

SITES v2

Reference Guide

For Sustainable Land Design and Development



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I. Overview of SITES

As the world's population grows, so does the pace of urbanization and development. What is built on the land profoundly impacts ecological systems as well as the health, safety, and welfare of our communities. Too often, however, landscapes, infrastructure, and buildings are designed without regard to their harmful impacts on scarce resources, underlying ecological systems, and quality of life in the community. A systematic comprehensive set of guidelines and a rating system is needed to define sustainable sites, measure their performance, and ultimately elevate the value of landscapes.

The Sustainable Sites Initiative™ (SITES™) is a program based on the understanding that land is a crucial component of the built environment and can be planned, designed, developed, and maintained to avoid, mitigate, and even reverse these detrimental impacts. Sustainable landscapes create ecologically resilient communities better able to withstand and recover from episodic floods, droughts, wildfires, and other catastrophic events. They benefit the environment, property owners, and local and regional communities and economies.

In contrast to buildings, built landscapes and green infrastructure have the capacity to protect and even regenerate natural systems, thereby increasing the ecosystem services they provide. These services are the beneficial functions of healthy ecosystems such as sequestering carbon, filtering air and water, and regulating climate. Their economic value is highly significant, yet the cost of replacing these functions is rarely reflected in conventional decision-making. For example, wetlands filter pollutants and provide protection against storm surges and flooding. When wetlands are lost to development, new and costly levees, pipes, and pollution-control technology must perform the functions those wetlands previously provided naturally. Nevertheless, estimates for a project's total cost or value typically include neither these subsequent expenses nor additional benefits such as wildlife habitat.

By aligning land design and development practices with the functions of healthy ecosystems, the SITES program demonstrates how the work of developers, property owners, landscape architects, engineers, planners, architects, and others can protect, restore, and enhance ecosystem services. For environmental designers, their clients, and the general public, SITES offers several significant benefits and values: 1) it advances best practices in landscape architecture and other environmental design professions, 2) it may help design professionals fulfill their health, safety, and welfare responsibilities for licensure, 3) clients can be assured that their project has achieved rigorous, field-tested standards for sustainability, 4) clients can market the SITES certification of their projects (as many do for the LEED® green building program), and 5) it is ethically responsible, protects natural systems for present-day use and appreciation, and preserves ecosystems and their essential services for future generations.

The central message of the SITES program is that any project—whether the site of a university campus, large subdivision, shopping mall, park, commercial center, or even a home—holds the potential to protect, improve, and regenerate the benefits and services provided by healthy ecosystems.

SITES provides guidance and incentives that can transform land development and management practices towards regenerative design. The United States Botanic Garden, the Lady Bird Johnson Wildflower Center at The University of Texas at Austin, and the American Society of Landscape Architects have led the development of these guidelines, which involves numerous other organizations and individuals. Development of the SITES v2 Rating System has been a collaborative, interdisciplinary effort made possible by the input of more than 70 dedicated contributors, including technical advisors, practitioners, and representatives of professional, advocacy, and educational organizations.

Since 2007, SITES has published three reports containing draft guidelines and performance benchmarks followed by extensive review of public comments. Following the release of the *Guidelines and Performance Benchmarks 2009* (version 1), this Rating System was field-tested through a two-year pilot program that involved more than 160 projects. Information and knowledge gained from participating pilot projects informed the development of the SITES v2 Rating System and this Reference Guide. The SITES Rating System is intended to be a living product that will evolve over time as research and experience generate more knowledge.

The purpose of the *SITES v2 Reference Guide* is to assist design teams in understanding and applying the SITES v2 Rating System. It includes credit examples, documentation criteria, calculation guidelines, and other materials and tools.

SITES GUIDING PRINCIPLES

These principles informed the development of specific and measurable criteria for site sustainability, and can also be applied to the land design and development process.

Do no harm.

Make no changes to the site that will degrade the surrounding environment. Promote sustainable design projects on sites where previous disturbance or development presents an opportunity to regenerate ecosystem services through sustainable design.

Apply the precautionary principle.

Be cautious in making decisions that could threaten human and environmental health. Some actions can cause irreversible damage. Examine a full range of alternatives (including no action), and be open to contributions from all potentially affected parties.

Design with nature and culture.

Create and implement designs that are responsive to economic, environmental, and cultural conditions and to the local, regional, and global context.

Use a decision-making hierarchy of preservation, conservation, and regeneration.

Maximize the benefit of ecosystem services by preserving existing environmental features, conserving resources in a sustainable manner, and regenerating lost or damaged ecosystem services.

Provide regenerative systems as intergenerational equity.

Provide future generations with a sustainable environment supported by regenerative systems and endowed with regenerative resources.

Support a living process.

Continuously re-evaluate assumptions and values, and adapt to demographic and environmental change.

Use a systems thinking approach.

Understand and value the relationships in an ecosystem. Use an approach that reflects and sustains ecosystem services and re-establishes the integral and essential relationship between natural processes and human activity.

Use a collaborative and ethical approach.

Encourage direct and open communication among colleagues, clients, manufacturers, and users to link long-term sustainability with ethical responsibility.

Maintain integrity in leadership and research.

Implement transparent and participatory leadership; develop research with technical rigor; and communicate new findings in a clear, consistent, and timely manner.

Foster environmental stewardship.

In all aspects of land development and management, foster an ethic of environmental stewardship—an understanding that responsible management of healthy ecosystems improves the quality of life for present and future generations.

ECOSYSTEM SERVICES: THE FRAMEWORK FOR SITES V2

The SITES v2 Rating System, and specifically its site-specific performance benchmarks, is based on the concept of ecosystem services; an understanding of natural processes; best practices in landscape architecture, ecological restoration, and related fields; and knowledge gained through peer-reviewed literature, case-study precedents, and SITES pilot projects. By achieving these benchmarks, a project will contribute to maintaining, supporting, and enhancing natural systems and the essential services they provide.

The services provided by healthy ecosystems are the unobtrusive foundation of daily life. Trees help regulate local climate by providing shade and acting as windbreaks. Through evaporation, transpiration, and the uptake and storage of carbon, plants moderate the climate of the world and provide a breathable atmosphere. Thousands of different pollinator species visit their respective flowers and promote the growth of myriad plants and crops. Soils and vegetation purify stormwater as it seeps through to groundwater and underground aquifers. Ecosystem services such as these occur at a variety of scales and in habitats ranging from equatorial rainforests to urban parks. Yet because these services occur largely unseen in the background and can be difficult to measure and monetize, their value is typically ignored in project design and budgeting. As a result, the ecosystem services provided by the site prior to construction are lost. Replacing these services, if it is possible to do so, would require expensive technological solutions.

An accurate accounting must take into consideration how the adoption of sustainable practices can not only be cost effective for both public and private entities but can leverage additional costs and provide multiple benefits. A growing body of research suggests that natural elements within cities and other areas generate ecosystem services that can substantially protect and improve a community's resiliency and quality of life in a variety of ways and in a range of contexts.

ECOSYSTEM SERVICES

Ecosystem services are goods and services of direct or indirect benefit to humans that are produced by ecosystem processes that involve the interactions of living elements, such as vegetation and soil organisms, and non-living elements such as bedrock, water, and air.

The *Millennium Ecosystem Assessment* 2005 report separated ecosystem services into four categories: Supporting (services that are necessary for the production of all other ecosystem services), Provisioning (products, such as food and water, obtained from ecosystems), Regulating (benefits obtained from the regulation of ecosystem processes such as carbon sequestration), and Cultural (nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences).

Researchers have developed various lists of these benefits and services. The Sustainable Sites Initiative has consolidated the research into the following list of ecosystem services that a sustainable site can protect or regenerate through sustainable land development and management practices.

Global climate regulation

- Maintaining balance of atmospheric gases at historic levels
- Maintaining healthy air quality
- Sequestering carbon

Local climate regulation

- Regulating local temperature, precipitation, and humidity through shading, evapotranspiration, and windbreaks

Air and water cleansing

- Removing and reducing pollutants in air and water

Water supply retention

- Storing and conserving water within watersheds and aquifers

Erosion and sediment control

- Retaining soil within an ecosystem
- Preventing damage from erosion and siltation

Hazard mitigation

- Reducing vulnerability to damage from flooding, storm surge, wildfire, and drought

Pollination

- Providing for the reproduction of crops and other plants

Habitat functions

- Providing refuge and reproduction habitat to plants and animals, contributing to the conservation of biological and genetic diversity and evolutionary processes

Waste decomposition and treatment

- Breaking down waste
- Cycling nutrients

Human health and well-being

- Enhancing physical, mental, and social well-being as a result of interaction with nature

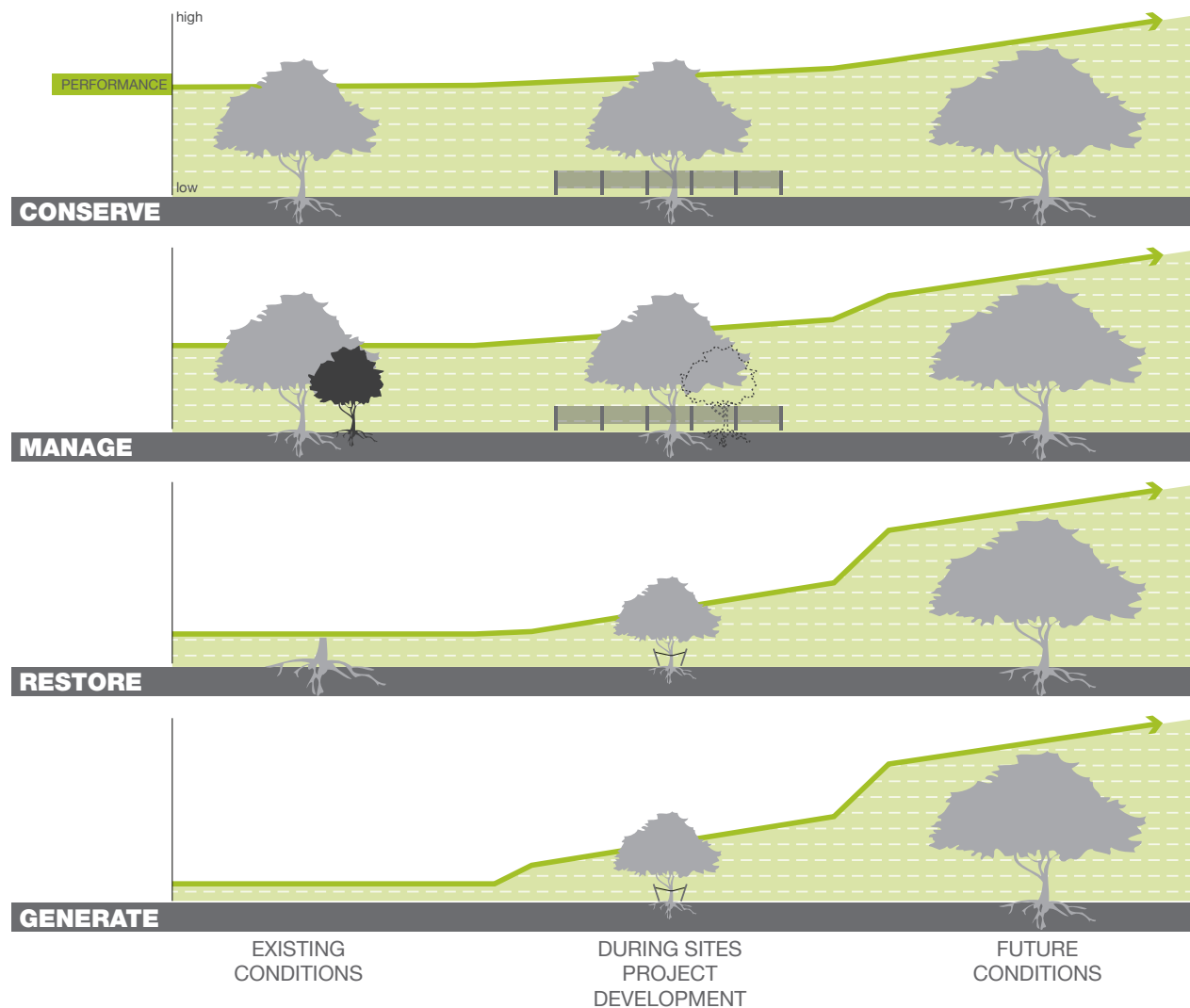
Food and renewable non-food products

- Producing food, fuel, energy, medicine, or other products for human use

Cultural benefits

- Enhancing cultural, educational, aesthetic, and spiritual experiences as a result of interaction with nature

SITES Decision-Making Hierarchy



Built sites can be modeled after healthy systems, thereby increasing the ecosystem services they provide post-development. Landscape performance increases as relationships between soil, vegetation, and organisms mature over long periods of time, becoming more complex and interdependent. The decision-making hierarchy provided by the SITES Guiding Principles (p. ix) gives projects a step-by-step framework for approaching existing site elements in order to conserve, manage, restore, or generate high-functioning ecosystems.

When healthy soil, vegetation, and habitat are found on site, management of these systems should take place to conserve biodiversity and the long-term health and vitality of the site. This management includes ensuring land design and development protect, maintain, and improve existing features (e.g., wetlands, habitat, floodplains) and appropriately remove and manage any undesirable elements (e.g., invasive species), which contribute to the loss of ecosystem function. When features such as large trees or streams have been lost to previous development, restore the landscape to regain performance benefits. On brownfields or previously developed sites with limited ecological activity, opportunities may exist to generate ecosystem services by planting native vegetation or implementing technologies such as raingardens or green roofs. Such management will ensure that future conditions will yield high-performance landscapes that provide ecosystem services.

THE GOALS FOR SITES V2

In the SITES v2 Rating System, a total of 200 potential points are allocated among 48 credits for a given project site. The Rating System reflects each credit's impact on improving site sustainability and protecting and restoring ecosystem services. Projects will receive SITES certification by achieving the minimum requirements (i.e. prerequisites) and a certain specified number of points for different levels of performance. The value assigned to each credit is based on its potential effectiveness in meeting the four goals outlined below.

SITES GOALS

Create Regenerative Systems and Foster Resiliency

- Protect and restore natural resources such as soil, water, and vegetation.
- Encourage biodiversity.
- Enhance landscapes to provide multiple ecosystem services such as cleaning air and water, providing habitat, and storing carbon.
- Mitigate for evolving hazards and natural disasters.
- Plan for monitoring and adaptive management.

Ensure Future Resource Supply and Mitigate Climate Change

- Minimize energy consumption and encourage use of low carbon and renewable energy sources.
- Minimize or eliminate greenhouse gas emissions, heavy metals, chemicals, and other pollutants.
- Reduce, reuse, recycle, and upcycle materials and resources.
- Conserve water.
- Increase the capacity of carbon sinks through re-vegetation.

Transform the Market through Design, Development, and Maintenance Practices

- Foster leadership in industry and professional practice.
- Use a systems-thinking, integrative and collaborative design approach.
- Use lifecycle analyses to inform the design process.
- Support local economies and sustainability policies.

Enhance Human Well-Being and Strengthen Community

- Reconnect humans to nature.
- Improve human health (physical, mental, and spiritual).
- Foster stewardship by providing education that promotes the understanding of natural systems, and recognizes the value of landscapes.
- Encourage cultural integrity and promote regional identity.
- Provide opportunities for community involvement and advocacy.

II. The SITES v2 Process

ELIGIBLE SITES: WHERE AND WHEN TO USE SITES V2

In this Reference Guide, a “site” is the physical location or land on which a “project” is developed. The SITES v2 Rating System applies to new construction projects as well as existing sites that include major renovations. There is no maximum size for a SITES project, but the minimum size is considered to be 2,000 square feet (185.8 square meters). For projects that were completed more than two years prior to SITES registration (i.e. completed by submitting an application and fee), the project team should closely examine the prerequisite and credit requirements to ensure that the associated documentation exists to prove compliance for certification.

The SITES v2 Rating System accommodates regional differences and various types of sites (e.g., urban, suburban, or rural locations; previously developed or undeveloped sites). Many benchmarks consider the site’s pre-existing condition and function in recommending performance criteria. While SITES can be applied worldwide, some references are specific to the United States; therefore, project teams in other countries are responsible for referencing and documenting comparable local resources.

The SITES v2 Rating System can apply to projects located on sites with or without buildings, including:

- Open spaces—local, state, and national parks; botanic gardens; arboreta
- Streetscapes and plazas
- Commercial—retail and office areas; corporate campuses
- Residential—neighborhoods or individual yards
- Educational/Institutional—public and private campuses; museums; hospitals
- Infrastructure
- Government
- Military
- Industrial

For sites that include buildings, the SITES v2 Rating System focuses on the area from the building skin outwards. For more details, see *Where to Start* on page xxiii.

The SITES program supports and encourages projects that plan to pursue simultaneous certification with the U.S. Green Building Council (USGBC) Leadership in Energy & Environmental Design (LEED) Green Building Rating Systems and the SITES v2 Rating System. For further guidance on the synergies and potential equivalences between the LEED and SITES rating systems, please visit the SITES website (www.sustainablesites.org).

HOW TO USE AND UNDERSTAND SITES V2

The SITES v2 Rating System consists of 18 prerequisites and 48 credits totaling 200 points for measuring project sustainability. Additionally, projects that employ innovative and exemplary performance strategies can receive bonus points (see Section 10: Innovation + Exemplary Performance). By providing performance measures rather than prescribing practices, SITES supports the unique conditions of each site and encourages project teams to be flexible and creative as they design and develop beautiful, functional, and regenerative sites appropriate for their context and intended use.

Prerequisites and credits in the SITES v2 Rating System are organized into 10 sections that follow typical design and construction phases. Achieving a sustainable site eligible for certification begins with proper site selection and site assessment, continues through site design and construction, and includes effective and appropriate operations and maintenance. SITES v2 concludes with an emphasis on education and performance monitoring in order to increase the knowledge base of site sustainability.

Prerequisite requirements must be met if a project is to be considered for certification. All credits are considered optional; however, a certain number of credit points must be approved for a project to achieve certification (see *Certification* on page xxxii). Not all credits will apply to every project, but the array of credits provides multiple opportunities to achieve certification.

A brief overview of the SITES v2 Rating System follows below. It aims to provide project teams with an understanding of the overarching goals of each section and how each relates to other areas.

Section 1: Site Context

Particular attention is placed on understanding the context of where a project is located and developed. SITES requires careful planning and the protection of existing, functioning natural features that are unique, critical, sensitive, or threatened, such as farmlands, floodplains, wetlands, and wildlife habitats. These features provide essential ecosystem functions for wildlife, site users, and the surrounding community.

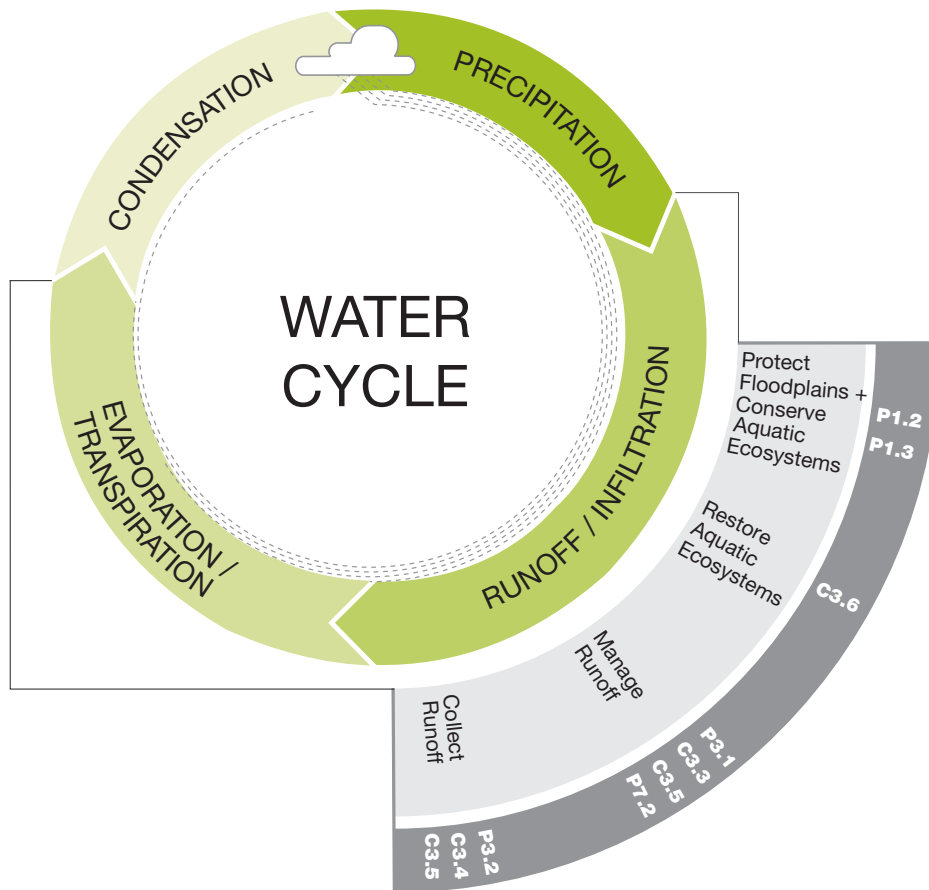
SITES considers previous uses of the site and rewards projects that are located on degraded sites because of the opportunity and, sometimes the urgency, to restore ecosystem services in these areas. Redevelopment also reduces pressure on undeveloped land, or greenfields. This section also looks beyond the site boundary to consider how the surrounding area can contribute to reducing pollution, improving human health and well-being, and supporting local economies and communities.

Section 2: Pre-Design Assessment + Planning

Before design begins, an integrated design team must conduct a comprehensive site assessment of existing physical, biological, and cultural conditions that will inform planning and design. This team must include experts in natural systems, design, construction, and maintenance, in addition to representatives of the community, the owners, and the intended site users.

Section 3: Site Design—Water

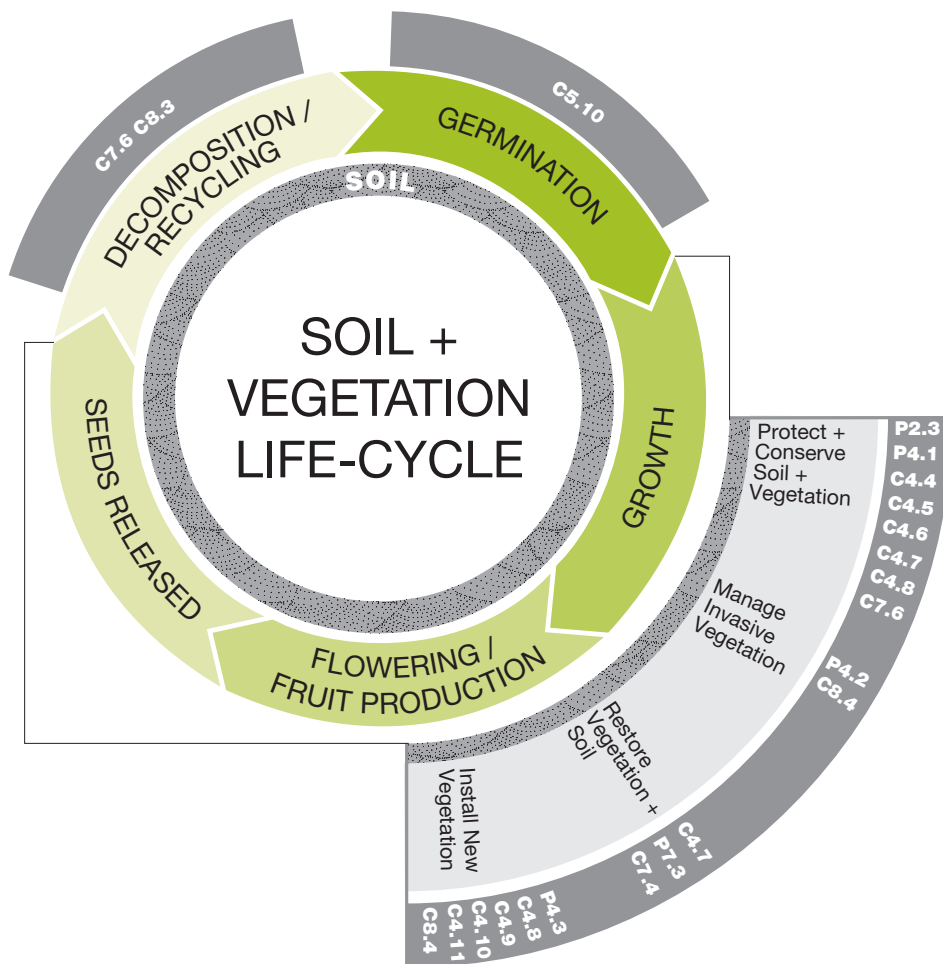
Natural systems are of critical value for their ability to store, clean, and distribute available water. This section encourages projects that are designed to conserve water, maximize the use of precipitation, and protect water quality. For example, a sustainable project may harvest rainwater on site and use it, rather than potable water, for irrigation and water features. The goal is to incorporate strategies and technologies that restore or mimic natural systems.



This diagram illustrates how prerequisites and credits in the SITES v2 Rating System relate to and support the processes of the natural water cycle, shown highlighted in the green circle above. The bottom right shows the actions that SITES encourages in gray, while the corresponding prerequisite and credit numbers are shown in the dark gray bar.

Section 4: Site Design—Soil + Vegetation

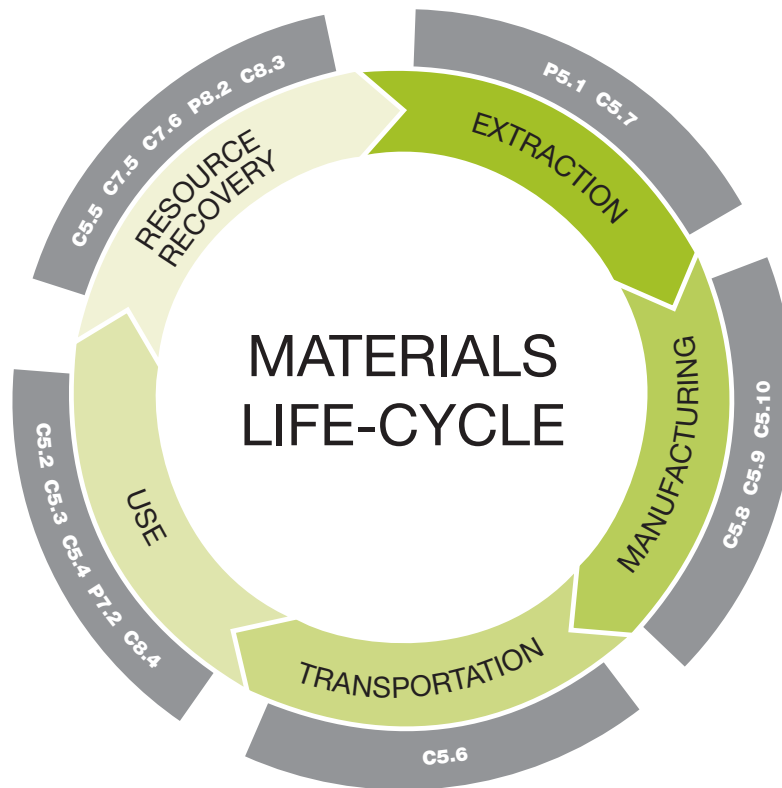
This section requires proper soil management as a design element and construction priority. In addition to serving as the foundation for robust vegetation, healthy soils filter pollutants and help prevent excess runoff, erosion, sedimentation, and flooding. Using appropriate vegetation, managing invasive plants, and restoring biodiversity (emphasizing native species) are some key strategies that have multiple environmental, economic, and social benefits. They can reduce or eliminate landscape irrigation, increase the quality of wildlife habitat, promote regional identity, and reduce maintenance needs.



This diagram illustrates how prerequisites and credits in the SITES v2 Rating System relate to and support the processes of the natural soil and vegetation life-cycle, shown highlighted in the green circle above. The bottom right shows the actions that SITES encourages in gray, while the corresponding prerequisite and credit numbers are shown in the dark gray bar.

Section 5: Site Design—Materials Selection

Appropriate selection and use of materials can contribute to a project's ability to support and enhance ecosystem services on the site and wherever the material exists throughout its life-cycle. The demolition, selection, procurement, and use of materials in site design and construction present considerable opportunities to decrease the amount of materials sent to landfills, to preserve natural resources, to reduce greenhouse gas emissions, and to support the use of sustainable building products.



This diagram illustrates how prerequisites and credits in the SITES v2 Rating System, shown in dark gray, relate to and support the processes of the materials life-cycle, shown highlighted in the green circle above.

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

Any access to nature, whether in a park or natural area, or simply viewing green space during daily life, positively affects mental health and facilitates social connection. These effects are essential to healthy human habitat and extend to include positive physical health outcomes. This section promotes outdoor opportunities for physical activity, restorative and aesthetic experiences, and social interaction. It also encourages projects to address social equity in their design and development choices. The intent is to build stronger communities and create or renew a sense of environmental stewardship.

Section 7: Construction

Sustainable construction practices start with ensuring that contractors are aware of sustainability goals set in the initial design phase. Then, proper actions can be taken through the construction phase. This section encourages projects to protect air quality through low-emitting equipment, strive for a net-zero waste site, ensure healthy vegetation through soil restoration strategies, and protect receiving waters from polluted runoff and sedimentation.

Section 8: Operations + Maintenance

To produce a design and to meet performance goals that will conserve resources and reduce pollution and waste throughout the life of the project, work with a maintenance professional during the design phase. This section promotes maintenance strategies that maximize the site's long-term potential in providing ecosystem services. Strategies include reducing material disposal, ensuring long-term health of soil and vegetation, reducing pollution, conserving energy, and encouraging the use of renewable energy.

Section 9: Education + Performance Monitoring

This section recognizes projects for efforts made to inform and educate the public about the project goals and sustainable practices implemented in site design, construction, and maintenance. It also creates an incentive to monitor, document, and report the performance of the site over time in order to influence and improve the body of knowledge in site sustainability.

Section 10: Innovation or Exemplary Performance

This section encourages creativity and innovation in fulfilling prerequisite and credit requirements. It awards bonus points to projects that demonstrate exemplary performance above and beyond the targets established by one or more of the credits. SITES also supports innovation by awarding extra points to projects that develop or pursue sustainable practices or meet benchmarks for sustainable performance that are not currently addressed in the SITES v2 Rating System.

Credit Format

Throughout the SITES v2 Rating System, each section is given a shorthand title (e.g., *Pre-Design* stands for *Pre-Design Assessment + Planning*) and references to prerequisites and credits have been shortened to “P” or “C”, followed by the section number, credit number and title.

Example: *Pre-Design P2.1: Use an integrative design process*

Section	Prerequisite or Credit	Section Number	Credit Number	Title
Pre-Design	P	2	.1	Use an integrative design process

PREREQUISITES AND CREDITS

A project must satisfy all prerequisites to be considered for certification. SITES considers each credit optional, but a certain number of credit points are required for certification. See the section on *Certification* on page xxxii for more details. Information about each prerequisite and credit is presented in a standard format for simplicity and quick reference as follows:

Title previews the content of the prerequisite or credit and offers a general overview of the action to be taken.

Point level sets forth the range of points that can be earned by fulfilling the requirements of each credit. Prerequisites are required; therefore, they do not have a point range.

Intent describes the objective or benefit of the prerequisite or credit.

Requirements are the measures or benchmarks a project must meet to satisfy the prerequisite or achieve the credit. For certain credits, multiple thresholds are provided and point values reflect these incremental improvements. In some prerequisites and credits, specific pathways are outlined as *Cases*, *Options*, or *Methods* (see below).

Cases indicate how projects with particular pre-existing conditions should document compliance.

Options allow project teams to choose actions to satisfy credit requirements. Options are allotted credit value commensurate with their requirements.

Methods indicate techniques for achieving the credit requirements, although all methods result in the same number of points. This term appears only in *HHWB Credit 6.8: Reduce light pollution*.

Submittal documentation specifies what a project must submit to prove compliance with the requirements of the prerequisite or credit. This documentation may include a site plan detailing specific criteria, calculations demonstrating a site's performance, or a narrative explaining procedures undertaken to meet the requirements. Consistent, clear documentation is critical to prove compliance.

Documentation guidance offers additional tools, procedures, or advice for assessing a requirement and submitting documentation. To assist projects with documentation for certain SITES credits, hypothetical project examples demonstrate the information that must be shown on maps and site plans submitted for certification review (See *Where to Start—Site Plans and Maps* on pages xxviii-xxxi for more background on these example sites).

Recommended strategies are site practices that a project team can use to fulfill the prerequisite or credit. The technologies and strategies listed in this section are not all-inclusive, and SITES encourages projects to use creative site-specific solutions to meet the requirements of a prerequisite or credit.

Economic and social benefits describe the value of ecosystem services that a prerequisite or credit could provide. Economic benefits may take the form of avoided costs, such as lower healthcare costs due to improved air and water quality; reduced infrastructure costs because rainwater capture lessens pressure on storm sewers; or increased property values. Social benefits make take the form of improved physical outcomes (e.g., weight loss); reduced symptoms of depression and aggression; or increase in performance on creative or problem-solving tasks. The benefits listed per credit are only examples and not all-inclusive. For further information on the benefits and value of sustainable sites, visit www.sustainablesites.org.

Definitions clarify the meaning of certain terms used in descriptions of each prerequisite or credit. A term that is defined will be underlined. Some definitions will link to a particular prerequisite or credit. A glossary is provided at the end of the reference guide citing each prerequisite and credit in which a term appears.

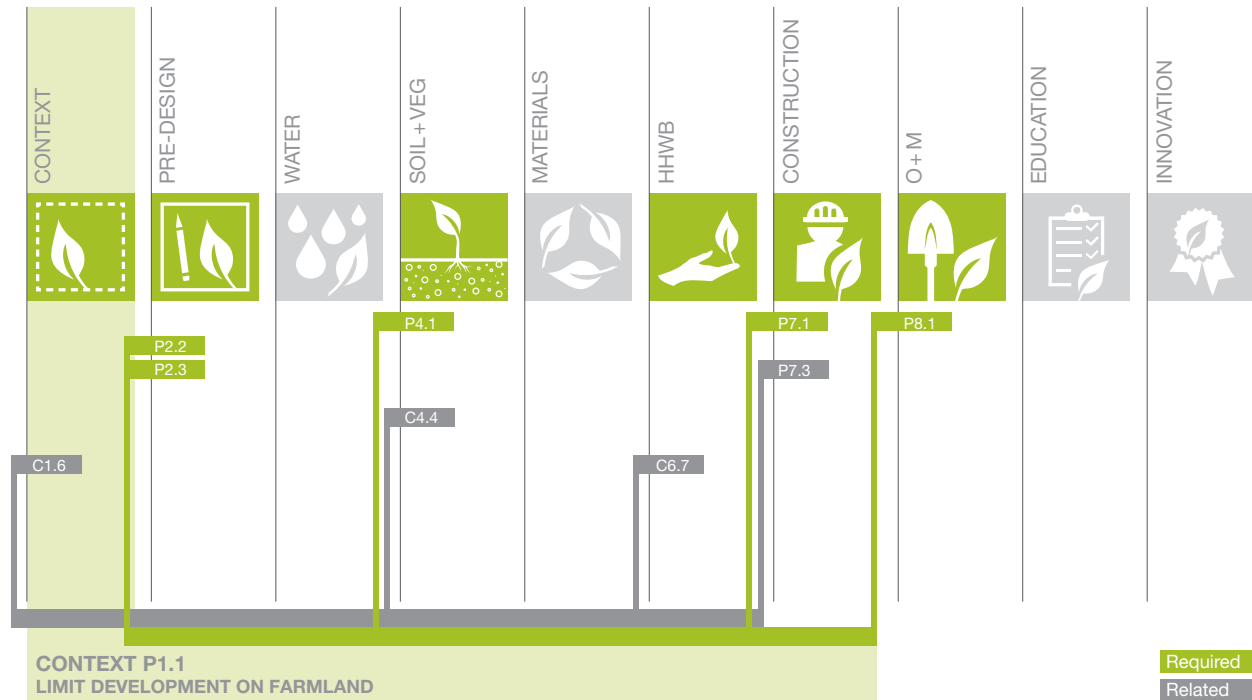
Resources provide additional guidance, information or research findings. All efforts have been made to ensure web links are current at the time of publishing, but the constantly changing nature of Internet information means they may not remain up to date indefinitely. For any SITES credits adapted from USGBC LEED credits, the applicable LEED credits are noted as the first bullet in this section.

Links to other SITES prerequisites and credits demonstrate the interrelationships and synergies within the rating system. This graphic is intended to guide project teams to higher levels of sustainability (through increased credit achievement) by outlining the connections between credits and performance criteria. Prerequisites and credits have a graphic (example below) that demonstrates *Required* and *Related Links* between other prerequisites and credits.

Required Links refer to any mandatory cross-credit documentation that teams must submit for a project to satisfy the requirements and intent of a given prerequisite or credit. In the graphic, *Required Links* are shown in green.

Related Links indicate other prerequisites or credits that might benefit from strategies used for a given credit or prerequisite. In the graphic, *Related Links* are shown in gray.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



WHERE TO START

Integrated Design Team

An integrative design process is a critical component of the SITES v2 Rating System. It requires project team members of diverse disciplines (i.e., knowledgeable about natural systems, design, construction, and maintenance) to engage with each other, the client or owner, and local stakeholders and experts. This inclusive, collaborative, goal-driven approach is aimed at achieving high-performance project design and widespread buy-in from all parties involved. An integrated design team must be formed before beginning site design (see *Pre-Design P2.1: Use an integrative design process*) and all participants should be included in the initial review of the rating system and in determining the associated performance goals of the project.

SITES Scorecard

The SITES scorecard is a list of all the SITES v2 prerequisites and credits and their respective points. This tool helps projects note their initial goals and their progress in terms of the required prerequisites as well as the credits that the project team intends to pursue. The scorecard is a concise summary of a project's credit goals, and SITES requires submission of the scorecard for certification review. Please visit www.sustainablesites.org to download the SITES v2 scorecard.

Prerequisites

There are 18 prerequisites in the SITES v2 Rating System, and a project must satisfy all of them in order to be considered for certification. Prerequisites represent a baseline performance for any SITES certified project. Projects must review and understand prerequisite requirements to assess whether their project is eligible, particularly those found in *Section 1: Site Context* and *Section 2: Pre-Design Assessment + Planning*.

The prerequisites are as follows:

Context P1.1: Limit development on farmland

Context P1.2: Protect floodplain functions

Context P1.3: Conserve aquatic ecosystems

Context P1.4: Conserve habitats for threatened and endangered species

Pre-Design P2.1: Use an integrative design process

Pre-Design P2.2: Conduct a pre-design site assessment

Pre-Design P2.3: Designate and communicate Vegetation and Soil Protection Zones

Water P3.1: Manage precipitation on site

Water P3.2: Reduce water use for landscape irrigation

Soil+Veg P4.1: Create and communicate a soil management plan

Soil+Veg P4.2: Control and manage invasive plants

Soil+Veg P4.3: Use appropriate plants

Materials P5.1: Eliminate the use of wood from threatened tree species

Construction P7.1: Communicate and verify sustainable construction practices

Construction P7.2: Control and retain construction pollutants

Construction P7.3: Restore soils disturbed during construction

O+M P8.1: Plan for sustainable site maintenance

O+M P8.2: Provide for storage and collection of recyclables

Site Assessment

The site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is a comprehensive data-gathering exercise in which the integrated design team assesses and maps the existing conditions and characteristics of the project site to help explore options for sustainable outcomes. This task informs future decisions about site design, construction, operations, and maintenance. SITES considers the site assessment as a roadmap to better understanding the rating system.

Vegetation and Soil Protection Zones (VSPZs)

The rating system requires projects to conserve existing healthy natural resources that are critical, rare, or sensitive, such as prime farmland, within Vegetation and Soil Protection Zones (see *Pre-Design P2.3: Designate and communicate Vegetation and Soil Protection Zones*). To prevent damage to vegetation, soil structure, and function, teams should identify these areas during the pre-design phase and protect them throughout construction according to VSPZ requirements. Not all sites will contain a VSPZ, because VSPZs are based on existing healthy site features.

Plans and Punchlist

Several prerequisites require projects to consider and document how a site will operate during the construction and maintenance phases. Teams must communicate the SITES goals for the project to all members including contractors and operations and maintenance personnel. This documentation also addresses requirements of other SITES prerequisites and credits.

Soil Management Plan (*Soil+Veg P4.1: Create and communicate a soil management plan*)

Teams should complete this plan in the design phase. It details actions required for soil protection and restoration during the construction phase of the project.

SITES Punchlist (*Construction P7.1: Communicate and verify sustainable construction practices*)

Prior to the pre-construction meeting, a team must develop a punchlist that details communication and accountability between team members and ensures that SITES goals are met throughout construction.

Site Maintenance Plan (*O+M P8.1: Plan for sustainable site maintenance*)

Created by the integrated design team (including a team member knowledgeable in site maintenance), this plan intends to inform and structure maintenance strategies that ensure long-term site sustainability. It serves as a foundation for a more extensive operations and maintenance manual.

Defining a SITES Project Boundary

The SITES project boundary defines the limits of the project submitted for SITES certification. All maps or plans provided as credit documentation must reflect this SITES project boundary.

Generally, the SITES project boundary must be the legal property boundary. For projects located on publicly owned land or campuses that do not have internal property lines, the SITES project boundary may use the legal limits of the campus or, for SITES purposes, define an alternative boundary that is wholly contained within the legally owned site. It may not exclude sections of land to create boundaries in unreasonable shapes for the sole purpose of complying with prerequisites or credits. Other criteria for defining the boundary are as follows:

- All contiguous land that is associated with and supports normal site operations must be included in the SITES project boundary, including all land disturbed, protected, or conserved during the project. The SITES project boundary must not contain non-contiguous parcels except for parcels separated by public rights-of-way.

- All activities (i.e., conservation, restoration, construction, maintenance) must occur within the SITES project boundary and be consistently accounted for in prerequisite and credit documentation.
- Existing land uses and buildings may be included, but a majority of the project's total area should either be recently completed (within two years of SITES registration), planned as new construction, or a major renovation of an existing site.
- The entire area contained within the project boundary must be held by the same ownership, property manager, or developer, or maintained under one operating body.

Special Cases

Regularly occupied buildings are buildings where occupants (e.g., workers, students, residents) are inside for extended periods of time. In situations where regularly occupied buildings are located within the SITES project boundary:

- SITES certification generally concerns the area from the building skin outward; therefore most materials and spaces within a regularly occupied building footprint should be excluded from SITES calculations. In general, this division occurs at the outside-most material layer of the building enclosure.
- Exterior building materials must be included if they are part of an area (e.g., green roof, living wall) being used for SITES credits. If the project team elects to include exterior building materials, they must consistently account for them in all applicable SITES prerequisites and credits.

In some cases, land and facilities outside the SITES project boundary may be included in submittals:

- Submittals for all credits within *Section 3: Site Design—Water* may include an offsite catchment area, defined as land outside the SITES project boundary.
- The project SITES boundary may exclude a construction staging area that includes previously developed land used solely for construction staging and materials sorting. However, all credit calculations within *Section 7: Construction* must include the staging area.
- A project may use facilities such as parking lots that are outside the SITES project boundary when they serve the project but are not a part of the SITES construction scope.

Base Calculation Guidance

SITES asks projects seeking certification to provide base calculations in multiple credit submittals, and these numbers should be used consistently across all prerequisites and credits.

Total site area represents the entire area within the SITES project boundary, and may be presented in square feet, acres, or square meters (for projects outside the United States). The total site area should exclude the area of regularly occupied buildings, unless a portion (e.g., green roof) counts toward SITES credits.

Vegetated area describes all portions of the sites that will support vegetation.

Existing vegetated area is the pre-project area within the SITES project boundary that supports vegetation, including any invasive vegetation, as noted in credits such as *Pre-Design P2.2: Conduct a pre-design site assessment*, and *Soil+Veg C4.4: Conserve healthy soils and appropriate vegetation*.

Final vegetated area represents the entire area within the SITES project boundary that will support vegetation after the project is complete as noted in credits such as *Water P3.2: Reduce water use for landscape irrigation*, *Soil+Veg C4.6: Conserve and use native plants*, and *Construction P7.3: Restore soils disturbed during construction*.

Total materials cost represents the total cost of all materials used in the SITES project. The *Materials Worksheet* is available to registered project teams to assist in tracking and calculating project materials costs.

Total site users number represents the typical number of simultaneous users on a site during the busiest time period, excluding rare or singular events. Site users are defined as individuals who are expected to occupy, work at, or pass through the site. Users may visit the site regularly or only periodically. Site users will range in age, ethnicity, and socio-economic status, but all users' needs should be considered.

For projects with regularly occupied buildings, the total number of site users should include both full-time equivalent (FTE) occupants and either calculated or estimated temporary occupants. FTE occupants are typically the users of a site during a standard eight-hour period. An FTE occupant has a value of 1.0, while a temporary occupant has a value based on his or her hours per day divided by eight (occupant value = occupant hours/8 hours). If there are multiple shifts, use only the highest volume shift in the FTE calculation but consider shift overlap when determining peak site users.

For projects with more transient populations, reasonable methods of calculating estimated site users are acceptable with SITES approval.

SITES recommends that the integrated design team work collaboratively to estimate the average number of users likely to be on site. SITES' suggested methodology includes the following metrics:

- Consider daily use patterns and recurring events. If an event occurs more than 10 times per year, the number of users at those events should be considered.
- Site visitors present for two hours or less need not be factored into the number of total site users.
- Consider overlapping use patterns to estimate the total simultaneous site users.

Worksheets and Calculators

Registered projects receive access to specific worksheets and calculators mentioned throughout the SITES v2 Rating System (e.g., *Vegetation Worksheet*, *Native Plants Calculator*, *Materials Worksheet*). SITES provides these tools to assist project teams in tracking and calculating data consistently throughout the design and development process.

SITES Maps and Plans

For consideration for SITES certification, projects must provide a pre- and post-construction base map of the site showing the project's key components. Credit documentation must use this information consistently as it helps demonstrate compliance with SITES prerequisites and credits. All additional maps or plans provided as supporting credit documentation must reflect this base map information and should also follow these guidelines:

- Include the SITES project ID number, project name, relevant credit or prerequisite, location, and date of preparation
- Choose colors and images that clearly communicate the intent of the project
- Include a legend if icons, hatch patterns, or color palettes are used
- Provide a scale and north arrow
- Clearly define the SITES project boundary on all maps provided for review
- Clearly define any Vegetation and Soil Protection Zones (VSPZs)

Hypothetical Project Examples:

Live Oak Place and Sumac River Nature Center

To assist projects with specific documentation for certain SITES credits, hypothetical project examples demonstrate the information that must be shown on maps and site plans submitted for certification review. These graphic examples appear in the following prerequisites and credits:

Context C1.5: Redevelop degraded sites

Context C1.6: Locate projects within existing developed areas

Context C1.7: Connect to multi-modal transit networks

Pre-Design P2.3: Designate and communicate Vegetation and Soil Protection Zones

Water P3.1: Manage precipitation on site

Water P3.2: Reduce water use for landscape irrigation

Soil+Veg P4.1: Create and communicate a soil management plan

Soil+Veg P4.3: Use appropriate plants

Soil+Veg C4.6: Conserve and use native plants

Soil+Veg C4.8: Optimize biomass

Materials C5.2: Maintain on-site structures and paving

HHWB C6.2: Provide optimum site accessibility, safety, and wayfinding

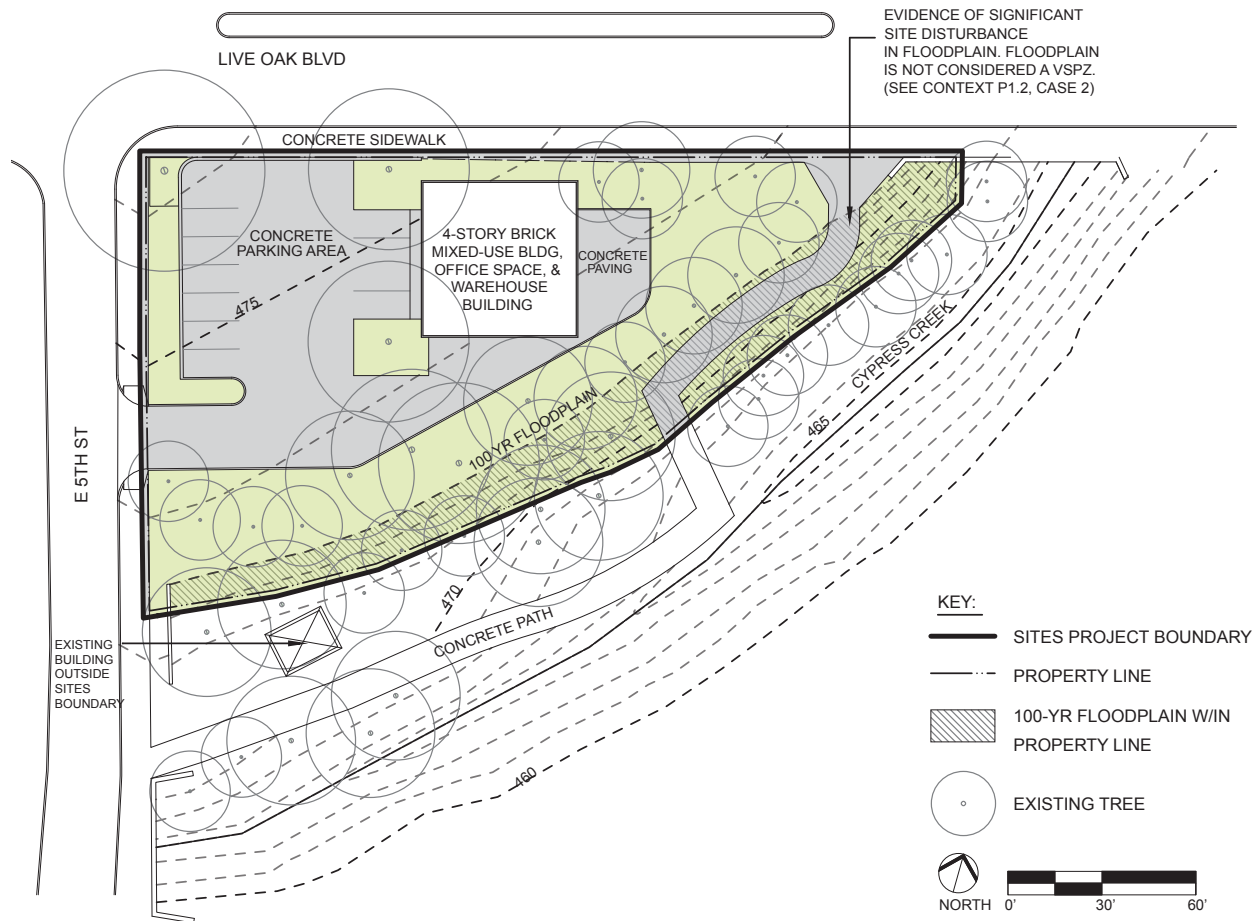
Construction P7.3: Restore soils disturbed during construction

O+M C8.5: Reduce outdoor energy consumption

Live Oak Place

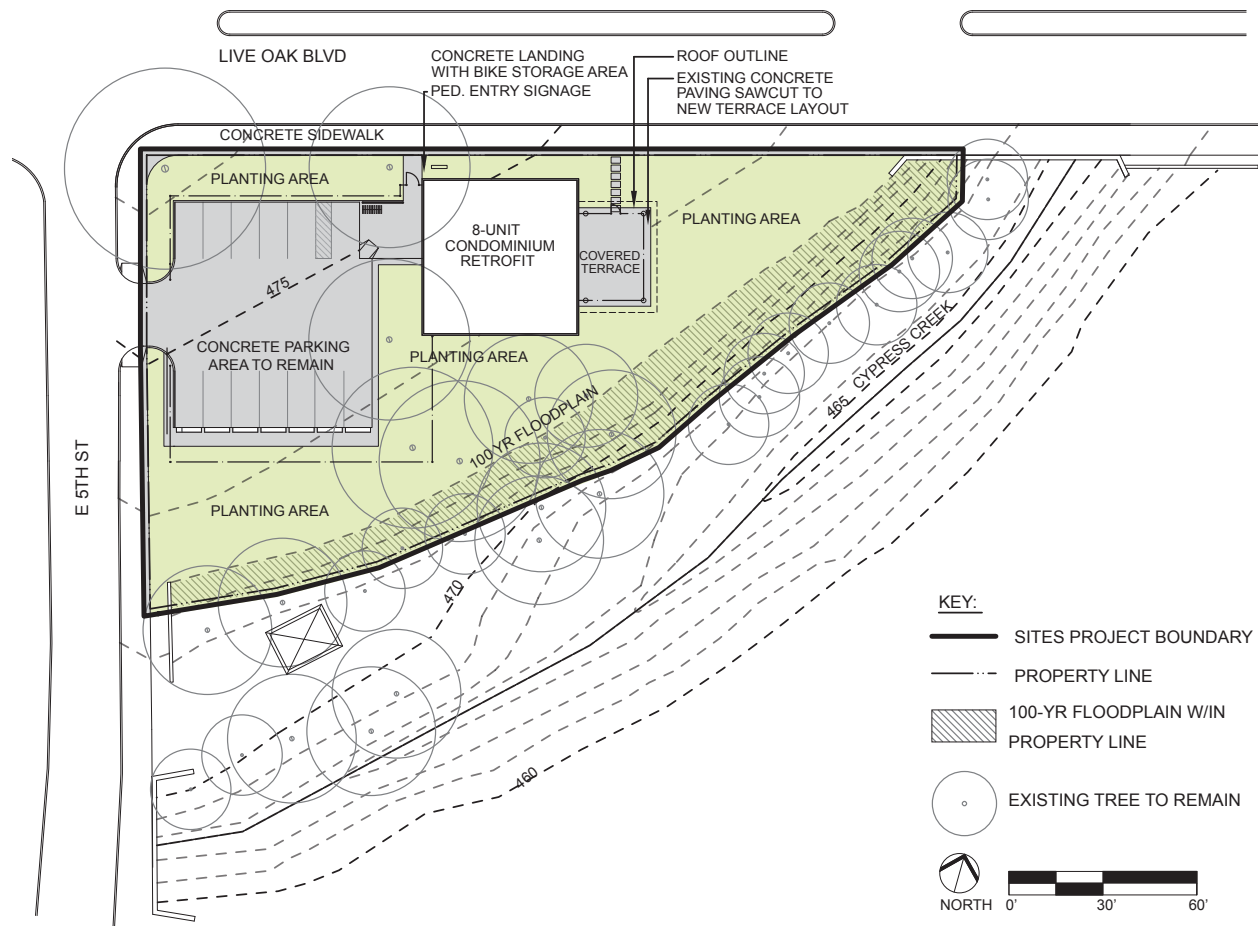
This hypothetical site is a small parcel in a heavily urbanized district. The property highlights a common scenario where the establishment of a Vegetation and Soil Protection Zone (VSPZ) is not applicable due to the degradation of existing soils and plant material. Small urban sites often have very few resources to protect due to their continual redevelopment over many years. However, Live Oak Place demonstrates a high level of credit potential based on its design strategy's resourcefulness, attention to context, and innovative construction methods.

Existing Conditions—Live Oak Place



The Live Oak Place site is 0.57 acres in downtown Austin, Texas. The single existing structure on site is a four-story brick structure on a pier and beam foundation that was constructed in 1966. Until the building was abandoned in 1998, it functioned primarily as a coffee company warehouse and packaging center. A concrete parking lot has existed on site since the time of the warehouse's construction. The 100-year floodplain of Cypress Creek covers the southern edge of the property; however, the site does not contain any water bodies. A small building within the floodplain exists outside of the SITES project boundary on an adjacent property owned by the municipality. A concrete sidewalk spans the off-site creek and cuts into the parcel's southeast corner. The prevalence of invasive plant species, compacted soils, and signs of prolonged erosion define the unpaved portions of the property. There are some large existing native trees on site that appear to have been planted in the 1950's as part of the city's streetscape program. The proposed design solution will conserve these native trees and protect them from compaction during the construction process, although they are not special status vegetation (see *Soil+Veg C4.5: Conserve special status vegetation*), nor do they, in total, make up the required percentage of existing native vegetated area (see *Soil+Veg C4.6: Conserve and use native plants*) to constitute a VSPZ. While there is some existing healthy vegetation and a floodplain onsite, the compaction levels of the soil and pervasiveness of invasive species eliminate the VSPZ requirement for this site. They also enable restoration and replanting as a major component of the site design.

Final Design—Live Oak Place

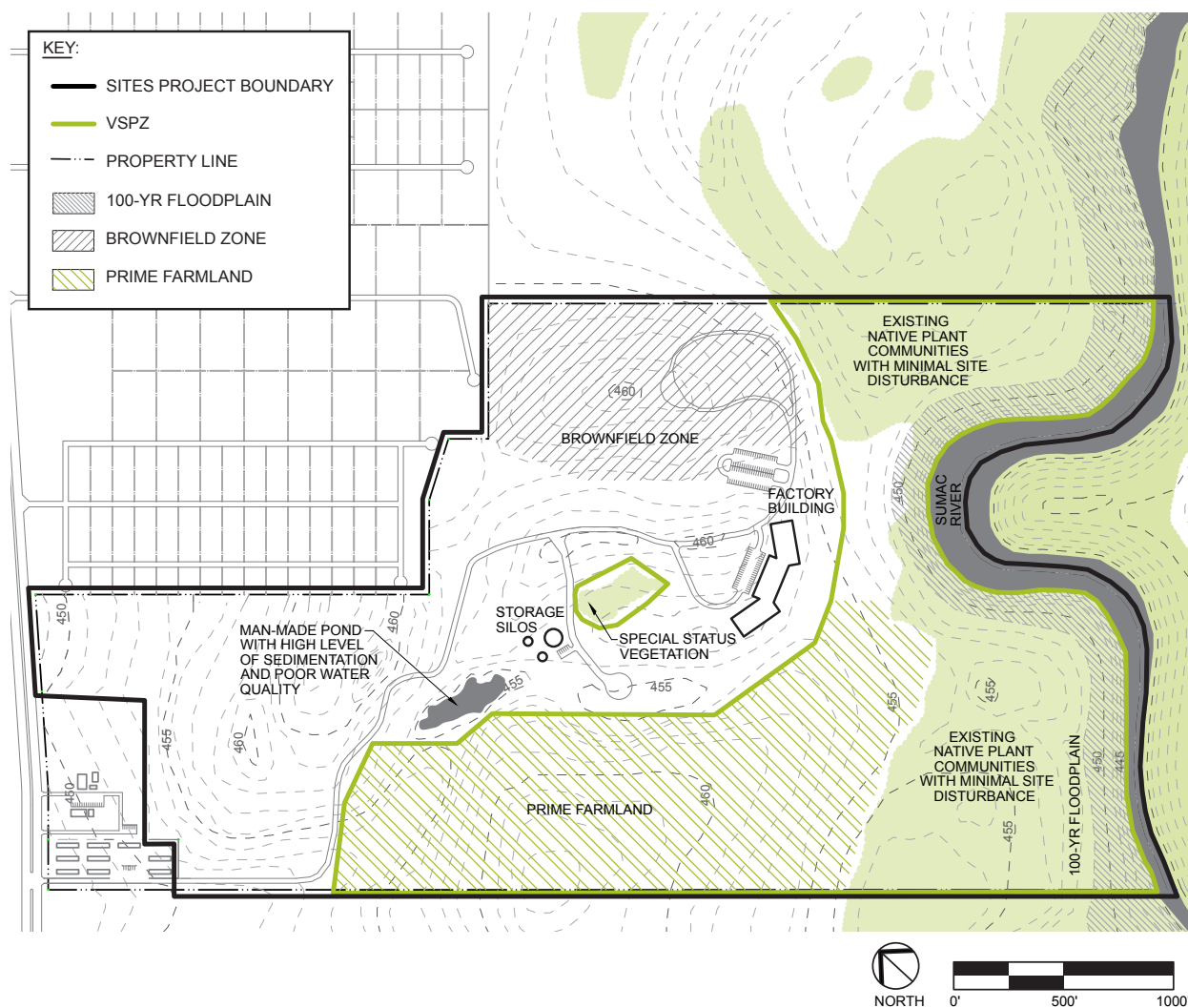


The proposed program within the SITES boundary for Live Oak Place includes a renovated parking area, a covered private terrace, and rehabilitated planting areas. A project goal was to restore floodplain functions, including that which existed outside the SITES project boundary. The integrated design team worked collaboratively with the municipality to remove the concrete sidewalk spanning both parcels. Restoration efforts included restoring soils and re-vegetating these areas with native plant communities. Renovations and improvements to the existing building are excluded from the SITES boundary and certification process in order to focus attention on the project's site design.

Sumac River Nature Center

This hypothetical site is a mid-scale brownfield project in a semi-rural context. The project has a multidimensional composition that includes greenfield farmland, a sensitive riparian habitat, native and invasive plant communities, a brownfield, and nearby residential and regional transportation resources.

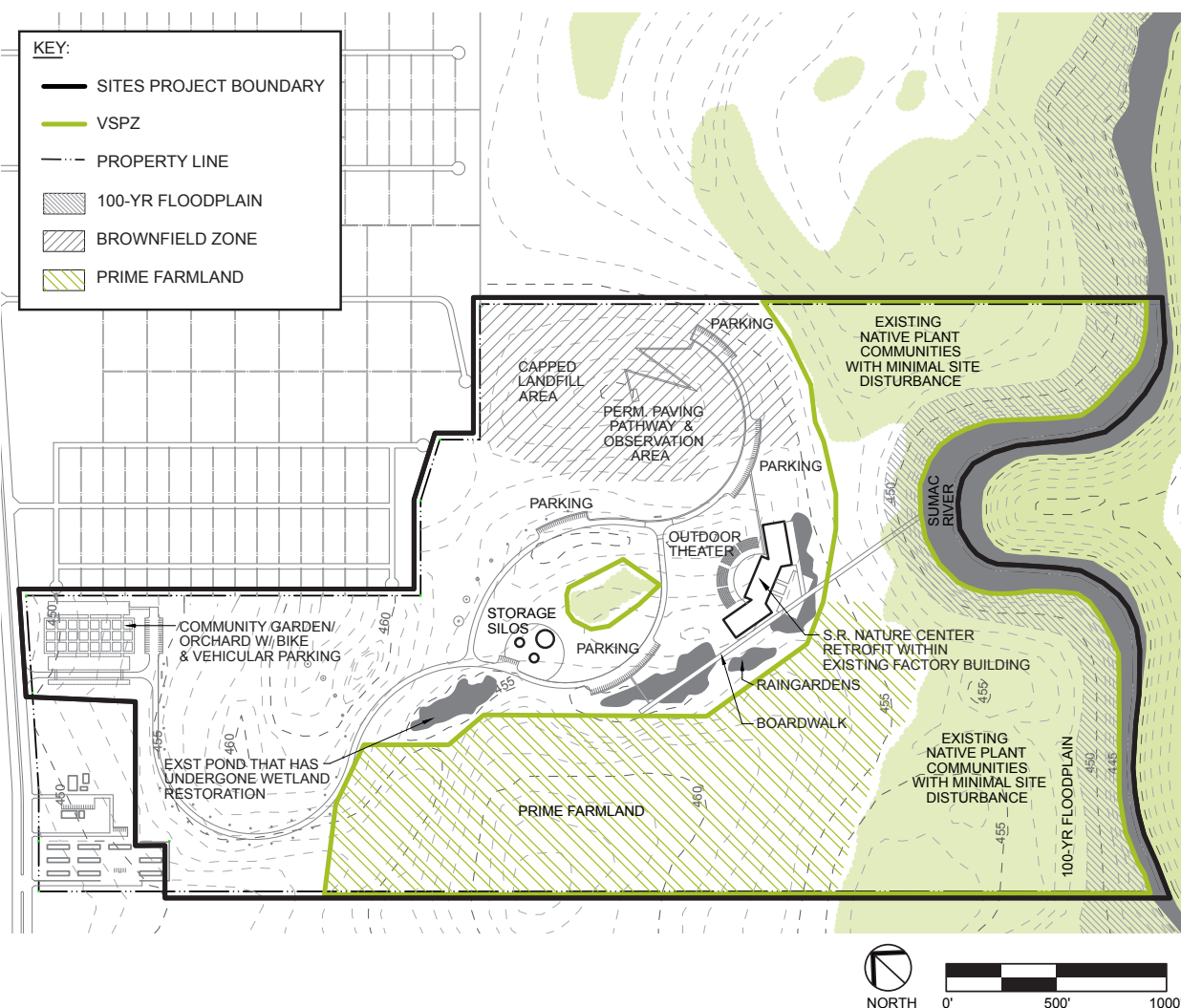
Existing Conditions—Sumac River Nature Center



The Sumac River Nature Center property is 227 acres located on the southern outskirts of Austin, Texas. The southern portion of the property borders farmland while the northern edge borders a single-family residential development. This area also contains a significant concentration of pollutants due to the property's use as an unregulated landfill operation for more than 20 years. The center of the Sumac River defined the site's eastern property line, and plant species native to the region dominate the river's edge. Prime farmland covers a large portion of the southern area of this property. The site's western boundary is bordered by Elmway Boulevard, a four-lane thoroughfare that connects a nearby regional transit center to downtown Austin. A single two-lane asphalt road enters the site and provides access to a two-story factory building that was built in 1968 and operated continuously as a semi-conductor plant and distribution center until 1987. In addition to the Sumac River, the site contains one man-made pond that was used originally as a livestock drinking water source. The pond has no active circulation or aeration system.

and shows a high level of sedimentation and concentration of animal waste. Both factors define the water body as an anaerobic health hazard to both humans and animals. A 10-acre storage facility and stone yard is located on the same property as the Sumac River Nature Center. This area is outside of the scope of the project and is not included within the SITES project boundary.

Final Design—Sumac River Nature Center



The design strategy for the Sumac River Nature Center conserves existing factory structures and native ecosystems and includes an extensive rehabilitation and restoration plan. Existing factory structures will be renovated to function as the main educational facility for the Sumac River Nature Center. This property will operate as a comprehensive regional amenity through the remediation of an existing brownfield, the construction of a community garden, and the protection of abundant existing ecological and cultural resources. The main pedestrian and vehicular entry to the property will be moved to facilitate accessibility to a regional transit center located 0.25 miles (0.40 kilometers) to the north of the property. A new community garden project, which is accessible by car, foot, and bicycle, surrounds this entrance. While a considerable portion of the site will remain protected within a VSPZ, large expanses of the property contain invasive species. These areas will undergo an extensive restoration process involving invasive species removal, soil amendments, and the introduction of native plant communities. The

property's existing pond will be incorporated into the larger stormwater strategies for the site. Due to its degraded condition and need for comprehensive restoration, this water body will remain outside of the VSPZ.

CERTIFICATION

The SITES v2 Rating System is a 200-point system with four certification levels of achievement.

The 18 prerequisites within the rating system are required and therefore are not assigned a point value. Credits are optional and assigned a point value or a range of possible points, which provides projects additional flexibility in selecting a target certification level that is appropriate and achievable.

Certification under the SITES v2 Rating System is awarded according to the following scale:

SITES v2 Certification Levels:	200 Points Total
Certified	70 points
Silver	85 points
Gold	100 points
Platinum	135 points

UPDATES AND ADDENDA

This is the first edition of the *SITES v2 Reference Guide: For Sustainable Land Design and Development*. The prerequisites and credits may need to be updated and amended as the science and body of knowledge on site sustainability improves and evolves. SITES will make updates and addenda available on its website (www.sustainablesites.org).



SECTION 1

SITE CONTEXT

PREREQUISITE / CREDIT	TITLE	POINTS
Context P1.1	Limit development on farmland	Required
Context P1.2	Protect floodplain functions	Required
Context P1.3	Conserve aquatic ecosystems	Required
Context P1.4	Conserve habitats for threatened and endangered species	Required
Context C1.5	Redevelop degraded sites	3-6 points
Context C1.6	Locate projects within existing developed areas	4 points
Context C1.7	Connect to multi-modal transit networks	2-3 points



Prerequisite 1.1: Limit development on farmland

Required

INTENT

Conserve the most productive farmland for future generations by protecting prime farmland, unique farmland, and farmland of statewide or local importance.

REQUIREMENTS

The requirements below apply exclusively to areas of the site that contain healthy soils, as identified in the site assessment (*see Pre-Design P2.2: Conduct a pre-design site assessment*), or areas of the site that have not been previously developed.

Refer to prime farmland, unique farmland, farmland of statewide importance, or farmland of local importance as defined by the U.S. Code of Federal Regulations, Title 7, Volume 6, Parts 400 to 699, Section 657.7 and identified in the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) soil survey (or local equivalent for projects outside the United States).

Case 1: Sites without farmland soils

- Locate the project on a site that does not contain soils defined by the NRCS (or local equivalent for projects outside the United States) as prime farmland, unique farmland, or farmland of statewide or local importance.

Case 2: Sites with farmland soils—VSPZs

- Designate at least 95 percent of all healthy soils on site defined by the NRCS (or local equivalent for projects outside the United States) as prime farmland, unique farmland, and farmland of statewide or local importance in Vegetation and Soil Protection Zones (VSPZs) (*see Pre-Design P2.3: Designate and communicate VSPZs*).
- Ensure the section of the site maintenance plan (*see O+M P8.1: Plan for sustainable site maintenance*) is complete and describes the on-going management activities to protect the integrity of the VSPZs.

Case 3: Sites with farmland soils—Mitigation

A site containing soils defined by the NRCS (or local equivalent for projects outside the United States) as prime farmland, unique farmland, or farmland of statewide or local importance is eligible for Case 3 if it is not located in an area designated by the municipality, county, or state as an agricultural conservation or rural conservation zone, and at least one of the following applies:

- Locate the project on an infill site (this action also satisfies the requirements of *Context C1.6: Locate projects within existing developed areas*).
- Locate the project within an area that has been designated by the municipality, county, or state as a “desired development zone,” a “preferred growth area,” or an “urban growth boundary,” using a comprehensive planning process (e.g., assessing future agricultural needs, affordable housing opportunities, transportation corridors, desires for density).

Section 1: Site Context

P1.1



Mitigation requirements: 100 percent of prime farmland, unique farmland, or farmland of statewide or local importance soils lost to development must be mitigated as follows:

- The purchase of agricultural conservation easements* must provide permanent protection from development on land with comparable soils at a 2:1 ratio (i.e., two acres or 0.81 hectares of easement for every one acre or 0.40 hectares of farmland soils lost to development).
 - Comparable soils must be productive farmland soils defined by the NRCS (or local equivalent for projects outside the United States) as prime farmland, unique farmland, or farmland of statewide or local importance
- All off-site mitigation (i.e., purchase of easements) must post-date SITES registration and must be located within 100 miles (160.93 kilometers) of the site.
- Up to 15 percent of the on-site soils defined by the NRCS (or local equivalent for projects outside the United States) as prime farmland, unique farmland, or farmland of statewide or local importance may be excluded from the mitigation requirements if it is permanently dedicated for on-site food production (see *HHWB C6.7: Provide on-site food production*). The minimum size of land designated for on-site food production must be at least 2,000 square feet (185.81 square meters).

* Criteria for agricultural conservation easements:

- > Must be used for the purpose of keeping land available for farming in perpetuity
- > Must maintain soil health (i.e., must be restored, vegetated with a perennial crop, or farmed with restorative agriculture practices that limit damage to soil and waterways)
- > Must allow (though not require) continued farming of the land
- > Refer to agricultural conservation easements proposed by the American Farmland Trust (or local equivalent for projects outside the United States)

SUBMITTAL DOCUMENTATION

Case 1: Sites without farmland soils

- Map, such as an NRCS Web Soil Survey (or local equivalent for projects outside the United States), showing the SITES project boundary and evidence that the site does not contain soils designated as prime farmland, unique farmland, or farmland of statewide or local importance

Case 2: Sites with farmland soils—VSPZs

- Map, such as an NRCS Web Soil Survey (or local equivalent for projects outside the United States), showing the SITES project boundary and soils on site designated as prime farmland, unique farmland, or farmland of statewide or local importance
- Applicable VSPZ documentation required to be submitted in *Pre-Design P2.3: Designate and communicate VSPZs*

Case 3: Sites with farmland soils—Mitigation

- Map, such as an NRCS Web Soil Survey (or local equivalent for projects outside the United States), showing the SITES project boundary and soils on site designated as prime farmland, unique farmland, or farmland of statewide or local importance
- Vicinity maps or plans showing:
 - SITES project boundary
 - Agricultural conservation or rural conservation zones, if any
 - The locations of the acquired agricultural conservation easements within 100 miles (160.93 meters) of the site
 - One of the two items below, depending on the project's location:
 - > Documentation demonstrating that the project is located on an infill site. Describe how the surrounding properties have been previously developed. (*Note: these are similar submittals to Context C1.6: Locate projects within existing developed areas*).

Section 1: Site Context

P1.1



- > Documentation from the municipality, county, or state that designates the “desired development zone,” “preferred growth area,” or “urban growth boundary.” Explain how future agricultural needs were considered when these areas or zones were designated.
 - Calculations showing the acreage of agricultural conservation easements required for mitigation
- Narrative explaining why the project as planned cannot be built and still satisfy Case 2 requirements
- Proof that sufficient easements have been purchased and that mitigation soils are comparable to those lost
- Applicable VSPZ documentation required to be submitted in *Pre-Design P2.3: Designate and communicate VSPZs*

DOCUMENTATION GUIDANCE

Example—Case 3: Mitigation calculations

- A 400-acre (161.87-hectare) site slated for development contains a total of 200 acres (80.94 hectares) of prime farmland soils. In this example, 50 percent, or 100 acres (40.47 hectares) of the farmland soils will be disturbed in order to build the project. Because of this, the Case 2 requirement that 95 percent of prime farmland soils on site must be designated in a VSPZ cannot be met. Additionally, the site is not located in an area designated by the municipality, county, or state as an agricultural conservation or rural conservation zone, and previously developed land borders 80 percent of the site’s perimeter, making it an infill site. Therefore, in order to meet this prerequisite, the project team will follow the Case 3 requirements as described below:
 - Five percent of the 200 acres (80.94 hectares), or 10 acres (4.07 hectares), will be permanently dedicated to community gardens. These 10 acres will be included in the 100-acre (40.47-hectare) project development.
 - The remaining 90 acres (36.42 hectares) of prime farmland soils that will be disturbed for development must be mitigated at a 2:1 ratio, equaling 180 acres (72.84 hectares). This must be land containing NRCS-designated prime farmland soils that will be purchased as agricultural conservation easements within 100 miles (160.93 kilometers) of the project. These easements will be purchased at two other sites; the first site is within 20 miles (32.19 kilometers) of the main project site and the second is within 60 miles (95.56 kilometers).

RECOMMENDED STRATEGIES

- Refer to the NRCS Web Soil Survey (websoilsurvey.nrcs.usda.gov/app/HomePage.htm), NRCS SSURGO soil surveys (soildatamart.nrcs.usda.gov), and NRCS soil survey maps from local Soil and Water Conservation District offices (or local equivalent for projects outside the United States) to determine if soils designated as prime farmland, unique farmland, or farmland of statewide or local importance are present on site.
- If farmland soils are present on site, consider relocating project development to an alternate site. If developing on an alternate site is not possible, locate project development within the site so as to conserve prime farmland soils and minimize disturbance due to construction activity.



ECONOMIC AND SOCIAL BENEFITS

Soils designated as prime farmland, unique farmland, or farmland of statewide or local importance have important biological, physical, and chemical characteristics needed to produce high crop yields. The USDA Natural Resources Conservation Service (NCRS) has judged them to be the best soils for producing food, fiber, feed, and high value crops in the United States.¹ Once converted to industrial and urban uses, this productive farmland is lost and cannot be regained. World consumption of many grain, oilseed, and meat commodities currently exceeds world production, and yet more than 900 million people suffer today from hunger and malnutrition.² Meeting this demand for agricultural products, including crops for biofuels, has placed a heavy burden on the productivity of U.S. farms and their soil resources.

Farmland in the United States is at risk. It is ripe for urban development because it tends to be flat, well drained, open, and comparatively inexpensive. In most states, the conversion of prime farmland to non-agricultural uses occurred at two to four times the rate of conversion of other, less productive farmland.³ In 2009, the NRCS further reported that 23 million acres (9.31 million hectares) of agricultural land, an area equal in size to Indiana, had been lost to development between 1982 and 2007. Of that lost acreage, 38 percent was prime farmland.⁴

Once soils on prime farmland succumb to industrial and urban uses, their productivity is generally lost. Additionally, their new land use designation typically is more harmful to the environment and human health. A recent study funded by the California Energy Commission's Public Interest Energy Research Program found that urban land accounts for 70 times more greenhouse gas emissions per acre than cropland.⁵ This land is unlikely to be returned to its original state or productive capacity, because development often increases land values beyond the reach of agricultural producers.

1. USDA Natural Resources Conservation Service, "Ecological and Interpretive Groups," NSSH Part 622, soils.usda.gov/technical/handbook/contents/part622.html (accessed April 2, 2013).
2. World Hunger Education Service, "2012 World Hunger and Poverty Facts and Statistics," www.worldhunger.org/articles/Learn/world%20hunger%20facts%202002.htm (accessed April 2, 2013).
3. Transport Research Center, *Transport, Urban Form and Economic Growth*, Report of the One Hundred and Thirty Seventh Round Table on Transport Economics (Paris, France: Organisation for Economic Co-operation and Development, 2007).
4. American Farmland Trust, "Farmland by the Numbers: The National Resources Inventory," www.farmland.org/programs/protection/American-Farmland-Trust-Farmland-Protection-Farmland-by-the-numbers.asp (accessed April 2, 2013).
5. R Brillinger and R Rominger, "Climate Benefits on Protecting Farmland," California Climate and Agricultural Network (2012), calclimateag.org/another-reason-to-protect-farmland/ (accessed April 2, 2013).

DEFINITIONS

- **Agricultural conservation easement (ACE)** is a voluntary, legally recorded deed restricting development on farmland. Land subjected to an ACE is generally restricted to farming and open space use. While other benefits may accrue because the land is not developed (e.g., scenic and habitat values), the easement must stipulate that the primary use of the land is agricultural. Such an easement prohibits practices that would damage or interfere with the agricultural use of the land. Because the easement is a restriction on the deed of the property, the easement remains in effect even when the land changes ownership (i.e., designated in perpetuity).
- **Farmland of local importance** refers to soils important to the local economy due to their productivity and which may include tracts of land that have been designated for agriculture by local ordinance. Each state Natural Resources Conservation Service or local ordinance designates which soils qualify.
- **Farmland of statewide importance** refers to soils that do not meet all of the prime farmland criteria but that are still able to economically produce high yields of crops when treated and managed according to acceptable farming methods. Each state Natural Resources Conservation Service designates which soils qualify.
- **Healthy soils** have not been significantly disturbed by previous human development activities. Healthy soils may include one or more of the following indicators:

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- Soil horizons similar to that of the reference soil
- Bulk densities that do not exceed the maximum allowable bulk densities shown in *P7.3: Restore soils disturbed during construction*
- Organic matter content similar to that of the reference soil
- Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) similar to that of the reference soil
- Absence of compounds toxic to the intended plants
- Presence of vegetation that is representative of native plant communities
- An **infill site** is a property that meets any one of the following four conditions:
 - At least 75 percent of its boundary borders land parcels that individually are at least 50 percent previously developed, and that in aggregate are at least 75 percent previously developed.
 - The site and bordering parcels form an aggregate parcel whose perimeter is 75 percent bordered by parcels that each are at least 50 percent previously developed, and that all together are at least 75 percent previously developed.
 - At least 75 percent of the land area, exclusive of rights-of-way, within a 0.5-mile (0.8 kilometer) distance from the SITES project boundary is previously developed.
 - The lands within a 0.5-mile (0.8 kilometer) distance from the project boundary have a pre-project connectivity of at least 140 intersections per square mile (or 54 intersections per square kilometer).
- * A street or other right-of-way does not constitute previously developed land; it is the status of the property on the other side of the right-of-way or the street that matters. For the first two conditions above, any fraction of the perimeter that borders waterfront is excluded from the calculation.
- A **previously developed site** consists of at least 75 percent of the site area that has been altered by preexisting paving, construction, or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural areas are considered undeveloped land.
- **Prime farmland** refers to a designation of specific soils by the state or U.S. Natural Resources Conservation Service. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. The land could be cropland, pastureland, rangeland, forestland, or other land, but cannot be urban built-up land or water. Prime farmland has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.
- **Unique farmland** refers to land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of a specific crop when treated and managed according to acceptable farming methods. The state or U.S. Natural Resources Conservation Service designates which soils qualify.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3: Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.

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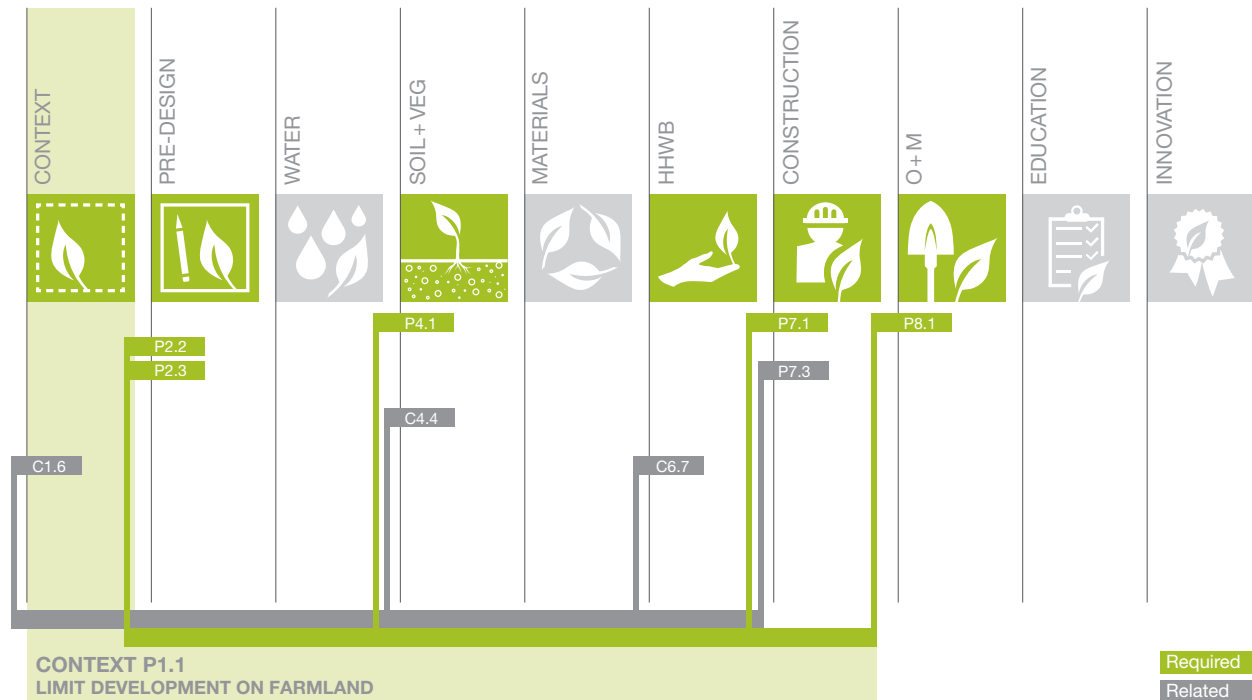
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RESOURCES

- For the online NRCS Web Soil Survey, consult websoilsurvey.nrcs.usda.gov/app/HomePage.htm.
- For Soil and Water Conservation District office locations by state, search www.nacdnet.org/about/districts/directory.
- For more information on agricultural conservation easements, consult these sources:
 - Farmland Information Center, www.farmlandinfo.org
 - State of California Department of Conservation, www.conservation.ca.gov/dlrp/cfcp/overview/Pages/ag_conserv_easements.aspx
 - American Farmland Trust, www.farmland.org/resources/national-view/default.asp

LINKS TO OTHER SITES PREREQUISITES AND CREDITS





Prerequisite 1.2: Protect floodplain functions

Required

INTENT

Protect floodplain functions (e.g., storage, habitat, water quality benefits) by limiting new development within the 100-year floodplain of all types of waterways and watercourses.

REQUIREMENTS

Case 1: Sites without floodplain

- Locate the project on a site that does not contain any land within a 100-year floodplain as defined and mapped by the Federal Emergency Management Agency (FEMA) or a local or state floodplain management agency map, whichever is more stringent (or local equivalent for projects outside the United States).
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete, including documentation that the site is not located within a 100-year floodplain.

Case 2: Previously developed and brownfield sites within floodplain

- Locate the project on a previously developed or brownfield site.
 - Demonstrate how the proposed development or redevelopment activities within the floodplain mitigate and improve existing floodplain conditions. Such activities must maintain or increase existing floodplain storage, improve water quality, and be designed so as not to be damaged by floods. Activities must not increase flood elevations.
 - Comply with the National Flood Insurance Program (NFIP) requirements for developing any structures within the 100-year floodplain (or local equivalent for projects outside the United States).
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and documents the location of the 100-year floodplain.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and describes the on-going management activities to protect the integrity of the floodplain functions.

Case 3: Greenfield sites within floodplain

- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and documents the location of the 100-year floodplain.
- Designate Vegetation and Soil Protection Zones (VSPZs) for 90 percent of the land within the 100-year floodplain (see *Pre-Design P2.3: Designate and communicate VSPZs*).
- Demonstrate that any minimal impact site development within the VSPZ improves existing floodplain conditions, which means it maintains or increases existing floodplain storage, improves water quality, is designed so as not to be damaged by floods, and does not singularly or cumulatively increase flood elevations.
- Comply with the National Flood Insurance Program (NFIP) requirements for developing any structures within the 100-year floodplain (or local equivalent for projects outside the United States).
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and describes the on-going management activities to protect the integrity of the VSPZs and the floodplain functions.

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SUBMITTAL DOCUMENTATION

Case 1: Sites without floodplain

- Map, such as a FEMA, state, or local floodplain management agency map (or local equivalent for projects outside the United States), showing the SITES project boundary and that the site does not contain land within the 100-year floodplain

Case 2: Previously developed and brownfield sites within floodplain

- Indicate that *Context C1.5: Redevelop degraded sites* is being pursued to qualify as a previously developed or brownfield site.
- Map, such as a FEMA, state, or local floodplain management agency map (or local equivalent for projects outside the United States), showing the SITES project boundary and the 100-year floodplain
- Site map showing:
 - Locations of any new development or redevelopment activities
 - Location of areas to be restored
 - Locations of any existing development or impervious cover
 - Percentage of existing development or impervious cover within the 100-year floodplain
- Calculations or narrative demonstrating that the proposed development or redevelopment activities within the floodplain mitigates and improves existing floodplain conditions, which means it maintains or increases existing floodplain storage, improves water quality, is designed so as not to be damaged by floods, and does not singularly or cumulatively increase flood elevations
- Narrative describing how any structures developed within the 100-year floodplain comply with the National Flood Insurance Program (NFIP) requirements (or local equivalent for projects outside the United States)

Case 3: Greenfield sites within floodplain

- Map, such as a FEMA, state, or local floodplain management agency map (or local equivalent for projects outside the United States), showing the SITES project boundary and the 100-year floodplain
- Calculations or narrative demonstrating that any minimal impact site development within the floodplain improves existing floodplain conditions, which means it maintains or increases existing floodplain storage, improves water quality, is designed so as not to be damaged by floods, and does not singularly or cumulatively increase flood elevations
- Narrative describing how any structures developed within the 100-year floodplain comply with the National Flood Insurance Program (NFIP) requirements (or local equivalent for projects outside the United States)
- Applicable VSPZ documentation required to be submitted in *Pre-Design P2.3: Designate and communicate VSPZs*

DOCUMENTATION GUIDANCE

- To evaluate the impacts of construction within the floodplain, incorporate the floodplain management guidance provided by FEMA (www.fema.gov/) and the U.S. Army Corps of Engineers models HECHMS for hydrology and HECRAS for hydraulics (www.hec.usace.army.mil/) (or local equivalent for projects outside the United States).
- To determine impacts in the floodplain:
 - Determine if there is any change in hydrology or peak flows (e.g., changes for 2-, 10-, and 100-year storms). If stormwater management techniques such as low impact development maintain the pre-development hydrology, then there should be minimal to no impact on the floodplain.
 - Look at any proposed fill within the 100-year floodplain, because each cubic foot or meter of fill is a cubic foot or meter of storage loss. If there will be fill, then

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determine whether or not the storage loss will have a significant impact. This can be a qualitative assessment. For example if the watershed above the site is 100 square miles (259 square kilometers), and the project is a trail with three to five cubic feet (0.08 to 0.14 cubic meters) of fill, the impact will be minimal. However, in other cases impact may be difficult to assess without using the hydrologic and hydraulic models. Also consider where fill is placed.

RECOMMENDED STRATEGIES

- Design the site to limit development and disturbance within the 100-year floodplain.
- Design new development, such as a trail or boardwalk, in such a way that it will not be damaged by flooding or result in a negative impact to existing floodplain storage or conveyance.
- Re-establish areas of vegetated floodplain on brownfield or previously developed sites, and manage invasive plant species where necessary.
- Carefully situate new development to avoid causing erosion and directing sediment and potential contaminants from stormwater runoff into receiving waters.

ECONOMIC AND SOCIAL BENEFITS

Floodplains store and convey water from spring rains, floods, hurricanes and other events. They can help remove pollutants from floodwaters by providing areas for the depositing of sediment carried in the water, which then nourishes and replenishes floodplain vegetation and soils. Floodplains also can provide areas for groundwater recharge, habitat corridors for plants and animals, and an urban oasis for human health and well-being. Protecting floodplain functions reduces flood risks to property owners, local ecosystems, and the health and safety of the general public. In addition, water quality improvement resulting from floodplain setback protection can lead to increased recreational opportunities for local and regional communities.

