

LEED for Neighborhood Development

Activity #4

Before completing this Activity Read: Reference Guide for Neighborhood Development v4 – Pages 305-484

Fill-In, Multiple Choice, Matching

Although the LEED ND reference guide does not number the LEED prerequisites and credits, for this exercise they have been numbered in the order presented in the credit category.

1. Test your knowledge of how well you know the names of the credits for the Green Infrastructure and Buildings (GIB) credit category:

Credit	Name
P1	certified Green Building
P2	Minimum Building Energy Performance
P3	Indoor Water Use Reduction
P4	Construction Activity Pollution Prevention
C1	Certified Green Buildings
C2	Optimize Building Energy Performance
C3	Indoor Water Use Reduction
C4	Outdoor Water Use Reduction
C5	Building Reuse
C6	Historic Reuse Preservation and Adaptive Reuse
C7	Minimized Site Disturbance
C8	Rainwater Management
C9	Heat Island Reduction
C10	Solar Orientation
C11	Renewable Energy Production
C12	District Heating and Cooling
C13	Infrastructure Energy Efficiency
C14	Wastewater Management
C15	Recycled and Reused Infrastructure
C16	Solid Waste Management
C17	Light Pollution Reduction

2. Match the intent shown below to the prerequisite or credit:

Credit	ANS	Credit	ANS	Credit	ANS
GIB – P1	Q	GIB – C4	E	GIB – C11	L
GIB – P2	J	GIB – C5	O	GIB – C12	C
GIB – P3	M	GIB – C6	F	GIB – C13	N
GIB – P4	D	GIB – C7	H	GIB – C14	G
GIB – C1	Q	GIB – C8	R	GIB – C15	P
GIB – C2	J	GIB – C9	B	GIB – C16	A
GIB – C3	M	GIB – C10	K	GIB – C17	I

	INTENT
A	To reduce the volume of waste deposited in landfills and promote the proper disposal of hazardous waste.
B	To minimize effects on microclimates and human and wildlife habitats by reducing heat islands.
C	To encourage the development of energy-efficient neighborhoods by employing district heating and cooling strategies that reduce energy use and energy-related environmental harms.
D	To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust.
E	To reduce outdoor water consumption.
F	To respect local and national landmarks and conserve material and cultural resources by encouraging the preservation and adaptive reuse of historic buildings and cultural landscapes.
G	To reduce pollution from wastewater and encourage water reuse.
H	To preserve existing noninvasive trees, native plants, and pervious surfaces.
I	To increase night sky access, improve nighttime visibility, and reduce the consequences of development for wildlife and people.
J	To encourage the design and construction of energy-efficient buildings that reduce air, water, and land pollution and environmental damage from energy production and consumption.
K	To encourage energy efficiency by creating optimum conditions for the use of passive and active solar strategies.
L	To reduce the environmental and economic harms associated with fossil fuel energy by increasing self-supply of renewable energy.
M	To reduce indoor water consumption.
N	To reduce the environmental harms from energy used for operating public infrastructure.
O	To extend the life cycle of buildings and conserve resources, reduce waste, and reduce environmental harm from materials manufacturing and transport for new buildings.
P	To avoid the environmental consequences of extracting and processing virgin materials by using recycled and reclaimed materials.
Q	To encourage the design, construction, and retrofit of buildings using green building practices.
R	To reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region.

- Sustainable building technologies reduce waste and use energy, water, and materials more efficiently than conventional building practices.
- Energy efficiency is an essential strategy for reducing pollution and greenhouse gas emissions, which are possibly the most negative environmental consequences of building and infrastructure operation.
- Many commonly used products are now available with recycled content, including metals, concrete, masonry, acoustic tile, carpet, ceramic tile, and insulation.

6. Changes to hydrology may deplete aquifers, reduce stream base flow, and cause thermal stress, flooding, and stream channel erosion.
7. The use of dark, nonreflective materials for parking, roofs, walkways, and other surfaces raises ambient temperatures when radiation from the sun is absorbed and transferred through convection and conduction back to surrounding areas.
8. Indoors, potable water consumption can be reduced by using low-flow plumbing fixtures and waterless urinals.
9. Outdoor water use, primarily for landscape maintenance, accounts for a large share of U.S. water consumption and can be reduced through careful plant selection and landscape design.
10. Wastewater can also be reused for landscape maintenance.

11. GIB Prerequisite: Certified Green Building Requirements

Design, construct, or retrofit one whole building within the project to be certified through a LEED rating system (if LEED for Interior Design and Construction, 75% of the total building floor area must be certified), or through a green building rating system requiring review by independent, impartial, third-party certifying bodies that have been accredited by an IAF-accredited body to ISO/IEC Guide 65 or, when available, ISO/IEC 17065.

Consider also that a certified green commercial building is likely to increase workers' productivity and reduce utility costs and should therefore command a premium in rents or sales price.

12. GIB Prerequisite: Minimum Building Energy Performance Requirements

The requirements apply to 90% of the total building floor area (rounded up to the next whole building) of all nonresidential buildings, mixed-use buildings, and multiunit residential buildings four stories or more constructed as part of the project or undergoing major renovations as part of the project. Each counted building must comply with one of the following options.

