

LEED Building Operations and Maintenance

Activity #3 – Sustainable Sites (SS)

Before completing this Activity Read Reference Guide: Building Operations and Maintenance v4 – Pages 61-138

Note the following abbreviations are used in this activity:

| | |
|-----|---|
| EB | LEED O+M: Existing Building |
| S | LEED O+M: Schools |
| R | LEED O+M: Retail |
| DC | LEED O+M: Data Centers |
| WDC | LEED O+M: Warehouses and Distribution Centers |
| HOS | LEED O+M: Hospitality |
| MF | LEED O+M: Multifamily |

Although the LEED O+M 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.

Fill-In, Multiple Choice, Matching

1. Test your knowledge of how well you know the names of the credits for the Sustainable Sites (SS) credit category and match the intent shown below to the prerequisite or credit:

| LEED O+M: EB, S, R, DC, WDC, HOS, MF | | |
|--------------------------------------|--------|---|
| Credit | Intent | Name |
| P1 | C/F | site management Policy |
| C1 | B | site Development - Protect or Restore Habitat |
| C2 | H | Rainwater Management |
| C3 | A | Heat Island Effect |
| C4 | E | Light Pollution Reduction |
| C5 | C/F | Site management |
| C6 | G | Site Improvement Plan |
| LEED O+M: Schools | | |
| C7 | D | Joint use of Facilities |

| | INTENT |
|---|--|
| A | To minimize effects on microclimates and human and wildlife habitats by reducing heat islands. |
| B | To conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity. |
| C | To preserve ecological integrity and encourage environmentally sensitive site management practices that provide a clean, well-maintained, and safe building exterior while supporting high-performance building operations and integration into the surrounding landscape. |
| D | To integrate the school with the community by sharing the building and its playing fields for nonschool events and functions. |
| E | To increase night sky access, improve nighttime visibility, and reduce the consequences of development for wildlife and people. |
| F | To preserve ecological integrity and encourage environmentally sensitive site management practices that provide a clean, well-maintained, and safe building exterior while supporting high-performance building operations and integration into the surrounding landscape. |
| G | To preserve and improve ecological integrity while supporting high-performance building operations. |
| H | 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. |

2. Rainwater runoff carries such pollutants as oil, sediment, chemicals, and lawn fertilizers directly to streams and rivers, where they contribute to eutrophication and harm aquatic ecosystems and species.
3. SS Prerequisite Site Management Policy requirements:

ESTABLISHMENT

Create and implement a site management policy that employs best management practices to reduce harmful chemical use, energy waste, water waste, air pollution, solid waste, and/or chemical runoff for all of the following operational elements on the building and grounds:

| | |
|---|--|
| • | use of low emissions maintenance equipment |
| • | snow and ice removal |
| • | cleaning of building exterior, pavement, and other impervious surfaces |
| • | erosion and Sedimentation Control (for ongoing operations and construction activity) |
| • | organic waste management (returned to the site or diverted from landfill) |
| • | invasive and exotic plants species management |
| • | fertilizer use |
| • | irrigation management |

PERFORMANCE
None. Storage of materials and equipment

4. Site management best practices not only protect soil, water, and air resources but also yield economic benefits.
5. SS Credit Site Development - Protect and Restore Habitat requirements:
OPTION 1. ON-SITE RESTORATION (2 POINTS)
ESTABLISHMENT
Have in place native or adapted vegetation on 20 % of the total site area (including the building footprint), a minimum of 5000 square feet (465 square meters), to provide habitat and promote biodiversity.

PERFORMANCE
None.

OR

OPTION 2. FINANCIAL SUPPORT (1 POINT)

ESTABLISHMENT

Provide financial support equivalent to at least \$ 0.05 per square foot (US\$0.50 per square meter) for the total site area (including the building footprint).

Financial support must be provided annually to a nationally or locally recognized land trust or conservation organization within the same EPA Level III ecoregion or the project's state (or within 100 miles [160 kilometers] for projects outside the U.S.). For U.S. projects, the land trust must be accredited by the Land Trust Alliance.

PERFORMANCE

Provide the specified financial support annually.

6. A small office building project has a total site area of 475,200 ft². The project team is increasing the site's vegetated area to earn SS Credit Site Development - Protect and Restore Habitat using Option 1. On-Site Restoration. The project has 88,000 ft² of vegetated area meeting the credit requirements. What is the total required area for native and adapted vegetation under Option 1?

