windows. Identify any problems with window configuration and placement. Confirm compliance with a check of design development drawings.

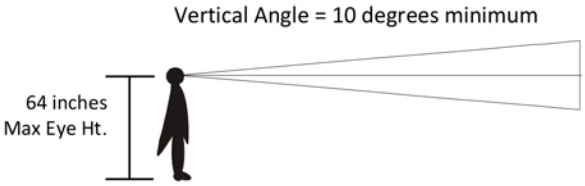
Observe and verify that the room, window, and furnishing variables (upon which estimated compliance was based) are proceeding according to goals as reflected in drawings and specifications through construction documents.

During occupancy log comments relating to view space and window access (see P.5 Operations Commissioning for recordkeeping procedures). Verify that performance criteria are met by checking performance onsite.

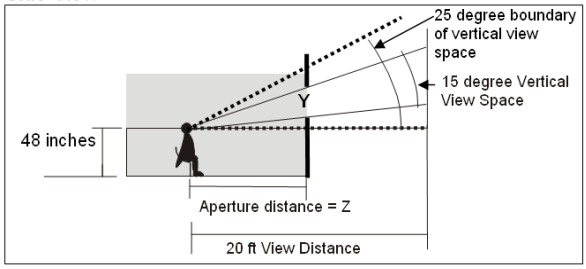
The diagrams and table below may be used to assist in determining view space aperture and vertical and horizontal

Allowable View Space Apertures:

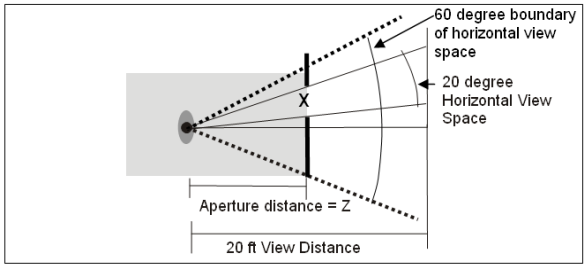




Side View



Plan View



View Space Aperture Approximately Corresponding to a 20 degree Horizontal by 15 degree Vertical View Angle

	Aperture Distance (Z) in Feet from Viewer																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Minimum Horizontal Dimension in feet (X) of Aperture to the 20-foot-view (Approximately Corresponding to the 20 deg. Horizontal View Angle)	0.4	0.7	1.1	1.4	1.8	2.2	2.5	2.9	3.2	3.6	4.0	4.3	4.7	5.0	5.4	5.8	6.1	6.5	6.8	7.2
Minimum Vertical Dimension in feet (Y) of Aperture to the 20-foot-view (Approximately Corresponding to the 15 deg. Horizontal View Angle)	0.3	0.5	0.8	1.1	1.3	1.6	1.9	2.1	2.4	2.7	2.9	3.2	3.4	3.7	4.0	4.2	4.5	4.8	5.0	5.3

Submittal Requirements

Final Design:

- I.9A: Verification that the design includes visual access to external windows within guideline parameters.
- I.9B: Verification that the design includes access to view spaces within the guideline parameters.
- I.9C: Verification that the design includes views as in guideline parameters.

Additional Resources

Rea, M. S., ed. IESNA Lighting Handbook, Tenth Edition. New York: Illuminating Engineering Society of North America, 2011: https://www.ies.org/store/lighting-handbooks/lighting-handbook-10th-edition/

Guideline I.10: Personal Control of IEQ Conditions and Impacts

Intent

To promote local occupant control of interior conditions to better support work performance. Personal control enables immediate improvement of intermittent discomfort and helps indicate personal availability or current work status. It also allows workers to increase personal comfort in changing organizational contexts.

Recommended Performance Criteria

Guidelines apply to all projects designated New Buildings and for Major Renovations.

A. Provide adjustable task lighting to include “on,” “off,” and intermediate levels.
B. Provide means of alleviating direct solar gain at all continuously occupied and assigned positions.
C. Provide means of mitigating intermittent noise, drafts or low air circulation at all continuously occupied and assigned positions.
D. Provide means of alleviating building control system malfunctions at all continuously occupied and assigned positions.
E. Provide access to operable windows at all continuously occupied and assigned positions.
F. Neck extension for continuously viewing monitors at workstation shall not be greater than 0 degrees vertical. Head rotation for continuous viewing shall not be greater than 10 degrees horizontal.
G. At keyboard rest, there shall be no continuous deviation from an approximate 0 degree angle in elevation from elbows at sides at rest through wrists to fingertips on keyboard.

Higher performance is achievable with the following personal control criteria:

H. Increase flexibility of workspace through adoption of standards for ergonomically adjustable and movable furniture elements (BIFMA Office Furniture Standard, European CEN Workplace Standard, NASA Man-System Integration Standards).
I. Use tools to perform Spatial Syntax and other (e.g., Isovist) analyses that can be used to improve flexibility and habitability of workspace.

Meeting the Guidelines

Implementation in the Design Process:

In predesign and early design, include performance criteria in programming documents. Perform an ecological matrix analysis to demonstrate the planned means of occupant control over environmental quality variables under their routine and foreseeable extreme variations .Take care to ensure that occupants are not be put in recurrent uncomfortable conditions requiring continual adaptation is necessary to maintain comfort.

Consider personal control criteria impact on the schematic design. Check that there are no obvious limits on personal control strategies in the schematic design and that personal control strategies are incorporated in the general design of building.

In the design documentation and documentation of compliance for this phase, call out the personal control strategies enabled by and included in the design. Include testing of occupant control options over indoor environmental qualities in the Commissioning Plan.

In the construction documents and construction administration and buyout of the project, verify achievement of performance criteria by exercising the range of occupant control strategies available onsite per the Commissioning Plan (see P.4 Design and Construction Commissioning for Commissioning Plan.)

During occupancy, log complaints or shortcomings noticed in lack of personal control over indoor environment (see P.5 Operations Commissioning for recordkeeping procedures.)

Submittal requirements

Final Design:

- I.10A: Verification that the design includes adjustable task lighting.
- I.10B: Verification that the design includes means of alleviating direct solar gain.
- I.10C: Verification that the design includes means of mitigating intermittent noise.
- I.10D: Verification that the design includes means of alleviating building control system malfunctions.
- I.10E: Verification that the design includes access to operable windows at prescribed locations.
- I.10F: Verification that the design includes work stations within continuously viewed monitors within parameters.
- I.10G: Verification that the design includes no deviation at keyboard rest per guideline requirements.
- I.10H: Verification that the design includes adoption of ergonomically adjustable and movable furniture elements.
- I.10I: Verification that the design includes specification of tools that perform Spatial Syntax and other analysis.