DEFINITIONS

- **100-year floodplain** includes all areas below the 100-year flood elevation of waterways of all sizes, including depressional areas, wetlands, areas behind levees, ephemeral and intermittent streams, rivers, lakes and shorelines, and coastal areas. These areas are generally depicted on the current FEMA Flood Insurance Rate Map as Zones A, AE, A1-A30, AH, AO, AR, A99, V, and VE; however, in some areas they may need to be calculated by the site development team.
- A **brownfield** is an abandoned, idled, or underused industrial and commercial facility or site where expansion or redevelopment is complicated by real or perceived environmental contamination; a site documented as contaminated by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local voluntary cleanup program, or a site defined as a brownfield by a local, state, or federal government agency.
- A **floodplain** is flat or nearly flat land adjacent to a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and that experiences flooding during periods of high discharge. Floodplains are subject to geomorphic (land-shaping) and hydrologic (water flow) processes.
- **Minimal impact site development** is development (e.g., a trail, picnic area, boardwalk) that does not significantly alter the existing vegetation and hydrology of the Vegetation and Soil Protection Zones (VSPZs).
- A **previously developed site** consists of at least 75 percent of the site area that has been altered by preexisting paving, construction or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land.

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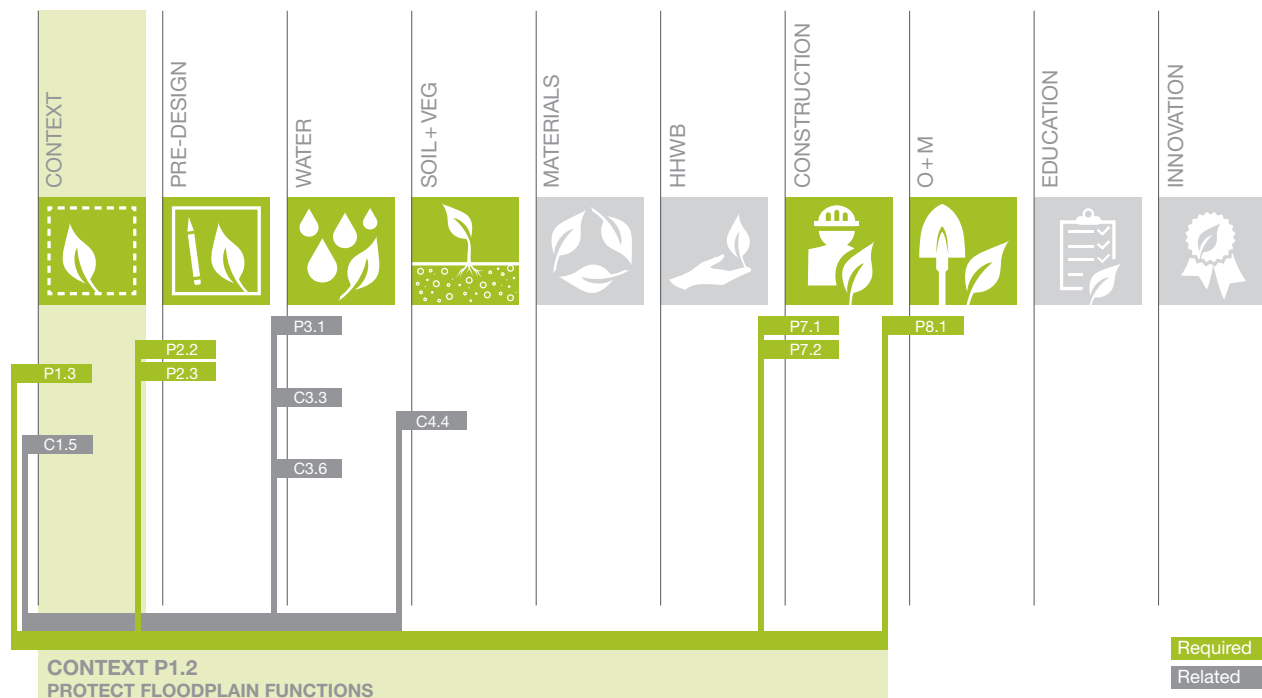


- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process, to prevent damage to vegetation, soil structure, and function. *Pre-Design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.

RESOURCES

- For more information on FEMA flood maps, see the online Map Service Center at msc.fema.gov, including the digitized Flood Insurance Rate Maps (FIRMs).
- For guidance on protecting riparian buffers during construction, see local sediment and erosion control regulations. If no local guidance is available, refer to the following resources:
 - Delaware's Sediment and Stormwater Management Program, www.swc.dnrec.delaware.gov/Pages/SedimentStormwater.aspx
 - 2005 Stormwater Management Manual for Western Washington, www.ecy.wa.gov/biblio/0510030.html
 - Sediment Source Control Handbook, www.ierstahoe.com/pdf/research/SSCH2008_FINAL.pdf
- For more information on low impact development techniques, see the Low Impact Development Center website, www.lowimpactdevelopment.org.
- For more information on the National Flood Insurance Program, visit www.floodsmart.gov/floodsmart.
- For 19 multi-objective project descriptions, read "Floods, Floodplains, and Folks" (National Park Service, ASFPM, Association of State Wetland Managers and FEMA, 1996). It is available online through the Association of State Floodplain Managers website at www.floods.org/PDF/PUBSLIST.pdf.
- For more information about the valuable functions of pristine or restored floodplains and their contributions to flood reduction and prevention, consult "Natural and Beneficial Functions of Floodplains" (FEMA Publication 409), available online at www.fema.gov/library/viewRecord.do?id=1546.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS





Prerequisite 1.3: Conserve aquatic ecosystems

Required

INTENT

Conserve and protect aquatic ecosystems, including wetlands and deepwater habitats that provide critical ecosystem functions for fish, other wildlife, and people.

REQUIREMENTS

Aquatic ecosystems include wetlands, deepwater habitats, and areas classified in accordance with the Classification of Wetlands and Deepwater Habitats of the United States as follows:

- Marine—Tidal wetlands, shorelines, mudflats, reefs
- Estuarine—Bays, lagoons, marshes
- Riverine—Streams, rivers (associated floodplains and their riparian buffer)
- Lacustrine—Lakes, ponds (associated shorelines and their riparian buffer)
- Palustrine—Non-tidal wetlands, seeps, springs, vernal pools, seasonal wetlands

Wetlands are defined in the U.S. Clean Water Act and delineated according to the appropriate regional supplement to the U.S. Army Corps of Engineers delineation manual (see Resources section). The boundaries of other aquatic ecosystems are defined by the ordinary high water mark (OHWM), which is also explained in Corps reports (see Resources section). Use local equivalent for projects outside the United States.

Case 1: Sites without aquatic ecosystems

- Locate the project on a site that does not contain any aquatic ecosystems, including isolated wetlands.
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and demonstrates that no aquatic ecosystems, including isolated wetlands, are located on site.

The following features are not considered aquatic ecosystems that must be protected for the purposes of this prerequisite:

- A previously developed site, unless the site contains naturally occurring wetlands, deepwater habitats, or previously constructed mitigation wetlands
- Human-made water bodies (e.g., industrial mining pits, concrete-lined canals, stormwater retention ponds) that lack natural edges and floors or native ecological communities in the water and along the edge.
- Human-made linear wetlands that result from the interruption of natural upland drainages by existing rights-of-way (except aquatic ecosystems that have been relocated by a right-of-way)
- Aquatic ecosystems including wetlands that are incidental results of development activity and have been rated “poor” for all measured wetland functions. A qualified professional using a method that is accepted by regional, state, or federal permitting agencies must perform an aquatic ecosystem quality assessment.

Case 2: Sites with naturally occurring aquatic ecosystems

- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and documents any aquatic ecosystems, including isolated wetlands, located on site.
- Delineate the full geographic extent, within the project site boundary, of the aquatic ecosystems according to U.S. Army Corps of Engineers guidance.

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- Designate Vegetation and Soil Protection Zones (VSPZs) for wetland and deepwater habitat buffer designations as defined below (see *Pre-Design P2.3: Designate and communicate VSPZs*). Restoration activities are encouraged within the limits of VSPZs.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and demonstrates how protection or restoration of the aquatic ecosystems will maintain their health long term. Indicate how maintenance and monitoring activities will ensure sustained proper aquatic function.
- Wetland and deepwater habitat buffers are designated by local, state, or federal regulations applicable to the jurisdiction in which the site is located, or as follows, whichever is greater:

Classification	Aquatic ecosystem habitat buffer designation
Marine	200 feet (60.96 meters) landward from normal high tide line
Estuarine	100 feet (30.48 meters) landward from the normal high tide line
Riverine	Tidal—100 feet (30.48 meters) landward from the normal high tide line
	Lower and upper perennial—100 feet (30.48 meters) from the ordinary high water mark or the 100-year floodplain, whichever is greater
	Intermittent and unknown perennial—50 feet (15.24 meters) from the ordinary high water mark or the 100-year floodplain, whichever is greater
Lacustrine	Water body greater than 50 contiguous acres (20.23 hectares)—100 feet (30.48 meters) landward from the normal water edge
	Water body less than 50 contiguous acres (20.23 hectares)—50 feet (15.24 meters) landward from the normal water edge
Palustrine	100 feet (30.48 meters) landward from the delineated edge of the delineated wetland

Note: An existing aquatic ecosystem cannot be utilized for primary water quality treatment. Stormwater management design must not impact existing aquatic ecosystem hydrology and features.

Case 3: Sites with naturally occurring poor quality aquatic ecosystems

This option is only available for naturally occurring aquatic ecosystems that have been rated “poor” for measured functions, including hydrologic function, vegetation, and habitat. A qualified professional using a method that is accepted by regional, state, or federal permitting agencies must perform the aquatic ecosystem quality assessment.

- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and documents any aquatic ecosystems, including isolated wetlands, located on site.
- Delineate the full geographic extent of the aquatic ecosystem, within the project site boundary, using the U.S. Army Corps of Engineers guidance (see Resources section).
- Demonstrate how the aquatic ecosystems’ functions will be protected, restored, and maintained for projects that will encroach on the required buffer of naturally occurring, poor quality aquatic ecosystems.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and demonstrates protection or restoration of the aquatic ecosystems to maintain their health long-term. Indicate how maintenance and monitoring activities will ensure sustained proper aquatic function.



SUBMITTAL DOCUMENTATION

Case 1: Sites without aquatic ecosystems

- Map, such as a U.S. Fish and Wildlife Service National Wetlands Inventory map or a state or local wetland map (or local equivalent for projects outside the United States), showing the SITES project boundary and that the site does not contain aquatic ecosystems

Case 2: Sites with naturally occurring aquatic ecosystems

- Map, such as a U.S. Fish and Wildlife Service National Wetlands Inventory map or a state or local wetland map (or local equivalent for projects outside the United States), showing the SITES project boundary, the full geographic extent of the delineated aquatic ecosystems, and the extent of all VSPZs, including:
 - Distances from edge of delineated aquatic ecosystems to edge of VSPZs
 - Locations of the buffer designations and percent of total area for any minimal impact site development that will occur in the VSPZs
- Applicable VSPZ documentation required to be submitted in *Pre-Design P2.3 Designate and communicate VSPZs*
- Documentation of the wetland assessment, including the credentials of the professional who performed the assessment (e.g., professional wetland scientist (PWS), Society of Wetland Scientists Professional Certification Program)

Case 3: Sites with naturally occurring poor quality aquatic ecosystems

- Map, such as a U.S. Fish and Wildlife Service National Wetlands Inventory map or a state or local wetland map (or local equivalent for projects outside the United States), showing the SITES project boundary and the full geographic extent of the delineated aquatic ecosystems
- Environmental assessments for each aquatic ecosystem, including ratings for all measured functions, including hydrologic function, vegetation, and habitat
- Narrative describing how the project will mitigate aquatic ecosystem impact during construction
- Documentation of the wetland assessment, including the credentials of the professional who performed the assessment (e.g., professional wetland scientist (PWS), Society of Wetland Scientists Professional Certification Program)

RECOMMENDED STRATEGIES

- During the site selection process, give preference to developing sites that do not contain aquatic ecosystems, such as wetlands or deepwater habitats.
- Design the site to minimize disruption to existing wetlands or deepwater habitats.
- If the project site boundary is directly adjacent to an off-site aquatic ecosystem, an on-site buffer may be implemented to protect all measured functions and the long-term health of the aquatic ecosystem.



ECONOMIC AND SOCIAL BENEFITS

Wetlands afford many benefits to society, including providing habitat for fish and other wildlife, improvements to natural water quality, storage of floodwater, protection against shoreline erosion, and opportunities for recreation and aesthetic appreciation. Wetlands are among the most productive and biodiverse ecosystems in the world—comparable to rain forests and coral reefs.¹ Estuaries and their coastal marshes are important nursery areas for the young of many recreational game and commercial fish and shellfish.

Wetlands help improve water quality, including that of drinking water, by intercepting surface runoff and removing or retaining inorganic nutrients, processing organic wastes, and reducing suspended sediments before they can reach open water.²

More than half of all adults in the United States hunt, fish, birdwatch, or photograph wildlife annually.³ As an outdoor activity, recreational birding is growing even faster than biking, walking, skiing, or golf. A large proportion of recreational birding is associated with wetlands and aquatic habitats, in large part because many birds are wetland-dependent.⁴

1. U.S. Environmental Protection Agency, "Wetland Functions and Values," cfpub.epa.gov/watertrain/pdf/modules/WetlandsFunctions.pdf (accessed April 2, 2013).

2. Ibid.

3. Ibid.

4. Ibid.

DEFINITIONS

- A **deepwater habitat** is permanently flooded land lying below the deepwater boundary of wetlands.
- A **floodplain** is flat or nearly flat land adjacent to a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and that experiences flooding during periods of high discharge. Floodplains are subject to geomorphic (land-shaping) and hydrologic (water flow) processes.
- **Geographic extent** refers to the measure of spatial extent bounded by a polygon with X and Y coordinates. It is described as the range, magnitude, or distance over which an aquatic ecosystem extends (i.e., the full area measurement from north to south and east to west).
- An **isolated wetland** is a wetland with no surface water connections to other aquatic resources.
- **Minimal impact site development** is development (e.g., a trail, picnic area, boardwalk) that does not significantly alter the existing vegetation and hydrology of the Vegetation and Soil Protection Zones (VSPZs).
- A **previously developed site** consists of at least 75 percent of the site area that has been altered by preexisting paving, construction or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land.
- A **riparian buffer** is the portion of the adjacent terrestrial ecosystem that directly affects or is affected by the aquatic environment (including streams, rivers, lakes, tidewaters, and bays and their adjacent side channels, floodplain, and wetlands). In specific cases, the riparian buffer may also include a portion of the hillslope that directly serves as streamside habitats for wildlife. A riparian buffer provides shade, intercepts runoff, and helps prevent erosion.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.

Section 1: Site Context

P1.3



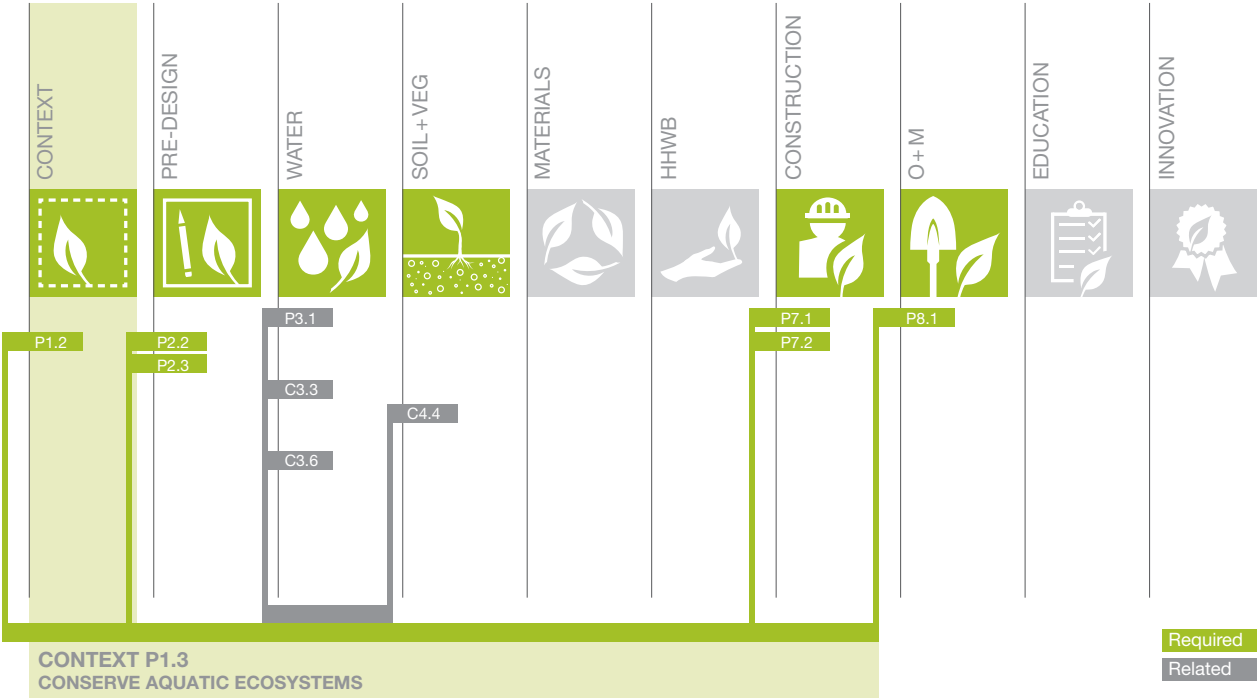
- **Wetlands** are areas that are inundated or saturated by surface or ground water (e.g., swamps, marshes, bogs) at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated conditions (Clean Water Act, U.S. Code of Federal Regulations 40 CFR 230.3).

RESOURCES

- For more information about the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al., 1979), see www.npwrc.usgs.gov/resource/wetlands/classwet.
- For a chart of Wetlands and Deepwater Habitats Classification, see www.fws.gov/wetlands/Documents/Wetlands-and-Deepwater-Habitats-Classification-chart.pdf.
- For guidance on delineating wetlands, see U.S. Army Corps of Engineers resources online at www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/reg_supp.aspx. Many wetlands are digitally mapped and can be downloaded from the U.S. Fish and Wildlife Service National Wetlands Inventory (www.fws.gov/wetlands) or from state, county, or municipal geographic information system departments or Natural Resources Conservation Service offices.
- For guidance delineating non-wetland aquatic resource boundaries see U.S. Army Corps of Engineers resources Regulatory Guidance Letter No. 05-05 on the Ordinary High Water Mark, www.usace.army.mil/Portals/2/docs/civilworks/RGLS/rgl05-05.pdf and Arid West Field Guide (www.crrel.usace.army.mil/library/technicalreports/ERDC-CRREL-TR-08-12.pdf).
- For the National Wetlands Inventory as determined by the U.S. Fish & Wildlife Service, see www.fws.gov/wetlands/Data/Wetland-Codes.html.
- For guidance on selecting an acceptable assessment models, please see the U.S. EPA's monitoring resources for aquatic ecosystems:
 - General Wetland Assessment Information, water.epa.gov/type/wetlands/assessment/index.cfm 2004
 - *Review of Rapid Assessment Methods for Evaluating Wetland Condition*, www.epa.gov/nheerl/download_files/publications/rapidmethodreview.pdf
 - Technical Resources for Stream Mitigation, water.epa.gov/lawsregs/guidance/wetlands/wetlandsmitigation_index.cfm—technical
- For additional wetland assessment standards potentially applicable to your region, see the following links:
 - California Rapid Assessment Method (CRAM), www.cramwetlands.org
 - Florida Uniform Mitigation Assessment Method, www.dep.state.fl.us/legal/Rules/surfacewater/62-345/62-345.pdf

Section 1: Site Context

LINKS TO OTHER SITES PREREQUISITES AND CREDITS





Prerequisite 1.4: Conserve habitats for threatened and endangered species

Required

INTENT

Protect ecosystem function by avoiding development of areas that contain habitat for plant and animal species identified as threatened or endangered.

REQUIREMENTS

Case 1: Brownfields and previously developed sites

- For all natural areas greater than 2,000 contiguous square feet (185.81 square meters):
 - As part of the pre-design site assessment (*Pre-design P2.2: Conduct a pre-design site assessment*), identify whether the site is in the range of potential habitats for any plant or animal species on U.S. federal or state threatened or endangered lists or on the International Union for Conservation of Nature (IUCN) “Red List of Threatened Species” as critically endangered (CR) or endangered (EN).
 - Designate the full extent of habitats for threatened or endangered species on the site as Vegetation and Soil Protection Zones (VSPZs) (see *Pre-Design P2.3: Designate and communicate VSPZs*).
 - Protect all listed animals and plants from damage or removal. Construction activities for minimal impact site development, and restoration and maintenance activities within VSPZs shall only occur during seasons when the animal species is not present.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and details the process for avoiding impacts to threatened and endangered species and their habitats during site maintenance.

Case 2: Greenfield sites

- As part of the pre-design site assessment (*Pre-design P2.2: Conduct a pre-design site assessment*), identify whether the site is in the range of potential habitats for any plant or animal species on U.S. federal or state threatened or endangered lists or on the International Union for Conservation of Nature (IUCN) “Red List of Threatened Species” as critically endangered (CR) or endangered (EN).
- If the site is in the range of any threatened or endangered plant or animal species, conduct a habitat assessment for each identified species.
- Designate the full extent of habitats for threatened and endangered species on the site as VSPZs (see *Pre-Design P2.3: Designate and communicate VSPZs*).
- Protect all listed animals and plants from damage or removal. Construction activities for minimal impact site development and maintenance activities within VSPZs shall only occur during seasons when the animal species is not present. Restoration activities may occur within this zone to increase the quality of the habitat.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and details the process for avoiding negative impacts to threatened and endangered species and their habitats during site maintenance.

Section 1: Site Context

P1.4



SUBMITTAL DOCUMENTATION

Case 1: Brownfields and previously developed sites

- List of threatened or endangered plant or animal species applicable for the site area
- For natural areas greater than 2,000 contiguous square feet (185.81 square meters), provide a habitat assessment or a letter signed by a qualified professional documenting whether the site contains habitat for threatened or endangered plant and animal species.
- If habitats are identified on site:
 - Applicable VSPZ documentation required to be submitted in *Pre-Design P2.3*
Designate and communicate VSPZs

Case 2: Greenfield sites

- List of threatened or endangered plant or animal species applicable for the site area
- Habitat assessment documenting whether the site contains habitat for threatened or endangered plant and animal species and including the credentials of the professional who performed the assessment.
- If habitats are identified on site:
 - Applicable VSPZ documentation required to be submitted in *Pre-Design P2.3*
Designate and communicate VSPZs

RECOMMENDED STRATEGIES

- During the site selection process, channel development to sites that do not include habitat for threatened or endangered plant and animal species.
- Design the site to minimize disruption to existing habitats.
- Design to allow species connectivity (habitat corridors) through the site and to adjacent sites.

ECONOMIC AND SOCIAL BENEFITS

Species extinctions can disrupt the interactions and feedback mechanisms of natural ecosystems that have developed over time to be relatively stable and resistant to pests and diseases. Stable natural ecosystems control more than 95 percent of the potential crop pests and carriers of human diseases.¹

Ecosystems that contain wildlife habitat serve as refugia, and can also support recreational and ecotourism activities such as hiking, birdwatching, and other opportunities for environmental education.²

1. PR Ehrlich, "The Concept of Human Ecology: A Personal View," *IUCN Bulletin* 16, No. 4-6 (1985): pp. 60-61.
2. RS De Groot, MA Wilson, and RMJ Boumans, "A Typology for the Classification, Description and Valuation of Ecosystem Functions, Goods and Services," *Ecological Economics* 41, No. 3 (2002): pp. 393-408.



DEFINITIONS

- A **brownfield** is an abandoned, idled, or underused industrial and commercial facility or site where expansion or redevelopment is complicated by real or perceived environmental contamination; a site documented as contaminated by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local voluntary cleanup program, or a site defined as a brownfield by a local, state, or federal government agency.
- **Habitat** is the area or natural environment in which an organism or population normally lives. A habitat is made up of physical factors such as soil, moisture, range of temperature, and availability of light as well as biotic factors such as the availability of food and the presence of predators.
- A **habitat assessment** is the visual, spatial, and temporal analysis of environmental data to determine types, distribution, and amount of habitat on a given site. This information includes an inventory of the geology, soils, water resources, and plant communities, which is used to identify the potential habitat for species of concern on site.
- **Minimal impact site development** is development (e.g., a trail, picnic area, boardwalk) that does not significantly alter the existing vegetation and hydrology of the Vegetation and Soil Protection Zones (VSPZs).
- A **previously developed site** consists of at least 75 percent of the site area that has been altered by preexisting paving, construction or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes requirements for VSPZs.

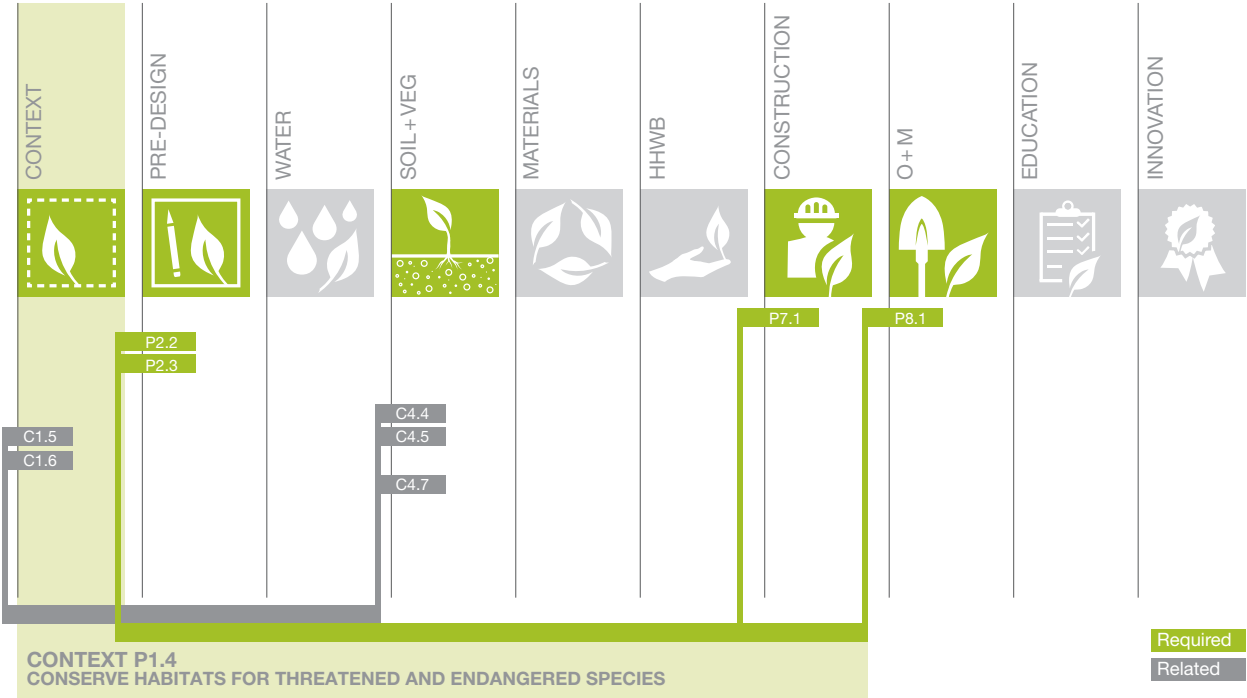
RESOURCES

- For federal lists of threatened or endangered species by state, consult the U.S. Fish & Wildlife Service website, ecos.fws.gov/tess_public/StateListing.do?state=all.
- For federal and state lists of endangered plants, consult the U.S. Department of Agriculture website, plants.usda.gov/threat.html.
- For a database searchable by location and assessment classification (e.g., critically endangered or endangered), refer to the IUCN Red List, www.iucnredlist.org.
- For the U.S. Fish & Wildlife Service “Critical Habitat for Threatened & Endangered Species” list, visit criticalhabitat.fws.gov/crithab.
- For information about California Rapid Assessment Method (CRAM), visit www.cramwetlands.org.
- For the State of Massachusetts Habitat Assessment Guidelines, visit www.mass.gov/dfwele/dfw/nhESP/regulatory_review/pdf/plantassessment.pdf.

Section 1: Site Context

LINKS TO OTHER SITES PREREQUISITES AND CREDITS

P1.4





Credit 1.5: Redevelop degraded sites

3–6 points

INTENT

Protect ecosystem function, reduce pressure on undeveloped land, reduce resource consumption, and restore ecosystem services to damaged sites by channeling development to urban and previously developed areas.

REQUIREMENTS

Case 1: Previously developed sites

3 points

- Redevelop a previously developed site.
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and documents the percent of total site area that is previously developed.

Case 2: Brownfield sites

6 points

- Redevelop a brownfield site and remediate site contamination such that the controlling public authority approves the protective measures or cleanup process as effective, safe, and appropriate for the planned use of the site. All investigations and evaluations must be conducted by an environmental professional, as defined by the U.S. EPA 40 CFR 312.10 b (or local equivalent for projects outside of the United States).
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and documents the site's status as contaminated or defined as a brownfield.

SUBMITTAL DOCUMENTATION

Case 1: Previously developed sites

- Site plan and aerial photographs showing the project site and areas of previous development, labeling the previous use locations and altered landscape features
- Areas that involve soil remediation should also be shown on the soil management plan (see *Soil+Veg P4.1: Create and communicate a soil management plan*).
- Calculations showing the percent of total site area that was previously developed
- Narrative describing the previous development on the site, including its type, approximate dates of existence, and any regulatory permitting that may have been issued for the previous activity
- Historical photographs or reports describing previous site use, if available

Case 2: Brownfield sites

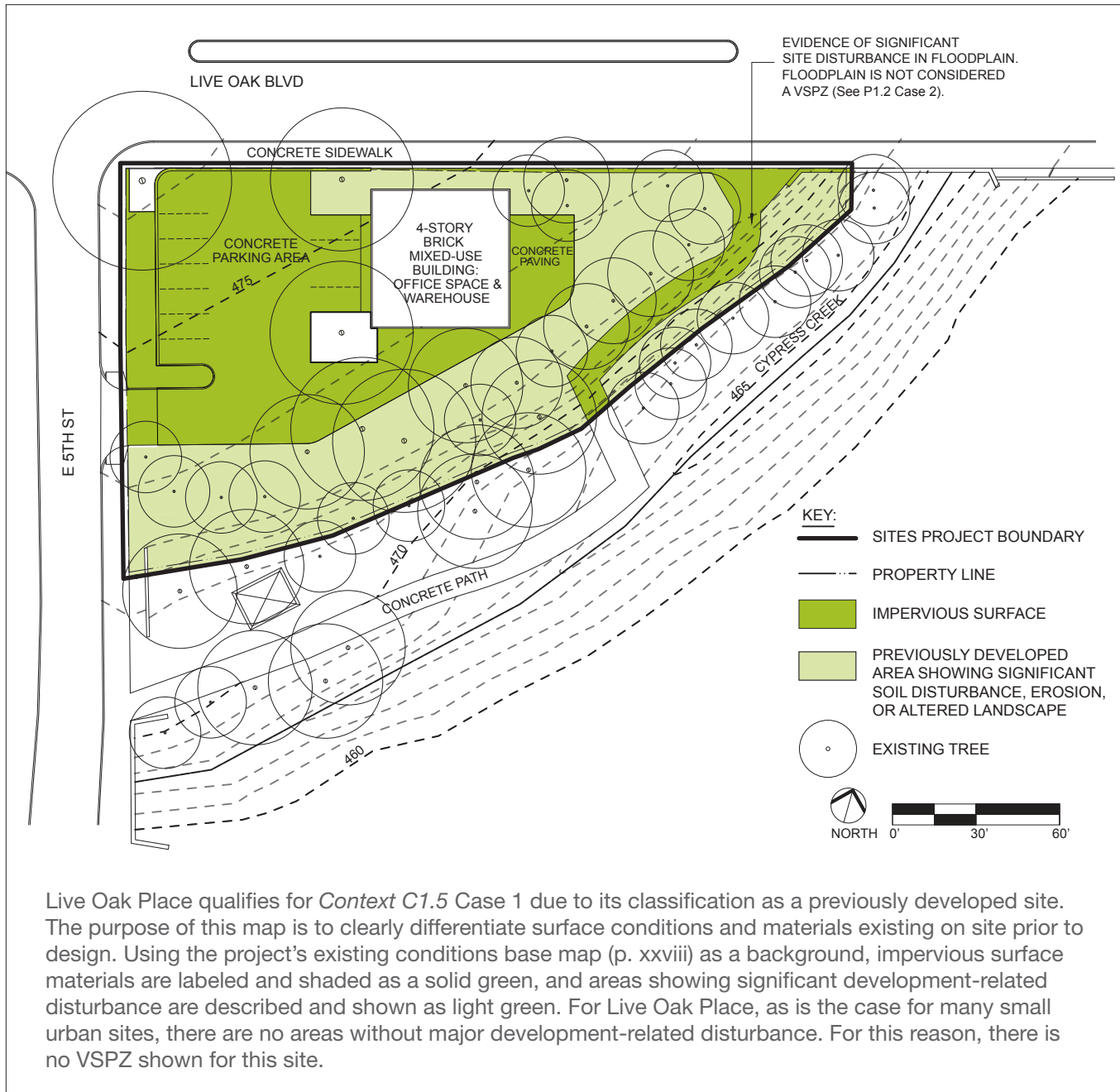
- Site plan delineating areas in which contaminants exceed applicable federal or state standards, including the percent of the total site area that is classified as a brownfield
- Areas that involve soil remediation should also be shown on the soil management plan (see *Soil+Veg P4.1: Create and communicate a soil management plan*).
- Confirmation that the site was contaminated or defined as a brownfield through a Phase II environmental site assessment or a federal or state listing as contaminated. Document that contaminant concentrations exceed federal or state limits.
- Narrative describing the following:
 - Site contamination
 - Risk reduction measures undertaken or to be undertaken during development to meet applicable federal or state standards
 - How the brownfield is incorporated into overall design
- Credentials of the environmental professional that investigated and evaluated the site

Section 1: Site Context

DOCUMENTATION GUIDANCE

Example—Case 1: Live Oak Place

C1.5



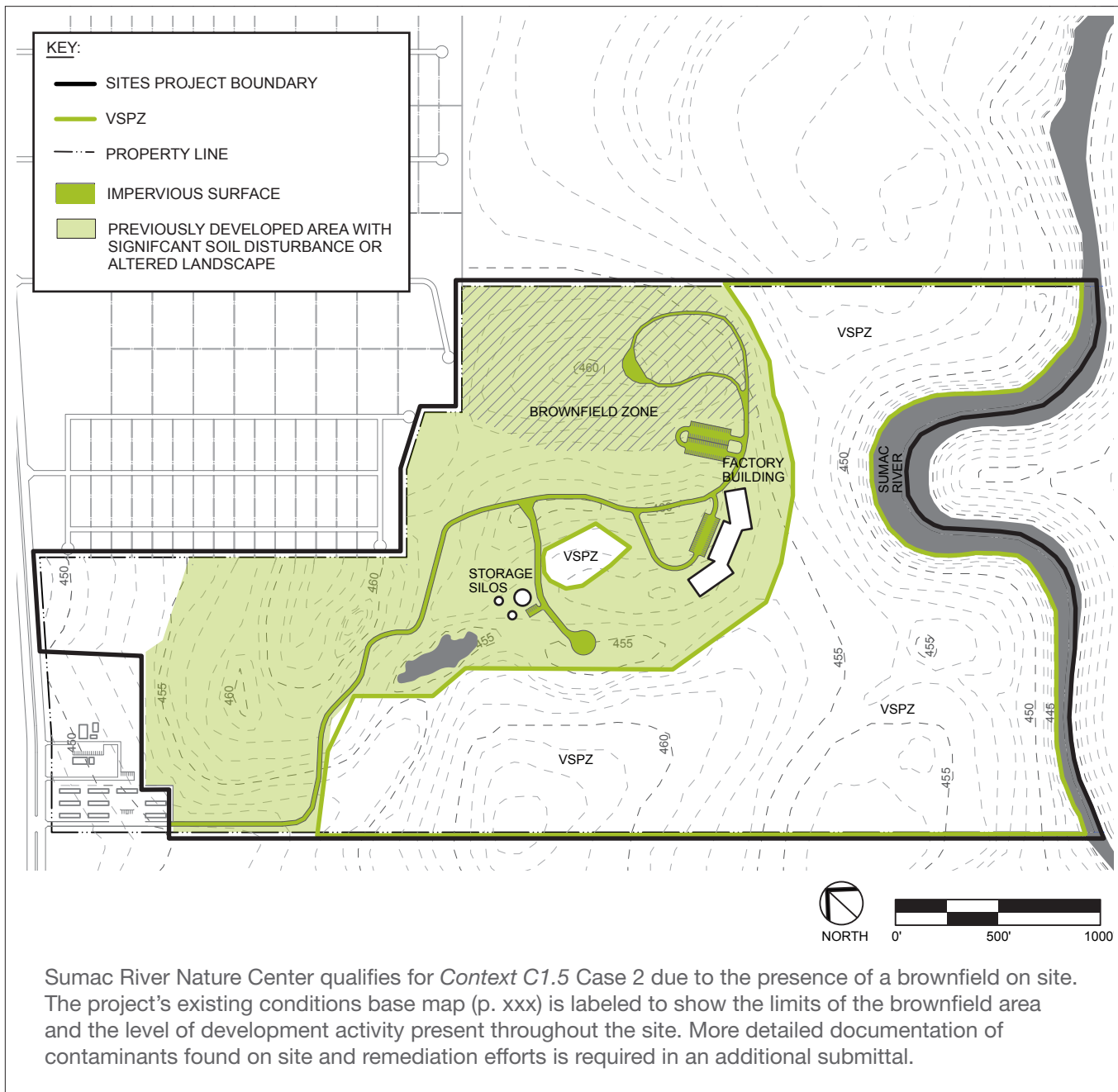
Live Oak Place qualifies for *Context C1.5 Case 1* due to its classification as a previously developed site. The purpose of this map is to clearly differentiate surface conditions and materials existing on site prior to design. Using the project's existing conditions base map (p. xxviii) as a background, impervious surface materials are labeled and shaded as a solid green, and areas showing significant development-related disturbance are described and shown as light green. For Live Oak Place, as is the case for many small urban sites, there are no areas without major development-related disturbance. For this reason, there is no VSPZ shown for this site.

Section 1: Site Context

C1.5



Example—Case 2: Sumac River Nature Center





RECOMMENDED STRATEGIES

- During the site selection process, give preference to previously developed or brownfield sites.
- Coordinate site development plans with remediation activity, and use of existing infrastructure and materials where appropriate.
- Consult available local and state government brownfield databases to find brownfield properties.

ECONOMIC AND SOCIAL BENEFITS

Redevelopment of brownfields and previously developed sites reduces pressure on undeveloped land, thereby protecting habitat and preserving natural resources. Using existing infrastructure and on-site materials can reduce project costs for new materials. The rehabilitation of a site with environmental contamination is an opportunity to improve the environmental quality and resources available to local communities, spur business investment, improve public health, and erase the general stigma of a degraded environment. Such properties may also cost less and be offered for sale with tax incentives.¹

1. U.S. Environmental Protection Agency, "A Guide to Federal Tax Incentives for Brownfields Redevelopment," nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100ADNA.txt (accessed April 02, 2013).

DEFINITIONS

- A **brownfield** is an abandoned, idled, or underused industrial and commercial facility or site where expansion or redevelopment is complicated by real or perceived environmental contamination; a site documented as contaminated by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local voluntary cleanup program; or a site defined as a brownfield by a local, state, or federal government agency.
- A **previously developed site** consists of at least 75 percent of the site area that has been altered by preexisting paving, construction or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land.

RESOURCES

- For techniques and benefits of utilizing previously developed land as an alternative to greenfield development, see:
 - Benfield, Kaid, et al, *Smart Growth in a Changing World*, APA Planners Press, 2007
 - Benfield, Kaid, et al, *Solving Sprawl: Models of Smart Growth in Communities Across America*, Natural Resources Defense Council, 2001
 - Dunham-Jones, Ellen, *Retrofitting Suburbia*, Wiley, 2011
 - Tachieva, Galina, *Sprawl Repair Manual*, Island Press, 2010
- For organizations that promote the reuse of previously developed land, see:
 - Lincoln Institute of Land Policy, www.lincolninst.edu
 - Smart Growth America, www.smartgrowthamerica.org
 - Smart Growth Online, www.smartgrowth.org
 - Urban Land Institute, www.uli.org
- For literature on the economic, social, and fiscal benefits of brownfield restoration and best practices for contamination assessment and remediation, see:
 - David, Todd, et al, *Brownfields: A Comprehensive Guide to Redeveloping Contamination Property*. American Bar Association, 2011
 - Dixon, Time, et al, *Sustainable Brownfield Regeneration*, Wiley-Blackwell, 2007

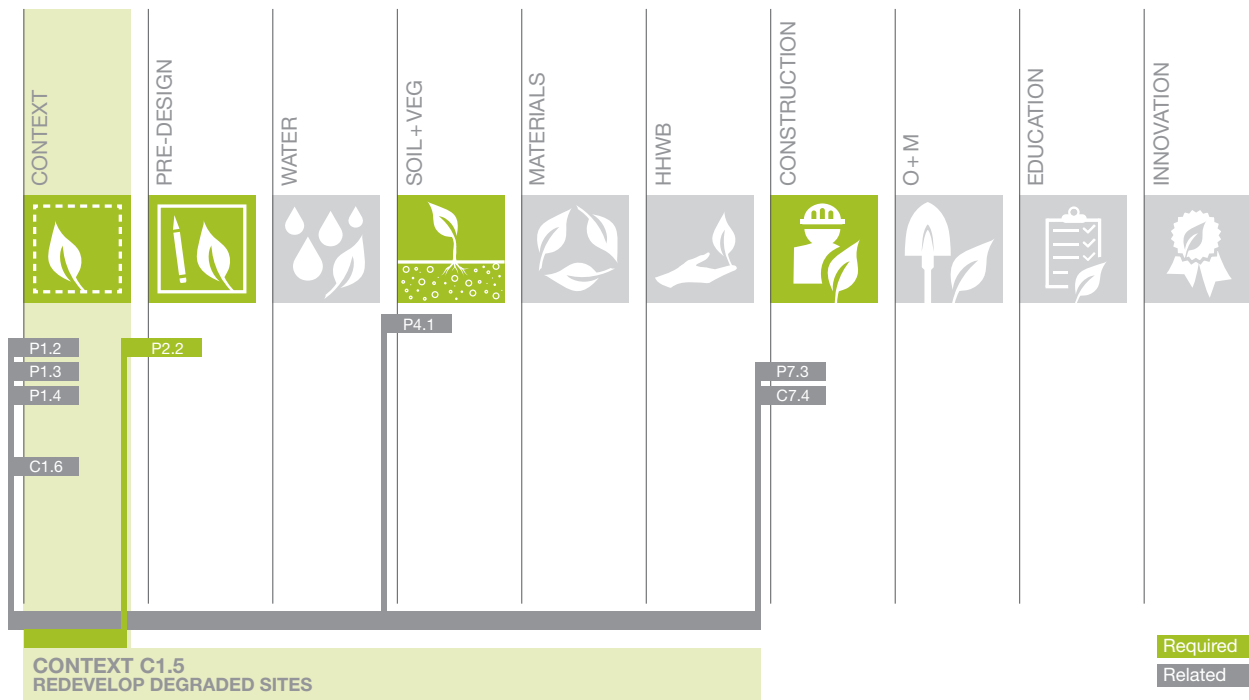
Section 1: Site Context

- Hollander, Justin, et al, *Principles of Brownfield Regeneration*, Island Press, 2010
- Sarni, William, *Greening Brownfields: Remediation through Sustainable Development*, McGraw-Hill, 2010
- For technical assistance in identifying and remediating brownfield properties, see:
 - State environmental agencies and brownfield organizations
 - U.S. Environmental Protection Agency's Brownfields and Land Revitalization, www.epa.gov/brownfields
 - National Brownfields Association, www.brownfieldassociation.org
 - National Association of Environmental Professionals, www.naep.org
 - Brownfields Center at the Environmental Law Institute, www.brownfieldscenter.org/big/about.shtml

C1.5



LINKS TO OTHER SITES PREREQUISITES AND CREDITS





Credit 1.6: Locate projects within existing developed areas

4 points

INTENT

Reduce development impacts, support local economy, and improve human health and well-being by selecting sites within existing developed areas.

REQUIREMENTS

Locate the project on a site that meets all of the following criteria:

- An infill site within 500 feet (152.4 meters) of existing publicly provided water and wastewater infrastructure
- Close proximity to basic services so that at least one entrance to the project is within a 0.5-mile (0.8-kilometers) walking distance of at least seven publicly available basic services. (Refer to the list of basic services in the Definitions section):
 - Each basic service must have a separate exterior entrance, and no more than half of the minimum number can be situated in a single building or under a common roof.
 - No more than two basic services of each type may be counted (e.g., if five restaurants are within walking distance, only two may be counted).
 - A single retail store of any type may be counted only once even if it sells products associated with multiple-use types.

SUBMITTAL DOCUMENTATION

- Vicinity map showing that the project is located on an infill site and is within 500 feet (152.4 meters) of existing water and wastewater infrastructure
- Site plan including the SITES project boundary, project entrance, and walking routes and distances from the entrance to at least seven basic services
- Table of walking distances between the project entrance and each relevant basic service

DOCUMENTATION GUIDANCE

For sites attempting to document infill status:

- For previous development on adjacent parcels:
 - On a vicinity map, identify the parcels adjacent to the entire project perimeter.
 - For each of these parcels, calculate the percentage that is previously developed.
 - Each adjacent parcel that is at least 75 percent previously developed is then considered a qualifying parcel that can contribute to the project's infill status.
 - Determine the aggregate percentage of previous development. Sum the previously developed land area of each qualifying parcel identified above, and divide by the total land area of all qualifying parcels. The result must be at least 75 percent.
 - Determine the qualifying project boundary percentage. Measure the entire project perimeter, the length of the portions adjacent to any waterfront, and the length of any portions adjacent to the qualifying parcels identified above. Subtract waterfront length from total perimeter length. Divide the perimeter length adjacent to qualifying parcels by the total net perimeter length. The result must be 75 percent or more.

Section 1: Site Context

C1.6



- For an aggregate parcel surrounded by previous development:
 - Using any parcels adjacent to the site, form an aggregate parcel that will achieve the condition described above.
 - If seeking to create an aggregate parcel, look for adjacent undeveloped parcels that are themselves surrounded by previous development. Adding on any parcels that share a border with the site can form the aggregate parcel. The aggregate parcel is not included in the SITES project boundary, but is used only to qualify the project as an infill site.
- For previous development within 0.5 miles (0.8 kilometers):
 - On a vicinity map, create a 0.5-mile (0.8-kilometer) buffer from the project boundary.
 - Exclude all rights-of-way such as streets or pathways.
 - Measure the total land area within the 0.5-mile (0.8-kilometer) buffer (after exclusions).
 - Delineate any previously developed land, which must constitute at least 75 percent of the total land within the 0.5-mile (0.8-kilometer) buffer, after right-of-way exclusions.
- For pre-project connectivity:
 - On a vicinity map, create a 0.5-mile (0.8-kilometer) buffer from the project boundary.
 - Exclude water bodies, parks larger than 0.5 acres (0.2 hectares), public facilities, campuses, airports, rail yards, slopes over 15 percent, and areas unbuildable under codified law. Street rights-of-way may not be excluded.
 - Calculate the total land area within the 0.5-mile (0.8-kilometer) buffer (after exclusions). This number will be the denominator of the calculation. The total land area may be smaller or larger than one square mile (2.59 square kilometers), depending on the size of the project.
 - Count the total number of circulation network intersections within 0.5 miles (0.8 kilometers), including streets, walking paths, or other portions of the circulation network. This number will be the numerator of the calculation.
 - Divide the numerator (number of intersections) by the denominator (land area within 0.5 miles, or 0.8 kilometers). The result must be at least 140 intersections per square mile (or 54 intersections per square kilometer).

Section 1: Site Context

Example: Live Oak Place

C1.6



Proximity to basic services is the primary focus of this map. A recent aerial photograph of several city blocks surrounding Live Oak Place is labeled to show the location and type of basic services close to the project's primary pedestrian entry. This map would be accompanied by an additional vicinity map demonstrating the project's infill status.



RECOMMENDED STRATEGIES

- During the site selection process, give preference to sites that are close to existing water and wastewater infrastructure, or properties within developed areas that have pedestrian access to a variety of existing services.
- For pedestrian safety along urban roads with speeds of 40 miles (64.37 kilometers) per hour or higher, design a buffer between the road and the sidewalk.
 - The width of a sidewalk depends primarily on the number of pedestrians who are expected to use the sidewalk at a given time; high-use sidewalks should be wider than low-use sidewalks.
 - A sidewalk width of five feet (1.52 meters) is needed for two adult pedestrians to comfortably walk side-by-side. This measurement should be the minimum width of all planned sidewalks.

ECONOMIC AND SOCIAL BENEFITS

A significant economic benefit of infill development is the reduction or elimination of new infrastructure, including roads and utility services. Municipal and county economic incentives for urban infill projects, especially brownfields, may also be available. Infill development reduces urban sprawl, which otherwise negatively affects quality of life because commuters must spend increasing amounts of time in their automobiles. The redevelopment of urban areas helps restore, invigorate, and sustain established urban living patterns, thereby creating a more stable and interactive community.

DEFINITIONS

- A **basic service** includes, but is not limited to: a bank, licensed child-care facility, community or civic center, convenience store, farmers market, food store with produce, hair care establishment, hardware store, health club or recreation facility, laundromat or dry cleaner, library, medical or dental office, museum, park, stand-alone pharmacy, place of worship, police or fire station, post office, restaurant, school, senior-care facility, social services center, supermarket, and theater.
- An **infill site** is a property that meets any one of the following four conditions:
 - At least 75 percent of its boundary borders land parcels that individually are at least 50 percent previously developed, and that in aggregate are at least 75 percent previously developed.
 - The site and bordering parcels form an aggregate parcel whose perimeter is 75 percent bordered by parcels that each are at least 50 percent previously developed, and that all together are at least 75 percent previously developed.
 - At least 75 percent of the land area, exclusive of rights-of-way, within a 0.5-mile (0.8 kilometer) distance from the SITES project boundary is previously developed.
 - The lands within a 0.5-mile (0.8 kilometer) distance from the project boundary have a pre-project connectivity of at least 140 intersections per square mile (or 54 intersections per square kilometer).

* A street or other right-of-way does not constitute previously developed land; it is the status of the property on the other side of the right-of-way or the street that matters. For the first two conditions above, any fraction of the perimeter that borders waterfront is excluded from the calculation.
- A **previously developed site** consists of at least 75 percent of the site area that has been altered by preexisting paving, construction, or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land.

Section 1: Site Context

C1.6

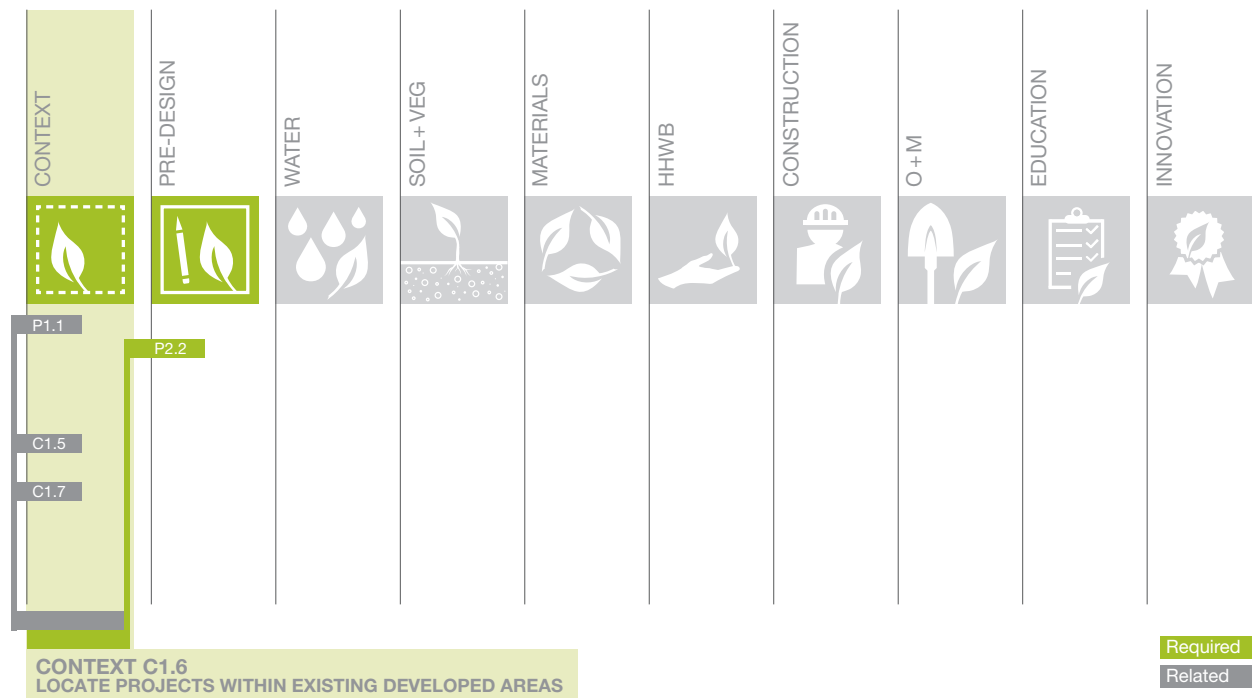


- **Walking distance** is the distance that a pedestrian must travel between origins and destinations without obstruction, in a safe and comfortable environment such as on a continuous network of sidewalks, all-weather surface footpaths, crosswalks, pedestrian transit malls, or equivalent pedestrian facilities in dedicated right-of-ways (ROWs). A ROW may be privately owned as long as it is deeded in perpetuity for general public use.

RESOURCES

- For techniques and benefits of infilling developed areas as an alternative to greenfield development, see:
 - Benfield, Kaid, et al, *Smart Growth in a Changing World*, APA Planners Press, 2007
 - Benfield, Kaid, et al, *Solving Sprawl: Models of Smart Growth in Communities Across America*, Natural Resources Defense Council, 2001.
 - Dunham-Jones, Ellen, *Retrofitting Suburbia*, Wiley, 2011.
 - Tachieva, Galina, *Sprawl Repair Manual*, Island Press, 2010.
- For more information about organizations that promote infill development, visit:
 - Smart Growth America, www.smartgrowthamerica.org
 - Lincoln Institute of Land Policy, www.lincolninst.edu
 - Urban Land Institute, www.uli.org
 - Congress for New Urbanism, www.cnu.org
- For guidelines on designing pedestrian-safe environments, consult PEDSAFE (Pedestrian Safety Guide and Countermeasure Selection System) at www.walkinginfo.org/pedsafe/moreinfo_sidewalks.cfm.
- To locate walkable basic services in a neighborhood, consult WalkScore at www.walkscore.com.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS





Credit 1.7: Connect to multi-modal transit networks

2–3 points

INTENT

Improve human health and reduce pollution by selecting a site that connects to pedestrian, bicycle, and mass-transit networks.

REQUIREMENTS

Option 1: Pedestrian and bicycle network

2 points

- Locate the project on a site that is accessible to pedestrians with the following planned or existing features:
 - Continuous sidewalk and crosswalk network, trail network, or a combination that extends at least one mile (1.61 kilometers) in radial distance from a project entrance
- And, locate the project on a site that is accessible to bicyclists with one of the following planned or existing features:
 - A street with bicycle lanes or shared lane markings (SLMs) on both sides that connect directly to a project entrance
 - A bicycle network located no further than a 0.75-mile (1.2-kilometer) bicycling distance from a project entrance and spanning at least five continuous miles (8.05 kilometers) in length

In the case of planned facilities, show that the relevant agency has committed to provide the designated facility within two years of project completion.

Option 2: Transit network

3 points

- Locate the project on a site with existing or planned transit service so that:
 - At least one project entrance is within a 0.25-mile (0.4-kilometer) walking distance of bus or streetcar stops, or within a 0.5-mile (0.8-kilometer) walking distance of rapid transit stops, passenger rail stations, or ferry terminals
 - Transit service at those stops in aggregate meets the needs of the site users

In the case of planned service, show that the relevant transit agency has committed to provide the transit service within two years of project completion.

Section 1: Site Context

C1.7



SUBMITTAL DOCUMENTATION

Option 1: Pedestrian and bicycle network

- Vicinity map showing scale, the SITES project boundary and entrances, sidewalks, bicycle lanes, SLMs, and bicycle networks
- For planned facilities, provide documentation from the relevant agency indicating that the identified facilities will be in place within two years of project completion.

Option 2: Transit network

- Vicinity map showing scale, the SITES project boundary and entrances, transit stops, and walking distances between project entrances and the closest transit stop
- Total number of site users
- Official schedules for the transit stops claimed within allowable walking distances
- Narrative describing how the type of transit service, route frequency, and schedule meet the needs of site users, including the SITES project's hours of operation, typical use, and ridership details if available
- For planned transit routes, provide documentation from the relevant transit authority indicating that transit service will be in place within two years of project completion.

Section 1: Site Context

DOCUMENTATION GUIDANCE

Example—Option 1: Live Oak Place

C1.7

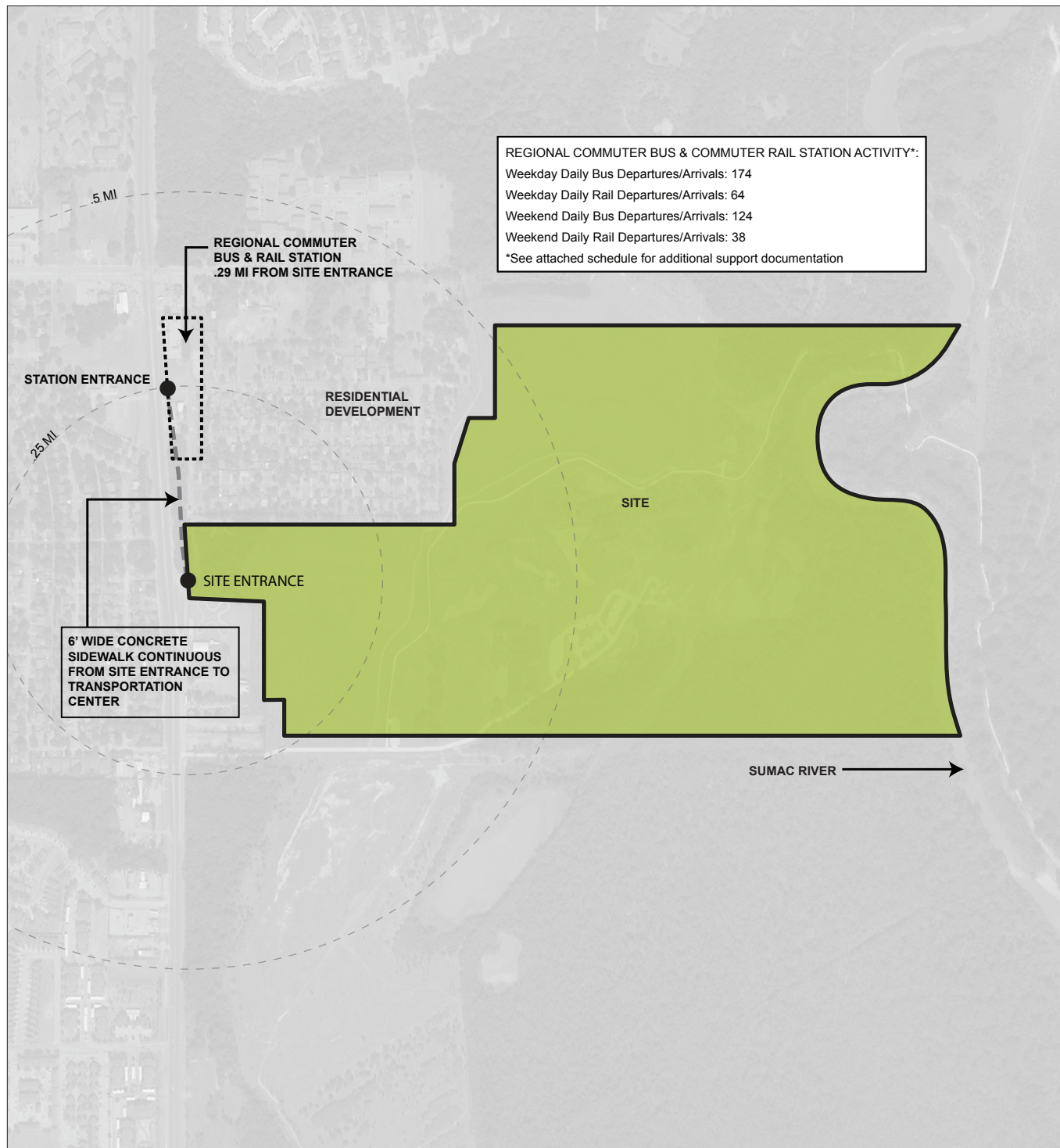


Live Oak Place meets the requirements for *Context C1.7 Option 1* due to the site's proximity to continuous sidewalks and bicycle lane networks. A recent aerial photograph is scaled and labeled to show the presence of designated bicycle lanes and sidewalks in relation to the site's main pedestrian entry.

Section 1: Site Context

Example—Option 2: Sumac River Nature Center

C1.7



A recent aerial photograph is scaled and labeled to show the location of a regional commuter bus and rail station and its connection to the Sumac River Nature Center property's entrance. A table summarizing daily rail and bus activity at this station is inserted to support this site's qualification for this credit. A more detailed bus/train schedule is required in additional submittal documentation.



RECOMMENDED STRATEGIES

- During site selection, give preference to areas that are served by existing pedestrian, bicycle, and transit networks.
- Examine transportation and transit agency plans for new facilities or services within two years of project completion. Establishing relationships with agencies responsible for pedestrian, bicycle, and transit systems early in a project's planning often can help with documentation required for SITES certification.
- Perform a transportation survey of future site users to identify transportation needs.

ECONOMIC AND SOCIAL BENEFITS

Car-dependent cities and suburbs encourage a sedentary lifestyle, which causes human health problems such as obesity. By one estimate, obesity adds as much as \$76 billion annually to U.S. medical expenses.¹ Riding public transportation and living with one less car in a household can save an individual \$9,242 a year (based on the January 11, 2010, national average gas price and the unreserved monthly parking rate).²

1. M Pratt, CA Macera, and G Wang, "Higher Direct Medical Costs Associated with Physical Inactivity," *The Physician and Sportsmedicine* 28, no.10 (2000): pp. 63–70.
2. American Public Transportation Association, "Riding Public Transit Saves Individuals \$9,242 Annually," www.apta.com/mediacenter/pressreleases/2010/Pages/100112_Transit_Savings.aspx (accessed April 2, 2013).

DEFINITIONS

- A **bicycle lane** is a striped lane designated for one-way travel by a bicycle on a street or highway. The standard bicycle lane width measured from the face of curb to the painted boundary should be at least four feet (1.22 meters) wide. If on-street parking is allowed, the minimum lane width is five feet (1.52 meters).
- A **bicycle network** is a continuous path consisting of any of the following: physically designated in-street bicycle lanes at least five feet (1.52 meters) wide, off-street bicycle paths or trails at least eight feet (2.44 meters) wide for a two-way path and at least five feet (1.52 meters) wide for a one-way path, or streets designed for a target speed of 25 miles (40.23 kilometers) per hour or slower.
- A **shared lane marking (SLM)** is a marking on a street (typically with a speed limit below 35 miles, or 56.33 kilometers, per hour) that indicates bicyclists are allowed to travel in a roadway too narrow for separate motor vehicle and bicycle lanes. These markings encourage safe passing of bicyclists by motorists, reduce the chance of a bicyclist hitting the open door of a parked vehicle in a shared lane with on-street parallel parking, alert road users of the lateral location bicyclists may occupy, and reduce the incidence of wrong-way bicycling.
- A **site user** is an individual who is expected to occupy, work at, or pass through the site. Users may visit the site regularly or periodically. Site users will range in age, ethnicity, and socio-economic status, but all users' needs should be considered.
- **Walking distance** is the distance that a pedestrian must travel between origins and destinations without obstruction, in a safe and comfortable environment such as on a continuous network of sidewalks, all-weather surface footpaths, crosswalks, pedestrian transit malls, or equivalent pedestrian facilities in dedicated right-of-ways (ROWS). A ROW may be privately owned as long as it is deeded in perpetuity for general public use.

Section 1: Site Context

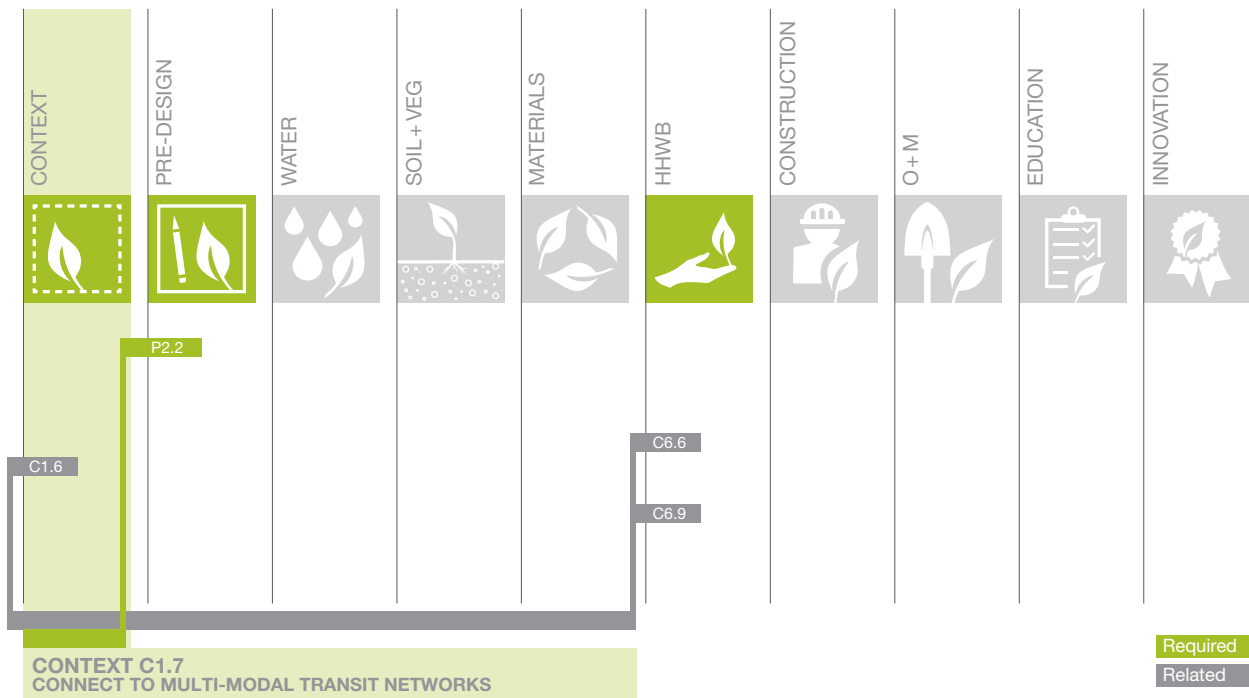
C1.7



RESOURCES

- For the planning and design of pedestrian, bicycle, and transit systems, as well as examinations of public policy to encourage these modes and the benefits of increasing their trip shares, see:
 - Meyer, Michael D., *Transportation Planning Handbook*, 3rd Ed., ITE, 2009.
 - *Smart Growth Transportation Guidelines*, ITE, 2010.
 - *Promoting Sustainable Transportation Through Site Design*, May 2010, www.cite7.org/resources/documents/ITERP-PromotingSustainableTransportationThroughSiteDesign.pdf
 - *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*, 2010, www.ite.org/emodules/scriptcontent/orders/ProductDetail.cfm?pc=RP-036A-E
 - Zegeer, Charles, et al, *Design and Safety of Pedestrian Facilities*, March 1998, www.ite.org/decade/pubs/RP-026A-E.pdf
 - *Improving the Pedestrian Environment through Innovative Transportation Design*, Jan 2005, www.ite.org/decade/pubs/IR-118-E.pdf
 - *Guide for the Development of Bicycle Facilities*, 4th Ed., AASHTO, 2012.
- The following organizations promote sustainable multi-modal travel or individual modes:
 - Reconnecting America, www.reconnectingamerica.org
 - Victoria Transport Policy Institute, www.vtpi.org
 - North American Sustainable Transportation Council, www.transportationcouncil.org
 - America Walks, www.americawalks.org
 - America Bikes, www.americabikes.org
 - American Public Transportation Association, www.apta.com

LINKS TO OTHER SITES PREREQUISITES AND CREDITS





SECTION 2

PRE-DESIGN ASSESSMENT + PLANNING

PREREQUISITE / CREDIT	TITLE	POINTS
Pre-Design P2.1	Use an integrative design process	Required
Pre-Design P2.2	Conduct a pre-design site assessment	Required
Pre-Design P2.3	Designate and communicate Vegetation and Soil Protection Zones (VSPZs)	Required
Pre-Design C2.4	Engage users and stakeholders	3 points

Prerequisite 2.1: Use an integrative design process

Required

P2.1



INTENT

Optimize site performance by identifying and executing synergistic opportunities across different disciplines throughout all phases of design and construction.

REQUIREMENTS

Projects must complete all of the following steps for prerequisite achievement:

1. Form an integrated design team

- The integrated design team should include, at minimum, the following roles:
 - Owner and/or client
 - Professionals knowledgeable in design, construction, and maintenance
 - Professionals knowledgeable in sustainable practices
 - Professionals with expertise in vegetation, water, soils, landscape ecology, materials, and human health and well-being, selected to meet the unique constraints and opportunities of the project and its site

2. Develop a collaborative communication process

- Develop an agreed upon communication method for team members. The method should be collaborative and allow the viewpoints and perspectives of all members to be fully considered in the decision-making process.
- Designate a team facilitator to be responsible for overseeing and ensuring a collaborative communication process.

3. Identify project sustainability principles and performance goals (see O+M P8.1: *Plan for sustainable site maintenance*)

- Identify the principles and performance goals of the project (both short- and long-term). Include an associated timeline and specific performance measures for each goal to determine when it has been achieved.
- Designate specific team members to track project goals throughout the development process.

4. Incorporate the sustainability principles and performance goals into a program plan

- Develop a program plan that at minimum includes the following information:
 - The unique characteristics, opportunities, and constraints of the site
 - General project parameters, such as the scope, budget, implementation schedule, purpose, and design intent of the project
 - A diagram or description of the intended function, arrangement, and relationship of desired features and their approximate dimensions
- Describe how the sustainability principles and performance goals will be incorporated into the design.

5. Identify stakeholders and site user groups

- Identify project stakeholders.
- Identify the full range of potential site users. List the primary and secondary user groups.

Section 2: Pre-Design Assessment + Planning

6. Plan for construction oversight

- Designate a team member, other than the contractor, who will be responsible for verifying the site is built per the construction specifications and drawings.
- Meet with the contractor (see *Construction P7.1: Communicate and verify sustainable construction practices*) prior to construction to review construction specifications, submittal requirements, and drawings and to convey the project's principles and performance goals.
- Describe the agreed upon method whereby changes can be made in the field during construction.

7. Develop a strategy for preparing a site maintenance plan

- Include all team members in the development of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*).

SUBMITTAL DOCUMENTATION

All members of the project team must sign the following documentation:

1. Integrated design team

- Table specifying the name of each team member and his or her expertise (e.g., vegetation, hydrology, soil, landscape ecology, materials, human health) and role on the project
 - If an individual fulfills more than one role on the project, explain how he or she has the various skill sets or expertise for each.

2. Collaborative communication process

- Narrative describing the collaborative communication process
- List of team members responsible for facilitating collaborative communication
- Signatures from all team members that participated in the collaborative communication process

3. Project sustainability principles and performance goals

- Narrative describing the sustainability principles and performance goals developed by the project team
- Timeline and specific performance measures for each goal
- List of team members responsible for tracking project goals throughout the design, construction, and maintenance process

4. Program plan

- Sections of the program plan noting the unique opportunities, characteristics, and constraints of the site
- Narrative describing how the the program plan incorporates sustainability principles and performance goals
- Diagrams or descriptions of the intended functions, arrangements, and relationships of desired features and their approximate dimensions

5. Stakeholders and site user groups

- List of all project stakeholders
- List of primary and secondary site user groups

6. Plan for construction oversight

- Narrative identifying the team member responsible for construction oversight and describing the proposed schedule for a pre-construction meeting and method for making changes in the field during construction

P2.1



Section 2: Pre-Design Assessment + Planning

7. Site maintenance plan

- Signatures from all team members acknowledging their participation in the development of the site maintenance plan

RECOMMENDED STRATEGIES

- Form a diverse team of qualified professionals as early as possible; team members will coordinate with one another throughout the life of the project. For optimal interaction and communication, ensure the project team has multiple face-to-face meetings.
- Discuss available resources (e.g., budget, staff, volunteers, equipment, materials) as part of the site maintenance plan. Determine short- and long-term maintenance principles and performance goals. Identify present and potential invasive species, and integrate a pest management plan into the performance goals.
- From the project onset, engage the client in participating in and ideally leading a design charrette process with the assistance of the project design team leadership. The design team should embrace a systems thinking design approach.

ECONOMIC AND SOCIAL BENEFITS

Innovative solutions are more likely to emerge when experts from several disciplines pool their talents and expertise. Sustainable goals and practices are easier and often less expensive to achieve when different perspectives are brought to bear on common goals.

The earlier a team considers sustainable design strategies and incorporates them into the project, the more cost-effective and beneficial the strategies are to implement. An integrative design process facilitates the development of coordinated project documents, because each professional discipline becomes aware of the requirements, constraints, and interests of all the other disciplines.

By including site users and stakeholders, an integrative design process reconciles multiple interests. The design outcomes tend to synthesize diverse viewpoints and needs,¹ leading to more culturally sustainable projects.

1. J Scheffran, "Tools for Stakeholder Assessment and Interaction," Aspen Global Change Institute, www.agci.org/dB/PDFs/05S1_JScheffran_Scheffran_StakeholderTools5.pdf (accessed April 6, 2013).

DEFINITIONS

- An **integrated design team** includes the owner, client, and professionals knowledgeable in design, construction, and maintenance. Team members should be selected to meet the unique constraints and opportunities of the site.
- **Principles and performance goals** are, respectively, the guiding overarching concepts and the observable and measurable end results of having one or more objectives achieved within a relatively fixed time frame.
- A **program plan** is a narrative or written design that provides a mechanism for clearly stating the vision and desired outcomes of the project and setting the direction of the design team.
- A **site user** is an individual who is expected to occupy, work at, or pass through the site. Users may visit the site regularly or periodically. Site users will range in age, ethnicity, and socio-economic status, but all users' needs should be considered.
- A **stakeholder** is an individual or group who has a vested interest in the project and may be a neighbor, public official from a local jurisdiction, community leader, local community group, or business organization.

P2.1



Section 2: Pre-Design Assessment + Planning

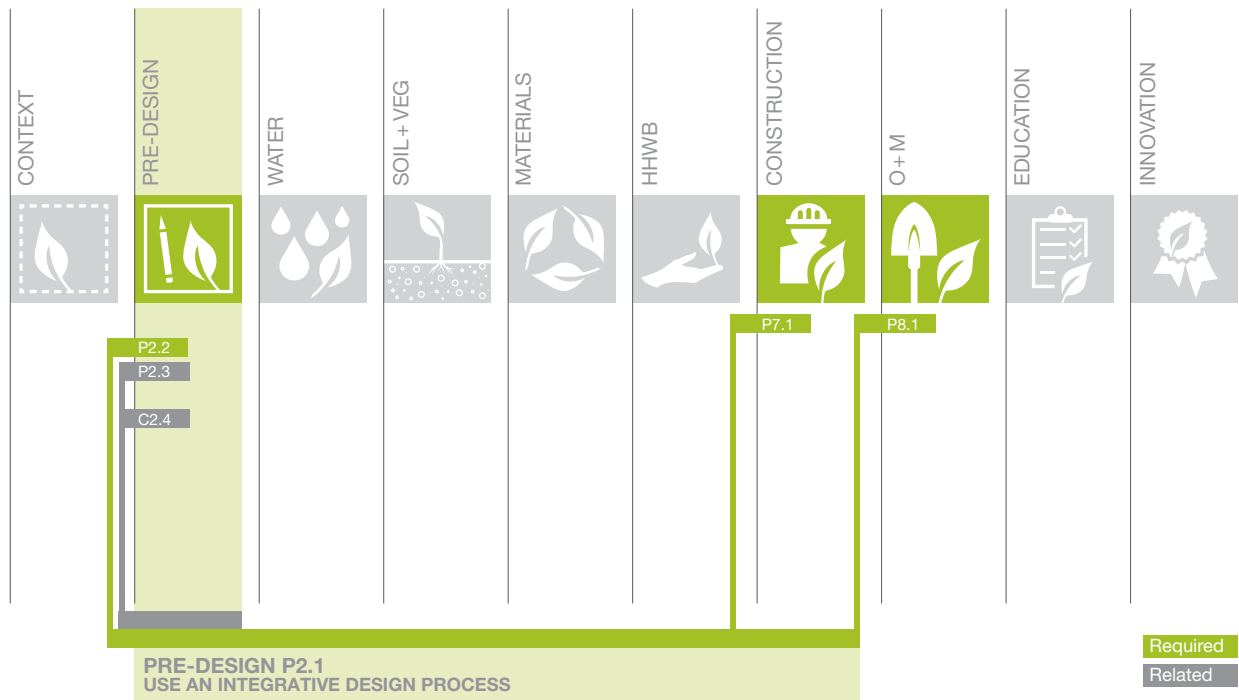
RESOURCES

- For information about Whole Building Design Guide resources, consult www.wbdg.org/design/engage_process.php.
- For information about integrated design, read
 - DR Macaulay and F McLennan, *Integrated Design*, Bainbridge Island, WA: Ecotone Publishing, 2008.
 - Bill Reed, The 7 Group, *The Integrative Design Guide to Green Building: Redefining the Practice of Sustainability* (Wiley Series in Sustainable Design).
 - Muscoe Martin, Gregory Franta, NCARB Monographs, Professional Development Program, Sustainable Design II
- To learn more about the integrative process ANSI standard, read the blog post “Clarifying the Integrative Design Process: ANSI Standard Gets Overhaul with IP Version 2.0,” buildingcapacity.typepad.com/blog/2011/02/clarifying-the-integrative-design-process-ansi-standard-gets-an-overhaul-with-ip-version-20.html.
- For a quick checklist of integrated design steps, see betterbricks.com/graphics/assets/documents/BB_Web_integrated_design.pdf?link=graphics/assets/documents/BB_Web_integrated_design.pdf.

P2.1



LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Prerequisite 2.2: Conduct a pre-design site assessment

Required

P2.2



INTENT

Maximize the opportunities for beneficial site performance by conducting an accurate and detailed assessment of site conditions and exploring options for sustainable outcomes prior to design.

REQUIREMENTS

With the integrated design team (see *Pre-Design P2.1: Use an integrative design process*), collect and assess information about the site to help identify opportunities to protect and improve ecosystem services and use sustainable strategies to guide the design, construction, operation, and maintenance of the site:

- Map and assess existing site conditions and resources according to the outline in the Submittal documentation section.
 - Not all topics in the outline apply to every site, and each site may contain additional important unique elements that are not explicitly addressed here. Include additional topics not listed, if any, and provide reasons for not addressing certain topics.
- Collect additional information on the site and surrounding areas to assess opportunities for sustainable site outcomes, including all non-physical influences that may affect the site design, and potential effects of the design.
- Explain how the identified site conditions and resources will influence the sustainable design of the site.

Note: For potential Rating System implications regarding the following site assessment topics, see the associated prerequisites and credits listed in the right-hand column of the outline.

SUBMITTAL DOCUMENTATION

- Comprehensive site map or multiple maps at the same scale and orientation addressing all physical existing conditions on site (map enlargements may be necessary to detail other relevant information)
- Completed *Site Assessment Worksheet* or an illustrated narrative addressing the following topics and describing how each could influence the site design
- Signatures from all integrated design team members stating the site assessment and relevant discussions were conducted collaboratively

Topic	Description	Prerequisite or Credit #
1. Site Context—community and connectivity (mapped information)	Existing or planned pedestrian, bicycle, or transit including: <ul style="list-style-type: none"> • Nearby transit routes and stops • <u>Bicycle lanes</u> and <u>shared lane markings</u> • <u>Bicycle racks/storage</u> • <u>Bicycle network</u> 	C1.7, C6.5, C6.9

continued

Section 2: Pre-Design Assessment + Planning

Topic	Description	Prerequisite or Credit #
2. A. Water (mapped information) (continued)	<u>100-year floodplain</u> , as determined by FEMA (or local equivalent for projects outside the United States)	P1.2
	Delineated aquatic ecosystem, including <u>isolated wetlands</u>	P1.3
	<u>Wetland</u> , shoreline, or <u>riparian buffers</u>	P1.3, C3.6
	Artificially modified streams, wetlands, or shorelines (e.g., buried, piped, drained, channelized, bulkheaded, armored) <ul style="list-style-type: none"> Determine existing conditions, dimensions, and historic extent. 	C3.6
	Overland water flow on site <ul style="list-style-type: none"> Determine topography, direction, and effects on the watershed, including natural rates of erosion. 	P3.1, C3.3, C3.6, P7.2
	Pollution sources <ul style="list-style-type: none"> Existing and potential Point and nonpoint sources Health hazards, both on-site and in adjacent areas 	C1.5, C3.3, P7.2
2. B. Water (narrative information)	Precipitation <ul style="list-style-type: none"> Average annual precipitation Average monthly precipitation 	P3.1, P3.2, C3.3, C3.4, C3.5
	Watershed conditions <ul style="list-style-type: none"> Common stormwater pollutants Specific pollutants of concern Local, regional, or state watershed plans Artificial modification of natural hydrology 	P1.2, P3.1, C3.3, C3.5, C3.6
	Water sources <ul style="list-style-type: none"> <u>Potable</u> and <u>non-potable water sources</u> for the site Opportunities to capture, treat, and reuse rainwater and graywater 	P3.2, C3.3, C3.4, C3.5
3. A. Soils (mapped information)	Farmland <ul style="list-style-type: none"> Soils defined by U.S. Natural Resources Conservation Service (or local equivalent for projects outside the United States) as <u>prime farmland</u>, <u>unique farmland</u>, <u>farmland of statewide importance</u>, or <u>farmland of local importance</u>. 	P1.1
	<u>Healthy soils</u>	P4.1, C4.4, P7.3
	Soils disturbed by previous development <ul style="list-style-type: none"> Degree of disturbance (<u>disturbed</u> or <u>severely disturbed soils</u>) 	C7.4

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Topic	Description	Prerequisite or Credit #
3. B. Reference Conditions for Soils and Vegetation (narrative information)	<u>Reference soil</u> (test results or verified allowable ranges) <ul style="list-style-type: none"> • <u>Organic matter</u> (required) • Compaction (field test or undisturbed core sample only) OR <ul style="list-style-type: none"> • Infiltration (field test only) • Soil chemical characteristics OR <ul style="list-style-type: none"> • Soil biological function 	P4.1, C6.7, P7.3, C7.4
	EPA level III ecoregion <ul style="list-style-type: none"> • Major native plant community types of the ecoregion based on the U.S. EPA (or local equivalent for projects outside the United States), www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm 	C4.6, C4.7
	<u>Terrestrial biome</u> <ul style="list-style-type: none"> • Use the World Wildlife Fund <i>Wildfinder</i>, www.worldwildlife.org/science/wildfinder/ 	C4.8
	On-site food production <ul style="list-style-type: none"> • Follow local, state, and federal regulations to ensure existing and imported soils are healthy for food production and are safe for physical contact by general public. • For <u>previously developed</u> sites, <u>brownfield</u> sites, or sites that have been subject to application of chlorinated <u>pesticides</u> and herbicides, the following actions may need to be conducted to ensure soil safety: <ul style="list-style-type: none"> - Certified environmental professional assessment - Soil contamination reports (follow local, state, and federal regulations) - Tests for lead, arsenic, other heavy metals or chemicals of potential concern that may be found in the site area either on site or from airborne pollutants (via certified environmental labs) - Potential plant requirements (e.g., exposure, irrigation) - Community involvement possibilities 	C6.7
4. A. Vegetation (mapped information)	Habitats for threatened or endangered species <ul style="list-style-type: none"> • Existing and potential habitats for threatened or endangered plant and animal species • Federal or state threatened or endangered lists • International Union for Conservation of Nature “Red List of Threatened Species” 	P1.4, P2.3
	Total existing vegetated area	C4.4, C4.6, C4.7, C4.8

continued

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Section 2: Pre-Design Assessment + Planning

Topic	Description	Prerequisite or Credit #
4. A. Vegetation (mapped information, <i>continued</i>)	<u>Invasive plants</u> <ul style="list-style-type: none"> Listed by regional, state, or federal entities 	P4.2
	<u>Native plants and native plant communities</u> <ul style="list-style-type: none"> For trees, note <u>diameter at breast height (DBH)</u>. 	C4.6, C4.7
	<u>Appropriate plant species</u>	P4.3, C4.4
	<u>Special status plants</u> <ul style="list-style-type: none"> For trees, note DBH. 	C4.5
	Risk of catastrophic wildfire <ul style="list-style-type: none"> On-site areas and adjacent landscapes at risk 	C4.11
4. B. Materials Inventory (mapped information)	Existing materials and site elements <ul style="list-style-type: none"> Note materials, structures, and paving that could be safely retained, <u>salvaged or reused</u>, or recycled. 	C5.2, C5.4, C7.5, C7.6
4. C. Materials, Plants, Soils, and Labor Procurement (narrative information)	Potential suppliers of salvaged or reused materials <ul style="list-style-type: none"> Local sites or suppliers that may have materials and appropriate vegetation 	C5.4
	Potential suppliers of recycled materials	C5.5
	Potential suppliers of regional and local materials <ul style="list-style-type: none"> Materials, plants, and soils that are extracted, manufactured, or grown within the region 	C5.6, C6.11
	Potential suppliers of sustainable extracted materials <ul style="list-style-type: none"> Materials that are responsibly extracted from the earth in ways that protect ecosystems, respect cultural and community values, and improve land use 	C5.7
	Potential suppliers of safer alternative materials <ul style="list-style-type: none"> Materials that have disclosed chemical inventories, chemical hazard assessments, or use safer chemical alternatives 	C5.8
	Potential sustainable materials manufacturers <ul style="list-style-type: none"> Materials manufacturers that actively implement better business practices to reduce negative impacts on human health and the environment 	C5.9
	Potential sustainable plant producers <ul style="list-style-type: none"> Plant nurseries that actively implement better business practices to reduce negative impacts to human health and the environment 	C5.10
	Potential local workforce and businesses	C6.11

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Topic	Description	Prerequisite or Credit #
5. Human Use of Site (mapped information)	Access to <u>basic services</u> <ul style="list-style-type: none"> Nearby shops, services, and facilities that have pedestrian access <u>Walking distances</u> from planned project entrance 	C1.6
	Historic buildings, structures, objects, and <u>cultural landscapes</u> <ul style="list-style-type: none"> Note whether these are listed in a historic register. Note significance to local culture and history. 	C6.1
	Unique or interesting site features <ul style="list-style-type: none"> View corridors Site landmarks Large shade trees Water features (natural or <u>created</u>) 	C6.2, C6.4, C6.5, C6.6
6. A. Climate and Energy (mapped information)	Microclimate considerations <ul style="list-style-type: none"> Positive sounds or excessive noises Wind direction Sun exposure (sun angles) and shading opportunities Any other unique microclimate factors that may affect site design decisions, building orientation, and plant selection 	C4.10, C4.11, C6.4, C6.5, C6.6
	Passive or active energy generation opportunities <ul style="list-style-type: none"> e.g., wind, solar, geothermal, low-impact hydro 	C8.6
6. B. Energy (narrative information)	<u>Renewable energy source</u> contract opportunities <ul style="list-style-type: none"> Green power contracts Carbon offsets 	C8.6
7. Additional Considerations (any site-specific conditions not included above)		

P2.2



RECOMMENDED STRATEGIES

- Consult with local experts and the community to evaluate existing site conditions and identify sustainable strategies prior to design.
- Evaluate the impact a design approach may have on sustainability during construction, operations, and maintenance (e.g., pruning requirements, deadheading to maintain formalized designs and uses of plants, water use requirements).

ECONOMIC AND SOCIAL BENEFITS

A site assessment evaluates resources and opportunities that can be incorporated into site design. For instance, social gathering spaces can be located near existing large trees that will provide shade, or existing materials can be reused, saving both money and resources.