OPTION 1. WHOLE-BUILDING ENERGY SIMULATION

Demonstrate an average improvement of 5% for new buildings, 3% for major building renovations, or 2% for core and shell buildings over ANSI/ASHRAE/IESNA Standard 90.1-2010, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.) across all buildings pursuing Option 1. Multiple buildings may be grouped into a single energy model, provided (1) the building type (new construction, major renovation, or core and shell) is consistent for all buildings included in the energy model, or (2) an average 5% improvement is demonstrated for the entire energy model. Calculate the baseline building performance according to ANSI/ASHRAE/IESNA Standard 90.1-2010, Appendix G, with errata, using a simulation model.

Buildings must meet the minimum percentage savings before taking credit for renewable energy systems.

Each building's proposed design must meet the following criteria:

- compliance with the mandatory provisions of ANSI/ASHRAE/IESNA Standard 90.1-2010, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.);
- inclusion of all energy consumption and costs within and associated with the building project; and
- comparison against a baseline building that complies with Standard 90.1-2010, Appendix G, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.).

Document the energy modeling input assumptions for unregulated loads. Unregulated loads should be modeled accurately to reflect the actual expected energy consumption of the building.

If unregulated loads are not identical for both the baseline and the proposed building performance rating, and the simulation program cannot accurately model the savings, follow the exceptional calculation method (ANSI/ASHRAE/IESNA Standard 90.1-2010, G2.5). Alternatively, use the COMNET modeling guidelines and procedures to document measures that reduce unregulated loads.

OR

OPTION 2. PRESCRIPTIVE COMPLIANCE: ASHRAE 50% ADVANCED ENERGY DESIGN GUIDE

Comply with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1-2010, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.).

Comply with HVAC and service water heating requirements applicable to the each building, including equipment efficiency, economizers, ventilation, and ducts and dampers, for the appropriate ASHRAE 50% Advanced Energy Design Guide and climate zone:

- ASHRAE 50% Advanced Energy Design Guide for Small to Medium Office Buildings, for office buildings smaller than 100,000 square feet (9 290 square meters);
- ASHRAE 50% Advanced Energy Design Guide for Medium to Large Box Retail Buildings, for retail buildings with 20,000 to 100,000 square feet (1 860 to 9 290 square meters);
- ASHRAE 50% Advanced Energy Design Guide for K-12 School Buildings; or
- ASHRAE 50% Advanced Energy Design Guide for Large Hospitals. Over 100,000 square feet (9 290 square meters)

For projects outside the U.S., consult ASHRAE/ASHRAE/IESNA Standard 90.1-2010, Appendixes B and D, to determine the appropriate climate zone.

OPTION 3. PRESCRIPTIVE COMPLIANCE: ADVANCED BUILDINGS CORE PERFORMANCE GUIDE

Comply with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1-2010, with errata (or USGBC approved equivalent standard for projects outside the U.S.).

Comply with Section 1: Design Process Strategies, Section 2: Core Performance Requirements, and the following three strategies from Section 3: Enhanced Performance Strategies, as applicable. Where standards conflict, follow the more stringent of the two. For projects outside the U.S., consult ASHRAE/ASHRAE/IESNA Standard 90.1-2010, Appendixes B and D, to determine the appropriate climate zone.

3.5 Supply Air Temperature Reset (VAV)

3.9 Premium Economizer Performance

3.10 Variable Speed Control

To be eligible for Option 3, the project must be less than 100,000 square feet (9 290 square meters).

Note: Healthcare, Warehouse or Laboratory projects are ineligible for Option 3.

AND

For new single-family residential buildings and new multiunit residential buildings three stories or fewer, 90% of the buildings must meet the requirements of LEED for Homes v4 EA Prerequisite Minimum Energy Performance.

13. GIB Prerequisite: Indoor Water Use Reduction

Requirements

Nonresidential Buildings, Mixed-Use Buildings, and Multifamily Residential Buildings four Stories or More For new buildings and buildings undergoing major renovations as part of the project, reduce indoor water usage by an average of 20% from a baseline. All newly installed toilets, urinals, private lavatory faucets, and showerheads that are eligible for labeling must be WaterSense labeled (or a local equivalent for projects outside the U.S.).

For the fixtures and fittings listed in Table 1, as applicable to the project scope, reduce water consumption by 20% from the baseline. Base calculations on the volumes and flow rates shown in Table 1.

The design case is calculated as a weighted average of water usage for the buildings constructed as part of the project based on their floor area.