Additional Resources

Tillman, Barry. 2016. Human Factors and Ergonomics Design Handbook, Third Edition, Barry Tillman. McGraw-Hill, NY.

Guideline I.11: Promotion of Healthful Physical Activity

Intent

To promote spatial conditions conducive to incidental physical activity. Movement (like walking) between workplace destinations helps maintain cardiovascular fitness, mental alertness, and encourages synergistic staff interactions that improve morale and wellbeing.

Recommended Performance Criteria

Guidelines apply to all projects designated New Buildings and for Major Renovations.

A. Provide an “open” or “enhanced” stair design that is visible and/or easy to locate connecting the main (entry level) floor with at least the next two floors above it and the first floor beneath it. This encourages and enables building occupants to safely and conveniently use the stairs to travel between floors in their daily building circulation.
B. Encourage staff to walk to routinely used building service centers and interior destinations through design of circulation path and its amenities. Features that encourage physical activity include:
    1. Separation of restrooms and service centers (like mailrooms and refreshment dispensers and break rooms) from work areas
    2. Enhanced daylight and views along a circulation path.
    3. Different routes to popular interior destinations.
    4. Interior circulation paths that allow round trips without reversal of direction.
    5. Interior circulation paths with adjoining meeting niches and nooks that encourage spontaneous staff interaction along the path lengths.
C. Encourage casual and continuous use of stairs include by: positioning stairs in floor plan, opening stairway to surrounding interior views; providing rest and incidental meeting nooks along stairway length; reversing or curving of stairway to facilitate expanded user view of stair traffic; and designing proper stairway riser/tread ratios, surfacing, and grab handles to meet Human Factors and Ergonomics Society (HFES) design recommendations.

Meeting the Guidelines

Implementation in the Design Process:

In Predesign and early design, look for opportunities in programming of building to encourage healthful physical activity by occupants. Include suggestions for activities and explicit performance criteria in programming documents.

Through the design process refine incorporated physical movement strategies in design of building. Include general layout and programming considerations for increasing occupant circulation as well as amenities that accommodate exercise activities during daily operations (e.g. ,inclusion of shower and locker room to accommodate lunchtime joggers). Call out explicit physical movement strategies in design documentation. Include necessary signage in design to encourage and direct circulation.

Test stair use for potential variety of users when project is completed. Check that signage and circulation amenities are present and installed correctly. Include a physical-movement-related question on scheduled staff surveys. Track improvements in staff health and organizational productivity related to better physical circulation and social communication, analyze and document results in the annual Guideline Report.

Submittal Requirements

Design:

- I.11A: Verification that design meets guideline requirements for open or enhanced stair design.
- I.11B: Verification that design meets guideline requirements for encouraging staff walking to building service centers and interior destinations.
- I.11C: Verification that design meets guideline requirements for encouraging staff interaction.
- I.11D: Verification that design includes amenities to encourage stair use.

Final Design:

- I.11A: Verification that design meets guideline requirements for open or enhanced stair design.
- I.11B: Verification that design meets guideline requirements for encouraging staff walking to building service centers and interior destinations.
- I.11C: Verification that design meets guideline requirements for encouraging staff interaction.
- I.11D: Verification of design includes amenities to encourage stair use.

Additional Resources

Tillman, Barry. 2016. Human Factors and Ergonomics Design Handbook, Third Edition, Barry Tillman. McGraw-Hill, NY.

Material and Waste Guidelines

Intent

To reduce embodied environmental impact and toxicity in the building materials.

Which products relate to which guidelines?

Different products contribute to compliance in different guideline categories. The table below lists which guidelines are related to only *interior materials* and which guidelines may be met using any product selected for the project. This includes Guideline I.1 as it relates to product selection.

	I.1: Low Emitting Materials	M.1B: Product Life Cycle Assessments	M.1: Environmentally Preferable Materials	M.4: Health
Interior Materials (see definition under I.1)	All interior materials in project must comply with I.1			10 materials required (if one of most common it may be double counted)
Any Materials in Project		5 materials required, may be any used in project	55% of all materials are required, some may contribute in multiple categories, so actual % of contributing materials may be lower	

General Material Information:

The following information is collected in the Materials section of the B3 Guidelines Tracking Tool, under Section M.0:

Final Design:

- Material strategies used, including narrative.

Guideline M.1: Life Cycle Assessment

Intent

To use life cycle analysis to quantify and minimize the environmental impact of building materials, which have significant effects on global warming, air pollution, water pollution, energy consumption, and waste.

Required Performance Criteria

Guidelines apply to all projects designated New Buildings and for Major Renovations. M1A is not required for renovation buildings or portions of buildings. M1A is required for all additions over 20,000 square feet and additions that are greater than or equal to 20% of a preexisting building's floor area.

A. Whole-Building Life Cycle Assessment (LCA):
Demonstrate a reduction in life cycle Global Warming Potential (GWP) of the building's construction materials through building massing, structural design, dematerialization, and alternative assembly and material selection. This credit shall be met by documenting GWP reduction using one of the three listed compliance paths and by using one of the approved whole-building LCA software tools to complete a whole-building LCA model. A whole-building LCA model representing the final design of the project is required regardless of the chosen GWP reduction compliance path.

1. GWP Reduction Documentation Paths:
    i. GWP Reduction Path 1: Whole-Building LCA Approach
    This path may be used for any building scenario and will provide a basis for comparing the impact-reduction strategies with the most potential. These include whole-building strategies such as changes to the building plan to optimize shape, layout, and surface area of assemblies. Impacts from assembly and material selections may also be documented by using this path.
    Following this path, use whole-building LCA models to document a 10% reduction in GWP. The basis for this reduction is a comparison between the Selected Building Design (the design of the building at the end of the CD phase, representing the final design of the building) and the Reference Building, developed by the end of the SD phase and updated as needed. There are several methods for creating the Reference Building discussed in more detail below.[9]
    ii. GWP Reduction Path 2: Assembly-Level LCA Approach
    This path requires the utilization of an LCA model of a representative portion of the building to document a 10% reduction in GWP. This approach is fundamentally similar to Path 1, but a smaller functional unit based on structural bays or another representative unit is modeled in lieu of the whole-building. The basis for this 10% reduction is a comparison between the Selected Design - Partial (the final design of the selected structural bays) to the Reference Model - Partial, developed by the end of the SD phase and updated as needed.
    This compliance path provides a basis for comparing assembly-level and material-level impact reduction strategies but cannot be used with building-level strategies such as massing and layout. Projects using this path must also complete and submit a whole-building LCA model at the completion of design.