Section 2: Pre-Design Assessment + Planning

DEFINITIONS

- A **100-year floodplain** includes all areas below the 100-year flood elevation of waterways of all sizes, including depressional areas, wetlands, areas behind levees, ephemeral and intermittent streams, rivers, lakes and shorelines, and coastal areas. These areas are generally depicted on the current FEMA Flood Insurance Rate Map as Zones A, AE, A1-A30, AH, AO, AR, A99, V, and VE, however, in some areas they may need to be calculated by the site development team.
- An **appropriate plant species** is vegetation adapted to site conditions, climate, and design intent. The following attributes should be considered in determining whether plants are appropriate for the site: cold hardiness, heat tolerance, salt tolerance, soil moisture range, plant water use requirements, soil volume requirements, soil pH requirements, sun and shade requirements, pest susceptibility, and maintenance requirements. Native and non-native plants are appropriate if they meet the above criteria.
- A **basic service** includes, but is not limited to: a bank, child-care facility (licensed), community or civic center, convenience store, farmers' market, food store with produce, hair care establishment, hardware store, health club or recreation facility, laundromat or /dry cleaner, library, medical or dental office, museum, park, stand-alone pharmacy, place of worship, police or fire station, post office, restaurant, school, senior-care facility, social services center, supermarket, and theater.
- A **bicycle lane** is a striped lane designated for one-way travel by a bicycle on a street or highway. The standard bicycle lane width measured from the face of curb to the painted boundary should be at least four feet (1.22 meters) wide. If on-street parking is allowed, the minimum lane width is five feet (1.52 meters).
- A **bicycle network** is a continuous path consisting of any of the following: physically designated in-street bicycle lanes at least five feet (1.52 meters) wide, off-street bicycle paths or trails at least eight feet (2.44 meters) wide for a two-way path and at least 5 feet (1.52 meters) wide for a one-way path, or streets designed for a target speed of 25 miles (40.23 kilometers) per hour or slower.
- A **bicycle rack** is a device consistent with industry standards that is capable of supporting a bicycle in a stable position, is made of durable materials, is no less than 36 inches (91.44 centimeters) tall from base to top of rack, and no less than 1.5 feet (0.30 meters) in length. It permits the securing of the bicycle frame and one wheel with a U-shaped lock, and is of a character and color that adds aesthetically to the immediate environment.
- A **brownfield** is an abandoned, idled, or underused industrial and commercial facility or site where expansion or redevelopment is complicated by real or perceived environmental contamination; a site documented as contaminated by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local voluntary cleanup program, or a site defined as a brownfield by a local, state, or federal government agency.
- A **created water feature** is a human-made object or feature that uses water for aesthetic purposes. Features include constructed wetlands (ornamental or water cleansing), ponds, streams, pools, fountains, and water gardens. Created water features can include those intended for limited human contact or for full human contact. Note that water intended for human contact must meet local and state health requirements.
- A **cultural landscape** is a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values. The quality of significance in history, architecture, archeology, engineering, landscape architecture, and culture is present in cultural landscapes that possess integrity of location, design, setting, materials, workmanship, feeling, association and:
 - That are associated with events that have made a significant contribution to the broad patterns of history; or
 - That are associated with the lives of significant persons in the past; or

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Section 2: Pre-Design Assessment + Planning

- That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master craftsman or designer, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- That has yielded, or may be likely to yield, information important in history or prehistory. U.S. National Park Service, www.nps.gov/nr/publications/bulletins/nrb15/nrb15_2.htm.
- **Diameter at breast height (DBH)** is a standard method for determining the trunk diameter of a standing tree. In the United States, DBH is typically measured in inches at 4.5 feet (1.37 meters) off the ground on the uphill side. Wounds, branches, multiple stems, and defects may change how diameter is measured. For guidance, see the International Society for Arboriculture website, www.isa-arbor.com/publications/tree-ord/measuringdbh.aspx.
- **Disturbed soils** are all areas of soils disturbed by human development activities, such as those that have been affected by grading, excavation, or compaction. Indicators of disturbed soils may include one or more of the following:
 - Soil horizons that differ significantly in either depth, texture, or physical or chemical properties from the reference soil
 - Bulk densities that exceed the maximum allowable bulk densities shown in *Construction P7.3: Restore soils during construction* Figure 7.3-A
 - Organic matter content lower than that of the reference soil
 - Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) different from that of the reference soil
 - Presence of compounds toxic to the intended plants
 - Presence of weedy, opportunistic, or invasive plant species
- **Farmland of local importance** refers to soils important to the local economy due to their productivity and which may include tracts of land that have been designated for agriculture by local ordinance. Each state Natural Resources Conservation Service or local ordinance designates which soils qualify.
- **Farmland of statewide importance** refers to soils that do not meet all of the prime farmland criteria but that are still able to economically produce high yields of crops when treated and managed according to acceptable farming methods. Each state Natural Resources Conservation Service designates which soils qualify.
- **Healthy soils** have not been significantly disturbed by previous human development activities. Healthy soils may include one or more of the following indicators:
 - Soil horizons that are similar to the reference soil
 - Bulk densities that do not exceed the maximum allowable bulk densities shown in *P7.3: Restore soils disturbed during construction*
 - Organic matter content similar to that of the reference soil
 - Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) similar to that of the reference soil
 - Absence of compounds toxic to the intended plants
 - Presence of vegetation that is representative of native plant communities
- An **integrated design team** includes the owner, client, and professionals knowledgeable in design, construction, and maintenance. Team members should be selected to meet the unique constraints and opportunities of the site.
- An **invasive species** is a plant or animal that is not native to the ecosystem under consideration and that causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health.
- An **isolated wetland** is a wetland with no surface water connections to other aquatic resources.
- A **native plant** is vegetation native to the EPA Level III ecoregion of the site or known to naturally occur within 200 miles (321.87 kilometers) of the site. Naturally occurring hybrids, varieties, and cultivars of species native to the ecoregion are acceptable.

P2.2



Section 2: Pre-Design Assessment + Planning

- A **native plant community** is an assemblage of plant species whose composition and structure are typical of native plant communities mapped at the EPA Level III ecoregion or are known to naturally occur within 200 miles (321.87 kilometers) of the site. Native plant communities include but are not limited to wetlands, woodlands, grasslands, riparian buffers, and habitat for wildlife species of concern within the region. A reference from a local plant list, local reference site, or published plant community description is needed to determine the dominant plant species, relative species abundances, and other characteristic elements of the plant community/communities to be preserved or restored.
- A **non-potable water source** can be harvested rainwater, surplus water from building or site operations that has been appropriately cleansed and cooled, or surplus site water that is not needed to maintain existing or restored site ecology. It does not include natural surface or subsurface water resources.
- **Organic matter** in soil is carbon-containing material composed of both living organisms and formerly living decomposing plant and animal matter. Soil organic matter (SOM) content can be supplemented with compost or other partially decomposed plant and animal material. SOM content is commonly measured using “loss on ignition” tests that measure the amount of the element carbon, a key constituent of all organic matter.
- A **pesticide** is a chemical used to control or eradicate insects, plants, animals, pathogens, and any other undesirable living organisms.
- **Potable water** is water that meets the standards for drinking purposes of the State or local authority having jurisdiction, or water that meets the standards prescribed by the U.S. Environmental Protection Agency’s National Primary Water Regulations (40 CFR 141).
- A **previously developed site** consists of at least 75 percent of the site area that has been altered by preexisting paving, construction, or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural areas are considered undeveloped land
- **Prime farmland** refers to a designation of specific soils by the state or U.S. Natural Resources Conservation Service. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. The land could be cropland, pastureland, rangeland, forestland, or other land, but cannot be urban built-up land or water. Prime farmland has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.
- A **reference soil** falls into at least one of the following categories:
 - Soils native to a site as described in Natural Resources Conservation Service Soil Surveys (refer to soils within the region if the site soils are not mapped or labeled as Urban Land Complex, Urban Fill, etc.)
 - For sites that have no undisturbed native soils, use undisturbed native soils within the site’s region that have native vegetation, topography, and soil textures similar to the site.
 - For sites that have no existing soil, use undisturbed native soils within the site’s region that support appropriate native plants or appropriate plant species similar to those intended for the new site.

P2.2



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- A **renewable energy source** includes nonpolluting renewable energy generation methods, such as solar, wind, geothermal, small-scale or micro hydroelectric, and biomass. Purchased renewables must meet the Center for Resource Solutions (CRS) Green-e products certification requirements. Other sources of green power are eligible if they satisfy the Green-e program's technical requirements.
- A **riparian buffer** is the portion of the adjacent terrestrial ecosystem that directly affects or is affected by the aquatic environment (including streams, rivers, lakes, tidewaters, and bays and their adjacent side channels, floodplain, and wetlands). In specific cases, the riparian buffer may also include a portion of the hillslope that directly serves as streamside habitats for wildlife. A riparian buffer provides shade, intercepts runoff, and helps prevent erosion.
- A **salvaged or reused material** is recovered from an existing building or site and employed on site without change to its condition. Structures, materials, plants and rocks preserved in situ and new materials with recycled content do not qualify
- **Severely disturbed soils** are soils in which topsoil is removed or is not present; subsoils compacted such that compaction levels exceed the maximum allowable bulk densities shown in *Construction P7.3: Restore soils disturbed during construction* Figure 7.3-A; or topsoil or subsoil that has been chemically contaminated or is covered with impervious material. Examples of soils that are severely disturbed include areas that are covered with buildings or paved surfaces and areas that are defined as brownfields by local, state, or federal agencies.
- A **shared lane marking (SLM)** is a marking on a street (typically with a speed limit below 35 miles, or 56.33 kilometers, per hour) that indicates bicyclists are allowed to travel in a roadway too narrow for separate motor vehicle and bicycle lanes. These markings encourage safe passing of bicyclists by motorists, reduce the chance of a bicyclist hitting the open door of a parked vehicle in a shared lane with on-street parallel parking, alert road users of the lateral location bicyclists may occupy, and reduce the incidence of wrong-way bicycling.
- **Special status vegetation** is designated as important by local, state, or federal entities. Designations may be for size, species, age, rare or special status collections, ecological and environmental value, unique genetic resources, aesthetics, location, or other unique characteristics (e.g. heritage or legacy trees). Groves and clusters may also be given special status.
- **Terrestrial biome** is the largest unit of vegetation type within the biosphere, with similar plant architecture and character, community structure, and climate (e.g., tropical rain forest or coral reef).
- **Unique farmland** refers to land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of a specific crop when treated and managed according to acceptable farming methods. The state or U.S. Natural Resources Conservation Service designates which soils qualify.
- **Walking distance** is the distance that a pedestrian must travel between origins and destinations without obstruction, in a safe and comfortable environment such as on a continuous network of sidewalks, all-weather surface footpaths, crosswalks, pedestrian transit malls, or equivalent pedestrian facilities in dedicated right-of-ways (ROWs). A ROW may be privately owned as long as it is deeded in perpetuity for general public use.
- **Wetlands** are areas that are inundated or saturated by surface or ground water (e.g., swamps, marshes, bogs) at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated conditions (Clean Water Act, U.S. Code of Federal Regulations 40 CFR 230.3).

P2.2



Prerequisite 2.3: Designate and communicate Vegetation and Soil Protection Zones

Required

P2.3



INTENT

Maximize the benefits of ecosystem services by designating and communicating to project team members a site development plan that protects healthy vegetation, soils, and sensitive environmental features.

REQUIREMENTS

- Identify, map, and protect critical and sensitive existing on-site features in Vegetation and Soil Protection Zones (VSPZs).
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and describes the on-going management activities to protect the integrity of VSPZs.

Note: Not all sites will contain a VSPZ.

VSPZ Mapping Requirements

Refer to the table below for relevant prerequisites (required) that may have VSPZ implications:

Prerequisite #	Prerequisite Name	VSPZ Requirement
Context P1.1	Limit development on farmland Case 2: Sites with farmland soils	95 percent of all <u>healthy soils</u> designated as <u>prime farmland</u> , <u>unique farmland</u> , <u>farmland of statewide importance</u> , or <u>farmland of local importance</u>
Context P1.2	Protect floodplain functions Case 3: <u>Greenfields</u> within floodplain	90 percent of <u>100-year floodplain</u> area
Context P1.3	Conserve aquatic ecosystems Case 2: Sites with naturally occurring aquatic ecosystems	Entire delineated buffer, according to aquatic ecosystem classification
Context P1.4	Conserve habitat for threatened or endangered species Case 1: <u>Brownfields/previously developed sites</u> Case 2: Greenfield sites	Full extent of identified <u>habitat</u>
Soil+Veg P4.1	Create and communicate a soil management plan	Healthy soils that will be retained in place—show VSPZs on SMP map

Section 2: Pre-Design Assessment + Planning

Refer to the table below for relevant optional credits that may have VSPZ implications. Only include those credits that the project intends to pursue:

Credit #	Credit Name	VSPZ Requirement
Soil+Veg C4.4	Conserve healthy soils and appropriate vegetation	Minimum of 50 percent of total site area containing healthy soils and appropriate vegetation
Soil+Veg C4.5	Conserve special status vegetation	One foot (0.30 meter) radius for each inch DBH for <u>special status</u> trees; for shrubs, perennials, see below
Soil+Veg C4.6	Conserve and use native plants	Percentage of existing <u>native plants</u> on site
Soil+Veg C4.7	Conserve and restore native plant communities	Percentage of existing <u>native plant communities</u> ≥ 2,000 square feet (185.81 square meters)

- VSPZs can encompass one plant or can include several plants in a group.
- VSPZ boundaries for trees should extend out from the trunk, to a minimum distance of a one foot (0.30 meter) radius (measured at ground level) per inch (2.54 centimeters) of diameter at breast height (DBH) or the full lateral extent of the actual root system as determined by ground-penetrating radar or by using the Clark-Matheny method (see the Resources section).
- VSPZ boundaries for shrubs should extend out from the stem to twice the radius of the shrub.
- VSPZ boundaries for herbaceous vegetation should extend to encompass the diameter of the plant.

VSPZ Requirements:

- Soils and vegetation within VSPZs must not be disturbed or compacted during construction.
- Management activities within VSPZs must not reduce the function and resiliency of wetlands or aquatic ecosystems.
- Invasive species present within VSPZs must be treated using equipment that can be carried in and out of the zone on foot or will not otherwise detrimentally affect soil compaction.
- Only minimal impact site development is allowed within VSPZs. No more than 10 percent of the total area of all VSPZs can contain minimal impact site development.
- Construction impacts from overall site development must not decrease the capacity of VSPZs to support the desired vegetation. For example, construction activities outside of a VSPZ should not change drainage patterns and microclimate effects within the VSPZ.
- Protect VSPZs from equipment parking and traffic, storage of materials, and other construction activities with a fence or other physical barrier that cannot be easily moved. (Use a wildlife-permeable barrier as appropriate).
- Communicate the locations and protective measures of VSPZs to construction and maintenance personnel. Outline consequences to contractors if they do not respect VSPZ boundaries.

P2.3



Section 2: Pre-Design Assessment + Planning

SUBMITTAL DOCUMENTATION

- Site plan showing all VSPZs according to the requirements
- Narrative describing:
 - The square footage (or square meters) of each VSPZ designated on site
 - How VSPZs will be preserved during construction (e.g., fence or other physical barrier that cannot be easily moved)
 - Other protective treatments and restoration activities planned for any areas within VSPZs
 - Efforts to educate all construction personnel about VSPZs
- Photographs of protection signage
- Construction documents describing all minimal impact site development occurring within VSPZs
- Specifications describing the location and protective measures of VSPZs

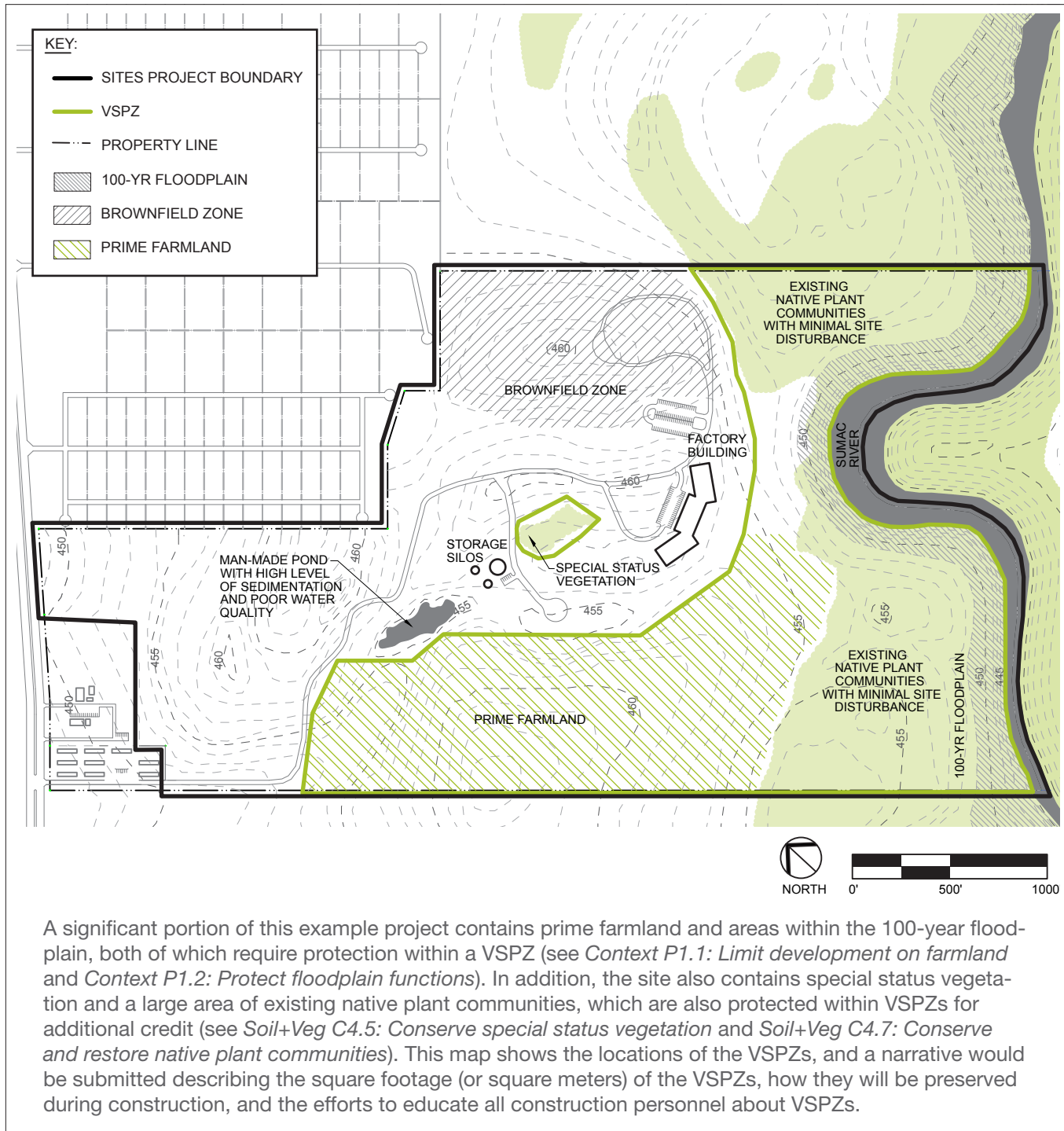
P2.3



Section 2: Pre-Design Assessment + Planning

DOCUMENTATION GUIDANCE

Example: Sumac River Nature Center



P2.3



Section 2: Pre-Design Assessment + Planning

RECOMMENDED STRATEGIES

- The number of roadways crossing through VSPZs should be minimized and constructed only when necessary, such as when a significant portion of the site can be reached only by crossing a VSPZ.
- Structures that must cross a VSPZ should be designed to minimize their impact on terrestrial and aquatic habitat connectivity.
- Additional planting within VSPZs must be done with care, because tree roots typically are located at the surface (sometimes to a depth of 2 to 3 inches, or 5.08 to 7.62 centimeters, at most).
- Perennial plantings within VSPZs should be done manually and without power equipment.
- Annual plantings are strongly discouraged within VSPZs.
- Additional planting within the one foot (0.30 meter) radius per inch (2.54 centimeters) DBH should be avoided. Planting here runs a high risk of damaging tree roots and soil chemistry and creating negative impacts due to excessive irrigation.
 - Planting should be limited to 25 percent of the area under the tree canopy or the area within a one-foot (0.30 meter) radius per inch (2.54 centimeters) DBH and must be done in consultation with a certified arborist or other appropriately qualified professional.
- Protect the root zone of trees found on site.
 - Try to protect groups rather than individual trees.
 - Design utility access away from the soil and roots of trees.
 - Reduce the need for utility trench work through strategic placement of utilities.
 - Where utility trench work is necessary, use air excavation to expose tree roots without damaging them (according to ANSI A300 Part 5).
 - If applicable, consider using directional boring technology (e.g., “mole,” “Ditch-Witch”).
 - For trees, ground-penetrating radar (GPR) or air excavation can be used to determine the location of tree roots.
- Consult with local experts qualified in plant health and safety to determine recommended special protection measures.
- Minimal impact site development should not require power equipment or wheeled vehicles and should not go beyond the necessary footprint of construction activity. Low impact construction is critical and essential to maintaining the integrity of VSPZs (e.g., construction attributes such as concrete slab foundations are strongly discouraged, permeable surfaces rather than impervious are strongly encouraged).

P2.3



ECONOMIC AND SOCIAL BENEFITS

Conserving vegetation, soils, and other features during construction is beneficial monetarily as well as environmentally. Healthy plant communities and the soils in which they thrive hold value that takes decades and even centuries to achieve. Raw lot prices are about 20 percent higher in value due to retention of existing vegetation in new development areas.¹ Healthy, native soils largely contribute to this value by providing the appropriate pore space, nutrients, and structural support needed for vegetation to grow.² Additionally, established vegetation is also linked to positive social effects, such as building social connections and increasing consumer purchases in business districts.³

1. KL Wolf, “City Trees and Property Values,” *Arborist News* 16, no.4 (2007): 34-36.

2. W Elmendorf, H Gerhold, and L Kuhns, *A Guide to Preserving Trees in Development Projects* (University, PA: The Pennsylvania State University, 2005).

3. KL Wolf, “With Plants in Mind: Social Benefits of Civic Nature,” *MasterGardener* 2, no. 1 (2008): 7-11.

Section 2: Pre-Design Assessment + Planning

DEFINITIONS

- **100-year floodplain** includes all areas below the 100-year flood elevation of waterways of all sizes, including depressional areas, wetlands, areas behind levees, ephemeral and intermittent streams, rivers, lakes and shorelines, and coastal areas. These areas are generally depicted on the current FEMA Flood Insurance Rate Map as Zones A, AE, A1-A30, AH, AO, AR, A99, V, and VE, however, in some areas they may need to be calculated by the site development team.
- A **brownfield** is an abandoned, idled, or underused industrial and commercial facility or site where expansion or redevelopment is complicated by real or perceived environmental contamination; a site documented as contaminated by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local voluntary cleanup program, or a site defined as a brownfield by a local, state, or federal government agency.
- **Diameter at breast height (DBH)** is a standard method for determining the trunk diameter of a standing tree. In the United States, DBH is typically measured in inches at 4.5 feet (1.37 meters) off the ground on the uphill side. Wounds, branches, multiple stems, and defects may change how diameter is measured. For guidance, see the International Society for Arboriculture website, www.isa-arbor.com/publications/tree-ord/measuringdbh.aspx.
- **Farmland of local importance** refers to soils important to the local economy due to their productivity and which may include tracts of land that have been designated for agriculture by local ordinance. Each state Natural Resources Conservation Service or local ordinance designates which soils qualify.
- **Farmland of statewide importance** refers to soils that do not meet all of the prime farmland criteria but that are still able to economically produce high yields of crops when treated and managed according to acceptable farming methods. Each state Natural Resources Conservation Service designates which soils qualify.
- A **greenfield** is a site that has not been previously developed or graded, including previous agricultural fields.
- **Habitat** is the area or natural environment in which an organism or population normally lives. A habitat is made up of physical factors such as soil, moisture, range of temperature, and availability of light as well as biotic factors such as the availability of food and the presence of predators.
- **Healthy soils** have not been significantly disturbed by previous human development activities. Healthy soils may include one or more of the following indicators:
 - Soil horizons that are similar to the reference soil
 - Bulk densities that do not exceed the maximum allowable bulk densities shown in *P7.3: Restore soils disturbed during construction*
 - Organic matter content similar to that of the reference soil
 - Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) similar to that of the reference soil
 - Absence of compounds toxic to the intended plants
 - Presence of vegetation that is representative of native plant communities
- **Minimal impact site development** is development (e.g., a trail, picnic area, boardwalk) that does not significantly alter the existing vegetation and hydrology of the Vegetation and Soil Protection Zones (VSPZs).
- A **native plant** is vegetation native to the EPA Level III ecoregion of the site or known to naturally occur within 200 miles (321.87 kilometers) of the site. Naturally occurring hybrids, varieties, and cultivars of species native to the ecoregion are acceptable.
- A **native plant community** is an assemblage of plant species whose composition and structure are typical of native plant communities mapped at the EPA Level III ecoregion or are known to naturally occur within 200 miles (321.87 kilometers) of the site. Native plant communities include but are not limited to wetlands, woodlands, grasslands, riparian buffers, and habitat for wildlife species of concern within the region. A reference from a local plant list, local reference site, or published plant community description is needed to determine the dominant plant species, relative species abundances, and

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other characteristic elements of the plant community/communities to be preserved or restored.

- A **previously developed site** consists of at least 75 percent of the site area that has been altered by preexisting paving, construction, or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural areas are considered undeveloped land.
- **Prime farmland** refers to a designation of specific soils by the state or U.S. Natural Resources Conservation Service. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. The land could be cropland, pastureland, rangeland, forestland, or other land, but cannot be urban built-up land or water. Prime farmland has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.
- **Special status vegetation** is designated as important by local, state, or federal entities. Designations may be for size, species, age, rare or special status collections, ecological and environmental value, unique genetic resources, aesthetics, location, or other unique characteristics (e.g. heritage or legacy trees). Groves and clusters may also be given special status.
- **Unique farmland** refers to land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of a specific crop when treated and managed according to acceptable farming methods. The state or U.S. Natural Resources Conservation Service designates which soils qualify.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.
- **Wetlands** are areas that are inundated or saturated by surface or ground water (e.g., swamps, marshes, bogs) at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated conditions (Clean Water Act, U.S. Code of Federal Regulations 40 CFR 230.3).

RESOURCES

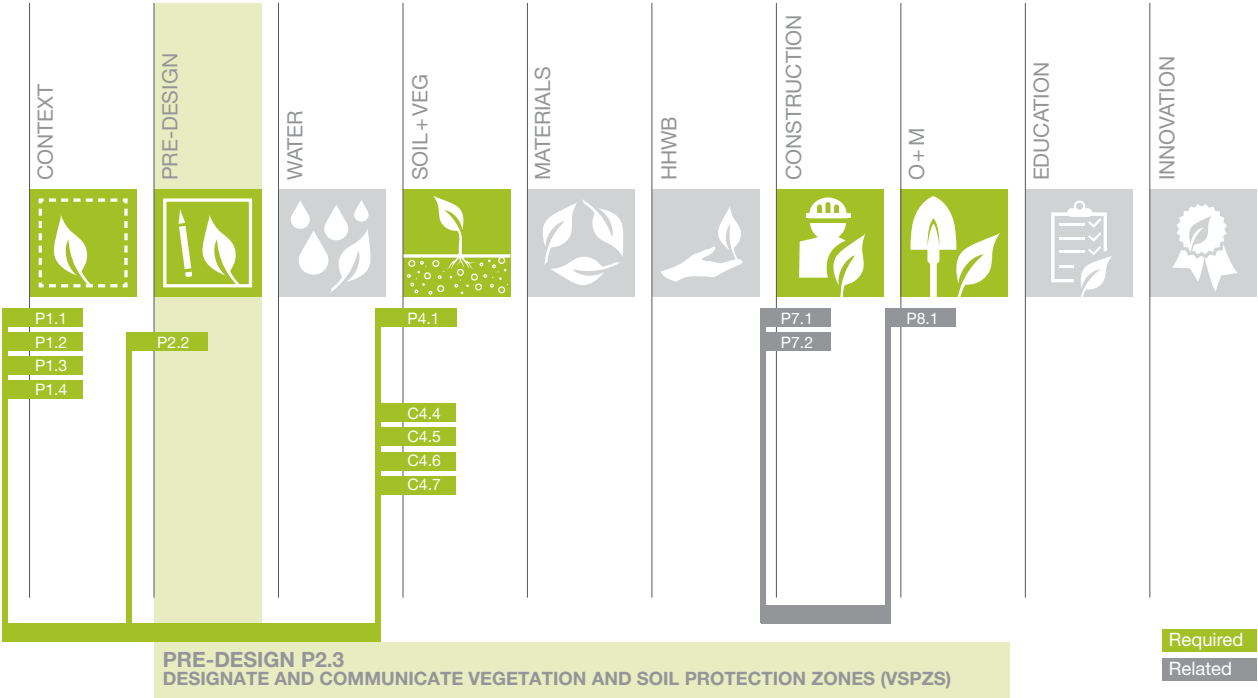
- For more information about arboriculture, consult RW Harris, N Matheny, and JR Clark, *Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines*. 3rd ed. (Upper Saddle River, NJ: Prentice Hall, 1999).
- For a discussion of sustainable landscape construction, read J. William Thompson, Kim Sorvig, *Sustainable Landscape Construction: A Guide to Green Building Outdoors* (Washington, D.C., Island Press, 2008).
- For a guide to protecting urban soils, see the USDA website, soils.usda.gov/sqi/management/files/protect_urban_sq.pdf.

P2.3



Section 2: Pre-Design Assessment + Planning

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



P2.3



Credit 2.4: Engage users and stakeholders

3 points

C2.4



INTENT

Identify specific, measurable, attainable, realistic, and timely project goals by engaging site users and stakeholders during the design process to supplement professional expertise with local knowledge.

REQUIREMENTS

Engage potential site users and stakeholders during the following design phases:

1. Site assessment process and program plan

- Engage site users and stakeholders in identifying specific, measurable, attainable, realistic, and timely project goals.
- Identify the programmatic and functional needs of the various site user groups.
- Ensure the section of the site assessment (see *P2.2: Conduct a pre-design site assessment*) is complete and describes the process of engaging site users and stakeholders (see *Pre-design P2.1: Use an integrative design process*). Incorporate the knowledge gained about the site and local area to into the program plan.
- Provide the site users and stakeholders with multiple schematic design alternatives and associated outcomes using visual representations.

2. Design development presentation and review

- Invite the site users and stakeholders to the design development presentation and review.

3. Present the design to the public

- Present the design to the public in at least two forms (e.g., website, community meeting, newspaper article, civic display).

SUBMITTAL DOCUMENTATION

1. Site assessment process and program plan

- List of site users and stakeholders (identified in *Pre-design P2.1: Use an integrative design process*) who participated in the program plan and site assessment process
- Narrative outlining the programmatic and functional needs of the various stakeholders and user groups based on their input

2. Schematic design review

- Copies of the schematic design alternatives provided to the participants
- Narrative of the associated outcomes of each design alternative that was shared with the participants
- Summary of the feedback on the schematic designs received from site users and stakeholders

3. Design development presentation and review

- A copy of the design development presentation given to the participants
- Narrative describing how the design reflects stakeholder feedback (if feedback was not incorporated, describe why)
- Summary of the feedback on the design received from site users and stakeholders

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4. Present the design to the public

- A copy of the site design presented to the public
- Narrative describing the opportunities for site users, stakeholders, and the public to view and understand the design

RECOMMENDED STRATEGIES

- Solicit input and feedback in imaginative and flexible ways, such as through websites; surveys; visual preference questionnaires; charrettes; focus groups; field visits and tours; workshops; geographic information system (GIS) modeling and mapping; and facilitated, interactive exercises.
- Consider using a variety of approaches to garner more widespread public participation and to present designs (e.g., web-based or town hall-style presentations).
- Engage a wide variety of community members by providing food, childcare, transportation, mediators, interpreters, and written translations during public meetings, and take special effort to include less influential groups or individuals. Conduct meetings at community development centers and other convenient local gathering places.

ECONOMIC AND SOCIAL BENEFITS

Involving the public in decision-making builds social ties among neighbors and trust between the community and planning organizations.^{1,2,3,4} Users and other stakeholders can contribute ideas resulting in designs that better serve the people most affected by the site, maximizing benefits and minimizing long-term, adverse effects. Public participation enhances stewardship, sense of place, and feelings of ownership for site users, which in turn develops shared expectations for the project's results. Public input often results in innovations that enhance community economic development.⁵

1. R Putnam, "The Prosperous Community: Social Capital and Public Life," *The American Prospect* 13 (Spring 1993): pp. 35–42.
2. R Putnam, "Bowling Alone: America's Declining Social Capital," *Journal of Democracy* 6, no. 1 (January 1995): pp. 65–78.
3. R Putnam, "The Strange Disappearance of Civic America," *The American Prospect* 24 (Winter 1996): p. 34.
4. F Fukuyama, *Trust: The Social Virtues and the Creation of Prosperity* (New York: Free Press, 1995).
5. C Schively, *Enhancing Transportation: The Effects of Public Involvement in Planning and Design Processes* (Minneapolis: Humphrey Institute of Public Affairs, University of Minnesota, 2007).

DEFINITIONS

- A **program plan** is a narrative or written design that provides a mechanism for clearly stating the vision and desired outcomes of the project and setting the direction of the design team.
- **Schematic design** is the phase during which the concept and basic framework for the design of the project are completed.
- A **site user** is an individual or group who is expected to occupy, work at, or pass through the site. Users may visit the site regularly or periodically. Site users will range in age, ethnicity, and socio-economic status, but all users' needs should be considered.
- A **stakeholder** is an individual or group who has a vested interest in the project and may be a neighbor, public official from a local jurisdiction, community leader, local community group, or business organization.

C2.4



Section 2: Pre-Design Assessment + Planning

RESOURCES

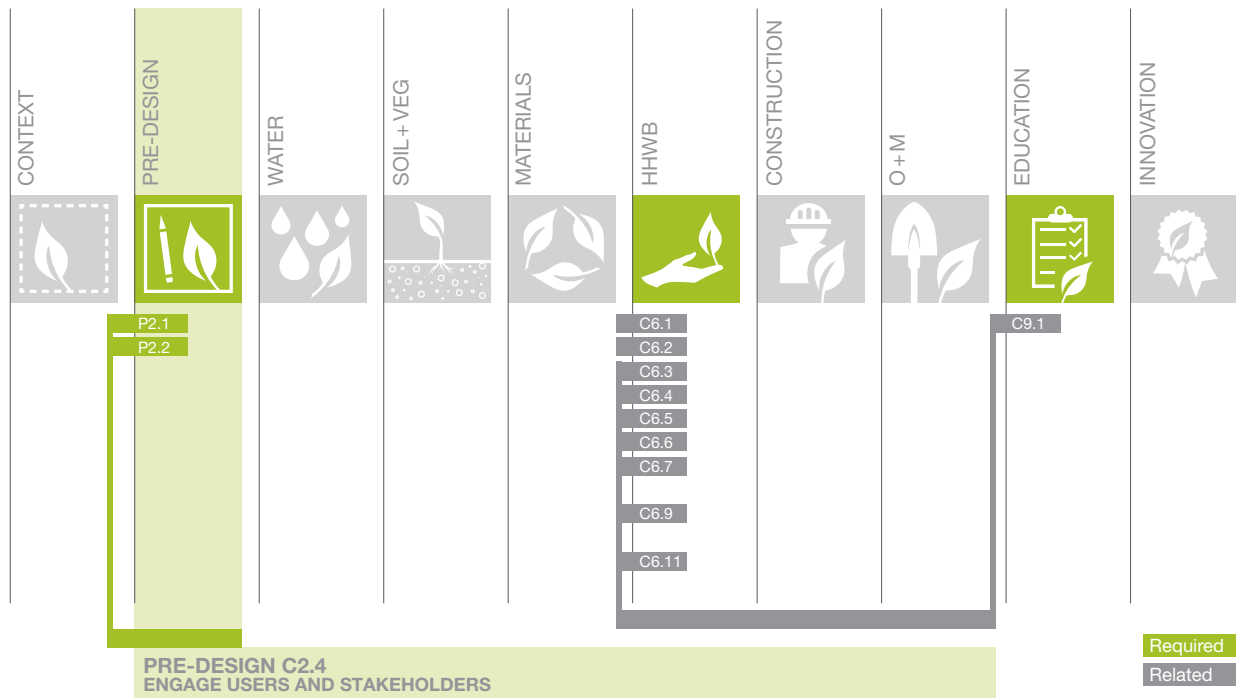
For additional information on identifying, engaging, and planning with the community, refer to the following resources:

- For tools and techniques, see the National Park Service Rivers, Trails and Conservation Assistance Community Toolbox, www.nps.gov/nero/rtcatoobox.
- For design and planning resources, consult the Project for Public Spaces *placemaking*. pps.org/parks_plazas_squares/info/design.
- For more information about charrette sessions and community planning, consult:
 - The National Charrette Institute, www.charretteinstitute.org.
 - B Lennertz and A Lutzenhiser, *The Charrette Handbook: The Essential Guide for Accelerated, Collaborative Community Planning* (Chicago: American Planning Association, 2006).
 - H Sanoff, *Community Participation Methods in Design and Planning* (New York City: John Wiley & Sons, 1999).
- For information on community benefits agreements and policies, see Partnership for Working Families Resources, www.forworkingfamilies.org/resources/policy-tools-community-benefits-agreements-and-policies.

C2.4



LINKS TO OTHER SITES PREREQUISITES AND CREDITS





SECTION 3

SITE DESIGN – WATER

PREREQUISITE / CREDIT	TITLE	POINTS
Water P3.1	Manage precipitation on site	Required
Water P3.2	Reduce water use for landscape irrigation	Required
Water C3.3	Manage precipitation beyond baseline	4-6 points
Water C3.4	Reduce outdoor water use	4-6 points
Water C3.5	Design functional stormwater features as amenities	4-5 points
Water C3.6	Restore aquatic ecosystems	4-6 points

Prerequisite 3.1: Manage precipitation on site

Required

INTENT

Reduce negative impacts to aquatic ecosystems, channel morphology, and dry weather base flow by replicating natural hydrologic conditions and retaining precipitation on site.

REQUIREMENTS

- Retain the precipitation volume from the 60th percentile precipitation event as defined by the U.S. EPA in the *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act* (or local equivalent for projects outside the United States).
- Retain precipitation volume through on-site infiltration, evapotranspiration, and reuse.
 - Implement runoff-reduction strategies (e.g., biofiltration through plants, soil) that also improve water quality.
 - Cisterns, if used, must be implemented in combination with other approaches to meet the requirements of this prerequisite.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and includes the maintenance activities used to ensure long-term effectiveness of stormwater features.

Note: On sites where the retention of the precipitation volume from the 60th percentile precipitation event is not feasible due to site constraints (such as clay soils, high groundwater elevations, geotechnical issues, below-ground contamination, underground utilities or transportation systems, watershed water balance considerations, low evapotranspiration rates, or lack of water use potential), retain the maximum precipitation volume possible on the site up to the 60th percentile precipitation event.

SUBMITTAL DOCUMENTATION

- Calculations documenting the precipitation volume from the 60th percentile precipitation event
- Calculations confirming there is sufficient capacity on site to retain and infiltrate, use, or evapotranspire the precipitation volume from the 60th percentile precipitation event in fewer than three days from the time of initial retention:
 - Total volume capacity of stormwater features
 - Designed infiltration rates
 - Evapotranspiration (ET) rates, vegetative cover type, and area calculation of vegetative cover if stormwater features use evapotranspiration to reduce volume
 - Total volume capacity of rainwater harvesting systems (e.g., cisterns) and discharge strategies, if applicable
- Narrative describing:
 - The process used to determine the 60th percentile precipitation event
 - > If a project is unable to meet the 60th percentile precipitation event requirement, document the specific prohibiting conditions.
 - The analysis conducted to demonstrate the maximum precipitation volume retained based on site (i.e., topography, soil, climate) and water use factors
 - The measures implemented on site to manage precipitation volume

P3.1



Section 3: Site Design—Water

DOCUMENTATION GUIDANCE

To find your project location's 60th percentile precipitation event:

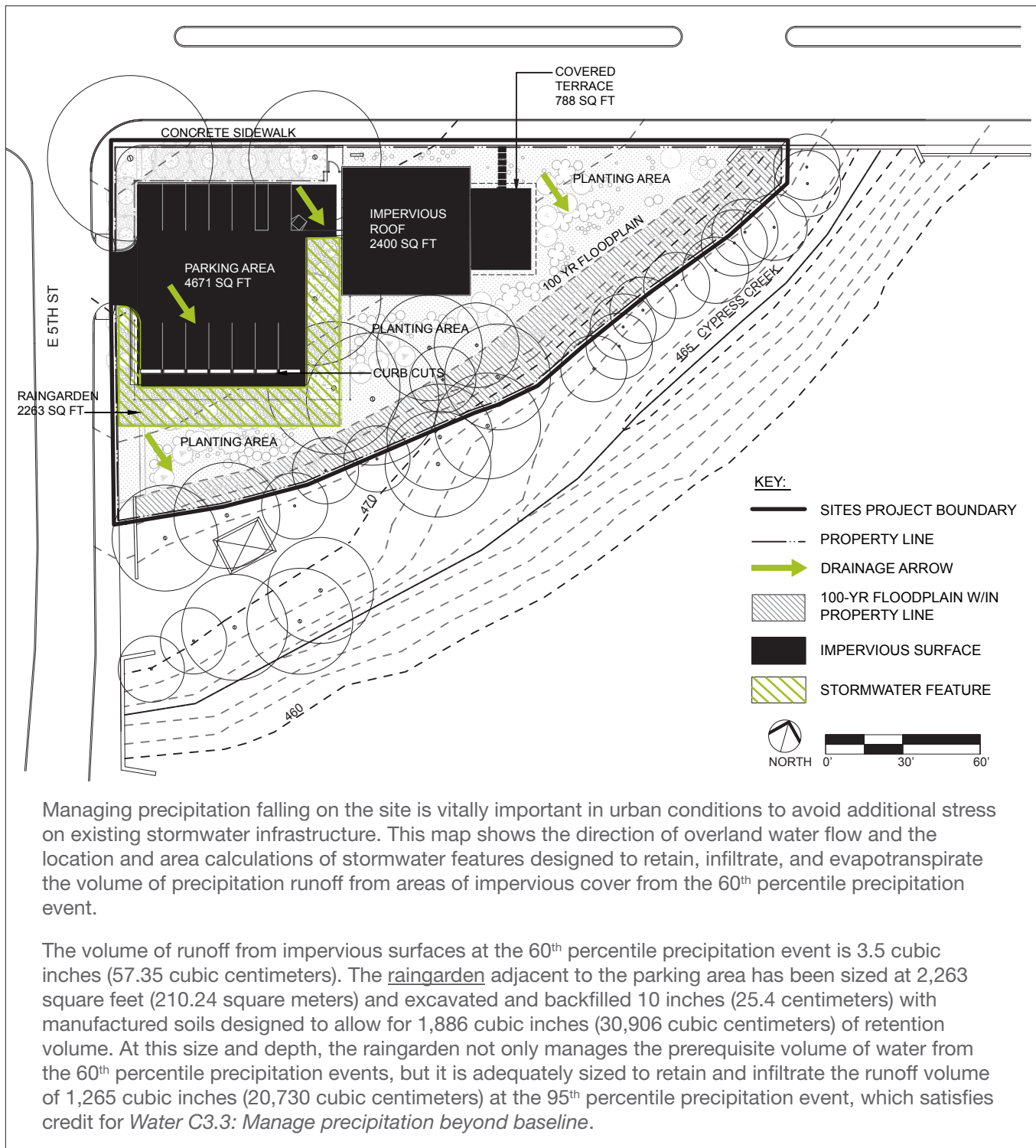
- Obtain a long-term rainfall record from a nearby weather station; attempt to obtain at least 30 years of daily records. Long-term rainfall records can be obtained from many sources, including the U.S. National Oceanic and Atmospheric Administration (NOAA) at (www.ncdc.noaa.gov/cdo-web/) (or local equivalent for projects outside the United States).
- Remove from the data set data for rainfall events that are 0.1 inch (0.25 cm) or less and snowfall events that do not immediately melt. These events should be deleted because they do not typically cause runoff and could potentially cause the analyses of the 60th percentile storm runoff volume to be inaccurate.
- Using a spreadsheet or simple statistical package, sort the rainfall events from highest to lowest. In the next column, calculate the percentage of rainfall events that are less than each ranked event (event number/total number of events). For example, if there were 1,000 rainfall events and the highest rainfall event was a four-inch (10.16 centimeter) event, then 999 events (or a percentile of 999/1000, or 99.9%) are less than the four-inch (10.16 centimeter) rainfall event.
- Use the rainfall event at 60 percent as the 60th percentile storm event.
- Calculate the volume of rainfall (in cubic feet or cubic meters) over the total area of impervious surfaces to determine the volume of precipitation runoff that must be managed on site.
- Compare the runoff volume calculated with the designed management volume of stormwater features. When sizing stormwater features or rainwater harvesting systems, consider infiltration rates, evapotranspiration rates, and rainwater harvesting outflow rates.

P3.1



Section 3: Site Design—Water

Example: Live Oak Place



P3.1



Section 3: Site Design—Water

RECOMMENDED STRATEGIES

- Ensure that discharge volumes and rates do not increase the natural rate of erosion in receiving water channels or negatively affect a receiving channel's ecological flows or natural groundwater replenishment rates and volumes.
- Implement strategies to reduce precipitation runoff volumes, peak flows, and pollutant discharges.
- Implement strategies to increase evapotranspiration, filtration and infiltration, and mitigate elevated water temperatures caused by contact with impervious surfaces. Use the following strategies and design approaches:
 - Design to minimize impervious surfaces; specify permeable materials for hard surfaces, including permeable concrete, asphalt, and pavers.
 - Design hard surfaces to drain into localized, on-site landscape areas, and design landscape areas to accept precipitation runoff from hard surfaces.
 - Provide infiltration opportunities in the landscape that use plants and healthy soils as filters, such as bioswales, raingardens, water quality ponds, constructed wetlands, or vegetated buffers, that filter, infiltrate, evapotranspire, and retain precipitation, recharge groundwater, and reduce pollutant loadings, runoff volumes, and rates.
 - Where runoff conveyance systems are needed, use vegetated channels when possible. Where vegetated channels are not practical, the use of hard non-erosive materials to convey surface water should take precedence over using pipes, culverts, or underground channels.
 - Create living landscapes using soil and vegetation features, such as vegetated roofs, walls, or facades; raingardens; or tree canopies.
 - Select appropriate vegetation features that can tolerate periodic inundation and soil saturation without harming the growth or vigor of the plant.
 - When selecting vegetation for managing precipitation runoff, select plants that are resistant or less susceptible to pollutants commonly found in precipitation runoff.
 - Where possible, select plants appropriate for the site and climate based on their capacity to reduce pollutant loadings for specific pollutants of concern in the receiving watershed.
- Improve the water-retention capacity of the soil by increasing the organic matter content of the soil through the addition of compost or other organic soil amendments.
- Use rainwater-harvesting systems to reduce precipitation runoff volumes and rates. Design rainwater harvesting and use systems to maintain the ecological flows of receiving waters and historical groundwater recharge rates.
- Avoid or minimize the use of materials used in buildings, hardscape, and landscape construction that can be a source of pollutants in stormwater, such as:
 - Copper and zinc roofs, roof gutters, downspouts, and siding
 - Galvanized materials (e.g. fences, fence posts, guardrails, signposts)
 - Treated lumber
- Use integrated pest management (IPM) practices to control pests
- Minimize the use of fertilizers on site and implement practices to reduce nutrient runoff (e.g., slow-release fertilizers, optimized application timing for plant uptake).
- Plan for and implement maintenance activities designed to reduce the exposure of pollutants to stormwater, such as:
 - Minimizing exposure of stored materials to precipitation to minimize the chance of pollutants running off the site or entering groundwater both on and off site
 - Developing and implementing a contaminated/chemical spill response plan
 - Minimizing the use of salt or other potentially harmful de-icing chemicals
 - Avoiding on-site maintenance of construction equipment to reduce pollutant loadings of oils, grease, or hydraulic fluids
 - Avoiding on-site fueling of vehicles to the maximum extent practicable

P3.1



Section 3: Site Design—Water

- Where appropriate, implement systems of practices in a treatment train to provide multiple pollutant removal processes (e.g., runoff reduction through evapotranspiration and infiltration, sedimentation, filtration, adsorption, biological degradation or uptake) to reduce the concentrations of pollutants in precipitation runoff and to provide redundancy in the system.
- Use soil and vegetation-based controls based on their capacity to reduce precipitation runoff and pollutant loadings through evapotranspiration and phytoremediation.
- Maintain infiltration rates, and regenerate the adsorption capacity of the soils.

ECONOMIC AND SOCIAL BENEFITS

Municipal water and wastewater treatment facilities account for up to 35 percent of the electricity consumed by municipal entities in the United States.¹ Capturing, treating, and reusing precipitation runoff on a site may help reduce potable water consumption, leading to reduced public and private utility costs and energy expenditures for pumping, cleaning, and processing water. Retaining precipitation runoff on site is the primary tool for preserving predevelopment hydrology and protecting aquatic ecosystems. Retaining water on site also decreases discharges to stormwater management systems, which can reduce combined sewer overflows, thus minimizing adverse effects on aquatic habitat and enhancing recreational opportunities such as fishing and birdwatching. This effort can also lead to a reduction in costly infrastructure requirements for stormwater collection and treatment. Energy efficiency not only reduces costs, but also reduces the generation of greenhouse gases.

The effects of climate change vary regionally, but green infrastructure and low impact development techniques can provide adaptation benefits for a wide array of circumstances. They can be used to conserve, harvest, and reuse water to recharge groundwaters and to reduce surface water discharges that contribute to flooding.² In addition, there are mitigation benefits such as reducing a site's energy demand and increasing its capacity for vegetative carbon sequestration.

1. American Council for an Energy-Efficient Economy, "Water and Wastewater," aceee.org/topics/water-and-wastewater (accessed March 22, 2013)

2. U.S. Environmental Protection Agency, "Why Green Infrastructure?," water.epa.gov/infrastructure/greeninfrastructure/gi_why.cfm (accessed March 24, 2013)

DEFINITIONS

- A **bioswale** is a linear stormwater runoff conveyance system that is used as an alternative to storm sewers to partially treat water quality, attenuate flooding potential, and convey stormwater away from critical infrastructure.
- **Integrated pest management (IPM)** is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. IPM is site-specific in nature, with individual tactics determined by the particular crop/pest/environment scenario. The IPM approach places an emphasis on the reduction of pesticide use and the implementation of preventative and alternative control measures.
- **Organic matter** in soil is carbon-containing material composed of both living organisms and formerly living decomposing plant and animal matter. Soil organic matter (SOM) content can be supplemented with compost or other partially decomposed plant and animal material. SOM content is commonly measured using "loss on ignition" tests that measure the amount of the element carbon, a key constituent of all organic matter.
- A **raingarden** is a depression formed on a natural slope and planted with deep-rooted native plants and grasses designed to hold and absorb rainwater from nearby impervious services such as roofs, drives, walkways, parking lots, or compacted lawn areas.
- **Receiving waters** include groundwater, creeks, streams, rivers, lakes, or other water bodies that receive treated or untreated wastewater or stormwater. They also include water from combined sewer systems (CSOs) and storm drains.

P3.1



Section 3: Site Design—Water

- A **specific pollutant of concern** is a pollutant listed in the U.S. Clean Water Act Cause of Impairment for 303(d) Listed Waters. See iaspub.epa.gov/waters10/attains_nation_cy.control?p_report_type=T-causes_303d.
- A **stormwater feature** uses precipitation as its sole source and function as an element to manage stormwater. Examples include pools, fountains, stormwater BMPs, water gardens, channels for local conveyance, raingardens, and water art.

RESOURCES

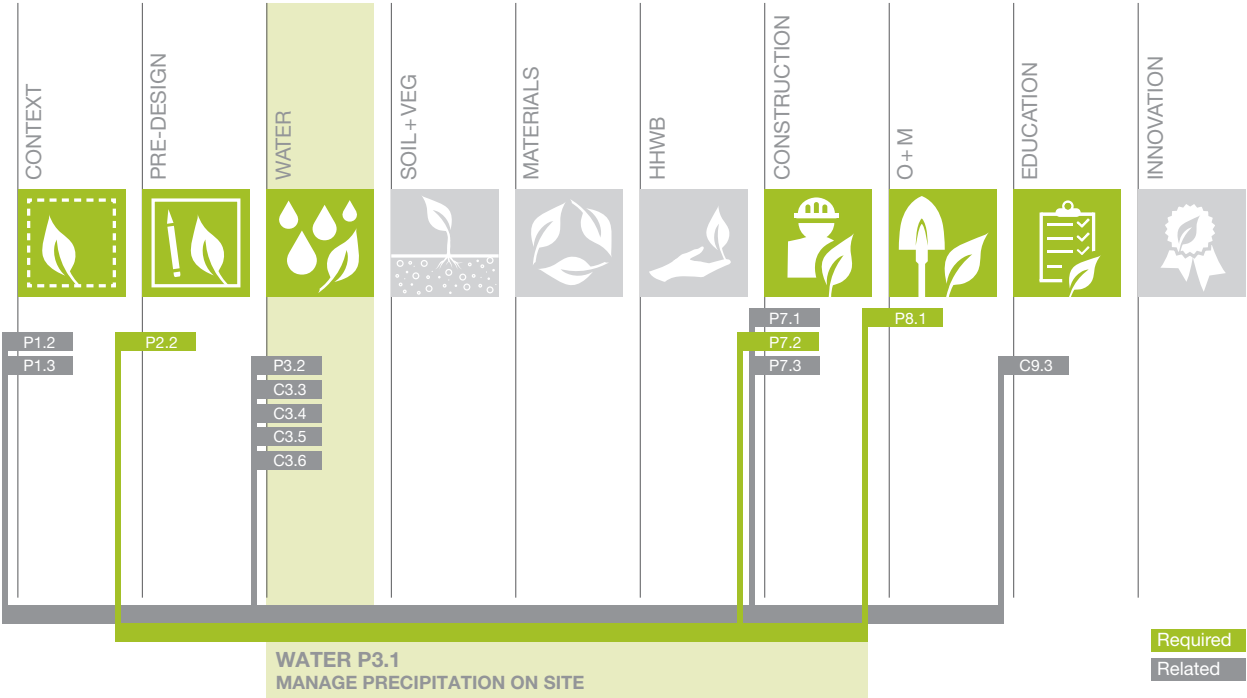
- For information on the *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act*, see: www.epa.gov/oaintrnt/documents/epa_swm_guidance.pdf.
- For local U.S. climate data, see:
 - National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center Search Tool, www.ncdc.noaa.gov/cdo-web
 - Weatherspark.com, weatherspark.com
- For more information on the Natural Resources Conservation Service National Engineering Handbook on Hydrology, see www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/?cid=stelprdb1043063.
- For BMP design guidance, see:
 - International Stormwater BMP Database resources, www.bmpdatabase.org/BMPPerformance.htm
 - *California Stormwater Best Management Practices Handbooks*, www.cabmphandbooks.org
 - *Maryland Department of the Environment Stormwater Design Manual*, www.mde.state.md.us/programs/Water/StormwaterManagementProgram/MarylandStormwaterDesignManual/Pages/programs/waterprograms/sedimentandstormwater/stormwater_design/index.aspx
 - *North Carolina Division of Water Quality Stormwater BMP Manual*, portal.ncdenr.org/web/wq/ws/su/bmp-manual
 - Texas Commission on Environmental Quality's "Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices," www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/rg/rg-348/index.html
 - *Washington State Department of Ecology Stormwater Management Manual*, www.ecy.wa.gov/PROGRAMS/wq/stormwater/manual.html
 - *City of Santa Barbara Storm Water BMP Guidance Manual*, www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf
 - M Clar, E Laramore, H Ryan, *Rethinking Bioretention Design Concepts*, www3.villanova.edu/vusp/Outreach/pasym07/papers/C_IV_3.pdf

P3.1



Section 3: Site Design – Water

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



P3.1



Prerequisite 3.2: Reduce water use for landscape irrigation

Required

INTENT

Conserve water resources and minimize energy use by reducing the use of potable water, natural surface water, and groundwater withdrawals for landscape irrigation after the establishment period.

REQUIREMENTS

This prerequisite applies only to long-term water use for the final vegetated area beyond the establishment period.

- Reduce or eliminate the use of potable water, natural surface water, (e.g., lakes, streams) and groundwater withdrawals for landscape irrigation (beyond the establishment period).
- Use the U.S. EPA WaterSense Water Budget Tool (or local equivalent for projects outside the United States) to identify the baseline case and water savings (www.epa.gov/watersense/water_budget/application.html).
 - Reduce water usage by at least 50 percent from the baseline case beyond the establishment period.
 - > If the water source does not come from a potable water source, local health standards must be met.
 - > Install water meters to record and measure water usage to compare to the established baseline.

OR

- Design the landscape to not require a permanent irrigation system.
- Ensure the sections of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) are complete and describe the anticipated watering schedule as well as the process for maintaining non-potable irrigation water sources.

Exemptions:

- Water volume used for the following purposes may be included or excluded from irrigation calculations at the project team's discretion:
 - Water used during establishment period
 - Water used to irrigate non-commercial food production gardens. Irrigation used on edible plants should not harm human health. (See *HHWB C6.7: Provide for on-site food production*.)
 - Water used as required by local regulations in fire-prone areas for fire suppression systems
 - Water used for athletic fields (if vegetated)

P3.2



Section 3: Site Design—Water

SUBMITTAL DOCUMENTATION

- Planting plan, including planting schedule showing plant types (ground cover, shrubs, trees, or turfgrass), associated square footages, and landscape coefficients (K_L)
- Irrigation plan clearly indicating water sources (i.e., if permanent irrigation is installed)
- Average monthly evapotranspiration and average monthly rainfall for the site's peak watering month, including the sources of information for a historic period of at least 10 years. (See the Resources section to help determine the site's local peak month reference evapotranspiration rate.)
- Water budget calculations made for Baseline, Landscape Water Allowance (LWA), Landscape Water Requirement (LWR), and results, according to the U.S. EPA WaterSense Water Budget Tool (or local equivalent for projects outside the United States)
- Narrative describing:
 - The landscaping and irrigation design strategies employed by the project, including during the establishment period
 - The size, brand, and model number of the water meter installed and how the data will be used to manage the irrigation system (if permanent irrigation is installed)
 - The reasoning to support the use of the selected landscape coefficient values (K_L) for the plant types on site, including references
 - For projects using non-potable water, include specific information regarding source and available quantity of non-potable supplies, and documentation showing the source and its application comply with local health regulations.
 - For projects using temporary irrigation systems, describe the type of irrigation system used and the process for decommissioning the system at the end of the specified establishment period.
- In the case of planned service for reclaimed water, show that the relevant agency has provided a "Letter of Availability" committing to provide the reclaimed water for the project.

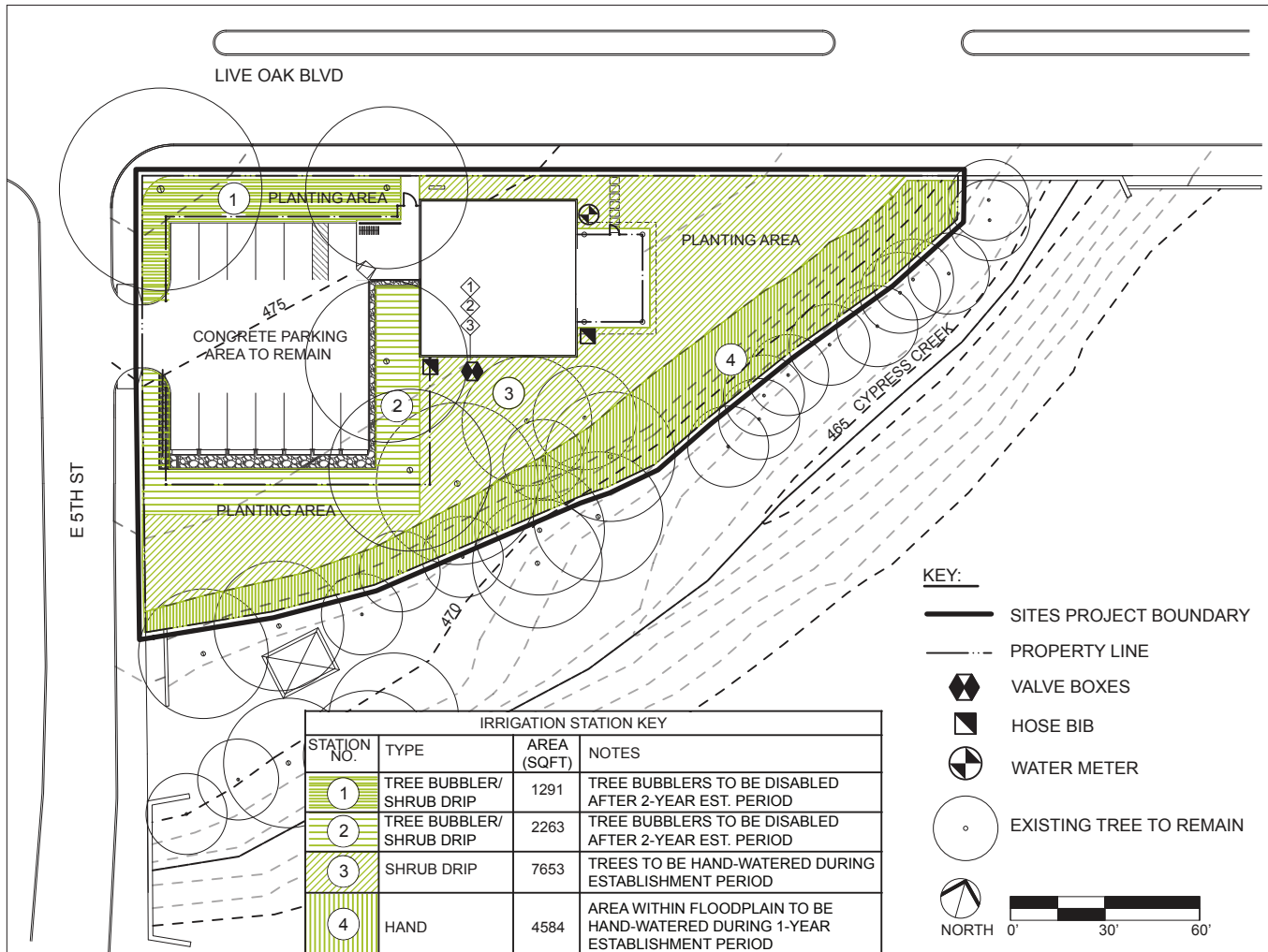
P3.2



Section 3: Site Design—Water

DOCUMENTATION GUIDANCE

Example: Live Oak Place



Water Budget Tool Report

s | gr
2013 BRENTWOOD ST AUSTIN, TX 78757

Your landscape is 77% below the baseline for this site.

Single Site or Development?
Single Site

Landscape Water Allowance
57530 gal/month

Landscape Area
157910 s sq. ft.

Landscape Water Requirement
19088 gal/month

Irrigation?
Yes

Potential Peak Watering Savings
38442 gal/month

Total Area of Turfgrass, Pools/Spas, and Water Features
0 sq. ft.

Summary of Hydrozones

Zone	Area (sq. ft.)	Plant Type / Landscape Feature	Water Demand	Irrigation Type	Required Water (gal/month)
1	1291	Trees	Low	Micro Spray	1561
2	2263	Trees	Low	Micro Spray	2735
3	7653	Shrubs	Low	Drip (Standard)	9251
4	4584	Shrubs	Low	Drip (Standard)	5541

The site design for Live Oak Place meets the requirements not only for this prerequisite, but also for *Water C3.4 Option 1: Reduce outdoor water use*. The chart to the left shows the U.S. EPA WaterSense Water Budget Tool determined the irrigation percentage reduction to be 77 percent for Live Oak Place. Water meter, valve box, and hose bib locations are clearly marked, and a series of simple hatch patterns show the irrigation zone size and composition.

Section 3: Site Design—Water

RECOMMENDED STRATEGIES

Reduce potable water use with any combination of the following items and methods:

- Design the site to maximize the use of captured stormwater for landscape elements
- Design the plantings, soils, and other features to be self-sustaining with natural precipitation only. Limit water use to time of planting only.
- Plant at the optimal season for your region to reduce or eliminate the need for watering for establishment.
- If turfgrasses are to be used, they should be regionally appropriate and minimize post-establishment requirements for irrigation.
- Improve water-retention capacity of soil by increasing organic matter (e.g., adding compost)
- Design irrigation systems in such a way that trees, shrubs, and ground cover are irrigated in separate hydrozones. This way, watering can be discontinued by zone as plants become established.
- Use high-efficiency equipment (e.g., drip irrigation) and climate-based controllers for irrigation systems
- Reuse graywater, captured rainwater, HVAC blowdown, or condensate water for irrigation to decrease potable water use for irrigation and to create a net benefit to the local watershed by making the landscape part of the natural water-treatment process.
- If graywater or wastewater is to be recycled for landscape irrigation, consider conducting chemical tests to determine suitability for reuse on intended vegetation.
- Use water treated and conveyed by a public agency specifically for non-potable uses

P3.2



ECONOMIC AND SOCIAL BENEFITS

In the United States, landscape irrigation uses nearly seven billion gallons of water per day during the peak-growing season. That means for the average family of four, approximately 30 percent of the water used daily typically is for outdoor activities such as watering lawns and gardens. In drier parts of the country, landscape irrigation can account for up to 70 percent of potable water use.¹

Typically, half of irrigation water can be wasted as a result of inefficiencies such as evaporation, wind spray, improper system design, and overwatering.² Selecting efficient irrigation systems, planting vegetation appropriate for site conditions and climate, and using captured rainwater or graywater can reduce water waste and conserve sources of potable water.

Municipal water and wastewater treatment facilities account for up to 35 percent of the electricity consumed by city governments in the United States.³ Given that a substantial portion of municipal energy demand is used to pump, clean, and process water, a site that decreases the need for municipally treated and provided water reduces energy. Reducing water waste and potable water use also reduces the user's utility costs for water pumping and water treatment.

1. EPA WaterSense Program epa.gov/watersense/our_water/start_saving.html

2. U.S. Environmental Protection Agency, "Outdoor Water Use in the United States," www.epa.gov/WaterSense/pubs/outdoor.html (accessed March 22, 2013)

3. American Council for an Energy-Efficient Economy, "Water and Wastewater," aceee.org/topics/water-and-wastewater (accessed March 22, 2013)

Section 3: Site Design—Water

DEFINITIONS

- An **athletic field** includes land that is dedicated to organized team sports (e.g., football, soccer) that involves high intensity use and is defined by distinct dimensions. Fields that are used for occasional recreational sports are not included.
- **Baseline** is the amount of water required by a site if watered at 100 percent of local reference evapotranspiration (ET).
- An **establishment period** begins at the time that vegetation is planted and is considered to be a maximum of three years for trees, two years for shrubs, and one year for herbaceous cover. Establishment period must be appropriate for plant species and site's climate and soil.
- **Graywater** is domestic wash water from kitchen, bathroom, and laundry sinks, tubs, and washers, conventionally thought of as wastewater.
- A **hydrozone** is a grouping of plants with similar water and environmental requirements for irrigation with one or more common station or zone valves.
- **Landscape coefficient (K_L)** is a constant used to modify the reference evapotranspiration. It takes into account the species factor, density factor, and microclimate factor. To reduce the complexity of the calculations for the purposes of the irrigation calculator, the density factor and microclimate factor are both assumed to equal approximately one. In general, a high landscape coefficient value is used for plants that need considerable amounts of water, and a low value is used for plants that need little water.
- **Landscape Water Allowance (LWA)** is the volume of water allocated to the entire landscape area over a specified period of time.
- **Landscape Water Requirement (LWR)** is the amount of water required by the landscape over a specified period of time.
- **Organic matter** in soil is carbon-containing material composed of both living organisms and formerly living decomposing plant and animal matter. Soil organic matter (SOM) content can be supplemented with compost or other partially decomposed plant and animal material. SOM content is commonly measured using “loss on ignition” tests that measure the amount of the element carbon, a key constituent of all organic matter.
- **Peak watering month** is the period with the greatest deficit between evapotranspiration and rainfall. This is the month when the plants in the site's region potentially require the most supplemental water.
- **Potable water** is water that meets the standards for drinking purposes of the state or local authority having jurisdiction, or water that meets the standards prescribed by the U.S. Environmental Protection Agency's National Primary Water Regulations (40 CFR 141).
- **Vegetated area** describes all portions of the site that will support vegetation.
- A **water budget** is used to calculate the amount of water a landscape needs, taking into account the inputs and outputs of water to and from the root zone. Inputs, such as precipitation, are subtracted from outputs, such as evapotranspiration, to calculate the water needs of the landscape. Many factors are taken into consideration when calculating a water budget, such as plant type and irrigation system efficiencies. (EPA WaterSense WaterBudget Approach)
- **Water meter** is an instrument or device for measuring and registering the quantity of water flowing through a pipe.

P3.2



Section 3: Site Design—Water

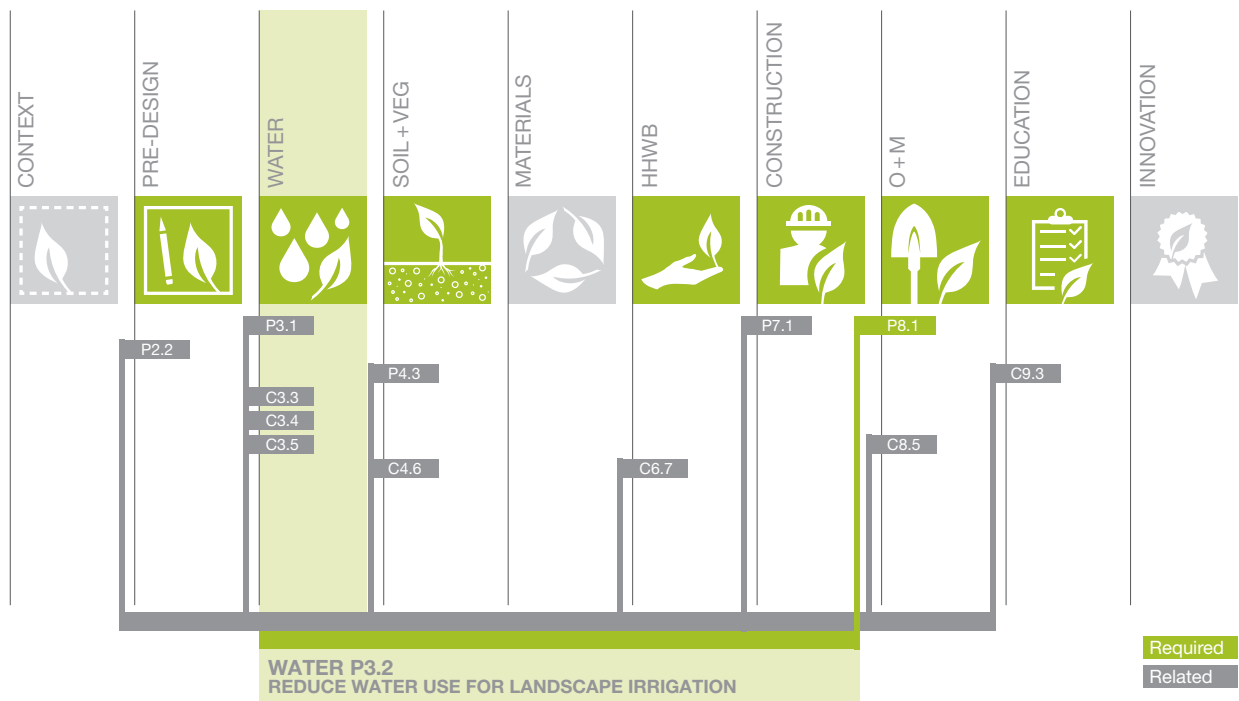
RESOURCES

- Components of this credit were adapted from the U.S. Green Building Council's LEED credit: LEED BD+C v4 *WE Prerequisite 1: Outdoor water use reduction*
- For an online calculator to determine your landscape water demands, consult the U.S. EPA WaterSense Water Budget Tool, www.epa.gov/watersense/water_budget/application.html.
- For evapotranspiration and rainfall data specific to a region in the United States, see:
 - U.S. EPA WaterSense Water Budget Data Finder, www.epa.gov/watersense/new_homes/wb_data_finder.html
 - The International Water Management Institute (IWMI) World Water and Climate Atlas, www.iwmi.cgiar.org/WAtlas/Default.aspx
- For more information on the U.S. EPA WaterSense Water Budget Approach, consult www.epa.gov/watersense/docs/home_final_waterbudget508.pdf.
- For information on calculating rainfall based upon climate and irrigation efficiencies, see <ftp://ftp.wcc.nrcs.usda.gov/wntsc/waterMgt/irrigation/NEH15/ch2.pdf>.
- For more information on efficient irrigation products, refer to the Irrigation Association at www.irrigation.org.
- For information on evapotranspiration, read "The ASCE Standardized Reference Evapotranspiration Equation," provided by the Irrigation Association, www.kimberly.uidaho.edu/water/asceewri/main.pdf.
- For more information on water-efficient landscaping, see resources such as the U.S. EPA's "Water-Efficient Landscaping: Preventing Pollution and Using Resources Wisely," www.epa.gov/npdes/pubs/waterefficiency.pdf.
- For more information on collecting and reusing rainwater and graywater, see American Rainwater Catchment Systems Association, www.arcsa.org.
- For information on irrigation scheduling, consult The University of California-Davis Biometeorology Program, biomet.ucdavis.edu/irrigation-scheduling.html.

P3.2



LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 3.3: Manage precipitation beyond baseline

4–6 points

INTENT

Maintain site water balance, protect water quality, and reduce negative impacts to aquatic ecosystems, channel morphology, and dry weather base flow by replicating natural hydrologic conditions and providing retention and treatment for precipitation on site.

REQUIREMENTS

Through on-site infiltration, evapotranspiration, and harvest use, retain or treat the maximum precipitation volume possible beyond the required baseline precipitation volume of the 60th percentile precipitation event described in *Water P3.1: Manage precipitation on site*.

These requirements pertain to the entire area within the SITES project boundary.

- Retain or treat precipitation volume for the following percentile precipitation events:
 - 80th percentile precipitation event **4 points**
 - 90th percentile precipitation event **5 points**
 - 95th percentile precipitation event **6 points**
- Retain or treat the maximum precipitation volume on site for the percentile precipitation event associated with the desired point total above, as defined by the U.S. EPA in the *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act* (or local equivalent for projects outside the United States). Use daily rainfall data and the methodology in the EPA document to determine the target percentile volume.
- For treatment of any precipitation volume not retained from the selected percentile precipitation event, listed above:
 - Treat any volume of runoff using an appropriate technology.
 - Ensure the entirety of the selected percentile precipitation event not retained is treated, and that remaining runoff will be discharged at rates consistent with the natural rate of erosion in the receiving water channel (i.e., discharge rate limit).
 - BMPs must be scaled to account for the additional volume of runoff entering the BMP from areas off site.
 - > The treatment practices implemented must achieve, at a minimum, an average discharge concentration of less than or equal to 25 milligrams per liter total suspended solids for the volume treated.
 - > In cases where receiving waters are impaired or threatened by specific pollutants of concern, treatment must be provided for these pollutants.
- Ensure the sections of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) are complete and detail the proper maintenance activities used to ensure long-term effectiveness of stormwater features, including water quality treatment activities.

C3.3



Section 3: Site Design—Water

SUBMITTAL DOCUMENTATION

Required for Retention:

- Calculations documenting the percentile precipitation volume retained beyond the 60th percentile precipitation event
- Calculations to confirm there is sufficient capacity on site to retain, use, infiltrate, or evapotranspire the precipitation volume beyond the 60th percentile precipitation event in fewer than three days from the time of initial retention
 - Calculations should include at a minimum:
 - > Total volume capacity of stormwater features
 - > Designed infiltration rates, evapotranspiration rates, and vegetative cover, if any, for stormwater features
 - > Total volume capacity of rainwater harvesting systems (e.g., cisterns), if applicable
- Narrative describing:
 - The analysis conducted to demonstrate that the maximum precipitation volume selected, beyond the 60th percentile precipitation event, has been retained on site based on site and water use factors per the requirement
 - Measures implemented on site to manage precipitation volume

Required for Treatment

This documentation pertains only to the amount of the percentile precipitation volume selected that is NOT retained, infiltrated, evapotranspired, or harvested and used, if any.

- Calculations documenting the precipitation volume treated beyond the 60th percentile precipitation event
- Narrative describing:
 - Measures implemented on site to manage and treat stormwater runoff volume. Included are any innovative technologies and their performance measures, which should demonstrate adequate pollutant removal for an average discharge concentration of less than or equal to 25 milligrams per liter total suspended solids for the volume treated.
 - Selection of exterior materials to avoid the generation of pollutants and specific pollutants of concern to runoff
- List of specific pollutants of concern

DOCUMENTATION GUIDANCE

See Documentation guidance in *Water P3.1: Manage precipitation on site*.

RECOMMENDED STRATEGIES

See Recommended strategies in *Water P3.1: Manage precipitation on site*.

C3.3



Section 3: Site Design—Water

DEFINITIONS

- **Discharge rate limit** is met if one of the following is accomplished:
 - The discharge of the design storm occurring over a period of not less than 36-48 hours
 - The discharge flow duration curve matches the greenfield flow duration curve for channel forming discharges
 - For infill and redevelopment projects, the project's discharge flow duration curve must match the pre-project flow duration curve for channel forming discharges (as opposed to matching the greenfield flow duration curve).
- **Receiving waters** include groundwater, creeks, streams, rivers, lakes, or other water bodies that receive treated or untreated wastewater or stormwater. They also include water from combined sewer systems (CSOs) and storm drains.
- A **specific pollutant of concern** is a pollutant listed in the U.S. Clean Water Act Cause of Impairment for 303(d) Listed Waters. See iaspub.epa.gov/waters10/attains_nation_cy.control?p_report_type=T-causes_303d.
- A **stormwater feature** uses precipitation as its sole source and function as an element to manage stormwater. Examples include pools, fountains, stormwater BMPs, water gardens, channels for local conveyance, raingardens, and water art.

RESOURCES

- Components of this credit were adapted from the U.S. Green Building Council's LEED credit: LEED BD+C v4 SS Credit 4: *Rainwater management*
- For access to *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act*, see www.epa.gov/oaintrnt/documents/epa_swm_guidance.pdf.
- For more information on the Natural Resources Conservation Service National Engineering Handbook on Hydrology, see U.S. www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/?cid=stelprdb1043063.
- For information on best management practices performance (including those that have achieved an average discharge concentration of less than or equal to 25 milligrams per liter, and those that provide treatment for applicable pollutants of concern), see:
 - International Stormwater BMP Database resources, www.bmpdatabase.org/BMPPerformance.htm
 - U.S. EPA's National Menu of Stormwater Best Management Practices, cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm
 - Michigan Water Quality Standards, www.michigan.gov/documents/deq/wb-npdes-TotalSuspendedSolids_247238_7.pdf
- For BMP design guidance, follow local requirements or, where none exist, use a recognized manual such as the following:
 - *California Stormwater Best Management Practices Handbooks*, www.cabmp.handbooks.org
 - *Maryland Department of the Environment Stormwater Design Manual*, www.mde.state.md.us/programs/Water/StormwaterManagementProgram/MarylandStormwaterDesignManual/Pages/programs/waterprograms/sedimentandstormwater/stormwater_design/index.aspx
 - *North Carolina Division of Water Quality Stormwater BMP Manual*, portal.ncdenr.org/web/wq/ws/su/bmp-manual
 - Texas Commission on Environmental Quality's "Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices," www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/rg/rg-348/index.html
 - *Washington State Department of Ecology Stormwater Management Manual*, www.ecy.wa.gov/PROGRAMS/wq/stormwater/manual.html

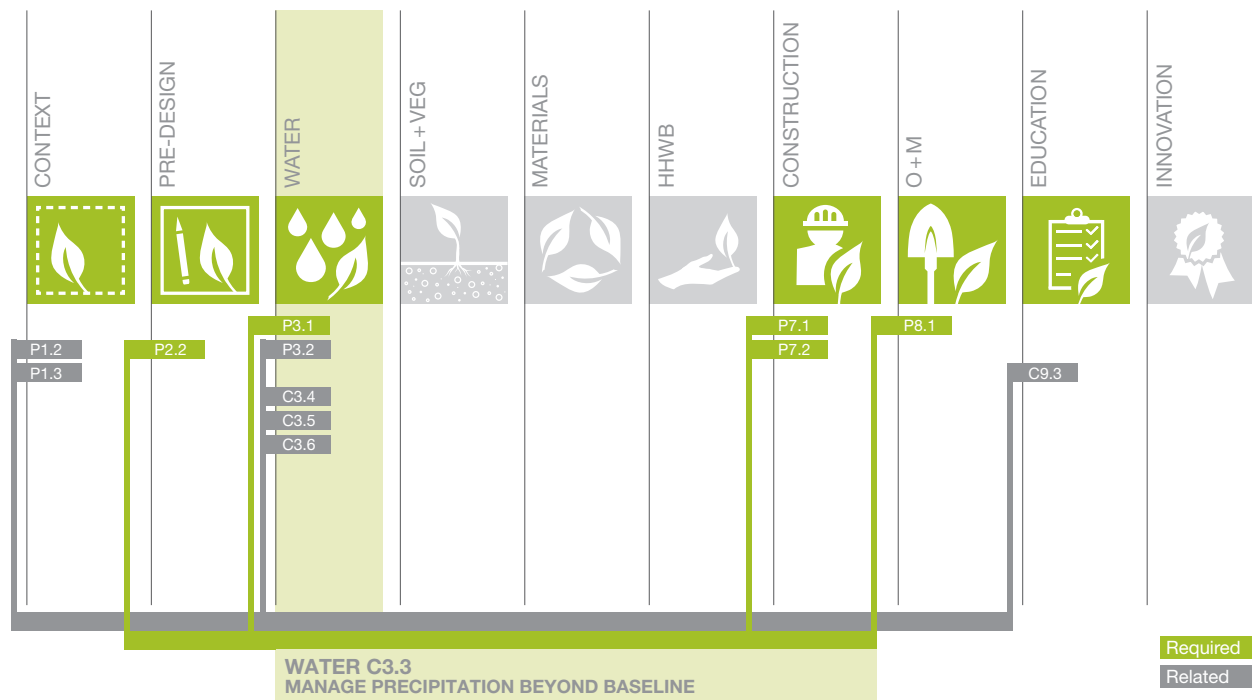
C3.3



Section 3: Site Design—Water

- City of Santa Barbara Storm Water BMP Guidance Manual, www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf
- M Clar, E Laramore, H Ryan, *Rethinking Bioretention Design Concepts*, www3.villanova.edu/vusp/Outreach/pasym07/papers/C_IV_3.pdf
- For more information about stormwater treatment and control, read EW Strecker, WC Huber, JP Heaney, et al., *Critical Assessment of Stormwater Treatment and Control Selection Issues*, Report No. 02-SW-1, Water Environment Research Foundation (2005).
- For more information about controlling nonpoint source pollution, consult the U.S. EPA's National Management Measures to Control Nonpoint Source Pollution from Urban Areas, www.epa.gov/nps/urbanmm.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C3.3



Credit 3.4: Reduce outdoor water use

4–6 points

INTENT

Conserve water resources and minimize energy use by encouraging alternative irrigation methods and water conservation strategies that limit or eliminate the use of potable water, natural surface water, and groundwater withdrawals for landscape irrigation and other outdoor use.

REQUIREMENTS

This credit applies to short- and long-term water use.

Reduce or eliminate the use of potable water, natural surface water (e.g., lakes, rivers streams), and groundwater withdrawals for outdoor use, including landscape irrigation and created water features. Ensure that water use will not negatively affect receiving waters.

Exemptions: Water volume used for the following purposes may be included or excluded from calculations at the project team's discretion:

- Water used during establishment period (excluding Option 3)
- Water used to irrigate non-commercial food production gardens. Irrigation used on edible plants should not harm human health. (See *HHWB C6.7: Provide for on-site food production.*)
- Water used as required by local regulations in fire-prone areas for fire-suppression systems

Option 1: Reduce outdoor water use

4 points

For landscape irrigation:

- Reduce water use by at least 75 percent from a baseline case beyond the establishment period. Refer to the U.S. EPA WaterSense Water Budget Tool (or local equivalent for projects outside the United States) used in *Water P3.2: Reduce water use for landscape irrigation* (www.epa.gov/watersense/water_budget/application.html).
- Install water meters to record and measure water usage to compare to the established baseline.

For created water features:

- Verify that 50 percent of annual make-up water for site water features comes from non-potable water sources OR that site water features only require a total of 10,000 gallons (37,854.12 liters) or less of potable water annually. Note that initial filling may be derived from potable water if less than 37,500 gallons (141,952.94 liters).
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete. Regarding the water features, the plan must describe appropriate maintenance activities that do not use chemicals likely to harm aquatic life, such as chlorine and bromine (except where required by local health code), and that ensure habitat for mosquitoes will not be created.

C3.4



Section 3: Site Design—Water

Option 2: Significantly reduce outdoor water use

5 points

For landscape irrigation:

- Use no potable water or other natural surface or groundwater withdrawal resources for landscape irrigation beyond the establishment period. Refer to the U.S. EPA WaterSense Water Budget Tool (or local equivalent for projects outside the United States) used in *Water P3.2: Reduce water use for landscape irrigation* (www.epa.gov/watersense/water_budget/application.html).
- Install water meters to record and measure water usage to compare to the established baseline.
- Use temporary irrigation systems that rely on potable water during the establishment period only if such systems will be removed or disconnected at the end of the period.
- Use the following water for landscape irrigation only after the establishment period:
 - Captured rainwater
 - Reclaimed water
 - Recycled wastewater
 - Recycled graywater
 - Air-conditioner condensate
 - Blowdown water from boilers and cooling towers
 - Water treated and conveyed by a public agency specifically for non-potable uses

For created water features:

- Site water features must total 5,000 gallons (18,927 liters) or less of potable water annually.
OR
- 75 percent of annual make-up water for water features must come from non-potable water sources.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete. Regarding the water features, the plan must describe appropriate maintenance activities that do not use chemicals likely to harm aquatic life, such as chlorine and bromine (except where required by local health code), and that ensure habitat for mosquitoes will not be created.

Option 3: Eliminate outdoor water use

6 points

For landscape irrigation:

- Eliminate long-term irrigation
- Use the following water for landscape irrigation only during the establishment period:
 - Captured rainwater
 - Reclaimed water
 - Recycled wastewater
 - Recycled graywater
 - Air-conditioner condensate
 - Blowdown water from boilers and cooling towers
 - Water treated and conveyed by a public agency specifically for non-potable uses

For created water features:

- 100 percent of annual make-up water for water features must come from non-potable water sources.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete. Regarding the water features, the plan must describe appropriate maintenance activities that do not use chemicals likely to harm aquatic life, such as chlorine and bromine (except where required by local health code), and that ensure habitat for mosquitoes will not be created.

C3.4



Section 3: Site Design—Water

SUBMITTAL DOCUMENTATION

For all options:

- Planting plan, including planting schedule, showing plant types (e.g., ground cover, shrubs, trees, or turfgrass), associated square footages, and landscape coefficients (K_L)
- Irrigation plan clearly indicating water sources in the drawings
 - For projects using non-potable water, include specific information regarding source and available quantity of non-potable supplies, as well as documentation proving the project meets local health standards, if applicable.
- Water budget calculations made for Baseline, Landscape Water Allowance (LWA), Landscape Water Requirement (LWR), and results, according to the U.S. EPA Water-Sense Water Budget Tool (or local equivalent for projects outside the United States)
- Average monthly evapotranspiration and average monthly rainfall for the site's peak watering month, including the sources of information for a historic period of at least 10 years. See the Resources section to help determine the site's local peak month reference evapotranspiration rate.
- Narrative describing:
 - The landscaping and irrigation design strategies employed by the project, including during the establishment period
 - The reasoning to support the use of the selected landscape coefficient values (K_L) for the plant types on site, including references
 - The size, brand, and model number of the water meter installed, and how the data will be used to manage the irrigation system
- For projects using temporary irrigation systems, describe the type of irrigation system used and the process for decommissioning the system at the end of the specified establishment period.

For sites with created water features:

- Site plan showing the locations of all created water features on site
- Calculations demonstrating that on-site water features can meet their water requirements with non-potable water source supplies
- Documentation proving the project meets local health standards for the use of non-potable water if applicable
 - Where local health codes require the use of treatment using chemicals such as chlorine or bromine, provide the section of the local health code stating such requirements

RECOMMENDED STRATEGIES

See strategies listed in *Water P3.2: Reduce water use for landscape irrigation*.

DEFINITIONS

- **Baseline** is the amount of water required by a site if watered at 100 percent of local reference evapotranspiration (ET).
- A **created water feature** is a human-made object or feature that uses water for aesthetic purposes. Features include constructed wetlands (ornamental or water cleansing), ponds, streams, pools, fountains, and water gardens. Created water features can include those intended for limited human contact or for full human contact. Note that water intended for human contact must meet local and state health requirements.
- An **establishment period** begins at the time that vegetation is planted and is considered to be a maximum of three years for trees, two years for shrubs, and one year for herbaceous cover. Establishment period must be appropriate for plant species and site's climate and soil.
- **Graywater** is domestic wash water from kitchen, bathroom, and laundry sinks, tubs, and washers, conventionally thought of as wastewater.

C3.4



Section 3: Site Design—Water

- **Landscape coefficient (K_L)** is a constant used to modify the reference evapotranspiration. It takes into account the species factor, density factor, and microclimate factor. To reduce the complexity of the calculations for the purposes of the irrigation calculator, the density factor and microclimate factor are both assumed to equal approximately one. In general, a high landscape coefficient value is used for plants that need considerable amounts of water, and a low value is used for plants that need little water.
- **Landscape Water Allowance (LWA)** is the volume of water allocated to the entire landscape area over a specified period of time.
- **Landscape Water Requirement (LWR)** is the amount of water required by the landscape over a specified period of time.
- A **non-potable water source** can be harvested rainwater, surplus water from building or site operations that has been appropriately cleansed and cooled, or surplus site water that is not needed to maintain existing or restored site ecology. It does not include natural surface or subsurface water resources.
- **Peak watering month** is the period with the greatest deficit between evapotranspiration and rainfall. This is the month when the plants in the site's region potentially require the most supplemental water.
- **Potable water** is water that meets the standards for drinking purposes of the state or local authority having jurisdiction, or water that meets the standards prescribed by the U.S. Environmental Protection Agency's National Primary Water Regulations (40 CFR 141).
- **Receiving waters** include groundwater, creeks, streams, rivers, lakes, or other water bodies that receive treated or untreated wastewater or stormwater. They also include water from combined sewer systems (CSOs) and storm drains.
- **Reclaimed water** is effluent derived from sewage from a wastewater-treatment system that has been adequately and reliably treated. As a result of that treatment, it is no longer considered wastewater and is suitable for a beneficial use or a controlled use that would not otherwise occur.
- A **water budget** is used to calculate the amount of water a landscape needs, taking into account the inputs and outputs of water to and from the root zone. Inputs, such as precipitation, are subtracted from outputs, such as evapotranspiration, to calculate the water needs of the landscape. Many factors are taken into consideration when calculating a water budget, such as plant type and irrigation system efficiencies. (EPA WaterSense Water Budget Approach)
- A **water meter** is an instrument or device for measuring and registering the quantity of water flowing through a pipe.