- A. 118,800 ft²
B. 95,040 ft²
C. 7040 ft²
D. 30.800 ft²

$$475,200 \text{ ft}^2 \times 20\% = 95,040 \text{ ft}^2$$

7. SS Credit Site Development - Protect and Restore Habitat: EXEMPLARY PERFORMANCE

Option 1. Double the 20 % restoration requirement (restore at least 40 %).

Option 2. Double the annual financial requirement by donating at least \$ 0.10 per square foot (\$1.00 per square meter).

8. SS Credit Rainwater Management requirements:

ESTABLISHMENT

Use low-impact development (LID) practices to capture and treat water from 25 % of the impervious surfaces for the 95th percentile storm event.

Establish and implement an annual inspection program of all rainwater management facilities to confirm continued performance.

PERFORMANCE

Document the annual inspections, including identification of areas of erosion, maintenance needs, and repairs.

Perform necessary maintenance, repairs, or stabilization within 60 days of inspection.

9. Conventional site development disrupts natural hydrological systems and watersheds through impervious surfaces, soil compaction, loss of vegetation, and loss of natural drainage patterns.

10. Obtain at least 10 years of historical rainfall data, or as much historical data as possible, representative of the project climate conditions based on proximity to site, elevation, region, etc.

11. A project site has a total impervious area of 5,000 ft². What is the total impervious area that must be managed to meet the requirements for SS Credit Rainwater Management?

- A. 5,000 ft²
- B. 1,250 ft²
- C. 1,500 ft²
- D. 1,000 ft²

$$5000 \text{ ft}^2 \times 25\% = 1250 \text{ ft}^2$$

12. Which of these is used to test compliance for the total volume of runoff for SS Credit Rainwater Management?

- A. One-year storm events
- B. Two-year storm events
- C. 75th percentile of regional storm events
- D. 95th percentile of regional storm events

13. To comply with the performance requirements for SS Credit Rainwater Management projects must perform necessary maintenance, repairs, or stabilization within how many days of inspection?

- A. ~~7 days~~ 15
- B. ~~10 days~~ 30
- C. ~~30 days~~ 60
- D. ~~60 days~~ 90

14. SS Credit Rainwater Management: Exemplary Performance

Use GI and LID practices to capture and treat water from 50 % of the impervious surfaces for the 95th percentile storm event.

15. List low-impact development (LID) design practices used to manage rainwater runoff:

1. rain gardens
2. vegetated swales and buffers
3. permeable pavement
4. rainwater harvesting
5. soil admendments

16. SS Credit Heat Island Effect requirements:

Choose one of the following options.

OPTION 1. NONROOF (1 POINT)

ESTABLISHMENT

Use any combination of the following strategies for a minimum of 50 % of the site paving.

- Use the existing plant material or install plants that provide shade over paving areas (including playgrounds) on the site within 10 years of planting. Plants must be in place at the time of certification application.
- Install vegetated planters. Plants must be in place at the time of occupancy permit and cannot include artificial turf.
- Provide shade with structures covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines.

- 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).

PERFORMANCE

Implement a maintenance program that ensures all high-reflectance paving surfaces are Cleaned at least every three years to maintain good reflectance.

OR

OPTION 2. ROOF (1 POINT)

ESTABLISHMENT

Use either roofing materials with a SRI equal to or greater than the values in Table 1 for a minimum of 75% of the roof area, or a vegetated roof for a minimum of 50% of the roof area, or both. If using both high-reflectance and vegetated roof surfaces, meet the following criterion:

(Complete the equation)

$$\frac{\text{Area of high-reflectance roof}}{0.75} + \frac{\text{Area of vegetated roof}}{0.5} \geq \text{Total roof area}$$

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

PERFORMANCE

Implement a maintenance program that ensures all high-reflectance roof surfaces are Cleaned at least every three years to maintain good reflectance, and all vegetated roofs are maintained for plant health and good structural condition.

OR

OPTION 3. NONROOF AND ROOF (2 POINTS)

ESTABLISHMENT

Meet the following criterion:

(Complete the equation)

$$\begin{array}{ccccccc} \uparrow & & & & & & \\ \frac{\text{Area of nonroof measures}}{0.5} & + & \frac{\text{Area of high-reflectance roof}}{0.75} & + & \frac{\text{Area of vegetated roof}}{0.5} & \geq & \text{Total site paving area} + \text{Total roof area} \end{array}$$

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

Use any combination of the following strategies.