[9] This compliance path closely follows the requirements of USGBC, "Materials and Resources Credit: Building Life-Cycle Impact Reduction," *LEED Building Design and Construction v.4*, with several key changes.

iii. GWP Reduction Path 3: Material-Level LCA Approach

Use the B3 LCA Material Selection Calculator to document that the building's primary construction materials achieve an aggregate group score of 1.6.

This compliance path may be used when the design team is only evaluating material substitutions to reduce GWP (e.g., exchanging one type of cladding for another). It does not compare impacts of broader building-level or assembly-level impact reduction strategies. This compliance path is limited to building projects that utilize one dominant structural and enclosure type, which must make up at least 60% of the building's structural volume and exterior surface area respectively. This compliance path is additionally limited to projects utilizing assemblies and materials that are well approximated by the assemblies and materials contained in the B3 LCA Material Selection Calculator. Projects using this path must also complete and submit a whole-building LCA model at the completion of design.

2. Whole-Building LCA Model:

This LCA building model must be completed using one of Approved Whole-Building LCA Software Tools. It should be submitted at the end of the CD phase and represent the final design of the building. If Path 1, Whole-Building LCA Approach was selected to document GWP reduction, the Selected Building Design LCA model from that approach fulfills this requirement. Whole-Building LCA models must follow the requirements as listed in Meeting the Guidelines: M.1A section below.

B. Product Life-Cycle Assessments[10]

Use at least 5 different permanently installed products sourced from at least five different manufacturers that meet one of the disclosure criteria below:

1. Product-specific declaration.
   i. Products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that report impacts from at least cradle to gate.
2. Environmental Product Declarations (EPD) which conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle-to-gate scope.
   i. Industry-wide (generic) EPD – Products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator are valued as one-half (½) of a product for purposes of compliance.
   ii. Product-specific Type III EPD – Products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as the participant by the program operator are valued as one whole product for purposes of compliance.

Meeting the Guidelines: M1A

Approved Whole-Building LCA Software Tools

- Tally
- Athena Impact Estimator
- For other methods, please contact guidelines@b3mn.org to request evaluation of additional methods of whole-building LCA evaluation. This list will be updated if other methods are approved.

[10] This guideline is aligned with the International Green Construction Code and ANSI/ASHRAE/USGBC/IES Standard 189.1, "9.4.1.4 Multiple-Attribute Product Declaration or Certification," some language also shared with LEED v.4.

Allowable GWP Impact Reduction Strategies by Path.

The strategies that can be used to reduce environmental impacts vary by path; below is a summary of the options available under the three compliance paths:

Impact Reduction Strategies	Path 1 Whole-Building	Path 2 Assembly Level	Path 3 Material Level
Building size (floor area)	no	no	no
Building service life	no	no	no
Building shape (layout, surface area)	yes	no	no
Building structural spacing (grid layout)	yes	no	no
Assembly substitutions (swap types)	yes	yes	no
Assembly design changes (thicknesses and layers of materials)	yes	yes	no
Window-to-wall area ratio changes	yes	yes	no
Floor-to-floor height changes	yes	yes	no
Structure design changes (type and sizing of beams + columns)	yes	yes	no
Material substitutions	yes	yes	yes

Whole-Building LCA Model Requirements:

Requirements of the whole-building LCA model:[11]

1. Building service life shall be 60 years.
2. The scope of the assessment must include EN15978 Phases A1–A5, B1–B5, and C1–C4 (cradle to grave) but omit phase D (beyond building life). Building operational energy and water use (Phases B6, B7) are not included for this requirement though both the Selected Building Design and the Reference Building must meet current B3 and SB 2030 requirements.
3. The LCA models must include the complete building enclosure from the interior to the exterior layer, structural elements (posts, beams, bearing walls), including the intermediate floors and foundation and any attached parking structures.
4. All interior finishes shall be omitted with the exception of those on exterior above and below grade walls.
5. The LCA models should omit electrical and mechanical equipment including elevators, pipes, plumbing fixtures, and control systems, as well as items exterior to the building such as landscaping and surface parking lots.
6. The Selected Building Design and Reference Building must be functionally equivalent. They must serve the same program, same gross floor area, and the same operational energy and water efficiency. The operational energy and water use for both the Selected Building Design and the Reference Building must meet current B3/SB 2030 requirements.[12]

[11] These whole-building LCA requirements are aligned in part on USGBC, "Materials and Resources Credit: Building Life-Cycle Impact Reduction," *LEED Building Design and Construction v.4*, with some changes noted.
[12] Differs from LEED v.4 credit: Interior non-structural walls and assemblies should be omitted from the LCA models.

GWP Reduction Documentation Options:

Documenting a 10% GWP reduction for a building's construction materials often requires early-phase design changes, which necessitate a start to LCA evaluation in the schematic design phase. Substantial changes to a building's structure, envelope, or building plan may be necessary. This often requires coordination between multiple team members – architects, structural engineers, and building owners.

GWP Reduction Path 1 – Whole-Building LCA Approach[13]

Defining the Reference Building:

The Reference Building LCA model should be completed early in the SD phase so it can be used as a benchmark for comparing design cases and gauging GWP reductions. For Path 1, the total area of exterior walls, floors, and roofs may differ between the Reference Building and the design cases to account for optimization in building shape, layout, and surface area. The Reference Building and Selected Building Design must remain functionally equivalent, with equal floor area and space use types. Water and energy consumption must be approximately equal and meet current SB 2030 standards.

There are a variety of valid approaches for defining the Reference Building.[14] The design team performing the LCA analysis may choose from the following options to best meet their needs:

1. Early design case – an early design for the building under study.
2. Existing building – a real-world benchmark, modified to match the floor area and energy efficiency of the project.
3. Building archetype – a design similar to an existing building modified to match the floor area and energy efficiency of the project.
4. Alternative design – a design based on the project design but that is more reflective of industry-standard materials and practices.

GWP Reduction Path 2 – Assembly-Level LCA Approach

The functional unit used in this path to document GWP reduction is a representative slice through the building incorporating the most common construction assemblies. It must extend from exterior wall to the opposite exterior wall and from the foundation to the roof. For buildings with structural bays this should incorporate at least two bays. For buildings without structural bays, project teams should contact B3 Guidelines Support to ask for guidance on selecting and sizing an appropriate functional unit for modeling. All applicable whole-building LCA modeling requirements (as listed in Meeting the Guidelines Part 1a–g) should be applied to the LCA models.

GWP Reduction Path 3 – Material-Level LCA Approach

To use this path, the building design and design team must comply with the following requirements.

1. The project must have one dominant structural and enclosure type, comprising at least 60% of the building's structural volume and exterior surface area respectively.
2. This method only documents GWP reductions from material substitutions.