RESOURCES

- Components of this credit were adapted from the U.S. Green Building Council's LEED credit: LEED BD+C v4 *WE Credit 1: Outdoor water use reduction*
- For an online calculator to determine your landscape water demands, consult the U.S. EPA WaterSense Water Budget Tool, www.epa.gov/watersense/water_budget/application.html.
- For evapotranspiration and rainfall data specific to a region in the United States, see:
 - U.S. EPA WaterSense Water Budget Data Finder, www.epa.gov/watersense/new_homes/wb_data_finder.html
 - The International Water Management Institute (IWMI) World Water and Climate Atlas, www.iwmi.cgiar.org/WAtlas/Default.aspx
- For more information on the U.S. EPA WaterSense Water Budget Approach, consult www.epa.gov/watersense/docs/home_final_waterbudget508.pdf.
- For information on calculating rainfall based upon climate and irrigation efficiencies: <ftp://ftp.wcc.nrcs.usda.gov/wntsc/waterMgt/irrigation/NEH15/ch2.pdf>
- For more information on efficient irrigation products, refer to the Irrigation Association, www.irrigation.org

C3.4



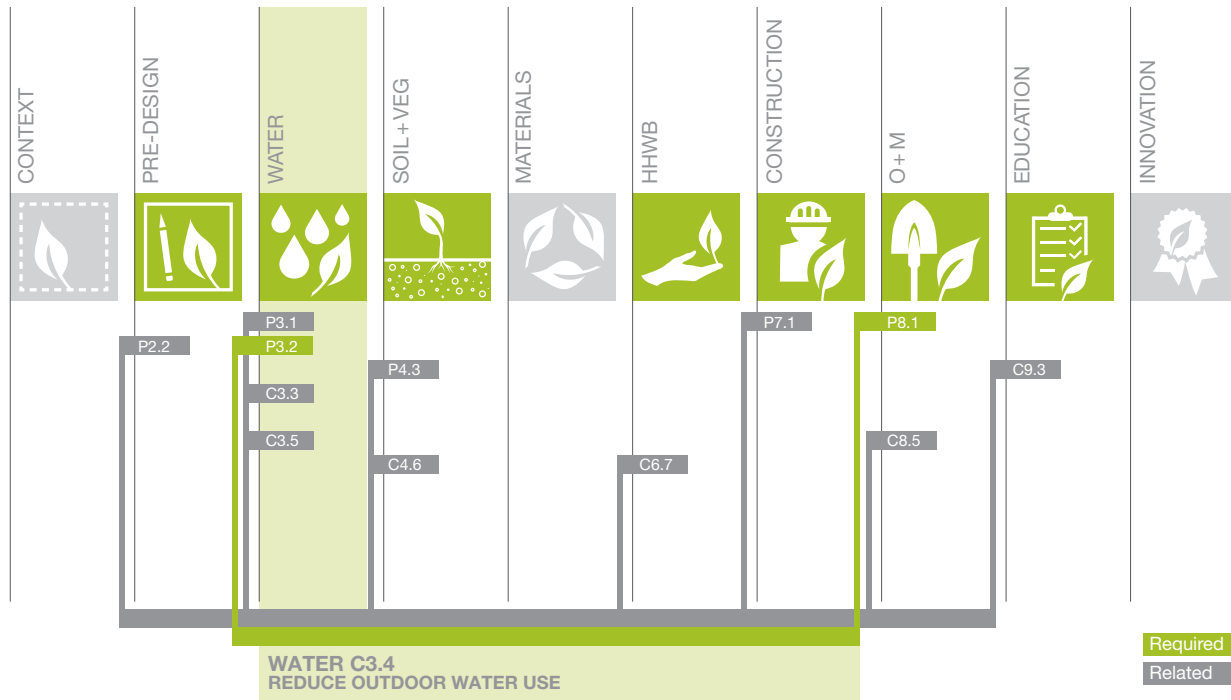
Section 3: Site Design—Water

- For information on evapotranspiration, read The ASCE Standardized Reference Evapotranspiration Equation provided by the Irrigation Association at www.kimberly.uidaho.edu/water/asceewri/main.pdf.
- For more information on water-efficient landscaping, see resources such as the U.S. EPA “Water-Efficient Landscaping: Preventing Pollution and Using Resources Wisely,” www.epa.gov/npdes/pubs/waterefficiency.pdf.
- For more information on collecting and reusing rainwater and graywater, see the American Rainwater Catchment Systems Association at www.arcsa.org.
- For information on irrigation scheduling, see the University of California-Davis Biometeorology Program at biomet.ucdavis.edu/irrigation-scheduling.html.
- For more information on landscapes that are sensitive to water management, see RL France, ed., *Handbook of Water Sensitive Planning and Design* (2002).
- For more information on adding amenity value to stormwater management techniques, see the article by S Echols and E Pennypacker, “From Stormwater Management to Artful Rainwater Design,” *Landscape Journal* 27 (2008): pp. 268–290.
- For more information on integrating water elements into site design, see H Dreiseitl and D Grau, eds., *New Waterscapes: Planning, Building, and Designing with Water* (Basel: Birkhäuser, 2005).

C3.4



LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 3.5: Design functional stormwater features as amenities

4–5 points

INTENT

Provide a connection to the local climate and hydrology by integrating aesthetically pleasing stormwater features that are visually and physically accessible and manage on-site stormwater.

REQUIREMENTS

The requirements apply to stormwater features that use precipitation as their sole source of water and that function as stormwater management elements (e.g., bioswales, raingardens, vegetated roofs). These features must be designed to be visually and physically accessible to site users from proposed high-use portions of the site.

- Ensure site precipitation is treated as an amenity in the way it is received, conveyed, and managed on site for at least:
 - 50 percent of stormwater features **4 points**
 - 100 percent of stormwater features **5 points**
 - > Percentages are based on total square footage (square meters) of the stormwater features, including conveyance features.
 - > Cisterns and vaults that are used for retention purposes and considered amenities should be included in the percentage calculations. However, exclude those used only for rainwater collection and reuse.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete. The plan must describe appropriate maintenance activities that do not use chemicals likely to harm aquatic life, such as chlorine and bromine (except where required by local health code), and that ensure habitat for mosquitoes will not be created.

SUBMITTAL DOCUMENTATION

- Site plan indicating the location of stormwater features that are considered amenities and the proximity and relationship of the features to proposed high-use portions of the site
- Calculations of the total square footage (square meters) of the stormwater features, including conveyance features
- Narrative describing:
 - How site precipitation is treated as an amenity in the way it is received, conveyed, and managed on the site
 - How the stormwater feature is made visually and physically accessible to site users and its relationship to proposed high-use portions of the site
 - > Include documentation demonstrating that the features are in compliance with local and state health standards.
 - How the stormwater feature is integrated into the site in an aesthetically pleasing way
- Photographs illustrating the described amenity

C3.5



Section 3: Site Design—Water

RECOMMENDED STRATEGIES

- Design and maintain water features as natural ecosystems with water sources, native plants and native plant communities, and other aquatic organisms appropriate for local conditions.
- Natural swimming pools or other water features intended for human contact may require additional treatment such as ozonation or thermal treatment.
- Employ artists and craftspeople to collaborate with the design team to create rainwater systems that combine function and aesthetic appeal.
- Employ low impact development strategies that emphasize site design and planning techniques to mimic the natural infiltration-based, groundwater-driven hydrology of historic landscapes.

ECONOMIC AND SOCIAL BENEFITS

Water in a landscape can provide opportunities for restorative experiences and reflection. Such activities may promote healing, stress reduction, and work productivity.¹ While other credits address the importance of restoring and maintaining natural hydrology and water quality on site, this credit deals specifically with the benefits of people having a stronger physical and mental connection to water and local climate.

1. DA Bowers, "Incorporating Restorative Experiential Qualities and Key Landscape Attributes to Enhance the Restorative Experience in Healing Gardens within Health Care Settings," www.healinglandscapes.org/resources/pdfs/bowers-thesis1.pdf (accessed March 22, 2013).

DEFINITIONS

- A **bioswale** is a linear stormwater runoff conveyance system that is used as an alternative to storm sewers to partially treat water quality, attenuate flooding potential, and convey stormwater away from critical infrastructure.
- A **conveyance feature** is a network of gutters and pipes designed to move water from a surface to a storage container.
- A **native plant** is vegetation native to the EPA Level III ecoregion of the site or known to naturally occur within 200 miles (321.87 kilometers) of the site. Naturally occurring hybrids, varieties, and cultivars of species native to the ecoregion are acceptable.
- A **native plant community** is an assemblage of plant species whose composition and structure are typical of native plant communities mapped at the EPA Level III ecoregion or are known to naturally occur within 200 miles (321.87 kilometers) of the site. Native plant communities include but are not limited to wetlands, woodlands, grasslands, riparian buffers, and habitat for wildlife species of concern within the region. A reference from a local plant list, local reference site, or published plant community description is needed to determine the dominant plant species, relative species abundances, and other characteristic elements of the plant community/communities to be preserved or restored.
- A **raingarden** is a depression formed on a natural slope and planted with deep-rooted native plants and grasses designed to hold and absorb rainwater from nearby impervious services such as roofs, drives, walkways, parking lots, or compacted lawn areas.
- A **stormwater feature** uses precipitation as its sole source and function as an element to manage stormwater. Examples include pools, fountains, stormwater BMPs, water gardens, channels for local conveyance, raingardens, and water art.

C3.5



Credit 3.6: Restore aquatic ecosystems

4–6 points

INTENT

Support healthy functioning of aquatic ecosystems for fish, other wildlife, and people by restoring the ecological function, integrity, and resiliency of those ecosystems that have been degraded, damaged, or destroyed.

REQUIREMENTS

The requirements apply to sites that contain only the following naturally occurring aquatic ecosystems that have been degraded, damaged, or destroyed:

- Marine/Estuarine—Tidal wetlands, mudflats, shorelines, reefs, seagrass beds
- Riverine—Streams, rivers (associated floodplains and their riparian buffer)
- Lacustrine—Lakes, ponds (associated shorelines and their riparian buffer)
- Palustrine—Non-tidal wetlands, seeps, springs, vernal pools, seasonal wetlands

Degradation, damage, or destruction may be a result of artificial modification (e.g., burying, filling, draining, piping, channeling, bulkheading, armoring, levees, water control structures, illicit discharges); sea level rise; alteration of natural hydrology; loss of native flora and fauna; invasive species; and alteration of biological processes, soils, geomorphology, and water quality.

- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and shows the locations of any existing aquatic ecosystems on site that have been degraded, damaged, or destroyed.
- Restore the geographic extent of the aquatic ecosystem within the SITES project boundary for a minimum of:
 - 30 percent of the geographic extent **4 points**
 - 60 percent of the geographic extent **5 points**
 - 90 percent of the geographic extent **6 points**
- Develop a restoration plan based on the nine *Attributes of Restored Ecosystems*.
 - Restoration plan must include a description of the reference site and its conditions, including its native plant communities, appropriate aquatic habitat, water quality improvements, and stable bank or shoreline conditions.
 - Restoration of river and stream channels must also be inclusive of their respective floodplain and riparian zone. Restoration of lakes and ponds must also be inclusive of their respective shorelines.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and includes ongoing management activities to protect the integrity of the aquatic ecosystems.

Attributes of Restored Ecosystems (From the Society for Ecological Restoration's *International Primer on Ecological Restoration*)

1. The restored ecosystem contains a characteristic assemblage of the species that occur in the reference ecosystem and that provide appropriate community structure.
2. The restored ecosystem consists of indigenous species to the greatest practicable extent.
3. All functional groups necessary for the continued development and/or stability of the restored ecosystem are represented or, if they are not, the missing groups have the potential to colonize by natural means.

C3.6



Section 3: Site Design—Water

4. The physical environment of the restored ecosystem is capable of sustaining reproducing populations of the species necessary for its continued stability or development along the desired trajectory.
5. The restored ecosystem apparently functions normally for its ecological stage of development, and signs of dysfunction are absent.
6. The restored ecosystem is suitably integrated into a larger ecological matrix or landscape, with which it interacts through abiotic and biotic flows and exchanges.
7. Potential threats to the health and integrity of the restored ecosystem from the surrounding landscape have been eliminated or reduced as much as possible.
8. The restored ecosystem is sufficiently resilient to endure the normal periodic stress events in the local environment that serve to maintain the integrity of the ecosystem.
9. The restored ecosystem is self-sustaining to the same degree as its reference system and has the potential to persist indefinitely under existing environmental conditions.

Note: Projects restoring aquatic ecosystems as compensatory mitigation to meet regulatory requirements may not be eligible for this credit. This credit does not apply to stormwater management practices. This credit also does not apply to the creation of a new aquatic ecosystem when none existed prior to current project development, except when it can be justified to shift the geographic extent of the aquatic ecosystem to compensate for projected sea level rise or changing hydrologic conditions.

C3.6



SUBMITTAL DOCUMENTATION

- Site plan and ecological assessment identifying and describing the geographic extent of the existing degraded, damaged, or destroyed aquatic ecosystems and proposed areas of restoration
 - Include calculations and dimensions of the existing and proposed geographic extent of the aquatic ecosystems to prove restoration has been achieved. Reference site conditions may need to be used to determine existing calculations.
- Restoration plan that includes the following documentation:
 - Description of the reference site conditions to show the restored aquatic ecosystem has the same native plant communities, appropriate aquatic habitat, water quality improvements, and stable bank or shoreline conditions.
 - Narrative describing how the project meets the goals and objectives of the latest edition of the Society of Ecological Restoration's *Attributes of Restored Ecosystems*
 - Narrative describing the restoration strategies implemented for each aquatic ecosystem to be restored
- Signature from a restoration ecologist or recognized expert verifying the restoration plan has been designed to achieve the above listed required goals and objectives

RECOMMENDED STRATEGIES

- Restoration prescriptions and strategies will vary, but base them on historic reference conditions, natural processes, natural materials, and the reestablishment of native vegetation communities.
- Develop a set of restoration and management practices that permanently will remove from the site stressors that are causing degradation or damage.
- Reconstruct and reintroduce to the site the array of biotic, geochemical, hydrological, morphological, and vegetative processes that will result in the aquatic ecosystems being placed on a trajectory toward partial or full recovery.
- Specific restoration methodologies and techniques should be in accordance with the current science and practice of restoration as applicable for the specific aquatic ecosystem being restored and within the context of its location.

Section 3: Site Design—Water

ECONOMIC AND SOCIAL BENEFITS

Several human influences and natural factors can negatively impact aquatic ecosystems. Human effects on aquatic ecosystems often result from pollution, changes to the landscape or hydrological systems, and larger-scale impacts such as global climate change.¹ Additionally, affecting one component of the ecosystem can lead to impacts on other ecosystem components.

However, improved water quality, as a result of restoring riparian buffers, can increase property values of waterside properties by up to 15 percent², provide increased recreational opportunities, such as fishing and swimming, and improve fisheries. Additionally, rehabilitating streams, wetlands, and coastal habitats can improve water quality, provide educational and recreational opportunities, and revitalize neighborhoods.

1. Regional Aquatics Monitoring Program, "Factors Affecting Aquatic Ecosystems," www.ramp-alberta.org/river/ecology/factors.aspx (accessed July 14, 2013).
2. J Braden and D Johnston, "Downstream Economic Benefits from Storm-Water Management," *Journal of Water Resources Planning and Management* 130, no. 6 (1994): pp. 498–505.

C3.6



DEFINITIONS

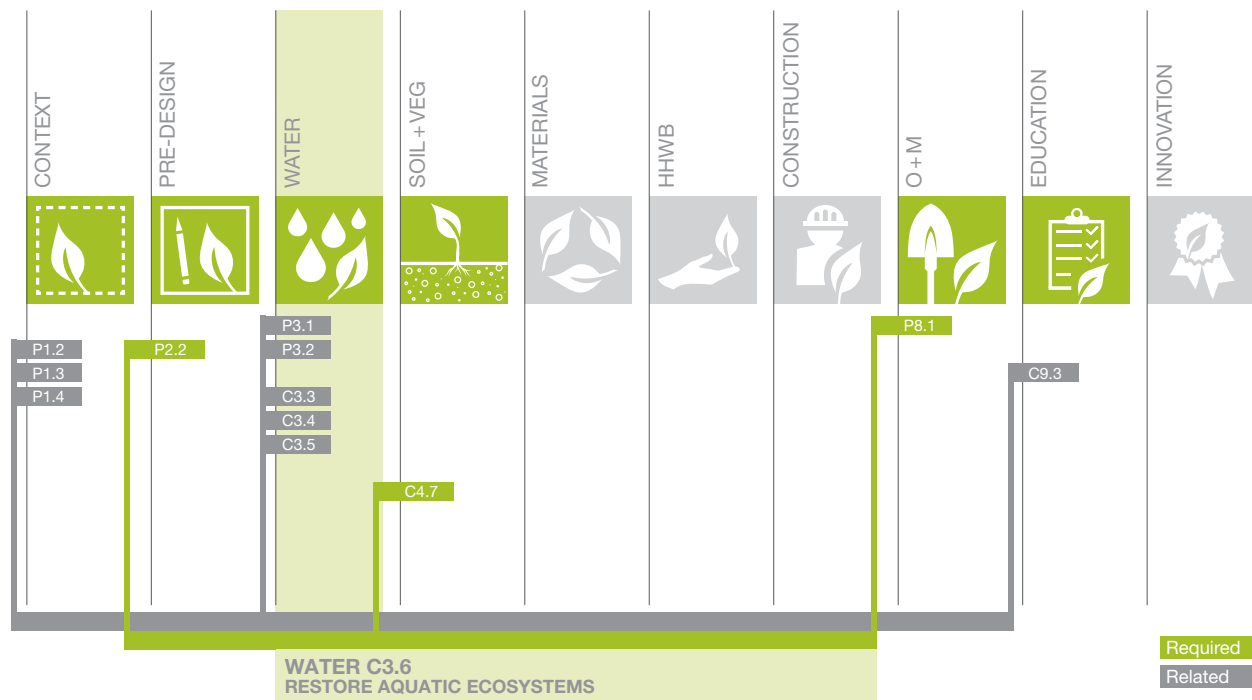
- A **floodplain** is flat or nearly flat land adjacent to a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and that experiences flooding during periods of high discharge. Floodplains are subject to geomorphic (land-shaping) and hydrologic (water flow) processes.
- **Geographic extent** refers to the measure of spatial extent bounded by a polygon with X and Y coordinates. It is described as the range, magnitude, or distance over which an aquatic ecosystem extends (i.e., the full area measurement from north to south and east to west).
- An **invasive species** is a plant or animal that is not native to the ecosystem under consideration and that causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health.
- A **native plant community** is an assemblage of plant species whose composition and structure are typical of native plant communities mapped at the EPA Level III ecoregion or are known to naturally occur within 200 miles (321.87 kilometers) of the site. Native plant communities include but are not limited to wetlands, woodlands, grasslands, riparian buffers, and habitat for wildlife species of concern within the region. A reference from a local plant list, local reference site, or published plant community description is needed to determine the dominant plant species, relative species abundances, and other characteristic elements of the plant community/communities to be preserved or restored.
- A **riparian buffer** is the portion of the adjacent terrestrial ecosystem that directly affects or is affected by the aquatic environment (including streams, rivers, lakes, tidewaters, and bays and their adjacent side channels, floodplain, and wetlands). In specific cases, the riparian buffer may also include a portion of the hillslope that directly serves as streamside habitats for wildlife. A riparian buffer provides shade, intercepts runoff, and helps prevent erosion.
- **Wetlands** are areas that are inundated or saturated by surface or ground water (e.g., swamps, marshes, bogs) at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated conditions (Clean Water Act, U.S. Code of Federal Regulations 40 CFR 230.3).

Section 3: Site Design—Water

RESOURCES

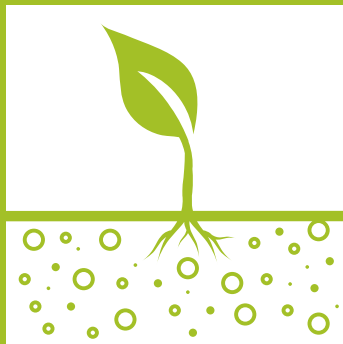
- For more information on restoration projects, consult the following sources:
 - Society for Ecological Restoration International Science & Policy Working Group *The SER International Primer on Ecological Restoration* (Version 2, October 2004) copyright 2004, www.ser.org/resources/resources-detail-view/ser-international-primer-on-ecological-restoration
 - Society for Ecological Restoration International: Guidelines for Developing and Managing Ecological Restoration Projects (2nd Edition, December 2005) copyright 2005, www.ser.org/resources/resources-detail-view/guidelines-for-developing-and-managing-ecological-restoration-projects
- For information on the restoration of incised rivers, see www.wildlandhydrology.com/assets/a_geomorphological_approach_to_restoration_of_incised_rivers.pdf.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C3.6





SECTION 4

SITE DESIGN – SOIL + VEGETATION

PREREQUISITE / CREDIT	TITLE	POINTS
Soil+Veg P4.1	Create and communicate a soil management plan	Required
Soil+Veg P4.2	Control and manage invasive plants	Required
Soil+Veg P4.3	Use appropriate plants	Required
Soil+Veg C4.4	Conserve healthy soils and appropriate vegetation	4-6 points
Soil+Veg C4.5	Conserve special status vegetation	4 points
Soil+Veg C4.6	Conserve and use native plants	3-6 points
Soil+Veg C4.7	Conserve and restore native plant communities	4-6 points
Soil+Veg C4.8	Optimize biomass	1-6 points
Soil+Veg C4.9	Reduce urban heat island effects	4 points
Soil+Veg C4.10	Use vegetation to minimize building energy use	1-4 points
Soil+Veg C4.11	Reduce the risk of catastrophic wildfire	4 points

Prerequisite 4.1: Create and communicate a soil management plan

Required

INTENT

Support healthy plants, biological communities, and water storage and infiltration by planning for soil restoration in the design stage and limiting soil disturbance during construction.

REQUIREMENTS

- Create a soil management plan (SMP) prior to construction that provides the following information in a site plan and a worksheet (see *Soil Management Plan Worksheet*):
 - Indicate locations of existing healthy soils on site and any Vegetation and Soil Protection Zones (VSPZs) (See *Pre-Design P2.3: Designate and communicate VSPZs*) and steps taken to protect these from any disturbance during construction.
 - Specify how construction activities are designed to minimize soil disturbance.
 - Identify disturbed soils that will be re-vegetated (soil restoration treatment zones):
 - > For soils disturbed during current construction activity (as required in *Construction P7.3: Restore soils disturbed during construction*)
 - > For soils disturbed by previous development (if pursuing *Construction C7.4: Restore soils disturbed by previous development*)
 - Identify severely disturbed soils that will be re-vegetated.
 - Describe in detail the planned treatment for each soil restoration treatment zone, including, if applicable, how reference soil characteristics (as identified in *Pre-Design P2.2: Conduct a pre-design site assessment*) will be met for each zone.
- Communicate the SMP to site contractors through site drawings and written specifications.

Note: Imported topsoils, or manufactured soil blends designed to serve as topsoil, may not be mined from the following locations (unless these soils are a byproduct of a construction process):

- Greenfield sites
- Prime farmland, unique farmland, farmland of statewide importance, or farmland of local importance as defined by the U.S. Natural Resources Conservation Service (or local equivalent for projects outside the United States)

Areas with disturbed soils (as a result of current construction activities) must be restored to a minimum 12-inch (30.48-centimeter) depth per the requirements of *Construction P7.3: Restore soils disturbed during construction*.

P4.1



Section 4: Site Design—Soil + Vegetation

SUBMITTAL DOCUMENTATION

Soil management plan (SMP), including the following documentation:

- Site plan illustrating the following information (label and provide square footage or square meters for each area or zone listed below):
 - Areas with existing healthy soils that will be designated as VSPZs
 - Areas with disturbed soils that will be re-vegetated
 - > Show areas that will be disturbed during current construction (for *Construction P7.3: Restore soils disturbed during construction*)
 - > Show areas already disturbed from previous development (for *Construction C7.4: Restore soils disturbed by previous development*)
 - Soil restoration treatment zones delineated for each soil restoration treatment (e.g., native plant restoration, planting beds, turf, raingardens)
 - Locations of construction staging areas and all laydown and storage areas, haul roads and construction vehicle access, temporary utilities and construction trailers, and parking (all of which must be included in soil restoration treatment zones, unless these areas will be covered by buildings, pavement, or remain bare of vegetation)
 - Building footprints, gravel, pavement (e.g., trails, roads), and any areas that will not be re-vegetated
- *Soil Management Plan Worksheet* clearly describing the following information:
 - Treatment plan for each soil restoration zone including the type, source, and expected volume of materials (e.g., compost amendments, mulch, topsoil) (See *Construction P7.3: Restore soils disturbed during construction*).
 - Methods in place to protect the VSPZs until project completion, including barrier specifications and dates for installation (beginning of project) and removal (project end)
- Signatures verifying that the SMP has been communicated to construction contractors via site drawings and written specifications

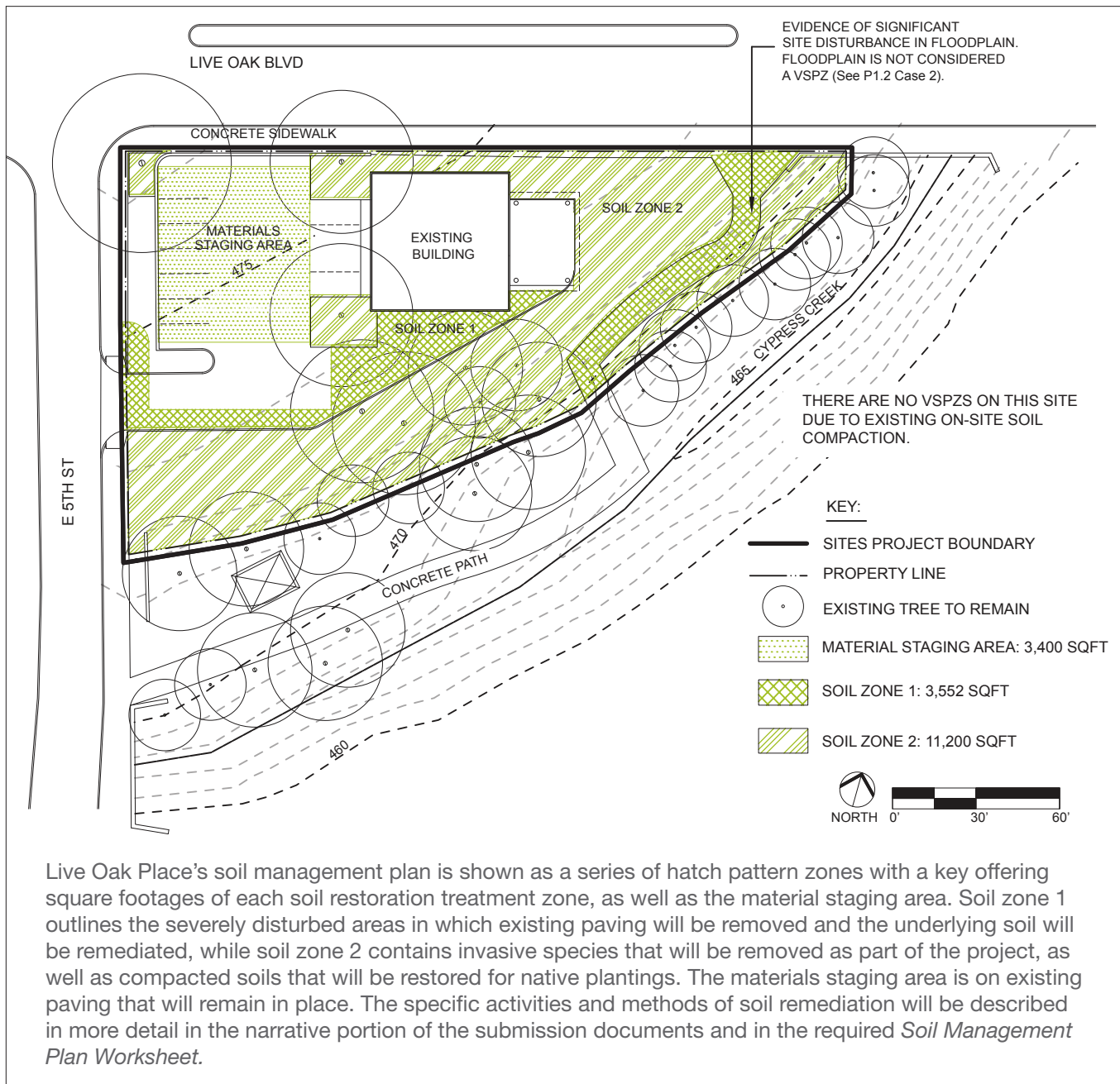
P4.1



Section 4: Site Design—Soil + Vegetation

DOCUMENTATION GUIDANCE

Example: Live Oak Place



P4.1



Section 4: Site Design—Soil + Vegetation

RECOMMENDED STRATEGIES

- Before construction begins, the SMP prescribes soil restoration treatments that will be used to restore all soil areas that will be disturbed during construction and re-vegetated at the end of the project, as required by *Construction P7.3: Restore soils disturbed during construction*.
- Consider existing soil conditions during site design, identify VSPZs and soil restoration treatments for soils that will be disturbed, and communicate clearly with all site contractors to ensure that soil protection and restoration goals are understood and achieved.
- Install fencing or provide other effective physical barriers to protect VSPZs before construction commences (as required by *Pre-Design P2.3: Designate and communicate VSPZs*).
- Integrate the SMP with site erosion and sediment control planning (e.g., stormwater pollution prevention plan (SWPPP) or erosion and sedimentation control (ESC) plan; see *Construction P7.2: Control and retain construction pollutants*). For instance, use compost blankets, berms, or socks for erosion and sediment control, and, at the end of the project, reuse the same compost as a soil restoration amendment.
- Limit disturbance during construction to minimize the need for additional restoration. In areas that will be re-vegetated, restore soil characteristics necessary to support the selected vegetation types. Example methods of restoring soils include the following:
 - Stockpiling and reusing existing site topsoils, incorporating organic amendments if needed
 - Amending site soils with organic matter in place and mechanically correcting compaction, if needed (e.g., by ripping or discing)
 - Importing a topsoil or soil blend designed to serve as topsoil
- When selecting a soil restoration strategy, consider the design, site use, and future site maintenance expectation. Potential strategies are:
 - Adding mature, stable compost to unscreened soil
 - Many un-screened and un-amended soils will drain adequately
 - Amending with other earth materials to modify a soil's gradation/texture and organic matter content
- Best management practices include using soils for functions comparable to their original function (e.g., topsoil is used as topsoil, subsoil as subsoil). In some cases, subsoil can be reused and amended to become functional topsoil.

P4.1



ECONOMIC AND SOCIAL BENEFITS

Healthy soils reduce site maintenance costs by improving plant health and growth and reducing needs for resources such as water and fertilizer. Healthy soils are the foundation of ecosystem services such as water and air purification, carbon sequestration, stormwater management, and wildlife habitat.¹ Clearly defining and communicating soil protection and restoration goals to all site contractors early in the project's development process will help protect these valuable soil functions and minimize restoration costs.

1. Organic Land Care Program, "Ecosystem Services Provided by Soil," www.organiclandcare.org/files/education/organic_landscape_management/Ecosystem%20Services.pdf (accessed March 23, 2013).

Section 4: Site Design—Soil + Vegetation

DEFINITIONS

- **Disturbed soils** are all areas of soils disturbed by human development activities, such as those that have been affected by grading, excavation, or compaction. Indicators of disturbed soils may include one or more of the following:
 - Soil horizons that differ significantly in either depth, texture, or physical or chemical properties from the reference soil
 - Bulk densities that exceed the maximum allowable bulk densities shown in *Construction P7.3: Restore soils during construction* Figure 7.3-A
 - Organic matter content lower than that of the reference soil
 - Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) different from that of the reference soil
 - Presence of compounds toxic to the intended plants
 - Presence of weedy, opportunistic, or invasive plant species
- **Farmland of local importance** refers to soils important to the local economy due to their productivity and which may include tracts of land that have been designated for agriculture by local ordinance. Each state Natural Resources Conservation Service or local ordinance designates which soils qualify.
- **Farmland of statewide importance** refers to soils that do not meet all of the prime farmland criteria but that are still able to economically produce high yields of crops when treated and managed according to acceptable farming methods. Each state Natural Resources Conservation Service designates which soils qualify.
- **Healthy soils** have not been significantly disturbed by previous human development activities. Healthy soils may include one or more of the following indicators:
 - Soil horizons that are similar to the reference soil
 - Bulk densities that do not exceed the maximum allowable bulk densities shown in *P7.3: Restore soils disturbed during construction*
 - Organic matter content similar to that of the reference soil
 - Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) similar to that of the reference soil
 - Absence of compounds toxic to the intended plants
 - Presence of vegetation that is representative of native plant communities
- **Mature, stable compost** is an important amendment for healthy plant growth. Stability refers to the rate of biological breakdown, measured by carbon dioxide release. Maturity refers to completeness of the aerobic composting process and suitability (lack of plant toxicity) as a plant growth media, often measured by ammonia release or by plant growth tests. For information on compost quality standards and test methods, see the Resources section of *Construction P7.3: Restore soils disturbed during construction*.
- **Organic matter** in soil is carbon-containing material composed of both living organisms and formerly living decomposing plant and animal matter. Soil organic matter (SOM) content can be supplemented with compost or other partially decomposed plant and animal material. SOM content is commonly measured using “loss on ignition” tests that measure the amount of the element carbon, a key constituent of all organic matter.
- **Prime farmland** refers to a designation of specific soils by the state or U.S. Natural Resources Conservation Service. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. The land could be cropland, pastureland, rangeland, forestland, or other land, but cannot be urban built-up land or water. Prime farmland has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity,

P4.1



Section 4: Site Design—Soil + Vegetation

acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.

- A **reference soil** falls into at least one of the following categories:
 - Soils native to a site as described in Natural Resources Conservation Service Soil Surveys (refer to soils within the region if the site soils are not mapped or labeled as Urban Land Complex, Urban Fill, etc.)
 - For sites that have no undisturbed native soils, use undisturbed native soils within the site's region that have native vegetation, topography, and soil textures similar to the site.
 - For sites that have no existing soil, use undisturbed native soils within the site's region that support appropriate native plants or appropriate plant species similar to those intended for the new site.
- **Severely disturbed soils** are soils in which topsoil is removed or is not present; subsoils compacted such that compaction levels exceed the maximum allowable bulk densities shown in *Construction P7.3: Restore soils disturbed during construction* Figure 7.3-A; or topsoil or subsoil that has been chemically contaminated or is covered with impervious material. Examples of soils that are severely disturbed include areas that are covered with buildings or paved surfaces and areas that are defined as brownfields by local, state, or federal agencies.
- A **soil restoration treatment zone** is any area of the site that is not protected in a Vegetation and Soil Protection Zone (VSPZ); not covered at project's end by buildings or pavement; and is re-vegetated as part of the project. Soil restoration treatment zones must be shown on the soil management plan (*Soil+Veg P4.1: Create and communicate a soil management plan*) and must be restored as required by *Construction P7.3: Restore soils disturbed during construction*.
- **Unique farmland** refers to land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of a specific crop when treated and managed according to acceptable farming methods. The state or U.S. Natural Resources Conservation Service designates which soils qualify.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.

RESOURCES

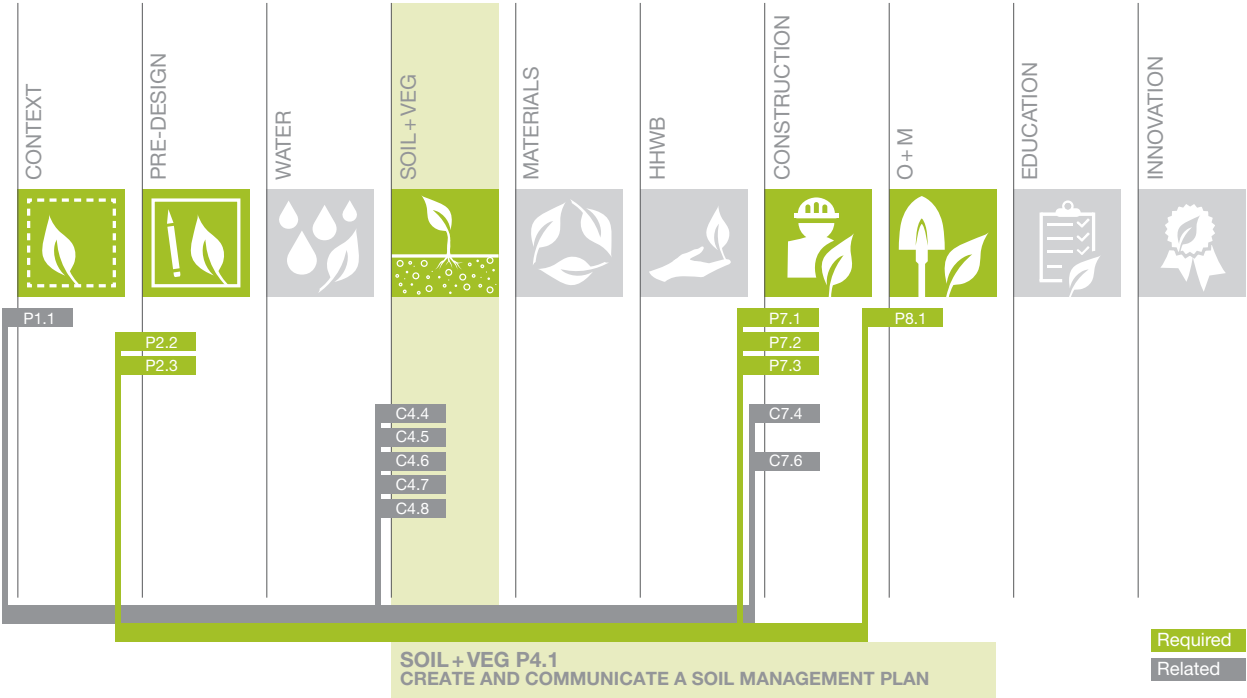
- For more information on developing a soil management plan, including calculating compost quantities needed, consult Soils for Salmon's resources, www.soilsforsalmon.org, including the manual *Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13* www.ecy.wa.gov/programs/wq/stormwater/municipal/MUNIdocs/SoilBMPManual.pdf. These resources, along with links to U.S. EPA-approved compost erosion control BMPs and other construction strategies, are also available at www.buildingsoil.org.
- For an explanation of the Clark and Matheny method of determining the extent of a tree's root system, see *Trees and Development: A Technical Guide to Preservation of Trees During Land Development*, Nelda P. Matheny and J. Clark, International Society of Arboriculture, 1998.
- For more resources on soil mapping, protection, and restoration methods, see *Construction P7.3: Restore soils disturbed during construction*.

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Section 4: Site Design—Soil + Vegetation

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



P4.1



Prerequisite 4.2: Control and manage invasive plants

Required

INTENT

Limit damage to local ecosystem services by developing and implementing an active management plan for the control and subsequent management of known invasive plants found on site, and by ensuring that no invasive species are brought to the site.

REQUIREMENTS

- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and evaluates and documents whether invasive species are present on the project site.
- During the project, use only plant species that are not currently listed as invasive on any federal or qualifying regional lists (or local equivalent for projects outside the United States), as described below (see Resources section for links):
 - State or local lists (when listing occurs through a vetted, transparent process and has been accepted by regional stakeholders)
 - The USDA Natural Resources Conservation Service PLANTS Database
 - Invasive Plant Atlas of the United States website
 - State Noxious Weed laws
 - Federal Noxious Weed laws
- Begin removal of invasive species before or during the construction phase of the project. Note that invasive species present within any Vegetation and Soil Protection Zones (VSPZs) on site must be treated using equipment that can either be carried in and out of the zone on foot or will not detrimentally affect soil compaction.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and includes a plan for active, multi-year invasive species control and management of any plant species currently listed as invasive on the above lists
 - The following components for invasive species management must be included in the site maintenance plan:
 - > Integrated pest management (IPM) or plant health care (PHC) strategies
 - > A procedure for identifying and monitoring for additional invasive species that may colonize the site and new species as they are recognized by local authorities
 - > Initial treatment, follow-up treatments, long-term control including monitoring, and methods of invasive plant material disposal to prevent spread

P4.2



Section 4: Site Design—Soil + Vegetation

SUBMITTAL DOCUMENTATION

Case 1: No invasive plants found on site

- Drawings or an excerpt of the construction specifications that illustrate how contractors will control and manage the threat of invasive plants during construction, including avoiding the introduction of invasives on site
- Completed *Vegetation Worksheet* describing site conditions and all plants being brought to the site, ensuring that no invasive plants are introduced

Case 2: Invasive plants identified on site

- Drawings or an excerpt from the construction specifications that illustrate how contractors will identify, control, and manage invasive plants during construction
- Completed *Vegetation Worksheet* describing site conditions and all plants being brought to the site, ensuring that no invasive plants are introduced
- Narrative describing the techniques used for the removal, control, and management of invasive species before and during construction

RECOMMENDED STRATEGIES

- Contact local and state governmental agencies, consultants, and educational facilities to learn the most appropriate and effective management techniques for invasive species identified on site.
- When removing invasive plants within VSPZs prior to construction, communicate strategies that limit levels of disruptive activity within these protected areas to every extent possible.
- The U.S. National Invasive Species Council's 2008-2012 National Invasive Species Management Plan recommends the following strategies to achieve long-term objectives:
 - Prevention is the first-line of defense. Prevention calls for preventing the introduction and establishment of invasive species to reduce their impact on the environment, the economy and health of the United States.
 - Early Detection, rapid assessment and Rapid Response (EDRR) may act as a critical second defense. EDRR calls for developing and enhancing the capacity to identify, report, and effectively respond to newly discovered and localized invasive species.
 - Through control and management, the spread of widely established invasive species can be slowed and their impacts reduced. Control and management calls for containing and reducing the spread of invasive populations to minimize their harmful impacts.
 - Invasive species can severely undermine the ability of plants and animal communities to recover. Restoration calls for the restoration of high-value ecosystems to meet natural resource conservation goals by conducting restoration efforts on multiple scales.
 - Invasive species cross project boundaries, making coordination and collaboration critical to success. Organizational collaboration calls for maximizing collaboration on invasive species issues among federal, state, local and tribal governments, private organizations, developers of neighboring sites, and individuals.

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Section 4: Site Design—Soil + Vegetation

ECONOMIC AND SOCIAL BENEFITS

Invasive species compete with and harm plant and animal communities. Approximately 5,000 invasive plant species have escaped into endemic ecosystems, resulting in millions of dollars in control costs.¹ For example, purple loosestrife (*Lythrum salicaria*), an invasive herbaceous species introduced as an ornamental plant in the United States, has aggressively spread to 48 states, resulting in control costs of almost \$45 million per year nationwide.² It is very expensive to prevent, monitor, and control the spread of invasives, not to mention the damage to crops, fisheries, forests, and other resources. Invasives cost the US \$137 billion annually. Some of the most harmful species cost in excess of \$100 million annually.³

1. RK Kohli, S Jose, LP Singh, and DR Batish, *Invasive Plants and Forest Ecosystems* (Boca Raton, FL: Taylor & Francis Group, LLC: 2009).
2. D Pimentel, R Zuniga, and D Morrison, "Update on the Environmental and Economic Costs Associated with Alien-Invasive Species in the United States," *Ecological Economics* 52 (2005): pp. 273-288.
3. Native Invasive Species Council, "National Management Plan: Introduction," www.invasivespeciesinfo.gov/council/intro.shtml (accessed March 23, 2013).

DEFINITIONS

- **Control of invasives** is the appropriate eradication, suppression, reduction, or management of invasive species populations, prevention of the spread of invasive species from areas where they are present, and taking of steps such as restoration of native or appropriate species and habitats to reduce the effects of invasive species and to prevent further invasion.
- **Integrated pest management (IPM)** is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. IPM is site-specific in nature, with individual tactics determined by the particular crop/pest/environment scenario. The IPM approach places an emphasis on the reduction of pesticide use and the implementation of preventative and alternative control measures.
- An **invasive species** is a plant or animal that is not native to the ecosystem under consideration and that causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health.
- **Management of invasives** is the implementation of control measures to prevent the spread of invasive species or lessen their impacts when they appear to be permanently established. Control and management of invasive species encompasses diverse objectives such as eradication within an area, population suppression, limiting spread, and reducing effects. Complete eradication is not generally feasible for widespread invasive species or where adequate control methods are not available.
- **Plant health care (PHC)** is a process of scheduled preventative maintenance based on monitoring and use of cultural and chemical tactics to enhance plant vitality. The plant and its requirements become the central focus of activities, rather than responding to symptoms caused by pest presence, physical agents, or nutritional deficiencies. A plant health care practice addresses the basic causes of the reduction in plant health and provides corrective measures to promote plant health.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.

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Section 4: Site Design—Soil + Vegetation

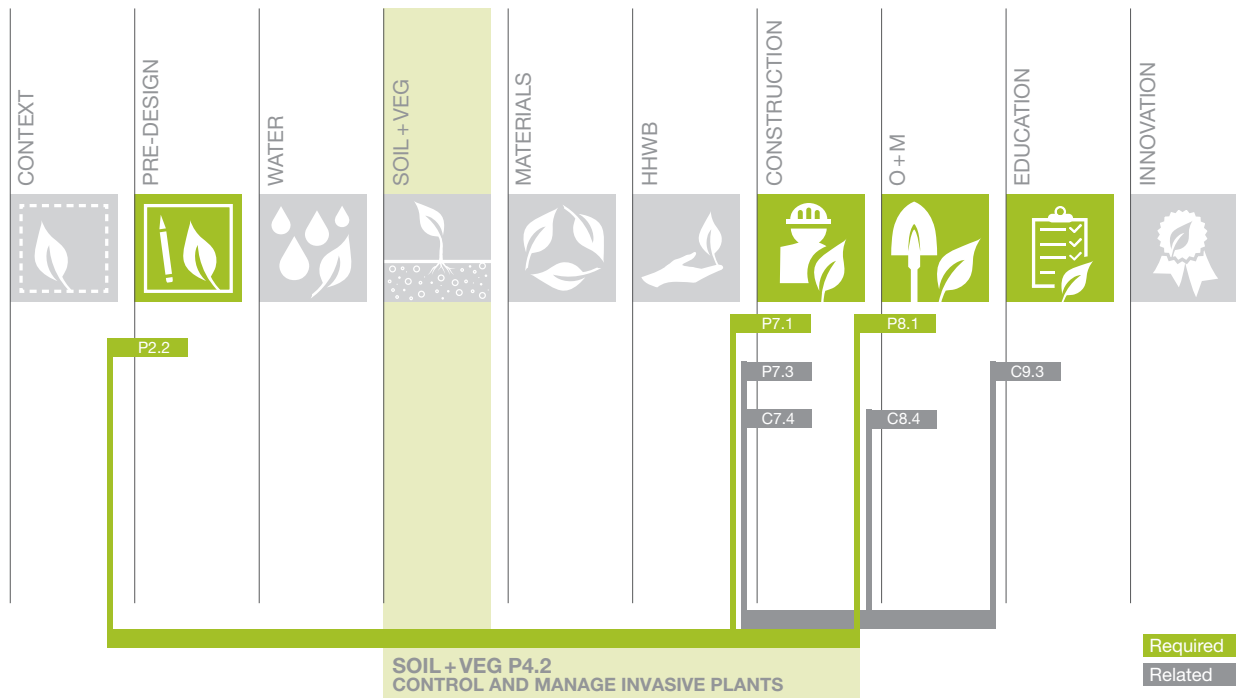
RESOURCES

- For information on invasive species, see regional, local, and national sources such as:
 - U.S. National Invasive Species Information Center, www.invasivespeciesinfo.gov
 - U.S. National Invasive Species Council, www.invasivespecies.gov
 - The Center for Plant Conservation's comprehensive list of links, www.centerforplantconservation.org/invasives/Links.asp
 - The National Association of Exotic Pest Plant Councils is a coalition of U.S. state and regional exotic pest plant councils (EPPCs) and invasive plant councils (IPCs) representing professional natural resource managers, scientists and others with an interest in invasive plant management, www.naeppc.org.
- For help identifying invasive plants in your area in the United States, refer to:
 - The USDA Natural Resources Conservation Service PLANTS Database, plants.usda.gov specifically the webpage on invasive and noxious weeds, plants.usda.gov/java/noxiousDriver.
 - Invasive Plant Atlas of the United States, www.invasiveplantatlas.org
- For additional links and invasive management tools, see:
 - The University of Georgia's Center for Invasive Species & Ecosystem Health, www.bugwood.org
 - The Center for Plant Conservation's comprehensive list of links, www.centerforplantconservation.org/invasives/links.asp
 - The Center for Invasive Plant Management, www.weedcenter.org, including the resources on invasive plant management, www.weedcenter.org/management/index.html
- For resources specific to regions of the United States, see:
 - The Eastern Oregon Agricultural Research Center, www.ebipm.org
 - Pestman, a Texas A&M University web-based weed and brush control advisor for Texas and New Mexico, pestman.tamu.edu
 - Liu, et al: *Using an integrated fuzzy set and deliberative multi-tasking criteria evaluation approach to facilitate decision-making in invasive species management*, ideas.repec.org/a/eee/ecolec/v69y2010i12p2374-2382.html.
 - The Texas Invasives Program, www.texasinvasives.org

P4.2



LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Prerequisite 4.3: Use appropriate plants

Required

INTENT

Improve landscape performance and reduce resource use by installing only plants that are appropriate for site conditions, climate, and design intent.

REQUIREMENTS

- Use only appropriate plant species that are suitable for site conditions, climate, and design intent. Both native plants and non-natives may qualify.
- Use plants that are nursery-grown, legally harvested, or salvaged for reuse from on or off site. All nursery-grown plants must use an applicable regional standard or regionally adopted guidelines. If no regional standards or guidelines exist, nursery-grown plants must use the ANSI Z60.1-2004 American Standard for Nursery Stock.

SUBMITTAL DOCUMENTATION

- Planting plan showing all new vegetation being installed
- Completed *Vegetation Worksheet* describing site conditions and how all plants being brought to the site are appropriate (see definition) for site conditions, climate, and design intent

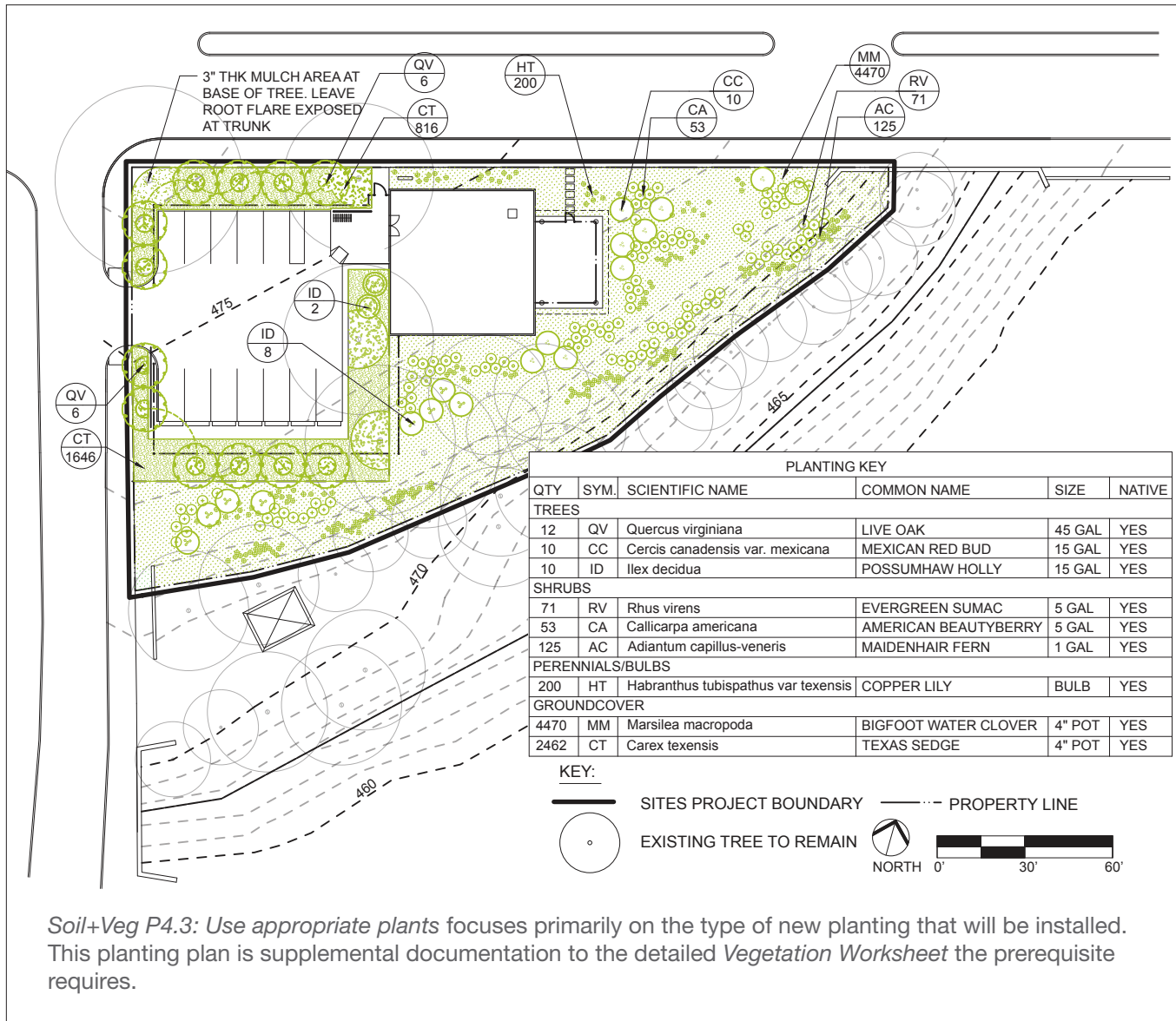
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Section 4: Site Design—Soil + Vegetation

DOCUMENTATION GUIDANCE

Example: Live Oak Place



P4.3



Section 4: Site Design—Soil + Vegetation

RECOMMENDED STRATEGIES

- Select plants that will thrive in the climate and conditions of the site. Avoid invasive species that may jeopardize local ecosystems.
- Refer to municipal lists of recommended appropriate and native plant species. Cross-check with state and federal noxious weed and invasive plants lists (see *Soil+Veg P4.2: Control and manage invasive plants*).
- If turf grasses are to be used, select them to be regionally appropriate and minimize post-establishment requirements for irrigation, pesticide, fertilizer, and maintenance.
- Contact local and regional governmental agencies, consultants, educational facilities, and native plant societies as resources for the selection of plants appropriate for the site.
- For tree plantings, use the ANSI A300 Best Management Practices for Tree Planting as a guide.
- Plant diversity provides resistance to insect and disease pests; as a general guide for larger sites, plant no more than 10 percent of any species, no more than 20 percent of any genus, and no more than 30 percent of any family. For smaller sites, select species that contribute to the plant diversity of the community and region as a whole.

ECONOMIC AND SOCIAL BENEFITS

Plants adapted to site conditions, climate, and design intent need fewer resources and less maintenance to thrive. Selecting appropriate plants can help conserve water, reduce mowing costs, provide habitat, reduce soil erosion, reduce the use of fertilizers and pesticides, and ultimately save money typically allocated for landscape maintenance.

DEFINITIONS

- An **appropriate plant species** is vegetation adapted to site conditions, climate, and design intent. The following attributes should be considered in determining whether plants are appropriate for the site: cold hardiness, heat tolerance, salt tolerance, soil moisture range, plant water use requirements, soil volume requirements, soil pH requirements, sun and shade requirements, pest susceptibility, and maintenance requirements. Native and non-native plants are appropriate if they meet the above criteria.
- An **invasive species** is a plant or animal that is not native to the ecosystem under consideration and that causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health.
- A **native plant** is vegetation native to the EPA Level III ecoregion of the site or known to naturally occur within 200 miles (321.87 kilometers) of the site. Naturally occurring hybrids, varieties, and cultivars of species native to the ecoregion are acceptable.

P4.3

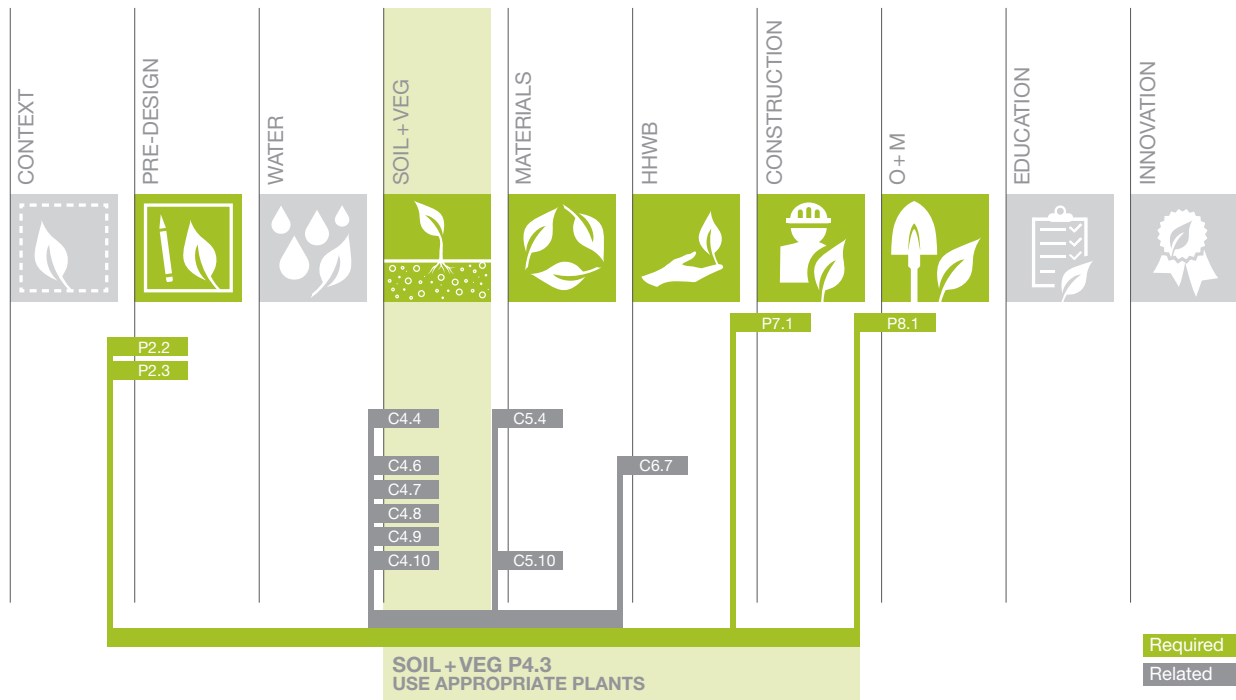


Section 4: Site Design—Soil + Vegetation

RESOURCES

- For information on native and appropriate plants, see:
 - USDA Plants Database, plants.usda.gov
 - Native Plant Information Network Native Plant Database, www.wildflower.org/plants
 - Native Plant Information Network Organizations Database, www.wildflower.org/organizations
 - Native Plant Information Network Suppliers Database, www.wildflower.org/suppliers
 - National Turf Grass Evaluation Program to determine regionally-appropriate turf grass, www.ntep.org/information.htm
 - North American Native Plant Society, www.nanps.org
- For regional information, consult the USDA Cooperative Extension System Offices, www.csrees.usda.gov/qlinks/partners/state_partners.html and local colleges and universities for resources such as the Cornell University Woody Plant Database, woodyplants.cals.cornell.edu

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



P4.3



Credit 4.4: Conserve healthy soils and appropriate vegetation

4–6 points

INTENT

Maintain existing ecosystem services and landscape performance, reduce resource use, and protect soil health by limiting the disturbance of existing appropriate plants and healthy soils.

REQUIREMENTS

- Conserve existing healthy soils and plants that are appropriate for site conditions, climate, and design intent in Vegetation and Soil Protection Zones (VSPZs) to equal at least:
 - 50 percent of the site's existing vegetated area **4 points**
 - 75 percent of the site's existing vegetated area **5 points**
 - 95 percent of the site's existing vegetated area **6 points**
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and describes and locates the healthy soils and appropriate plant species found on site.

Note: Limited restoration activities, including invasive species removal, are allowed within VSPZs (see *Pre-Design P2.3: Designate and communicate Vegetation and Soil Protection Zones (VSPZs)*).

SUBMITTAL DOCUMENTATION

- Existing conditions plan showing:
 - Vegetated areas prior to construction
 - Areas of healthy soils prior to construction
 - Designated VSPZs to protect healthy soils and appropriate vegetation
- Site plan showing:
 - Final vegetated areas, including pre-construction vegetated areas conserved on site
- Calculations demonstrating that the area of conserved healthy soils and appropriate vegetation equals the percentage of total existing vegetated area chosen from the list above
- *Vegetation Worksheet* cataloging existing plants to remain on site and documenting that they are appropriate for site conditions
- Narrative that describes how areas of healthy soils and appropriate vegetation will be conserved during construction
- Photographs of areas of conserved healthy soils and appropriate vegetation both prior to and after construction
- Applicable VSPZ documentation required to be submitted in *Pre-Design P2.3: Designate and communicate VSPZs*

C4.4



Section 4: Site Design—Soil + Vegetation

RECOMMENDED STRATEGIES

- Locate construction activities, including storage of materials, vehicular access and parking, and placement of utilities, on areas of previously disturbed soils as identified in the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*).
- Limit grading to areas of previously disturbed soils.
- Establish clear construction boundaries to minimize disturbance to healthy soils and appropriate vegetation.
- Limit construction to a tight envelope around development, which will reduce the area of soil that needs to be restored in *Construction P7.3: Restore soils disturbed during construction*.
- Additional planting within the one foot (0.31 meter) radius per inch (2.54 centimeters) diameter at breast height (DBH) should be avoided. Planting here runs a high risk of damaging tree roots and soil chemistry and having other negative impacts due to excessive irrigation.
 - Planting should be limited to 25 percent of the area under the tree canopy or the area within a one foot (0.31 meter) radius per inch DBH and must be done in consultation with a certified arborist or other appropriately qualified professional.
- Protect the root zone of trees found on site:
 - Try to protect groups of trees rather than individual trees.
 - Design utility access away from the soil and roots of trees.
 - Reduce the need for utility trench work through strategic placement of utilities.
 - Where utility trench work is necessary, use air excavation to expose tree roots without damaging them (according to ANSI A300 Part 5).
 - If applicable, consider using directional boring technology (e.g., “mole,” “Ditch-Witch”).
 - For trees, ground-penetrating radar (GPR) or air excavation can be used to determine the location of tree roots.

C4.4



ECONOMIC AND SOCIAL BENEFITS

Healthy soils effectively cycle nutrients, store carbon as organic matter, minimize runoff, and maximize water-holding capacity. They also absorb excess nutrients, sediments, and pollutants; provide a healthy rooting environment and habitat to a wide range of organisms; and help those organisms maintain their structure and aggregation. Preserving soil horizons saves money by reducing the need for soil restoration and surface drainage improvements. By limiting grading activity, sites can also reduce costs for construction machinery and transport of imported soils.

Plants adapted to site conditions, climate, and design intent need fewer resources and less maintenance. Selecting appropriate plants can help conserve water, reducing mowing costs, provide habitat, protect soil by reducing erosion, reduce the use of fertilizers and pesticides, and ultimately save money.¹

1. U.S. Environmental Protection Agency, “Landscaping With Native Plants,” www.epa.gov/greenacres/nativeplants/factsht.html (accessed March 23, 2013).

Section 4: Site Design—Soil + Vegetation

DEFINITIONS

- An **appropriate plant species** is vegetation adapted to site conditions, climate, and design intent. The following attributes should be considered in determining whether plants are appropriate for the site: cold hardiness, heat tolerance, salt tolerance, soil moisture range, plant water use requirements, soil volume requirements, soil pH requirements, sun and shade requirements, pest susceptibility, and maintenance requirements. Native and non-native plants are appropriate if they meet the above criteria.
- **Disturbed soils** are all areas of soils disturbed by human development activities, such as those that have been affected by grading, excavation, or compaction. Indicators of disturbed soils may include one or more of the following:
 - Soil horizons that differ significantly in either depth, texture, or physical or chemical properties from the reference soil
 - Bulk densities that exceed the maximum allowable bulk densities shown in *Construction P7.3: Restore soils during construction* Figure 7.3-A
 - Organic matter content lower than that of the reference soil
 - Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) different from that of the reference soil
 - Presence of compounds toxic to the intended plants
 - Presence of weedy, opportunistic, or invasive plant species
- **Healthy soils** have not been significantly disturbed by previous human development activities. Healthy soils may include one or more of the following indicators:
 - Soil horizons that are similar to the reference soil
 - Bulk densities that do not exceed the maximum allowable bulk densities shown in *P7.3: Restore soils disturbed during construction*
 - Organic matter content similar to that of the reference soil
 - Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) similar to that of the reference soil
 - Absence of compounds toxic to the intended plants
 - Presence of vegetation that is representative of native plant communities
- **Vegetated area** describes all portions of the site that will support vegetation.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.

RESOURCES

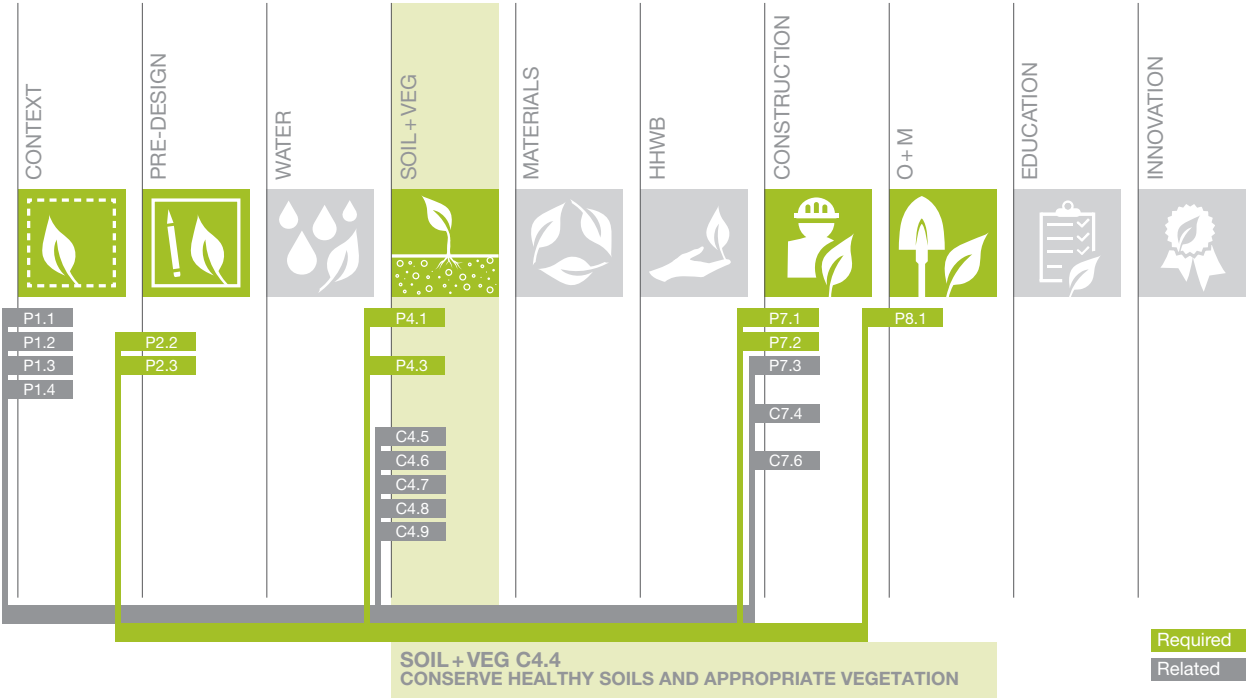
- For an explanation of the Matheny and Clark method of determining the extent of a tree's root system, please see the following guides:
 - *Trees and Development: A Technical Guide to Preservation of Trees During Land Development*, Nelda P. Matheny and J. Clark, International Society of Arboriculture, 1998.
 - *Guidelines for Optimum Tree Protection Zone, Table 11.1*, in *Arboriculture*, 4th edition, Harris, Clark, and Matheny, 2004.

C4.4



Section 4: Site Design—Soil + Vegetation

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C4.4



Required

Related

Credit 4.5: Conserve special status vegetation

4 points

INTENT

Protect existing ecosystem services by identifying and conserving all vegetation on site designated as special status by local, state, or federal entities.

REQUIREMENTS

This requirement applies only to plants designated as special status by local, state, or federal entities. These plants may include, but are not limited to, heritage or legacy trees, specimen trees (as designated by a local tree board), rare and endangered species, rare vegetation in a unique habitat, and unusual genetic variants of a particular species. Native plant communities and cultural landscapes are addressed in other credits (see the Links to other SITES prerequisites and credits section).

- Establish Vegetation and Soil Protection Zones (VSPZs) to protect special status trees and other plants (see *Pre-Design P2.3: Designate and communicate VSPZs*).
- Ensure the section of the site assessment (See *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and documents locations of trees or other plants with special status designations.
- Ensure the section of the site maintenance plan (See *O+M P8.1: Plan for sustainable site maintenance*) is complete and describes the ongoing management activities to protect the integrity of the VSPZs, including a description of how the critical aspects of the special status plants' culture and habitat are being protected and maintained (e.g., hydrology, associated plant communities, exposure).

Note: VSPZs can encompass one plant or can include several plants in a group (see *Pre-Design P2.3: Designate and communicate VSPZs*).

SUBMITTAL DOCUMENTATION

- Site map indicating the location, species, and size (diameter at breast height (DBH) and canopy width) of all special status vegetation. Indicate the extent of all VSPZs, noting distances from protected vegetation.
- Letter from a local, state, or federal agency describing how the vegetation has special status. The design team may make the case that certain vegetation has special status even when no agency that has documented the vegetation as such.
- Applicable VSPZ documentation required to be submitted in *Pre-Design P2.3: Designate and communicate VSPZs*

RECOMMENDED STRATEGIES

- Design the site to minimize harm to special status trees and other plants.
- Consult with local experts qualified in plant health and safety to determine appropriate special protection measures.
- Additional planting within the one foot (0.31 meter) radius per inch (2.54 centimeter) DBH should be avoided. Planting here runs a high risk of damaging tree roots and soil chemistry and having other negative impacts due to excessive irrigation.
 - Planting should be limited to 25 percent of the area under the tree canopy or the area within one foot (0.31 meter) radius per inch (2.54 centimeter) DBH and must be done in consultation with a certified arborist or other appropriately qualified professional.

C4.5



Section 4: Site Design—Soil + Vegetation

- Protect the root zone of trees found on site.
 - Try to protect groups of trees rather than individual trees.
 - Design utility access away from the soil and roots of trees.
 - Reduce the need for utility trench work through strategic placement of utilities.
 - Where utility trench work is necessary, use air excavation to expose tree roots without damaging them (according to ANSI A300 Part 5).
 - If applicable, consider using directional boring technology (e.g., “mole,” “Ditch-Witch”)
 - For trees, ground-penetrating radar (GPR) or air excavation can be used to determine the location of tree roots.

ECONOMIC AND SOCIAL BENEFITS

Mature trees and other plants are significant community resources because of their cultural, aesthetic, and historic relevance. Special status vegetation may be deemed important because it is associated with a significant historic event or place, located in a place that provides critical functions (such as soil stability along a stream), or is relatively rare in an area.¹

1. TJ Swiecki and EA Bernhardt, “Guidelines for Developing and Evaluating Tree Ordinances,” International Society of Arboriculture (2001), www.isaarbor.com/education/onlineResources/treeOrdinanceGuidelines.aspx (accessed March 23, 2013).

C4.5



DEFINITIONS

- A **cultural landscape** is a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values. The quality of significance in history, architecture, archeology, engineering, landscape architecture, and culture is present in cultural landscapes that possess integrity of location, design, setting, materials, workmanship, feeling, association and:
 - That are associated with events that have made a significant contribution to the broad patterns of history; or
 - That are associated with the lives of significant persons in the past; or
 - That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master craftsman or designer, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
 - That has yielded, or may be likely to yield, information important in history or prehistory.

(U.S. National Park Service, www.nps.gov/nr/publications/bulletins/nrb15/nrb15_2.htm is reference to whole definition. See this definition in C6.1.)

- **Diameter at breast height (DBH)** is a standard method for determining the trunk diameter of a standing tree. In the United States, DBH is typically measured in inches at 4.5 feet (1.37 meters) off the ground on the uphill side. Wounds, branches, multiple stems, and defects may change how diameter is measured. For guidance, see the International Society for Arboriculture website, www.isa-arbor.com/publications/tree-ord/measuringdbh.aspx.
- A **native plant community** is an assemblage of plant species whose composition and structure are typical of native plant communities mapped at the EPA Level III ecoregion or are known to naturally occur within 200 miles (321.87 kilometers) of the site. Native plant communities include but are not limited to wetlands, woodlands, grasslands, riparian buffers, and habitat for wildlife species of concern within the region. A reference from a local plant list, local reference site, or published plant community description is needed to determine the dominant plant species, relative species abundances, and other characteristic elements of the plant community/communities to be preserved or restored.

Section 4: Site Design—Soil + Vegetation

- **Special status vegetation** is designated as important by local, state, or federal entities. Designations may be for size, species, age, rare or special status collections, ecological and environmental value, unique genetic resources, aesthetics, location, or other unique characteristics (e.g. heritage or legacy trees). Groves and clusters may also be given special status.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs

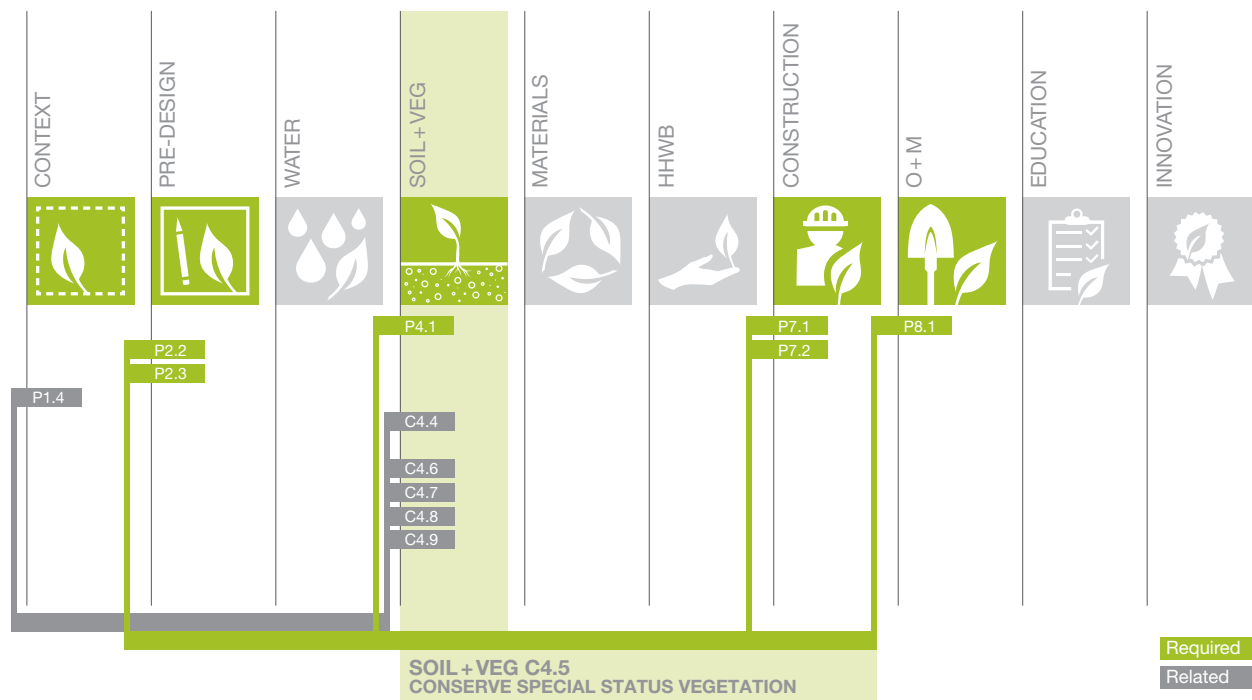
RESOURCES

- For information to help identify heritage, historic, or landmark trees, read the International Society of Arboriculture's Tree Ordinance Guidelines at www.isa-arbor.com/publications/tree-ord/heritage.aspx.
- Consult with state forest resource agencies for lists of champion trees.
- For more information about integrated management, consult RW Harris, N Matheny, and JR Clark, *Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines*. 3rd ed. (Upper Saddle River, NJ: Prentice Hall, 1999).
- For the industry standard for management of trees and shrubs, see *ANSI A300 (Part 5)-2012 Management of Trees and Shrubs During Site Planning, Site Development, and Construction*, available for purchase from the Tree Care Industry Association www.tcia.org.

C4.5



LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 4.6: Conserve and use native plants

3–6 points

INTENT

Foster habitat for native wildlife that is necessary for plant reproduction by conserving or installing plants that are native to the site's ecoregion.

REQUIREMENTS

- Conserve existing appropriate native plants and/or install new native plants that, according to the *SITES Native Plants Calculator*, equal a native plant score of at least:
 - 20 percent total native plant score **3 points**
 - 40 percent total native plant score **4 points**
 - 60 percent total native plant score **6 points**
- Conserve a percentage of the site's existing appropriate native plants in Vegetation and Soil Protection Zones (VSPZs) (see *Pre-Design P2.3: Designate and communicate VSPZs*).
 - The requirements apply to existing appropriate native plants as identified in the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*). This option is limited to conserving individual native plants in situ, not ones that are growing within a preserved native plant community (see *Soil+Veg C4.7: Conserve and restore native plant communities*).
 - Conservation calculations are measured by surface area of existing native plant area.
- Install new appropriate native plants to equal a percentage of the site's final vegetated area.
 - New native plant calculations are measured by surface area of final vegetated area, using estimated vegetated cover within 10 years of installation.
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete, shows existing vegetated area, and distinguishes which plants are existing native species.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and describes the on-going management activities to protect the integrity of the VSPZs.

C4.6



Section 4: Site Design—Soil + Vegetation

SUBMITTAL DOCUMENTATION

For projects that are conserving existing, appropriate native plants:

- Site map showing existing vegetated area, distinguishing which plants are existing native species, and indicating those that will be conserved. Clearly outline VSPZ boundaries.
- Completed *Native Plants Calculator* showing area takeoffs for native plants and the project's native plant score
- Plant species list of the native vegetation that will be conserved, including common and scientific names and the USDA plants symbol for each species
- Applicable VSPZ documentation required to be submitted in *Pre-Design P2.3: Designate and communicate VSPZs*

For projects that are installing new appropriate native plants:

- Site plan showing final vegetated area and indicating the portions of the vegetated area that will contain native plants
- Planting and seeding plan and written specifications with performance requirements
- Completed *Native Plants Calculator* showing area takeoffs for native plants and the project's native plant score
- Completed *Vegetation Worksheet* describing site conditions and all plants being brought to the site in order to document native status

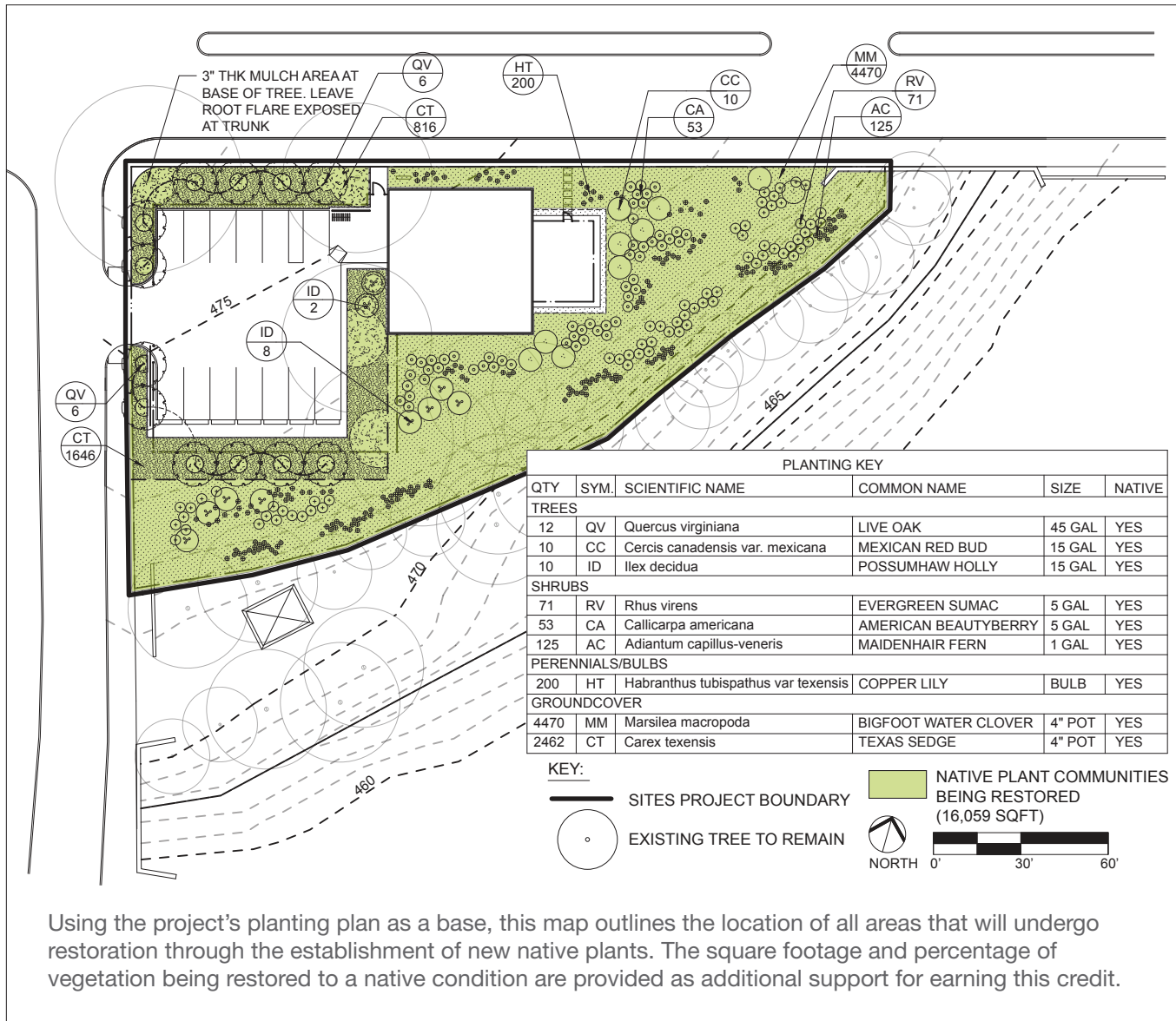
C4.6



Section 4: Site Design—Soil + Vegetation

DOCUMENTATION GUIDANCE

Example: Live Oak Place



C4.6



Section 4: Site Design—Soil + Vegetation

RECOMMENDED STRATEGIES

- Native plants can be used to express multiple styles of design.
- On sites with existing native vegetation, design the site to preserve native plants, where possible.
- On previously developed sites, use local and regional governmental agencies, consultants, educational facilities, and native plant societies as resources for the selection of native plants appropriate for the site.
- Consult qualified professionals (e.g., an arborist, biologist, environmental scientist) to conduct a vegetation assessment and identify appropriate plant species for the site.

ECONOMIC AND SOCIAL BENEFITS

Native plants can provide habitat for native wildlife, including important pollinator species (e.g., insects, birds, bats) that are necessary for plant reproduction, including crop cultivation. Up to 80 percent of the world's food plant species depend on pollination by animals.¹ Wildlife habitat also supports recreational and ecotourism activities such as fishing, bird-watching, and other opportunities for environmental education.²

1. SL Buchman and GP Nabhan, *The Forgotten Pollinators* (Washington, DC: Island Press, 1996).

2. RS De Groot, MA Wilson, and RMJ Boumans, "A Typology for the Classification, Description and Valuation of Ecosystem Functions, Goods and Services," *Ecological Economics* 41, no. 3 (2002): pp. 393–408.

C4.6



DEFINITIONS

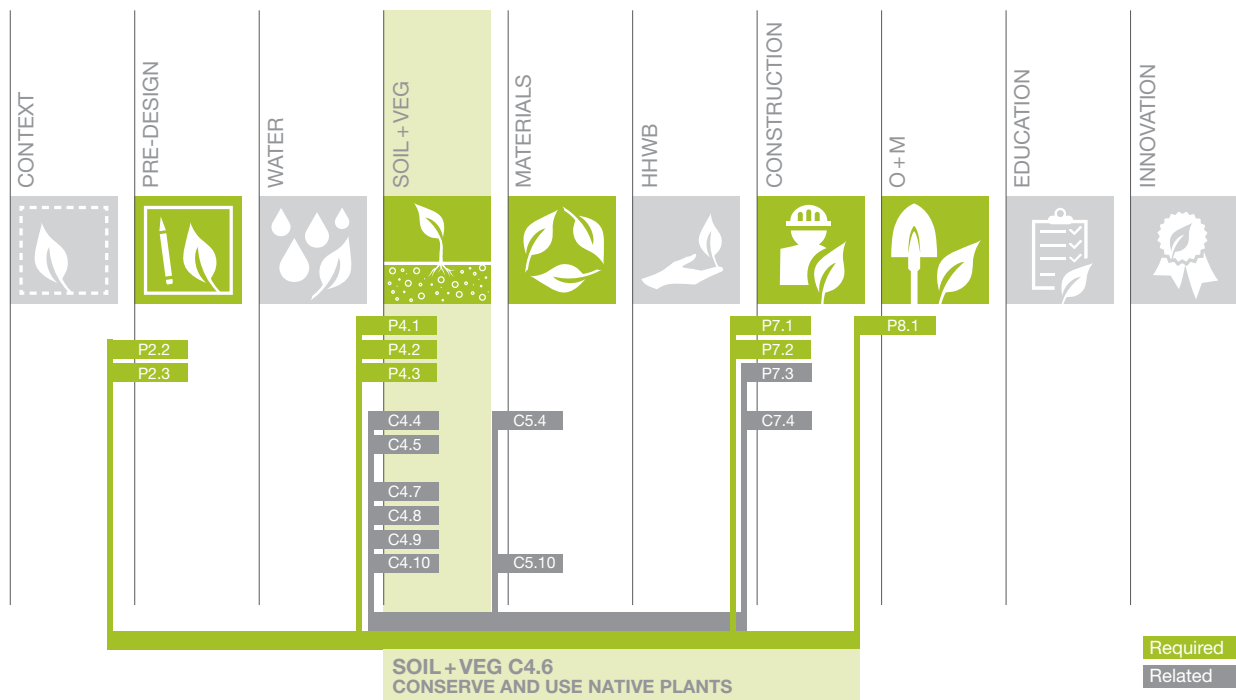
- An **appropriate plant species** is vegetation adapted to site conditions, climate, and design intent. The following attributes should be considered in determining whether plants are appropriate for the site: cold hardiness, heat tolerance, salt tolerance, soil moisture range, plant water use requirements, soil volume requirements, soil pH requirements, sun and shade requirements, pest susceptibility, and maintenance requirements. Native and non-native plants are appropriate if they meet the above criteria.
- A **native plant** is vegetation native to the EPA Level III ecoregion of the site or known to naturally occur within 200 miles (321.87 kilometers) of the site. Naturally occurring hybrids, varieties, and cultivars of species native to the ecoregion are acceptable.
- A **native plant community** is an assemblage of plant species whose composition and structure are typical of native plant communities mapped at the EPA Level III ecoregion or are known to naturally occur within 200 miles (321.87 kilometers) of the site. Native plant communities include but are not limited to wetlands, woodlands, grasslands, riparian buffers, and habitat for wildlife species of concern within the region. A reference from a local plant list, local reference site, or published plant community description is needed to determine the dominant plant species, relative species abundances, and other characteristic elements of the plant community/communities to be preserved or restored.
- **Vegetated area** describes all portions of the site that will support vegetation.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.

Section 4: Site Design—Soil + Vegetation

RESOURCES

- For more information about soils, consult the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey, soils.usda.gov/survey.
- For more information about native plants, refer to the following resources:
 - NatureServe, www.natureserve.org
 - The North American Native Plant Society, www.nanps.org
 - The Lady Bird Johnson Wildflower Center's Native Plant Information Network's Native Plant Database, www.wildflower.org/plants
 - USDA PLANTS Database, plants.usda.gov
 - List of U.S. state native plant societies, www.wildflower.org/organizations/search.php?name=Name+search&category=Native+Plant+Society
- For regional information, consult local colleges and universities and USDA Cooperative Extension System Offices, www.csrees.usda.gov/qlinks/partners/state_partners.html.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C4.6



Credit 4.7: Conserve and restore native plant communities

4–6 points

INTENT

Contribute to regional diversity of flora and provide habitat for native wildlife by conserving existing native plant communities and installing vegetation that contributes to plant communities native to the ecoregion.

REQUIREMENTS

- Conserve existing native plant communities and/or restore native plant communities that, according to the *SITES Native Plant Communities Calculator*, equal a native plant community score of at least:
 - 20 percent total native plant community score **4 points**
 - 40 percent total native plant community score **5 points**
 - 60 percent total native plant community score **6 points**
- Conserve a percentage of the site's existing native plant communities in Vegetation and Soil Protection Zones (VSPZs) (see *Pre-Design P2.3: Designate and communicate VSPZs*).
 - The requirements apply to existing native plant communities, as identified in the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*), in which evidence of human disturbance is minimal and exotic and invasive plants make up less than 10 percent of the total area of existing native plant communities.
 - Make conservation calculations by surface area. Each area conserved must be contiguous and a minimum of 2,000 square feet (185.81 square meters).
- Restore a percentage of the site's final vegetated area with native plant communities.
 - Make restoration calculations by surface area of vegetated area, using estimated vegetated cover within 10 years of installation. Each area restored must be contiguous and a minimum of 2,000 square feet (185.81 square meters).
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and indicates the original area and characteristics of existing native plant communities on site.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and describes the ongoing management activities to protect the integrity of VSPZs.