TABLE 1. Baseline water consumption of fixtures and fittings

Fixture or fitting	Baseline (IP units)	Baseline (SI units)
Toilet (water closet)*	1.6 gpf	6 lpf
Urinal*	1.0 gpf	3.8 lpf
Public lavatory (restroom) faucet	0.5 gpm at 60 psi all others except private applications	1.9 lpm at 415 kPa, all others except private applications
Private lavatory faucet*	2.2 gpm at 60 psi	8.3 lpm at 415 kPa
Kitchen faucet (excluding faucets used exclusively for filling operations)	2.2 gpm at 60 psi	8.3 lpm at 415 kPa
Showerhead*	2.5 gpm at 80 psi per shower stall	9.5 lpm at 550 kPa per shower stall

* WaterSense label available for this product type

gpf = gallons per flush

gpm = gallons per minute

psi = pounds per square inch

lpf = liters per flush

lpm = liters per minute

kPa = kilopascals

New Single-Family Residential Buildings and New Multiunit Residential Buildings Three Stories or Fewer 90% of residential buildings must use a combination of fixtures and fittings that would earn 2 points under LEED for Homes v4 WE Credit Indoor Water Use Reduction

14. GIB Prerequisite: Construction Activity Pollution Prevention

Requirements

Create and implement an erosion and sedimentation control plan for all new construction activities associated with the project. The plan must incorporate best management practices (BMPs) to control erosion and sedimentation in runoff from the entire project site during construction. The BMPs must be selected from EPA's BMPs for construction and post-construction site runoff control.

The erosion and sedimentation control plan must list the BMPs employed and describe how the project team will do the following:

- preserve vegetation and mark clearing limits;
- establish and delineate construction access;
- control flow rates;
- install sediment controls;
- stabilize soils;
- prevent soil loss during construction;
- stockpile topsoil for reuse;
- protect slopes;
- protect drain inlets, all rainwater conveyance systems, and receiving water bodies;

- stabilize channels and outlets;
- control pollutants including dust and particulate matter;
- control dewatering;
- maintain the BMPs; and
- manage the erosion and sedimentation control plan.

15. GIB Credit: Certified Green Building Requirements

OPTION 1. PROJECTS WITH 10 OR FEWER HABITABLE BUILDINGS (1–5 POINTS)

Design, construct, or retrofit one building as part of the project, beyond the prerequisite requirement, to be certified under a LEED green building rating systems (for LEED for Interior Design and Construction, 75% of the total building floor area must be certified), or through a green building rating system requiring review by independent, impartial, third-party certifying bodies that have been accredited by an IAF-accredited body to ISO/IEC Guide 65 or, when available, ISO/IEC 17065. Up to five points may be earned for each additional certified building that is part of the project.

OR

OPTION 2. PROJECTS OF ALL SIZES (1–5 POINTS)

Design, construct, or retrofit a percentage of the total project building floor area, beyond the prerequisite requirement, to be certified under a LEED green building rating systems or through a green building rating system requiring review by independent, impartial, third-party certifying bodies that have been accredited by an IAF accredited body to ISO/IEC Guide 65 or, when available, ISO/IEC 17065.

TABLE 1. Points for green building certification	
Percentage of total floor area certified	Points
≥ 10% and < 20%	1
≥ 20% and < 30%	2
≥ 30% and < 40%	3
≥ 40% and < 50%	4
≥ 50%	5

For all projects

Detached accessory dwelling units must be counted as separate buildings. Accessory dwellings attached to a main building are not counted separately.

16. GIB Credit: Optimize Building Energy Performance Requirements

The requirements apply to 90% of the total building floor area (rounded up to the next whole building) of all nonresidential buildings, mixed-use buildings, and multiunit residential buildings four stories or more constructed as part of the project or undergoing major renovations as part of the project.

Each counted building must comply with one of the following efficiency options.

OPTION 1. WHOLE-BUILDING ENERGY SIMULATION (1–2 POINTS)

New buildings must demonstrate an average percentage improvement of 12% (1 point) or 20% (2 points) over ANSI/ASHRAE/IESNA Standard 90.1–2010, with errata. Buildings undergoing major renovations as part of the project must demonstrate an average percentage improvement of 10% (1 point) or 18% (2 points). Core and shell buildings must demonstrate an average percentage improvement of 11% (1 point) or 15% (2 points). To determine percentage improvement, follow the method outlined in GIB Prerequisite Minimum Building Energy Performance.

OR

OPTION 2. PRESCRIPTIVE COMPLIANCE: ASHRAE 50% ADVANCED ENERGY DESIGN GUIDE (2 POINTS)

To be eligible for Option 2, project must comply with all of requirements of Option 2 in GIB Prerequisite Minimum Building Energy Performance.

AND

Comply with the applicable recommendations and standards in Chapter 4, Design Strategies and Recommendations by climate Zone, for the appropriate ASHRAE 50% Advanced Energy Design Guide and climate zone. For projects outside the U.S., consult ASHRAE/ASHRAE/IESNA Standard 90.1–2010, Appendixes B and D, to determine the appropriate climate zone.