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[13] Differs from LEED v.4 credit: for compliance with this requirement (M.1a), a 10% reduction is required for GWP only. Impacts in other environmental indicator categories such as eutrophication potential and acidification potential should be monitored, but performance improvements are not required in those areas. Compliance options 1, 2, and 3 of USGBC, "Materials and Resources Credit: Building Life-Cycle Impact Reduction," *LEED Building Design and Construction v.4* will not be considered as a compliance paths for this credit.

[14] Reference Building options and descriptions follow LEED v.4 credit requirements.

3. The building project is limited to the selection of materials that are well approximated by the assemblies and materials contained in the Path 3 B3 LCA Material Selection Calculator.

Using B3 LCA Material Selection Calculator:

The calculator contains a database with GWP impacts for ten different categories of material, such as cladding and roofing. Only one material type may be selected per category, and it must make up 60% or more of the material used by the building in that category (i.e., it must be the primary material type). If a building does not contain material in a particular category, that category must be entered as NA.

Within the calculator's database, specific materials are ranked by their GWP impact. The lowest GWP materials are assigned a material Impact Score group number of 1 or 2. Materials with medium GWP impact are assigned a material Impact Score of 3. High GWP materials are assigned a material Impact Score of 4 or 5. The building's Impact Score (averaged) across all categories must be 1.6 or lower to achieve compliance using this documentation path. If the building's Impact Score is greater than 1.6, Paths 1 and 2 may be used instead to allow the design team more flexibility to apply additional impact reduction strategies not available under Path 3. A series of graphs comparing the GWP impact of functionally equivalent building materials is provided to assist the practitioner in selecting materials that will help achieve compliance. These may be useful for guiding structure and envelope decisions in the early design phases.

Submittal Requirements: M.1A

Design:

- M.1A: Documentation of either Path 1, Path 2 or Path 3

  GWP Reduction Path 1 – Whole-Building LCA Approach

  - Upload the Reference Building LCA model and selected reports showing GWP impact. These reports should show impacts for life-cycle phases A–C only and must include total whole-building GWP impact as well as a breakdown of GWP by assembly type. Total GWP for the Reference Building must also be input separately.
  - Upload an iteration of the whole-building LCA model and reports that show reduction in GWP impact compared to the submitted Reference Building LCA model. Total GWP reduction must also be input into the Tracking Tool.
  - Required submittal files for Athena users:
    - Athena IE base files (Reference Building and current design iteration)
    - Reports: "Detailed LCA Results by Assembly Group Embodied Effects" in table format (reports for both Reference Building and current design iteration)
  - Required submittal files for Tally users:
    - Revit model files with included Tally specifications (Reference Building and current design iteration)
    - Reports: "Full Building Summary" (reports for both Reference Building and current design iteration)

  GWP Reduction Path 2 – Assembly-level LCA Approach

  - Upload the Reference Model structural bay model (Athena IE or Tally) and selected reports showing GWP impact. These reports should show impacts for life cycle phases A–C only, and must include total whole-building GWP impact as well as a breakdown of GWP by assembly type. Total GWP for the Reference Model must also be input into the Tracking Tool.

- Upload an iteration of the structural bay model (Athena IE or Tally) and reports that show reduction in GWP impact compared to the submitted Reference Model structural bay model. Total GWP for this model iteration must also be input separately.
- Required submittal files for Athena users:
  - Athena IE base files (Reference Model and current model iteration).
  - Reports: "Detailed LCA Results by Assembly Group Embodied Effects" in table format (reports for both Reference Case and current model iteration).
- Required submittal files for Tally users:
  - Revit model files with included Tally specifications (Reference Model and current model iteration)
  - Reports: "Full Building Summary" (reports for both Reference Model and current model iteration)

GWP Reduction Path 3 – Material-Level LCA Approach

- Upload a preliminary version of the completed Path 3 Compliance Calculator demonstrating selection of compliant assemblies. The Impact Score computed by the calculator must be 1.6 or lower to achieve compliance. Also input the Impact Score to the Tracking Tool.

Final Design:

- M.1A: Whole-Building LCA Model and Documentation of either Path 1, Path 2 or Path 3

Whole-Building LCA Model

- Regardless of the compliance path chosen, all projects must upload a final whole-building LCA model and selected reports showing GWP impact at the end of the construction documents (CD) phase. These reports should show impacts for life cycle phases A–C only, and must include total whole-building GWP impact as well as a breakdown of GWP by assembly type. The model should represent the closest available approximation of the building as it will be built. If the design team selected GWP Reduction Path 1 to demonstrate compliance, the final Selected Building Design LCA model satisfies this requirement.

GWP Reduction Path 1 – Whole-Building LCA Approach

- If there has been changes to the Owner's Project Requirements (OPR) (established in P1), confirm that the Reference Building model uploaded at the end of the Design phase still meets the updated OPR. If not, the Reference Building model may need to be updated.
- Upload the final Selected Design whole-building model and reports that show 10% reduction in total building GWP impact compared to the submitted Reference Building. The Selected Building Design should represent the closest available approximation of the building as it will be built.
- Required submittal files for Athena users:
  - Athena IE base files (Reference Building and Selected Building Design)
  - Reports: "Detailed LCA Results by Assembly Group Embodied Effects" in table format (reports for both Reference Building and Selected Building Design)
- Required submittal files for Tally users:
  - Revit model files with included Tally specifications (Reference Building and Selected Building Design)
  - Reports: "Full Building Summary" (reports for both Reference Building and Selected Building Design)

GWP Reduction Path 2 – Assembly-Level LCA Approach

- If there has been changes to the Owner's Project Requirements (OPR) (established in P1), confirm that the Reference Model structural bay model uploaded at the end of the schematic design phase still meets the updated OPR.
- Upload the final Selected Design Model structural bay model and reports that show 10% reduction in GWP impact compared to the submitted Reference Model structural bay model. The Selected Design Model should represent the closest available approximation of the building as it will be built.
- Required submittal files for Athena users:
  - Athena IE base files (Reference Model and Selected Design Model)
  - Reports: "Detailed LCA Results by Assembly Group Embodied Effects" in table format (reports for both Reference Model and Selected Design Model)
- Required submittal files for Tally users:
  - Revit model files with included Tally specifications (Reference Model and Selected Design Model)
  - Reports: "Full Building Summary" (reports for both Reference Model and Selected Design Model)

GWP Reduction Path 3 – Material-Level LCA Approach

- Upload a final version of the completed Path 3 Compliance Calculator. The Impact Score computed by the calculator must be 1.6 or lower to achieve compliance. Also input the Impact Score to the Tracking Tool.

Meeting the Guidelines: M.1B

Select which product option(s) to pursue. Early product research can help the project team capitalize on opportunities for products contributing to multiple credits and options. Individual products may contribute under either Option 1 or Option 2 but not be counted toward both.