SUBMITTAL DOCUMENTATION

For projects that are conserving existing native plant communities:

- Site plan indicating the area of existing native plant communities and distinguishing each community that will be conserved. Clearly outline the VSPZ boundary.
- List of the native vegetation that will be conserved, including common and scientific names, plant communities, and the USDA plants symbol for each species
- Completed *Native Plant Community Calculator* showing area takeoffs for native plant communities and the project's native plant community score

C4.7



Section 4: Site Design—Soil + Vegetation

- Narrative documenting the existing native plant communities, including:
 - Dominant plant species
 - Relative species abundances
 - Other characteristic elements of the native plant community/communities
 - EPA Level III ecoregion map
 - One reference (or local reference site)
- Applicable VSPZ documentation required to be submitted in *Pre-Design P2.3: Designate and communicated VSPZs*

For projects that are restoring native plant communities:

- Site plan showing final vegetated area indicating the portions of the vegetated area that will contain native plant communities, distinguishing each community
- Planting and seeding plan and written specifications with performance requirements
- Completed *Native Plant Community Calculator* showing area takeoffs for native plant communities and the project's native plant community score
- Completed *Vegetation Worksheet* noting the plants that are part of a native plant community
- Narrative describing how restored vegetation has been identified as a native plant community, including:
 - Dominant plant species
 - Relative species abundances
 - Other characteristic elements of the native plant community/communities
 - EPA Level III ecoregion map
 - One reference (or local reference site)

C4.7



RECOMMENDED STRATEGIES

- Native plants can express multiple styles of design.
- On sites with existing native plant communities, design the site to minimize damage to existing healthy native plant communities, especially those areas that provide opportunities for wildlife habitat connectivity.

ECONOMIC AND SOCIAL BENEFITS

Native plants can provide habitat for native wildlife, including important pollinator species (e.g., insects, birds, bats) that are necessary for plant reproduction, including crop cultivation. Up to 80 percent of the world's food plant species are dependent on pollination by animals.¹ Wildlife habitat also supports recreational and ecotourism activities such as fishing, bird-watching, and other opportunities for environmental education.²

1. SL Buchman and GP Nabhan, *The Forgotten Pollinators* (Washington, DC: Island Press, 1996).

2. RS De Groot, MA Wilson, and RMJ Boumans, "A Typology for the Classification, Description and Valuation of Ecosystem Functions, Goods and Services," *Ecological Economics* 41, no. 3 (2002): pp. 393–408.

DEFINITIONS

- A **native plant** is vegetation native to the EPA Level III ecoregion of the site or known to naturally occur within 200 miles (321.87 kilometers) of the site. Naturally occurring hybrids, varieties, and cultivars of species native to the ecoregion are acceptable.
- A **native plant community** is an assemblage of plant species whose composition and structure are typical of native plant communities mapped at the EPA Level III ecoregion or are known to naturally occur within 200 miles (321.87 kilometers) of the site. Native plant communities include but are not limited to wetlands, woodlands, grasslands, riparian buffers, and habitat for wildlife species of concern within the region. A reference from a local plant list, local reference site, or published plant community description is needed to determine the dominant plant species, relative species abundances, and other characteristic elements of the plant community/communities to be preserved or restored.

Section 4: Site Design—Soil + Vegetation

- **Vegetated area** describes all portions of the site that will support vegetation.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.

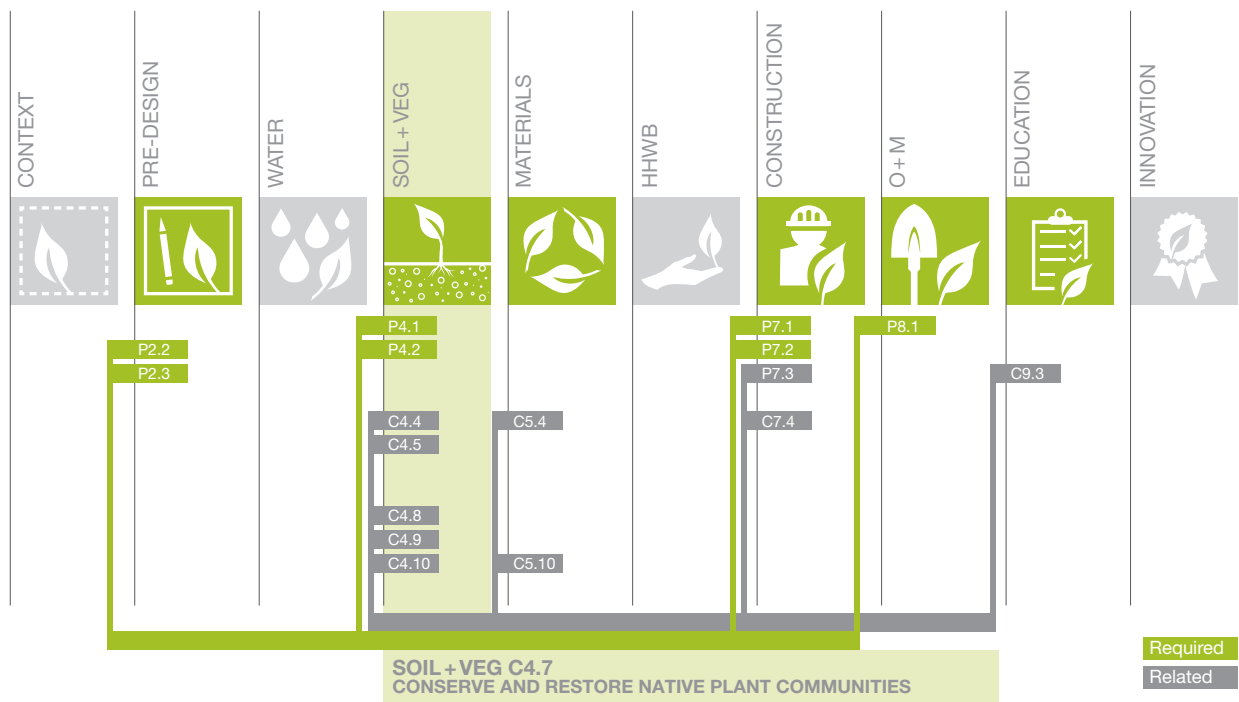
RESOURCES

- For more information about soils, consult the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey, soils.usda.gov/survey.
- For more information about native plants, refer to the following resources:
 - NatureServe, www.natureserve.org
 - The North American Native Plant Society, www.nanps.org
 - The Lady Bird Johnson Wildflower Center's Native Plant Information Network's Native Plant Database, www.wildflower.org/plants
 - USDA PLANTS Database, plants.usda.gov
- For more information on state wildlife action plans, consult the Association of Fish & Wildlife Agencies, www.wildlifeactionplan.org.
- For more regional resources, consult local colleges and universities and the USDA Cooperative Extension System Offices, www.csrees.usda.gov/qlinks/partners/state_partners.html.
- For information about wildlife distribution across ecoregions, consult the World Wildlife Fund Wildfinder, www.worldwildlife.org/science/wildfinder.

C4.7



LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 4.8: Optimize biomass

1–6 points

INTENT

Support the water, nutrient, atmospheric gas, and climate regulation ecosystem service benefits provided by vegetation on site by maintaining or establishing regionally appropriate vegetative biomass.

REQUIREMENTS

- Conserve and/or restore vegetation biomass on site to a level appropriate to the site's region.
 - Determine the terrestrial biome for the site.
 - Determine the existing site biomass density index (BDI) and planned site BDI.
 - Determine the points earned in accordance with the site's terrestrial biome and the difference in site BDI according to Tables 4.8 B-E in the Documentation guidance section below.

Calculate existing BDI for the site as it stands prior to site design (see *Pre-Design P2.2: Conduct a pre-design site assessment*). Planned BDI is calculated for the site as designed and anticipated within 10 years of vegetation installation.

SUBMITTAL DOCUMENTATION

- Site plan demonstrating existing and planned site conditions using estimated height and spread within 10 years of vegetation installation
- Site map or aerial photographs
- Terrestrial biome for project location
- Calculations for the existing site BDI and planned site BDI. See the Documentation guidance section to determine applicable point values.

DOCUMENTATION GUIDANCE

To determine the terrestrial biome for the site, use the World Wildlife Fund Wildfinder, www.worldwildlife.org/science/wildfinder.

To calculate the existing site BDI:

- Use information from the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) to draw a map of the zones of land cover or vegetation types existing on the site. Determine the percent of total area for each distinct zone.
- All vegetated areas or land cover zones should fall into only one category and should not overlap.
- BDI calculations include all vegetated areas or land cover zones (including roof area), as well as all other horizontal and vertical surfaces covered with vegetation (e.g., green roofs, green walls, trellises, pergolas) on the site.
- Exclude areas of open water and areas of invasive species in existing site BDI calculations, and from the existing total site area calculation.

To calculate the planned site BDI:

- Use site design and planting plans to map the zones of cover and vegetation types estimated at 10 years following landscape installation. Determine the percent of total area for each distinct zone.
- All vegetated areas or land cover zones should fall into only one category and should not overlap.

C4.8



Section 4: Site Design—Soil + Vegetation

- BDI calculations include all vegetated areas or land cover zones (including roof area), as well as all other horizontal and vertical surfaces covered with vegetation (e.g., green roofs, green walls, trellises, pergolas) on the site.
- Exclude areas of open water in planned site BDI calculations, and from the total site area calculation.

Table 4.8-A: Calculations for Existing & Proposed Site BDI

The following calculations should be performed twice—once with the percentages for existing site conditions and once for planned site conditions, as stated above. For each zone in column A, enter the percent of total area in column C below. Multiply those percentages by their respective biomass density values from column B, and enter the result in column D. The Site BDI is the sum of all data in column D.

Land cover/vegetation type zone	Biomass density value*	Percent of total site area	Biomass density value x percent total site area (column B x column C)
A	B	C	D
Trees with understory	6		
Trees without understory (less than 10 percent herbaceous/shrub cover)	4		
Shrubs	3		
Perennials	2		
Desert plants	1.5		
Annual plantings	1.5		
Managed turf > 3" **	3		
Managed turf < 3" **	2		
Unmanaged grass layer (prairie/pasture) > 9" **	2		
Unmanaged grass layer (prairie/pasture) < 9" **	1.5		
Wetlands ***	6		
Impervious cover, removed invasives or bare ground not shaded by vegetation or vegetated structures	0		
SUBTOTAL (sum of all rows)	n/a	100%	
ADDITIONAL VALUE for other horizontal and vertical surfaces covered with vegetation (e.g. green walls, trellises, pergolas), if applicable: Calculate the total surface area of the vegetated surface, multiply by a biomass density value of 1, and divide by the total site area.			
Site BDI (sum of Subtotal and Additional Value)			

* The biomass density values in Column B are based on a literature review of leaf area index (LAI) for various vegetation types that included approximately 1,000 historical estimates of LAI summarized by biome or cover type in JMO Scurlock, GP Asner, and ST Gower, *Worldwide Historical Estimates of Leaf Area Index, 1932-2000* (Oak Ridge, TN: Oak Ridge National Laboratory, 2001).

** Height defined as consistently achieved during the growing season.

*** This category includes wetlands with emergent vegetation and does not include open water.

C4.8



Section 4: Site Design—Soil + Vegetation

Region-specific point value tables: The region-specific point value tables below show a matrix of existing site BDI values along the y-axis and planned site BDI values along the x-axis. Use the World Wildlife Fund *Wildfinder*, www.worldwildlife.org/science/wildfinder, to determine the biome within which the site is located. Then find the corresponding table (from Tables 4.8 B-E) for point values specific to that biome. Differences in point values between biomes are based on mean leaf area index (LAI) for approximately 1,000 historical estimates of LAI summarized by biome or cover type in JMO Scurlock, GP Asner, and ST Gower, *Worldwide historical estimates of leaf area index, 1932–2000* (Oak Ridge, TN: Oak Ridge National Laboratory, 2001).

Table 4.8-B: Point values for sites in the following biomes:

- Tropical and subtropical coniferous forests
- Tropical and subtropical dry broadleaf forests

Use this table to look up the applicable point value (**1-6 points**) for the difference between the existing site BDI and planned site BDI on your site.

		Planned Site BDI				
		0–1	>1–2	>2–3	>3–4	>4
Existing Site BDI	0–1	1 point	3 points	5 points	6 points	6 points
	>1–2	No Credit	1 point	3 points	5 points	6 points
	>2–3	No Credit	No Credit	1 point	3 points	5 points
	>3–4	No Credit	No Credit	No Credit	1 point	3 points
	>4	No Credit	No Credit	No Credit	No Credit	1 point

Table 4.8-C: Point values for sites in the following biomes:

- Temperate broadleaf and mixed forests
- Temperate conifer forests

Use this table to look up the applicable point value (**1-6 points**) for the difference between the existing site BDI and planned site BDI on your site.

		Planned Site BDI					
		0–1	>1–2	>2–3	>3–4	>4–5	>5
Existing Site BDI	0–1	1 point	3 points	5 points	6 points	6 points	6 points
	>1–2	No Credit	1 point	3 points	5 points	6 points	6 points
	>2–3	No Credit	No Credit	1 point	3 points	5 points	6 points
	>3–4	No Credit	No Credit	No Credit	1 point	3 points	5 points
	>4–5	No Credit	No Credit	No Credit	No Credit	1 point	3 points
	>5	No Credit	No Credit	No Credit	No Credit	No Credit	1 point

C4.8



Section 4: Site Design—Soil + Vegetation

Table 4.8-D: Point values for sites in the following biomes:

- Mediterranean forests, woodlands and scrub
- Temperate grasslands, savannas and shrublands
- Boreal forests and taiga
- Tropical and subtropical grasslands, savannas and shrublands
- Flooded grasslands and savannas

Use this table to look up the applicable point value **(1-6 points)** for the difference between the existing site BDI and planned site BDI on your site.

		Planned Site BDI				
		0–0.5	>0.5–1.0	>1.0–1.5	>1.5–2.0	>2.0
Existing Site BDI	0–0.5	1 point	3 points	5 points	6 points	6 points
	>0.5–1.0	No Credit	1 point	3 points	5 points	6 points
	>1.0–1.5	No Credit	No Credit	1 point	3 points	5 points
	>1.5–2.0	No Credit	No Credit	No Credit	1 point	3 points
	>2.0	No Credit	No Credit	No Credit	No Credit	1 point

Table 4.8-E: Point values for sites in the following biome:

- Deserts

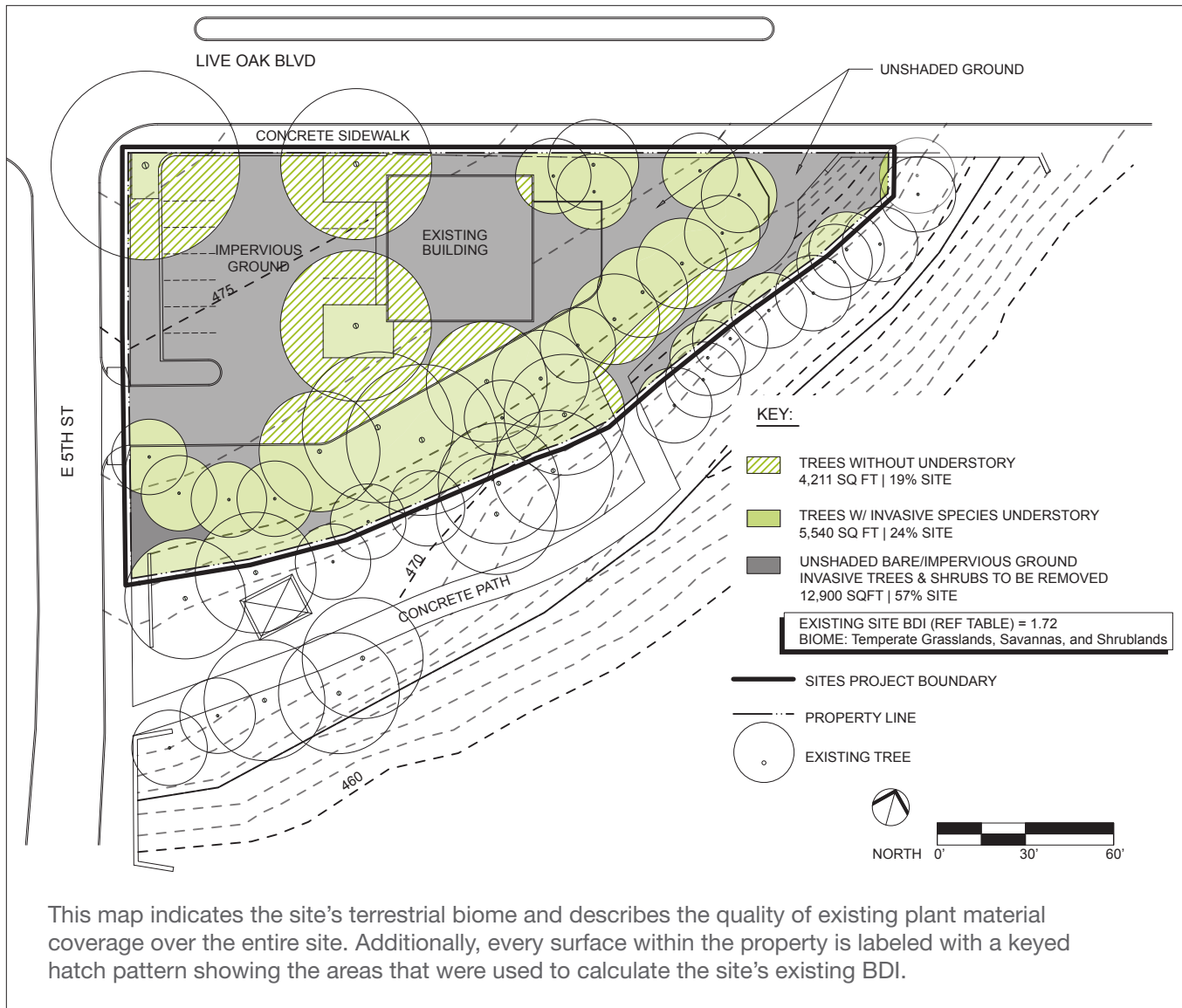
Use this table to look up the applicable point value **(1-6 points)** for the difference between the existing site BDI and planned site BDI on your site.

		Planned Site BDI			
		0–0.5	>0.5–1.0	>1.0–1.5	>1.5
Existing Site BDI	0–0.5	1 point	3 points	5 points	6 points
	>0.5–1.0	No Credit	1 point	3 points	5 points
	>1.0–1.5	No Credit	No Credit	1 point	3 points
	>1.5	No Credit	No Credit	No Credit	1 point



Section 4: Site Design—Soil + Vegetation

Example: Live Oak Place Existing BDI

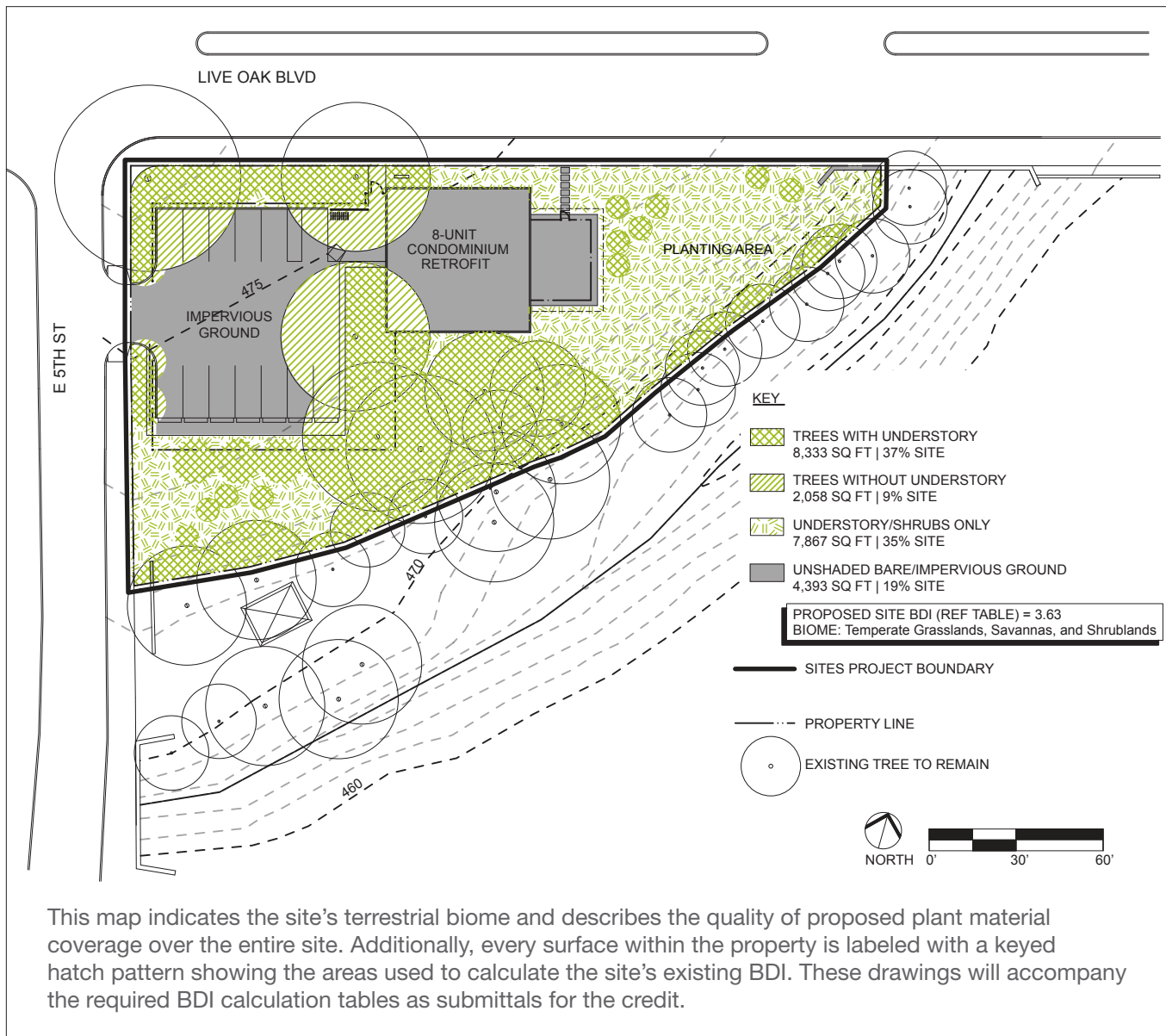


C4.8



Section 4: Site Design—Soil + Vegetation

Proposed BDI



C4.8



Section 4: Site Design—Soil + Vegetation

RECOMMENDED STRATEGIES

- On greenfield sites, carefully design the site to minimize disruption to existing appropriate vegetation.
- On brownfield sites, carefully design the site to achieve planned BDI 10 years following landscape installation. The long-term capacity of a site to deliver ecosystem services is compromised by overplanting a brownfield site to achieve a target BDI level prematurely.
- Green walls can increase BDI without changing the overall development footprint.
- Be careful to select shade-tolerant and sun-tolerant species that will adjust in the understory as trees and shrubs mature.
- Use trees, green roofs, or vegetated structures (e.g., trellises) to cover non-vegetated surfaces such as walkways, roofs, or parking lots. Select vegetation-based methods to achieve stormwater management goals for the site.
- Before the design phase, examine the appropriate table for your biome (Tables B through E) to make sure that you do not unnecessarily add more layered vegetation than you can earn credit for. Many of the biome tables are limited at the upper end, e.g. Table 4.8C ranging from <1 to >3 is the same point value as going from <1 to >5 planned BDI.

ECONOMIC AND SOCIAL BENEFITS

Biomass density index (BDI) is a measure of the optimization of vegetation biomass appropriate to the regional climate. Environmental, economic, and social benefits emerge from all general characteristics of living vegetation, such as shading of structures or recreational spaces, atmospheric and building cooling, building protection from cold or otherwise damaging winds, reduced soil water evaporation (hence reduced irrigation), improved air quality (absorption of particulates PM10 and PM20 and low level ozone), noise reduction, storm run-off reduction (from improved soil permeability and vegetation canopy interception and transpiration), and improved water quality (as runoff or sub-soil recharge).

DEFINITIONS

- **Biomass density index (BDI)** is the density of plant layers covering the ground. It is calculated by summing the existing or proposed biomass value as a proportion of total site area (not including water or invasive species) for all on-site structural vegetation types.
- **Terrestrial biome** is the largest unit of vegetation type within the biosphere, with similar plant architecture and character, community structure, and climate (e.g., tropical rain forest or coral reef).
- **Vegetated area** describes all portions of the site that will support vegetation.

C4.8

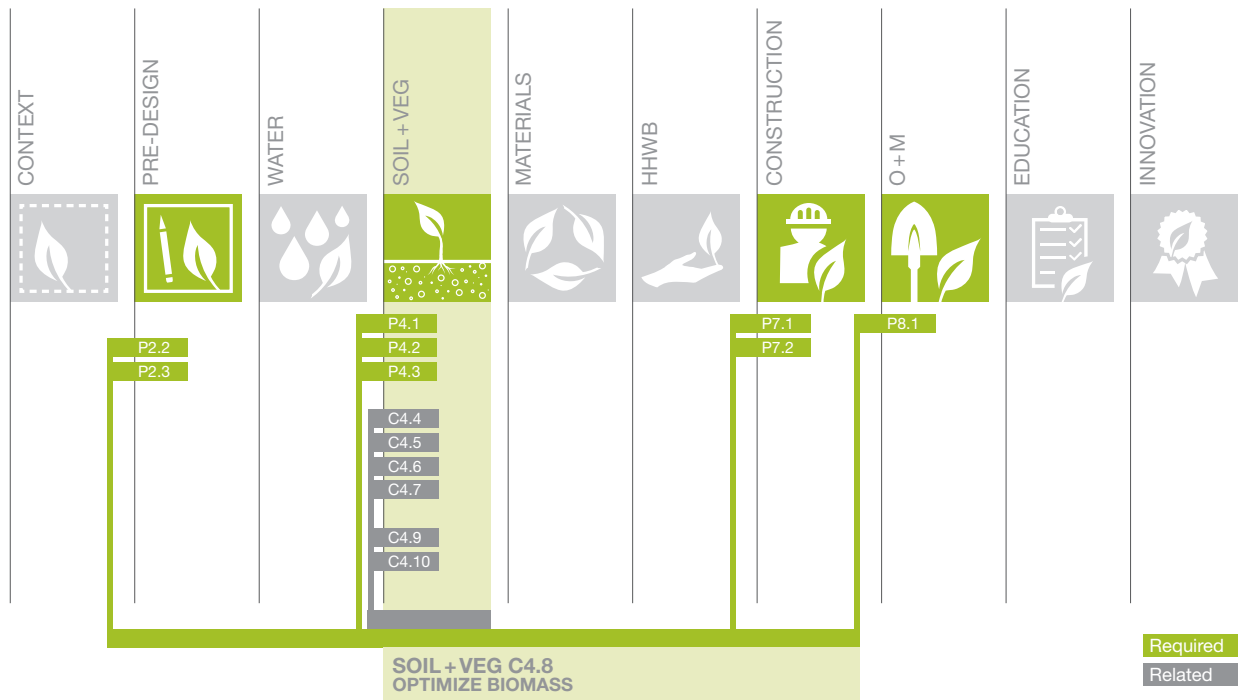


Section 4: Site Design—Soil + Vegetation

RESOURCES

- For information to help determine a site's terrestrial biome, consult the World Wildlife Fund Wildfinder at www.worldwildlife.org/science/wildfinder.
- For more information about leaf area index, consult GP Scurlock, and JA Hicke, "Global synthesis of leaf area index observations: Implications for ecological and remote sensing Asner, JMO studies," *Global Ecology & Biogeography* 12 (2003): pp. 191-205.
- For information on turf and turfgrasses, see these sources:
 - AD Brede Initial mowing of Kentucky bluegrass-perennial ryegrass seedling turf mixtures. *Agron. J.* 1984. 76 (5): 711–714.
 - DM Kopec *An indirect method for estimating turfgrass leaf area index.* *Crop Sci.* 27 (1987): 1298–1300.
 - H Lee, DJ Bremer, K Su, and SJ Keeley *Relationships between NDVI and visual quality in turfgrasses: Effects of mowing height* (Kansas State University thesis) (2011) retrieved from krex.ksu.edu.
 - D Johns *Resistances to evapotranspiration from a St. Augustine grass turf canopy.* *Agron. J.* 1981. 75:419–422.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C4.8



Credit 4.9: Reduce urban heat island effects

4 points

INTENT

Minimize effects on microclimate and human and wildlife habitat by using vegetation and reflective materials to reduce heat island effects.

REQUIREMENTS

Use any combination of the following measures to reduce urban heat island effects for site paving and structures (including roads, sidewalks, courtyards, playgrounds, shelters, and parking lots) according to the formula below:

$$\frac{\text{area of non-roof measures}}{0.5} + \frac{\text{area of high-reflectance roof}}{0.75} + \frac{\text{area of vegetated roof}}{0.5} \geq \text{total site paving area} + \text{total roof area}$$

Alternatively, a solar reflectance index (SRI) and solar reflectance (SR) weighted average approach may be used to calculate compliance.

- Non-roof measures
 - 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 time of certification application and cannot contain artificial turf.
 - Provide shade with structures covered by energy generation systems that produce renewable energy such as solar thermal heaters, photovoltaics, and wind turbines.
 - Provide shade with architectural devices or structures that have an SR value at installation of at least 0.33 OR a three-year old SR of at least 0.28, and incorporate into the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) activities to ensure these surfaces are cleaned at least every two years to maintain reflectivity.
 - Provide shade with vegetated structures.
 - Use paving materials with an SR of at least 0.33 at installation, OR a three-year aged SR value of at least 0.28, and incorporate into the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) activities to ensure these surfaces are cleaned at least every two years to maintain reflectivity.
 - Use an open-grid pavement system (e.g., concrete-grass lattice) that is at least 50 percent unbound.
- High-reflectance roof
 - Use roofing materials that have an SRI equal to or greater than the values in the table below. Meet either the initial SR value, the three-year aged SR value, or both.

Minimum Solar Reflectance Index Value, By Roof Slope

	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.

C4.9



Section 4: Site Design—Soil + Vegetation

Shade calculations must be based on the arithmetic mean of the percent wall and roof coverage at 10 a.m., noon, and 3 p.m. on the summer solstice.

SUBMITTAL DOCUMENTATION

- Site plan showing the total area of site paving and structures and the total area covered by any combination of the measures listed above
- Shade calculations demonstrating the percentage of site paving and structures that will be shaded
- Calculations following the given formula showing the project's compliance with the requirements
- List of selected materials that demonstrate the required SR or SRI values
- Manufacturer documentation of SR, SRI, and paving permeability

RECOMMENDED STRATEGIES

- Select strategies, materials, and landscaping techniques that reduce heat absorption by exterior surfaces.
- Reduce use of constructed impervious surfaces (e.g., roads, sidewalks, parking lots).
- Increase use of vegetated surfaces and planted areas.
- Use shade from appropriate trees, large shrubs, vegetated trellises, walls, or other exterior structures.
- Consider the use of new coatings and integral colorants for asphalt pavement to achieve light-colored surfaces instead of traditional dark surface materials.
- Position photovoltaic cells to shade impervious surfaces.
- Neither permeable concrete nor permeable asphalt meet the definition of open-grid paving system because both are more than 50 percent impervious. However, the SR of permeable concrete may be greater than 0.33.
- Consider placing parking under cover that complies with the above measures.

C4.9



ECONOMIC AND SOCIAL BENEFITS

Urban heat island effects can increase air-conditioning costs, air pollution levels, and heat- and pollution-related illness and mortality.¹ Use of vegetation, shade structures, and other techniques to cool the air can reduce costs associated with urban heat islands. Vegetation provides cooling through shading and evapotranspiration. Evapotranspiration alone can reduce peak summer air temperatures by as much as 2 to 9 degrees F.²

Shade trees planted in parking lots reduce evaporative emissions of volatile organic compounds—precursors to ground-level ozone—from parked cars.³ Shade trees in parking lots also reduce pavement's solar exposure, reducing heat absorption and emittance while potentially reducing pavement aging and maintenance requirements. Heat islands may provide winter benefits in colder climates, but these are often outweighed by harmful effects during the summer. Some heat island reduction strategies, such as using open-grid paving or shading with deciduous trees, can reduce summertime heat islands while providing wintertime benefits.⁴

Lighter-colored surfaces (as opposed to shiny, dark ones) increase reflectance and reduce absorption of solar radiation and may cause less disorienting effects on birds and insects.⁵

1. U.S. Environmental Protection Agency, "Heat Island Effect," www.epa.gov/hiri/index.html (accessed March 23, 2013).
2. K Lee and G Moller, "Urban Heat Island Effect," University of Idaho, www.webpages.uidaho.edu/sustainability/ch04-p05e.html (accessed March 23, 2013).
3. DJ Nowak, "The Effects of Urban Trees on Air Quality," USDA Forest Service (2002), www.nrs.fs.fed.us/units/urban/local-resources/downloads/Tree_Air_Qual.pdf (accessed March 23, 2013).
4. U.S. Environmental Protection Agency, "Heat Island Effect," www.epa.gov/hiri/index.html (accessed March 23, 2013).
5. G Horvath, G Kriska, P Malik, and B Robertson, "Polarized Light Pollution: A New Kind of Ecological Photopollution," *Frontiers in Ecology and the Environment* 7, no. 6 (2009): pp.317-325.

Section 4: Site Design—Soil + Vegetation

DEFINITIONS

- **Heat islands** are thermal gradient differences between developed and undeveloped areas.
- **Open-grid pavement** is pavement that is less than 50 percent impervious and contains vegetation in the open cells.
- **Solar reflectance (SR)** is the fraction of solar energy that is reflected by a surface on a scale of 0 to 1. Black paint has a solar reflectance of 0; white paint (titanium dioxide) has a solar reflectance of 1. The standard technique for its determination uses spectrophotometric measurements, with an integrating sphere to determine the reflectance at each wavelength. The average reflectance is then determined by an averaging process, using a standard solar spectrum, as documented by ASTM Standards E903 and E892.
- **Solar reflectance index (SRI)** is a measure of a material's ability to reject solar heat, as shown by a small temperature rise. Standard black (reflectance 0.05, emittance 0.90) is 0 and standard white (reflectance 0.80, emittance 0.90) is 100. For example, a standard black surface has a temperature rise of 90°F (50°C) in full sun, and a standard white surface has a temperature rise of 14.6°F (8.1°C). Once the maximum temperature rise of a given material has been computed, the SRI can be calculated by interpolating between the values for white and black. Materials with the highest SRI values are the coolest choices for paving. Because of the way SRI is defined, particularly hot materials can take slightly negative values, and particularly cool materials can exceed 100.

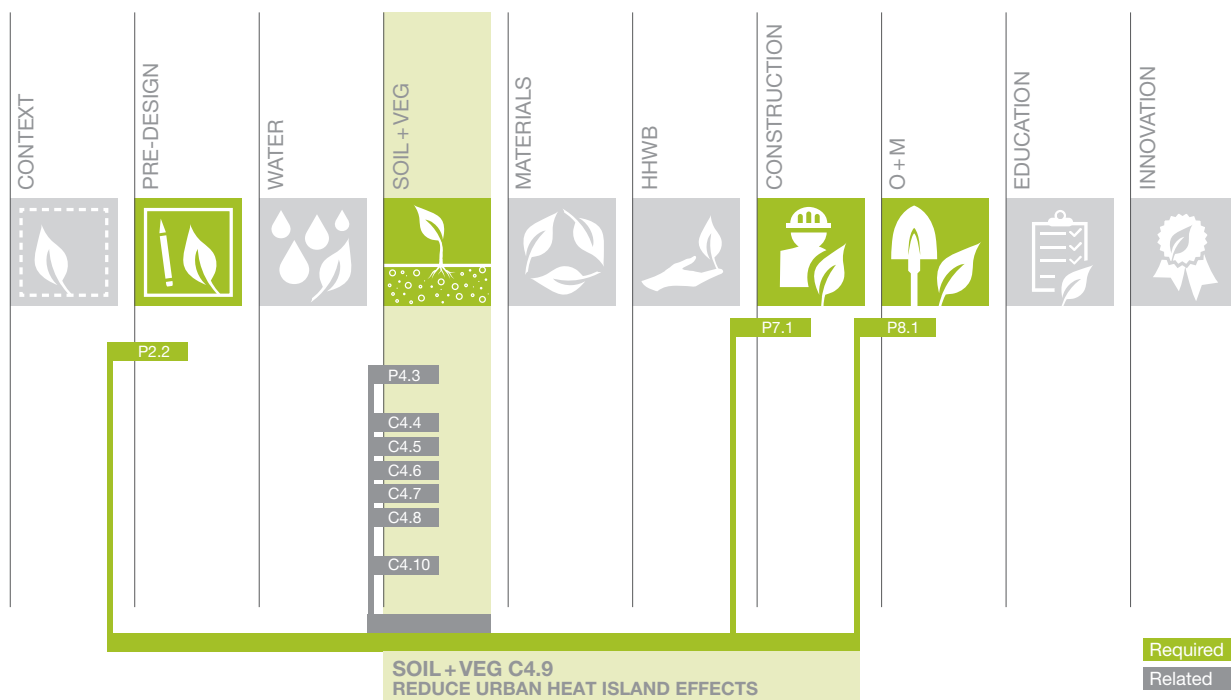
C4.9



RESOURCES

- Components of this credit were adapted from the U.S. Green Building Council's LEED credits:
 - LEED BD+C v2009 SS *Credit 7.1: Heat island effect—nonroof*
 - LEED BD+C v2009 SS *Credit 7.2: Heat island effect—roof*
 - LEED BD+C v4 SS *Credit 5: Heat island reduction*
- For more information about heat island effects, consult these sources:
 - U.S. EPA Heat Island Reduction Initiative, www.epa.gov/hiri.
 - Lawrence Berkeley National Laboratory, heatisland.lbl.gov

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 4.10: Use vegetation to minimize building energy use

1–4 points

INTENT

Place vegetation or vegetated structures in strategic locations around regularly occupied buildings to reduce energy consumption and costs associated with indoor climate control.

REQUIREMENTS

This credit only applies to sites with regularly occupied buildings or buildings that use HVAC temperature regulation.

Option 1: Reduce energy use

- Use vegetation or vegetated structures to reduce total annual building energy use for heating and cooling by:
 - 5 percent **2 points**
 - 7 percent **4 points**

Note: See Documentation guidance section.

Option 2: Provide shade structures

- Use vegetation or vegetated structures to shade 100 percent of the exposed surface area of all HVAC units within 10 years of installation.

AND

- Shade a percentage of the surface area of west, southwest, southeast, and east building façades and 30 percent of total roof area within 10 years of installation as follows:
 - 30 percent **1 point**
 - 60 percent **2 points**

Note: See Documentation guidance section.

Option 3: Provide a windbreak

- Use trees and dense shrubs to serve as a windbreak for the buildings as follows:
 - One row of trees and dense shrubs that extends for the full length of the building's façades facing the prevailing winter wind **1 point**
 - Two or more rows of trees and dense shrubs in a staggered planting formation, with rows planted 12 to 20 feet (3.66 to 6.10 meters) apart, extending at least 50 feet (15.24 meters) longer than the building's walls facing the prevailing winter wind **2 points**

The windbreak must:

- Be at least 60 feet (18.29 meters) and no more than 200 feet (60.96 meters) from the building walls facing the prevailing winter wind (the windbreak provides ideal wind protection at distances two to five times the mature height of the trees)
- Not cast shadows on the building
- Use densely branched trees and dense shrubs, or a combination of these, branched to the ground in a row or rows to increase the density of the windbreak

C4.10



Section 4: Site Design—Soil + Vegetation

- Use spacing guidelines in the resources listed below for trees and shrubs in the windbreak to provide vegetation density that is adequate to protect the building. Spacing between rows and within rows should allow for proper use of suitable maintenance equipment.

Note: Projects can pursue both Option 2 and Option 3.

SUBMITTAL DOCUMENTATION

Option 1: Reduce energy use

- Site plan including a north arrow and the project's latitude and longitude and showing the following information:
 - The direction of prevailing winds
 - Building footprint
 - Locations of vegetation providing cooling benefits or windbreak vegetation relative to the building or buildings
 - Distances between individual plants (within-row and between-row distances, if applicable)
- Calculations and information sources used to estimate energy use for heating and cooling purposes and the annual energy savings from vegetation and vegetated structures
- *Vegetation Worksheet*, including scientific names, number of each species, leaf retention (evergreen or deciduous), and the estimated mature size (height and width) of the vegetation providing cooling benefits or windbreak
- Narrative outlining the planting strategy

Option 2: Provide shade structures

- Site plan including a north arrow, the project's latitude and longitude, building footprints, and locations of vegetation providing cooling benefits
- Plan and cross-section drawings to demonstrate the anticipated shading of wall or roof area (and HVAC unit, if applicable)
- Calculations documenting that the shaded surface area requirements will be met
- *Vegetation Worksheet*, including scientific names, number of each species, leaf retention, and the estimated mature size (height and width) of the vegetation providing cooling benefits

Option 3: Provide a windbreak

- Site plan including a north arrow and the project's latitude and longitude and showing the following information:
 - The direction of prevailing winds
 - Building footprint
 - Locations of windbreak vegetation relative to the building
 - Distances between individual plants (both within-row and between-row distances, if applicable)
- Plan and cross-section drawings to demonstrate the anticipated shading of wall or roof area (and HVAC unit, if applicable).
- List with scientific names, number of each species, leaf retention, and the estimated mature size (height and width) of the windbreak vegetation
- Narrative outlining the planting strategy

C4.10



Section 4: Site Design—Soil + Vegetation

DOCUMENTATION GUIDANCE

Option 1: Reduce energy use

- Estimate the building's baseline energy use for heating and cooling, using one of the following methods (or a local equivalent for projects outside the United States):
 - U.S. Department of Energy Commercial Buildings Energy Consumption Survey (www.eia.doe.gov/emeu/cbecs)
 - Multiply the building square footage by the average electricity intensity (kWh/square foot) for heating/cooling for all non-mall buildings. See the map from the U.S. Census Bureau (www.census.gov/geo/www/us_regdiv.pdf) to determine your region, and find U.S. regional averages below:
 - > Northeast: 0.8 kWh/square foot
 - > Midwest: 0.9 kWh/square foot
 - > South: 3.1 kWh/square foot
 - > West: 1.8 kWh/square foot
- Use i-Tree Design (www.itreetools.org/design.php) to calculate the estimated annual energy savings (kWh saved) from the vegetation or vegetated structures, using the estimated height and spread within 10 years of installation.

Option 2: Provide shade structures

- Perform shade studies for the site showing areas of shade coverage at 10 a.m., noon, and 3 p.m. on the summer solstice.
- Average the above areas of shade coverage.
- Calculate the percent of wall and roof shade coverage.

RECOMMENDED STRATEGIES

- Consult a local professional (e.g., arborist) for information on plant species that maximize benefits appropriate to the climate. Select tree and shrub species that can provide additional benefits to the site, such as food and habitat for wildlife or visual barriers from highways.
- In addition to trees, use shade trellises, green roofs, green façades, and green walls to increase shading. Select deciduous trees that allow access to the sun in winter and provide shade in summer.
- Vegetated roofs and walls may be an appropriate technique in helping to insulate the building envelope as well as providing ecosystem services such as water retention, habitat, and mentally restorative views for building occupants.

ECONOMIC AND SOCIAL BENEFITS

Vegetation used as windbreaks can result in heat energy savings of up to 40 percent.¹ Vegetation insulates buildings by reducing wind velocity and air movement inside the structure, provides cooling benefits through shading and evapotranspiration, and helps prevent heat loss in buildings by reducing wind speed. For example, a study of street trees in New York City found that natural gas savings from avoided heating requirement resulted in \$20.8 million in savings annually,² and that the climate-moderating benefits provided by trees resulted in annual energy savings of \$27.8 million, or \$47.63 per tree.³

1. JP Slusher and D Wallace, "Planning Tree Windbreaks in Missouri," University of Missouri Extension, G5900 (1997), extension.missouri.edu/publications/DisplayPub.aspx?P=G5900 (accessed March 23, 2013).
2. PJ Peper, EG McPherson, JR Simpson et al., *New York City, New York: Municipal Forest Resource Analysis*, Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service (2007), www.urbanforestry.south.org/resources/library/new-york-city-new-york-municipal-forest-resource-analysis (accessed March 23, 2013).
3. PJ Peper, EG McPherson, JR Simpson et al., *New York City, New York: Municipal Forest Resource Analysis*, Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service (2007), www.fs.fed.us/psw/programs/uesd/uep/products/2/psw_cufr687_NYC_MFRA.pdf (accessed March 23, 2013).

C4.10



Section 4: Site Design—Soil + Vegetation

DEFINITIONS

- **A regularly occupied building** is a building where occupants (e.g., workers, students, residents) are inside for extended periods of time.

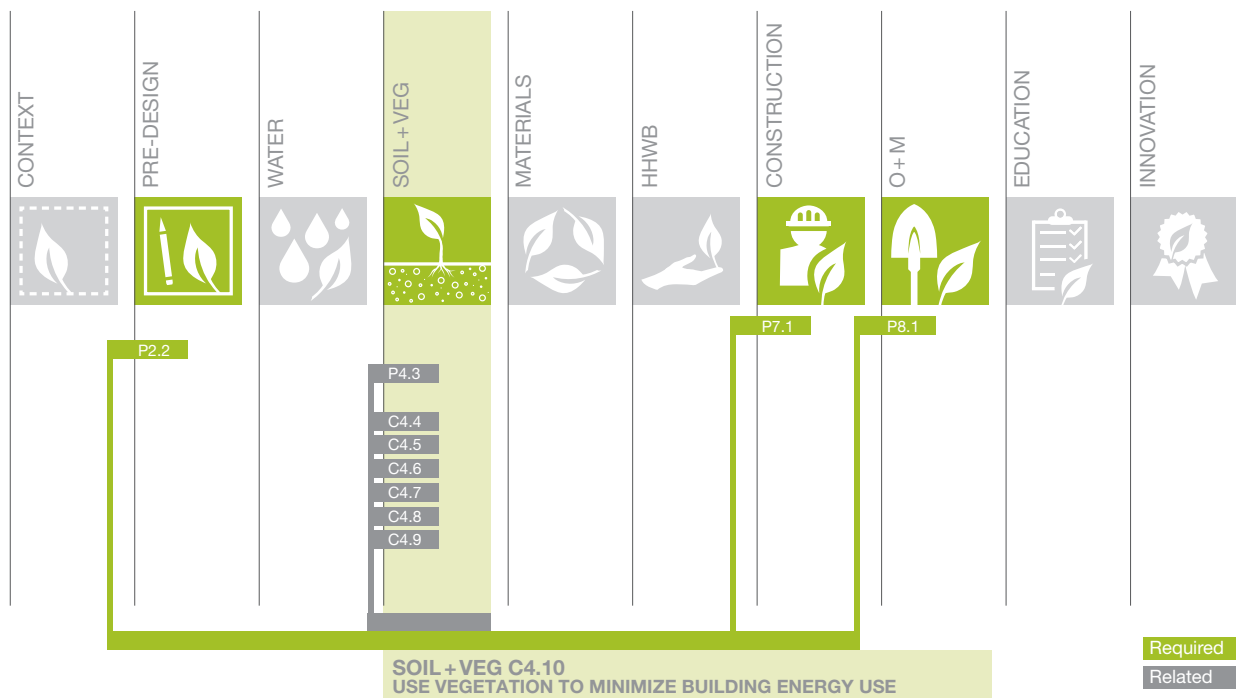
RESOURCES

- For estimated annual energy savings from vegetation, see the i-Tree Design tool, www.itreetools.org/design.php.
- For additional guidance on planning a site windbreak, see resources from state extension services and other sources:
 - Missouri, extension.missouri.edu/xplor/agguides/forestry/g05900.htm
 - Utah, forestry.usu.edu/html/rural-forests/windbreaks/windbreaks-for-livestock-and-wildlife
 - USDA Natural Resources Conservation Service Windbreak Series, www.unl.edu/nac/windbreaks.htm
 - U.S. National Renewable Energy Laboratory's "Landscaping for Energy Efficiency" report, www1.eere.energy.gov/library/pdfs/16632.pdf
- For additional guidance on tree placement, tree selection, and other techniques to maximize energy savings, refer to
 - USDA Forest Service Center for Urban Forest Research, Pacific Southwest Research Station community tree guides, www.fs.fed.us/psw/programs/cufr/tree_guides.php
 - USDA Forest Service Pacific Southwest Research Station report "Carbon Dioxide Reduction through Urban Forestry: Guidelines for Professional and Volunteer Tree Planters," www.fs.fed.us/psw/programs/cufr/products/cufr_43.pdf
- For a comprehensive Tree Carbon Calculator for sites in California, consult the USDA Forest Service Pacific Southwest Research Station Center for Urban Forest Research, www.fs.fed.us/ccrc/topics/urban-forests/ctcc.
- For additional information about landscaping to reduce cooling costs, consult the U.S. Department of Energy resources online at, www.energysavers.gov/your_home/landscaping/index.cfm/mytopic=11910.

C4.10



LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 4.11: Reduce the risk of catastrophic wildfire

4 points

INTENT

Reduce the risk of catastrophic wildfire on site and in adjacent landscapes by designing, building, and maintaining sites to manage fuels.

REQUIREMENTS

- Document that the project is in a fire-prone zone (see *Pre-Design P2.2: Conduct a pre-design site assessment*).
- Design, build, and maintain the landscape and structures according to the techniques listed in the “Firewise Landscaping Checklist,” which is Appendix E of *Safer from the Start: A Guide to Firewise-Friendly Developments*, [www.firewise.org/~media/Firewise/Files/Pdfs/Booklets and Brochures/BookletSaferFromtheStart.pdf](http://www.firewise.org/~media/Firewise/Files/Pdfs/Booklets%20and%20Brochures/BookletSaferFromtheStart.pdf).
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and includes strategies to manage vegetative biomass and fuel loads at responsible levels and to reduce accumulation of dead plant material throughout the vegetated portions of the site. Use prescribed fires or other fuel management techniques in frequencies and intensities similar to the natural fire regime for the ecosystem.

Note: SITES encourages projects to design for scaled resiliency to other catastrophic natural events (e.g., flooding, earthquakes, drought, hurricanes, tornadoes) and encourages projects to apply for *Innovation C10.1: Innovation or exemplary performance* to earn innovation credit for such efforts.

SUBMITTAL DOCUMENTATION

- Site plan and photographs showing the landscape design around structures on site
- If prescribed burns are performed on site, provide the burn plan approved by the state or local fire agency, including smoke management, back up, protection from soil erosion, and expected fire cycle.
- Completed *Vegetation Worksheet* listing all plants installed on site
- List of techniques from the “Firewise Landscaping Checklist” that have been incorporated into site design
- Narrative describing how the landscape design reduces fire risk
- Letter from local fire agency stating that the site is in a fire-prone zone or at risk of catastrophic wildfire
- Signatures from the contractor or owner that confirms fire risk reduction techniques were incorporated into the design

RECOMMENDED STRATEGIES

- Contact local fire departments or state forestry agencies for recommendations on plant spacing, fire-resistant plant species, and fuel management practices appropriate to the local area.
- Use prescribed fires or other fuel management techniques in frequencies and intensities similar to the natural fire regime for the ecosystem.

C4.11



Section 4: Site Design—Soil + Vegetation

ECONOMIC AND SOCIAL BENEFITS

Designing defensible space around structures protects property from wildfire damage by reducing flame heights and making fires easier to extinguish.¹ When fuel loads exceed historical conditions, high intensity fires are more likely to occur, causing significant ecological damage.² Management of fuels on site reduces risks to local ecosystems, property, and lives.

1. Colorado State Forest Service, "Protecting Your Home from Wildfire: Creating Wildfire-Defensible Zones," Fire 2012-1, csfs.colostate.edu/pdfs/FIRE2012_1_DspaceQuickGuide.pdf (accessed March 23, 2013).
2. Society of American Foresters Council, "Wildfire Management: A Position of the Society of American Foresters," Society of American Foresters, www.safnet.org/fp/documents/wildland_fire.pdf (accessed March 23, 2013).

RESOURCES

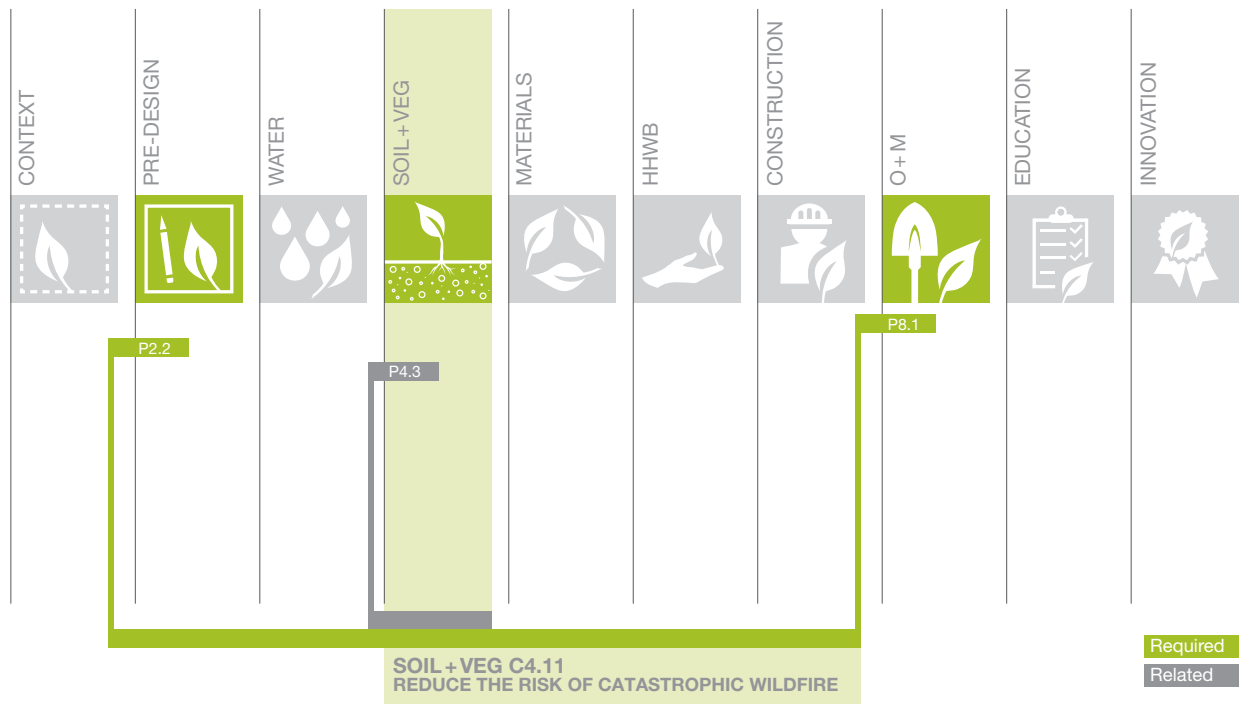
- For the "Firewise Landscaping Checklist" see Appendix E (page 35) of the *Safer from the Start: A Guide to Firewise-Friendly Developments*, [www.firewise.org/~media/Firewise/Files/Pdfs/Booklets and Brochures/BookletSaferFromtheStart.pdf](http://www.firewise.org/~media/Firewise/Files/Pdfs/Booklets%20and%20Brochures/BookletSaferFromtheStart.pdf)
- For more information on designing for defensible spaces, see Firewise Communities resources, www.firewise.org or Fire Safe Council resources, www.firesafecouncil.org.
- For guidelines and resources specific to U.S. states, consult the Firewise "Landscaping and Plants List," www.firewise.org/information/research-and-guidance/firewise-landscaping-and-plant-lists.aspx.
- For information on fire regimes and fire regime condition classes throughout the United States, see the U.S. Geological Survey LANDFIRE data distribution site, www.landfire.gov/viewer.
- For information about fire ordinances, see RF Brzuszek and JB Walker "Trends in Community Fire Ordinances and Their Effects on Landscape Architecture Practice" *Landscape Journal* 27, no.1 (2008): pp. 142–153.
- For information about plants for protection against and restoration after wildfires, consult the USDA Natural Resources Conservation Service, www.nrcs.usda.gov/wps/portal/nrcs/detail/national/home/?cid=STELPRDB1044051.
- For information about the International Wildland-Urban Interface Code, consult the International Code Council, publicecodes.cyberregs.com/icod/iwuic/2012/index.htm.
- For a sample local fuel modification plan, see the California Fuel Modification Plan Checklist, fire.lacounty.gov/forestry/FuelModificationPlan.asp.

C4.11



Section 4: Site Design—Soil + Vegetation

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C4.11





SECTION 5

SITE DESIGN – MATERIALS SELECTION

PREREQUISITE / CREDIT	TITLE	POINTS
Materials P5.1	Eliminate the use of wood from threatened tree species	Required
Materials C5.2	Maintain on-site structures and paving	2-4 points
Materials C5.3	Design for adaptability and disassembly	3-4 points
Materials C5.4	Reuse salvaged materials and plants	3-4 points
Materials C5.5	Use recycled content materials	3-4 points
Materials C5.6	Use regional materials	3-5 points
Materials C5.7	Support responsible extraction of raw materials	1-5 points
Materials C5.8	Support transparency and safer chemistry	1-5 points
Materials C5.9	Support sustainability in materials manufacturing	1-5 points
Materials C5.10	Support sustainability in plant production	1-5 points

Prerequisite 5.1: Eliminate the use of wood from threatened tree species

Required

INTENT

Minimize negative effects on ecosystems by purchasing wood products extracted only from non-threatened tree species.

REQUIREMENTS

This prerequisite applies to all new wood products purchased and installed on the project (e.g., mulch, wood for site furniture, decks, railings, outdoor structures) as well as temporary wood used during construction (e.g., formwork, pallets, scaffolding, sidewalk protection, guardrails).

- Do not use wood species that meet the following criteria (see Resources section):
 - Listed by the Convention on International Trade in Endangered Species (CITES) as threatened with extinction (Appendix I)
 - Listed by CITES as requiring trade controls in order to avoid utilization incompatible with their survival (Appendix II)
 - On the International Union for Conservation of Nature (IUCN) “Red List of Threatened Species” as extinct in the wild (EW), critically endangered (CR), and endangered (EN)
- Threatened tree species are allowed if a recognized third-party sustainable forestry management certification program has certified the wood product per *Materials C5.7: Support responsible extraction of raw materials*.

SUBMITTAL DOCUMENTATION

- *Materials Worksheet* listing all purchased wood products, their species names, and indicating that the tree species’ classifications are not listed by IUCN or CITES
- For any threatened tree species used, provide documentation to demonstrate a recognized third-party sustainable forestry management certification program has certified the product.

RECOMMENDED STRATEGIES

- Identify suppliers who provide wood products from sustainably managed forests.
- Consider using recycled plastic or composite lumber instead of wood.

ECONOMIC AND SOCIAL BENEFITS

The interactions and feedback mechanisms of natural ecosystems have developed over time to result in relative stability and resistance to pests and diseases. Reducing populations of already threatened species can disrupt stable natural ecosystems, which control more than 95 percent of the potential crop pests and carriers of human diseases.¹

1. PR Ehrlich “The Concept of Human Ecology: A Personal View,” IUCN Bulletin 16, no. 4–6 (1985): pp. 60–61.

P5.1

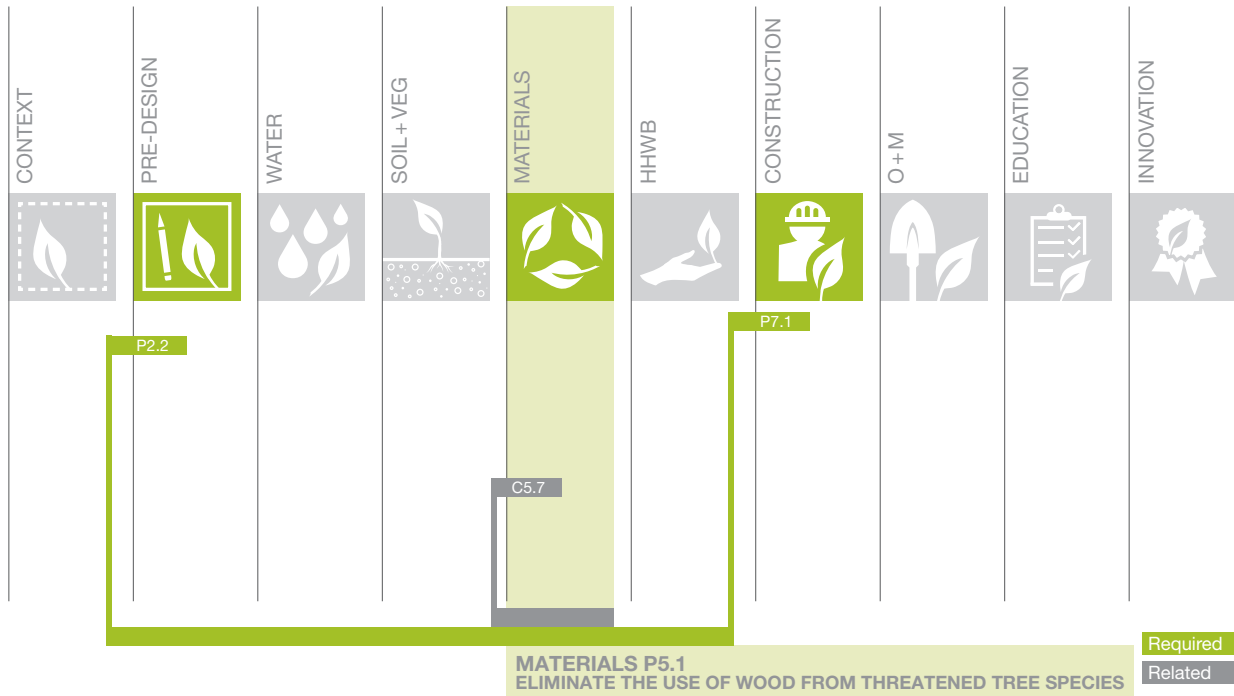


Section 5: Site Design – Materials Selection

RESOURCES

- For information about threatened species, consult the IUCN “Red List of Threatened Species” website, which is searchable by species, www.iucnredlist.org.
- For an online searchable species database, consult the CITES website, www.cites.org/eng/resources/species.html.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 5.2: Maintain on-site structures and paving

2–4 points

INTENT

Extend the life-cycle of building and infrastructure stock, conserve resources, and reduce waste by maintaining existing structures and paving in their existing form.

REQUIREMENTS

Existing on-site structures and paving that are maintained in situ are eligible for this credit. Regularly occupied buildings, which are outside of the scope of SITES, should not be counted for this credit.

Surface area calculations should include any below-grade components such as foundations and footings, when determination of these elements is feasible. Exclude materials hazardous to plants, animals, or humans from total surface area calculations.

- Maintain existing structures and paving on site for at least:
 - 10 percent of the total existing built surface area **2 points**
 - 20 percent of the total existing built surface area **3 points**
 - 30 percent of the total existing built surface area **4 points**
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and shows all existing on-site structures and paving.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete, details the processes used for maintaining structures and paving to ensure site safety, and meets the needs of the intended uses of the site.

SUBMITTAL DOCUMENTATION

- Site plans showing:
 - The locations of all existing structures and paving
 - The locations and areas of existing structures and paving designed to remain on site
- Calculations including total surface area of all existing structures (including foundations and footings, where feasibly determined) and paving on site (excluding hazardous materials), and the surface area and percentage of these materials that will remain in situ
- Pre- and post-development photographs showing maintained structures and paving

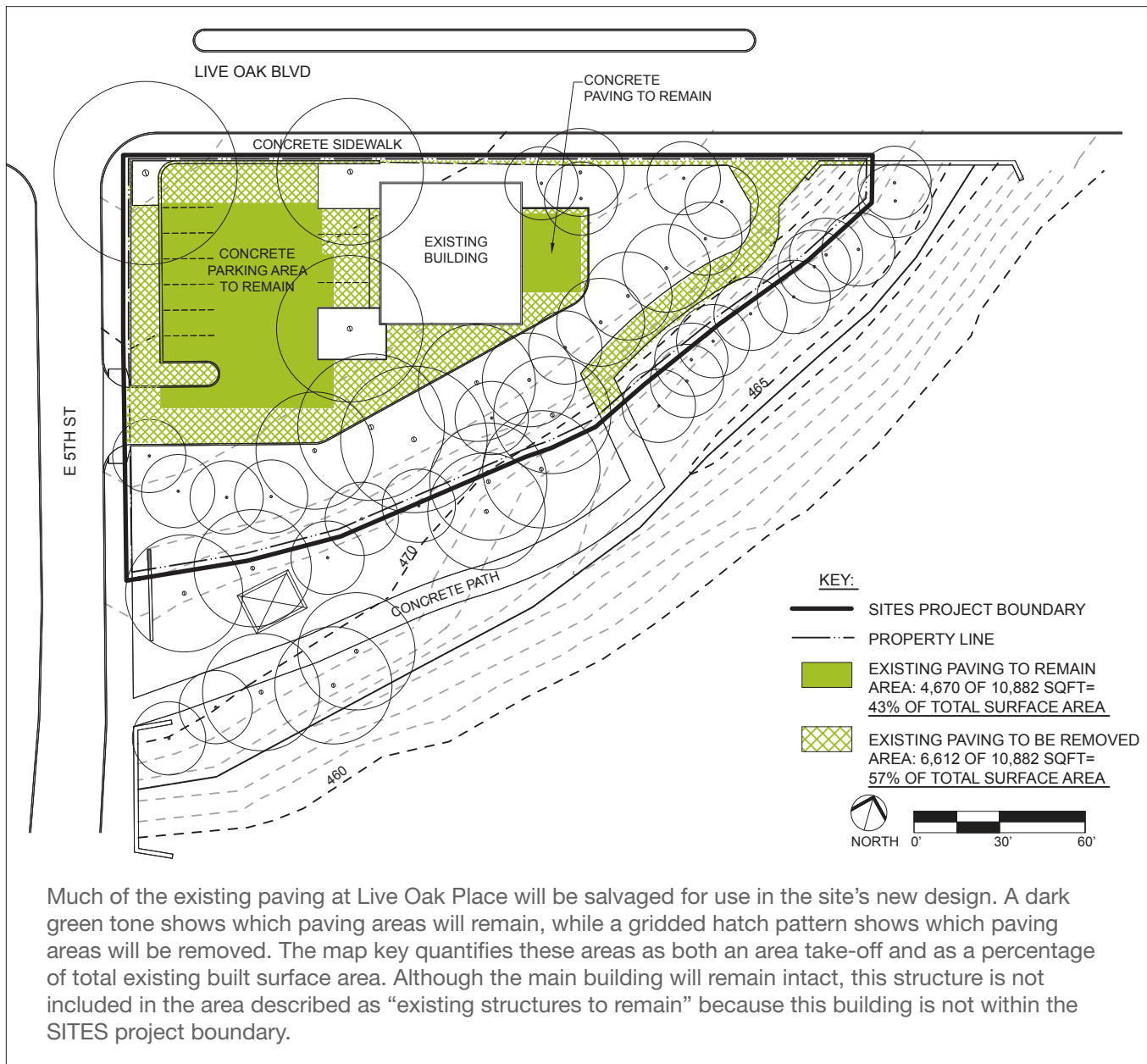
C5.2



Section 5: Site Design—Materials Selection

DOCUMENTATION GUIDANCE

Example: Live Oak Place



C5.2



Section 5: Site Design—Materials Selection

RECOMMENDED STRATEGIES

- Identify and inventory structures (including ones that are subgrade) that can be refurbished and reused in place.
- Clean, repair, and refinish existing structures and paving.

ECONOMIC AND SOCIAL BENEFITS

Retaining existing structures and paving avoids costs for demolition, transportation, and the disposal of demolished materials in a landfill. Using existing structures and paving in new site development reduces the cost of constructing new structures and paving.¹ Reusing existing landscape structures can also create a unique sense of place and connect site users to historical or cultural legacies, which may result in tourism opportunities and strengthened cultural pride.

1. J Thompson and K Sorvig, *Sustainable Landscape Construction: A Guide to Building Outdoors* (Washington, DC, Island Press: 2000).

DEFINITIONS

- A **regularly occupied building** is a building where occupants (e.g., workers, students, residents) are inside for extended periods of time.

RESOURCES

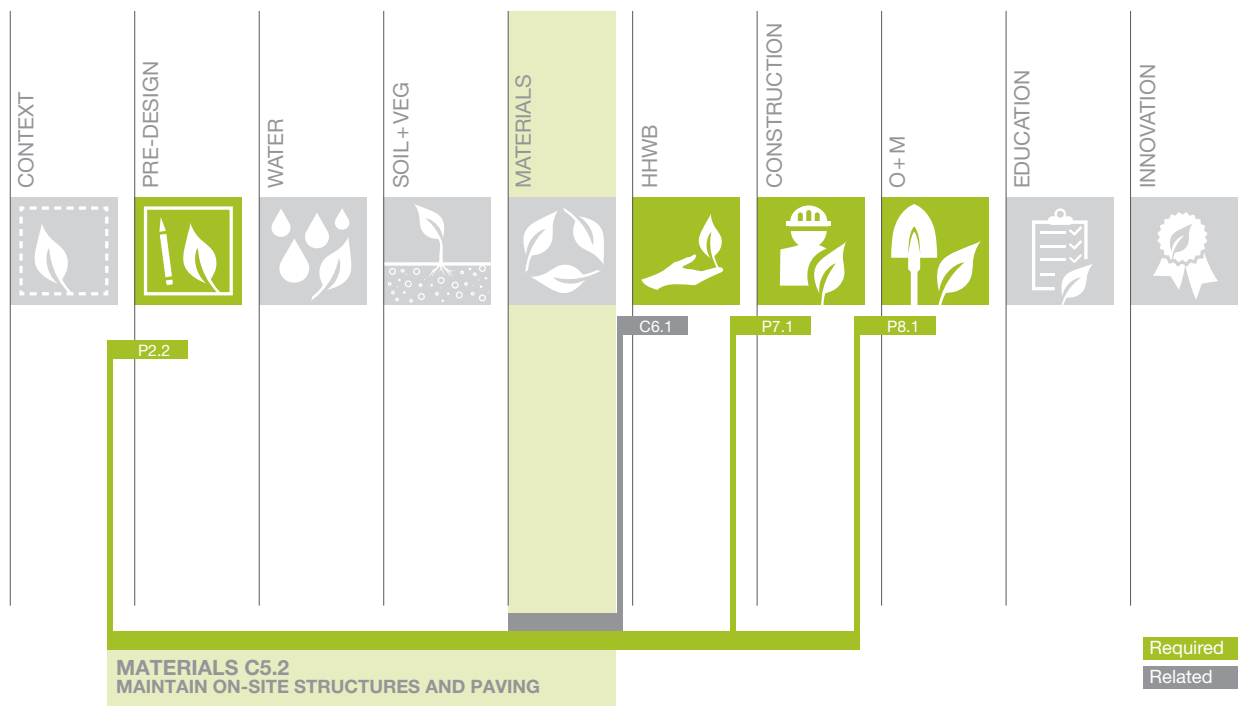
- Components of this credit were adapted from the U.S. Green Building Council's LEED credits:
 - LEED BD+C v2009 *MR Credit 1.1: Building reuse—maintain existing walls, floors, roofs*
 - LEED BD+C v2009 *MR Credit 1.2: Building reuse—maintain interior nonstructural elements*.
- For information regarding whole building guidance, criteria, and technology, consult the Whole Building Design Guide, www.wbdg.org.
- For information about procuring green building products and construction and renovation services, consult the Whole Building Design Guide's Federal Green Construction Guide for Specifiers, www.wbdg.org/ccb/browse_cat.php?c=250.

C5.2



Section 5: Site Design – Materials Selection

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 5.3: Design for adaptability and disassembly

3–4 points

INTENT

Minimize materials use and waste flows over the life-cycle of site design projects by increasing the efficient use of materials at construction, facilitating flexibility and adaptation, and increasing the reuse and recycling of materials resulting from renovation and demolition.

REQUIREMENTS

Percentages are based on cost or replacement value. In the case of mixed material assemblies, determine the portion of the total weight that is reusable. Multiply the portion of total weight by the total cost to determine the proportion of product assembly that meets the requirements of this credit (*Materials Worksheet* automatically does this). Plants, rocks, and soils are excluded from this credit.

- Use material assemblies, products, or product components that are designed for disassembly and facilitate reuse for at least:
 - 30 percent of total materials cost, excluding plants, rocks, and soils **3 points**
 - 60 percent of total materials cost, excluding plants, rocks, and soils **4 points**
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete, explains how to replace any deteriorating or damaged components, and lists any proper maintenance techniques.

SUBMITTAL DOCUMENTATION

- *Materials Worksheet* listing the costs of materials assemblies, products, and product components used for purposes of verifying this credit. Indicate which items are designed for disassembly and reuse and the corresponding percentage of total materials cost (excluding plants, rocks, and soils).
- Narrative describing:
 - How each listed material assembly, product, or product component proposed for credit was fabricated, designed, or site-constructed for disassembly or adaptability, ease of adaptation, and possible reuse in the future
 - Appropriate way to disassemble each material assembly, product, or product component so that it can be reused
- Adaptability plan, if applicable, including construction details identifying what each component is made of and how it should be assembled or disassembled and listing any and all potential reuse applications

C5.3



Section 5: Site Design—Materials Selection

RECOMMENDED STRATEGIES

- Establish a project goal for future adaptation and renovation of the project and reusable products, and identify material and product suppliers who can help achieve this goal.
- Design construction details to facilitate disassembly without damage to the material:
 - Use reversible connections (e.g., bolts, screws) and avoid the use of mortar, adhesives, welded connections, or nailed connections that cannot be easily removed.
 - Use friction-fit and other mechanical connections that rely on compression or lateral or vertical forces (e.g., mortar-less retaining walls, interlocking sand-laid pavers).
 - Avoid the use of coatings on products for which current industry practice prohibits recycling of the material.
 - Eliminate or reduce the use of composites for which current industry practice prohibits recycling of the material.
 - Use durable and high-quality materials that exceed minimum performance standards.
 - Document as-built drawings if outcome on site is different from design drawings.

ECONOMIC AND SOCIAL BENEFITS

In the future, project sites may generate revenue for sales of materials salvaged from reusable or recyclable products on site. Alterations will be more economical and produce less waste than in systems not designed for reuse or recycling.¹

1. M Calkins, *Materials for Sustainable Sites: A Complete Guide to the Evaluation, Selection, and Use of Sustainable Construction Materials* (Hoboken, NJ: John Wiley & Sons, Inc.: 2009).

C5.3



DEFINITIONS

- An **assembly** is an arrangement of more than one material or component to serve specific overall purposes.
- A **component** is any distinct, identifiable part of an assembly or landscape construction.
- **Design for disassembly** is the design of buildings or products to facilitate future change and the eventual dismantlement (in part or whole) for recovery of systems, components, and materials. This design process includes developing the assemblies, components, materials, construction techniques, and information and management systems to accomplish this goal.
- **Disassembly** is a process of carefully taking apart constructed elements with the intention of either reusing or recycling the materials. It may be undertaken during redevelopment, adaptation, or at the end of use on a site.
- **Replacement value** can be determined by pricing a comparable material in the local market.
- **Reuse** is a process of utilizing a used product or material in a manner that generally retains its original form and identity with minor refurbishments. Materials reusable in whole form might include sand-set pavers, segmental retaining walls, or mechanical fasteners, connections, or joinery (e.g., avoidance of adhesives and mortar).

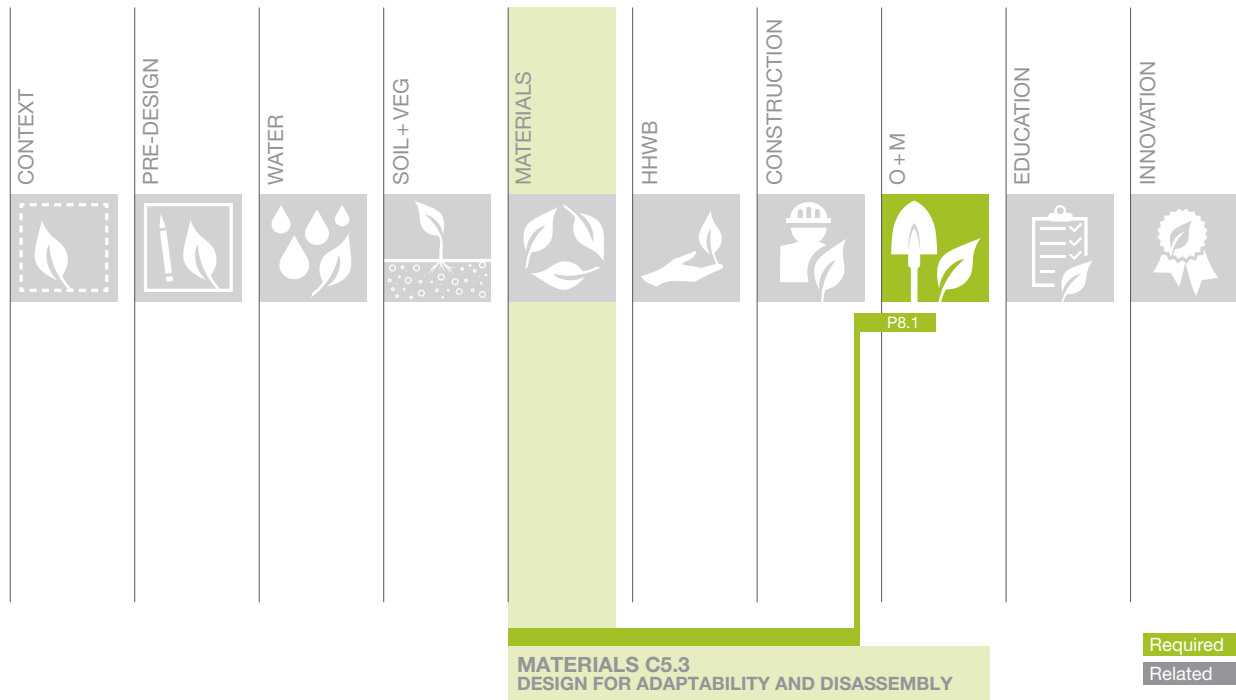
Section 5: Site Design – Materials Selection

RESOURCES

For more information on designing for deconstruction, refer to the following sources:

- Lifecycle Building Challenge, www.lifecyclebuilding.org/resources.php
- B Guy and N Ciamrimboli, *Design for Disassembly in the Built Environment: A Guide to Closed-Loop Design and Building* (Hamer Center for Community Design, The Pennsylvania State University, 2007).
- Canadian Standards Association (CSA) Z782-06 *Guideline for design for disassembly and adaptability in buildings*

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C5.3



Credit 5.4: Reuse salvaged materials and plants

3–4 points

INTENT

Conserve resources and avoid landfilling useful materials by reusing salvaged materials and appropriate plants.

REQUIREMENTS

Percentages are based on cost or replacement value. Soils and new materials with recycled content are excluded from this credit.

- Reuse salvaged materials (including plants) for at least:
 - 10 percent of total materials cost, excluding soils **3 points**
 - 20 percent of total materials cost, excluding soils **4 points**

SUBMITTAL DOCUMENTATION

- *Materials Worksheet* listing all salvaged or reused materials and plants and their costs or replacement values. Demonstrate using salvaged materials and plants meets the appropriate percentage of the applicable total materials cost.
- Description of each salvaged material or plant and how it will be reused

RECOMMENDED STRATEGIES

- Establish a project goal for salvaged materials and identify material suppliers or local projects that can help achieve this goal by supplying salvaged goods.
- Salvaged plants should be disease-free and show no signs of stress prior to moving
- Some native plant societies will rescue plants prior to construction and can also be a resource for conserving plants off site until they are ready to be reinstalled.

ECONOMIC AND SOCIAL BENEFITS

Reusing materials and plants may reduce costs for site development by eliminating or minimizing the need for purchasing new materials. Salvageable materials not used for site development can be supplied to local outlets for reuse, thus avoiding landfill disposal.¹

1. T Cook and AM Vanderzanden, *Sustainable Landscape Management* (Hoboken, NJ: John Wiley & Sons, Inc.: 2011).

DEFINITIONS

- **Recycled content** is the proportion, by mass, of pre-consumer or post-consumer recycled material in a product (ISO 14021). Salvaged materials do not qualify.
- **Replacement value** can be determined by pricing a comparable material in the local market.
- **Reuse** is a process of utilizing a used product or material in a manner that generally retains its original form and identity with minor refurbishments. Materials reusable in whole form might include sand-set pavers, segmental retaining walls, or mechanical fasteners, connections, or joinery (e.g., avoidance of adhesives and mortar).
- A **salvaged or reused material** is recovered from an existing building or site and employed on site without change to its condition. Structures, materials, plants, and rocks preserved in situ and new materials with recycled content do not qualify.

C5.4

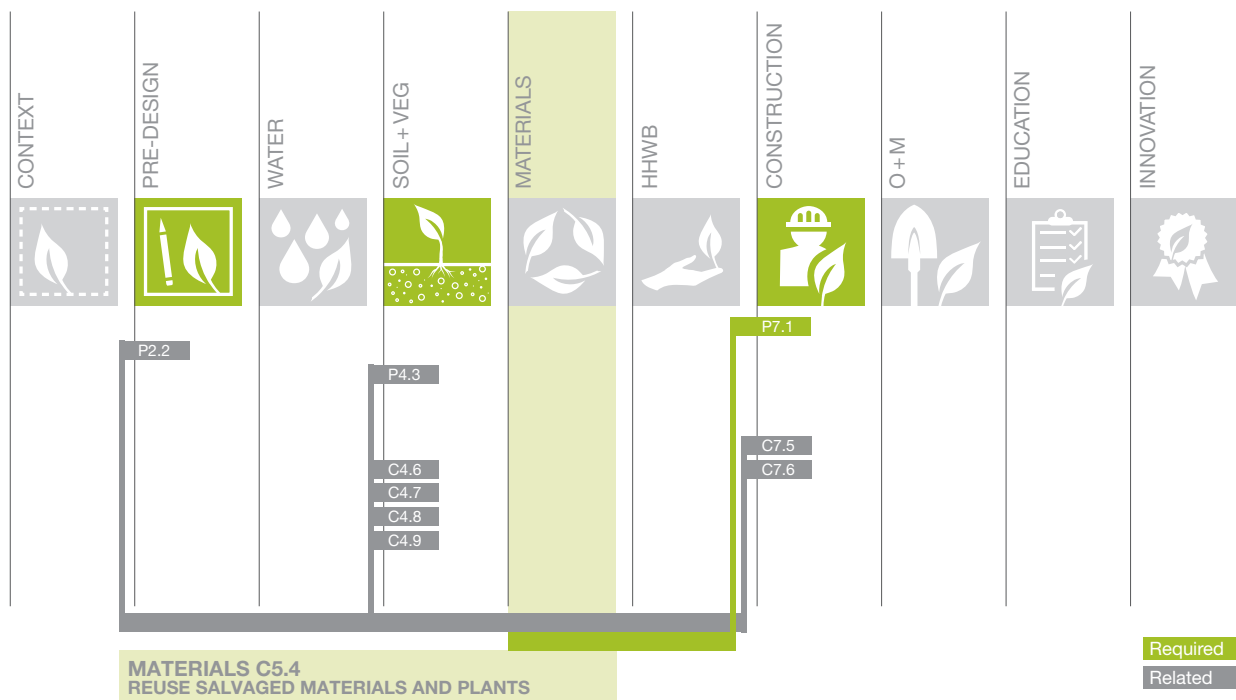


Section 5: Site Design – Materials Selection

RESOURCES

- Components of this credit were adapted from the U.S. Green Building Council's LEED credit: LEED BD+C v2009 *MR Credit 3: Materials reuse*.
- For more information on salvaged materials, see resources such as:
 - Green Building Research Guide's searchable database, www.greenguide.com/exchange/search.html
 - Reuse Development Organization, www.redo.org
- For directories of reuse stores, visit the following websites:
 - Building Materials Reuse Association, www.buildingreuse.org
 - Habitat for Humanity's ReStore, www.habitat.org/env/restores.aspx
- For guidance on tree valuation protocols, see the "Guide for Plant Appraisal," authored by representatives to the Council of Tree and Landscape Appraisers and available through the International Society of Arboriculture, www.isa-arbor.com.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 5.5: Use recycled content materials

3–4 points

INTENT

Reduce the consumption of virgin materials and avoid landfilling useful materials by purchasing products with recycled content.

REQUIREMENTS

Percentages are based on cost or replacement value. Determine the recycled content value of a material assembly by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

Plants and soils are addressed in other credits and are excluded from this credit.

Salvaged or reused materials do not qualify for this credit.

- Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least:

- 20 percent of total materials cost, excluding plants and soils

3 points

- 40 percent of total materials cost, excluding plants and soils

4 points

SUBMITTAL DOCUMENTATION

- *Materials Worksheet* listing all purchased materials, their cost or replacement values, and any of their post- and pre-consumer recycled content. Demonstrate that using materials with recycled content meets the appropriate percentage of the applicable total materials cost.
- Description of each recycled material and the percentage of post-consumer and pre-consumer or total recovered materials content

RECOMMENDED STRATEGIES

- Establish a project goal for recycled content, and identify material suppliers or local products that can help achieve this goal.
- Strategies that could be used to achieve this credit include:
 - Specifying plastic lumber made with recycled content
 - Using crushed concrete for aggregate bases
 - Specifying new asphalt with recycled asphalt aggregate
 - Specifying high recycled content steel
 - Utilizing spent iron and foundry sand as fine aggregate in concrete

ECONOMIC AND SOCIAL BENEFITS

Use of recycled materials eliminates the human health impacts of raw material extraction and reduces impacts from manufacturing. Using products with recycled content may also result in cost savings for the manufacturer, because recycled content materials generally are less expensive than virgin raw materials.¹ This cost savings may be passed on to the specifier. On-site recycling of materials such as concrete and asphalt eliminates the transportation and landfill costs associated with demolition. There is additional cost savings because new aggregate materials will not need to be purchased for the site.

1. M Calkins, *Materials for Sustainable Sites: A Complete Guide to the Evaluation, Selection, and Use of Sustainable Construction Materials* (Hoboken, NJ: John Wiley & Sons, Inc.: 2009).

C5.5



Section 5: Site Design – Materials Selection

DEFINITIONS

- **Post-consumer material** is waste material 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.
- **Pre-consumer material** is material diverted from the waste stream during the manufacturing process that could be used in a separate and different manufacturing process (e.g., reuse of flue gas desulfurization gypsum in drywall production). Excluded are materials such as rework, regrind, or scrap generated during processing that are capable of being reclaimed within the same process that generated them.
- **Recycled content** is the proportion, by mass, of pre-consumer or post-consumer recycled material in a product (ISO 14021). Salvaged materials do not qualify.
- **Replacement value** can be determined by pricing a comparable material in the local market.
- A **salvaged or reused material** is recovered from an existing building or site and employed on site without change to its condition. Structures, materials, plants, and rocks preserved in situ and new materials with recycled content do not qualify.

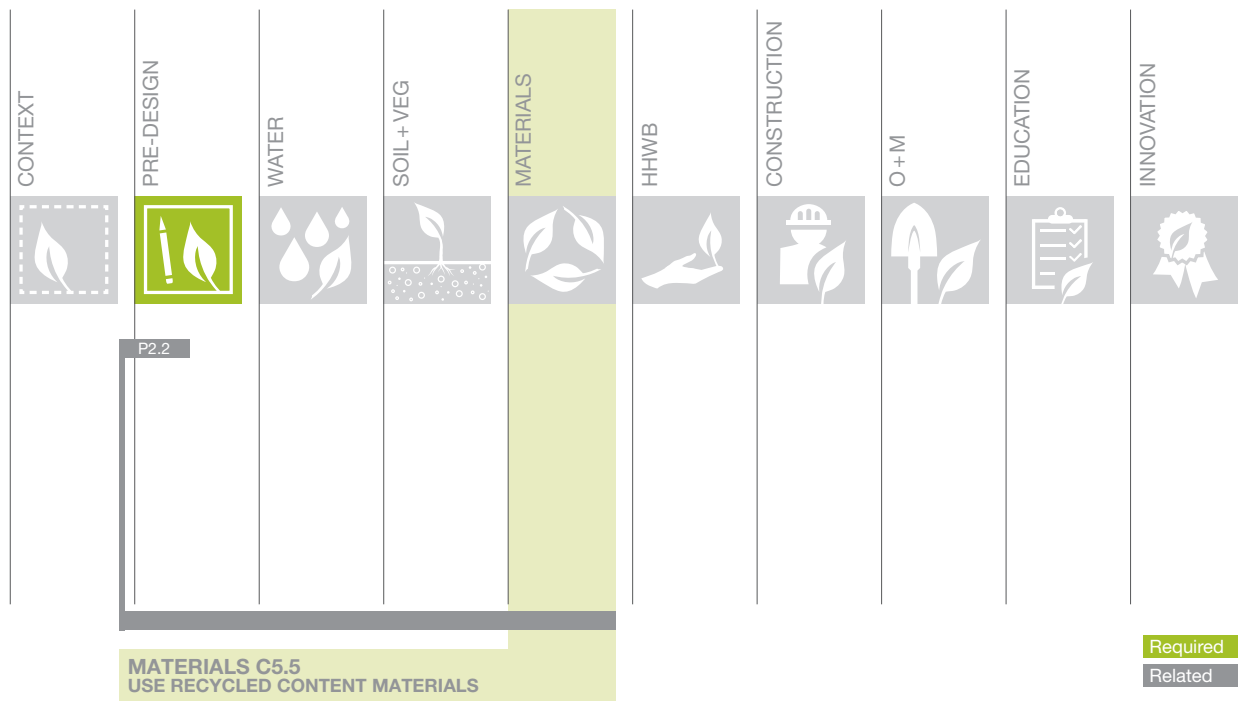
RESOURCES

- Components of this credit were adapted from the U.S. Green Building Council's LEED credit: LEED BD+C v2009 *MR Credit 4: Recycled content*.
- For more information on recycled products and industry materials recycling in the United States, consult these resources:
 - The U.S. EPA Industrial Materials website, www.epa.gov/industrialmaterials
 - The U.S. EPA Comprehensive Procurement Guidelines, www.epa.gov/cpg
 - California Department of Resources and Recycling, Recycled Content Products Directory, www.calrecycle.ca.gov/RCP/default.asp

C5.5



LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 5.6: Use regional materials

3–5 points

INTENT

Reduce energy use for transportation; increase demand for regional materials, plants, and soils; and promote regional identity by supporting the use of local resources.