ASHRAE 50% Advanced Energy Design Guide for Small to Medium Office Buildings

- Building envelope, opaque: roofs, walls, floors, slabs, doors, and continuous air barriers
- Building envelope, glazing: vertical fenestration
- Interior lighting, including daylighting and interior finishes
- Exterior lighting
- Plug loads, including equipment and controls

ASHRAE 50% Advanced Energy Design Guide for Medium to Large Box Retail Buildings

- Building envelope, opaque: roofs, walls, floors, slabs, doors, and vestibules
- Building envelope, glazing: fenestration - all orientations
- Interior lighting, excluding lighting power density for sales floor
- Additional interior lighting for Sales floor
- Exterior lighting
- Plug loads, including equipment choices and controls

ASHRAE 50% Advanced Energy Design Guide for K–12 School Buildings

- Building envelope, opaque: roofs, walls, floors, slabs, and doors
- Building envelope, glazing: vertical fenestration
- Interior lighting, including daylighting and interior finishes
- Exterior lighting
- Plug loads, including equipment choices, controls, and kitchen equipment

ASHRAE 50% Advanced Design Guide for Large Hospitals

- Building envelope, opaque: roofs, walls, floors, slabs, doors, vestibules, and continuous air barriers
- Building envelope, glazing: vertical fenestration
- Interior lighting, including daylighting (form or nonform driven) and interior finishes
- Exterior lighting
- Plug loads, including equipment choices, controls, and kitchen equipment

For new single-family residential buildings and new multiunit residential buildings three stories or fewer, 90% of the buildings must reduce absolute estimated annual energy usage by 20%

compared with the LEED energy budget for each building. Follow the method outlined in LEED for Homes v4, EA Credit Annual Energy Use.

17. GIB Credit: Indoor Water Use Reduction

Requirements

NONRESIDENTIAL BUILDINGS, MIXED-USE BUILDINGS, AND MULTIFAMILY RESIDENTIAL BUILDINGS FOUR STORIES OR MORE

For new buildings and buildings undergoing major renovations as part of the project, reduce indoor water usage by an average of 40% from a baseline.

All newly installed toilets, urinals, private lavatory faucets, and showerheads that are eligible for labeling must be WaterSense labeled (or local equivalent for projects outside the U.S.).

For fixtures and fittings listed in Table 1, as applicable to the project scope, calculate the baseline water consumption using estimated occupant usage.

The design case is calculated as a weighted average of water usage for the buildings constructed as part of the project, based on their floor area.

TABLE 1. Baseline water consumption of fixtures and fittings

Fixture or fitting	Baseline (IP units)	Baseline (SI units)
Toilet (water closet)*	1.6 gpf	6 lpf
Urinal*	1.0 gpf	3.8 lpf
Public lavatory (restroom) faucet	0.5 gpm at 60 psi all others except private applications	1.9 lpm at 415 kPa, all others except private applications
Private lavatory faucet*	2.2 gpm at 60 psi	8.3 lpm at 415 kPa
Kitchen faucet (excluding faucets used exclusively for filling operations)	2.2 gpm at 60 psi	8.3 lpm at 415 kPa
Showerhead*	2.5 gpm at 80 psi per shower stall	9.5 lpm at 550 kPa per shower stall

* WaterSense label available for this product type
 gpf = gallons per flush
 gpm = gallons per minute
 psi = pounds per square inch

lpf = liters per flush
 lpm = liters per minute
 kPa = kilopascals

NEW SINGLE-FAMILY RESIDENTIAL BUILDINGS AND NEW MULTIUNIT RESIDENTIAL BUILDINGS THREE STORIES OR FEWER

90% of buildings must use a combination of fixtures and fittings that would earn 4 points under LEED for Homes v4 WE Credit Indoor Water Use.

18. GIB Credit: Outdoor Water Use Reduction

Requirements

Reduce outdoor water use through one of the following options. Nonvegetated surfaces, such as permeable or impermeable pavement, should be excluded from landscape area calculations. Athletic fields and playgrounds (if vegetated) and food gardens may be included or excluded at the project team's discretion.

OPTION 1. NO IRRIGATION REQUIRED (2 POINTS)

Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period.

OR

OPTION 2. REDUCED IRRIGATION (1–2 POINTS)

Reduce the project's landscape water requirement (LWR) by at least 30% from the calculated baseline for the site's peak watering month. Reductions must first be achieved through plant species selection and irrigation system efficiency as calculated in the Environmental Protection Agency (EPA) WaterSense Water Budget Tool.

Additional reductions beyond 30% may be achieved using any combination of efficiency, alternative water sources, and smart scheduling technologies.

TABLE 1. Points for reducing irrigation water	
Percentage reduction from baseline	Points
30%	1
50%	2

19. GIB Credit: Building Reuse Requirements

CASE 1. FIVE BUILDINGS OR FEWER

For projects with five or fewer buildings undergoing major renovations, reuse 50% of one such building, based on surface area. Calculations must include structural elements (e.g., floors, roof decking) and enclosure materials (e.g., skin, framing). Exclude from the calculations Window assemblies, nonstructural roofing material, and any hazardous materials that are remediated as part of the project.

CASE 2. MORE THAN FIVE BUILDINGS

For projects with more than five buildings undergoing major renovations, reuse 20% of the total surface area of such buildings (including structure and enclosure materials, as defined in Case 1).

FOR ALL PROJECTS

Do not demolish any historic buildings or contributing buildings in a historic district, or portions thereof, or alter any cultural landscapes as part of the project.