The required scope of this guideline is for permanently installed building products, excluding mechanical, plumbing, electrical (MEP), and specialty equipment and items purchased for temporary use on the project. Furniture is not considered permanently installed and is not required to be included in the submission.

Option 1 is for projects with permanently installed products that have a product-specific declaration adhering to third-party certification programs to ensure that they conform to ISO 14044, which defines how LCAs are critically reviewed.

Option 2 is for projects with products with either product-specific or Environmental Product Declarations (EPDs) or industry-wide EPDs. Products must be sourced from multiple manufacturers, as indicated in the Required Performance Criteria. Various thresholds are available to accommodate stages of EPD development in different industries.

The table below compares different EPD formats to product-specific declarations:

	Product-Specific Declaration	Industry-Wide EPD	Product-Specific EPD
Data are critically reviewed	x	x	x
Data are specific to product	x		x
Data are reported according to product category rules (PCR)			x

Reference Guide for Building Design and Construction. Washington, DC: US Green Building Council, 2013. Print.

Suggested Implementation in the Design Process:

In Predesign and early design, refer to Additional Resources section below for information on product-specific declarations, EPDs, and how to obtain them.

Use the databases listed in Tools & Resources to search for common building product categories with disclosed EPDs. Material categories that are likely to have EPDs are wood products and interior finishes.

If, at this stage, a particular manufacturer and/or product is intended as a partner, contact manufacturer and learn about their current product life-cycle assessments. Refer to Tools and Resources section of M.1B for information on how to create a product-specific declaration or an Environmental Product Declaration.

Establish an initial list of products or building materials for the project. Review and update this list at each stage of the project. This will be useful for the Design phase in order to research compliant products. Also track whether the products or product categories identified are anticipated to meet option 1 (product-specific declaration) or option 2 (EPD).

Through the design process, refine selection of products and/or materials and establish a list of potential manufacturers. Review online resources for available product-specific declarations or EPDs that match the specified products or building materials for the project. Contact manufacturers and inquire about their current product life-cycle assessments. If needed, provide information on how to create a product-specific declaration and/or an EPD. Create specifications ensuring that this guideline can be met. Some additional information on specifying compliant products can be found under Additional Resources below.

Begin collecting documentation on compliant products by compiling product-specific declarations and/or EPDs and upload to the B3 Guidelines Tracking Tool. Declarations are typically in the form of a PDF document. If a product-specific declaration or EPD is in the process of being created for a particular product or building material, a PCR may be submitted in the Design phase and replaced by the completed documentation at the Final Design phase in the B3 Guidelines Tracking Tool.

In the construction documents phase of the project, establish final selection of compliant products and/or materials, ensuring that at least five meet the criteria here. It is recommended that the design team have researched and specified more than five products anticipating that some may not be eventually installed in the product due to requested changes or product availability. In the Tracking Tool submit at least five final product-specific declarations or EPDs. If necessary, make appropriate updates to products where only a PCR was submitted in the previous phase. Keep all documentation pertaining to specified products or materials.

During construction check in periodically with team members (contractors, subcontractors, and suppliers) to verify progress toward guideline achievement and address any gaps in credit compliance.

Continually track substitutions and change orders to ensure replacement products comply with the guidelines. Any product and/or building material substitutions or submittals should be carefully reviewed by the design team for compliance with the guidelines. Compile documentation to verify environmental claims for each product. Retain product data for all materials that contribute to guideline compliance.

Documentation of Product-Specific Declarations:

Declarations based on a life-cycle assessment of a product but not constituting a full EPD: To document this claim, the project team must provide the following information:

- Name (declaration holder or producer, typically the manufacturer)
- Contact information
- Product type
- Product name
- Product description
- Summary of impact categories measured and overall values
- Functional unit
- Standards met
- Independent review body name, including a review statement.

Documentation of Environmental Product Declarations (EPDs)

Documentation of an EPD (this includes Industry-wide or "generic" declarations, and product-specific Type III declarations). The project team must provide the following:

- Declaration holder (the company, usually the manufacturer, that the EPD is attributed to).
- EPD program operator (the entity that creates and registers the EPD).
- LCA verifier (the third-party entity that verifies the life cycle assessment).
- PCR reviewer (the third-party entity that has reviewed the product category rules).
- During the selection of products with EPDs, identify two items about the document: the type of EPD it is, and the summary that will be uploaded for guideline compliance.

Note that similar products from the same manufacturer can be counted as separate products if they have distinct formulations, but not if they are just aesthetic variations or reconfigurations. For example: Paints of different gloss levels are separate products, but different colors of the same paint, or different colorways of the same carpet, are not. During collection of EPDs ensure that EPD documentation includes a summary sheet of measured impacts.

Submittal Requirements: M.1B

Design:

- M.1B: Submit at least five different Product Declarations or Environmental Product Declarations that comply with the guideline requirements.

Final Design:

- M.1B: Submit at least five different Product Declarations or Environmental Product Declarations that comply with the guideline requirements.

Additional Resources

Standard EN15978: "Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method" https://www.en-standard.eu/csn-en-15978-sustainability-of-construction-works-assessment-of-environmental-performance-of-buildings-calculation-method/

Environmental Product Declarations: The International EPD® System: www.environdec.com/

Healthy Building Network and Pharos: www.healthybuilding.net/content/pharos-v3

Thinkstep: www.thinkstep.com

Underwriter's Laboratory (UL) SPOT database: www.ul.com and https://spot.ulprospector.com/en/na/BuiltEnvironment

ICC Evaluation Service: ICC-ES technical evaluations: www.icc-es.org

NSF International: www.nsf.org

Declare Products: www.living-future.org/declare-products

Cradle2Cradle: www.c2ccertified.org

Greenguard: UL Environment's GREENGUARD Certification program: www.greenguard.org/

Ecoinvent: http://www.ecoinvent.org/

Athena Sustainable Materials Institute: http://www.athenasmi.org/our-software-data/lca-databases/

openLCA Nexus: https://nexus.openlca.org/database

ISO Standards: http://www.iso.org/iso/home.htm

Glossary

Reference Building

A base-case whole-building LCA model used to compare performance with design cases. Embodied global warming potential (GWP) reductions for compliance Path 1 are measured by comparing embodied GWP of the design cases to the embodied GWP of the Reference Building. There are four accepted methods of determining the design of the Reference Building, discussed in the Meeting the Guidelines section.

Selected Building Design

The final design case whole-building LCA model, representing the building as it is expected to be built. The final global warming potential (GWP) reduction for compliance Path 1 is measured by comparing embodied GWP of the Selected Building Design to the embodied GWP of the Reference Building.