REQUIREMENTS

Percent calculations are based on cost or replacement value. If only a fraction of a material is extracted, harvested, recovered, and manufactured within the specified distances, then only that percentage (by weight) shall contribute to the regional value.

- Use materials, plants, and soils that are sourced within the distances specified in the table below such that they constitute at least:
 - 30 percent of total materials cost **3 points**
 - 60 percent of total materials cost **4 points**
 - 90 percent of total materials cost **5 points**

Material Type	Distance Requirements
Soils, compost, and mulch	Extraction, harvest or recovery, and manufacture must occur within 50 miles (80.47 kilometers)
Boulders, rocks, and aggregate	Extraction, harvest or recovery, and manufacture must occur within 50 miles (80.47 kilometers)
Plants	All growing facilities and suppliers for the plant must be within 250 miles (402.34 kilometers)
All other materials	Extraction, harvest or recovery, and manufacture must occur within 500 miles (804.67 kilometers)

C5.6



SUBMITTAL DOCUMENTATION

- *Materials Worksheet* listing all materials, plants, and soils and the following information for each:
 - Cost or replacement value
 - Name and address of the manufacturer or grower
 - Distance between the site and the manufacturer or grower
 - Distance between the site and the extraction location for each raw material contained within each product (or grower or harvest location for plants or seeds)
 - Percentage of product by weight that meets both the extraction and manufacture criteria
 - Total percentage of regional materials transported to the site

RECOMMENDED STRATEGIES

- Identify regional sources for plants, soils, and other landscape materials, including those that are salvaged or reused or contain recycled content.
- Confirm that plant re-wholesalers and retailers obtain their products regionally.
- During construction, ensure that the specified local materials, plants, and soils are installed or used.

Section 5: Site Design—Materials Selection

ECONOMIC AND SOCIAL BENEFITS

The use of local materials deepens a sense of place and regional identity. Additionally, using local materials supports local business and feeds money into the regional economy. It also reduces fossil fuels used for transport, thus decreasing dependence on non-renewable resources and lowering carbon outputs.¹

1. University of Florida IFAS Extension, "Sustainable Landscape Construction: Materials and Products—Life Cycle Assessments," edis.ifas.ufl.edu/ep402 (accessed March 14, 2013).

DEFINITIONS

- **Recycled content** is the proportion, by mass, of pre-consumer or post-consumer recycled material in a product (ISO 14021). Salvaged materials do not qualify.
- **Replacement value** can be determined by pricing a comparable material in the local market.
- A **salvaged or reused material** is recovered from an existing building or site and employed on site without change to its condition. Structures, materials, plants, and rocks preserved in situ and new materials with recycled content do not qualify.

RESOURCES

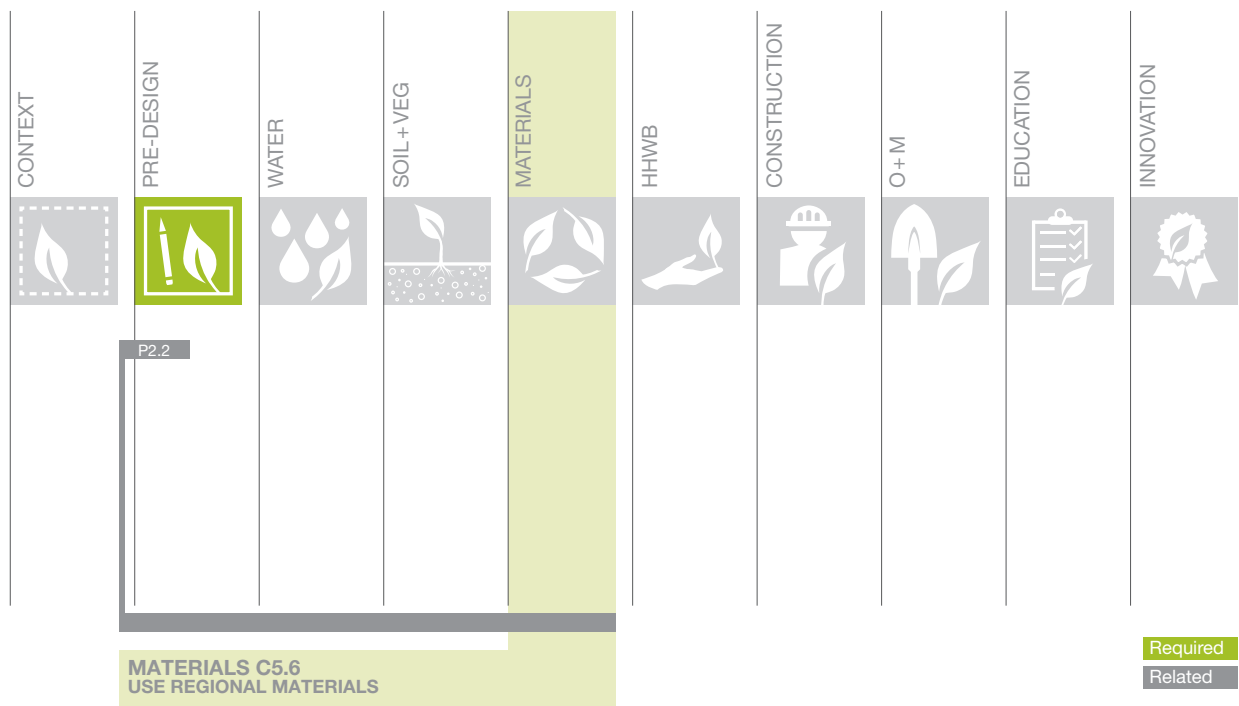
- Components of this credit were adapted from the U.S. Green Building Council's LEED credit: LEED BD+C v2009 *MR Credit 5: Regional materials*.
- For information on reducing energy use in transportation, consult these resources:
 - Center for Climate and Energy Solutions, "Medium- and Heavy-Duty Vehicles," www.c2es.org/docUploads/Medium-andHeavy-DutyVehicles_0.pdf
 - Native Energy's Travel Calculator, www.nativeenergy.com/travel-carbon-calculator.html
 - U.S. EPA Transportation and Climate webpage, www.epa.gov/otaq/climate/index.htm
- JW Thompson and K Sorvig, *Sustainable Landscape Construction: A Guide to Green Building Outdoors* (Washington, D.C., Island Press, 2000).
- For more information about materials and resources, consult the U.S. Green Building Council's webpage on the topic, leedcasestudies.usgbc.org/materials.cfm?ProjectID=189.

C5.6



Section 5: Site Design – Materials Selection

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 5.7: Support responsible extraction of raw materials

1–5 points

INTENT

Protect ecosystems, respect cultural and community values, and improve land use through responsible extraction of raw materials for site design and construction.

REQUIREMENTS

The requirements apply to all materials purchased for the project excluding products containing recycled content and salvaged, reused, or refurbished materials. Plants are addressed in other credits and are excluded from this credit. If only part of a composite material or assembly meets the requirements, count only that fraction, based on weight.

Option 1: Advocate for sustainable extraction of raw materials **1 point**

- Submit a letter to all raw materials suppliers and/or materials manufacturers asking them to track and disclose sustainable extraction practices.

Option 2: Support raw material suppliers and/or manufacturers that disclose data on environmental practices **3 points**

- Obtain five percent of the total materials costs (excluding recycled content, salvaged, reused, or refurbished materials) from raw materials suppliers and/or materials manufacturers that:
 - Report annual environmental performance via the Global Reporting Initiative (GRI), or equivalent, including the Mining and Metals supplement, if applicable
 - Provide a publicly available sustainability statement that discloses efforts to achieve sustainable practices

Option 3: Support raw material suppliers and/or manufacturers that meet or exceed standards for raw material extraction **5 points**

- Obtain five percent of the total materials costs (excluding recycled content, salvaged, reused, or refurbished materials) from raw materials suppliers and/or manufacturers that meet one or more of the following criteria:
 - Have third-party verified corporate sustainability reports (CSRs), including statements of environmental impacts of extraction operations and activities associated with the manufacturer's product and the product's supply chain
 - Meet responsible extraction criteria for the raw material sources listed below

Responsible extraction criteria:

- *Mined or quarried materials:*
 - Follow the Framework for Responsible Mining's recommendations for Leading Edge Issues
 - Publicly declare a commitment to responsible mining
- *Bio-based materials (excluding hide products):*
 - Bio-based products must meet the Sustainable Agriculture Network's Sustainable Agriculture Standard
 - Bio-based raw materials must meet ASTM Test Method D6866 and be harvested legally, as defined by the exporting and receiving country

C5.7



Section 5: Site Design—Materials Selection

- *New wood products:*
 - Be certified by the Forest Stewardship Council (FSC) (or local equivalent for projects outside the United States)
- *Other extracted materials:*
 - Meet all applicable laws for exporting and receiving countries, including human rights laws
 - Make publicly available a third-party verified corporate sustainability report that includes ALL of the following:
 - > A commitment to long-term ecologically responsible land use
 - > A commitment to reducing environmental harms from extraction and any manufacturing processes
 - > Evidence of economic and social support of adjacent communities
 - > A voluntary commitment to meeting applicable standards or programs that address responsible sourcing criteria
 - > Labor practices
 - > Governance structure

SUBMITTAL DOCUMENTATION

Option 1: Advocate for sustainable extraction of raw materials

- *Materials Worksheet* listing all purchased materials, their costs, and the manufacturer or supplier for each
- Copies of the letters sent to all raw materials suppliers and/or materials manufacturers, noting if any response has been received for each

Option 2: Support raw material suppliers and/or manufacturers that disclose data on environmental practices

- *Materials Worksheet* listing all purchased materials, their costs, the manufacturer or supplier for each and demonstrating that five percent of the applicable total materials is from raw materials suppliers and/or manufacturers that disclose data on environmental practices
- Documentation from manufacturers and/or suppliers demonstrating disclosure of environmental practices via GRI sustainability report, or equivalent, including the Mining and Metals supplement, if applicable
- Documentation showing that manufacturers have a publicly available sustainability statement

Option 3: Support raw material suppliers and/or manufacturers that meet or exceed standards for raw material extraction

- *Materials Worksheet* listing all purchased materials, their costs, the manufacturer or supplier for each and demonstrating that five percent of the applicable total materials cost meets the responsible extraction criteria listed below
- Third-party verified corporate sustainability reports (CSR) must follow one of the following acceptable frameworks:
 - Global Reporting Initiative (GRI) sustainability report
 - Organisation for Economic Co-operation and Development (OECD) Guidelines for Multinational Enterprises
 - U.N. Global Compact: Communication of Progress
 - ISO 26000: 2010 Guidance on Social Responsibility
 - Other programs meeting CSR criteria that become available (will be evaluated and added by SITES as deemed appropriate)
- Applicable documentation for each of the responsible extraction criteria, as listed on the next page:

C5.7



Section 5: Site Design—Materials Selection

Responsible extraction criteria

- *Mined or quarried materials:*
 - Letter signed by the owner of each manufacturer and its raw materials suppliers, stating that they have reviewed and understood the Framework for Responsible Mining
 - Checklist for each manufacturer listing all of the Framework for Responsible Mining's Leading Edge Issues, and identifying which Leading Edge measures they are currently implementing
 - A copy of the public declaration from each manufacturer committing to responsible mining practices
- *Bio-based materials (excluding hide products):*
 - For bio-based products:
 - > Documentation of compliance with the Sustainable Agriculture Network's Sustainable Agriculture Standard, including any audit reports
 - For bio-based raw materials:
 - > Documentation from each manufacturer demonstrating that it meets ASTM Test Method D6866
 - > Letter signed by the owner of each manufacturer and its raw materials suppliers, addressing all laws governing harvest procedures, as defined by the exporting and receiving country
- *New wood products:*
 - Receipts of vendor invoices documenting which wood products meet certification requirements
 - Chain-of-custody documentation demonstrating certification by the Forest Stewardship Council or SITES-approved equivalent
- *Other extracted materials:*
 - Letter signed by the owner of each manufacturer and its raw materials suppliers, addressing all laws governing extraction and manufacturing procedures as defined by the exporting and receiving country, including human rights laws
 - Publicly available third-party verified corporate sustainability report including ALL of the following information:
 - > A commitment to long-term ecologically responsible land use
 - > A commitment to reducing environmental harms from extraction and/or manufacturing processes
 - > Evidence of their economic and social support of adjacent communities
 - > A commitment to meeting applicable standards or programs voluntarily that address responsible sourcing criteria
 - > Labor practices
 - > Governance structure

C5.7



RECOMMENDED STRATEGIES

- Establish project goals for the use of responsibly extracted materials, and identify suppliers early in the project process that can help achieve these goals.
- Write standards into the project specifications that support the goals of this credit.
- During construction administration, ensure that the responsibly extracted materials or products are installed.

Section 5: Site Design—Materials Selection

ECONOMIC AND SOCIAL BENEFITS

The responsible extraction of raw materials benefits local communities by reducing stress on local ecosystems and human health.¹ Companies with responsible mining and extraction practices may also have policies that support fair labor and fair trade practices, and these policies may also benefit local economies.

1. Institute for Local Self-Reliance, "How Self-Reliant Cities Use Raw Materials," www.ilsr.org/self-reliant-cities-raw-materials/ (accessed March 14, 2013).

DEFINITIONS

- **Recycled content** is the proportion, by mass, of pre-consumer or post-consumer recycled material in a product (ISO 14021). Salvaged materials do not qualify.
- **Reuse** is a process of utilizing a used product or material in a manner that generally retains its original form and identity with minor refurbishments. Materials reusable in whole form might include sand-set pavers, segmental retaining walls, or mechanical fasteners, connections, or joinery (e.g., avoidance of adhesives and mortar).
- A **salvaged or reused material** is recovered from an existing building or site and employed on site without change to its condition. Structures, materials, plants, and rocks preserved in situ and new materials with recycled content do not qualify.

RESOURCES

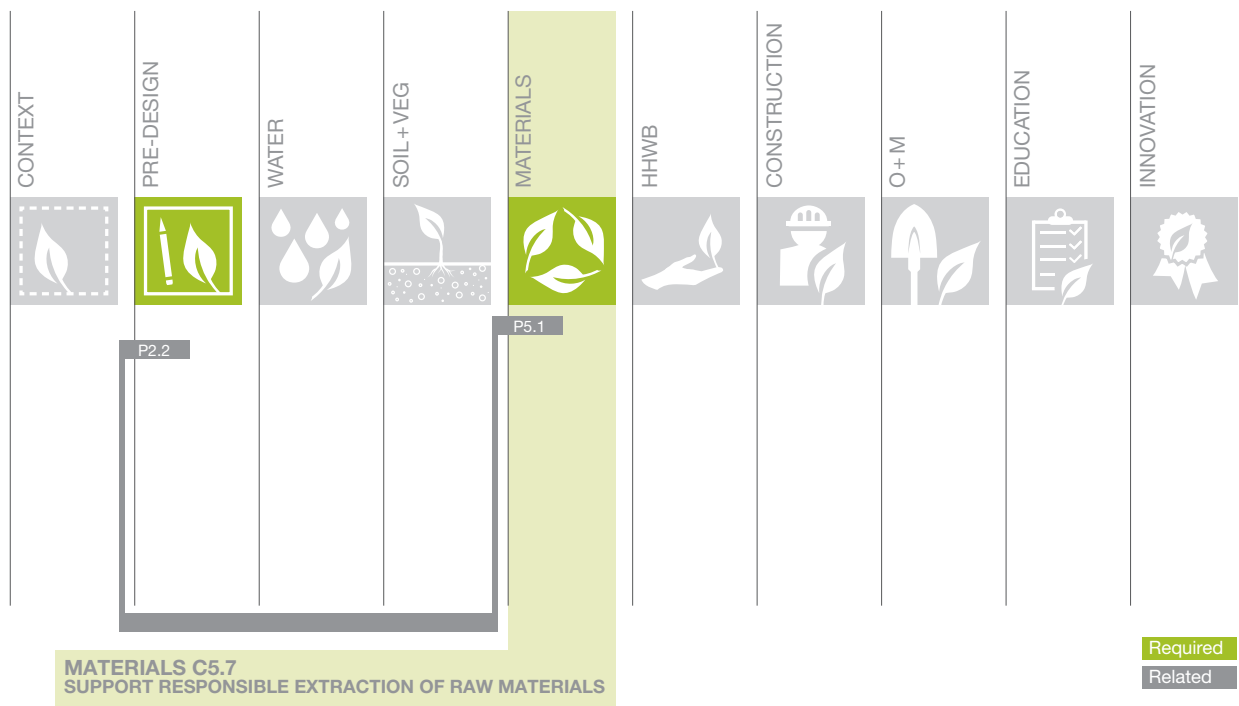
- Components of this credit were adapted from the U.S. Green Building Council's LEED credit: LEED BD+C v4 *MR Credit: 3: Building product disclosure and optimization—sourcing of raw materials*.
- For more information on the Forest Stewardship Council, go to www.fsc.org.
- For information about responsible mining practices, consult the Framework for Responsible Mining, www.frameworkforresponsiblemining.org.
- For information on the Sustainable Agriculture Network, go to sanstandards.org.
- For information about sustainability reporting, see the *Global Reporting Initiative*, www.globalreporting.org.
- For information about international guidelines for extraction companies, consult the Organisation for Economic Co-operation and Development (OECD) Guidelines for Multinational Enterprises, www.oecd.org/daf/inv/mne.
- For information about the *United Nations Global Compact: Communication of Progress*, go to www.unglobalcompact.org/COP/index.html.
- For more information about international standards regarding social and sustainability responsibly, consult ISO 26000: 2010 Guidance on Social Responsibility, www.iso.org/iso/home/standards/iso26000.htm.

C5.7



Section 5: Site Design – Materials Selection

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C5.7



Credit 5.8: Support transparency and safer chemistry

1–5 points

INTENT

Decrease harmful health and environmental impacts and encourage the use of safer alternatives by promoting the use of materials with available chemical inventories, life-cycle information, and hazard assessments.

REQUIREMENTS

This credit applies to all of the following product categories and must meet at least one of the four options listed below:

- Decking, railing, fencing, trellises, or lattices (wood and non-wood)
- Pipes, hoses, and irrigation components
- Conduit, wiring, and electrical equipment
- Lighting
- Membranes, liners, and geotextiles
- Fabrics and canvas
- Extruded, spray, or board foams
- Paints and coatings
- Adhesives, sealants, elastomers (e.g., flexible plastics), water proofing, weather stripping, expansion joint filling, and flashing
- Synthetic surfacing materials and associated products (e.g., crumb rubber, artificial turf)

This credit excludes products that are salvaged or reused or refurbished.

Option 1: Advocate for transparency and safer chemistry 1 point

- Submit a letter to all manufacturers for all materials specified in the product categories asking them to develop and disclose chemical inventories or conduct chemical hazard assessments according to the criteria outlined in Options 2 or 3.

Option 2: Support manufacturers that disclose material chemistry and hazards 3 points

- Specify products for at least five percent of the total material costs (excluding products that are salvaged, reused, or refurbished) for all materials included in the product categories, from manufacturers who:
 - Develop chemical inventories covering all chemicals, whether used intentionally or otherwise known to be present, in all life cycle stages of the product
 - In cases where the compilation of a complete chemical inventory is not feasible, the inventory requirements should cover chemicals and their life cycle stages thought to present the greatest hazards to workers, consumers, the general population, and environmental species
 - Report all known hazards and their concentrations regardless of whether the chemical's presence in the product or process is intentional. This reporting includes the identification of any impurities, byproducts, and emissions from finished products or product curing steps.

C5.8



Section 5: Site Design—Materials Selection

Option 3: Support manufacturers that have completed chemical hazard assessments

5 points

- Specify products for at least five percent of the total material costs (excluding products that are salvaged, reused, or refurbished) for all materials included in the product categories, from manufacturers who conduct chemical assessments using one of the following screening-level hazard assessment tools (see Resources section):
 - BizNGO's Chemical Alternatives Assessment Protocol
 - GreenScreen for Safer Chemicals
 - U.S. EPA's DfE Alternatives Assessment Criteria for Hazard Evaluation
 - U.S. EPA's Sustainable Futures tool suite (to be used only when measured data is not available)
 - An equivalent robust hazard assessment strategy using recognized and reliable data sources.

SUBMITTAL DOCUMENTATION

Option 1: Advocate for transparency and safer chemistry

- *Materials Worksheet* listing all purchased materials included in the listed product categories and the manufacturer for each
- Copies of the letters sent to all manufacturers for the materials in the listed product categories, noting any response received for each

Option 2: Support manufacturers that disclose material chemistry and hazards

- *Materials Worksheet* listing all purchased materials included in the listed product categories, their costs, the manufacturer for each, and demonstrating that five percent of the applicable total materials costs are from manufacturers that disclose material chemistry and hazards
- Documentation from materials manufacturers demonstrating disclosure of material chemistry, including GHS-compliant (see Resources section), or otherwise complete Safety Data Sheets, and chemical safety reports (as outlined in the Documentation Guidance section). Include any additional information received from manufacturers.

Option 3: Support manufacturers that have completed chemical hazard assessments

- *Materials Worksheet* listing all purchased materials included in the listed product categories, their costs, the manufacturer for each, and demonstrating that five percent of the applicable total materials costs are from manufacturers that have completed chemical hazard assessments
- Documentation from materials manufacturers demonstrating disclosure of material chemistry, including GHS-compliant (see Resources section), or otherwise complete safety data sheets, and chemical safety reports (as outlined in the Documentation Guidance section). Include any additional information received from manufacturers.
- Documentation from one of the following screening level hazard assessment tools (see Resources section):
 - BizNGO's Chemical Alternatives Assessment Protocol
 - GreenScreen for Safer Chemicals
 - U.S. EPA's DfE Alternatives Assessment Criteria for Hazard Evaluation
 - U.S. EPA's Sustainable Futures tool suite (to be used only when measured data is not available)
 - An equivalent robust hazard assessment strategy using recognized and reliable data sources

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Section 5: Site Design—Materials Selection

DOCUMENTATION GUIDANCE

Documentation from materials manufacturers disclosing material chemistry (including GHS-compliant, or otherwise complete Safety Data Sheets, and chemical safety reports) should adhere to the following standards:

- Each substance should be identified by Chemical Abstract Service (CAS) name, number, and weight percentage, and include the identification of known impurities and byproducts.
- Criteria should be consistent with federal regulations, including the U.S. Occupational Safety and Health Administration (OSHA) Occupational and Health Hazard Communication Standards (29 CFR 1910); the U.S. Consumer Product Safety Commission Consumer Product Safety Act and Federal Hazardous Substances Act; and the U.S. Federal Trade Commission laws and guidelines prohibiting deceptive acts or practices, including deceptive representations in advertising, labeling, product inserts, catalogs, and sales presentations (or local equivalent for projects outside the United States).
- For products required by the U.S. OSHA to have a safety data sheet (SDS), make a comprehensive SDS, in addition to all product ingredient and warning labels as required by the Consumer Product Safety Commission. SDSs should be provided for chemical components of formulated mixtures (particularly multi-component product systems) that undergo chemical reactions in situ. Also provide SDSs for final products resulting from such chemical reaction.
- For substances for which the manufacturer or supplier has developed an SDS consistent with the United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS), only GHS-compliant SDSs will satisfy this requirement. For substances for which no GHS-compliant SDS is available, a report prepared within the previous five years in accordance with the NSF/GCI/ANSI 355 Greener Chemicals Products and Processes Information Standard (see Resources section) shall be deemed to satisfy this requirement.

C5.8



RECOMMENDED STRATEGIES

- Use materials without finishes (e.g., dye, paint, gloss) or other chemical additives whenever possible per performance requirements.
- Utilize product certification systems (standards and ecolabels) that incentivize transparency and safer chemistry.
- Prioritize product categories based upon human and environmental risk of exposure.
- Continue open dialogue with all suppliers about your current and future projects' transparency and safer chemistry goals and needs.

ECONOMIC AND SOCIAL BENEFITS

Green chemistry represents a market opportunity that will grow from \$2.8 billion in 2011 to \$98.5 billion by 2020.¹ However, markets currently are nascent, with many technologies still at laboratory or pilot scale. Manufacturers can reduce their financial risks by better understanding their chemical inventories and moving toward safer chemicals. The use of products and materials with safer chemicals supports the health protection of manufacturing workers, construction workers, and site users. Overall, greater disclosure of chemical risks supports both a local community's and the larger society's "Right-to-Know."

1. Pike Research, "Green Chemical Industry to Soar to \$98.5 Billion by 2020," www.pikeresearch.com/newsroom/green-chemical-industry-to-soar-to-98-5-billion-by-2020 (accessed March 14, 2013).

Section 5: Site Design—Materials Selection

DEFINITIONS

- A **chemical hazard assessment** refers to the process of identifying product constituents; collecting, developing, and evaluating data on human health and environmental endpoints such as carcinogenicity, reproductive toxicity, neurotoxicity, aquatic toxicity, and persistence; and identifying potential hazards. This process allows for comparisons of alternatives to determine relative “greenness” and safety. The process also identifies areas for improvement. Chemical hazard assessments, focused on inherent risks of chemicals, do not take into account exposure scenarios as a more in-depth and lengthy risk assessment would.
- **Chemical inventory** refers to the listing of all chemicals associated with the manufacturing of a material and should include, to the extent known or reasonably ascertainable, all chemicals intentionally added by the manufacturer, any intermediate chemicals that may be wholly or partially consumed during the manufacturing process, and any process chemicals that may end up in manufacturing effluent or be otherwise released.
- A **salvaged or reused material** is recovered from an existing building or site and employed on site without change to its condition. Structures, materials, plants, and rocks preserved in situ and new materials with recycled content do not qualify.

RESOURCES











- Components of this credit were adapted from the U.S. Green Building Council’s LEED credits:
 - LEED BD+C v4 MR Credit 2: *Building product disclosure and optimization—environmental product declarations*
 - LEED BD+C v4 MR Credit 4: *Building product disclosure and optimization—material ingredients*.
- For more information about OSHA requirements, consult the following resources:
 - OSHA Hazard Communication webpage, www.osha.gov/dsg/hazcom/index.html
 - OSHA SDS section information requirements, www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099
- For more information about international standards for chemicals, see the United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS), www.osha.gov/dsg/hazcom/ghs.html.
- For greener chemicals standards, see NSF/GCI/ANSI 355 Greener Chemicals Products and Processes Information Standard, www.nsf.org/business/sustainability/product_greener_chemicals.asp?program=Sustainability.
- For more information about resources available from the U.S. EPA, see:
 - Design for Environment Program Alternatives Assessment Criteria for Hazard Evaluation version 2.0, www.epa.gov/dfe/alternative_assessments.html
 - Sustainable Future tool suite, www.epa.gov/oppt/sf
 - ChemView, www.epa.gov/chemview
- For information about screening level hazard assessment tools, consult these resources:
 - BizNGO’s Chemical Alternatives Assessment Protocol, www.bizngo.org/safer.php
 - Clean Production Action’s GreenScreen for Safer Chemicals Criteria version 1.2, www.cleanproduction.org/Greenscreen.v1-2.php
- For more information about chemicals in building products, consult Pharos Project’s Chemical and Material Library at www.pharosproject.net/material.

C5.8



Section 5: Site Design – Materials Selection

LINKS TO OTHER SITES PREREQUISITES AND CREDITS

CONTEXT	PRE-DESIGN	WATER	SOIL+ VEG	MATERIALS	HHWB	CONSTRUCTION	O + M	EDUCATION	INNOVATION
									
	P2.2								
	<div> <div>MATERIALS C5.8</div> <div>SUPPORT TRANSPARENCY AND SAFER CHEMISTRY</div> </div>								
								<div>Required</div> <div>Related</div>	

C5.8



Credit 5.9: Support sustainability in materials manufacturing

1–5 points

INTENT

Support sustainability in materials manufacturing by specifying and using materials from manufacturers whose practices increase energy efficiency, reduce resource consumption and waste, and minimize negative effects on human health and the environment.

REQUIREMENTS

The requirements apply to manufacturers of new products purchased for use on site. Rocks, plants, soils, salvaged or reused, or refurbished materials are covered in other credits and are excluded from the calculations for this credit.

Option 1: Advocate for sustainable materials manufacturing **1 point**

Submit a letter to all materials manufacturers asking them to perform, track, and disclose sustainable practices.

Option 2: Support manufacturers that disclose data on sustainable practices **3 points**

Obtain 25 percent of the total applicable materials cost from businesses that complete one of the following actions:

- Report annual environmental performance via the Global Reporting Initiative (GRI) or equivalent
- Conduct and publish a peer-reviewed full life-cycle assessment (LCA) or an environmental product declaration (EPD) for the product
- Set and publicly announce specific goals to reduce, by at least 25 percent (per unit product or equivalent basis) over a five-year period, the company's performance metrics in the following areas:
 - Use of energy, water, and toxics
 - Releases of key pollutants to air and water
 - Disposal of hazardous and non-hazardous wastes

Option 3: Support manufacturers that achieve significant improvements in sustainable practices **5 points**

Obtain 25 percent of the total applicable materials cost from businesses that employ and document at least three of the five achievements below. Percentages are based on cost. If multiple manufacturers are involved in the development of a product, the requirements apply to the manufacturer responsible for producing or assembling the final product.

C5.9



Section 5: Site Design—Materials Selection

Sustainable manufacturing achievements:

1. *Reduce emissions:*

- In at least two of the following three categories, document at least 50 percent reduction (normalized, per unit product or equivalent basis) in the company's direct environmental impacts over the most recent 10-year period where data are available.
 - Emission of hazardous air pollutants (per U.S. Clean Air Act or local equivalent for projects outside the United States)
 - Emission of toxic water pollutants (per U.S. Clean Water Act or local equivalent for projects outside the United States)
 - Generation of hazardous and non-hazardous waste (per U.S. Resource Conservation and Recovery Act or local equivalent for projects outside the United States).

2. *Reduce or offset greenhouse gas emissions:*

- The product manufacturer demonstrates that the three lowest years for carbon emissions (or global warming potential equivalent, per unit of product) in the previous 10 years are at least 25 percent better than its corresponding 10-year average (per unit of product) OR the product manufacturer purchases carbon offsets from a legally binding trading system that provides independent third-party verification for 25 percent of its carbon emissions (or global warming potential equivalent).

3. *Reduce energy consumption:*

- Demonstrate that the manufacturing process per unit of product consumes 25 percent less energy than the industry average. Consult the National Institute of Standards and Technology Building for Environmental and Economic Sustainability (BEES), National Renewable Energy Laboratory (NREL) U.S. Life-Cycle Inventory Database, or Commercial Buildings Energy Consumption Survey for industry-specific data (see Resources section).

4. *Use renewable energy sources:*

- Use on-site renewable energy sources to meet 10 percent of electricity demands OR engage in at least a four-year contract for the purchase of 20 percent of electricity from renewable sources for the facility at which the product is made.

5. *Reduce use of potable water:*

- Use potable or other natural surface or subsurface water resources for less than 25 percent of total water consumption during manufacturing for the product line specified (i.e., non-potable sources are used to meet 75 percent of water consumption).

C5.9



Section 5: Site Design—Materials Selection

SUBMITTAL DOCUMENTATION

Option 1: Advocate for sustainable materials manufacturing

- *Materials Worksheet* listing all materials, products, and product assemblies; their costs; and the manufacturer for each
- Copies of the letters sent to all materials manufacturers, noting if any response is received for each

Option 2: Support manufacturers that disclose data on sustainable practices

- *Materials Worksheet* listing all materials, products, and product assemblies; their costs; and the manufacturer for each and demonstrating that 25 percent of purchased materials (excluding rocks, plants, soils, salvaged or reused, and refurbished materials) are from businesses that disclose and provide transparency of manufacturing practices
- Documentation from materials manufacturers meeting disclosure requirements, including:
 - Global Reporting Initiative (GRI) reports, or equivalent
 - Life-cycle assessments (LCAs) or environmental product declarations (EPDs)
- Copies of public announcement regarding (or website links to) future environmental impact reduction goals

Option 3: Support manufacturers that achieve significant improvements in sustainable practices

Materials Worksheet listing all materials, products, and product assemblies; their costs; and the manufacturer for each and demonstrating that 25 percent of purchased materials (excluding rocks, plants, soils, salvaged or reused, and refurbished materials) are from businesses that meet at least three of the five following sustainable achievements:

1. *Reduce emissions:*
 - Emissions reports from the manufacturer demonstrating reductions of at least 50 percent overall or per unit of product in at least two of the three categories listed above
2. *Reduce or offset greenhouse gas emissions:*
 - Emissions reports from the manufacturer demonstrating that the three lowest years for carbon emissions in the previous 10 years are at least 25 percent better than its corresponding 10-year average (per unit of product) OR receipts for purchased carbon offsets from a legally binding trading system that provides independent third-party verification for 25 percent of carbon emissions
3. *Reduce energy consumption:*
 - Documentation from the manufacturer demonstrating that the manufacturing process per unit of product consumes 25 percent less energy than the industry average. Consult the National Institute of Standards and Technology Building for Environmental and Economic Sustainability (BEES), National Renewable Energy Laboratory U.S. Life-Cycle Inventory Database, or Commercial Buildings Energy Consumption Survey for industry-specific data (see Resources section below).
4. *Use renewable energy sources:*
 - Letter from the plant provider describing renewable energy sources and the percent of annual energy use generated or purchased from each renewable source, including contracts with utility company if applicable
5. *Reduce use of potable water:*
 - Calculations from the manufacturer showing the total water volume consumed for manufacturing for the specified product line and the total volume of non-potable sources. The calculations should also include a brief description of available sources of non-potable water used for manufacturing processes.

C5.9



Section 5: Site Design—Materials Selection

DOCUMENTATION GUIDANCE

LCA and EPD documentation used for products should be made public in references such as a peer-reviewed journal or the National Renewable Energy Laboratory (NREL) U.S. Life-Cycle Inventory Database. The LCA must follow the ISO 21930 or 14044 methodologies or ASTM E1991-05. The EPD must be consistent with ISO 14025 and ISO 21930 (see Resources section).

RECOMMENDED STRATEGIES

- Identify and select materials from manufacturers that actively implement better business practices to reduce negative impacts to human health and the environment. For example, a site could meet the low point requirements for this credit by selecting wooden benches (for 10 percent of total costs) from a manufacturer that meets the requirements for reduced potable water and energy use, and selecting concrete (for 15 percent of total costs) from a manufacturer that has conducted a LCA and uses at least 10 percent renewable energy.

ECONOMIC AND SOCIAL BENEFITS

Manufacturers can save money by reducing resource consumption and increasing energy and water efficiency. Greater disclosure of environmental performance achievements and targets increases knowledge about and among marketplace players.¹

1. R Kashmanian, R Wells, and C. Keenan, "Corporate Environmental Sustainability Strategy: Key Elements," *Journal of Corporate Citizenship*, Vol. 44, Winter 2012, pp. 107-130.

DEFINITIONS

- An **environmental product declaration (EPD)** is a manufacturer declaration "providing quantified environmental data [based on an ISO 14040 LCA] using pre-defined parameters, and, where relevant, additional environmental information" (ISO 14025, 2006a).
- **Life-cycle assessment (LCA)** is a "cradle-to-grave" approach for assessing industrial systems. "Cradle-to-grave" begins with the gathering of raw materials from the earth to create a product and ends at the point when all materials are returned to the earth. Specifically, it is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service, by:
 - Compiling an inventory of relevant energy and material inputs and environmental releases
 - Evaluating the potential environmental impacts associated with identified inputs and releases
 - Interpreting the results to help you make a more informed decision
- **Potable water** is municipally treated water or well water that is suitable for drinking.
- A **renewable energy source** includes nonpolluting renewable energy generation methods, such as solar, wind, geothermal, small-scale or micro hydroelectric, and biomass. Purchased renewables must meet the Center for Resource Solutions (CRS) Green-e products certification requirements. Other sources of renewable energy are eligible if they satisfy the Green-e program's technical requirements.
- **Reuse** is a process of utilizing a used product or material in a manner that generally retains its original form and identity with minor refurbishments. Materials reusable in whole form might include sand-set pavers, segmental retaining walls, or mechanical fasteners, connections, or joinery (e.g., avoidance of adhesives and mortar).
- A **salvaged or reused material** is recovered from an existing building or site and employed on site without change to its condition. Structures, materials, plants, and rocks preserved in situ and new materials with recycled content do not qualify.

C5.9



Section 5: Site Design—Materials Selection

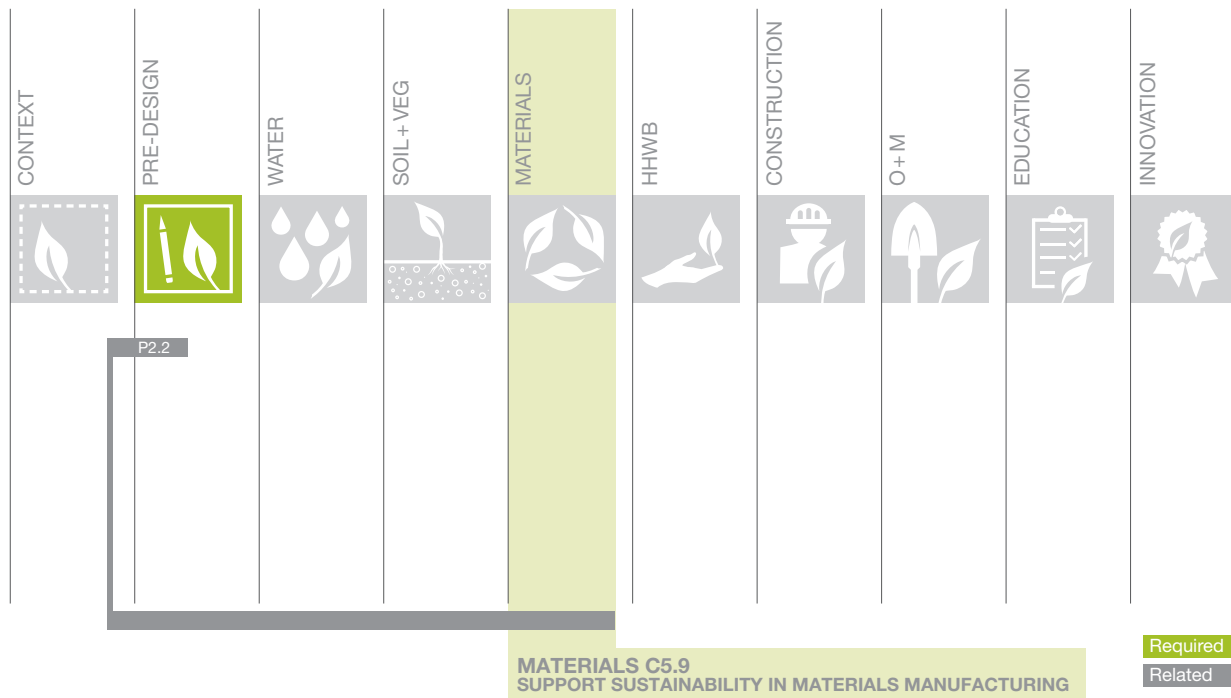
RESOURCES

- Components of this credit were adapted from the U.S. Green Building Council's LEED credit: LEED BD+C v4 *MR Credit 2: Building product disclosure and optimization—environmental product declarations*.
- For information about international reporting standards, read more from these sources:
 - Global Reporting Initiative, www.globalreporting.org
 - International Organization for Standards, www.iso.org
- For more information about renewable energy, consult the National Renewable Energy Laboratory (NREL) U.S. Life-Cycle Inventory Database, www.lcacommons.gov/nrel/search
- For a green toolkit for smaller manufacturers, consult the Organisation for Economic Co-operation and Development (OCED), www.oecd.org/innovation/green/toolkit.
- For more information on the National Institute of Standards and Technology Building for Environmental and Economic Sustainability (BEES) software, go to www.nist.gov/el/economics/BEESSoftware.cfm.
- For information about software that may be helpful in analyzing environmental performance, see these organizations:
 - Simapro, GaBi, www.gabi-software.com
 - Umberto, www.umberto.de/en
 - Open LCA, www.openlca.org
- For more information on hazardous air pollutants included in the U.S. Clean Air Act, see the Code of Federal Regulations at 40 CFR 61.01, ecfr.gpoaccess.gov.
- For more information on toxic water pollutants included in the U.S. Clean Water Act, see the Code of Federal Regulations at 40 CFR 401.15, ecfr.gpoaccess.gov.
- For more information on hazardous and non-hazardous waste according to the U.S. Resource Conservation and Recovery Act (RCRA), consult these resources:
 - Code of Federal Regulations at 40 CFR 261, ecfr.gpoaccess.gov
 - The U.S. EPA RCRA Frequent Questions Database, www.epa.gov/waste/inforesources/online/index.htm

C5.9



LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 5.10: Support sustainability in plant production

1–5 points

INTENT

Support sustainable practices in plant production by purchasing plants, sod, and seed from providers whose practices increase energy efficiency, reduce resource consumption and waste, and minimize negative effects on human health and the environment.

REQUIREMENTS

The requirements apply to the businesses from which plants, sod, and seed are purchased for the site. If multiple businesses are involved in plant production, the requirements apply to the business that grows the plant material until it is ready for sale (finishes the plant material). Percentages are based on cost.

Option 1: Advocate for sustainable plant production **1 point**

Submit a letter to all businesses from which plants, sod, and seed are purchased asking them to perform, track, and disclose sustainable practices in plant production.

Option 2: Support producers that disclose data on sustainable practices **3 points**

Obtain 80 percent of purchased plants, sod, and seed from businesses that have a publicly available sustainability statement that discloses efforts to achieve at least six of the 10 practices listed below.

Option 3: Support producers that achieve significant improvements in sustainable practices **5 points**

Obtain 80 percent of purchased plants, sod, and seed from businesses that achieve at least six of the 10 sustainable practices listed below.

Sustainable practices in plant production:

1. *Reduce use of potable water or other natural surface or subsurface water resources:* Use non-potable water (e.g., captured rainwater, recycled graywater, reclaimed/treated wastewater, water treated and conveyed by a public agency specifically for non-potable uses) for 50 percent of the total annual irrigation volume or reduce total irrigation volume by 50 percent.
2. *Reduce runoff from irrigation:* Capture and recycle all irrigation runoff water on site (i.e., no dry-weather discharges).
3. *Choose sustainable soil amendments and growing media:* Use peat-free growing media or other sustainable sources. Use cover crops and amend soils with compost, manure, or other sustainable sources.
4. *Recycle organic matter:* Compost or recycle 100 percent of vegetation trimmings on site for use in nursery operations or for sale to the public.
5. *Reduce waste:* Conduct a waste audit to identify the weight or volume of ongoing consumables, and reuse, recycle, or compost 50 percent of the on-going consumables waste stream.
6. *Use integrated pest management (IPM):* Employ a certified IPM practitioner OR use an IPM-certified nursery.
7. *Prevent use and distribution of invasive species:* Demonstrate that invasive species are managed and are not distributed.

C5.10



Section 5: Site Design—Materials Selection

8. *Reduce energy consumption:* Demonstrate that the energy use during the three most recent years is at least 25 percent less than the average energy use over the previous 10 years.
9. *Use renewable energy sources:* Use on-site renewable energy sources to meet 10 percent of electricity demands OR engage in at least a four-year contract for the purchase of 20 percent of electricity from renewable energy sources.
10. *Provide safe and fair working conditions:* Develop nursery employment policies in order to establish open communication with employees about issues such as workplace safety and job satisfaction.

SUBMITTAL DOCUMENTATION

Option 1: Advocate for sustainable plant production

- *Materials Worksheet* listing all plants, sod, or seed purchased, their costs, and the plant provider for each
- Copies of the letters sent to all plant providers, noting if any response is received for each

Option 2: Support producers that disclose data on sustainable practices

- *Materials Worksheet* listing all plants, sod, or seed, their costs, the supplier and/or grower for each, and demonstrating that 80 percent of purchased plant materials are from producers that disclose data on sustainable practices
- Documentation from plant providers demonstrating disclosure of six of the 10 sustainable production practices listed below, including publicly available sustainability statements and any other information received

Option 3: Support producers that achieve significant improvements in sustainable practices

- *Materials Worksheet* listing all plants, sod, or seed purchased, their costs, the supplier and/or grower for each, and demonstrating that 80 percent of purchased plant materials are from producers that employ at least six of the 10 sustainable practices
- Documentation from providers demonstrating that sustainable practices are employed:
 1. *Reduce use of potable water or other natural surface or subsurface water resources:*
 - Calculations from the plant provider showing the total water volume consumed for irrigation and the total volume of non-potable sources, including a brief description from the plant provider regarding the availability and sources of non-potable water used for irrigation
 2. *Reduce runoff from irrigation:*
 - Letter from the plant provider describing the methods by which all runoff from irrigation is captured and reused
 3. *Use sustainable soil amendments:*
 - Letter from the plant provider describing planting media and verifying that all planting media is peat-free
 4. *Recycle organic matter:*
 - Letter from the plant provider describing the process for composting or recycling vegetation trimmings, including a description of the end use of compost produced
 5. *Reduce waste:*
 - A copy of the plant provider's waste audit and list of ongoing consumables, including a description of the process for reusing, recycling, or composting at least 50 percent of the weight or volume of on-going consumables
 6. *Use integrated pest management:*
 - Letter from the plant provider including the name of the employed certified IPM practitioner or a copy of the IPM certification
 7. *Prevent use and distribution of invasive species:*
 - Letter from the plant provider describing the invasive species management plan and policy regarding distribution of invasive plants

C5.10



Section 5: Site Design—Materials Selection

8. *Reduce energy consumption:*
 - Calculations from the plant provider based on utility bills and showing the average energy consumption over the previous 10 years and the average energy consumption over the three most recent years
9. *Use renewable energy sources:*
 - Letter from the plant provider describing renewable energy sources and the percent of annual energy use generated or purchased from each renewable source, including contracts with utility company if applicable
10. *Provide safe and fair working conditions:*
 - A copy of the employment policy that addresses employee communication and workplace safety

RECOMMENDED STRATEGIES

- Identify and select plants from nurseries that actively implement better business practices to reduce damage to the environment and conserve resources.
- Contact state and regional nursery and other plant producer associations to identify growers using sustainable practices in plant production. Also contact USDA extension offices to help identify suppliers.

ECONOMIC AND SOCIAL BENEFITS

Nurseries can save costs by reducing resource consumption and minimizing waste generation.¹ By eliminating the use and distribution of invasive species, nurseries can also help reduce the costs of controlling and managing the damage done by introducing invasive species in natural ecosystems.

1. JS Owen and SA White, *Production Practices for an Environmentally Friendly Nursery Industry*, Environmental Resource Management Research Group, Floriculture and Nursery Research Initiative, USDA—Agricultural Research Service, Horticulture Research Institute SCA #58-6618-2-2027, www.clemson.edu/extension/horticulture/nursery/images/sustainable_prod_prac.pdf (accessed March 14, 2013).

C5.10



DEFINITIONS

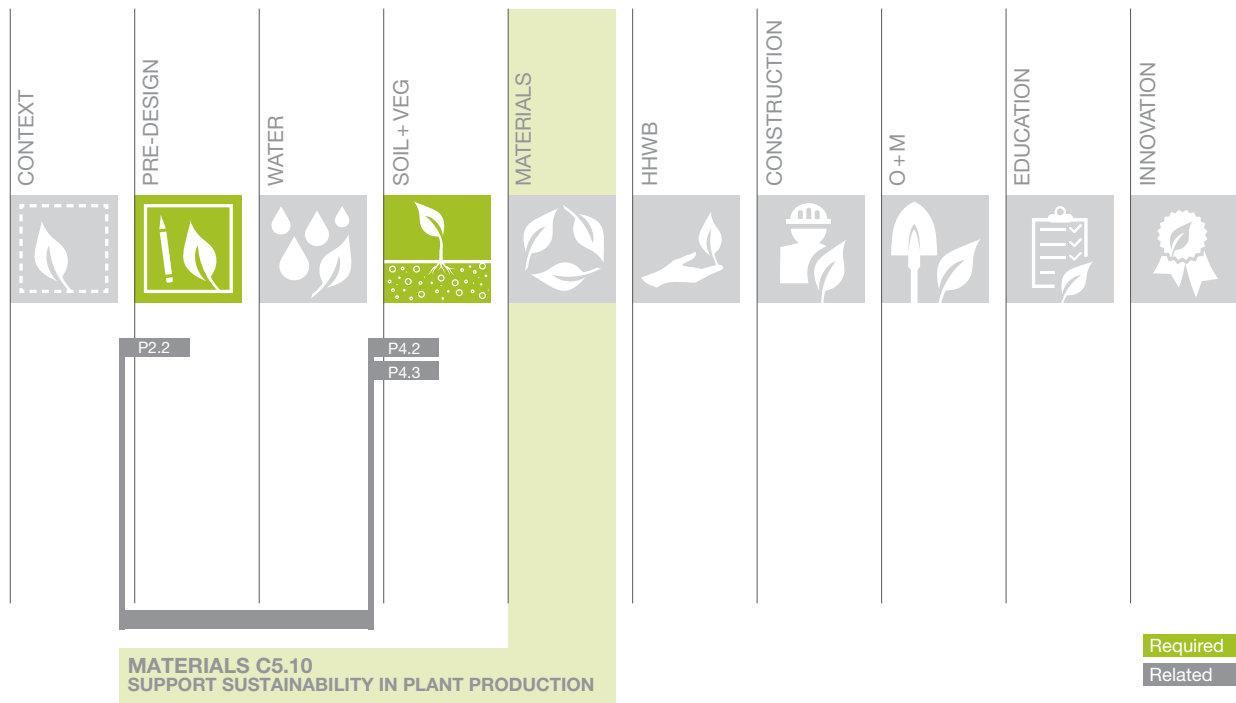
- **Integrated pest management (IPM)** is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. IPM is site-specific in nature, with individual tactics determined by the particular crop/pest/environment scenario. The IPM approach places an emphasis on the reduction of pesticide use and the implementation of preventative and alternative control measures.
- An **invasive species** is a plant or animal that is not native to the ecosystem under consideration and that causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health.
- An **ongoing consumable** is a material that is regularly used and replaced through the course of business. Such materials can include, but are not limited to, paper, glass, plastics, cardboard, and metals.
- **Potable water** is municipally treated water or well water that is suitable for drinking.
- A **renewable energy source** includes nonpolluting renewable energy generation methods, such as solar, wind, geothermal, small-scale or micro hydroelectric, and biomass. Purchased renewables must meet the Center for Resource Solutions (CRS) Green-e products certification requirements. Other sources of renewable energy are eligible if they satisfy the Green-e program's technical requirements.
- **Vegetation trimmings** include only non-invasive plant material free of disease and herbicide residues.

Section 5: Site Design – Materials Selection

RESOURCES

- For more regional information consult the following sources:
 - Cornell University's Cooperative Extension Agriculture / Horticulture Sustainability program, which supports growers, communities and residents by encouraging the implementation of management and production practices that are environmentally, economically, and socially sustainable and that are based on unbiased research, counties.cce.cornell.edu/schenectady/agriculture_horticulture.html
 - Massachusetts Nursery Industry Best Management Practices Guide, www.mass.gov/eea/docs/agr/programs/bmp/nursery-bmp.pdf
 - National Green Centre, Western Nursery & Landscape Association, www.nationalgreencentre.org
- For help finding local USDA extension offices, consult their Cooperative Extension System Offices map, www.csrees.usda.gov/Extension
- For more information about carbon offsets certification, see the Green-e program at www.green-e.org

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C5.10





SECTION 6

SITE DESIGN – HUMAN HEALTH + WELL BEING

PREREQUISITE / CREDIT	TITLE	POINTS
HHWB C6.1	Protect and maintain cultural and historic places	2-3 points
HHWB C6.2	Provide optimum site accessibility, safety, and wayfinding	2 points
HHWB C6.3	Promote equitable site use	2 points
HHWB C6.4	Support mental restoration	2 points
HHWB C6.5	Support physical activity	2 points
HHWB C6.6	Support social connection	2 points
HHWB C6.7	Provide on-site food production	3-4 points
HHWB C6.8	Reduce light pollution	4 points
HHWB C6.9	Encourage fuel efficient and multi-modal transportation	4 points
HHWB C6.10	Minimize exposure to environmental tobacco smoke	1-2 points
HHWB C6.11	Support local economy	3 points

Credit 6.1: Protect and maintain cultural and historic places

2–3 points

INTENT

Enhance a site's identity and meaning by protecting and maintaining significant historic buildings, structures, and objects, as well as cultural landscapes.

REQUIREMENTS

Option 1: Historic buildings, structures, or objects

2 points

- Identify and protect existing historic buildings, structures, and objects that are included, or are eligible for inclusion, in one of the following:
 - A local historic register
 - A state historic register
 - The U.S. National Register of Historic Places, which includes National Historic Landmarks (or local equivalent for projects outside the United States)
 - The Native American/American Indian tribal register
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete. It must outline long-term strategies and short-term tasks to achieve preservation maintenance goals for the site or the site's cultural or historic features.

Option 2: Historic or cultural landscapes

3 points

- Identify and protect existing historically significant cultural landscapes that are included, or are eligible for inclusion, in one of the following:
 - A local historic register
 - A state historic register
 - The U.S. National Register of Historic Places, which includes National Historic Landmarks (or local equivalent for projects outside the United States)
 - The Native American/American Indian tribal register
 - A conservation easement register
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete. It must outline long-term strategies and short-term tasks to achieve preservation maintenance goals for the site or the site's cultural or historic features.

SUBMITTAL DOCUMENTATION

Option 1: Historic buildings, structures, or objects

- Current site photographs and maps or plans documenting the historic artifacts or structures
- Narrative stating the importance of the historic building, structures, or objects
- A letter or documentation from one of the following that verifies or qualifies the eligibility of the buildings, structures, and objects as historic:
 - The local historic preservation authority
 - The State Historic Preservation Office (SHPO)
 - The U.S. National Park Service Keeper of the National Register of Historic Places (or local equivalent for projects outside the United States)
 - The Tribal Historic Preservation Office

C6.1



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

Option 2: Historic or cultural landscapes

- Current site photographs and maps or plans documenting the historic site features, artifacts, or structures
- Narrative stating the importance of the historic or cultural landscape
- A letter from one of the following that verifies or qualifies the eligibility of the landscape as cultural or historic:
 - The local historic preservation authority
 - The State Historic Preservation Office (SHPO)
 - The U.S. National Park Service Keeper of the National Register of Historic Places (or local equivalent for projects outside the United States)
 - The Tribal Historic Preservation Office
 - The local, state, or federal land trust preservation office

RECOMMENDED STRATEGIES

- Communicate with the local community; local, state, federal, and Native American/American Indian Tribal preservation agencies; educational facilities; and historical associations to identify important cultural or historic landscapes to protect and incorporate into site design.

ECONOMIC AND SOCIAL BENEFITS

Protecting historic and cultural landscapes by treating them as integral components of site design has economic benefits. These may include opportunities for increased employment, entrepreneurship, improved adjacent property values, tourism, and resource and energy conservation. Social benefits include fostering a respect for spaces and places associated with history and cultural traditions and fostering community by preserving such spaces and places for current and future generations. Preservation of sites with historic or cultural landscape enhances human knowledge and experience of landscapes and their evolution, which in turn fosters a stronger sense of stewardship and an improved quality of life.

DEFINITIONS

- A **cultural landscape** is a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person, or exhibiting other cultural or aesthetic values. The quality of significance in history, architecture, archeology, engineering, landscape architecture, and culture is present in cultural landscapes that possess integrity of location, design, setting, materials, workmanship, feeling, association and:
 - That are associated with events that have made a significant contribution to the broad patterns of history; or
 - That are associated with the lives of significant persons in the past; or
 - That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master craftsperson or designer, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
 - That has yielded, or may be likely to yield, information important in history or prehistory.(U.S. National Park Service, www.nps.gov/nr/publications/bulletins/nrb15/nrb15_2.htm.)

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

RESOURCES

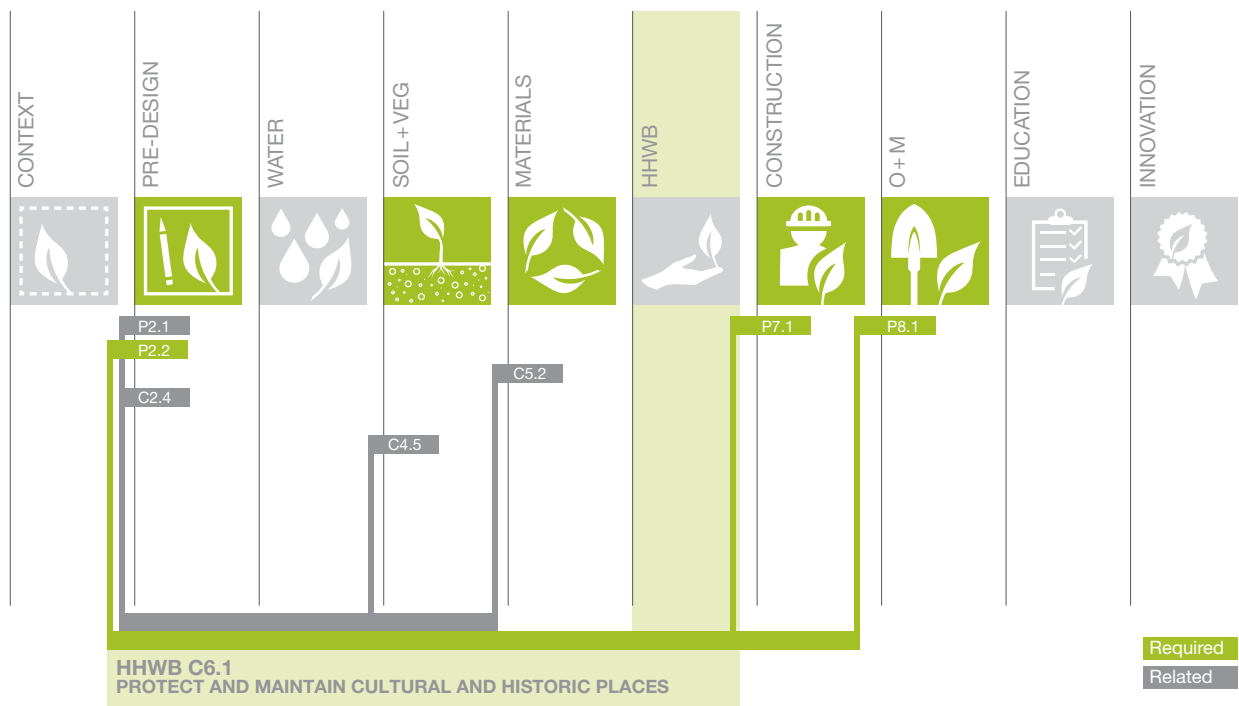
- Components of this credit were adapted from the U.S. Green Building Council's LEED credits:
 - LEED ND v2009 *GIB Credit 6: Historic resource preservation and adaptive use*
 - LEED ND v4 *GIB Credit 6: Historic preservation and adaptive use*
- For information on the fundamentals of the U.S. National Register of Historic Places, see www.nps.gov/nr/national_register_fundamentals.htm.
- For information on researching the U.S. National Register of Historic Places, see www.nps.gov/history/nr/research.
- For treatment of historic properties in the United States, refer to the following sources:
 - The Secretary of the Interior's standards, www.nps.gov/tps/standards.htm
 - The Secretary of the Interior's "Guidelines for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes," www.nps.gov/tps/standards/four-treatments/landscape-guidelines/index.htm
- For information on U.S. National Historic Landmarks, see www.nps.gov/history/nhl/QA.htm.
- For information on U.S. State Historic Preservation Offices, see www.nps.gov/nr/shpolist.htm.
- For overview information on historic and cultural landscapes, refer to the following U.S. sources:
 - U.S. National Park Service's Historic American Landscapes Survey, www.nps.gov/history/hdp/standards/halsguidelines.htm
 - U.S. National Park Service's Historic Landscape Initiative, "Protecting Cultural Landscapes Planning, Treatment, and Management of Historic Landscapes," www.nps.gov/tps/how-to-preserve/briefs/36-cultural-landscapes.htm
- For information on documenting historic and cultural landscapes, refer to the U.S. National Park Service report "A Guide to Cultural Landscape Reports: Contents, Process, and Techniques," 2005 (not available online).
- For information on rural historic districts, see the National Register Bulletin report "Guidelines for Evaluating and Documenting Rural Historic Landscapes," www.nps.gov/nr/publications/bulletins/nrb30.
- For information on modern landscapes, consult the Cultural Landscape Foundation tclf.org.
- For information on historic preservation easements, refer to the U.S. National Park Service's Technical Preservation Services, www.nps.gov/tps/index.htm.
- For information on historic preservation easement potential tax benefits, consult the U.S. National Park Service report "Easements to Protect Historic Properties: A Useful Historic Preservation Tool with Potential Tax Benefits," www.nps.gov/tps/tax-incentives/taxdocs/easements-historic-properties.pdf.
- For information on Native American/American Indian tribal preservation, see the U.S. National Park Service webpage "Connecting with Native Americans" www.nps.gov/tribes/Tribal_Historic_Preservation_Officers_Program.htm
- For information on the economic benefits of historic preservation, see the following reports:
 - Preservation Action Council of San Jose, "Sustainability and Historic Preservation," www.preservation.org/rypkema.htm
 - Brookings Institute, "Economics and Historic Preservation: A Guide and Review of the Literature," www.brookings.edu/~media/research/files/reports/2005/9/metropolitanpolicy_mason/20050926_preservation.pdf

C6.1



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

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C6.1



Credit 6.2: Provide optimum site accessibility, safety, and wayfinding

2 points

INTENT

Increase site users' ability to understand and access outdoor spaces by incorporating elements of accessibility, safety, and wayfinding into the site design.

REQUIREMENTS

- Enable site use by including the following elements in the project design:
 - Accessibility*: Provide site access and usability as required by local and national accessibility standards (e.g., Americans with Disabilities Act)
 - Safety: Improve actual and perceived safety of site users by providing at least four of the six components below:
 - > Clear, defined spaces and access control
 - > Natural surveillance with adequate lighting levels
 - > Natural surveillance at entrances and walkways
 - > Clear visibility and good sight lines
 - > A variety of options for access
 - > Site design elements that improve the effectiveness of policing and security efforts
 - Wayfinding: Create an environment that makes it easy and intuitive for users to orient themselves and navigate from place to place, by providing at least five of the eight components below:
 - > Clear entrances and gateways
 - > Viewpoints and sight lines
 - > Landmarks
 - > Decision points or nodes
 - > Hierarchy of pedestrian and vehicular circulation
 - > Distinct areas and regions
 - > Orientation devices and systems
 - > Maps and brochures

* *Note:* This requirement does not apply to single-family residential projects.

SUBMITTAL DOCUMENTATION

- Site plan illustrating how the site design optimizes accessibility, safety, and wayfinding
- Wayfinding map and written explanation of how it directs people through the space (if applicable)
- Photographs or video illustrating how each component is addressed on the site

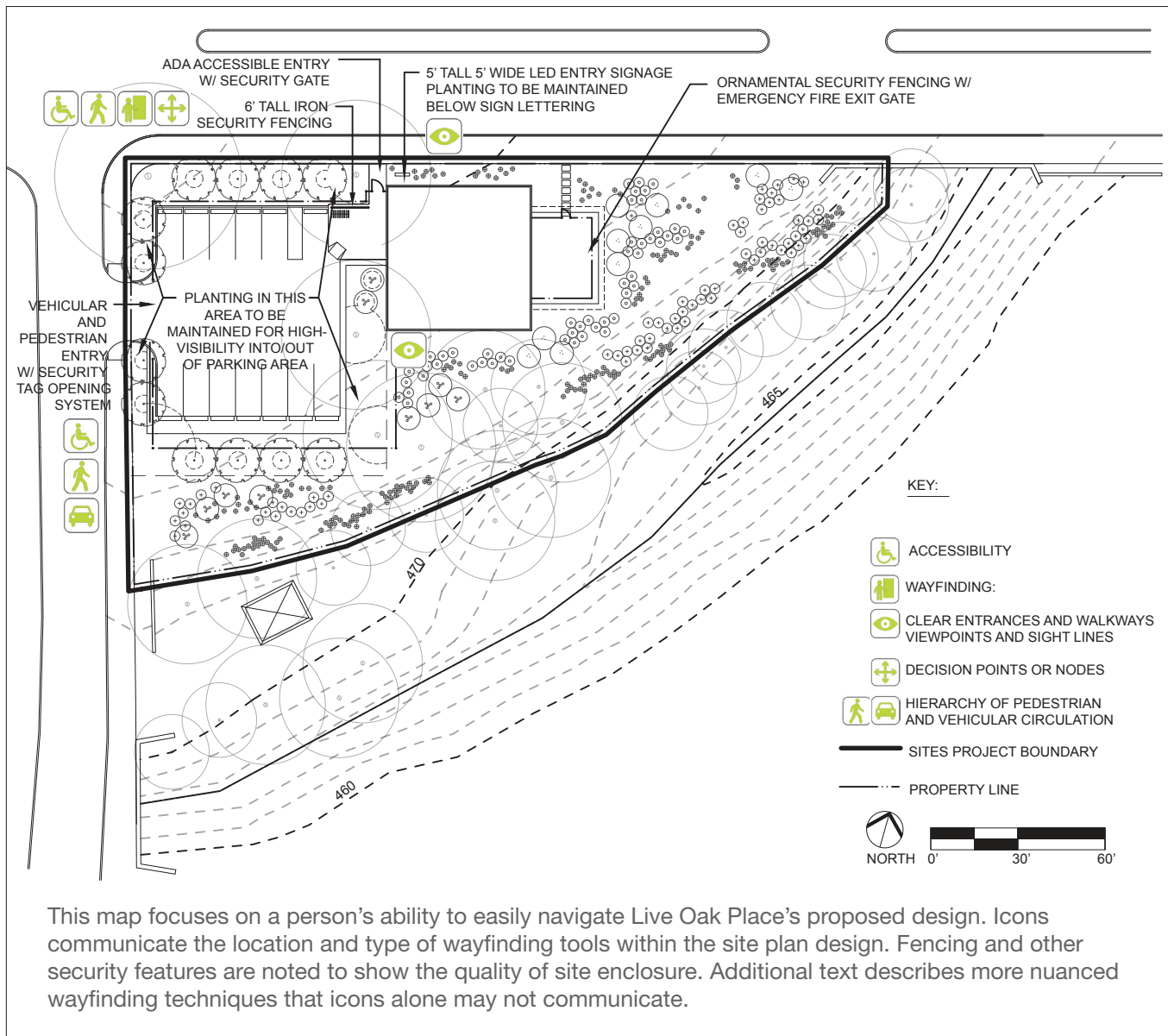
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DOCUMENTATION GUIDANCE

Example: Live Oak Place



C6.2



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

RECOMMENDED STRATEGIES

- To address safety and accessibility concerns during site design, identify techniques appropriate to the site type and user groups.
- Identify techniques to improve legibility and understanding of the site's layout and intended uses.
- Consider implementing the elements to enable site use without compromising sensitive site features.
- Adapt universal design practices to enable all users to participate equally in access and enjoyment of site features and amenities.

ECONOMIC AND SOCIAL BENEFITS

Providing optimum site accessibility, safety, and wayfinding in an integrative design approach creates a sense of security, connection, social interaction, and quality of life improvement through the reduced fear of crime and ease of navigation for people of all ages and abilities.^{1,2} Businesses benefit from universal access and a safe environment that attracts a higher number and broader spectrum of customers, which contributes to a vibrant economic community.

1. American Planning Association, *Crime and Planning: Building Socially Sustainable Communities* (Boca Raton, FL: Taylor & Francis Group, 2013).
2. BJ Huelat, "Wayfinding: Design for Understanding," A Position Paper for the Environmental Standards Council of The Center for Health Design (October 2007), www.healthdesign.org/advocacy/adgroups/documents/WayfindingPosition-Paper_000.pdf (accessed March 24, 2013).

DEFINITIONS

- **Natural surveillance** is the placement of physical features, activities, people, and amenities that maximize visibility and provide and encourage informal monitoring of the site.
- A **site user** is an individual who is expected to occupy, work at, or pass through the site. Users may visit the site regularly or periodically. Site users will range in age, ethnicity, and socio-economic status, but all users' needs should be considered.
- **Universal design** is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. (Center for Universal Design, www.ncsu.edu/ncsu/design/cud/.)

RESOURCES

- For more information on accessibility, see the following webpages:
 - U.S. Access Board guidelines for Americans with Disabilities Act standards, www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards
 - The Center for Universal Design, www.design.ncsu.edu/cud/about_ud/udresourcepage.htm
- For more information on safety, read the following information:
 - National Crime Prevention Council training program Crime Prevention through Environmental Design,
 - www.ncpc.org/training/training-topics/crime-prevention-through-environmental-design-cpted
 - O Newman, *Creating Defensible Space* (Washington, DC: U.S. Department of Housing and Urban Development, Office of Policy Development and Research, 1996).
 - SE Michael and RB Hull IV, *Effects of Vegetation on Crime in Urban Parks* (Blacksburg, VA: Virginia Polytechnic Institute & State University, Department of Forestry, 1994).
- For use of lighting for safety, refer to the Illuminating Engineering Society (IES) standards, www.ies.org.

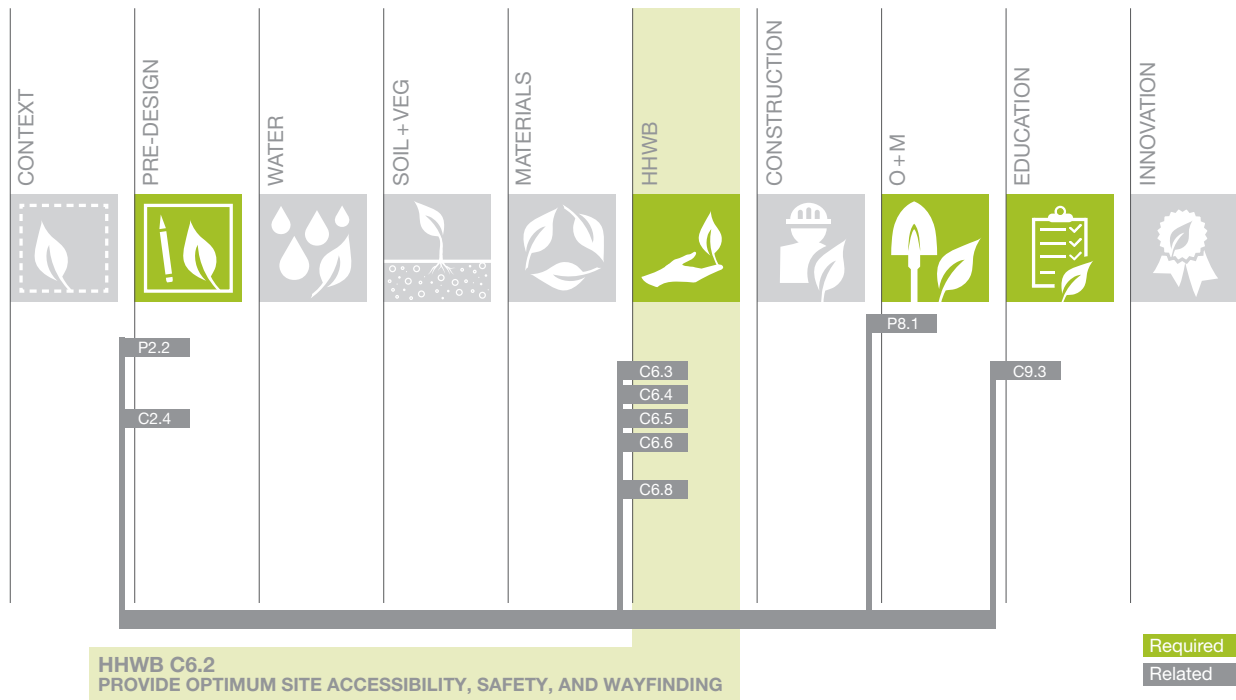
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Section 6: Site Design—Human Health + Well-Being

- For more information on wayfinding, consult the following publications:
 - R Kaplan, S Kaplan, and RL Ryan, *With People in Mind: Design and Management of Everyday Nature* (Washington, DC: Island Press, 1998). (This publication also includes information on safety.)
 - P Arthurand and R Passini, *Wayfinding: People, Signs and Architecture* (New York: McGraw-Hill Ryerson, 1992).
- For information on public rights-of-way, consult the Access Board, www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 6.3: Promote equitable site use

2 points

INTENT

Provide economic and social benefits to the local community by providing publicly available on-site events, facilities, amenities, or programming.

REQUIREMENTS

- Achieve *Pre-Design C2.4: Engage users and stakeholders*.*
- Achieve two of the following four SITES credits:
 - HHWB C6.4: Support mental restoration
 - HHWB C6.5: Support physical activity
 - HHWB C6.6: Support social connection
 - Education C9.1: Promote sustainability awareness and education
- Provide free public site access to four specific, equitable site elements (which may include some combination of amenities, activities, facilities, programs, or events) in the first three years of operation. Elements must be associated with the above credits that have been identified by the local community as a need or desirable element.

* *Note:* This requirement does not apply to single-family residential projects.

SUBMITTAL DOCUMENTATION

- Narrative describing the following:
 - Feedback and needs of local community groups concerning the publicly available site elements
 - Specific elements to be provided for the community
 - The character, timing, and use potential of the elements
 - Opportunities, including distinct options, to address the needs of specific user groups (e.g., additional access hours, transportation to and from the site, interpretation in multiple languages)
- Letter confirming the intent to provide free public access to the agreed-upon elements, signed by the property owner, and accompanied by planning documents and public relations communications about the elements

RECOMMENDED STRATEGIES

- Actively engage with the local community to identify needs and develop options to generate or share the economic and social benefits of the site.
- Permanent elements and temporary installations may promote benefits for different user groups. Select options that allow use of the site to benefit and engage a wide range of local residents, beyond the primary user groups.

C6.3



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

ECONOMIC AND SOCIAL BENEFITS

Site development that addresses its own effects on local residents can promote long-term economic stability of local families and businesses. By capitalizing on and sharing economic opportunities that result from site development, a site supports resilient neighborhoods.¹

1. R Kniech, "Beyond the Environment: Socio-economic Sustainability and Meaningful Community Input in Land Use Decisions," *Research Monologue Series: Community Identity and Governance*, Rocky Mountain Land Use Institute (2008), law.du.edu/images/uploads/rmlui/rmlui-sustainable-Socio-EconomicSustainability.pdf (accessed March 24, 2013).

DEFINITIONS

- **Equitable** is a publicly acknowledged commitment that the site and its use elements are available to and accessible by as many people as possible (including users, residents, and visitors); that barriers to access are identified and removed; and that this commitment to social inclusion is not limited by cultural, physical, or socio-economic considerations.
- **Free public site access** includes free parking, free admission to events, and being regularly open to the public.

RESOURCES

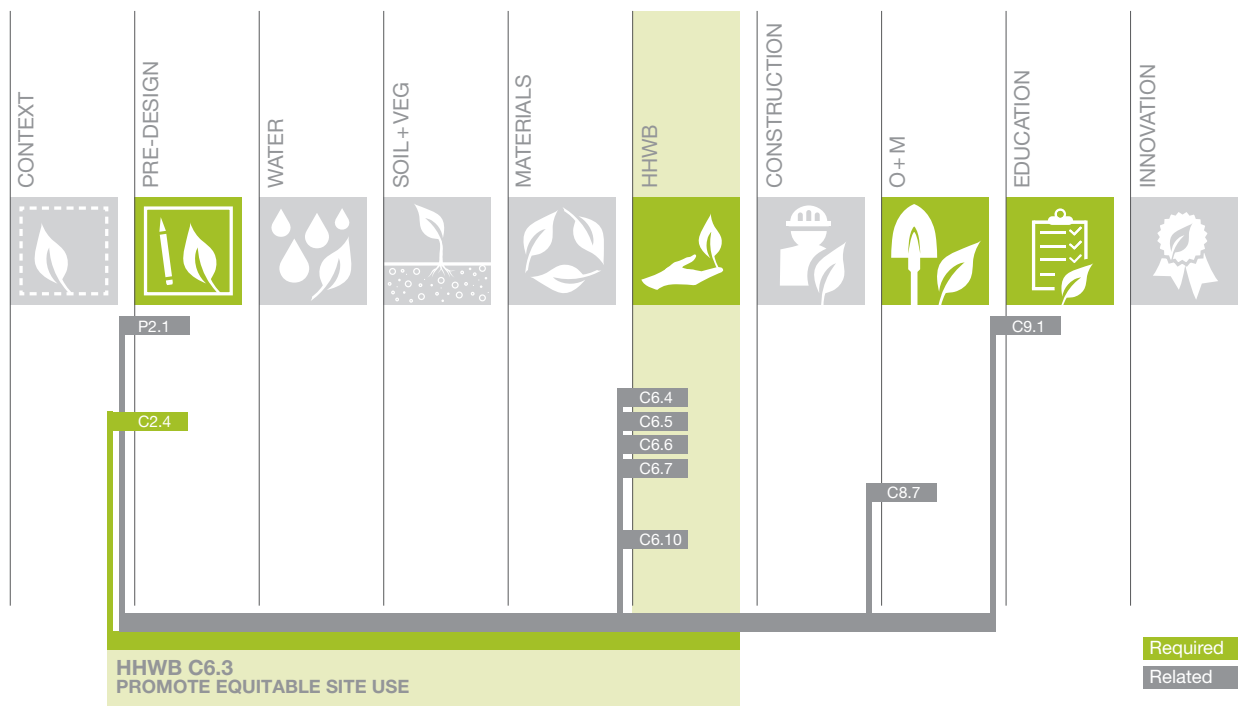
- For more information about opportunities for on-site activities, facilities, programs, and events identifying, engaging, and planning with the community, see the following resources:
 - Parcourse and Fitness Trails, www.healthcentral.com/diet-exercise/c/727598/154390/exercise
 - Trust for Public Lands Fitness Zones®, www.tpl.org/what-we-do/where-we-work/california/los-angeles-county/fitness-zones.html
 - Active Network, "How to Plan for a Marathon," www.activeendurance.com/resources/how-to-plan-a-marathon.htm
 - Geocaching, www.sedl.org/afterschool/lessonplans/index.cgi?show_record=16
 - GreenSpace toolkit for organizing community events, www.green-space.org.uk/resources/communityresources/toolkits.php
 - GreenSpace toolkit for organizing events in parks, www.green-space.org.uk/resources/communityresources/events/index.php
 - Play by Design custom designed and built play structures, www.playbydesignonline.com
 - City of Los Angeles Department of Cultural Affairs, "Festival Producers' Handbook" www.culturela.org/events/Festivals/festivalproducer/Festival_Handbook.pdf
 - U.S. festivals and events, festivalsandevents.com/resources/festival-planning/index.shtml
 - Farmers Market Coalition, farmersmarketcoalition.org
 - Purdue University Extension guide "Starting a Farmers' Market," www.extension.purdue.edu/extmedia/EC/EC-739.pdf
 - University of Missouri Extension guide "Publicizing a Community Event," extension.missouri.edu/p/CM304

C6.3



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

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C6.3



Credit 6.4: Support mental restoration

2 points

INTENT

Improve human health and well-being by providing visual and physical connections to restorative outdoor spaces.

REQUIREMENTS

- Provide accessible, quiet outdoor spaces that include:
 - Seating for five percent of total site users
 - Visual and physical access to vegetation
 - Elements that reduce noise and mitigate negative distractions
 - Elements that address microclimate and other site-specific conditions (e.g., sun, shade, wind)
- For sites with regularly occupied buildings, provide unobstructed views of vegetation from 50 percent of common spaces (e.g., office spaces, classrooms, waiting rooms, living areas, dining rooms).

Note: A project cannot achieve this credit for the same space that is submitted for *HHWB C6.6: Support social connection*. SITES encourages the development of multiple types of spaces to serve the intents of both credits; therefore, submit two separate spaces in order to achieve both credits.

SUBMITTAL DOCUMENTATION

- Site plan illustrating the locations of the outdoor spaces and the amount of seating provided
- For sites with regularly occupied buildings:
 - Plans showing views provided by common spaces
 - Calculations demonstrating that 50 percent of common spaces have views to vegetation
 - Photographs showing views from common spaces
- Total number of site users
- Narrative describing how the quiet outdoor space:
 - Provides visual and physical access to vegetation
 - Minimizes noise and mitigates negative distractions to an acceptable noise level
 - Addresses microclimate and other site-specific conditions
- Video or photographs (with camera angle locations designated on the site plan) illustrating the character of the restorative outdoor spaces

RECOMMENDED STRATEGIES

- During the site assessment process, identify areas that are quiet and could optimize the mental health benefits for site users. Look for shade trees, views, or site landmarks as well as potential stressful factors on or off site.
- During site planning and design, meet with stakeholders and potential site users to identify needs and techniques appropriate to the site type and user groups. Work with designers to design the project so that buildings can optimize views and deflect surrounding noise.

C6.4



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

- Design a variety of smaller, mentally restorative spaces conveniently located throughout a site rather than one large space. If possible, consider integrating these outdoor spaces with interior public spaces to enhance the connection to nature throughout a site.
- Design the outdoor mental restoration spaces away from distractions, such as noise from mechanical systems, building and facility operations, and traffic. To minimize noise, incorporate multiple solutions such as quieter pavement or road surfacing, dense foliage, earth berms, and barriers or screens. Schedule maintenance activities when site users are not present.
- To create a sense of enclosure, define seating areas with low walls, fences, vegetation, or topography. Walls, fences, and vegetation can also break, guide, deflect, or filter the wind and thereby alter its effects.
- Provide a variety of seating options within defined spaces. Consider providing comfortable, moveable seating in both sun and shade.
- Design the site with protective windbreaks, awnings, and other sources of shade where necessary. Use vegetation, green walls, or barriers to minimize or buffer excessive wind, sunlight, traffic, or unsightly features.
- Provide amenities or vegetation that enhance a multi-sensory aesthetic experience, such as a grove of trees, water features, scents from flowers or foliage, tactile variation, or art.

ECONOMIC AND SOCIAL BENEFITS

Vegetation and other natural elements have the potential to provide for restorative experiences in a number of ways.¹ People are inspired by and gain pleasure from the aesthetic experiences provided by nature.² Work that demands focused attention (such as desk work or studying) for a lengthy period of time can result in mental fatigue, which can be expressed as irritability, physical tiredness, and inability to concentrate; brief interludes in natural settings are mentally restorative, helping people get back on track with work.³

Stress induced by noise can contribute to anxiety and a sense of helplessness in children.⁴ Exposure to high levels of traffic noise can produce disturbances of daily necessities such as sleeping and relaxation, and general well-being.⁵ Studies show that noise is reduced more with broad-leaved trees than with conifers and is strongest when foliage extends close to the ground. The best location for a noise barrier is either very close to the source or very close to the receiver, while the worst position for attenuation is halfway between them.⁶

1. S Kaplan, "The Restorative Benefits of Nature: Toward an Integrative Framework," *Journal of Environmental Psychology* 15 (1995): pp. 169–182.
2. RE Chenoweth and PH Gobster, "The Nature and Ecology of Aesthetic Experiences in the Landscape," *Landscape Journal* 9, no. 1 (1990): pp. 1–8.
3. R Kaplan and S Kaplan, *The Experience of Nature: A Psychological Perspective* (Cambridge: Cambridge University Press, 1989).
4. G Evans, P Lercher, M Meis and W Kofler, "Community Noise Exposure and Stress in Children," *Journal of the Acoustical Society of America* 109, no. 3 (2001): pp. 1023–1027.
5. J Bjork, J Ardo, E Strohm, et al., "Road Traffic Noise in Southern Sweden and Its Relations to Annoyance, Disturbance of Daily Activities and Health," *Scandinavian Journal of Work, Environment & Health* 31, no. 5 (2006): pp. 392–401.
6. Bucur, *Urban Forestry Acoustics* (New York: Springer, 2006).

DEFINITIONS

- A **regularly occupied building** is a building where occupants (e.g. workers, students, residents) are inside for extended periods of time.
- A **site user** is an individual who is expected to occupy, work at, or pass through the site. Users may visit the site regularly or periodically. Site users will range in age, ethnicity, and socio-economic status, but all users' needs should be considered.

C6.4

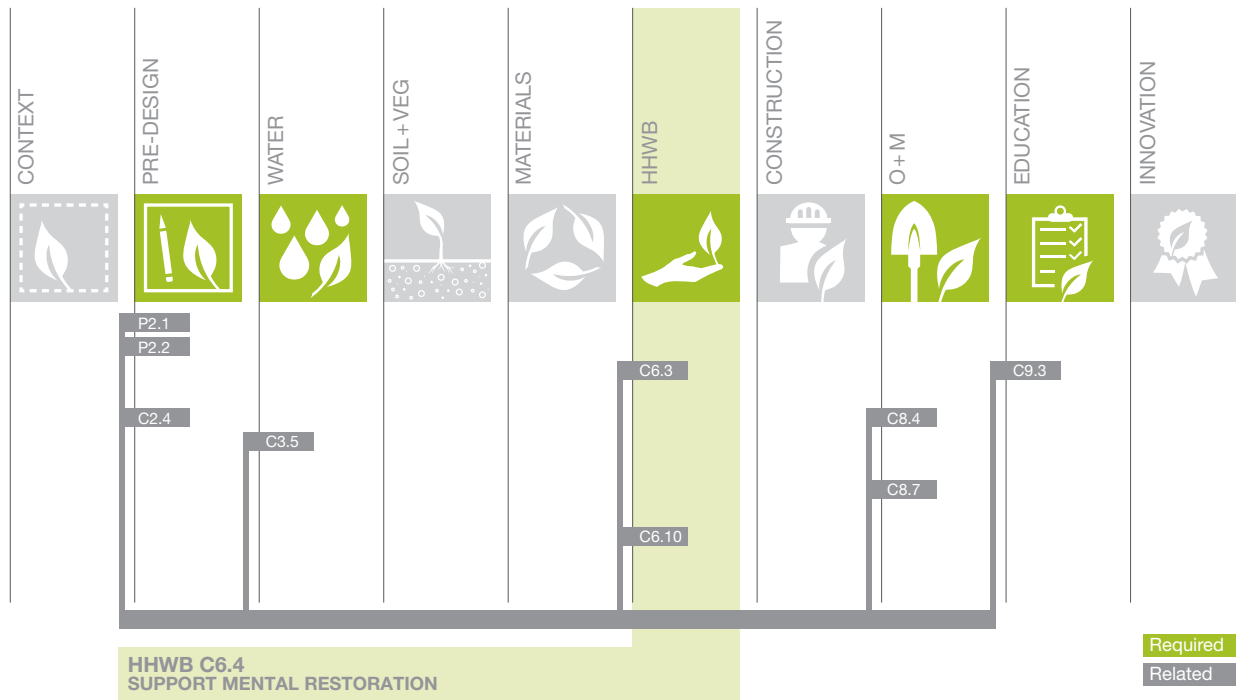


Section 6: Site Design—Human Health + Well-Being

RESOURCES

- For information on acoustics and noise pollution, see the following resources:
 - V Bucur, *Urban Forestry Acoustics* (New York: Springer, 2006).
 - Noise Pollution Clearinghouse, www.nonoise.org
 - Local and state health departments and government websites
- For information on noise pollution ordinances and laws, contact a local or state health department or government website.
- For a study entitled “The Cognitive Benefits of Interacting with Nature,” see the journal *Psychological Science*, pss.sagepub.com/content/19/12/1207.short.
- For information on the importance of nature to human health and well-being, consult the following organizations:
 - The Centre for Confidence and Well-being, www.centreforconfidence.co.uk/flourishing-lives.php?p=cGkPTE3MiZpZD02Njk
 - Therapeutic Landscapes Network, www.healinglandscapes.org/blog
- For an interactive online tool to explore how ecosystem services affect human health and well-being, use the U.S. EPA Eco-Health Relationship Browser, www.epa.gov/research/healthscience/browser/introduction.html.
- For research on how sustainably designed cities promote well-being, consult the University of Washington webpage Green Cities: Good Health, depts.washington.edu/hhwb.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C6.4



Credit 6.5: Support physical activity

2 points

INTENT

Improve human health by providing on-site opportunities that encourage outdoor physical activity.

REQUIREMENTS

- Estimate the total number of site users and the peak times of use.
 - Identify, describe, and list the four largest user groups.
- Develop and implement a functional plan that encourages outdoor physical activity for the largest four distinct user groups identified.
- Provide services to support site users during physical activity (e.g., drinking fountains, bicycle racks, emergency call boxes).
- Provide at least two of the following five outdoor physical activity features:
 - On-site trail or bicycle path that is a minimum of one mile (1.61 kilometers) in length, and is either a closed loop or has a turn-around at both ends.
 - > If connecting to either an off-site bicycle lane or multi-use trail that meets the local minimum standards, the on-site trail or bicycle path must be a minimum of 0.5 miles (0.8 kilometers) in length.
 - Playgrounds that are physically challenging and engaging
 - Fitness courses (e.g., pull-up bars, disc golf, steps, inclined surfaces)
 - Physical activity programs (e.g., yoga classes, tai chi, regular sports programs) to be established within six months of project completion
 - Scheduled events that support physical activity (e.g., tournaments, races)

SUBMITTAL DOCUMENTATION

- Site plans or drawings illustrating the site design for the physical activity features provided, indicating applicable standards and guidelines for intended usage
- Total number of site users and peak times of use
- List and brief definition of the largest four distinct user groups
- Narrative describing:
 - The support services provided on site
 - How the physical activity features accommodate a range of user groups, providing particular detail on the largest four distinct user groups listed
 - A minimum of two different methods for how the physical activity programming will be announced and scheduled
- Videos or photographs that illustrate the physical activity features provided

RECOMMENDED STRATEGIES

- Identify potential site users and the physical activities preferred by intended user groups.
- Locate desirable and accessible spaces on site to enable and encourage physical activity.
- For small sites, creatively design meandering pathways to maximize on-site physical activity opportunities.
- If public sidewalks are used as part or all of a trail or pathway, conduct a walkability audit to assess the safety and desirability of the walking routes.
- If a private site provides access to the public, consider pedestrian level lighting as part of the design.
- For larger sites, provide a variety of opportunities for active living that may physically challenge the users and offer seating at key nodes of activity.