An exception is granted only with approval from an appropriate review body. For buildings or landscapes listed locally, approval must be granted by the local historic preservation review board, or equivalent. For buildings or landscapes listed in a state register or in the National Register of Historic Places (or equivalent for projects outside the U.S.), approval must appear in a programmatic agreement with the state historic preservation office or National Park Service (or local equivalent for projects outside the U.S.).

20. GIB Credit: Historic Resource Preservation and Adaptive Reuse Requirements

This credit is available to projects with at least one historic building, contributing building in a historic district, or cultural landscape on the project site.

Do not demolish any historic buildings or contributing buildings in a historic district, or portions thereof, or alter any cultural landscapes as part of the project.

An exception is granted only with approval from an appropriate review body. For buildings or landscapes listed locally, approval must be granted by the local historic preservation review board, or

equivalent. For buildings or landscapes listed in a state register or in the National Register of Historic Places (or equivalent for projects outside the U.S.), approval must appear in a programmatic agreement with the state historic preservation office or National Park Service (or local equivalent for projects outside the U.S.).

If any historic building or a contributing building in a historic district in the project site is to be altered (rehabilitated, preserved, or restored), use one of the following approaches for each building, as applicable.

- Building subject to local review. Obtain approval, in the form of a certificate of appropriateness, from a local historic preservation commission or architectural review board for any exterior alterations or additions.
- Building subject to state or federal review. If the building is subject to review by a state historic preservation office or the National Park Service (or equivalent body for projects outside the U.S.), the alteration must meet the Secretary of the Interior's Standards for the Treatment of Historic Properties (or equivalent for projects outside the U.S.).
- Listed or eligible building not subject to review. If a building is listed or determined eligible but alteration is not subject to local, state, or federal review, include on the project team a preservation professional who meets the U.S. federal qualifications for historic architects or architectural historians (or a local equivalent for projects outside the U.S.). The preservation professional must confirm adherence to the Secretary of the Interior's Standards for the Treatment of Historic Properties, or a local equivalent for projects outside the U.S.

If a cultural landscape is to be rehabilitated, restored, or preserved, do so in accordance with the Guidelines for the Treatment of Cultural Landscapes or local equivalent for projects outside the U.S. whichever is more Stringent.

21. GIB Credit: Minimized Site Disturbance Requirements

OPTION 1. DEVELOPMENT FOOTPRINT ON PREVIOUSLY DEVELOPED LAND (1 POINT)

Locate 100% of the development footprint and the construction impact zone on previously developed land.

OR

OPTION 2. UNDEVELOPED PORTION OF PROJECT LEFT UNDISTURBED (1 POINT)

Depending on the density of the project, do not develop or disturb a portion of the site that has not been previously developed, exclusive of (1) any land preserved by codified law, (2) a prerequisite of LEED for Neighborhood Development or (3) exempt areas designated as nonbuildable in comprehensive land-use plans. Stipulate in covenants, conditions, and restrictions (CCR 15) or other binding documents that the undisturbed area will be protected from development by a private or governmental agency for the purpose of long-term conservation. When determining the minimum area to be left undeveloped, mixed-use projects must use the lowest applicable density from Table 1 or use the weighted average methodology in NPD Credit Compact Development. Densities and minimum percentages are as follows:

TABLE 1. Minimum undeveloped area, by project density			
Residential density (DU/acre)	Residential density (DU/hectare)	Nonresidential density (FAR)	Minimum area left undisturbed
< 13	< 32	< 0.5	20%
> 13 and ≤ 18	> 32 and ≤ 45	≥ 0.5 and ≤ 1	15%
> 18	> 45	> 1	10%

DU = dwelling unit; FAR = floor-area ratio.

For portions of the site that are not previously developed, identify construction impact zones that limit disturbance to the following:

- 40 feet (12 meters) beyond the building perimeter;
- 10 feet (3 meters) beyond surface walkways, patios, surface parking, and utilities less than 12 inches (30 centimeters) in diameter;
- 15 feet (4.5 meters) beyond street curbs and main utility branch trenches; and
- 25 feet (7.5 meters) beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater retention facilities, and playing fields) that require additional staging areas to limit compaction in the constructed zone.

FOR ALL PROJECTS

Survey the site to identify the following:

- trees in good or excellent condition, as determined by an arborist certified by the International Society of Arboriculture (ISA) or local equivalent professional for projects outside the U.S.;
- any heritage or champion trees of special importance to the community because of their age, size, type, historical association, or horticultural value, as defined by a government forester;
- all trees larger than 6 inches (15 centimeters) in diameter at breast height (dbh, 4 feet 6 inches [1.4 meters] above ground); and
- any invasive plant species that affect trees present on the site, and whether those plants threaten the health of other trees to be preserved on the site, as determined by an ISA-certified arborist or local equivalent professional.

Preserve the following trees that are also identified as in good or excellent condition:

- all heritage or champion trees and trees whose dbh exceeds 50% of the state champion dbh for the species;
- a minimum of 75% of all noninvasive trees (including the above) larger than 18 inches (45 centimeters) dbh; and
- a minimum of 25% of all noninvasive trees (including the above) larger than 12 inches (30 centimeters) dbh if deciduous and 6 inches (15 centimeters) dbh if coniferous.