Reference Model

A base-case structural bay LCA model used to compare performance with design cases. Embodied global warming potential (GWP) reductions for compliance Path 2 are measured by comparing embodied GWP of the design cases to the embodied GWP of the Reference Model. The exact contents of the structural bay model are discussed in the Meeting the Guidelines section.

Selected Design Model

The final design case structural bay LCA model, representing the building as it is expected to be built. The final global warming potential (GWP) reduction for compliance Path 2 is measured by comparing embodied GWP of the Selected Design Model to the embodied GWP of the Reference Model.

Guideline M.2: Environmentally Preferable Materials

Intent

To improve environmental impacts of construction through the selection of environmentally preferable materials and products.

Required Performance Criteria

A. At least 55% of the total building materials used in the project must have one of the following attributes: salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced or regional as defined in Sections 1 through 6 below. The combined calculation is based on mass, volume or cost. Where a material has more than one attribute, the material value will be multiplied by its number of qualifying attributes.[15]

1. Salvaged or reused materials and components:
   i. The salvaged material content will be determined based on the actual mass, volume, or cost of the salvaged material or the cost of a comparable alternative component material. Portions of a building retained and reused in a renovation may contribute in this category.[16]
2. Recycled content:
   Recycled content building materials must comply with one of the following:
   i. Contain not less than 25% combined postconsumer and/or pre-consumer recovered material, and be recyclable (see definition in 3 below).
   ii. Contain not less than 50% combined postconsumer and/or pre-consumer recovered material.
3. Bio-based:
   Bio-based materials are materials that comply with one or more of the following:
   i. The bio-based content is not less than 75% as determined by testing in accordance with ASTM D6866.
   ii. The requirements of USDA 7CFR Part 2902.
4. Responsible sourced:
   Responsibly sourced materials are materials that comply with the following:
   i. Wood and wood products labeled in accordance with the following standards:[17]
   ii. If wood comes from a North American source, it is certified using SFI, FSC, CSA, or ATF.
   iii. If wood comes from a source outside North America, it is certified using FSC or PEFC.
   iv. Other approved standards for extraction of raw materials (see additional resources in Meeting the Guidelines below).

[15] This section is aligned with International Green Construction Code (IGCC) and ANSI/ASHRAE/USGBC/IES Standard 189.1, Section "505.1 Material selection and properties." Areas that differ are noted in subsequent footnotes. Recycleable materials contribute to the IGCC guideline but do not contribute to meeting this guideline

[16] Salvaged or reused category differs from the IGCC requirements.

[17] Wood product requirements differ from the IGCC.

5. Regional:
   Regional materials or components must be composed of resources that are recovered, harvested, extracted, and manufactured within a 500-mile radius of the building site.
   i. Where only a portion of a material or product is recovered, harvested, extracted, and manufactured within 500 miles, only that portion can be included.
   ii. Where resources are transported by water or rail, the distance to the building site must be determined by multiplying the distance that the resources are transported by water or rail by 0.25, and adding that number to the distance transported by means other than water or rail.

Recommended Performance Criteria

B. At least 75% of the total building materials combined to be used in the project must have one of the following attributes: salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced, or regional as defined in the preceding section.

Meeting the Guidelines

Implementation During the Design Process:
During Design, make initial selection of building materials and products with the following attributes: salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced, or regional.

During the construction documents phase, represent chosen materials from Guideline M.2 in drawings and specifications. Ensure that 55% compliance level for environmentally preferable materials is met. Through construction, monitor submittals to ensure project includes selected materials; review substitutions based on selected criteria to ensure consistency and compliance with goals and objectives.

Other Approved Responsible Sourcing Standards:

There are no additional approved responsible sourcing standards at this time.

Submittal Requirements

Design:

- M.2A and M.2B: Selection of preliminary calculation method (mass, volume, or cost), total anticipated material mass, volume or cost, a list of building materials anticipated to achieve compliance with this guideline. This will include the material name, manufacturer (if known at this phase) and the percent contribution of each attribute category (salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced, or regional).

Final Design:

- M.2A and M.2B: Selection of calculation method (mass, volume, or cost), total anticipated material mass, volume or cost, a list of building materials anticipated to achieve compliance with this guideline. This will include the material name, manufacturer (if known at this phase) and the percent contribution of each attribute category (salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced, or regional).

Closeout:

- M.2A and M.2B: Verification of calculation method (mass, volume, or cost), total anticipated material mass, volume or cost, a list of installed building materials used to achieve compliance with this guideline. This will include the material name, manufacturer (if known at this phase) and the percent contribution of each attribute category (salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced, or regional).

Additional Resources

2015 International Green Construction Code: https://www.iccsafe.org/codes-tech-support/international-green-construction-code-igcc/international-green-construction-code/

ANSI/ASHRAE/USGBC/IES Standard 189.1-2014, Standard for the Design of High Performance Green Buildings: https://www.ashrae.org/resources--publications/bookstore/standard-189-1

ASTM D6866: https://www.astm.org/Standards/D6866.htm

SFI Standard: http://www.sfiprogram.org/sfi-standard/

FSC STD-40-004 V2-1 EN: https://us.fsc.org/preview.fsc-std-40-004-v3-0-chain-of-custody-certification.a-561.pdf

CSA Standard: http://www.csasfmforests.ca/

PEFC Council Technical Document: https://www.pefc.org/resources/technical-documentation/pefc-international-standards-2010

USDA 7CFR Part 2902: https://www.gpo.gov/fdsys/granule/CFR-2010-title7-vol15/CFR-2010-title7-vol15-part2902

Glossary

Bio-Based Material

A commercial or industrial material or product, other than food or feed, that is composed of, or derived from, in whole or in significant part, biological products or renewable domestic agricultural materials, including plant, animal, and marine materials, or forestry materials (IGCC 2015).

Post-Consumer Recycled Content

The proportion of recycled material in a product generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product that can no longer be used for its intended purpose. This includes returns of material from the distribution chain (IGCC 2015).

Pre-Consumer (Post-Industrial) Recycled Content

The proportion of recycled material in a product diverted from the waste stream during the manufacturing process. Pre-consumer recycled content does not include reutilization of material such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it (IGCC 2015).

Raw Material

The basic substance from which products are made, such as concrete, glass, gypsum, masonry, metals, recycled materials (e.g., plastics and metals), oil (petroleum, polylactic acid), stone, agrifiber, bamboo, and wood (LEED v.4).

Reuse

To divert a material, product, component, module, or a building from the waste stream in order to use it again (IGCC 2015). Reuse includes the recovery and reemployment of materials recovered from existing building or construction sites. Also known as salvage (LEED v.4).