C6.5



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

ECONOMIC AND SOCIAL BENEFITS

Physical inactivity is an independent risk factor for chronic diseases and overall causes an estimated 1.9 million deaths globally.¹ According to the U.S. Centers for Disease Control, more than one-third of people in the United States are obese, and nearly three-quarters do not get the recommended 30 minutes of physical activity on most days.² In 2000, the health costs of obesity were estimated at 117 billion USD.³ In 2003 a study of the state of Michigan suggested that physical inactivity accounts for \$8.9 billion USD in indirect and direct costs.⁴

Because many adults spend 20, 30, 40, or more hours a week at work, adding physical activity to employee workdays through the frequent exposure to an activity-promoting space may be one way to help working Americans become healthier. Researchers have found for youth, the prevalence of being overweight was lower among those who spent more time outdoors.⁵ Daily moderate activity decreases the incidence of chronic diseases such as diabetes and heart disease. Physical activity and exercise can also improve mental health by reducing feelings of depression and anxiety, reducing stress, and promoting psychological well-being.⁶

1. K Singh, "Avoiding Health Risks through Physical Activities: Significance and Analysis," *Indian Streams Research Journal* August (2012): pp.1.
2. Weight-Control Information Network, "Overweight and Obesity Statistics," win.niddk.nih.gov/statistics/index.htm (accessed March 25, 2013).
3. AM Wolf, JE Manson, and GA Colditz, "The Economic Impact of Overweight, Obesity and Weight Loss," in R Eckel, ed., *Obesity Mechanisms and Clinical Management* (Philadelphia: Lippincott, Williams and Wilkins, 2002).
4. G DeJong, L Sheppard, M Lieber, and D Chenoweth, "Executive Summary: The Economic Cost of Physical Inactivity in Michigan," Governor's Council for Physical Fitness, Health, and Sports and the Michigan Fitness Foundation (2003).
5. V Cleland, D Crawford, LA Baur, C Hume, A Timperio, and J Salmon, "A Prospective Examination of Children's Time Spent Outdoors, Objectively Measured Physical Activity and Overweight," *International Journal of Obesity* 32, no. 11 (2008): pp. 1685–1693.
6. Centers for Disease Control and Prevention, "The Benefits of Physical Activity," www.cdc.gov/nccdphp/dnpa/physical/everyone/health/index.htm (accessed March 25, 2013).

DEFINITIONS

- **Physical activity** includes moderate-intensity activities in a usual week (e.g., brisk walking, bicycling, gardening, anything that causes small increases in breathing or heart rate) for greater than or equal to 30 minutes per day, five or more days per week; vigorous-intensity activities in a usual week (e.g., running, aerobics, heavy yard work, anything that causes large increases in breathing or heart rate) for greater than or equal to 20 minutes per day, three or more days per week; or both.
- A **site user** is an individual who is expected to occupy, work at, or pass through the site. Users may visit the site regularly or periodically. Site users will range in age, ethnicity, and socio-economic status, but all users' needs should be considered.
- **User group** is a distinct group of individuals who are expected to occupy, work at, or pass through the site, and may range in age, ethnicity and socio-economic status.
- A **walkability audit** is a tool designed to broadly assess pedestrian facilities, destinations, and surroundings along and near a walking route and identify specific improvements that would make the route more attractive, safe, and convenient to pedestrians. (U.S. Centers for Disease Control and Prevention, www.cdc.gov/nccdphp/dnpao/hwi/toolkits/walkability.)

RESOURCES

- For more information on identifying, engaging, and planning with the community, see the following resources:
 - Active Living Research Tools and Measures website Active Neighborhood Checklist, activelivingresearch.com/files/Protocol_ActiveNeighborhoodChecklist.v2.pdf
 - National Charrette Institute, www.charretteinstitute.org
 - Project for Public Spaces, placemaking.pps.org/parks_plazas_squares/info/design

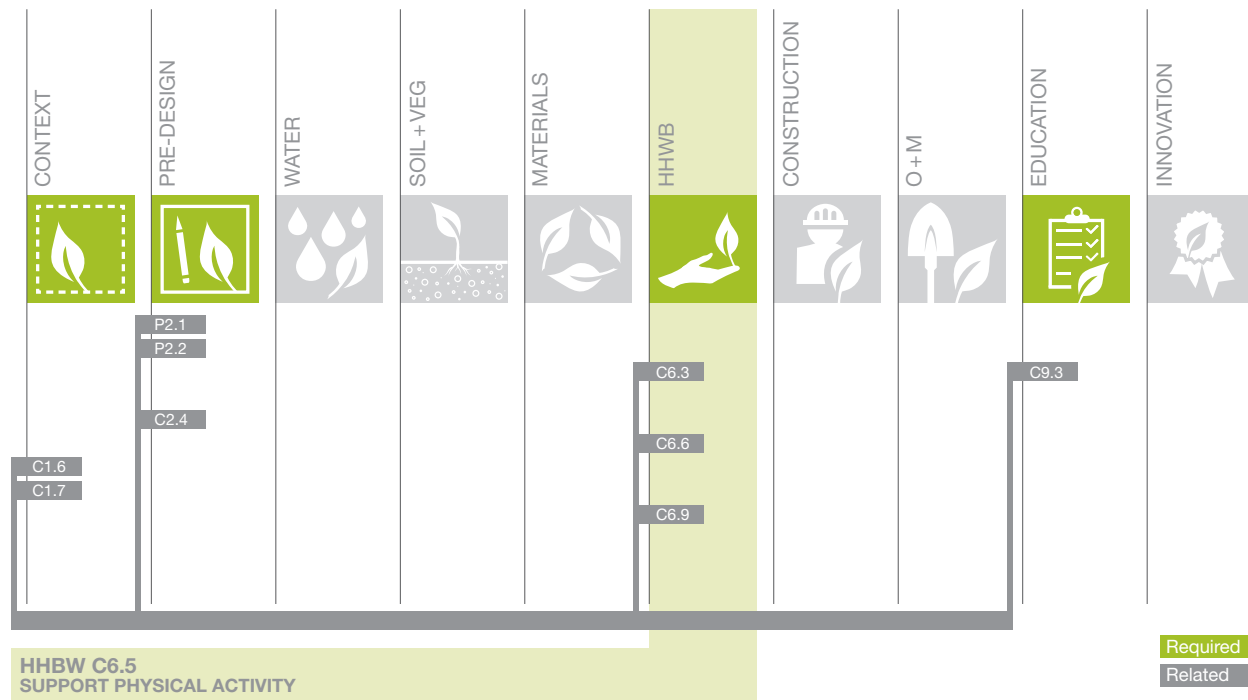
C6.5



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

- B Lennertz and A Lutzenhiser, *The Charrette Handbook: The Essential Guide for Accelerated, Collaborative Community Planning* (Chicago: American Planning Association, 2006).
- H Sanoff, *Community Participation Methods in Design and Planning* (New York City: John Wiley & Sons, 1999).
- CS Slotterback, M Beekman, C Carlson, and J Reed, *Enhancing Transportation: The Effects of Public Involvement in Planning and Design Processes*. Report No. CTS 07-10, Series: Moving Communities Forward (2007).
- For information about conducting a walkability audit, see www.cdc.gov/nccdphp/dnpao/hwi/toolkits/walkability.
- For information on increasing physical activity through community design, see the Active Living By Design website, www.activelivingbydesign.org/our-approach/strategies-tactics/5P.
- For resources from the Center for Active Design, see centerforactivedesign.org/guidelines.
- For information on boosting a community's physical activity, see:
 - U.S. Centers for Disease Control (CDC) "Guide to Strategies to Increase Physical Activity in the Community," www.cdc.gov/obesity/downloads/PA_2011_WEB.pdf
 - CDC "Guide for Community Action" www.cdc.gov/physicalactivity/strategies/communityguide.html
 - Alliance for Biking and Walking bicyclist and pedestrian resource library, www.peoplepoweredmovement.org/site/index.php/members/members2/C285
- For information on urban parks promoting health and wellness, consult the Trust for Public Land, www.tpl.org/publications/books-reports/ccpe-publications/fitness-zones-to-medical-mile.html.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C6.5



Credit 6.6: Support social connection

2 points

INTENT

Strengthen community and encourage social connections by providing outdoor gathering spaces to support people gathering, eating, working, and playing together.

REQUIREMENTS

- Provide outdoor spaces to encourage social connection that include:
 - Seating for a minimum of 10 percent of the total site users that accommodates a variety of group sizes and is appropriate to the site
 - Elements that address microclimate and other site-specific conditions (e.g., sun, shade, wind)
 - Amenities, services, or activity spaces (e.g., games, wireless access, food concessions, picnic or dining areas, outdoor auditoriums, playgrounds, farmers' markets)

Note: A project cannot achieve this credit for the same space that is submitted for *HHWB C6.4: Support mental restoration*. SITES encourages the development of multiple types of spaces to serve the intents of both credits; therefore, submit two separate spaces in order to achieve both credits.

SUBMITTAL DOCUMENTATION

- Site plan illustrating the locations of the outdoor spaces and the amount of seating provided
- Total number of site users
- Narrative describing how the outdoor space:
 - Encourages social connection
 - Addresses microclimate and other site-specific conditions
 - Provides amenities, services, or activity spaces
- Video or photographs (with camera angle locations designated on the site plan) illustrating the character of the outdoor social spaces

RECOMMENDED STRATEGIES

- During the site assessment process, identify areas that could accommodate moderate and large groups. To find areas that may encourage social connection, look for shade trees or views.
- During site planning and design, meet with stakeholders and potential site users to identify needs and appropriate techniques.
- Design a variety of smaller social spaces conveniently located throughout a site rather than one large space.
- Moveable seating is preferred, if possible. Enclose and define seating areas with low walls or vegetation. Provide comfortable seating in sun and shade.
- Consider the needs of a variety of user groups. Provide seating, games, and spaces specifically designed for children, such as a tot-lot playground.

C6.6



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

ECONOMIC AND SOCIAL BENEFITS

Social science studies show that having social connections is beneficial for individuals and communities.¹ Social activity in public green spaces provides “eyes on the street” to monitor activity and prevent crime.² In addition, people in communities having strong social ties show greater resilience and ability to cope with change. Social gathering encourages a child’s development as they observe and model positive social behaviors. Elders having strong social ties have been shown to live longer and recover from illness more quickly.³

1. DG Unger and A Wandersman, “The Importance of Neighbors: The Social, Cognitive, and Affective Components of Neighboring,” *American Journal of Community Psychology* 13 (1985): pp. 139–169.
2. FE Kuo and WC Sullivan, “Environment and Crime in the Inner City,” *Environment and Behavior* 33, no.3 (2001): pp.343–367.
3. S Liffem, et. al., “Health Risk Appraisal in Older People 2: The Implications for Clinicians and Commissioners of Social Isolation Risk in Older People,” *British Journal of General Practice* 57 (2007): pp.277–282.

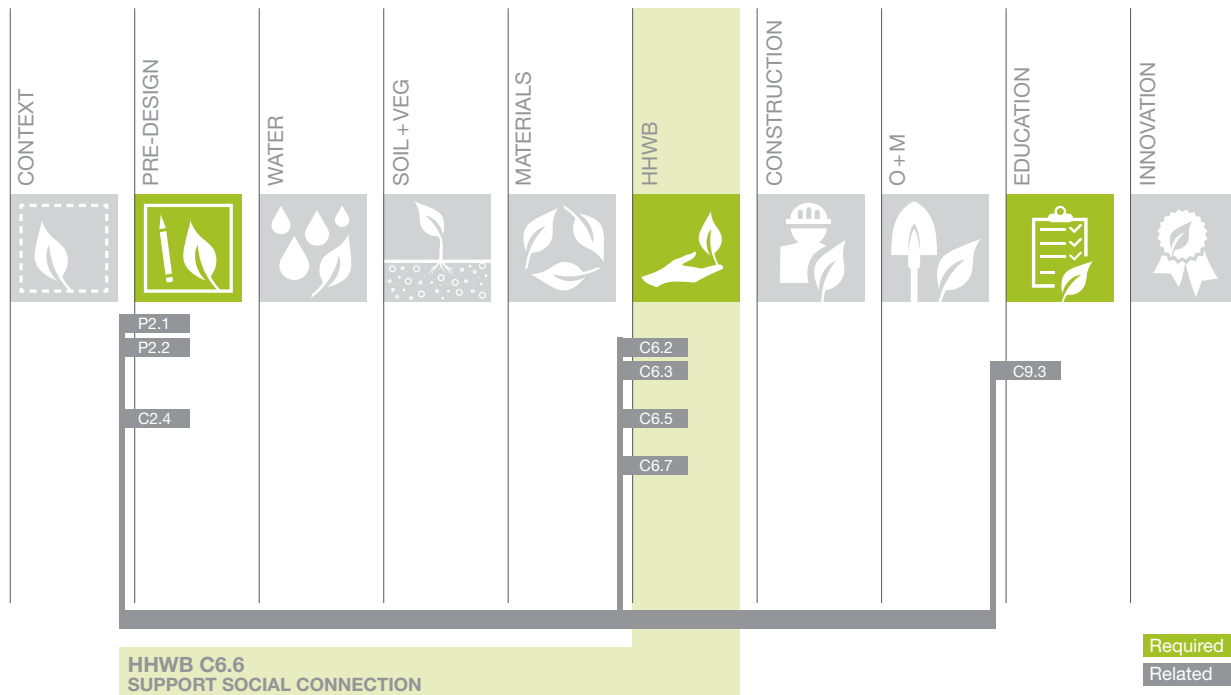
DEFINITIONS

- A **site user** is an individual who is expected to occupy, work at, or pass through the site. Users may visit the site regularly or periodically. Site users will range in age, ethnicity, and socio-economic status, but all users’ needs should be considered.

RESOURCES

- For information on seating that meets the needs of site users, see S Carr, M Francis, LG Rivlin, and AM Stone, *Public Space* (New York: Cambridge University Press, 1992).
- For information on designing spaces for social interaction, refer to the following resources:
 - CC Marcus and C Francis, *People Places: Design Guidelines for Urban Space* (New York: John Wiley & Sons, 1997).
 - WH Whyte, *The Social Life of Small Urban Spaces* (Washington, DC: Conservation Foundation, 1980).
 - University of Washington *Green Cities: Good Health—Community Building*, depts.washington.edu/hhwb/Thm_Community.html.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C6.6



Credit 6.7: Provide on-site food production

3–4 points

INTENT

Improve human health and well-being, community involvement, and education about food production and nutrition by designing and managing food production on site.

REQUIREMENTS

- Provide for on-site food production including vegetable gardens or edible nut and fruit-bearing plants appropriate to the site (see *Soil+Veg P4.3: Use appropriate plants*).

Option 1: Food production

3 points

- Dedicate a minimum of 10 percent of the site's final vegetated area to food production.
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and describes how site conditions are appropriate for food production.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and details practices for maintaining a food-producing garden.

Option 2: Food production and regular distribution

4 points

- Dedicate a minimum of 10 percent of the site's final vegetated area to food production (e.g., community gardens) and distribute or sell food produced to site users and the community (e.g., farmers' market, local food sources, restaurants, schools, hospitals, and community supported agriculture).
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and describes how site conditions are appropriate for food production.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and details specific practices for maintaining a food-producing garden.

SUBMITTAL DOCUMENTATION

Option 1: Food production

- Site plan highlighting food production locations, access points, and water sources
- Area calculations showing that the food production areas make up at least 10 percent of the site's final vegetated area
- *Vegetation Worksheet* listing all plants installed at time of project implementation, noting which are used for food production (see *Soil+Veg P4.3: Use appropriate plants*)
- Narrative describing:
 - The process used to verify that any existing or imported soil used meets local, state, and federal regulations as safe to produce food for human consumption and for human contact
 - How site users or community members will maintain food production areas (e.g., mulching and fertilization schedules)
 - Watering and irrigation strategies (see *Water P3.2: Reduce water use for landscape irrigation*)

C6.7



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

Option 2: Food production and distribution

- Site plan highlighting food production locations, access points, and water sources
- Area calculations showing that the food production areas make up at least 10 percent of the site's final vegetated area
- *Vegetation Worksheet* listing all plants installed at time of project implementation, noting which are used for food production (see *Soil+Veg P4.3: Use appropriate plants*)
- Narrative describing:
 - The process used to verify that any existing or imported soil used meets local, state, and federal regulations as safe to produce food for human consumption and for human contact
 - How site users or community members will maintain food production areas (e.g., mulching and fertilization schedules)
 - Watering and irrigation strategies (see *Water P3.2: Reduce water use for landscape irrigation*)
 - How food will be utilized, distributed, or sold to the site users and the community

RECOMMENDED STRATEGIES

- Research historical uses of the site and surrounding context to determine the potential for in-ground and airborne contaminants. If needed, consult environmental professionals for acceptable databases.
- Contaminated soils can negatively affect the healthfulness of food crops. Sites should be evaluated regarding their safety for food production (e.g., be aware of previously developed sites, including those previously used as orchards for nut or fruit production, and brownfield sites that may have contaminated soils). To certify the site's soils and plants produced in them do not pose a health risk, it is recommended that only a qualified environmental professional determine the safety of the site for food production.
- Contact local or county cooperative extension offices to determine which soil tests are available to check for potential contaminants harmful to human health. Recommended soil tests and sampling protocol must meet local, state, and federal regulatory standards.
- Use organic gardening methods to reduce human consumption of harmful chemicals.
- Use various gardening methods (e.g., greenhouses, raised beds, container gardens) to provide alternative spaces for food production and reduce risk if contaminated soils are present and not remediated.
- Harvest rainwater or use another sustainable water harvesting method that minimizes the use of potable water.
- If food waste and vegetation trimmings are generated on site, incorporate this waste material into composting strategies.
- Practices in animal husbandry may be considered for credit in *Innovation C10.1 Innovation in site design*, with adequate documentation proving the design meets state and local regulations.

C6.7



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

ECONOMIC AND SOCIAL BENEFITS

Growing and distributing foods locally can reduce negative impacts to the environment, enhance the local economy, promote community development, and enhance the quality and freshness of produce. Foods such as nuts, fruits, herbs, and vegetables are an essential part of daily nutrition and the overall health and well-being of people; they should be accessible to communities. Community gardening improves people's quality of life by providing a catalyst for neighborhood and community development;¹ stimulating social connection; encouraging self-reliance; beautifying neighborhoods; producing nutritious food;² reducing family food budgets; conserving resources; and creating opportunities for recreation, exercise, therapy, and education.³

1. Okvat, H.A., and A.J. Zautra. 2011. "Community Gardening: A Parsimonious Path to Individual, Community, and Environmental Resilience," (*American Journal of Community Psychology*) 47, 3: 374-387.
2. Litt, J.S., M.J. Soobader, M.S. Turbin, J.W. Hale, M. Buchenau, and J.A. Marshall. 2011. "The Influence of Social Involvement, Neighborhood Aesthetics, and Community Garden Participation on Fruit and Vegetable Consumption," (*American Journal of Public Health*) 101, 8: 1466.
3. Guitart, D., C. Pickering, and J. Byrne. 2012. Past Results and Future Directions in Urban Community Gardens Research," (*Urban Forestry & Urban Greening*) 11, 4: 364-373.

DEFINITIONS

- An **appropriate plant species** is vegetation adapted to site conditions, climate, and design intent. The following attributes should be considered in determining whether plants are appropriate for the site: cold hardiness, heat tolerance, salt tolerance, soil moisture range, plant water use requirements, soil volume requirements, soil pH requirements, sun and shade requirements, pest susceptibility, and maintenance requirements. Native and non-native plants are appropriate if they meet the above criteria.
- A **brownfield** is an abandoned, idled, or underused industrial and commercial facility or site where expansion or redevelopment is complicated by real or perceived environmental contamination; a site documented as contaminated by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local voluntary cleanup program, or a site defined as a brownfield by a local, state, or federal government agency.
- A **community garden** is a single piece of land cultivated collectively by members of a neighborhood or likeminded group.
- A **farmers' market** is a public market place where the people that have grown or gathered the produce within 150 miles (241.40 kilometers) of the distribution site sell fresh produce. The market runs annually at least once a week for at least five months.
- A **local food source** produces food on site and/or distributes food grown within 150 miles (241.40 kilometers) of the site and may include, but is not limited to, farmers' markets, community supported agriculture (CSA) initiatives, community gardens, and home gardens that provide fresh produce to any number of people.
- A **previously developed site** consists of at least 75 percent of the site area that has been altered by preexisting paving, construction, or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural areas are considered undeveloped land.
- A **site user** is an individual who is expected to occupy, work at, or pass through the site. Users may visit the site regularly or periodically. Site users will range in age, ethnicity, and socio-economic status, but all users' needs should be considered.
- **Vegetated area** describes all portions of the site that will support vegetation.
- **Vegetation trimmings** include only non-invasive plant material free of disease and herbicide residues.

C6.7

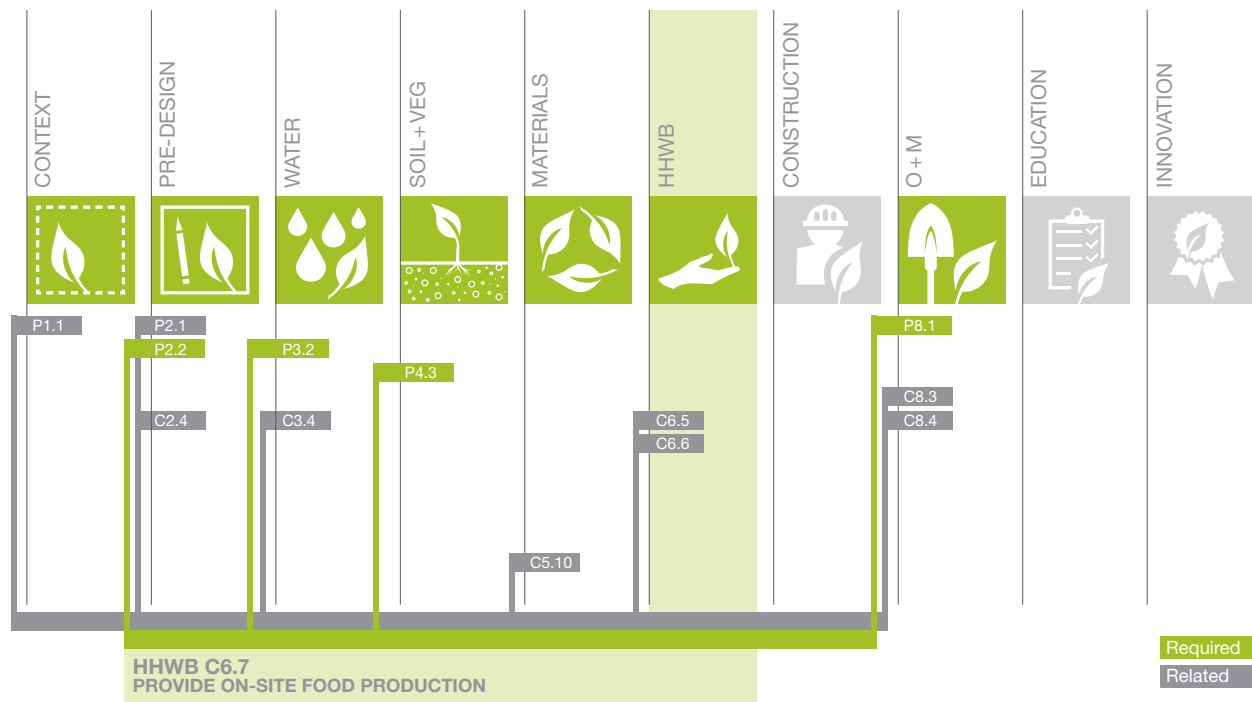


Section 6: Site Design – Human Health + Well-Being

RESOURCES

- For concerns regarding contaminated soils, consult the following U.S. national and state resources:
 - U.S. EPA “Urban Agriculture & Improving Local, Sustainable Food Systems,” www.epa.gov/brownfields/urbanag
 - Washington State University, “Gardening on Lead- and Arsenic-Contaminated Soils,” www.ecy.wa.gov/programs/tcp/area_wide/AW/AppK_gardening_guide.pdf
 - University of Minnesota, “Urban Gardens and Soil Contaminants: A Gardener’s Guide to Healthy Soil,” www.misa.umn.edu/prod/groups/cfans/@pub/@cfans/@misa/documents/asset/cfans_asset_287228.pdf
 - Cornell University Waste Management Institute, “Guide to Soil Testing and Interpreting Results,” cwmi.css.cornell.edu/guidetosoil.pdf, and “Soil Contaminants and Best Practices for Healthy Gardens,” cwmi.css.cornell.edu/Soil_Contaminants.pdf
- For more information about testing labs, see these resources:
 - National Environmental Laboratory Accreditation Program (includes a list of certified laboratories for each U.S. state), www.nelac-institute.org/accred-bodies.php
 - University of Massachusetts Soil and Plant Testing Laboratory, soiltest.umass.edu
- For more information about local food sources, refer to the following resources:
 - The American Horticultural Society, www.ahs.org
 - American Community Gardening Association, communitygarden.org
 - Local Harvest (provides locations of farms across the United States and Canada where produce can be purchased), www.localharvest.org
 - Series of starter guides for urban food gardeners, www.seattle.gov/neighborhoods/ppatch/gardeningresources.htm

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C6.7



Credit 6.8: Reduce light pollution

4 points

INTENT

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

REQUIREMENTS

In order to reduce light pollution:

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

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

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

Method 1: BUG rating method

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

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

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

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

C6.8



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

Backlight ratings

Table 6.8-A

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

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

Uplight ratings

Table 6.8-B

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

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

Glare ratings

Table 6.8-C

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

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

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

Method 2: Calculation method

Uplight

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

Table 6.8-D

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

Light trespass (backlight and glare)

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

Table 6.8-E

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

Exemptions from uplight and light trespass requirements

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

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

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

SUBMITTAL DOCUMENTATION

Method 1: BUG rating method

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

Method 2: Calculation method

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

DOCUMENTATION GUIDANCE

Method 1: BUG rating method

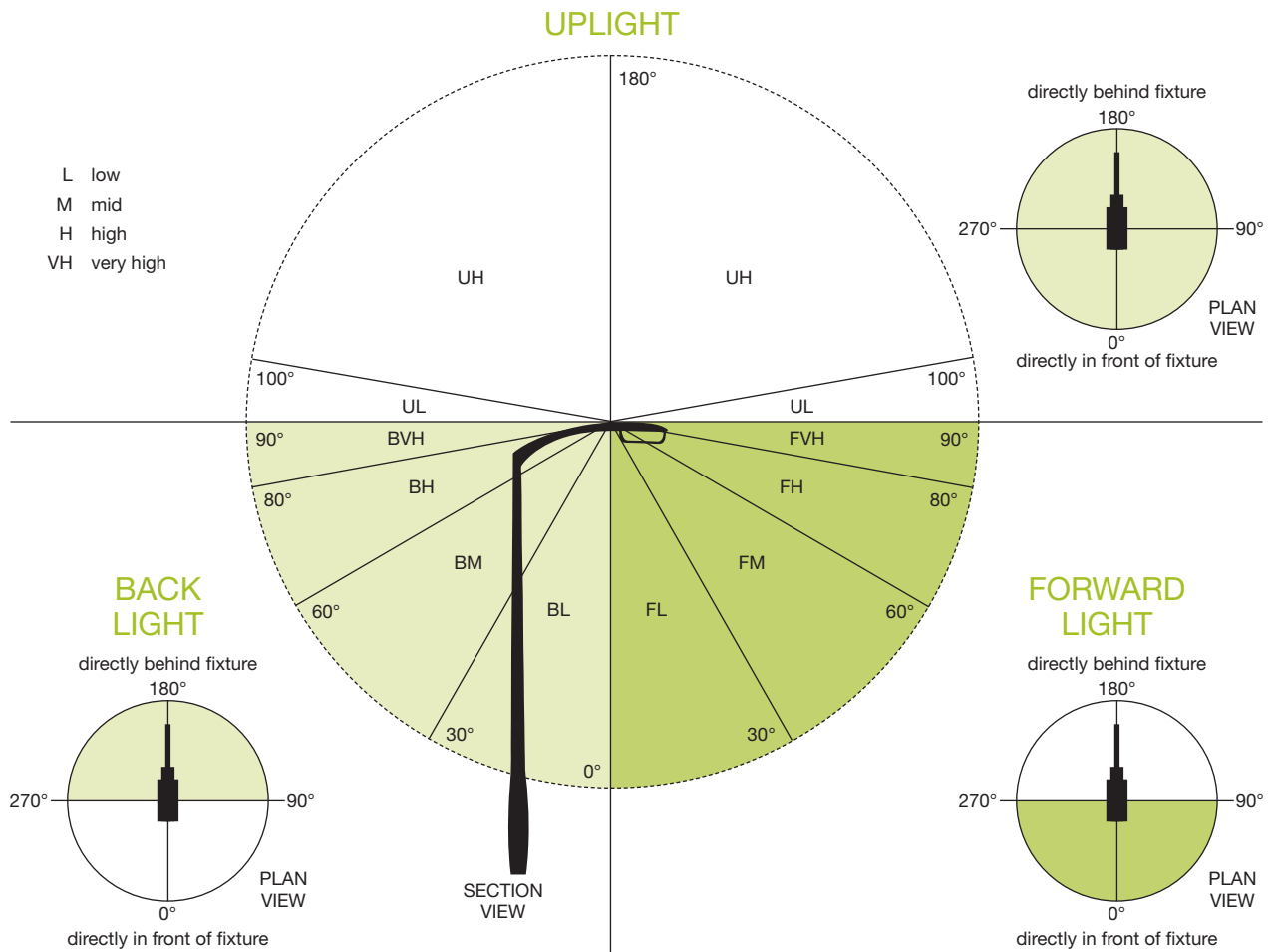
Figure 6.8-F describes the zones to be measured for each luminaire in order to determine the BUG ratings for Method 1. Zones are based on the spherical secondary solid angles created by light emitted from the luminaire. Determine the rating for each zone using Tables 6.8-G through J. The overall rating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

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Figure 6.8-F



C6.8



Table 6.8-G

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

Table 6.8-H

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

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Table 6.8-I

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

Table 6.8-J

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

RECOMMENDED STRATEGIES

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

ECONOMIC AND SOCIAL BENEFITS

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

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

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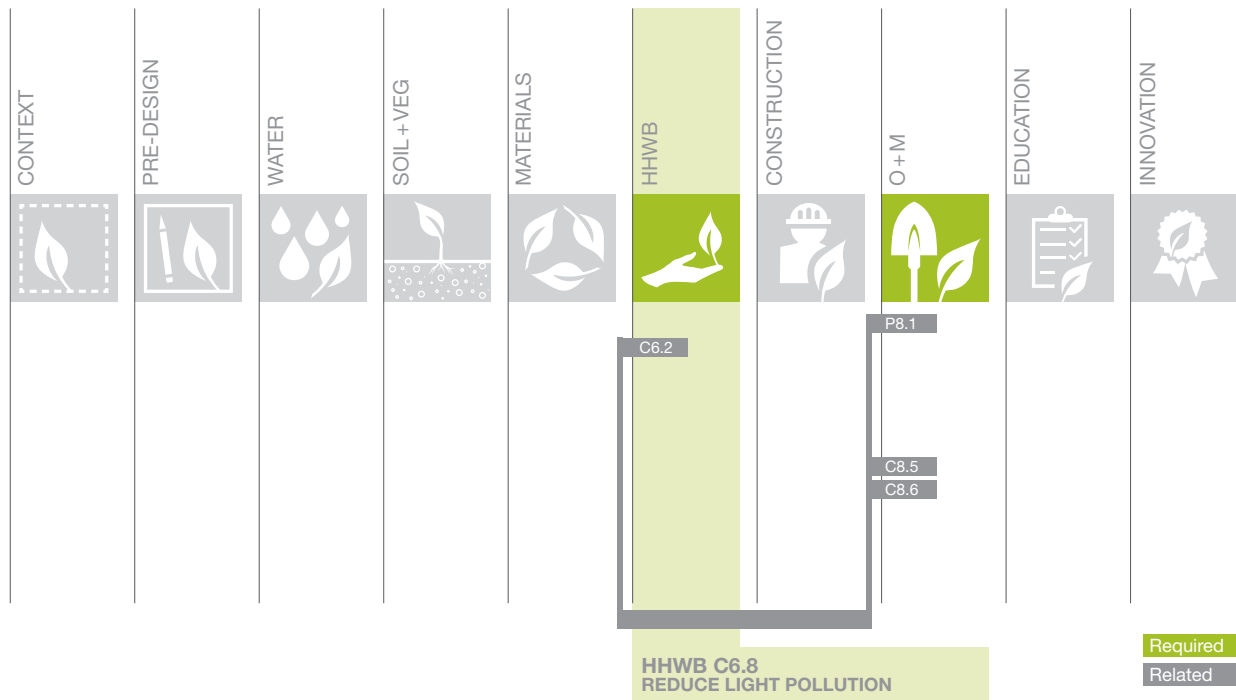
DEFINITIONS

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

RESOURCES

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

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 6.9: Encourage fuel efficient and multi-modal transportation

4 points

INTENT

Reduce emissions and promote a healthy lifestyle by encouraging and supporting efficient and adaptable modes of transportation.

REQUIREMENTS

- Provide at least three of the following options:
 - Preferred parking for vehicles that have reduced emissions and/or high fuel-efficiency for three percent of the total vehicle parking capacity of the site
 - Preferred parking for carpools or vanpools for three percent of the total vehicle parking capacity
 - Parking capacity that is reduced by 20 percent from the base ratios, as recommended by the Parking Consultants Council (shown in the *Institute of Transportation Engineers' Transportation Planning Handbook*, 3rd Edition, Tables 18-2 through 18-4)
 - Site amenities at structured bus shelters (e.g. appropriate weather protection structures, seating, waste and recycling receptacles)
 - Electric re-charge stations or alternative fuel stations
 - Short-term bicycle parking for no less than six bicycles within 50 feet (15.24 meters) of each primary entrance of a building and long-term bicycle parking, either enclosed and secured or within 200 feet (60.96 meters) of inhabited buildings, for seven percent of the building's total users
 - Infrastructure, facilities, or incentives to promote shared usage such as carpool drop-off areas, car-share programs, bicycle-share programs, and shuttle services to mass transit
- Ensure the section of the site assessment (see *Pre-Design P2.2: Conduct a pre-design site assessment*) is complete and includes locations of the existing or planned pedestrian, bicycle, or transit routes and any existing parking.

SUBMITTAL DOCUMENTATION

- Total number of site users
- The total vehicle and bicycle parking capacity of the site
- Provide the following as necessary:
 - Site plan showing locations of major site entrances; buildings and their primary entrances; and the location and design of either short-term bicycle parking, long-term bicycle parking, or both. If providing long-term bicycle parking, also list the total number of the building's users.
 - Site plan showing locations of preferred parking spaces for carpools or vanpools and how these are designated to the users (i.e., signage)
 - Site plan showing locations of preferred parking spaces for vehicles that have reduced emissions or high fuel-efficiency and how these are designated to the users (i.e., signage)
 - Site plan showing structured bus shelter amenities that provide minimum protection from wind, rain, and sun
 - Narrative describing the infrastructure and support programs that are in place to facilitate and promote shared vehicle usage

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

- Site plan showing locations of electric re-charge stations or alternative fuel stations
- Calculations showing reduced parking capacity from the base ratio for the site, counting all existing and new parking spaces for the project, including any located in off-site facilities

RECOMMENDED STRATEGIES

- Provide transportation facilities such as alternative fuel refueling stations.
- Provide fuel-efficient vehicles for employee use during the workday.
- Support for bicycle riders may include access to bicycle racks, on-site showers, enclosed parking lockers, and flexible work scheduling to avoid rush hour traffic congestion.

ECONOMIC AND SOCIAL BENEFITS

Although initial costs for alternative vehicles are higher than for conventional vehicles, local, state, and federal government tax incentives can partially offset these costs.¹ For fuel-efficient vehicles, reduced operation costs on a per-mile or per-kilometer basis can offset higher initial purchase prices or higher fuel costs. Different alternative fuel vehicles need different refueling stations, and costs may vary. Hybrid vehicles are gaining traction in the marketplace, which should start to drive down their cost.

Roughly 41 percent of all commutes in the United States are shorter than five miles², which for many people would be an easy distance to travel by bike. Bicycling can be a fun, dependable, and very low cost mode of transportation that reduces commuters' stress on infrastructure while improving their health. Bicycling reduces the time spent searching for parking spaces and waiting in traffic congestion. According to the US Census Bureau's American Community Survey³, the share of Americans commuting by bike has grown by 47 percent since 2000.

1. Congressional Budget Office, "Effects of Federal Tax Credits for the Purchase of Electric Vehicles," www.cbo.gov/sites/default/files/cbofiles/attachments/09-20-12-ElectricVehicles_0.pdf (accessed March 23, 2013).
2. U.S. Department of Transportation Federal Highway Administration "Bicycle and Pedestrian Commuting Information," www.fhwa.dot.gov/environment/bicycle_pedestrian/commute/ (accessed March 23, 2013).
3. U.S. Census Bureau, "American Community Survey," www.census.gov/acs/www/ (accessed March 23, 2013).

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DEFINITIONS

- A **bicycle rack** is a device consistent with industry standards that is capable of supporting a bicycle in a stable position, is made of durable materials, is no less than 36 inches (91.44 centimeters) tall from base to top of rack, and no less than 1.5 feet (0.30 meters) in length. It permits the securing of the bicycle frame and one wheel with a U-shaped lock, and is of a character and color that adds aesthetically to the immediate environment.
- A **bicycle-share program** is a network of bicycles distributed around a city for public use at a low cost. Users can pick up bicycles at any designated self-serve station and return them to any other such station. This functionality makes bicycle-shares ideal for Point-A-to-Point-B transportation. (Adapted from the New York City Government, www.nyc.gov.)
- **Carpool** is an arrangement in which two or more people share a vehicle for transportation.
- A **car-share program** allows an individual who is a registered member of a car share organization to use vehicles on an as-needed basis, typically by the hour. A member has access to a variety of vehicles that are maintained by the car share organization and stored at dispersed locations. (New York City government, www.nyc.gov.)

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- **Long-term bicycle parking** is the provision of bicycle storage (e.g., basic racks, bicycle corrals, hanging racks, lockers) that is indoor or sheltered, with semi-passive security (achieved by locks or surveillance) that is primarily intended for bicyclists who need bicycle parking for more than two hours at a time.
- **Preferred parking** includes the parking spots that are closest to the main entrance of the project (exclusive of spaces designated for handicapped) or parking passes provided at a discounted price.
- **Short-term bicycle parking** is the provision of secure, well-designed bicycle racks or a bicycle corral that is conveniently located on the site or at the building entry and is highly visible. It is intended for bicyclists who need parking for fewer than two hours.
- A **site user** is an individual who is expected to occupy, work at, or pass through the site. Users may visit the site regularly or periodically. Site users will range in age, ethnicity, and socio-economic status, but all users' needs should be considered.
- A **vehicle that has reduced emissions and/or high fuel-efficiency** is a vehicle classified as a zero emission vehicles (ZEV) by the California Air Resources Board or has achieved a minimum green score of 40 on the American Council for an Energy Efficient Economy (ACEEE) annual vehicle-rating guide.

RESOURCES

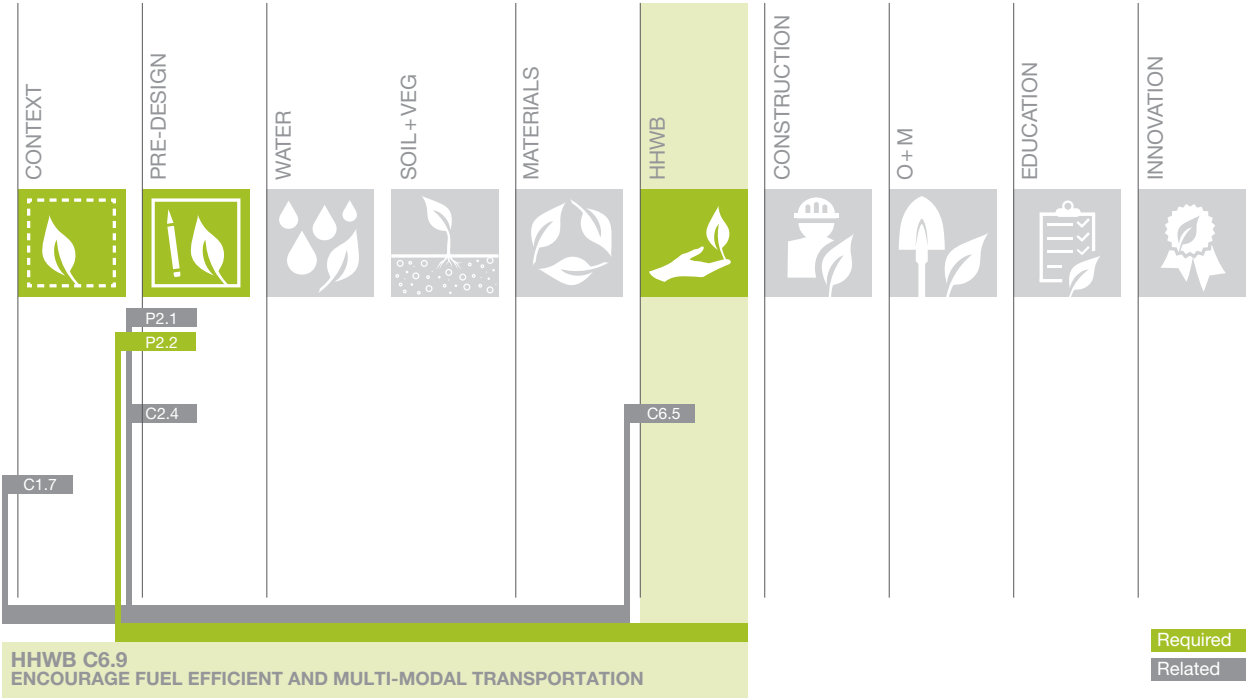
- Components of this credit were adapted from the U.S. Green Building Council's LEED credits:
 - LEED BD+C v2009 SS *Credit 4: Alternative transportation*
 - LEED BD+C v4 LT *Credit 6: Bicycle facilities*
 - LEED BD+C v4 LT *Credit 7: Reduced parking footprint*
 - LEED BD+C v4 LT *Credit 8: Green vehicles*
- For information about the California Air Resources Board Zero Emissions Vehicle (ZEV) Program, go to www.arb.ca.gov/msprog/zevprog/zevprog.htm.
- For more information about vehicles that have reduced emissions or high fuel-efficiency, consult the American Council for an Energy-Efficient Economy, www.aceee.org.
- For an online searchable green car guide based on a combination of tailpipe emission levels, visit ACEEE's "Green Book," www.greenercars.org/index.htm.
- For information about alternative fuels and alternative field vehicles and a locator for alternative refueling stations, visit the U.S. Department of Energy Alternative Fuels and Advanced Vehicles Data Center, www.afdc.energy.gov.
- For parking capacity base ratios recommended by the Parking Consultants Council, see the *Institute of Transportation Engineers' Transportation Planning Handbook*, 3rd Edition, Tables 18-2 through 18-4.
- For online information about bicycle planning and best practices to encourage bicycle mobility, consult BizCycle, bizcycle.cascade.org.
- For information about short- and long-term bicycle parking and bicycle racks and lockers, consult these resources:
 - *Bicycle Parking Guidelines, 2nd Edition 2012*, Association of Pedestrian and Bicycle Professionals, www.apbp.org/?page=publications
 - *Portland, Oregon, Bureau of Transportation*, bikeportland.org/wp-content/uploads/2010/05/PDX_Bike_Corral_Study.pdf

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

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



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Credit 6.10: Minimize exposure to environmental tobacco smoke

1–2 points

INTENT

Improve human health by minimizing site users' exposure to environmental tobacco smoke (i.e., secondhand smoke).

REQUIREMENTS

Option 1: Designate smoke-free zones

1 point

- Develop and implement a smoke-free policy to prohibit smoking outdoors within 25 feet (7.62 meters) of all regularly occupied building entries, operable windows, air intakes, bus stops, parking for persons with disabilities, patios, overlooks, playgrounds, recreational fields, and other outdoor gathering areas where people could inadvertently come in contact with tobacco smoke when occupying, entering, or leaving the site.
- Clearly designate outdoor smoking areas that meet the above requirements and provide adequate waste disposal. Permanent signage indicating the smoke-free policy must be installed within 10 feet (3.05 meters) of all building entrances.*
- Ensure employees, contractors, and visitors will be informed and asked to comply with the smoke-free policy.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and outlines the long-term strategies to monitor the smoke-free policy for compliance by all employees, contractors, and visitors to the site.

Option 2: Prohibit smoking on site

2 points

- Develop and implement a smoke-free policy to prohibit smoking within the entire site.
- Install permanent signage indicating the smoke-free policy.*
- Ensure employees, contractors, and visitors will be informed and asked to comply with the smoke-free policy.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and outlines the long-term strategies to monitor the smoke-free policy for compliance by all employees, contractors, and visitors to the site.

* *Note:* This step is not required for single-family residential projects.

SUBMITTAL DOCUMENTATION

Option 1: Designate limited smoking zones

- Site plan showing designated smoking areas; locations of signage; and their distances from entries, operable windows, air intakes, outdoor gathering areas, and other locations where occupants could inadvertently come in contact with tobacco smoke
- The smoke-free policy and implementation plan
- Photographs showing signage indicating the designated smoking areas and where smoking is prohibited

Option 2: Prohibit smoking on site

- The smoke-free policy and implementation plan
- Photographs showing signage indicating smoking is prohibited

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

RECOMMENDED STRATEGIES

- In locating exterior smoking areas, take into account prevailing winds and microclimate effects.
- To limit the effects of tobacco smoke on site users, consider innovative techniques such as placing filters near air intakes or creating outdoor smoke rooms.

ECONOMIC AND SOCIAL BENEFITS

Cleaner air is linked to reduced health-care costs. Individual cigarettes are point sources of air pollution; smokers in groups become an area source of secondhand smoke pollution. Secondhand smoke contains respirable particles that can cause breathing difficulty for those with chronic respiratory diseases or trigger an asthma attack in those with disabling asthma.

Outdoor smoke-free zones reduce exposure to secondhand smoke, which is responsible for an estimated 3,000 lung cancer deaths and 46,000 heart disease deaths in non-smoking individuals in the United States each year.¹

According to the U.S. Centers for Disease Control and Prevention, there is no risk-free level of exposure to secondhand smoke. Even low levels can harm non-smokers' health. Separating smokers from non-smokers, cleaning the air, and ventilating buildings cannot eliminate secondhand smoke exposure. Conventional air-cleaning systems can remove large particles, but they cannot filter smaller particles or gases found in secondhand smoke. Establishing a smoke-free environment is the only effective way to protect non-smokers from secondhand smoke.²

1. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, "Targeting Tobacco Use: The Nation's Leading Cause of Preventable Death 2008," U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, www.cdc.gov/nccdphp/publications/aag/pdf/osh.pdf (accessed March 25, 2013).
2. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, "The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General," U.S. Department of Health and Human Services, Office of the Surgeon General (2006), www.surgeongeneral.gov/library/secondhandsmoke/ (accessed March 25, 2013).

DEFINITIONS

- A **regularly occupied building** is a building where occupants (e.g. workers, students, residents) are inside for extended periods of time.
- **Tobacco smoke** is produced by the burning of any type of lighted pipe, cigar, cigarette, or other smoking equipment, whether filled with tobacco or any other type of material.

RESOURCES

- Components of this credit were adapted from the U.S. Green Building Council's LEED credits:
 - LEED BD+C v2009 EQ Prerequisite 2: *Environmental tobacco smoke control*
 - LEED BD+C v4 EQ Prerequisite 2: *Environmental Tobacco Smoke (ETS) control*
- For data about smoking and tobacco use, refer to the U.S. Centers for Disease Control and Prevention, www.cdc.gov/tobacco.
- For information about tobacco prevention strategies, treatment programs, and policies, visit *Tobacco Free Partners* at www.tobaccofreepartners.org.
- For a model voluntary comprehensive non-smoking policy for businesses and organizations, see California's Clean Air Project secondhand smoke resources for outdoor tobacco smoke, www.yubacity.net/documents/boards/2009/parks-rec/agenda-05-20-09-smoke-free-parks-report-handout.pdf.
- For sample ordinances for smoke-free events and outdoor areas, consult ChangeLab Solutions, changelabsolutions.org/landing-page/additional-TC-resources.
- For ordinance lists, maps, and data, visit the American Nonsmokers' Rights Foundation, www.no-smoke.org/goingsmokefree.php?id=519.

C6.10



Credit 6.11: Support local economy

3 points

INTENT

Provide economic and social benefits to the local community during site construction by providing employment opportunities and purchasing local materials and services.

REQUIREMENTS

- Hire a local workforce and support local businesses during the construction phase by doing two or more of the following steps:
 - Commit to employing no fewer than 75 percent of workers at or above a living wage requirement during construction of the site.
 - Employ local individuals for 75 percent of new hires during the construction phase.
 - Employ low-income individuals for 75 percent of new hires during the construction phase.
 - Support on-the-job training by hiring individuals from government-sponsored, union, or accredited educational programs such as GreenCorps, Jobcorps, VISTA or AmeriCorps.
 - Purchase materials and construction services equal to 10 percent or more of the construction budget from locally owned and operated businesses.

SUBMITTAL DOCUMENTATION

Provide the following, as applicable:

- Calculations showing:
 - The living wage for the project location
 - The total number of construction workers
 - The percentage of construction workers receiving a living wage
- Completed *Construction Hiring Worksheet* showing that 75 percent of newly hired construction employees are local or low-income individuals, which includes the following information:
 - Name of the contractor or subcontractor
 - Contact or authorized representative
 - Value of contract
 - Total hours of contract
 - Total local hours
 - Percentage of local hours
 - Local apprentice (or entry level) hours
- List of individuals from programs that support on-the-job training or green collar jobs for the project site, signed by appropriate contract holders
- The overall construction budget and a list of locally owned and operated businesses and construction service providers equal to 10 percent or more of the construction budget

RECOMMENDED STRATEGIES

- Actively engage with the local community to identify and develop options for sharing the economic and social benefits of the site's development.
- Select options that allow the site's development to benefit a wide range of local residents, beyond the primary user groups.
- Contact union and other worker organizations to identify potential workforce hires for the project.

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

ECONOMIC AND SOCIAL BENEFITS

Site development that addresses effects on local residents can promote the long-term economic sustainability of local families and businesses. By capturing economic opportunities that result from site development and providing these opportunities to local residents, a site helps support resilient neighborhoods.¹ Reducing unemployment significantly impacts social and economic costs to individuals, families, and communities, and local job creation and purchasing has direct and indirect economic and social benefits for the individuals employed, local businesses, and the community as a whole. Local job income and growth increase local spending and stimulate economic activity supporting public, social, and community services. They also have indirect effects on communities by reducing crime, drugs, and family disputes.

1. R Kniech, "Beyond the Environment: Socio-economic Sustainability and Meaningful Community Input in Land Use Decisions," *Research Monologue Series: Community Identity and Governance*, Rocky Mountain Land Use Institute (2008), law.du.edu/images/uploads/rmlui/rmlui-sustainable-Socio-EconomicSustainability.pdf (accessed March 24, 2013).

DEFINITIONS

- **Living wage** is the hourly rate that an individual must earn to support his or her family, if he or she is the sole provider and is working full-time (2080 hours per year). The state minimum wage is the same for all individuals, regardless of how many dependents they may have. The poverty rate is typically quoted as gross annual income (Living Wage Calculator, MIT).
- **Low-income** is defined by the poverty guidelines established by the U.S. Department of Health and Human Services in the *Federal Register*, Vol. 77, No. 17, January 26, 2012, pp. 4034-4035 (www2.ed.gov/about/offices/list/ope/trio/incomelevels.html.)

RESOURCES

- For help estimating the living wage for the site's location, see the Living Wage Calculator at livingwage.mit.edu.
- For sample language for "first source" hiring systems, consult the Partnership for Working Families at www.forworkingfamilies.org/page/policy-tools-targeted-hiring-and-first-source-referral-systems.
- For an example of a city connecting low-income workers with entry-level jobs, read about the San Francisco's First Source Hiring Program, mission.sfgov.org/OCA_BID_ATTACHMENTS/FA27284.pdf.
- To learn more about fair employment for low-income workers, visit the Worker's Defense Project, www.workersdefense.org.
- For more information on identifying, engaging, and planning with the community, see the following resources:
 - National Charrette Institute, www.charretteinstitute.org
 - Project for Public Spaces resources, placemaking.pps.org/parks_plazas_squares/info/design
 - B Lennertz and A Lutzenhiser, *The Charrette Handbook: The Essential Guide for Accelerated, Collaborative Community Planning* (Chicago: American Planning Association, 2006).
 - H Sanoff, *Community Participation Methods in Design and Planning* (New York City: John Wiley & Sons, 1999).
 - CS Slotterback, M Beekman, C Carlson, and J Reed, *Enhancing Transportation: The Effects of Public Involvement in Planning and Design Processes*, Report No. CTS 07-10, Series: Moving Communities Forward (2007).

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SECTION 7

CONSTRUCTION

PREREQUISITE / CREDIT	TITLE	POINTS
Construction P7.1	Communicate and verify sustainable construction practices	Required
Construction P7.2	Control and retain construction pollutants	Required
Construction P7.3	Restore soils disturbed during construction	Required
Construction C7.4	Restore soils disturbed by previous development	3-5 points
Construction C7.5	Divert construction and demolition materials from disposal	3-4 points
Construction C7.6	Divert reusable vegetation, rocks, and soil from disposal	3-4 points
Construction C7.7	Protect air quality during construction	2-4 points

Prerequisite 7.1: Communicate and verify sustainable construction practices

Required

INTENT

Ensure site performance by communicating and verifying the implementation of sustainable practices throughout the construction process.

REQUIREMENTS

- Designate an integrated design team member (see *Pre-Design P2.1: Use an integrative design process*), other than the contractor, who will be responsible for verifying the site is built per the construction specifications and drawings.
- Before construction starts, hold a meeting that includes at least one person from each discipline from the integrated design team, plus the major subcontractors.
 - Review construction specifications and drawings and convey the project's sustainability principles and performance goals to the contractor and subcontractors.
 - Review the steps needed to achieve all the prerequisites and pursued credits.
 - Hold additional meetings as necessary when additional subcontractors are hired.
- Prior to construction, create a SITES Punchlist that assigns responsibility for each prerequisite and desired credit in a worksheet (see *SITES Punchlist Worksheet*) to a member of the integrated design team. That person will sign off on each assigned item as it is implemented.

SUBMITTAL DOCUMENTATION

- *SITES Punchlist Worksheet*, with sign-off signatures and dates for implementation of each SITES prerequisite and pursued credits
- Meeting minutes from the pre-construction meeting, complete with signatures demonstrating at least one person from each discipline from the integrated design team was present

RECOMMENDED STRATEGIES

- Provide *SITES Punchlist Worksheet* for distribution to contractor prior to the beginning of construction. Update and re-issue it as construction progresses.
- Encourage the site contractor to designate a staff person to track SITES-related work and communicate with the integrated design team as needed from design phase through maintenance period.
- To increase awareness of critical path items, coordinate with construction sequencing to produce and distribute a graphic timeline for *SITES Punchlist* items.
- Discuss resources (i.e., budget, staff, volunteers, equipment, and materials) available during the construction process. Determine short- and long-term sustainability principles and performance goals.

P7.1



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ECONOMIC AND SOCIAL BENEFITS

The sustainable performance of a site provides the project owners, end users, surrounding community, and local ecosystems the many benefits embodied in each prerequisite and credit. However, sustainable performance of a site cannot be achieved without the effective communication of design intent and construction documents to the relevant construction leads and staff and tracking and verifying proper implementation.

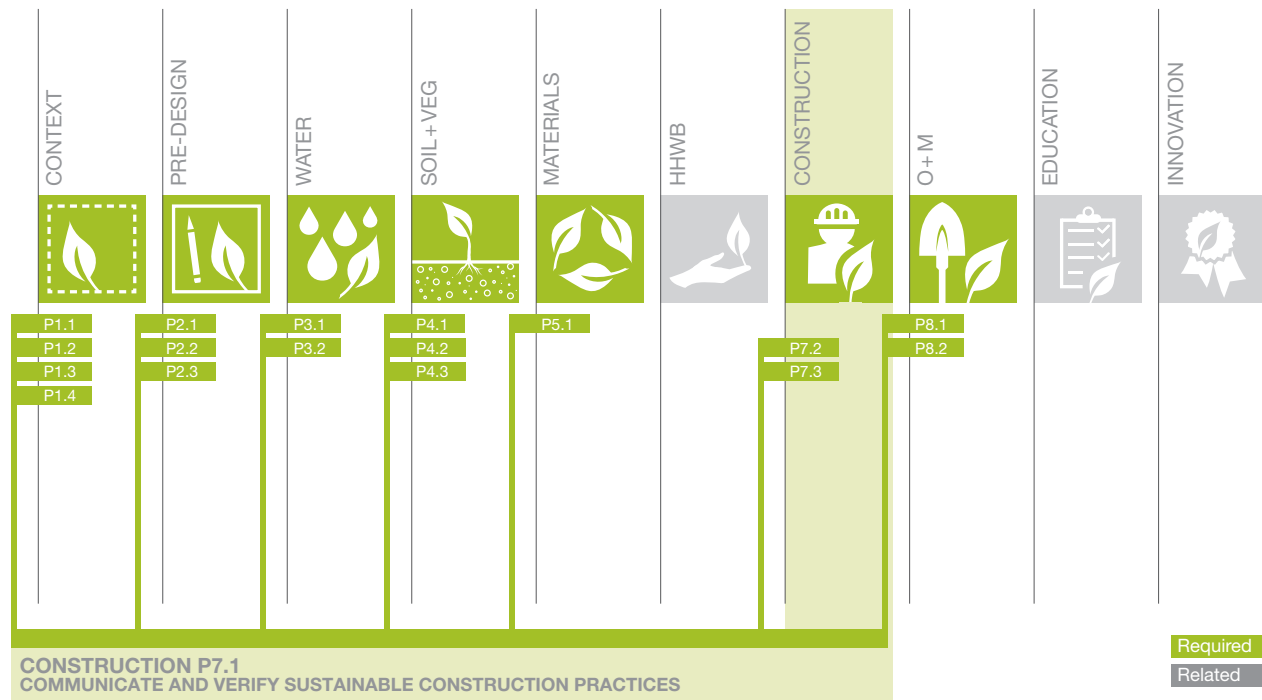
DEFINITIONS

- An **integrated design team** includes the owner, client, and professionals knowledgeable in design, construction, and maintenance. Team members should be selected to meet the unique constraints and opportunities of the site.
- **Principles and performance goals** are, respectively, the guiding overarching concepts and the observable and measurable end results of having one or more objectives achieved within a relatively fixed time frame.
- A **SITES Punchlist** is a set of line items to be carried out by a contractor in order to achieve SITES prerequisites and credits.

RESOURCES

- For detailed resources for communicating with site contractors, please see *Pre-Design P2.1: Use an integrative design process.*

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Prerequisite 7.2: Control and retain construction pollutants

Required

INTENT

Protect receiving waters (including surface water, groundwater, and combined sewers or stormwater systems), air quality, and public safety by preventing and minimizing the discharge of construction site pollutants and materials.

REQUIREMENTS

- Create and implement an erosion, sedimentation, and pollutant control plan, commonly referred to as a stormwater pollution prevention plan (SWPPP) or erosion and sedimentation control plan (ESC) for all construction activities associated with the project.
 - Regardless of project size, the plan (SWPPP or ESC) must conform to erosion and sedimentation requirements of the most current version of the U.S. EPA Construction General Permit (or local equivalent from projects outside the United States) or local erosion and sedimentation control standards and codes, whichever is more stringent. The plan must list the best management practices (BMPs) employed and describe how the BMPs accomplish the following objectives:
 - > Prevent loss of soil during construction by stormwater runoff or wind erosion, including protecting topsoil by stockpiling or covering for reuse.
 - > Prevent and reduce sediment discharges into storm conveyances, receiving waters, or other public infrastructure components or systems.
 - > Prevent polluting the air with dust and particulate matter.
 - > Prevent runoff and infiltration of other pollutants from construction sites (e.g., thermal pollution, concrete wash, fuels, solvents, hazardous chemical runoff, high or low pH discharges, pavement sealants) and ensure proper disposal of all construction related materials.
 - > Protect any Vegetation and Soil Protection Zones (VSPZs) and other areas of vegetation that will remain on site from construction activities.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and describes the on-going management activities to protect the integrity of VSPZs.

Note: The construction phase of the project is considered complete when the site is stabilized, a notice of termination is filed, or a notice of substantial completion is issued.

The construction general permit (CGP) outlines the provisions necessary to comply with Phase I and Phase II of the U.S. EPA National Pollutant Discharge Elimination System (NPDES) program (or local equivalent for projects outside the United States). Although the CGP applies only to sites greater than one acre (0.40 hectares), its requirements are applied to all projects for the purposes of this prerequisite.

P7.2



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SUBMITTAL DOCUMENTATION

- The SWPPP, ESC, or other local required plan (whichever is more stringent)
 - If a local standard has been followed, provide documentation to demonstrate the local standard is equal to or more stringent than the referenced NPDES program.
- Site plan showing the erosion and sedimentation control measures implemented on site
- Narrative describing the erosion and sedimentation control measures implemented on-site
- Video or photos that document the erosion and sedimentation control measures implemented on site

RECOMMENDED STRATEGIES

- Employ strategies such as a combination of temporary and permanent seeding, mulching, earth dikes, sediment traps, sediment basins, filter socks, compost berms and blankets, secondary containment, spill control equipment, hazardous waste manifests, and overfill alarms.
- Implement post-construction stormwater management with construction sequencing (e.g., infiltration systems constructed or rehabilitated at the end of the project). Account for weather conditions during construction activities to minimize unintended chemical dispersal or other adverse effects on and off site (e.g. apply pavement sealers and perform mass-grading operations only when no rain is predicted).

ECONOMIC AND SOCIAL BENEFITS

Retaining pollutants and sediment on site improves water quality and provides associated benefits such as protection of aquatic ecosystems and opportunities for recreation such as fishing and swimming.¹

1. U.S. Environmental Protection Agency, "Wetland Functions and Values," cfpub.epa.gov/watertrain/pdf/modules/WetlandsFunctions.pdf (accessed April 11, 2013).

DEFINITIONS

- **Receiving waters** include groundwater, creeks, streams, rivers, lakes, or other water bodies that receive treated or untreated wastewater or stormwater. They also include water from combined sewer systems (CSOs) and storm drains.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.

RESOURCES

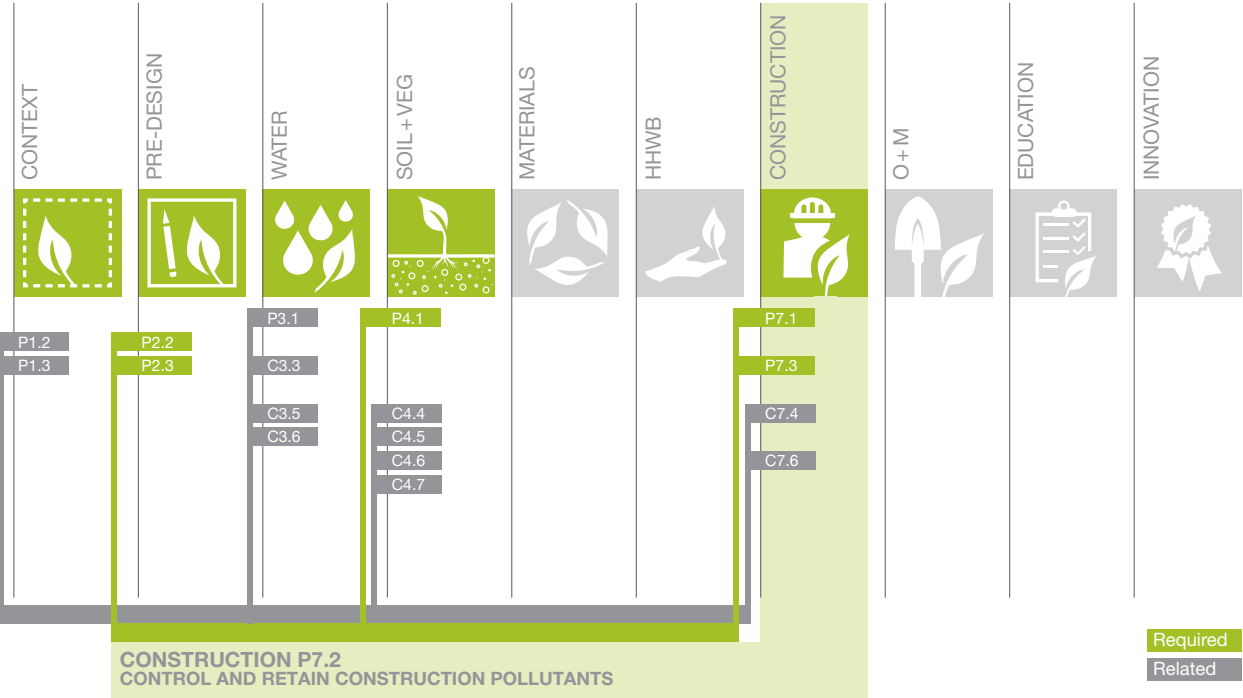
- Components of this credit were adapted from the U.S. Green Building Council's LEED credit:
 - LEED BD+C v2009 SS *Prerequisite 1: Construction activity pollution prevention*
 - LEED BD+C v4 SS *Prerequisite 1: Construction activity pollution prevention*
- For more information available from the U.S. EPA, consult the following webpages:
 - 2012 U.S. EPA General Construction Permit, cfpub.epa.gov/npdes/stormwater/cgp.cfm
 - National Pollutant Discharge Elimination System, cfpub.epa.gov/npdes
 - Stormwater best management practices, cfpub.epa.gov/npdes/stormwater/menuofbmps
 - Stormwater pollution prevention plan template, cfpub.epa.gov/npdes/stormwater/swppp.cfm

P7.2



Section 7: Construction

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



P7.2



Prerequisite 7.3: Restore soils disturbed during construction

Required

INTENT

Support healthy plants, biological communities, water storage, and infiltration by restoring soils disturbed during construction.

REQUIREMENTS

Restore all soils on site that have been disturbed by current construction activities and that will serve as the final vegetated area (regardless whether the pre-construction soil condition was classified as healthy or disturbed):

- Locate reference soils to guide performance criteria that are appropriate for the site's vegetation, intended program, and site elements.
 - If identified reference soils are not appropriate for the design intent, explain why and describe the soil characteristics that will guide soil restoration treatment efforts. (See *Pre-Design P2.2: Conduct a pre-design site assessment* and *Soil+Veg P4.1: Create and communicate a soil management plan*.)
- Restore soils to a minimum depth of 12 inches (30.48 centimeters).
 - Where planting trees, restore soils to a greater depth and volume to support (biologically, structurally, hydrologically, and geotechnically) the intended mature tree canopy.
- Test restored (final) soil conditions to ensure the following soil restoration criteria are met:
 1. **Organic matter** (required):
 - Achieve appropriate organic matter for plant growth, water storage, and infiltration. Amend soils with mature, stable compost such that, at minimum, the top 12 inches of soil (30.48 centimeters) contain at least three percent organic matter or organic matter levels and depths that are comparable to the site's reference soil and appropriate for vegetation and program needs. Do not use sphagnum peat or organic amendments that contain sphagnum peat.
 - Acceptable test methods for determining soil organic matter include the most current version of ASTM D2974 Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils and TMECC 05.07A Loss-On-Ignition Organic Matter Method.
 2. **Compaction** (field test or undisturbed core sample only):
 - Ensure bulk densities within 100 percent of the root zone do not exceed the maximum values given in Figure 7.3-A or Figure 7.3-B (see the Documentation guidance section).

OR

 - Infiltration** (field test only):
 - Achieve infiltration rates (inches or centimeters per hour) or saturated hydraulic conductivity (millimeters per second) comparable to the site's reference soils and appropriate for vegetation and program needs.

Note: This test must only be done in the field.

P7.3



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3. Soil chemical characteristics:

- Restore appropriate soil chemical characteristics for plant growth. The minimum basic profile that must be tested includes:
 - pH
 - Soluble salts (electrical conductivity)
 - Cation exchange capacity (CEC)
 - Extractable phosphorus
 - Potassium
 - Calcium
 - Magnesium
 - Sodium (in semi-arid and arid climates)
- The pH, cation exchange capacity, and nutrient profiles should be comparable to the original undisturbed soil or the site's reference soil and appropriate for vegetation and program needs. Salinity must be suitable for regionally appropriate plant species.

OR

Soil biological function:

- Ensure that soil biological function is restored in remediated soils. Soil biota assays are complex and vary regionally, making potentially mineralizable nitrogen serve as a proxy assessment of biological activity.

Required tests per project area:

Restored Vegetated Area	Minimum Number of Soil Tests Required
≤ 0.5 acre (0.20 hectares)	1 set for each soil restoration treatment zone type (see Soil+Veg P4.1)
> 0.5 acre (0.20 hectares) to ≤ 1 acre (0.40 hectares)	2 sets for each soil restoration treatment zone type
> 1 acre (0.40 hectares) to 2 acres (0.81 hectares)	3 sets for each soil restoration treatment zone type
> 2 acres (0.81 hectares) to ≤ 20 acres (8.09 hectares)	1 set per acre for each soil restoration treatment zone type
> 20 acres (8.09 hectares)	1 set per 3 acres for each soil restoration treatment zone type

Note: If multiple soil restoration treatment zones have the same soil restoration methods, treat them as one type.

Structural or engineered media:

These specialized media are exempt from meeting the soil restoration criteria above when used for applications such as the following. However, all other requirements must be met and documentation submitted accordingly:

- Athletic fields
- Green roofs
- Raingardens
- Vertical green walls
- Trees in paving
- Bioswales
- Green vehicle easements
- Steep slopes
- Food gardens
- Constructed wetlands

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Note: Neither imported topsoils nor manufactured soil blends designed to serve as topsoil may be mined from the following locations (unless soils are a byproduct of a construction process):

- Greenfield sites
- Prime farmland, unique farmland, farmland of statewide importance or farmland of local importance, as defined by the U.S. Natural Resources Conservation Service (or local equivalent for projects outside the United States)

SUBMITTAL DOCUMENTATION

- Site plan illustrating the full extent of the site's final vegetated area
 - Indicate which parts of the final vegetated area contain soils that have been disturbed during construction (noting degree of disturbance), which parts will be restored, and which parts will be re-vegetated, as included in the soil management plan (see *Soil+Veg P4.1: Create and communicate a soil management plan*).
- Narrative clearly and concisely describing the following steps:
 - The approach to restoring soil conditions that support the intended plantings
 - The results and strategy of the soil sampling and testing and how test results complete the following steps:
 - > Address required soil restoration criteria
 - > Reflect reference soil characteristics
 - > Inform a sustainable approach to restoring soil conditions
 - Calculations or description correlating quantities of amendments with soil testing results
 - Special circumstances that may have influenced soil restoration techniques or sampling and testing, including the following examples:
 - > For structural or engineered media, provide a narrative describing the components of media and how the media will be specified and mixed to provide good growing conditions for intended plants. By referencing published soil specification or blending guidelines, the narrative should show that the proposed specification meets current best available science and practice standards for that media.
 - > If soil disturbance is due to prescribed burning, provide both a narrative outlining how burning will be done so as to minimize damage to the soil horizon, and verification from the prescribed burning professional indicating that soil horizons modified due to burning have been restored.
- Soil tests to demonstrate that the selected restoration techniques achieved criteria for the following categories in restored soils:
 - 1. Organic matter** (required)
 - 2. Compaction** (field test or undisturbed core sample only)
OR
Infiltration (field test only)
 - 3. Soil chemical characteristics**
OR
Soil biological function
- Receipts from soil, compost, and amendments suppliers to demonstrate that measures were taken to restore soil

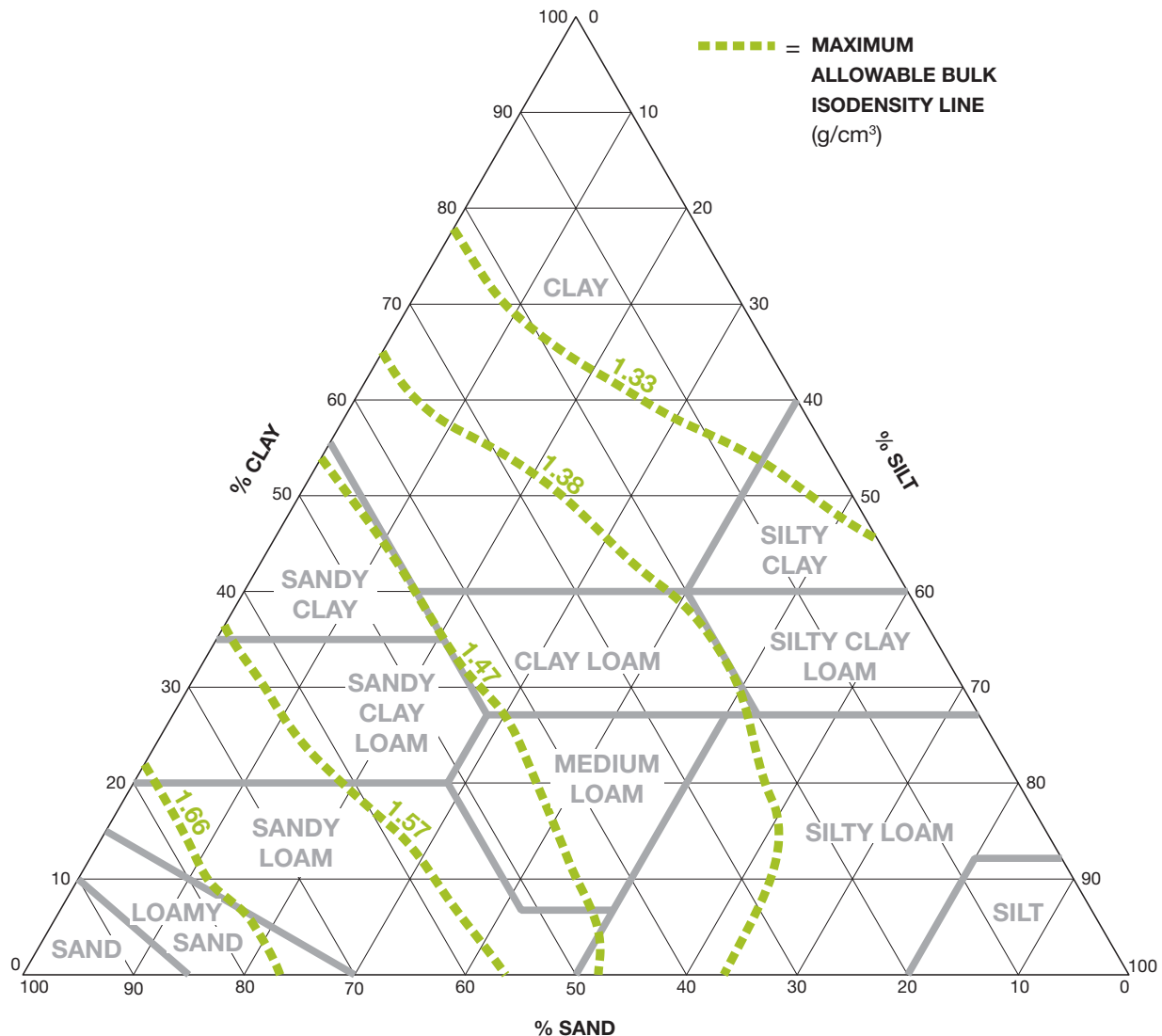
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DOCUMENTATION GUIDANCE

Figure 7.3-A: Maximum Allowable Bulk Densities



Note: Acceptable test methods include the most current versions of ASTM D 4564 Standard Test Method for Density and Unit Weight of Soil in Place by the Sleeve Method, ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method, and ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth).

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Maximum allowable bulk densities for sustainable soil management are based on 95 percent of the bulk density value at which growth limitations are expected for an average range of plant material, as described by Daddow and Warrington (1983). While these requirements are expressed as maximum allowable bulk densities, it is important to note that densities that are too low can also cause problems, especially for lawn areas or slopes.

- To calculate the maximum allowable bulk density for a soil:
 - Obtain a laboratory analysis of the sand, silt, and clay percentages
 - Sketch a parallel line for each percentage along the appropriate axis
 - At the point of intersection, interpolate a value between the isodensity lines
 - > For example, in Figure 7.3-A, clay loam reflects a soil comprised of 33 percent sand, 33 percent silt, and 33 percent clay. Interpolating a value between the 1.47 and 1.38 isodensity lines yields an approximate maximum allowable bulk density of 1.43 g/cm³. Proctor laboratory tests are not useful to document compliance with this compaction requirement.

Table 7.3-B: Acceptable Cone Penetrometer Readings

Surface Resistance (PSI)	Subsurface Resistance (PSI)		
All Textures	Sand (includes loamy sand, sandy loam, sandy clay loam, and sandy clay)	Silt (includes loam, silt loam, silty clay loam, and silty clay)	Clay (includes clay loam)
≤ 110	≤ 260	≤ 260	≤ 225

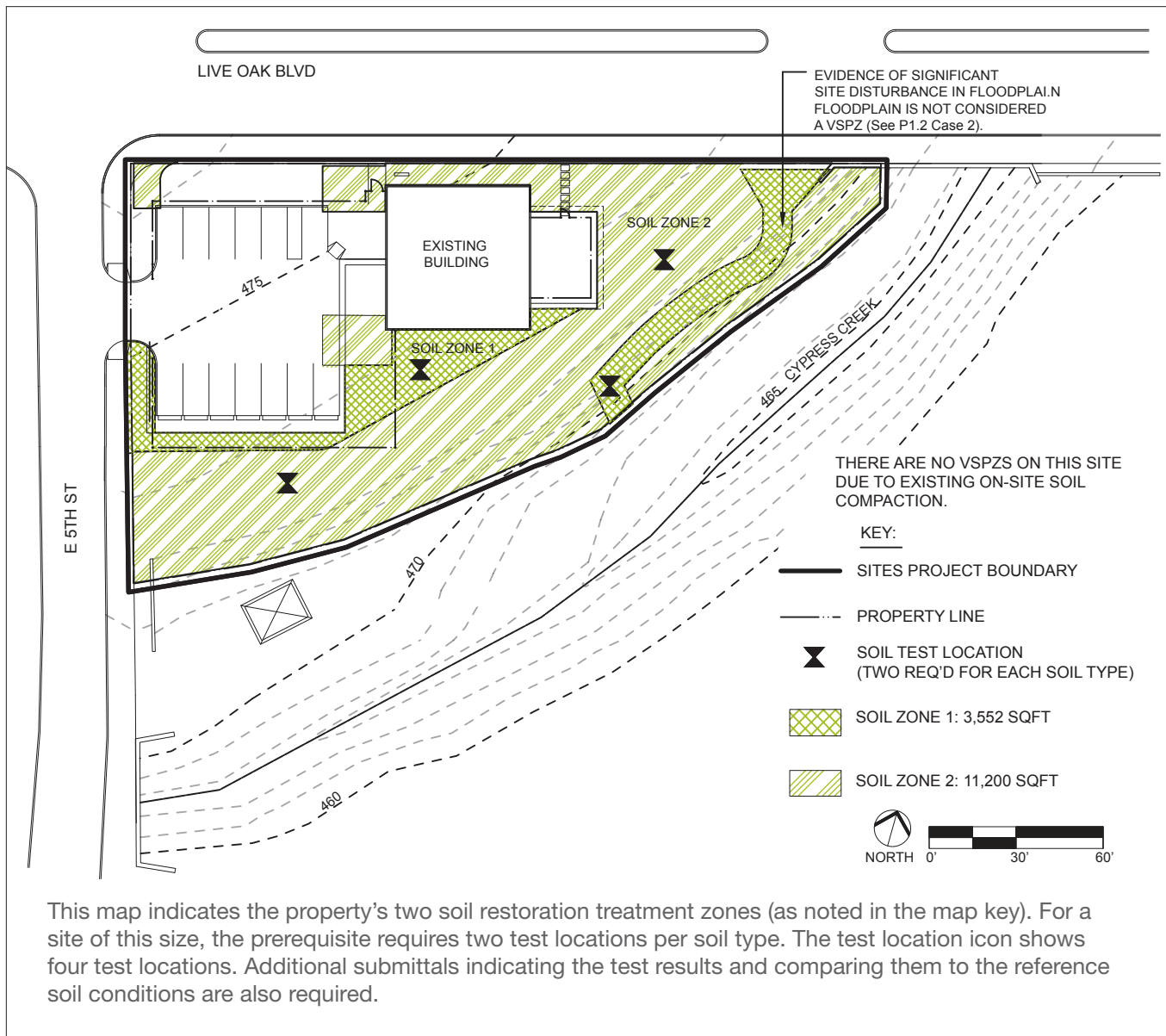
Note: Acceptable test methods include ASTM D3441 Standard Test Method for Mechanical Cone Penetration or methods described in references such as *Methods of Soil Analysis, Part 1, Physical and Mineralogical Methods*, 2nd ed., EA Klute, ed. (Soil Science Society of America: Madison, WI 1986). The penetration reading must be taken when soil is at or below field capacity (i.e., several days after free drainage). Along with penetration readings, document the soil's moisture level and the spacing interval for conducting the test. Apply slow, even pressure so the penetrometer advances in the soil at a rate of four seconds per six inches (15.24 centimeters) or less. Record the highest pressure at two points: 1) the surface of the restored soil and 2) a depth of 12 inches (30.48 centimeters) OR at 90 percent of the total depth of the reference soil's A horizon.

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Example: Live Oak Place



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RECOMMENDED STRATEGIES

- Limit disturbance during construction to minimize the need for additional restoration. In areas that will be re-vegetated, restore soil characteristics necessary to support the selected vegetation types. Below are sample methods to restore soils:
 - Stockpiling and reusing existing site topsoils, incorporating organic amendments, if needed
 - Amending site soils in place with organic matter and mechanically correcting compaction if needed (e.g., by ripping or discing)
 - Importing a topsoil or soil blend designed to serve as topsoil, avoiding prime farmland sources or greenfield sites unless soils are a byproduct of a construction process
- When selecting a soil restoration strategy, consider the design, site use, and future site maintenance expectations. Consider the following possibilities:
 - Adding mature, stable compost to unscreened soil can be a sustainable strategy.
 - Many un-screened and un-amended soils will drain adequately.
 - Amend with other earth materials to modify a soil's gradation, texture, and organic matter content.
- Select organic materials for on-site amendment or for blending of imported soils from sources that are renewable within a 50-year cycle:
 - Mature, stable compost is recommended as the best source of organic matter, for its stability, biological activity, and soil structure building qualities. If mature, stable compost is not locally available, look for locally available organic residuals that can be composted on or off site to produce a mature composted organic amendment.
 - Involve a qualified horticultural or soil professional in selecting and balancing amendments for healthy plant growth.
- Guidelines for compost include these qualitative measurements:
 - Has a carbon to nitrogen ratio (C:N) below 25:1. Higher C:N ratios may be acceptable if specified by a qualified professional to be more appropriate for the type of vegetation to be established.
 - Does not exceed pollutant concentration limits established by the U.S. EPA in the 40 CFR Part 503 Biosolids Rule, section 503.13 table 3 "Pollutant Concentrations" (or local equivalent for projects outside the United States) or any applicable state or local regulations
 - Does not contain viable weed seeds or invasive plant propagules
 - Results in final soil conditions conducive to growing the type of vegetation to be established
- Before placing stockpiled or imported topsoils, consider scarifying any areas of construction-compacted subsoil, except where this process will damage existing tree roots. Ideally, the first lift of replaced soil is mixed into this scarification zone in order to improve the transition between the subsoil and overlying soil horizons.
- Most planting soil should be installed in 12-inch (30.48-centimeter) lifts at compaction between 78 to 85 percent of maximum dry density per the Standard Proctor Test. Understand that installed soil, even when correctly installed, will settle slightly after the completion of work. Set final grades slightly higher than the desired long-term grades (10 to 15 percent of the installed soil depth) to account for this settlement. Where there is a low tolerance for settlement or slope stability issues, use sandier soils and compact soil in eight-inch (20.32-centimeter) lifts to 80 to 84 percent maximum dry density per the Standard Proctor Test.
- Engineered growing media* (e.g., soils specified for green roofs, street trees, wetlands, environmental restoration sites) should meet the intent of this prerequisite, follow the requirements to the greatest extent practical, and follow current best available science and practical standards for the engineered growing media and application.

* *Note:* There is no current standard for engineered growing media, but if growing media are used on-site, the rough guidelines described here are recommended.

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ECONOMIC AND SOCIAL BENEFITS

Addressing aspects of soil health such as compaction, organic matter, soil biological functioning, and soil volume can restore soils' ability to store and infiltrate water and to provide healthy rooting environments for plants. Soil restoration can save costs in the long run, because healthy soils support healthy plant growth with less need for pesticides, fertilizers, and irrigation.^{1,2}

1. E Stell, *Secrets to Great Soil* (North Adams, MA: Storey Publishing, 1998).
2. D Hanks and A Lewandowski, "Protecting Urban Soil Quality: Examples for Landscape Codes and Specifications," USDA Natural Resources Conservation Service (2003), soils.usda.gov/SQL/management/files/protect_urban_sq.pdf (accessed April 11, 2013).

DEFINITIONS

- An **appropriate plant species** is vegetation adapted to site conditions, climate, and design intent. The following attributes should be considered in determining whether plants are appropriate for the site: cold hardiness, heat tolerance, salt tolerance, soil moisture range, plant water use requirements, soil volume requirements, soil pH requirements, sun and shade requirements, pest susceptibility, and maintenance requirements. Native and non-native plants are appropriate if they meet the above criteria.
- An **athletic field** includes land that is dedicated to organized team sports (e.g., football, soccer) that involves high intensity use and is defined by distinct dimensions. Fields that are used for occasional recreational sports are not included.
- **Disturbed soils** are all areas of soils disturbed by human development activities, such as those that have been affected by grading, excavation, or compaction. Indicators of disturbed soils may include one or more of the following:
 - Soil horizons that differ significantly in either depth, texture, or physical or chemical properties from the reference soil
 - Bulk densities that exceed the maximum allowable bulk densities shown in *Construction P7.3: Restore soils during construction* Figure 7.3-A
 - Organic matter content lower than that of the reference soil
 - Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) different from that of the reference soil
 - Presence of compounds toxic to the intended plants
 - Presence of weedy, opportunistic, or invasive plant species
- **Farmland of local importance** refers to soils important to the local economy due to their productivity and which may include tracts of land that have been designated for agriculture by local ordinance. Each state Natural Resources Conservation Service or local ordinance designates which soils qualify.
- **Farmland of statewide importance** refers to soils that do not meet all of the prime farmland criteria but that are still able to economically produce high yields of crops when treated and managed according to acceptable farming methods. Each state Natural Resources Conservation Service designates which soils qualify.
- **Healthy soils** have not been significantly disturbed by previous human development activities. Healthy soils may include one or more of the following indicators:
 - Soil horizons that are similar to the reference soil
 - Bulk densities that do not exceed the maximum allowable bulk densities shown in *P7.3: Restore soils disturbed during construction*
 - Organic matter content similar to that of the reference soil
 - Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) similar to that of the reference soil
 - Absence of compounds toxic to the intended plants
 - Presence of vegetation that is representative of native plant communities

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- **Mature, stable compost** is an important amendment for healthy plant growth. Stability refers to the rate of biological breakdown, measured by carbon dioxide release. Maturity refers to completeness of the aerobic composting process and suitability (lack of plant toxicity) as a plant growth media, often measured by ammonia release or by plant growth tests. For information on compost quality standards and test methods, see the Resources section of *Construction P7.3: Restore soils disturbed during construction*.
- **Mature tree canopy** refers to the aboveground portion of a tree at its mature size, often measured as “crown projection area” in square feet or square meters. Trees without adequate soil volume for their roots will decline and die before reaching mature size. A guideline for adequate soil volume for mature tree health is 1.5 cubic feet (0.04 cubic meters) of soil volume for each square foot (0.09 square meters) of mature crown projection. If there is any doubt that adequate soil volume is available, consult an arborist, urban forester, or horticulturist for recommendations specific to the site and intended species.
- **Organic matter** in soil is carbon-containing material composed of both living organisms and formerly living decomposing plant and animal matter. Soil organic matter (SOM) content can be supplemented with compost or other partially decomposed plant and animal material. SOM content is commonly measured using “loss on ignition” tests that measure the amount of the element carbon, a key constituent of all organic matter.
- **Prime farmland** refers to a designation of specific soils by the state or U.S. Natural Resources Conservation Service. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. The land could be cropland, pastureland, rangeland, forestland, or other land, but cannot be urban built-up land or water. Prime farmland has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.
- A **reference soil** falls into at least one of the following categories:
 - Soils native to a site as described in Natural Resources Conservation Service Soil Surveys (refer to soils within the region if the site soils are not mapped or labeled as Urban Land Complex, Urban Fill, etc.)
 - For sites that have no undisturbed native soils, use undisturbed native soils within the site’s region that have native vegetation, topography, and soil textures similar to the site.
 - For sites that have no existing soil, use undisturbed native soils within the site’s region that support appropriate native plants or appropriate plant species similar to those intended for the new site.
- A **soil restoration treatment zone** is any area of the site that is not protected in a Vegetation and Soil Protection Zone (VSPZ); not covered at project’s end by buildings or pavement; and is re-vegetated as part of the project. Soil restoration treatment zones must be shown on the soil management plan (*Soil+Veg P4.1: Create and communicate a soil management plan*) and must be restored as required by *Construction P7.3: Restore soils disturbed during construction*.
- **Unique farmland** refers to land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of a specific crop when treated and managed according to acceptable farming methods. The state or U.S. Natural Resources Conservation Service designates which soils qualify.
- **Vegetated area** describes all portions of the sites that will support vegetation.