Tree condition ratings must be determined by an ISA-certified arborist using ISA-approved assessment measures or by a local equivalent professional utilizing an equivalent methodology.

Develop a plan, in consultation with and approved by an ISA-certified arborist or equivalent, for the health of the trees, including fertilization and pruning, and for their protection during construction.

If an ISA-certified arborist or local equivalent professional has determined that any trees to be preserved are threatened by invasive vegetation, develop a plan to reduce the invasive vegetation. Stipulate in codes, covenants, and restrictions or other binding documents that the undisturbed area of the preserved trees will be protected from development by a private or governmental agency for the purpose of long-term conservation.

22. GIB Credit: Rainwater Management Requirements

In a manner best replicating natural site hydrology processes, manage on site the runoff from the developed site for the percentile of regional or local rainfall events listed in Table 1, using low-impact development (LID) and green infrastructure.

Use daily rainfall data and the methodology in the U.S. Environmental Protection Agency (EPA) Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of

the Energy Independence and Security Act to determine the percentile amounts listed in Table 1. The percentile rainfall event indicates the total volume to be retained on site.

TABLE 1. Points for retaining rainwater on site	
Percentile rainfall event	Points
80th	1
85th	2
90th	3
95th	4

Projects that earn at least 2 points under this credit may earn an additional point if the site meets one of the following criteria.

- The project is located on a previously developed site.
- The project achieves 1 point in SLL Credit Brownfield Remediation.
- The project is designed to be transit ready by achieving at least 2 points each under NPD Credit Walkable Streets, NPD Credit Compact Development, and NPD Credit Mixed-Use Neighborhoods.

23. GIB Credit: Heat Island Reduction Requirements

OPTION 1. NONROOF (1 POINT)

Use any combination of the following strategies for 50% of the nonroof site paving (including roads, sidewalks, courtyards, parking lots, parking structures, and driveways).

- Use the existing plant material or install plants that provide shade over the paving areas on the site within 10 years of plant material installation.
- Install and plant planters, either at grade or raised. Plant material cannot include artificial turf.
- Provide shade with structures covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines, that produce energy used to offset some nonrenewable resource use.
- Provide shade with architectural devices or structures that have a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation.
- Provide shade with vegetated structures.
- Use paving materials with a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with an initial SR of at least 0.33 at installation.
- Use an open-grid pavement system (at least 50% unbound).

OR

OPTION 2. HIGH-REFLECTANCE AND VEGETATED ROOFS (1 POINT)

Use roofing materials that have an SRI equal to or greater than the values in Table 1. Meet the three-year aged SRI value (if three-year aged value information is not available, use materials that meet the initial SRI value) for a minimum of 75% of the roof area of all new buildings within the project, or install a vegetated ("green") roof for at least 75% of the roof area of all new buildings within the project.

Combinations of SRI-compliant and vegetated roofs can be used, provided they satisfy the equation in Option 3.

TABLE 1. Minimum solar reflectance index value, by roof slope		
	Initial SRI	3-year aged SRI
Low ($\leq 2:12$)	82	64
Steep ($> 2:12$)	39	32

OR

OPTION 3. MIXED NONROOF AND ROOF MEASURES (1 POINT)

Use any of the strategies listed under Options 1 and 2 that in combination meet the following criterion:

$$\frac{\text{Area of Nonroof Measures}}{0.5} + \frac{\text{Area of High-Reflectance Roof}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.75} \geq \frac{\text{Total Site Paving Area}}{\text{Total Roof Area}}$$

Alternatively, an SRI and SR weighted average approach may be used to calculate compliance.

24. GIB Credit: Solar Orientation Requirements

OPTION 1. BLOCK ORIENTATION (1 POINT)

This option is for projects that earn at least 2 points under NPD Credit Compact Development.

Design and orient the project or locate the project on existing blocks such that one axis of 75% or more of the blocks is within ±15 degrees of geographical east-west, and the east-west lengths of those blocks are at least as long as the north-south lengths.

OR

OPTION 2. BUILDING ORIENTATION (1 POINT)

Design and orient 75% or more of the project's total building floor area (excluding existing buildings) such that one axis of each qualifying building is at least 1.5 times longer than the other, and the longer axis is within 15 degrees of geographical east-west. The length-to-width ratio applies only to walls enclosing conditioned spaces; walls enclosing unconditioned spaces, such as garages, arcades, or porches, cannot contribute to credit achievement. The surface area of equator-facing vertical surfaces and slopes of roofs of buildings counting toward credit achievement must not be more than 25% shaded at the time of initial occupancy, measured at noon on the winter solstice.

25. GIB Credit: Renewable Energy Production Requirements

Incorporate on-site nonpolluting renewable energy generation, such as solar, wind, geothermal, small-scale or micro-hydro electric, or biomass, with production capacity of at least 5% of the project's annual electrical and thermal energy cost (exclusive of existing buildings).

Points are awarded according to Table 1.