Total Building Materials

Includes all building materials except electrical, mechanical, plumbing, security and fire detection, and alarm equipment and controls, automatic fire sprinkler systems, elevators and conveying systems (IGCC 2015).

Wood

Plant-based materials that are eligible for certification under the FSC and other programs. Examples include bamboo and palm (monocots) as well as hardwoods (angiosperms) and softwoods (gymnosperms) (LEED v.4).

Guideline M.3: Waste Reduction and Management

Intent

To minimize use of resources and negative environmental impacts through design decisions and careful reduction and management of waste generated during the construction process and building occupancy.

Required Performance Criteria[18]

A. Material Conservation and Waste Management Plan[19]

Create a material conservation and waste management plan that includes the sections outlined below:

1. A plan to adaptively reuse an existing structure or salvage and reuse materials from an existing structure being demolished or deconstructed onsite.
2. A plan to select materials with appropriate durability for service life. In many cases, state-funded buildings are intended to have a 50–100 year service life for the structure and envelope.
3. A plan to specify the use of prefabricated products, preassembled products, and/or modular building units to minimize construction waste onsite.
4. A plan that addresses both partial deconstruction (for renovations) and total deconstruction (for end-of-life removal) of the building to maximize the reuse and recycling of building components and materials. Indicate specific strategies to facilitate disassembly.
5. A construction waste management plan that includes the following:
    i. Specification of materials to be diverted from disposal by efficient usage, recycling, reuse, manufacturer's reclamation, or salvage for future use, donation or sale.
    ii. Specification of the percentage of materials to be diverted ; calculate by weight or volume, but not both. Include separate average percentages for those materials collected by construction and demolition materials processing facilities that end up as alternative daily cover and incineration.
6. An operational waste plan that includes the following:
    i. Description of waste streams and discuss how waste will be minimized and diverted from disposal (recycled, composted, reverse distribution).
    ii. Description of the collection plan including a collection plan for consumables and durables (this can be done at a campus or organization scale).

B. Construction Waste Reduction

At least 75% of nonhazardous construction and demolition waste must be diverted from landfill. The percentage of materials diverted can be calculated by weight or volume, but not both.[20]

For the purposes of this section, construction materials and waste include, but are not limited to (1) all materials delivered to the site and intended for installation prior to the issuance of the certificate of occupancy, including related packaging; (2) construction materials and waste removal during demolition or razing. For the purposes of this section, construction and waste materials do not include land-clearing debris (including trees, rocks, and vegetation), excavated soils, and fill and base materials such as topsoil, sand, and gravel. Waste used as alternative daily cover or in waste-to-energy incineration will not be counted as diverted material.

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[18] This section is aligned with International Green Construction Code (IGCC) and ANSI/ASHRAE/USGBC/IES Standard 189.1, Section "1006.1 Deconstruction and demolition material and waste management plan." Areas that differ are noted in subsequent footnotes.

[19] Differs from the IGCC requirements.

[20] Differs from the IGCC requirements.

Recommended Performance Criteria

C. Additional Construction Waste Reduction
At least 90% of nonhazardous construction and demolition waste must be diverted from landfill. The percentage of materials diverted can be calculated by weight or volume, but not both.

Meeting the Guidelines

During Predesign, ensure that adequate space is planned for dedicated recycling areas, processing and holding space, and reverse distribution space in the building. Begin to draft a Material Conservation and Waste Management Plan.
At site selection, evaluate the potential for adaptive reuse of an existing structure or salvage and reuse materials from an existing structure being demolished onsite.
Ensure that products are selected and specified that have appropriate durability. Specify the use of prefabricated products, preassembled products, and/or modular building units to minimize construction waste onsite. Incorporate design for disassembly and deconstruction that addresses both partial deconstruction (for renovations) and total deconstruction (for end of life removal). Verify that recycling areas are included in plans.
As the construction documents are being developed, incorporate details and specifications that support the minimization of material use and clearly require construction waste management that meets project requirements. Include specification language mandating compliance with the pursued level of construction waste landfill diversion. Request reduced, reused, or eliminated material packaging. Develop detailing and construction recommendations that minimize material use and maximize performance of materials to support intended goals of durability, disassembly, and use of prefabricated products, preassembled products, and/or modular building units. Compile material and product documentation from the manufacturer, declaring life cycle and warranty recommendations indicating durable life cycle projections for building components. Provide specifications that require contractor submittals highlighting service life of materials installed.
During construction administration monitor submittals to ensure project construction waste diversion meets requirements. Review revisions to program to ensure consistency and compliance with goals and objectives.

Submittal Requirements

Design:

- M.3A: Material conservation plan.

Final Design:

- M.3A: Material conservation report (on execution of the material conservation plan), specification mandating waste management plan, and draft of operational waste management plan.

Closeout:

- M.3A: Operational waste management plan and waste management report
- M.3B and M.3C: A waste management report documenting actual construction waste disposal and recycling rates of at least 75% diversion (90% if pursuing M.3C), including receipts or other documentation related to diversion through the course of construction.

Additional Resources

2015 International Green Construction Code: https://www.iccsafe.org/codes-tech-support/international-green-construction-code-igcc/international-green-construction-code/

ANSI/ASHRAE/USGBC/IES Standard 189.1-2014, Standard for the Design of High Performance Green Buildings: https://www.ashrae.org/resources--publications/bookstore/standard-189-1

Living Building Challenge includes standards on net positive waste: https://living-future.org/lbc/

Glossary

Deconstruction:

The process of systematically disassembling a building, structure, or portion thereof, so that the materials, products, components, assemblies, and modules can be salvaged for repurpose, reuse, or recycling (IGCC 2015).

Guideline M.4: Health

Intent

To minimize potentially hazardous materials used in B3 projects.

Required Performance Criteria

A. Demonstrate that the chemical inventories of at least ten permanently installed interior materials from at least five different manufacturers do not contain likely hazardous materials by one of the following screening methods: [21]

1. GreenScreen List Translator: Qualifying materials must demonstrate, based on a full chemical inventory to 100 ppm, that they are free of List-Translator-1 (LT-1) or List-Translator Possible 1 chemicals (LT-P1) as defined by the most current version of GreenScreen.
2. Full GreenScreen Assessment: Qualifying materials must demonstrate, based on a full chemical inventory to 100 ppm that they are free of Benchmark-1 (BM-1) chemicals as defined by the most current version of GreenScreen. A GreenScreen label indicating the product is free of BM-1 chemicals is sufficient for this method.
3. Products certified under Cradle to Cradle v2 Gold or Platinum or Cradle to Cradle v3 Silver, Gold or Platinum.
4. Products certified as meeting Declare Label Declaration Status of LBC Red List Free

Qualifying materials that are among the ten most prevalent by area may be double-counted. If a project team is unable to find adequate available compliant materials, documentation of letters to manufacturers requesting GreenScreen BM-1, List Translator results for products not currently reporting GreenScreen hazard assessment will be accepted. The team may also document the request for materials that have identified BM-1 chemicals to remove these chemicals from the product. Each documented requests for product evaluation may contribute as one material under this guideline. Compliance is determined by identification and specification of compliant products. Manufacturers may report qualification under Part 1 or Part 2 above by inclusion in a Health Product Declaration (HPD).