Nonroof Measures

Use the measures listed in Option 1. Plant material must be in place at time of certification application.

High-Reflectance Roof

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.

(Complete the table)

| | Slope | Initial SRI | 3-year aged SRI |
|-------------------|--------|-------------|-----------------|
| Low-sloped roof | ≤ 2:12 | 82 | 64 |
| Steep-sloped roof | > 2:12 | 39 | 32 |

Vegetated Roof

Install a vegetated roof.

PERFORMANCE

Implement a maintenance program that ensures all high-reflectance surfaces are cleaned at least every three years to maintain good reflectance, and all vegetated roofs are maintained for plant health and good structural condition.

OR

OPTION 4. PARKING UNDER COVER (1 POINT)

ESTABLISHMENT

Place at least 50% of parking spaces under cover. Any roof used to shade or cover parking must (1) have a three-year aged SRI of at least 32 (if three-year aged value information is not available, use materials with an initial SRI of at least 39 at installation), (2) be a vegetated roof, or (3) be covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines.

PERFORMANCE

Implement a maintenance program that ensures all SRI surfaces are cleaned at least every three years to maintain good reflectance, and all vegetated roofs are maintained for plant health and good structural condition.

- Dark, nonreflective surfaces used for parking, roads, walkways, walkways, and other hardscapes absorb the sun's warmth and radiate heat, creating heat islands.
- Urban areas can have temperatures 1.8° to 5.4° F warmer than surrounding suburban and undeveloped areas, and as much as 22° F warmer in evenings.

19. Heat islands increase cooling loads in the summer, necessitating larger, more powerful air-conditioners that use more energy, in turn increasing cooling costs, producing more greenhouse gases, and generating pollution.
20. According to a study of the metropolitan areas of Baton Rouge, Chicago, Houston, Sacramento, and Salt Lake City by the Department of Energy's Lawrence Berkeley National Laboratory, the energy savings potential of heat island reduction measures ranges from
- A. \$1 million to \$2 million per year
 - B. \$2 million to \$4 million per year
 - C. \$4 million to \$15 million per year
 - D. \$30 million to \$50 million per year
21. Which of these is the most effective measure of a roofing materials ability to reject solar heat?
- A. ET_0
 - B. SR
 - C. VOC
 - D. SRI
22. Which of these is used by LEED to measure the solar heat rejection of components that are not roofing materials, or "nonroof"—for example, vegetation, shading devices, and other less reflective components?
- A. ET_0
 - B. SR
 - C. VOC
 - D. SRI
23. List examples of hardscape areas:
1. paved roads
 2. sidewalks
 3. courtyards
 4. parking lots
24. Applicable roof area excludes roof area covered by:
1. mechanical equipment
 2. solar energy panels
 3. skylights
 4. other appurtenances
25. For SS Credit Heat Island Effect Option 4. Parking under cover which of these parking spaces can be excluded?
- A. Handicap parking
 - B. Motorcycle parking
 - C. Bicycle parking
 - D. Structured parking

26. SS Credit Heat Island Effect: Exemplary Performance

Option 1. Install SR-compliant materials and/or open-grid paving, or provide shading within 10 years, for at least 95% of nonroof impervious surfaces.

Option 2. Install a vegetated roof system for at least 95% of the project's roof area (excluding any mechanical equipment, photovoltaic panels, and skylights).

Option 3. Achieve exemplary performance for both Option 1 and Option 2: install SR-compliant materials and/or open-grid paving, or provide shading within 10 years, for at least 95% of nonroof impervious surfaces AND install a vegetated roof system for at least 95% of the project's roof area (excluding any mechanical equipment, photovoltaic panels, and skylights).

Option 4. Locate at least 95% of parking under cover.

27. Black paint has a solar reflectance of 0; white paint (titanium dioxide) has a solar reflectance of 1.

28. SS Credit Light Pollution Reduction requirements:

ESTABLISHMENT

Meet the requirements of one of the options below:

OPTION 1. Fixture Shielding

Shield all exterior fixtures (where the sum of the mean lamp lumens for that fixture exceeds 2500) such that the installed fixtures do not directly emit any light at a vertical angle more than 90 degrees from straight down.

OR

OPTION 2. Perimeter measurements

Measure the night illumination levels at regularly spaced points on the project boundary, taking the measurements with the building's exterior and site lights both on and off. At least eight measurements are required, at a maximum spacing of 100 feet (30 meters) apart. The illumination level measured with the lights on must not be more than 20 % above the level measured with the lights off.