TABLE 1. Points for renewable energy production	
Percentage of annual electrical and thermal energy cost	Points
5%	1
12.5%	2
20%	3

26. GIB Credit: District Heating and Cooling Requirements

Incorporate a district heating and/or cooling system for space conditioning and/or water heating of new buildings (at least two buildings total) such that at least 80% of the project's annual heating and/or cooling consumption is provided by the district plant. Single-family residential buildings and existing buildings of any type may be excluded from the calculation.

Each system component that is addressed by ANSI/ASHRAE/IESNA Standard 90.1–2010 must have an overall efficiency performance at least 10% better than that specified by the standard's mandatory requirements. Additionally, annual district pumping energy consumption that exceeds 2.5% of the annual thermal energy output of the heating and cooling plant must be offset by increases in the component's efficiency beyond the 10% improvement. If a combined heat and power (CHP) system is used to comply with the credit requirements, show equivalence by demonstrating that energy consumption savings from the CHP plant at least equal the energy savings that would result from using a conventional district energy system with components that are 10% better than ANSI/ASHRAE/IESNA Standard 90.1–2010. When determining equivalency, take into account the pumping energy as described above.

27. GIB Credit: Infrastructure Energy Efficiency Requirements

Design, purchase, or work with the municipality to install all new infrastructure (e.g., traffic lights, street lights, water and wastewater pumps) to achieve a 15% annual energy reduction below an estimated baseline energy use for this infrastructure. When determining the baseline, assume the use of lowest first-cost infrastructure items.

28. GIB Credit: Wastewater Management Requirements

Design and construct the project to retain on-site at least 25% of the average annual wastewater generated by the project (excluding any existing buildings), and reuse that wastewater to replace potable water. Provide on-site treatment to a quality required by state and local regulations for the proposed reuse, whichever is more stringent. Calculate the percentage of wastewater diverted and reused by determining the total wastewater flow, using the design case from GIB Prerequisite Indoor Water Use Reduction and adding wastewater flow from residential buildings, then determining how much of that volume is reused on site.

TABLE 1. Points for reusing wastewater

Percentage of wastewater reused	Points
25%	1
50%	2

29. GIB Credit: Recycled and Reused Infrastructure Requirements

Use materials for new infrastructure such that the sum of the post consumer recycled content, on-site reused materials, and one-half of the pre consumer recycled content constitutes at least 50% of the total mass of infrastructure materials.

Count materials in all of the following infrastructure items, as applicable:

- roadways, parking lots, sidewalks, unit paving, and curbs;
- water retention tanks and vaults;
- base and sub-base materials for the above; and
- rainwater, sanitary sewer, steam energy distribution, and water pipng.

Recycled content is defined in accordance with ISO/IEC 14021, Environmental Labels and Declaration, Self-Declared Environmental Claims (Type II environmental labeling).

30. GIB Credit: Solid Waste Management Requirements

Meet at least four of the following five requirements and publicize their availability and benefits.

- Include as part of the project at least one recycling or reuse station, available to all project occupants, dedicated to the separation, collection, and storage of materials for recycling; or locate the project in a local government jurisdiction that provides recycling services. The recycling must cover at least Paper, corrugated cardboard, glass, plastic, and metals.
- Include as part of the project at least one drop-off point, available to all project occupants, for potentially hazardous office or household wastes and establish a plan for postcollection disposal or use; or locate the project in a local government jurisdiction that provides collection services. Examples of potentially hazardous wastes include paints, solvents, oil, mercury-containing lamps, electronic waste, and batteries.
- Include as part of the project at least one compost station or location, available to all project occupants, dedicated to the collection and composting of food and yard wastes, and establish a plan for postcollection use; or locate the project in a local government jurisdiction that provides composting services.
- On every mixed-use or nonresidential block or at least every 800 feet (245 meters), whichever is shorter, include recycling containers either adjacent to or integrated into the design of other receptacles.
- Recycle, reuse, or salvage at least 50% of nonhazardous construction, demolition, and renovation debris. Calculations can be done by weight or volume but must be consistent throughout. Develop and implement a construction waste management plan that identifies the materials to be diverted from disposal and specifies whether the materials will be stored on site or commingled. Reused or recycled asphalt, brick, and concrete (ABC) can account for no more than 75% of the diverted waste total. Excavated soil, land-clearing debris, alternative daily cover (ADC), and materials contributing toward GIB Credit Building Reuse do not qualify for this credit.

31. GIB Credit: Light Pollution Reduction

Requirements

Meet the Light Pollution Reduction requirements for the following:

1. One option in Exterior Lighting for Residential Areas
2. Exterior Lighting for Circulation Network
3. Uplight and light trespass requirements in Exterior Lighting for All Other Areas
4. Covenants, Conditions, and Restrictions.

Divide the project into model lighting ordinance (MLO) lighting zones LZ0 to LZ4 based on site-specific characteristics using the definitions of lighting zones provided in the Illuminating Engineering Society and International Dark Sky Association (IES/IDA) MLO User Guide.

Meet the requirements below for each lighting zone within the project.