[21] This section is aligned with in part on USGBC, "Materials and Resources Credit: Building product disclosure and optimization, Option 2: Material Ingredients," *LEED Building Design and Construction v.4*, though with different required numbers of materials submitted for compliance and with different available methods of chemical inventory verification.

B. Mercury content in fluorescent lamps. The mercury content in straight fluorescent lamps and compact fluorescent lamps must comply with the limitations stated below.[22]
    1. Straight fluorescent lamps.
        A. Non-preheat straight, double-ended fluorescent lamps less than 70 inches (1800 mm) and greater than 21 inches (550 mm) in length and containing a medium bi-pin base or miniature bi-pin base must comply with the following:
        B. T-5 lamps with a rated lifetime of less than 25,00 hours at 3 hours per start must not contain more than an average of 3 milligrams of mercury per lamp.
        C. T-8 lamps with a rated lifetime less than 25,000 hours at 3 hours per start on an instant start ballast must not contain more than an average of 4 milligrams of mercury per lamp.
        D. All other T5 or T8 lamps must not contain more than an average of 5 milligrams of mercury per lamp.
    2. Compact fluorescent lamps.
        Single-ended pin- base and screw-base compact fluorescent lamps must not contain more than an average of 5 milligrams of mercury per lamp, and must be listed and labeled in accordance with UL 1993.
        Exception: mercury content is not limited for lighting integral to equipment or instrumentation and installed by the manufacturer, or for lamps with a high color-rendering index that is greater than or equal to 87.

Recommended Performance Criteria

C. Demonstrate that the chemical inventories of all permanently installed interior materials do not contain any Benchmark-1 chemicals as defined by the most current version of GreenScreen.
D. Demonstrate that the chemical inventories of at least ten different permanently installed interior materials from at least five different manufacturers do not contain any Benchmark-2 chemicals as defined by the most current version of GreenScreen.

Meeting the Guidelines

Implementation in the Design Process:

For M.4A, M.4C and M.4D:

In Predesign and early design, determine likely product categories that will contribute to compliance with this requirement. Early product research should be conducted to evaluate opportunities specific to project needs. This may be done by searching for approved products in databases or by contacting product reps and manufacturers. GreenScreen certification marks compliant with LEED v.4 are acceptable as documentation for B3 compliance. Health Product Declarations (HPDs) may also demonstrate GreenScreen results.

Through the design process refine contributing product list and look for opportunities to add contributing products as the design changes. A product may contribute toward M.4A, M.4C or M.4D if that product has been evaluated as defined in GreenScreen v1.2 Benchmark, has received a Cradle to Cradle (C2C) v2 Gold or Platinum or Cradle to Cradle v3 Silver, Gold or Platinum certification, or are certified as meeting Declare Label Declaration Status of LBC Red List Free.

[22] This section is aligned with International Green Construction Code (IGCC) and ANSI/ASHRAE/USGBC/IES Standard 189.1, Section "506.1 Mercury Content in Fluorescent Lamps."

Under GreenScreen products that have fully inventoried chemical ingredients to 100 ppm that have no LT-1, LT-P1 or BM-1 (Benchmark 1) hazards are:

- Any materials that have all its ingredients assessed with the GreenScreen List Translator and have been found to be free of LT-1 chemicals.
- Any materials for which all ingredients have undergone a full GreenScreen Assessment and have been found to be free of BM-1 chemicals.
- Any materials referenced in the Pharos or Portico databases and vetted for use in B3 Guidelines documenting either no LT-1 or no BM-1 chemicals.

For M.4B:

As in early design, evaluate opportunities for reduction in fluorescent fixtures to reduce the need for low-mercury bulbs. In construction documents specify any fluorescent lamps that fall under this guideline meet the limits specified above.

Submittal Requirements

Design:

- M.4A, M.4C, and M.4D: Submit list of identified product types anticipated to comply with this guideline.
- M.4B: Submit list of fluorescent lighting fixtures or systems expected to fall under this guideline.

Final Design:

- M.4A, M4C, and M4D: Submit specified materials list compliant with this guideline, including documentation of: GreenScreen compliance at one of the listed allowable levels or documentation of product manufacturer requests.
- M.4B: Submit list of fluorescent lighting fixtures or systems falling under this guideline and compliant specifications.

Closeout:

- M.4A, M.4C, and M.4D: Submit documentation of final product selection and any received responses from product manufacturers in response to requests for information.
- M.4B: Submit documentation that relevant lighting fixtures comply with this guideline.

Additional Resources

How to Use GreenScreen for LEED v.4: http://www.greenscreenchemicals.org/practice/leed

Full GreenScreen Chemical Hazard Assessment Procedure: http://www.greenscreenchemicals.org/learn/full-greenscreen-method

GreenScreen Assessment Report Template: https://www.pharosproject.net/uploads/files/gs/1405445287.pdf

GreenScreen Information Sources :https://chemicalprofiler.wiki.zoho.com/List-of-Lists.html

GreenScreen List Translator: http://www.greenscreenchemicals.org/method/greenscreen-list-translator

Understanding GreenScreen and List Translator Benchmarks: https://www.buildinggreen.com/primer/understanding-greenscreen-and-list-translator-benchmarks

GreenScreen Store: http://www.greenscreenchemicals.org/gs-assessments

Cradle to Cradle Certified Products Registry: http://www.c2ccertified.org/products/registry

Interstate Chemicals Clearinghouse: http://www.theic2.org/hazard-assessment

Declare Label: https://living-future.org/declare/declare-about/

Glossary

Interior Materials

Interior materials are defined as all materials interior to the enclosure's least vapor-permeable and continually air-sealed barrier system. For most enclosure systems, this definition will encompass all materials interior and exclusive of the vapor barrier. For some assemblies with several systems providing vapor impermeability, a further determination will need to be made.

Continually Air-Sealed Barrier System

A set of air-sealed building materials that is intended to prevent air-flow through a wall assembly. This may take the form of a continually sealed vapor barrier or a set of materials that when combined provide the least vapor-permeable system. Note that some materials have low vapor permeability but may not be part of a continually sealed system and would not be considered to be the boundary of the building's interior.