PERFORMANCE

None.

29. Light pollution is the misdirection or misuse of light, generally resulting from an inappropriate application of exterior lighting.

30. Backlight creates light trespass onto adjacent sites by directing light in the opposite direction of the area intended to be lighted.

31. Uplight causes artificial sky glow.

32. Glare is caused by high-angle front light.

33. SS Credit Site Management requirements:

ESTABLISHMENT

None.

PERFORMANCE

Demonstrate that the following performance criteria were met:

- Use no calcium chloride or sodium chloride deicers, and/or establish reduced treatment areas equal to 50% of applicable paving area.
- Prevent erosion and sedimentation, and restore any eroded soils.
- Prevent air pollution from construction materials and activities.
- Divert from landfills 100% of plant material waste via low-impact means.
- Prevent the overapplication of nutrients. Use no ammonia-based fertilizers, biosolid-based fertilizers (for continuous application), synthetic quick-release fertilizers, or "weed and feed" formulations. Blanket applications of herbicides are prohibited; turf weeds may be controlled by spot spraying only.
- Monitor irrigation systems manually or with automated systems at least every two weeks during the operating season and correct any leaks, breaks, inappropriate water usage, or incorrect timing.
- Store materials and equipment to prevent air and site contamination.

AND

Meet one of the following options:

OPTION 1. Limited Turf Area

Limit turf to 25% or less of the vegetated area.

Playgrounds and athletic fields in schools or parks are excluded from this option.

OR

OPTION 2. All manual or electric-powered Equipment

Use all manual or electric powered equipment in all site management operations.

OR

OPTION 3. Reduction in Emissions from Site Management Equipment

Show and maintain a 50% reduction in hydrocarbon (HC) and nitrogen oxide (NOx) emissions, and a 75% reduction in carbon monoxide (CO) emissions from baseline conditions.

34. Which of these gasoline-powered maintenance equipment are exempt from the requirements for SS Credit Site Management Option 3. Reduction in Emissions from Site Management Equipment?

- A. Walk-behind mowers
- B. Trucks for snow removal
- C. Leaf blowers
- D. Line trimmer-edgers

35. SS Credit Site Improvement Plan requirements:

ESTABLISHMENT

Develop a five-year site improvement plan that includes the following:

- documentation of existing site conditions;
- site improvement objectives;
- performance standards to evaluate ongoing progress; and
- monitoring protocols.

The improvement plan must address the following topics.

- Hydrology. Protection and improvement of water bodies on-site, rainwater management and reuse opportunities, potable water-use reduction.
- Vegetation. Documentation of existing vegetation on-site, turf area reduction, management of native and invasive plants, protection of threatened, endangered or unique species.
- Soils. Documentation of general soil structure, preservation of healthy soils, remediation of compacted soils, identification of previously disturbed area.

The plan must be developed with professionals trained and experienced in the above disciplines.

PERFORMANCE

Show that at least 5% of the site is vegetated. Implement all no-cost and low-cost measures.

Develop a new improvement plan and implement all new no-cost and low-cost measures every five years.

36. SS Credit Joint Use of Facilities requirements:

ESTABLISHMENT

OPTION 1. make Building Space Open to General Public (1 POINT)

In collaboration with the school authorities, establish at least three of the following types of spaces as accessible to and available for shared use by the general public:

1. auditorium
2. gymnasium
3. cafeteria
4. one or more classrooms
5. playing fields and stadiums
6. joint parking

Provide access to toilets in joint-use areas after normal school hours.

OR

OPTION 2. Contract with Specific Organizations to Share Bldg Space (1 POINT)

In collaboration with the school authorities, contract with community or other organizations to provide at least two types of dedicated-use spaces in the building, such as the following:

1. commercial office
2. health clinic
3. community service centers (provided by state or local offices)
4. police offices

5. library or media centers
6. parking lot
7. one or more commercial businesses

Provide access to toilets in joint-use areas after normal school hours.

OR

OPTION 3. Use shared space owned by other organizations (1 POINT)

In collaboration with the school authorities, establish at least two of the following six types of spaces (owned by other organizations/agencies) are accessible to students:

1. auditorium
2. gymnasium
3. cafeteria
4. one or more classrooms
5. swimming pool
6. playing fields and stadiums

Provide direct pedestrian access to these spaces from the school. In addition, provide signed joint-use agreements with the other organizations or agencies that stipulate how these spaces will be shared.

PERFORMANCE

None.