Exterior Lighting for Residential Areas

Meet either Option 1 or Option 2 for all exterior lighting in new residential construction and residential buildings undergoing major renovations. Existing residential construction is _____.
Projects may use different options for uplight and light trespass.

OPTION 1. BUG RATING METHOD

Each fixture must have a backlight-uplight-glare (BUG) rating (as defined in IES TM-15-11, Addendum A) of no more than B2-U2-G2.

OR

OPTION 2. CALCULATION METHOD

Meet the requirements of Option 2 in Exterior Lighting for All Other Areas, below.

Exterior Lighting for Circulation Network

For any portions of the circulation network not governed by national, state, or other superseding regulations, do not install street lighting unless conditions warrant the need for street lighting.

New and existing street lighting luminaires must not emit any light above 90 degrees (horizontal), based on the photometric characteristics of each luminaire when mounted in the same orientation and tilt as specified in the project design or as currently installed.

Exception for ornamental luminaires: Using the lowest MLO lighting zone for immediately adjacent properties, meet the requirements of the IES/IDA MLO, Table H.

AND

Exterior Lighting for All Other Areas

Use either the BUG method (Option 1) or the calculation method (Option 2) to meet uplight and light trespass requirements. Projects may use different options for uplight and light trespass.

UPLIGHT

OPTION 1. BUG RATING METHOD

Do not exceed the following luminaire uplight ratings, based on the specific light source installed in the luminaire as defined in IES TM-15-11, Addendum A.

TABLE 1. Maximum uplight ratings for luminaires, by lighting zone

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

OPTION 2. CALCULATION METHOD

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

TABLE 2. Maximum percentage of lumens above horizontal

MLO lighting zone	Maximum allowed percentage of total luminaire lumens emitted above horizontal
LZ0	0%
LZ1	0%
LZ2	1.5%
LZ3	3%
LZ4	6%

LIGHT TRESPASS**OPTION 1. BUG RATING METHOD**

Do not exceed the following luminaire backlight and glare ratings (based on the specific light source installed in the luminaire) as defined in IES TM-15-11, Addendum A, based on the mounting location and distance from the lighting boundary.

TABLE 3. Maximum backlight and glare ratings, by lighting zone

Luminaire mounting	MLO lighting zone				
	LZ0	LZ1	LZ2	LZ3	LZ4
	Allowed backlight ratings				
> 2 mounting heights from lighting boundary	B1	B3	B4	B5	B5
1 to 2 mounting heights from lighting boundary and properly oriented	B1	B2	B3	B4	B4
0.5 to 1 mounting height to lighting boundary and properly oriented	B0	B1	B2	B3	B3
< 0.5 mounting height to lighting boundary and properly oriented	B0	B0	B0	B1	B2
	Allowed glare ratings				
Building-mounted > 2 mounting heights from any lighting boundary	G0	G1	G2	G3	G4
Building-mounted 1-2 mounting heights from any lighting boundary	G0	G0	G1	G1	G2
Building-mounted 0.5 to 1 mounting heights from any lighting boundary	G0	G0	G0	G1	G1
Building-mounted < 0.5 mounting heights from any lighting boundary	G0	G0	G0	G0	G1
All other luminaires	G0	G1	G2	G3	G4

The lighting boundary is located at the property lines of the property, or properties, that the LEED project occupies. The lighting boundary can be modified under the following conditions:

- When the property line abuts a public area that includes, but is not limited to, a walkway, bikeway, plaza, or parking lot, the lighting boundary may be moved to 5 feet (1.5 meters) beyond the property line.
- When the property line abuts a public street, alley, or transit corridor, the lighting boundary may be moved to the center line of that street, alley, or corridor.
- When there are additional properties owned by the same entity that are contiguous to the property, or properties, that the LEED project is within and have the same or higher MLO lighting zone designation as the LEED project, the lighting boundary may be expanded to include those properties.

Orient all luminaires less than two mounting heights from the lighting boundary such that the backlight points toward the nearest lighting boundary line. Building-mounted luminaires with the backlight oriented toward the building are exempt from the backlight rating requirement.

OPTION 2. CALCULATION METHOD

Do not exceed the following vertical illuminances at the lighting boundary of each lighting zone in the project (use the definition of lighting boundary in Option 1). Calculation points may be no more than 5 feet (1.5 meters) apart. Vertical illuminances must be calculated on vertical planes running parallel to the lighting boundary, with the normal to each plane oriented toward the property and

perpendicular to the lighting boundary, extending from grade level to 33 feet (10 meters) above the height of the highest luminaire.

TABLE 4. Maximum vertical illuminance at lighting boundary, by lighting zone	
MLO lighting zone	Vertical illuminance
LZ0	0.05 fc (0.5 lux)
LZ1	0.05 fc (0.5 lux)
LZ2	0.10 fc (1 lux)
LZ3	0.20 fc (2 lux)
LZ4	0.60 fc (6 lux)

FC = footcandle

Exemptions from Uplight and Light Trespass Requirements

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

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

Covenants, Conditions, and Restrictions

Establish covenants, conditions, and restrictions (CC&R) or other binding documents that require continued adherence to the above requirements.