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RESOURCES

- For information about the mature canopy size of most trees, see M Dirr, B Dirr, M Stephan, and A Sadauskas, *Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics, Culture, Propagation and Uses* (2009).
- For more information on soil volume for trees and strategies for providing it in urban environments, see J Urban, *Up by Roots: Healthy Soils and Trees in the Built Environment*, (2008).
- For more information on improving soil quality, see USDA Natural Resources Conservation Service resources, soils.usda.gov/sqi and Cornell Soil Health Resources, soilhealth.cals.cornell.edu/resources/index.htm.
- For more information on methods and practices for soil amendment, including how to calculate the volume of compost to incorporate to meet a target soil organic matter content, see *Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth*, www.ecy.wa.gov/programs/wq/stormwater/municipal/MUNIdocs/SoilBMPManual.pdf, also available at www.buildingsoil.org/tools/Soil_BMP_Manual.pdf.
- For additional information on planning and managing soils in urban areas, consult the following resources:
 - USDA Natural Resources Conservation Service, soils.usda.gov/use/urban
 - USDA “Urban Soil Primer,” soils.usda.gov/use/urban/primer.html
 - Building Soil, www.buildingsoil.org
- For additional information on soil preservation and amendments, see “Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMPT5.13” in *WDOE Stormwater Management Manual for Western Washington*, with specifications and an amendment calculator, www.soilsforsalmon.org or www.buildingsoil.org.
- For additional information on stockpiling, see AASHTO Center for Environmental Excellence, *Environmental Stewardship Practices, Procedures, and Policies for Highway Construction and Maintenance*, Chap. 4, “Construction Practices,” 4.11.4 Topsoil Preservation, environment.transportation.org/environmental_issues/construct_maint_prac/compendium/manual/4_11.aspx.
- For additional information on compost quality standards and test methods:
 - Compost suppliers use:
 - > Solvita Compost Maturity Index Rating, which is a combination of carbon dioxide and ammonia maturity tests, www.solvita.com
 - > U.S. Composting Council, Seal of Testing Assurance Program, www.compostingcouncil.org/sta-benefits
 - In addition, field tests are recommended to measure compost stability and maturity, such as:
 - > Solvita Compost Maturity Index Rating, which is a combination of carbon dioxide and ammonia maturity tests, of 6 or higher, www.solvita.com
- For additional information on contaminant limits acceptable to organic amendments, see *A Plain English Guide to the EPA Part 503 Biosolids Rule*, Chap. 2, p. 29, Table 2-1, column 2, “Pollutant Concentration Limits for EQ and PC Biosolids,” www.epa.gov/owm/mtb/biosolids/503pe/index/htm. Also see applicable state and local regulations on compost and biosolids.
- For additional information on erosion control with compost (which can then be reused to amend site soils), consult these sources:
 - U.S. EPA NPDES Construction Site Stormwater Runoff Control, menu of BMPs, has the standard national specifications for compost blankets, berms, and socks, cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=4.
 - Building Soil, “Erosion Control with Compost,” www.buildingsoil.org

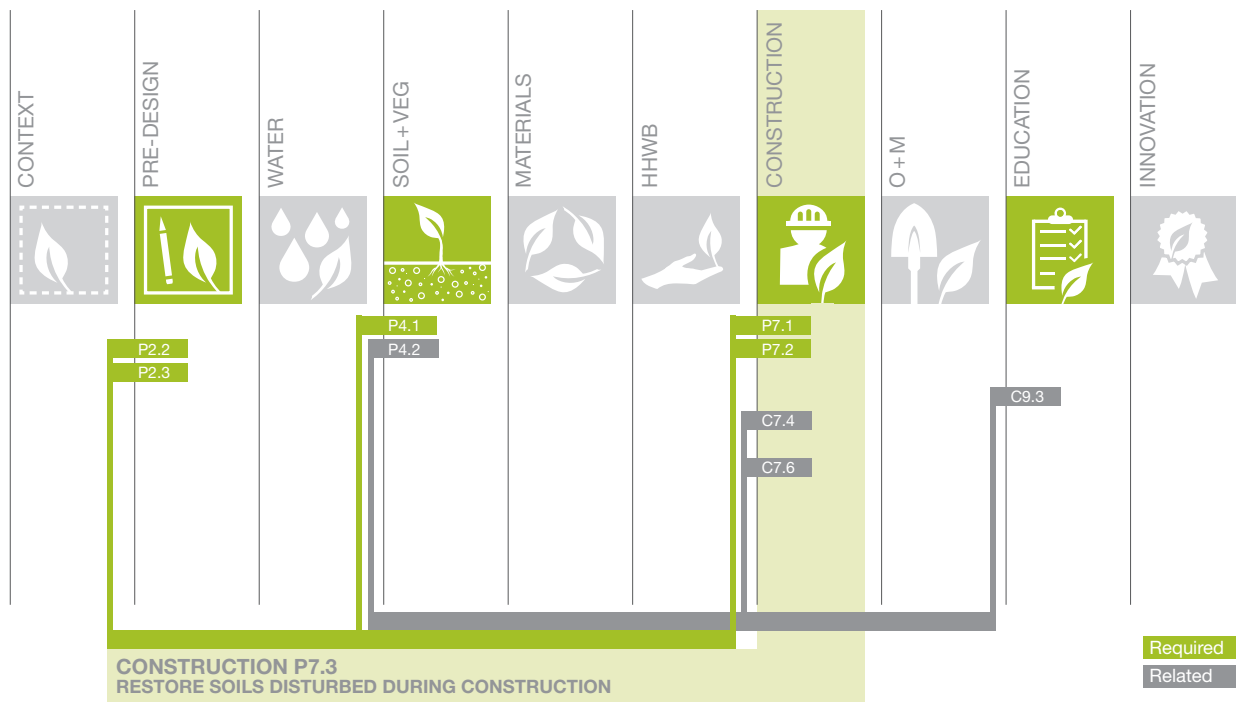
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- For additional information on soil biology and quality, consult these resources:
 - U.S. Natural Resources Conservation Service's *Soil Biology Primer*, soils.usda.gov/sqi/concepts/soil_biology/biology.html and soils.usda.gov/sqi/index.html
 - Cornell Soil Health Assessment Training Manual, soilhealth.cals.cornell.edu/extension/manual.htm
- For additional information on soil surveys for native or reference soil data, including a database covering most of the United States, see the USDA Natural Resources Conservation Service's "Web Soil Survey," websoilsurvey.nrcs.usda.gov/app.
- For additional information on test methods for infiltration rates on sloped areas, see A Amoozegar and AW Warrick, "Hydraulic Conductivity of Saturated Soils: Field Methods," Chap. 29 in *Methods of Soil Analysis, Part I, 2nd ed.* (Madison, WI: 1986): pp. 735-770.
- For more information on ASTM standards, consult their website at www.astm.org.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 7.4: Restore soils disturbed by previous development

3–5 points

INTENT

Support healthy plants, biological communities, water storage, and infiltration by restoring soils in areas disturbed by previous development.

REQUIREMENTS

Restore soils on site disturbed by previous development. These requirements apply only to previously disturbed areas that will be re-vegetated. Areas with soils that were previously developed and restored per requirements in *Construction P7.3: Restore soils disturbed construction* may also be included here.

To count towards this credit, restored soils must cover a minimum of 500 square feet (46.46 square meters) or five percent of the total project area. Credit point values are based on the surface area of soil disturbed by previous development that will be re-vegetated and the degree of disturbance of those soils (disturbed or severely disturbed). See Point Value Table 7.4-A below.

- Locate reference soils to guide and determine performance criteria that are appropriate for the site's vegetation, intended program, and site elements.
 - If identified reference soils are not appropriate for the design intent, explain why and describe the soil characteristics that will guide soil restoration treatment efforts. (See *Pre-Design P2.2: Conduct a pre-design site assessment* and *Soil+Veg P4.1: Create and communicate a soil management plan*.)
- Restore disturbed existing soils to a minimum depth of 12 inches (30.48 centimeters)
 - Where planting trees, restore soils to a greater depth and volume to support (biologically, structurally, hydrologically, and geotechnically) the intended mature tree canopy.
- Test restored (final) soil conditions to ensure the following soil restoration criteria are met (see *Construction P7.3: Restore soils disturbed during construction* for details):
 1. **Organic matter** (required)
 2. **Compaction** (field test or undisturbed core sample only)
OR
Infiltration (field test only)
 3. **Soil chemical characteristics**
OR
Soil biological function

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Required tests per project area:

Restored Vegetated Area	Minimum Number of Soil Tests Required
≤ 0.5 acre (0.20 hectares)	1 set for each soil restoration treatment zone type (see Soil+Veg P4.1)
> 0.5 acre (0.20 hectares) to ≤ 1 acre (0.40 hectares)	2 sets for each soil restoration treatment zone type
> 1 acre (0.40 hectares) to 2 acres (0.81 hectares)	3 sets for each soil restoration treatment zone type
> 2 acres (0.81 hectares) to ≤ 20 acres (8.09 hectares)	1 set per acre for each soil restoration treatment zone type
> 20 acres (8.09 hectares)	1 set per 3 acres for each soil restoration treatment zone type

Note: If multiple soil restoration treatment zones have the same soil restoration methods, treat them as one type.

TABLE 7.4-A: Point Value Table

	Percent or total site area that will be re-vegetated		
	500 sq ft to 0.5 acres (46 square meters to 0.20 hectares) OR at least 5%	0.5 acres to 5 acres (0.20 to 2.02 hectares) OR 10% or more	More than 5 acres (2.02 hectares) OR 30% or more
Disturbed	3 points	3 points	4 points
Severely disturbed	3 points	4 points	5 points

Note: Soils must be reused for functions comparable to their original function (i.e., topsoil is used as topsoil, subsoil as subsoil, or subsoil is amended to become functional topsoil).

Structural or engineered media:

These specialized media are exempt from meeting the soil restoration criteria above when used for applications such as the following. However, all other requirements must be met and documentation submitted accordingly:

- Athletic fields
- Green roofs
- Raingardens
- Vertical green walls
- Trees in paving
- Bioswales
- Green vehicle easements
- Steep slopes
- Food gardens
- Constructed wetlands

Note: Imported topsoils, or manufactured soil blends designed to serve as topsoil, may not be mined from the following locations (unless soils are a byproduct of a construction process):

- Greenfield sites
- Prime farmland, unique farmland, farmland of statewide importance or farmland of local importance, as defined by the U.S. Natural Resources Conservation Service (or local equivalent for projects outside the United States)

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SUBMITTAL DOCUMENTATION

- Site plan indicating the full extent of the site's final vegetated area
 - Indicate which parts of the final vegetated area contain soils that have been disturbed during construction (noting degree of disturbance), which parts will be restored, and which parts will be re-vegetated, as included in the soil management plan (see *Soil+Veg P4.1: Create and communicate a soil management plan*).
- Narrative clearly and concisely describing the following:
 - The approach to restoring soil conditions that support the intended plantings
 - The results and strategy of the soil sampling and testing and how test results complete the following steps:
 - > Address required soil restoration criteria
 - > Reflect reference soil characteristics
 - > Inform a sustainable approach to restoring soil conditions
 - Calculations or description correlating quantities of amendments with soils testing results
 - Special circumstances that may have influenced soil restoration techniques or sampling and testing, including the following examples:
 - > For structural or engineered media, provide a narrative describing the components of media and how the media will be specified and mixed to provide good growing conditions for intended plants. By referencing published soil specification or blending guidelines, the narrative should show that the proposed specification meets current best available science and practice standards for that media.
 - > If soil disturbance is due to prescribed burning, provide both a narrative outlining how burning will be done so as to minimize damage to the soil horizon, and verification from the prescribed burning professional indicating that soil horizons modified due to burning have been restored.
- Soil tests to demonstrate that the selected restoration techniques achieved criteria for the following categories in restored soils:
 1. **Organic matter** (required)
 2. **Compaction** (field test or undisturbed core sample only)
OR
Infiltration (field test only)
 3. **Soil chemical characteristics**
OR
Soil biological function
- Receipts from soil, compost, and amendments suppliers to demonstrate that measures were taken to restore soil

DOCUMENTATION GUIDANCE

Please see detailed documentation guidance for soil restoration in *Construction P7.3: Restore soils disturbed during construction*.

RECOMMENDED STRATEGIES

Please see detailed recommended strategies for soil restoration in *Construction P7.3: Restore soils disturbed during construction*.

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DEFINITIONS

- An **athletic field** includes land that is dedicated to organized team sports (e.g., football, soccer) that involves high intensity use and is defined by distinct dimensions. Fields that are used for occasional recreational sports are not included.
- **Disturbed soils** are all areas of soils disturbed by human development activities, such as those that have been affected by grading, excavation, or compaction. Indicators of disturbed soils may include one or more of the following:
 - Soil horizons that differ significantly in either depth, texture, or physical or chemical properties from the reference soil
 - Bulk densities that exceed the maximum allowable bulk densities shown in *Construction P7.3: Restore soils during construction* Figure 7.3-A
 - Organic matter content lower than that of the reference soil
 - Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) different from that of the reference soil
 - Presence of compounds toxic to the intended plants
 - Presence of weedy, opportunistic, or invasive plant species
- **Farmland of local importance** refers to soils important to the local economy due to their productivity and which may include tracts of land that have been designated for agriculture by local ordinance. Each state Natural Resources Conservation Service or local ordinance designates which soils qualify.
- **Farmland of statewide importance** refers to soils that do not meet all of the prime farmland criteria but that are still able to economically produce high yields of crops when treated and managed according to acceptable farming methods. Each state Natural Resources Conservation Service designates which soils qualify.
- **Healthy soils** have not been significantly disturbed by previous human development activities. Healthy soils may include one or more of the following indicators:
 - Soil horizons that are similar to the reference soil
 - Bulk densities that do not exceed the maximum allowable bulk densities shown in *P7.3: Restore soils disturbed during construction*
 - Organic matter content similar to that of the reference soil
 - Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) similar to that of the reference soil
 - Absence of compounds toxic to the intended plants
 - Presence of vegetation that is representative of native plant communities
- **Mature tree canopy** refers to the aboveground portion of a tree at its mature size, often measured as “crown projection area” in square feet or square meters. Trees without adequate soil volume for their roots will decline and die before reaching mature size. A guideline for adequate soil volume for mature tree health is 1.5 cubic feet (0.04 cubic meters) of soil volume for each square foot (0.09 square meters) of mature crown projection. If there is any doubt that adequate soil volume is available, consult an arborist, urban forester, or horticulturist for recommendations specific to the site and intended species.
- **Organic matter** in soil is carbon-containing material composed of both living organisms and formerly living decomposing plant and animal matter. Soil organic matter (SOM) content can be supplemented with compost or other partially decomposed plant and animal material. SOM content is commonly measured using “loss on ignition” tests that measure the amount of the element carbon, a key constituent of all organic matter.
- **Prime farmland** refers to a designation of specific soils by the state or U.S. Natural Resources Conservation Service. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. The land could be cropland, pastureland, rangeland, forestland, or other land, but cannot be urban built-up land or water. Prime farmland has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general,

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Section 7: Construction

prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.

- A **reference soil** falls into at least one of the following categories:
 - Soils native to a site as described in Natural Resources Conservation Service Soil Surveys (refer to soils within the region if the site soils are not mapped or labeled as Urban Land Complex, Urban Fill, etc.)
 - For sites that have no undisturbed native soils, use undisturbed native soils within the site's region that have native vegetation, topography, and soil textures similar to the site.
 - For sites that have no existing soil, use undisturbed native soils within the site's region that support appropriate native plants or appropriate plant species similar to those intended for the new site.
- **Severely disturbed soils** are soils in which topsoil is removed or is not present; subsoils compacted such that compaction levels exceed the maximum allowable bulk densities shown in *Construction P7.3: Restore soils disturbed during construction* Figure 7.3-A; or topsoil or subsoil that has been chemically contaminated or is covered with impervious material. Examples of soils that are severely disturbed include areas that are covered with buildings or paved surfaces and areas that are defined as brownfields by local, state, or federal agencies.
- A **soil restoration treatment zone** is any area of the site that is not protected in a Vegetation and Soil Protection Zone (VSPZ); not covered at project's end by buildings or pavement; and is re-vegetated as part of the project. Soil restoration treatment zones must be shown on the soil management plan (*Soil+Veg P4.1: Create and communicate a soil management plan*) and must be restored as required by *Construction P7.3: Restore soils disturbed during construction*.
- **Unique farmland** refers to land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of a specific crop when treated and managed according to acceptable farming methods. The state or U.S. Natural Resources Conservation Service designates which soils qualify.
- **Vegetated area** describes all portions of the sites that will support vegetation.

RESOURCES

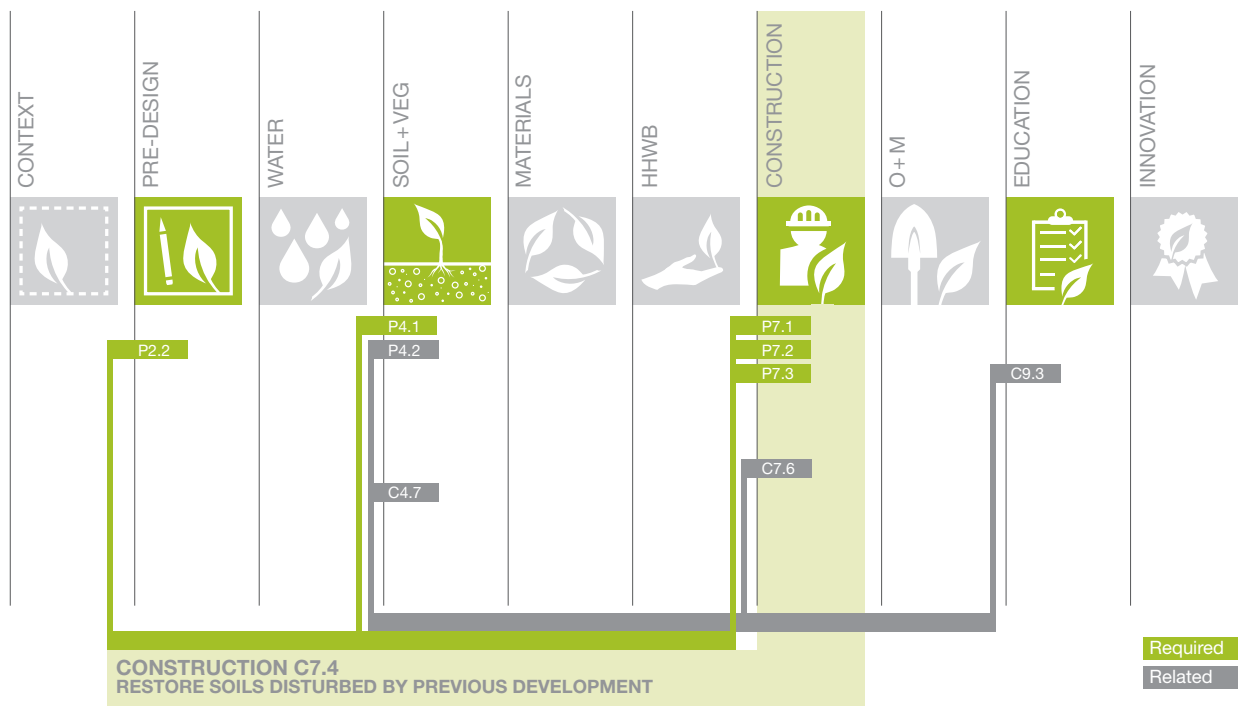
Please see detailed resources for soil restoration in *Construction P7.3: Restore soils disturbed during construction*.

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Section 7: Construction

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C7.4



Credit 7.5: Divert construction and demolition materials from disposal

3–4 points

INTENT

Support a net-zero waste site and minimize down-cycling of materials by diverting, reusing, or recycling construction and demolition materials to avoid disposal in landfills or combustion in incinerators.

REQUIREMENTS

Percent calculations may be based on weight or volume (tons or cubic yards), but must be submitted consistently throughout. The requirements apply to non-hazardous construction and demolition materials.

Calculations in this credit exclude land-clearing materials generated during all phases of design and construction and structures and paving reused on site in their existing form (see Links to other SITES prerequisites and credits section).

- Develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether they will be sorted on site or comingled.
- Divert materials from disposal by recycling, salvaging or reusing structural materials (e.g. bricks, steel, wood), and road and infrastructure materials (e.g., pavement, drainage structures) for at least:
 - 50 percent of structural materials and 95 percent of road and infrastructure materials **3 points**
 - 75 percent of structural materials and 95 percent of road and infrastructure materials **4 points**

SUBMITTAL DOCUMENTATION

- List or table that includes:
 - All construction and demolition (C&D) materials generated on site, specifying each material as either structural or road and infrastructural
 - Location of receiving agent
 - Quantity of waste (tons or cubic yards) diverted by type (e.g., structural and road and infrastructure materials)
 - Total C&D waste (tons or cubic yards) generated during construction
- Narrative that describes the implementation of the construction and demolition management plan and practices followed on site
- Project specifications and details on the handling of demolition materials, including sorting on site or comingling

DOCUMENTATION GUIDANCE

If salvaging on-site C&D materials for reuse within the SITES project boundary (see *Materials C5.4: Reuse salvaged materials and plants*), the project location is the receiving agent.

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RECOMMENDED STRATEGIES

- Inventory existing materials on site and use the results to establish project goals for salvaged materials.
- Reuse existing materials on site or recycle them for on-site use when possible.
- Develop a construction waste management plan to specify and communicate the expectations and requirements of the project.
- If materials are to be reused as soil amendments (e.g., gypsum, lime), soils tests should be conducted first to determine that the material is appropriate for use with the site soils.
 - Non-composted and non-organic materials should not be added to soil as an amendment unless these materials can be demonstrated to benefit site soils and planned vegetation.

ECONOMIC AND SOCIAL BENEFITS

Retaining C&D materials on site reduces the cost of disposal at a landfill. Rather than viewing them as “waste,” using C&D materials as resources for new site development reduces the need for and costs associated with purchasing new materials such as wood, concrete and other types of masonry, and drywall.

DEFINITIONS

- **Land-clearing materials** are plant material, mineral and rock waste, and soils generated during all phases of construction and demolition.
- **Reuse** is a process of utilizing a used product or material in a manner that generally retains its original form and identity with minor refurbishments. Materials reusable in whole form might include sand-set pavers, segmental retaining walls, or mechanical fasteners, connections, or joinery (e.g., avoidance of adhesives and mortar).
- A **salvaged or reused material** is recovered from an existing building or site and employed on site without change to its condition. Structures, materials, plants, and rocks preserved in situ and new materials with recycled content do not qualify.

RESOURCES

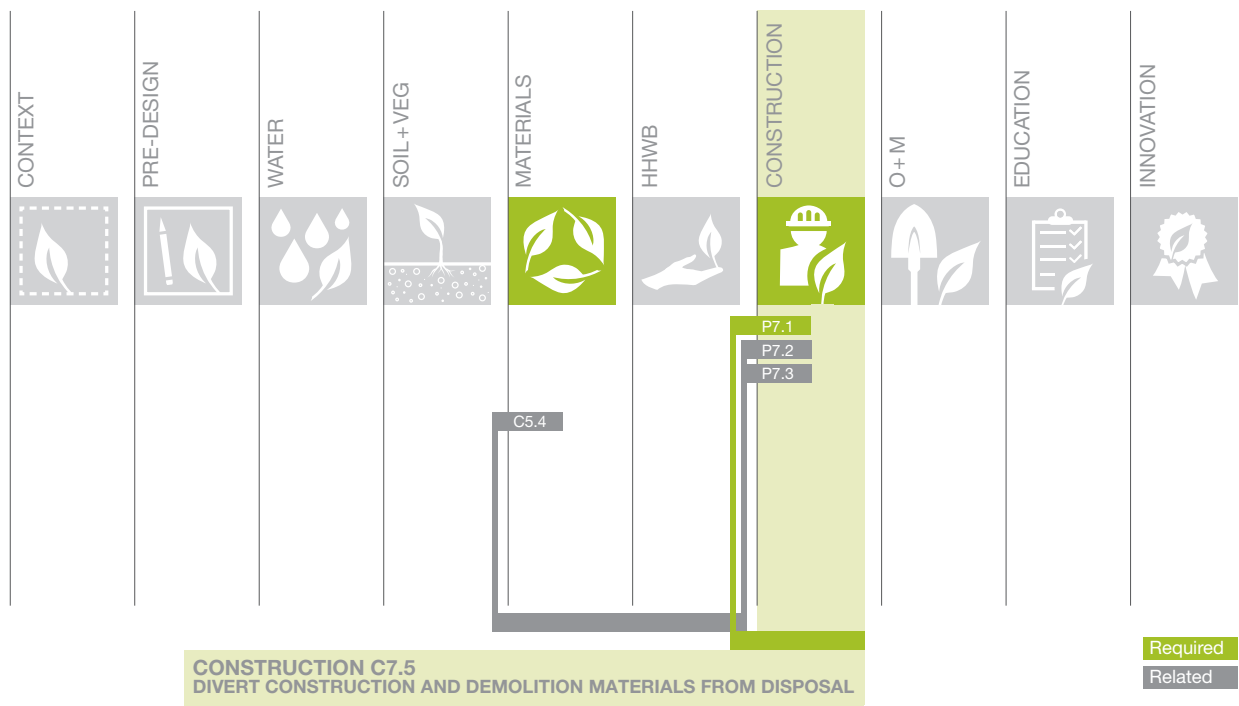
- Components of this credit were adapted from the U.S. Green Building Council’s LEED credits:
 - LEED BD+C v2009 *MR Credit 2: Construction waste management*
 - LEED BD+C v4 *MR Credit 5: Construction and demolition waste management*
- For guidance on developing C&D waste management specifications, see resources such as:
 - California Integrated Waste Management Board, Construction and Demolition Debris Recycling Specifications webpage, www.ciwmb.ca.gov/condemo/Specs
 - WasteCap Resource Solutions, www.wastecap.org/resources/construction-demolition
- For information about programs, strategies, research, and guidance for managing and reducing construction and demolition materials, see the U.S. EPA’s webpage about resource conservation, www.epa.gov/epawaste/conservation/imr/cdm/index.htm.

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Section 7: Construction

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C7.5



Credit 7.6: Divert reusable vegetation, rocks, and soil from disposal

3–4 points

INTENT

Support a net-zero waste site by diverting from disposal vegetation, mineral and rock waste, and soils generated during construction.

REQUIREMENTS

The requirements apply to all on-site plant material, mineral and rock waste, and soils generated during the land-clearing activities of the site during all phases of design and construction.

Contaminated soils and diseased or invasive plant materials should not be included in calculations of land-clearing materials totals. Salvaging plants is a technique that can be used to meet the requirements of this credit (see Links to other SITES prerequisites and credits section).

Soils must be reused for functions comparable to their original function (i.e., topsoil is used as topsoil, subsoil as subsoil, or subsoil amended to become functional topsoil).

- Retain 100 percent of land-clearing materials:
 - For use within 50 miles (80.47 kilometers) of the site **3 points**
 - On site **4 points**

SUBMITTAL DOCUMENTATION

- Estimated total of the plant material, mineral and rock waste, and soils to be generated during the land-clearing activities of the site during all phases of design and construction (in tons or cubic yards)
- Location of receiving agents (if applicable), their distance from the site, and quantity of materials (in tons or cubic yards) received
- Documentation (such as receipts and photographs) to verify that land-clearing materials are diverted, retained, reused, or amended according to requirements
- Signature of owner or owner's representative that no land-clearing materials were disposed of in a landfill

DOCUMENTATION GUIDANCE

If salvaging on-site vegetation or rocks for reuse within the SITES project boundary (see *Materials C5.4: Reuse salvaged materials and plants*), the receiving agent is the project location.

C7.6



Section 7: Construction

RECOMMENDED STRATEGIES

- Inventory salvageable plants existing on the site and use the results to establish project goals for salvaged vegetation, rocks, and soils.
- Use existing vegetation, mineral and rock materials, and soils as resources in site design.
- Recycle excess vegetation generated during land-clearing to produce compost, mulch, erosion-protection measures, or other site amenities.
- Where possible, balance cut and fill volumes, and reuse existing soils and rocks in the proposed site design instead of specifying and importing new materials for the project
- Manage and prevent spread of diseased and invasive plant materials found on site using methods such as hot composting.
- Divert reusable vegetation, rocks, and soils that exceed the amount that can be used on site to local outlets such as soil blenders and mulch and compost producers.

ECONOMIC AND SOCIAL BENEFITS

Diverting land-clearing materials that cannot be reused on site from disposal to municipal or commercial composting, mulch, or topsoil blending facilities helps to achieve a net-zero waste site and may reduce the cost of waste disposal.

DEFINITIONS

- **Land-clearing materials** are plant material, mineral and rock waste, and soils generated during all phases of construction and demolition.
- An **invasive species** is a plant or animal that is not native to the ecosystem under consideration and that causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health.
- A **salvaged or reused material** is recovered from an existing building or site and employed on site without change to its condition. Structures, materials, plants, and rocks preserved in situ and new materials with recycled content do not qualify.

RESOURCES

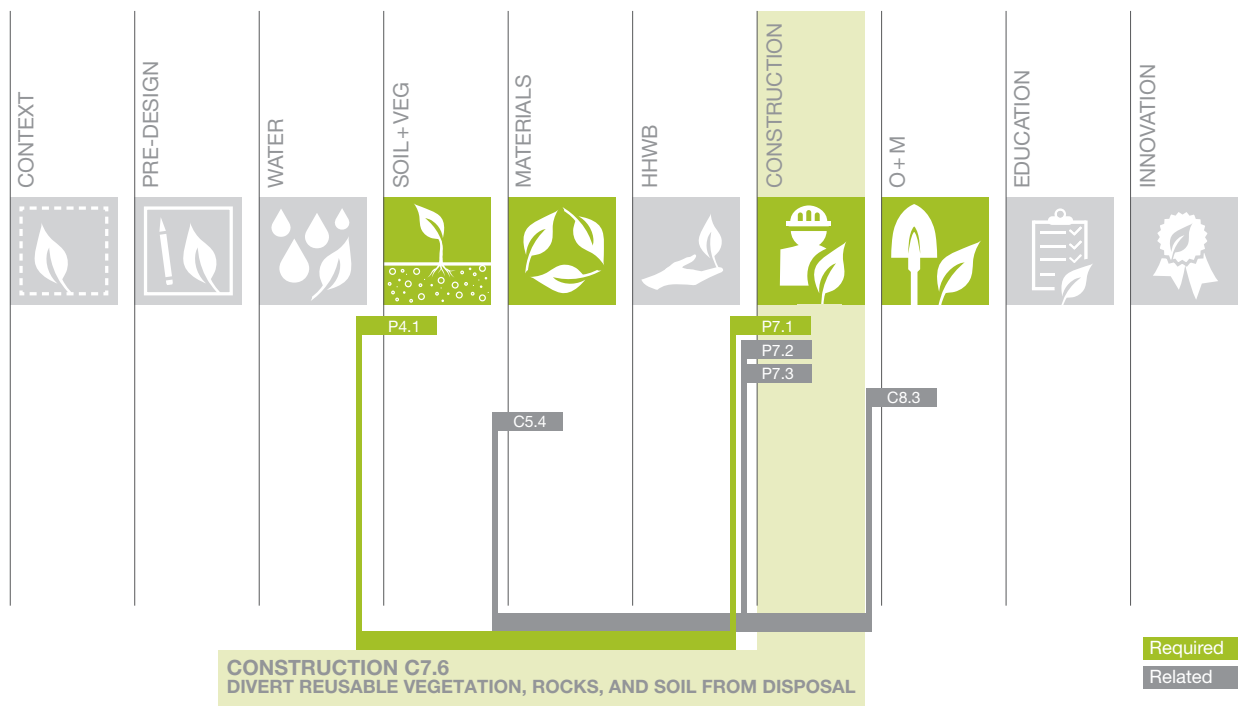
- For more information about diverting land-clearing materials from landfills, see these websites:
 - U.S. EPA GreenScapes program, www.epa.gov/epawaste/conservation/tools/greenscapes/index.htm
 - Local Government Environmental Assistance Network, www.lgean.org/wastes/candd.htm
 - Washington Organic Recycling Council guidelines for builders, developers and landscapers, www.buildingsoil.org
 - Mecklenburg County, North Carolina "Waste Reduction and Recycling Resource Guide," charmeck.org/mecklenburg/county/SolidWaste/ConstructionRecycling/Documents/CDresourceguide.pdf

C7.6



Section 7: Construction

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C7.6



Credit 7.7: Protect air quality during construction

2–4 points

INTENT

Protect air quality and reduce pollution by using construction equipment that reduces emissions of localized air pollutants and greenhouse gasses.

REQUIREMENTS

These requirements apply to all diesel engines used on site during construction. Delivery vehicles are not covered in this credit; exclude them from calculations.

- Establish a policy to reduce diesel emissions from idling construction equipment. Limit unnecessary idling to no more than five minutes in any 60-minute period.
- Implement a preventative maintenance plan for all equipment according to engine manufacturer specifications.
- Use ultra-low sulfur diesel fuel that meets American Society of Testing and Materials (ASTM) specifications with sulfur less than or equal to 15 ppm for all non-road diesel equipment.
- Use no construction equipment with Tier 0 engines.
- 50 percent of the total run-time hours of construction equipment meets one of the following criteria:
 - Tier 2 or higher engines **2 points**
 - Tier 3 or higher engines **3 points**
 - Tier 4 or higher engines **4 points**

SUBMITTAL DOCUMENTATION

- Calculations demonstrating the appropriate percentage of equipment run-time hours meets tier requirements
- A list of all construction equipment used on site, indicating the engine tier and run-time hours for each
- Fuel purchase records demonstrating fuel used during site construction is ultra-low sulfur or biodiesel that meets ASTM standards
- An equipment maintenance plan demonstrating equipment will be maintained according to manufacturer's specifications
- The idle-reduction policy used on site
- Narrative describing how the idle-reduction policy will be enforced during construction

RECOMMENDED STRATEGIES

- Select construction contractors who are committed to reducing diesel emissions from construction equipment and vehicles.
- Reduce construction emissions by reducing idling; enhancing maintenance practices; using cleaner fuels; retrofitting engines with technologies designed to reduce emissions; and replacing older equipment with newer, cleaner engines and equipment.
- Use GPS devices to provide data that track machinery's run time and idle time.

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Section 7: Construction

ECONOMIC AND SOCIAL BENEFITS

Construction equipment generates emissions of nitrogen oxides and particulate matter, both of which contribute to human health problems such as heart and lung disease and respiratory illness.¹ Reduced emissions of these pollutants are projected to prevent premature deaths, hospitalizations, and workdays lost, and result in substantial benefits to public health.²

1. Environmental and Human Health, Inc. "The Harmful Effects of Vehicle Exhaust," www.ehhi.org/reports/exhaust/summary.shtml (accessed April 11, 2013).
2. U.S. Environmental Protection Agency, "Fuels and Engines," www.epa.gov/agriculture/tfuel.html (accessed April 11, 2013).

RESOURCES











- For more information on reducing emissions during construction, see the resources available at the U.S. EPA's Clean Construction USA website, www.epa.gov/cleanschoolbus/construct-overview.htm.
- For more information on technologies and strategies for reducing diesel emissions, see the U.S. EPA National Clean Diesel Campaign at www.epa.gov/cleandiesel.
- For more information on ultra low sulfur diesel, consult the Clean Diesel Fuel Alliance at www.clean-diesel.org/nonroad.html.
- For a tool for evaluating clean diesel projects, see the U.S. EPA's Clean Diesel Emissions Quantifier at cfpub.epa.gov/quantifier.
- For information about retrofit technology verification programs that evaluate the emissions performance of advanced emissions control technologies and engine rebuild kits, consult the U.S. EPA and the California Air Resources Board (CARB):
 - EPA-verified technologies, epa.gov/cleandiesel/verification/verif-list.htm
 - CARB verification program, www.arb.ca.gov/diesel/verdev/verdev.htm
- For more information on ASTM standards, go to www.astm.org/Standard/index.html
- For information on health, environmental, and climate impacts from air pollution, see research from the U.S. EPA at www.epa.gov/cleandiesel/documents/air-pollution-excerpt-454r09002.pdf.
- For information about mission standards, consult the resources from DieselNet:
 - Tier 1-3 non-road diesel engines, www.dieselnet.com/standards/us/nonroad.php—tier3
 - Tier 4 Emission Standards, www.dieselnet.com/standards/us/nonroad.php—tier4

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Section 7: Construction

LINKS TO OTHER SITES PREREQUISITES AND CREDITS

CONTEXT	PRE-DESIGN	WATER	SOIL+VEG	MATERIALS	HHWB	CONSTRUCTION	O+M	EDUCATION	INNOVATION
									
						<div>P7.1</div> <div>P7.2</div>			
						CONSTRUCTION C7.7 PROTECT AIR QUALITY DURING CONSTRUCTION			
							Required		
							Related		

C7.7





SECTION 8

OPERATIONS + MAINTENANCE

PREREQUISITE / CREDIT	TITLE	POINTS
O+M P8.1	Plan for sustainable site maintenance	Required
O+M P8.2	Provide for storage and collection of recyclables	Required
O+M C8.3	Recycle organic matter	3-5 points
O+M C8.4	Minimize pesticide and fertilizer use	4-5 points
O+M C8.5	Reduce outdoor energy consumption	2-4 points
O+M C8.6	Use renewable sources for landscape electricity needs	3-4 points
O+M C8.7	Protect air quality during landscape maintenance	2-4 points

Prerequisite 8.1: Plan for sustainable site maintenance

Required

INTENT

Ensure long-term site sustainability by developing a site maintenance plan outlining the project's strategies and required implementation tasks.

REQUIREMENTS

- With the integrated design team (see *Pre-Design P2.1: Use an integrative design process*), prepare a site maintenance plan according to the outline below.
- Explain the short-term tasks and the long-term strategic plan (i.e., 10-year desired outcome) to achieve sustainable maintenance goals.
- Ensure the maintenance contractor or site manager commits to educating maintenance personnel on the goals and implementation of the site maintenance plan.

Note: For additional information and resources regarding the following maintenance topics, see the associated prerequisites and credits listed in the right-hand column of the outline.

SUBMITTAL DOCUMENTATION

- Signatures from all integrated design team members stating the site maintenance plan and relevant discussions were conducted collaboratively
- Documentation, signed by the maintenance contractor or site manager, confirming that he or she has:
 - Reviewed and agreed to implement the site maintenance plan
 - Committed to communicating the site maintenance plan to maintenance personnel and educating them on the goals and implementation of the plan
- Completed *Site Maintenance Plan Worksheet* or an illustrated narrative addressing all of the following topics, including the maintenance activities, required specialists, and the timeline or schedule for the maintenance activities implemented in order to achieve the 10-year desired outcome for each:

Topic	Description	Prerequisite or Credit #
1. Water	Stormwater features and BMPs effectiveness <ul style="list-style-type: none"> • Proper maintenance activities (including anticipated maintenance schedule) used to ensure continued effectiveness of stormwater features and BMPs (e.g., replacement of vegetation, removal of accumulated sediment load) 	P3.1, C3.3, C3.5
	Water treatment <ul style="list-style-type: none"> • Process used for treating any water features (e.g., avoid chlorine, bromine) 	C3.3, C3.4, C3.5
	Water quality <ul style="list-style-type: none"> • Appropriate maintenance activities designed to reduce: <ul style="list-style-type: none"> - Exposure to pollutants - Mobilization and transport of pollutants in runoff 	C3.3, C3.4, C3.5, C3.6

P8.1



continued

Section 8: Operations + Maintenance

Topic	Description	Prerequisite or Credit #
1. Water (continued)	Irrigation allotment and schedule <ul style="list-style-type: none"> Anticipated watering schedule (frequency and duration) that allows the site to meet annual volume requirements and restrictions 	P3.2, C3.4
	Irrigation water source <ul style="list-style-type: none"> Process used for maintaining non-potable irrigation water sources (e.g., rainwater harvesting, <u>graywater</u> systems) 	P3.2, C3.4
	Temporary irrigation <ul style="list-style-type: none"> Process used for disconnecting or removing any temporary irrigation systems after the plant establishment period 	C3.4
2. Soil stewardship	Soil amendments <ul style="list-style-type: none"> Process used for identifying soil deficiencies, including conducting soils tests prior to adding amendments <ul style="list-style-type: none"> Specify use of least harmful amendments (such as compost) when necessary. 	P4.1, C6.7, P7.3, C7.4, C8.4
	Use of fertilizers <ul style="list-style-type: none"> Process used for applying fertilizers (only if needed) to ensure that application is effective and prevents harm to environmental and human health 	P4.1, P4.3, C6.7, C8.4
	Erosion and compaction <ul style="list-style-type: none"> Process used for alleviating soil erosion or compaction (due to site use or maintenance) that is detrimental to plant health 	P4.1, P7.3, C7.4
3. A. Vegetation (Plant stewardship)	<u>Plant health care (PHC)</u> <ul style="list-style-type: none"> Process used for maintaining vegetation according to long-term plans for the site, including food producing gardens Recognized standards of professional horticultural practices used Process used for monitoring plant health to prevent problems List of potential <u>appropriate</u>, noninvasive plants to be used for plant replacement <ul style="list-style-type: none"> When replacing plants, consider maintenance needs and design consistency. 	C3.5, C3.6, P4.3, C4.4, C4.5, C4.6, C4.7, C4.8, C4.9, C4.10, C4.11, C6.7, C8.3, C8.4
	Healthy plant material management <ul style="list-style-type: none"> Process used for managing excess organic plant material generated on site (e.g., composting, recycling) Plan and schedule for harvest of food producing gardens 	C6.7, C8.3, C8.4
	Diseased and invasive plant material disposal <ul style="list-style-type: none"> Process used for disposing of organic plant materials generated on site that are not suitable for composting or recycling (i.e., dead diseased, invasive, or pest-infested vegetation) in a manner that does not increase the likelihood of spread. 	P4.2, C7.6, C8.3

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Section 8: Operations + Maintenance

Topic	Description	Prerequisite or Credit #
3. A. Vegetation (Plant stewardship, <i>continued</i>)	Site Safety <ul style="list-style-type: none"> Process used for maintaining vegetation to ensure site safety and that meets the intended uses of the site Prevention of wildfire Process used for managing vegetative biomass to reduce risk of catastrophic wildfire <ul style="list-style-type: none"> If prescribed fires are to be used, describe burn plan that is similar in technique, frequencies, and intensities to natural fire regimes in the ecosystem. 	C4.11, C8.3, C8.4
	Pest management <ul style="list-style-type: none"> <u>Integrated pest management (IPM)</u> techniques used to control pests, diseases, and any unwanted species of plants and animals on site 	P4.2, C6.7, C8.4
3. B. Vegetation (Invasive species management)	Invasive species list <ul style="list-style-type: none"> List of <u>invasive</u> plant species identified in the area according to: <ul style="list-style-type: none"> Regional lists (when listing occurs through a vetted, transparent process and has been accepted by the regional stakeholders) State Noxious Weed laws Federal Noxious Weed laws 	P4.2
	Invasive management plan <ul style="list-style-type: none"> Active multi-year plan for <u>control</u> and subsequent <u>management</u> of any plant species included above, including: <ul style="list-style-type: none"> IPM strategies Procedure for identifying and monitoring for additional invasive species that may colonize the site Procedure for adding new species as they are recognized by local authorities Initial treatment, follow-up treatments, and long-term control including monitoring Methods to dispose of invasive plant materials 	P4.2, C8.4
4. Materials management	Materials replacement <ul style="list-style-type: none"> List of preferred characteristics for replacement materials (e.g., materials from local and regional sources, recycled content materials, certified wood, energy-efficient lighting) 	P5.1, C5.4, C5.5, C5.6, C5.7, C5.8, C5.9, C5.10, C6.8, C8.5
	Functionality and extended use <ul style="list-style-type: none"> Process used for repairing and maintaining structures and paving in a way that reduces harm to environmental and human health and ensures the effectiveness of the material (e.g., clean permeable surfaces, low-emitting sealants) Process used for maintaining structures and paving to ensure site safety and that meets the needs of the intended uses of the site 	C4.9, C5.2, C5.3, C5.4, C5.8

continued

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Section 8: Operations + Maintenance

Topic	Description	Prerequisite or Credit #
4. Materials management <i>(continued)</i>	<p>Site safety</p> <ul style="list-style-type: none"> • Process used for repairing and maintaining structures and paving that reduces harm to environmental and human health and ensures the effectiveness of the material (e.g., clean permeable surfaces, low-emitting sealants) • Process used for maintaining structures and paving to ensure site safety and that meets the needs of the intended uses of the site • Process used for properly disposing of harmful materials 	C5.2, C6.2, P8.2, C8.3, C8.4
	<p>Historic buildings, structures, objects, and cultural landscapes</p> <ul style="list-style-type: none"> • Process for maintaining the integrity of historic buildings, structures, and cultural landscapes, including: <ul style="list-style-type: none"> - Detailed specifications related to the repair or replacement of features and any maintenance work to be documented for records - Process for determining how conflicts between historic and environmental concerns will be addressed 	C4.5, C5.2, C6.1
	<p>Recyclable materials</p> <ul style="list-style-type: none"> • Process used for managing and recycling all paper, glass, plastics, and metals generated on site 	P8.2
	<p>On-site food waste</p> <ul style="list-style-type: none"> • Process used for on-site collection of compostable organics to prevent them from entering the municipal solid-waste stream 	C6.7, C8.3
5. Sensitive site features	<p>Conserve aquatic ecosystems</p> <ul style="list-style-type: none"> • Maintenance and monitoring techniques that will ensure proper aquatic ecosystem function 	P1.2, P1.3, C3.5, C3.6
	<p>Conserve habitats for threatened and endangered species</p> <ul style="list-style-type: none"> • Process used for avoiding impacts during site maintenance to threatened or endangered species and their habitats 	P1.4, C4.7
	<p>Maintain <u>Vegetation and Soil Protection Zones (VSPZs)</u></p> <ul style="list-style-type: none"> • Ongoing management activities to protect the integrity of VSPZs 	P1.1, P1.2, P1.3, P1.4, P2.3, P4.1, C4.4, C4.5, C4.6, C4.7
6. Landscape maintenance equipment	<p>Equipment maintenance</p> <ul style="list-style-type: none"> • Types of equipment (i.e., manual, electric, low-emitting, or gasoline powered) to be used on site • Process used for maintaining equipment • Process used for cleaning equipment to remove invasive species to prevent transport to other sites 	P4.2, C8.7
	<p>Site user experience</p> <ul style="list-style-type: none"> • Maintenance schedule that minimizes users' exposure to noise, localized air pollution, and other disturbances 	C6.4, C8.4, C8.7

P8.1



Section 8: Operations + Maintenance

Topic	Description	Prerequisite or Credit #
7. Snow and ice	Managing snow and ice <ul style="list-style-type: none"> • Process (including stockpiling) used for managing snow and ice in ways that limit degradation of water quality and surrounding plants and soil health • Process used for stockpiling areas and managing any snow-melt that will be used as a water source on site 	P1.2, P1.3, P1.4, P3.1, C3.3, C3.5, C3.6, C6.2
8. Adaptive Management	Update site maintenance plan <ul style="list-style-type: none"> • Process used for reevaluating the maintenance plan on an annual basis and revising as needed to adapt to future conditions and unforeseen changes 	
9. Other Maintenance-Related Topics		

ECONOMIC AND SOCIAL BENEFITS

An achievable, long-term maintenance plan done in unison with design development is necessary for accomplishing the design intent of a project. As the project is being developed, maintenance resources should be evaluated for short and long-term care. Developing a clear understanding of anticipated maintenance in the beginning of a project will reduce any unexpected issues that may come up later.¹

1. C Camp, E Houston, J Everett, and R Fraley, "Landscape Design Guidelines," Tennessee Department of Transportation (2010), www.tdot.state.tn.us/environment/beautification/landscapedesign.htm (accessed July 14, 2013).

DEFINITIONS

- An **appropriate plant species** is vegetation adapted to site conditions, climate, and design intent. The following attributes should be considered in determining whether plants are appropriate for the site: cold hardiness, heat tolerance, salt tolerance, soil moisture range, plant water use requirements, soil volume requirements, soil pH requirements, sun and shade requirements, pest susceptibility, and maintenance requirements. Native and non-native plants are appropriate if they meet the above criteria.
- **Control of invasives** is the appropriate eradication, suppression, reduction, or management of invasive species populations, prevention of the spread of invasive species from areas where they are present, and taking of steps such as restoration of native or appropriate species and habitats to reduce the effects of invasive species and to prevent further invasion.
- **Graywater** is domestic wash water from kitchen, bathroom, and laundry sinks, tubs, and washers, conventionally thought of as wastewater.
- An **integrated design team** includes the owner, client, and professionals knowledgeable in design, construction, and maintenance. Team members should be selected to meet the unique constraints and opportunities of the site.
- **Integrated pest management (IPM)** is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. IPM is site-specific in nature, with individual tactics determined by the particular crop/pest/environment scenario. The IPM approach places an emphasis on the reduction of pesticide use and the implementation of preventative and alternative control measures.

P8.1



Section 8: Operations + Maintenance

- An **invasive species** is a plant or animal that is not native to the ecosystem under consideration and that causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health.
- **Management of invasives** is the implementation of control measures to prevent the spread of invasive species or lessen their impacts when they appear to be permanently established. Control and management of invasive species encompasses diverse objectives such as eradication within an area, population suppression, limiting spread, and reducing effects. Complete eradication is not generally feasible for widespread invasive species or where adequate control methods are not available.
- **Plant health care (PHC)** is a process of scheduled preventative maintenance based on monitoring and use of cultural and chemical tactics to enhance plant vitality. The plant and its requirements become the central focus of activities, rather than responding to symptoms caused by pest presence, physical agents, or nutritional deficiencies. A plant health care practice addresses the basic causes of the reduction in plant health and provides corrective measures to promote plant health.
- **Vegetation and Soil Protection Zones (VSPZs)** are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.

RESOURCES

- For an example of an IPM plan, see Portland Parks and Recreation, “Integrated Pest Management Program,” www.portlandonline.com/parks/index.cfm?c=38296&a=116237.
- For examples of various landscape maintenance plans, see the resources available from the local government of city of Seattle at www.seattle.gov/util/ForBusinesses/Landscapes/LandscapeMaintenancePlans/index.htm.

P8.1



Prerequisite 8.2: Provide for storage and collection of recyclables

Required

INTENT

Facilitate recycling and reduce waste generation and disposal in landfills by providing space for recyclable materials collection in outdoor areas.

REQUIREMENTS

- Conduct a waste stream study to estimate the amount of recyclable materials generated in outdoor areas, including:
 - Paper
 - Glass
 - Plastics
 - Metals
- Co-locate collection containers for recyclables next to all trash receptacles
- Ensure that service is provided for collection of recyclable materials, or advocate for implementation of a local recycling program.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and includes the processes for collecting recyclable materials on site.

SUBMITTAL DOCUMENTATION

- Site plans showing the recycling collection containers and storage areas
- Results of the waste stream study estimating the amount and type of recyclable materials that will be generated on site
- Narrative or calculations demonstrating:
 - The size and location of recycling collection areas are adequate for expected site program needs
 - The types of materials that are being collected for recycling
 - The recycling facility or location where materials will be deposited
 - Frequency of pickup for recyclables
- A copy of the vendor contract or other documentation of service for collection and recycling of recyclable materials
 - If service does not exist, provide documentation of contacting the local community or municipality requesting the implementation of a recycling program.

RECOMMENDED STRATEGIES

- Coordinate the size and function of the recycling areas with the anticipated collection services for glass, plastics, paper, and metals to maximize the effectiveness of the dedicated areas.

P8.2



Section 8: Operations + Maintenance

ECONOMIC AND SOCIAL BENEFITS

Recycling programs can reduce costs for disposal of waste at landfills, and they generate revenue through sales of materials.¹ Additionally, recycling stations in public places may encourage visitors to engage in recycling activities at home.

1. U.S. Environmental Protection Agency, "Communicating the Benefits of Recycling," www.epa.gov/osw/conserve/tools/localgov/benefits/ (accessed April 11, 2013).

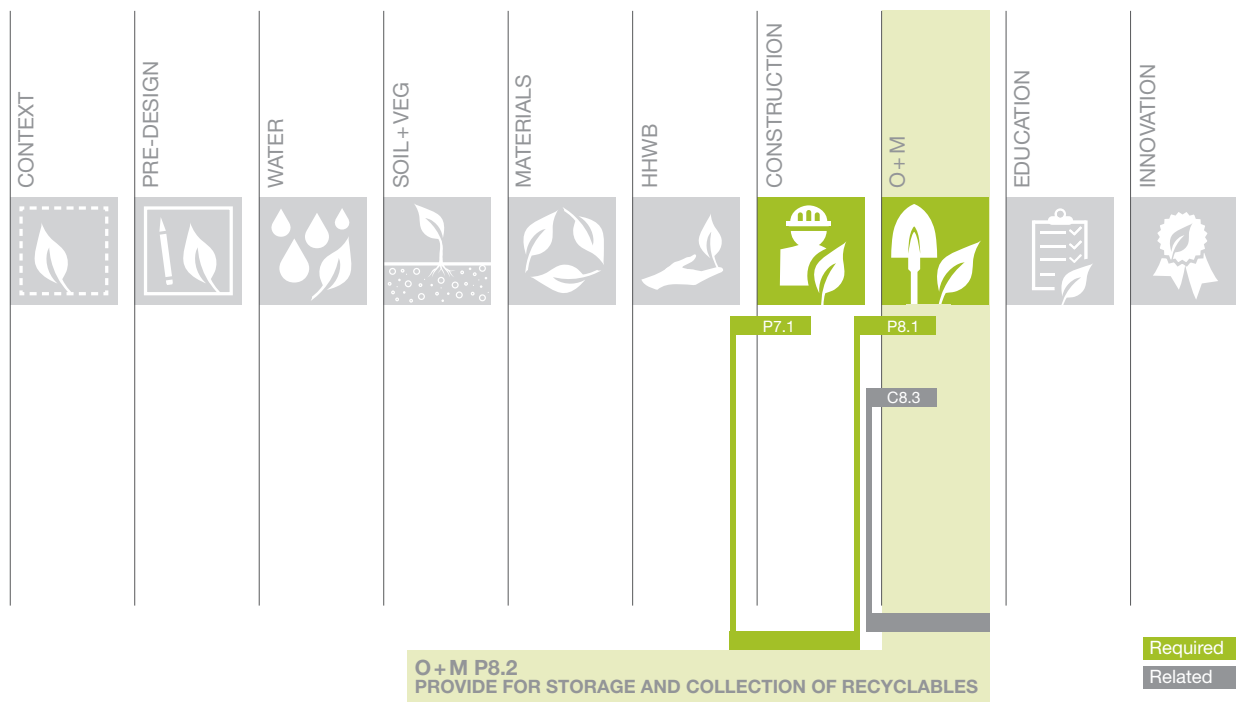
DEFINITION

- A **waste stream study** is a systematic review of a site and its operations to quantify the types and amounts of waste generated, estimate waste that will be generated, and study management practices that impact that waste generation. It includes an assessment of purchasing practices and identifies the areas and materials in which waste reduction efforts will be most effective. A waste stream study also sets a baseline for measuring future progress of waste reduction efforts.

RESOURCES

- Components of this credit were adapted from the U.S. Green Building Council's LEED credits:
 - LEED BD+C v2009 *MR Prerequisite 1: Storage and collection of recyclables*
 - LEED BD+C v4 *MR Prerequisite 1: Storage and collection of recyclables*
- For information on estimating waste generation to set up recycling programs, see California Integrated Waste Management Board webpage on solid waste characterization, ciwmb.ca.gov/WasteChar.
- For information and education programs on recycling as well as links to local recyclers, see the Earth911 website, earth911.com.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 8.3: Recycle organic matter

3–5 points

INTENT

Support nutrient cycling, improve soil health, and reduce transportation costs and materials going to landfills by recycling vegetation trimmings or food waste to generate compost and mulch.

REQUIREMENTS

- Conduct a waste stream study to estimate the amount of vegetation trimmings and food waste, if applicable, that will be generated.
- Compost and/or recycle:
 - 100 percent of vegetation trimmings off site within 50 miles (80.47 kilometers) **3 points**
 - 100 percent of vegetation trimmings on site **4 points**
 - 100 percent of vegetation trimmings AND compostable food waste on site **5 points**
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and demonstrates anticipated strategies for composting or recycling any vegetation trimmings and food waste.

SUBMITTAL DOCUMENTATION

- Site plan showing the organic matter collection and processing areas on site
- Calculations from the waste stream study showing the amount or estimates of any vegetation trimmings and food waste and the collection and processing capacity provided
- Narrative describing the process for composting or the strategy for recycling
 - If composting or recycling takes place off site, provide a copy of the contract with the receiving company and its distance from the site.

RECOMMENDED STRATEGIES

- Collect excess vegetation generated during site maintenance to divert to a composting facility on or off site.
- Consider using a mulching mower when trimming grass and leaving plant materials in situ.
- Sites with limited space for composting can utilize neighborhood facilities and programs to process organic matter.
- If generating food waste, capitalize on the results of waste stream study to determine source reduction opportunities (e.g., alter purchasing practices, join food donation programs).

C8.3



Section 8: Operations + Maintenance

ECONOMIC AND SOCIAL BENEFITS

Recovering landscape trimmings for use as compost or mulch saves money by reducing or eliminating the need to pay for fertilizers, pesticides, or irrigation.¹ Reusing landscape “waste” as a resource on site also reduces costs for waste disposal, transport costs for removing trimmings, and maintenance costs for annually amending soils. When clippings are mulched and left on the lawn, total lawn maintenance time may also be reduced.²

1. U.S. Environmental Protection Agency, “Innovative Uses of Compost: Erosion Control, Turf Remediation, and Landscaping,” EPA 530-F-97-043 (October, 1997), www.epa.gov/compost/pubs/erosion.pdf (accessed April 11, 2013).
2. U.S. Environmental Protection Agency, *Decision-Makers’ Guide to Solid Waste Management*, Vol. II, EPA 530-R-95-023 (August, 1995), www.epa.gov/osw/nonhaz/municipal/dmg2/preface.pdf (accessed April 11, 2013).

DEFINITIONS

- **Food waste** is any food substance, raw or cooked, that is either discarded or intended to be discarded. This does not include vegetation trimmings from food-bearing plants before the consumer receives them.
- **Vegetation trimmings** include only non-invasive plant material free of disease and herbicide residues.
- A **waste stream study** is a systematic review of a site and its operations to quantify the types and amounts of waste generated, estimate waste that will be generated, and study management practices that impact that waste generation. It includes an assessment of purchasing practices and identifies the areas and materials in which waste reduction efforts will be most effective. A waste stream study also sets a baseline for measuring future progress of waste reduction efforts.

RESOURCES

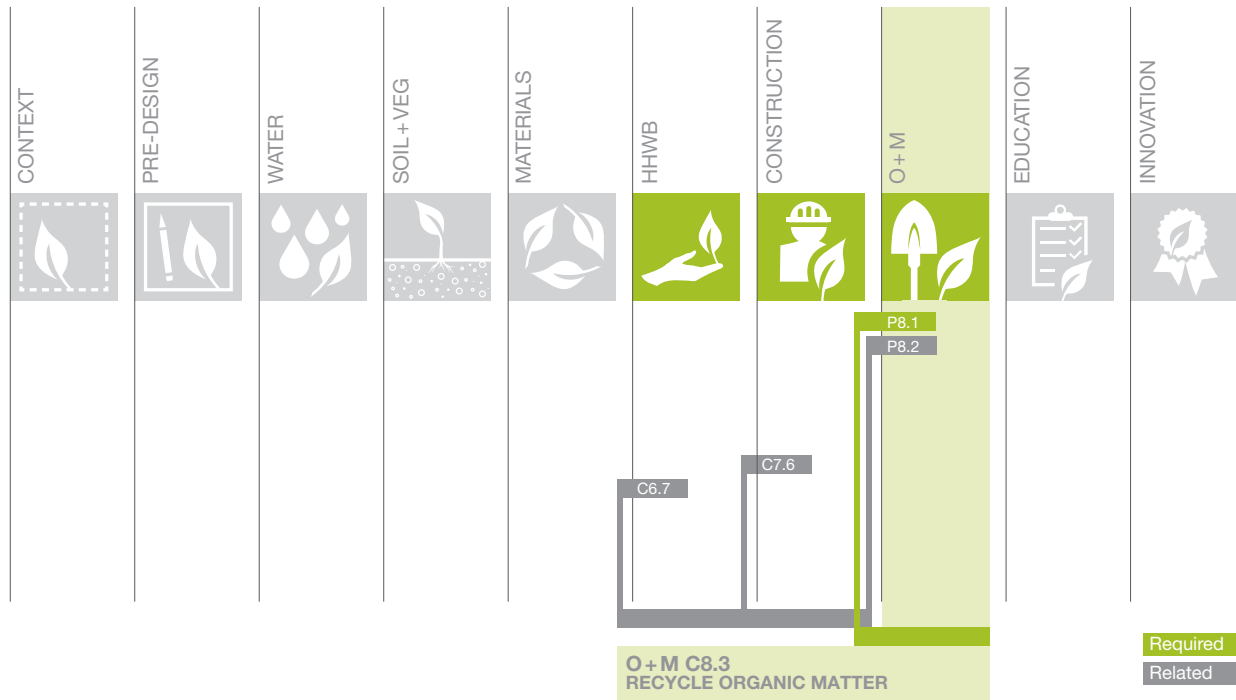
- For more information about environmentally beneficial landscaping, consult the resources available from the U.S. EPA GreenScapes program www.epa.gov/wastes/consERVE/tools/greenscapes/index.htm.
- For additional articles and links on composting and organics recycling, see the following resources:
 - *Biocycle Magazine*, www.biocycle.net
 - Cornell Waste Management Institute (additional information about small-scale composting), cwmi.css.cornell.edu/composting.htm — *smallcomposting*
- For more information on conducting waste audits, see the U.S. EPA’s WasteWise webpage at www.epa.gov/smm/wastewise/plan-program.htm#conduct.

C8.3



Section 8: Operations + Maintenance

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C8.3



Credit 8.4: Minimize pesticide and fertilizer use

4–5 points

INTENT

Reduce stress on plants, decrease negative effects on human health, and have the lowest possible negative ecological and environmental impacts by promoting practices based on observation and planning to minimize or eliminate synthetic pesticide and fertilizer use.

REQUIREMENTS

- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and provides non-toxic maintenance measures for ecologically sensitive areas (e.g., streams, drains, surface waters, wetlands, wells, groundwater, grassed waterways, existing buffers, areas sensitive to erosion, sensitive wildlife habitat) and human use areas (e.g., areas for children and pets, food production areas) that exist within or in proximity to the SITES project boundary.

Option 1: Plant health care plan

4 points

Include all of the following policies and practices and adapt them to the specific plants, pests, ecologically sensitive areas, and human use areas on site.

Pesticides and Fertilizers

- Ban all “weed and feed” type fertilizers.
- Set and enforce buffer zones where fertilizers and pesticides may not be applied.
 - Buffer zones should be applied around areas such as:
 - > Water bodies, wetlands, and other aquatic ecosystems
 - > Drains, conveyance features, and areas where runoff can directly impact water quality (e.g., near curbs and on sidewalks and driveways)
 - > Human use areas (e.g., playgrounds, seating areas, places of respite, food production areas)
 - Minimum buffer zones should be set at 10 feet (3.05 meters) but may need to be larger depending on local regulations and conditions (e.g., slope, habitat)
- Develop written safety requirements for proper storage, mixing, labeling, transporting, application, and disposal of fertilizers, pesticides, leftover mixtures, and containers. Refer to appropriate local, state, and federal regulations.
- Outline procedures and list contacts for handling accidental spills of pesticides and fertilizers.
- Require detailed record keeping for the application of any fertilizers or pesticides, including substance used, concentration, total volume applied, area treated, target species, weather, and environmental conditions.
- Communicate policies to all facilities operators, maintenance contractors, and other relevant parties.

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Section 8: Operations + Maintenance

Pesticides

- Establish action thresholds that define pest population levels and approved management strategies that may be used to reduce them. Physical and mechanical controls should be implemented first, then biotic controls; targeted chemical controls should be a last resort.
- Require prior notification to all site users and to the public when chemical pesticides will be applied. Define how and when communication will be given (e.g., size, location, and number of posted signs; office memo).
- Specify the use of third-party certified (e.g., EcoWise, Greenshield, or equivalent) integrated pest management (IPM) service providers, when pest control services are contracted out.

Fertilizers

- Outline the need for the use of fertilizers.
- Require soil or plant tissue testing in order to determine the type and amount of fertilizer needed.
- Define thresholds and set levels for fertilizer concentrations and frequency of application according to testing results.
- Define how much water should be applied after fertilizer applications. Explain the choices made by referring to regional climatic conditions, soil data (e.g., type, texture, composition) and fertilizer concentrations.
- Specify the use of service providers that have current certifications in fertilizer best management practice (in cities or states where certification is offered) when fertilization services are contracted.

Option 2: Best management practices for plant health care

5 points

Fulfill all requirements for Option 1 and incorporate four of the seven additional policy options listed below:

Pesticides and Fertilizers

1. Incorporate vegetative and grading components into the site design that help mitigate the spread or migration of pesticides and fertilizers in the landscape (e.g. buffer zones, vegetative filter strips, berms, swales).

Pesticides

2. Ban the use of all pesticides for cosmetic purposes.
3. Ban the use of all pre-emergent herbicides.
4. Create a list of herbicides, insecticides, and fungicides approved for use when physical, mechanical, and biotic control methods for pests have been ineffective. Specify chemicals that are the least toxic (i.e., biodegrade quickly and do not threaten human health, water quality, ground water, or aquatic species).

Fertilizers

5. Develop a list of organic or slow-release fertilizer products that are approved for use on the site.
6. Ban the application of all fertilizers during rainy seasons, before predicted heavy rainfall events, and during summer months.
7. Ban the use of all fertilizers after the establishment period, except for periodic applications of mature stable compost or other soil amendments as indicated by soil or plant tissue tests.

C8.4



Section 8: Operations + Maintenance

SUBMITTAL DOCUMENTATION

Option 1: Plant health care plan

- An IPM or plant health care (PHC) document, including:
 - Table of contents
 - Site map noting planting plan, sensitive areas and, if applicable, protective buffer zones
 - Context map showing sensitive areas adjacent to the site or potentially impacted by the site
 - List of all existing, purchased, and salvaged plant species used on the site along with plant phenology calendars
 - Monitoring schedule based on plant phenology
 - List of known and suspected plant, insect, fungal, and other pests; their life-cycle and natural predator information; and action threshold levels
 - Written policies based on the credit requirements above that govern the use of pesticides and fertilizers
 - Templates for recordkeeping (one each for pesticides and fertilizers)
- Documentation from a qualified professional consultant such as a biologist, environmental scientist, or certified arborist that identified pests on site and recommended IPM strategies
- Copies of current certifications of contracted service providers, if known
- Training provided to maintenance personnel, such as a state agricultural extension certification program, to identify pests and diseases

Option 2: Best management practices for plant health care

- All documentation for Option 1, and:
- The following information, where applicable:
 - Developed list of approved non- or least-toxic pesticides
 - Developed list of approved organic or slow-release fertilizers
 - Include on the site map vegetative and/or grading components designed to mitigate spread of pesticides and fertilizers

RECOMMENDED STRATEGIES

- Use appropriate plant species.
- During the planning and design stage, incorporate a variety of plant types in the landscape to avoid planting too many of one species. Low species diversity can create problems such as pest outbreaks.
- If using plants susceptible to pest infestation, learn to identify pest life stages. Incorporate this information into the monitoring schedule.
- Use practices that rely on observation and planning (e.g., IPM) to reduce synthetic inputs that may have short and long-term deleterious impacts on human health and the environment.
- Comply with any local, state, and federal regulations or ordinances (e.g., groundwater protection zones) that govern applications of fertilizers and pesticides.

C8.4



Section 8: Operations + Maintenance

ECONOMIC AND SOCIAL BENEFITS

Proper planning, selection, maintenance, and monitoring can greatly reduce the need for pesticides and added costs in the management of landscapes. Plant stress is often a result of poor soil, site, and water management, and it can cause plants to decline in health.¹ Unhealthy plants attract pests, and standard practice for reducing pest populations relies on the use of pesticides. Pesticides are known to be toxic to human health and the environment and should be avoided in site maintenance.² Worldwide, about three million people are hospitalized due to pesticide poisoning annually.³

1. Colorado State University Extension, "Plant Pathology," www.cmg.colostate.edu/gardennotes/331.html (accessed April 12, 2013).
2. U.S. Environmental Protection Agency, "Human Health Issues," www.epa.gov/pesticides/health/human.htm (accessed April 11, 2013).
3. ED Ritcher, "Acute human pesticide poisonings," *Encyclopedia of Pest Management*, (2002): pp.3-6.

DEFINITIONS

- **Action threshold** is a point at which pest populations or environmental conditions indicate that pest control action must be taken. A single pest, or even a small population of a pest species, does not necessarily require any action for removal. The threshold level is reached when a pest becomes a threat to plant, soil or human health or causes severe economic damage.
- An **appropriate plant species** is vegetation adapted to site conditions, climate, and design intent. The following attributes should be considered in determining whether plants are appropriate for the site: cold hardiness, heat tolerance, salt tolerance, soil moisture range, plant water use requirements, soil volume requirements, soil pH requirements, sun and shade requirements, pest susceptibility, and maintenance requirements. Native and non-native plants are appropriate if they meet the above criteria.
- **Fertilizer** is any organic or inorganic material of natural or synthetic origin that is added to a soil to supply one or more plant nutrients essential to the growth of plants.
- **Integrated pest management (IPM)** is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. IPM is site-specific in nature, with individual tactics determined by the particular crop/pest/environment scenario. The IPM approach places an emphasis on the reduction of pesticide use and the implementation of preventative and alternative control measures.
- **Mature, stable compost** is an important amendment for healthy plant growth. Stability refers to the rate of biological breakdown, measured by carbon dioxide release. Maturity refers to completeness of the aerobic composting process and suitability (lack of plant toxicity) as a plant growth media, often measured by ammonia release or by plant growth tests. For information on compost quality standards and test methods, see the Resources section of *Construction P7.3: Restore soils disturbed during construction*.
- **Non-toxic maintenance** involves practices that eliminate the use of chemicals that are known to cause physiological harm to any living organism.
- A **pest** is an insect, plant, animal, pathogen, or any other undesirable living organism that threatens the health, structure, or safety of other living organisms.
- A **pesticide** is a chemical used to control or eradicate insects, plants, animals, pathogens, and any other undesirable living organisms.
- **Phenology** is the relationship between climate and physiological events, such as bud break, bloom, and leafing-out in plants.
- **Plant health care (PHC)** is a process of scheduled preventative maintenance based on monitoring and use of cultural and chemical tactics, to enhance plant vitality. The plant and its requirements become the central focus of activities, rather than responding to symptoms caused by pest presence, physical agents, or nutritional deficiencies. A plant

C8.4



Section 8: Operations + Maintenance

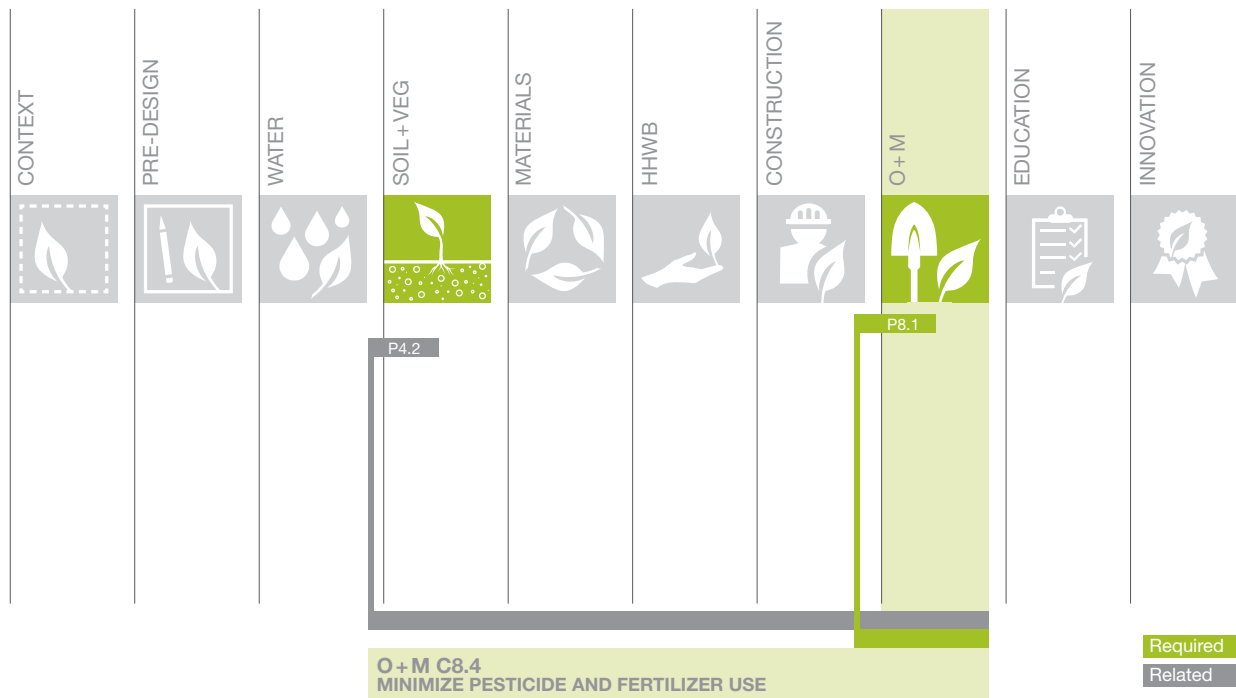
health care practice addresses the basic causes of the reduction in plant health and provides corrective measures to promote plant health.

- A **targeted chemical control** is the limited use of chemical substances, carefully and deliberately administered to specific species or otherwise small areas or populations, for the control of unwanted insects, plants, or other harmful biota.

RESOURCES

- For information regarding PHC, see the International Society of Arboriculture's Trees are Good website, www.treesaregood.com/treecare/phc.aspx.
- For information on tree care, see the ANSI A300 Best Management Practices series available at secure.isa-arbor.com/webstore/Default.aspx.
- For information regarding sustainable landscape management, see Harvard University's webpage on organic landscaping, www.uos.harvard.edu/fmo/landscape/organic/landscaping/getting_started.shtml.
- To learn about common insect, arthropod, and disease problems in your region, refer to Bartlett's Tree Services, www.bartlett.com/region.cfm?setupRegion.
- For examples and information regarding IPM policies and ideas for getting started, refer to the following resources:
 - Portland Parks and Recreations, "Healthy Parks, Healthy Portland: IPM" report, www.portlandonline.com/parks/index.cfm?a=116237&c=38296
 - California Academy of Sciences, "Integrated Pest Management Plan," sfenvironment.org/sites/default/files/fliers/files/sfe_th_california_academy_of_sciences_ipm_plan.pdf
 - The Nature Conservancy, "Weed Control Methods Handbook: Tools & Techniques for Use in Natural Areas," [www.wilderness.net/toolboxes/documents/invasive/Weed Control Methods Handbook.pdf](http://www.wilderness.net/toolboxes/documents/invasive/Weed%20Control%20Methods%20Handbook.pdf)
- For information about low- and least-toxic pesticides, consult the following resources:
 - City of San Francisco's Tier 3 pesticide list, www.up3project.org/documents/2007rpplbyaicomplete.pdf
 - Ontario's Class 4, 6, and 11 pesticides lists, www.ene.gov.on.ca/environment/en/category/pesticides/STDPROD_079355.html

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



Credit 8.5: Reduce outdoor energy consumption

2–4 points

INTENT

Reduce greenhouse gas emissions by minimizing energy consumption and costs associated with site use and operations.

REQUIREMENTS

- Select outdoor lighting and other site equipment (e.g., aerators, ceiling fans, water pumps, transformers) to achieve an annual energy reduction from the estimated baseline energy use for at least:
 - 30 percent reduction from baseline energy use for those products **2 points**
 - 60 percent reduction from baseline energy use for those products **3 points**
 - 90 percent reduction from baseline energy use for those products **4 points**
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and includes details for repair and replacement materials (e.g., energy-efficient lighting).

Note: The baseline energy use is calculated using that of the lowest-cost comparable item.

SUBMITTAL DOCUMENTATION

- Product cut sheets for all purchased and comparable items
- Calculations demonstrating that the average annual energy reduction for outdoor appliances and fixtures has been met
- Completed worksheet below:

Annual Energy Consumption—Specified Items

#	Description	Model No.	Manufacturer	Equivalent Desired Function Value	Qty	Watts Each	Total Wattage	Hours of use per year	Annual kWh
1	LED Pathlight 1	BX-1234	GE	1,000 lumens	12	2	24	1456	34.9
2									
3									
4									
5									

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Annual Energy Consumption—Lowest-Cost Comparable Items

#	Description	Model No.	Manufacturer	Equivalent Desired Function Value	Qty	Watts Each	Total Wattage	Hours of use per year	Annual kWh
1	Pathlight	ZAW-1	Phillips	1,000 lumens	12	60	720	1456	1048.2
2									
3									
4									
5									

DOCUMENTATION GUIDANCE

Determine the equivalent desired function for a fixture using accepted standard units of measure (e.g., kW).

Calculating Annual Energy Consumption

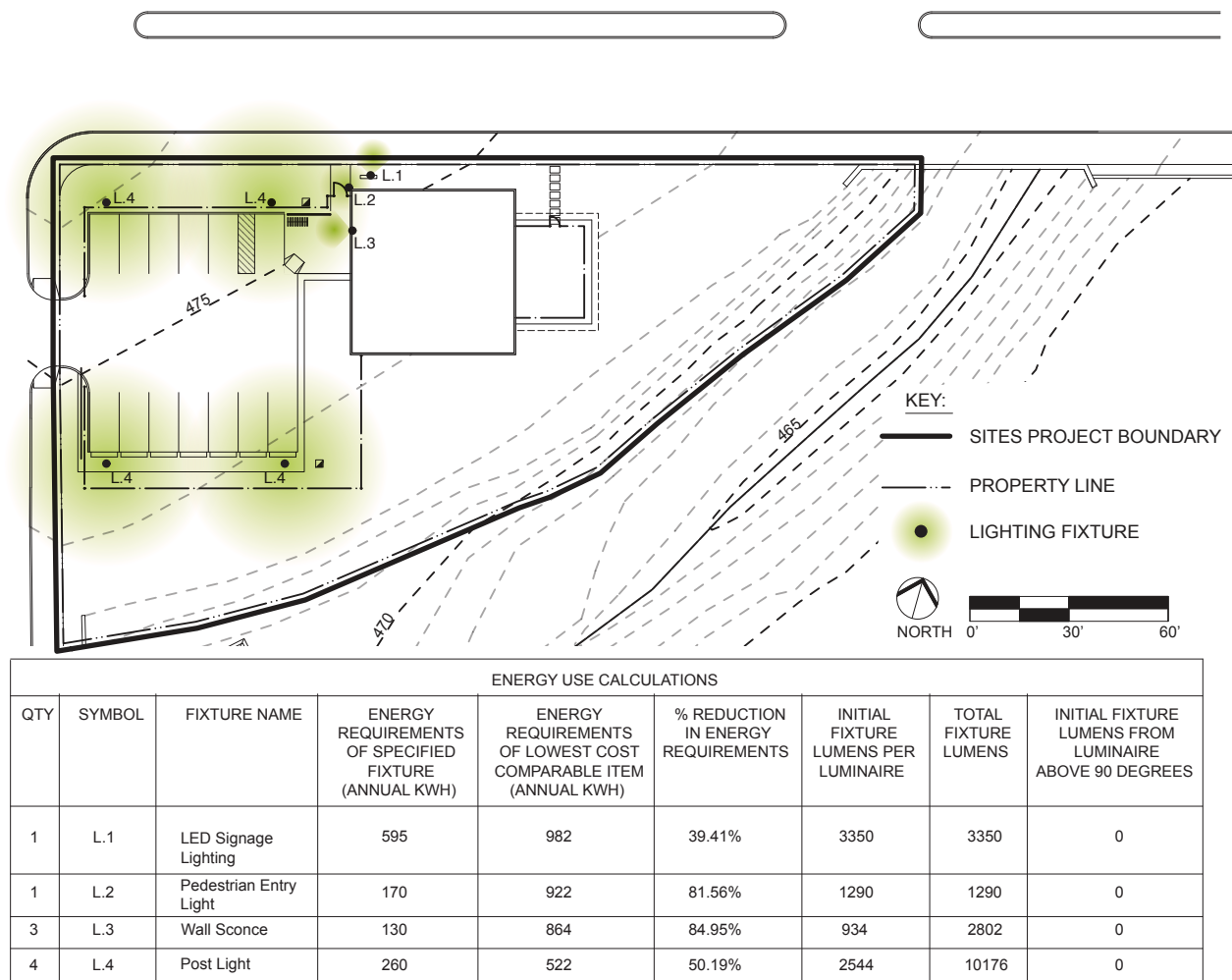
- After determining that the appliances selected for comparison have equivalent desired functions, calculate the annual energy consumption for the lowest cost comparable item and the specified item using the following method:
 - Determine each appliance's wattage (usually written somewhere on the product), which is the maximum power that can be drawn by the appliance. Sometimes an appliance will note its current draw in amperes, instead of wattage. To determine wattage from amperes, multiply amperes by the voltage used (either 120V or 240V in the United States).
Note: Some types of appliances have a range of settings (e.g., lights with dimmers, ceiling fans with multiple speeds), which means the actual amount of power consumed depends on the setting used at any one time.
- Energy consumption is typically measured in kilowatt hours (kWh). Since 1 kilowatt (kW) is 1,000 Watts, then use the following formula to determine annual kWh consumption:
$$\text{Watts} \times \text{hours used per year} / 1000 = \text{Annual kWh consumption}$$

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Section 8: Operations + Maintenance

Example: Live Oak Place



This simplified lighting plan shows the location and types of lighting fixtures in the proposed site design. A table is included to quantify the energy usage of each fixture. Lighting fixture specification sheets will be supplied as additional support material for this credit.

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Section 8: Operations + Maintenance

RECOMMENDED STRATEGIES

- Research various alternatives for each type of outdoor appliance to be installed on the project, in order to identify those options that are most energy efficient.
- When possible, look for solar-powered alternatives to conventional products.

ECONOMIC AND SOCIAL BENEFITS

Energy-efficient outdoor appliances lead to lowered costs for electricity during operations. Exterior lighting alone represents an estimated 1.34 percent of California's total energy use.¹ Minimizing the energy needs of a site also reduces the greenhouse gas emissions associated with consumption of purchased electricity.

1. RW Wright, *California Outdoor Lighting Baseline Assessment*, California Energy Commission, Technical Report P500-03-082-A-18 (2003).

DEFINITIONS

- **Equivalent desired function** measures the task that an appliance is meant to perform without taking energy consumption into account. For example, lighting elements should be compared using an equivalent desired function that is measured in lumens, not watts. A lumen measures the total amount of visible light emitted by a source, while a watt is a unit of power used to measure the rate of energy conversion used by that source.
- **Lowest-cost comparable item** is the most inexpensive item that provides an equivalent desired function.

RESOURCES

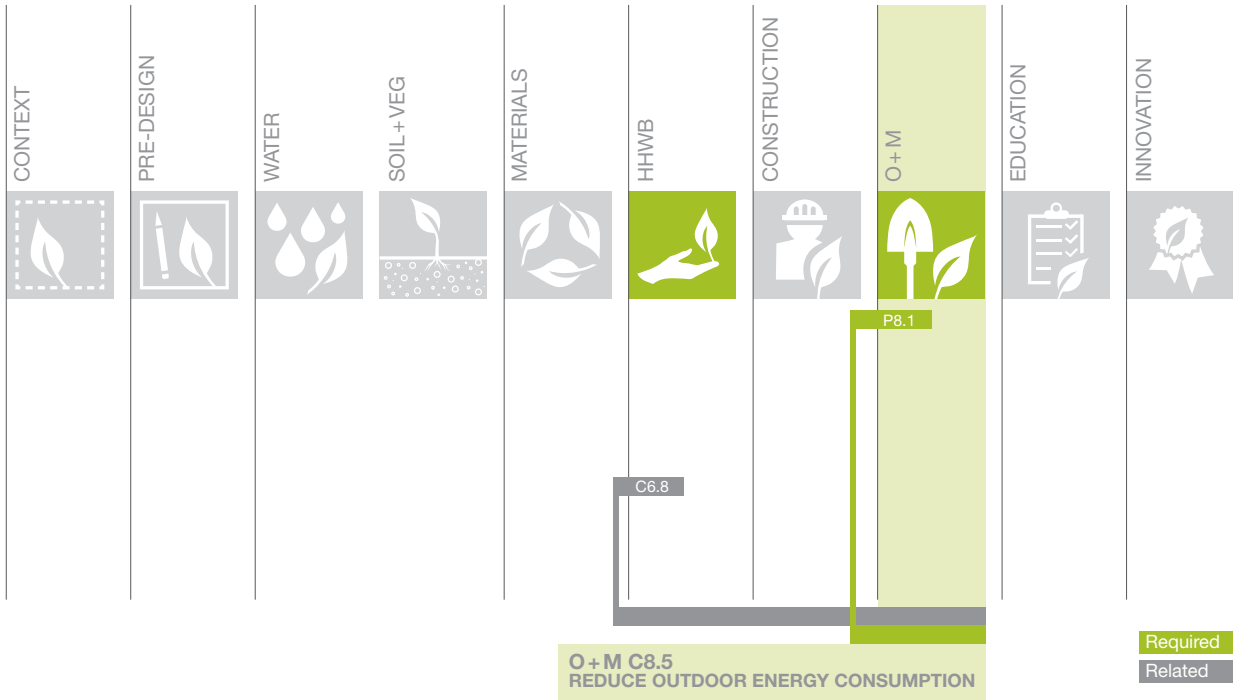
- For guidelines on efficient outdoor lighting (including system efficacy, controls, luminaire cutoff, and lighting power density), consult the U.S. Department of Energy (DOE) at apps1.eere.energy.gov/buildings/publications/pdfs/ssl/outdoor_lighting_guidance.pdf.
- For information about efficient exterior lighting, see chapter six of the U.S. EPA *Energy Star Building Upgrade Manual* at www.energystar.gov/index.cfm?c=business.bus_upgrade_manual.
- For additional information on specific lighting strategies, see the following resources:
 - DOE parking lot lighting performance specifications, apps1.eere.energy.gov/buildings/publications/pdfs/alliances/led_site_lighting_spec_06_09.pdf
 - DOE solid-state lighting street light demonstration projects, www1.eere.energy.gov/buildings/ssl/consortium.html
- For information on conserving energy and reducing light pollution, read the International Dark Sky Association, "Simple Guidelines for Lighting Regulations for Small Communities, Urban Neighborhoods, and Subdivisions" [c0133311.cdn.cloudfiles.rackspacecloud.com/Guide—Simple Guidelines for Lighting Regulations.pdf](https://c0133311.cdn.cloudfiles.rackspacecloud.com/Guide—Simple%20Guidelines%20for%20Lighting%20Regulations.pdf).

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Section 8: Operations + Maintenance

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C8.5



Credit 8.6: Use renewable sources for landscape electricity needs

3–4 points

INTENT

Reduce greenhouse gas emissions associated with site operations and minimize air pollution, habitat destruction, and pollution from fossil fuel-based energy production by supporting a renewable energy market.

REQUIREMENTS

Option 1: On-site renewable production

- Use on-site renewable energy sources to generate outdoor site electricity for at least:
 - 50 percent of annual outdoor site electricity **3 points**
 - 100 percent of annual outdoor site electricity **4 points**
- Calculate the electricity generated by quantity (e.g., kilowatts), not cost.

The use of a community renewable energy system, such as a solar garden, is allowed if the following requirements are met:

- Actual ownership in the system or a signed lease agreement for a period of at least 15 years
- The system is located within the same utility service area as the facility claiming the use

The percentage of credit will be determined as a percentage of ownership or percent utilization assigned in the lease agreement, or other written and signed document, as it applies to the project's total annual outdoor site electricity use.

Option 2: Green power

- Engage in a contract for the delivery of green power or offsets from qualified resources that have come online since January 1, 2005. Contracts should be for a minimum of five years to be delivered at least annually. The contract must specify the quantity, not the cost, of the project's energy that comes from green power, carbon offsets, or renewable energy certificates (RECs).
 - 50 percent of annual outdoor site electricity **3 points**
 - 100 percent of annual outdoor site electricity **4 points**

Note: Carbon offsets may be used to mitigate Scope 1 or Scope 2 emissions on a metric ton of carbon dioxide-equivalent basis. They must be certified by Green-e Climate or an equivalent program.

Green power and RECs must be certified by Green-e Energy certified or an equivalent program. RECs can only be used to mitigate the effects of Scope 2.

For U.S. projects, the offsets must be from greenhouse gas emissions reduction projects within the United States.

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Section 8: Operations + Maintenance

SUBMITTAL DOCUMENTATION

Option 1: On-site renewable production

- Calculations showing the percentage of annual outdoor site electricity use provided by the renewable energy source
- Product data for the renewable energy source installed on site
- Energy bills, meter readings, or other documentation demonstrating the actual or estimated annual outdoor site electricity usage
- Signed lease or ownership agreement (when applicable) for community renewable energy systems

Option 2: Green power

- Contract documenting the type of green power or RECs purchased and the percentage of annual outdoor site electricity use that is offset
- Energy bills, meter readings, or other documentation demonstrating the actual or estimated annual outdoor site electricity usage

RECOMMENDED STRATEGIES

- Assess the project for non-polluting and renewable energy potential, including solar, wind, geothermal, and low-impact hydropower.
- Determine the energy needs of the site, and investigate opportunities to engage in a green-power contract.

ECONOMIC AND SOCIAL BENEFITS

Renewable energy sources add an economically stable source of energy to the mix of U.S. generation technologies.¹

1. Center for Resource Conservation, "Energy Efficiency 101," conservationcenter.org/energy-division-main/energy-efficiency-101-2/ (accessed April 11, 2013).

DEFINITIONS

- A **community renewable energy system** is a system that relies on a renewable energy source such as solar or wind power and that is interconnected and shared by neighbors or larger communities. For SITES purposes, they can include private systems shared by two or more properties and unconnected to a commercial grid, stand-alone systems that are connected to a commercial electricity provider's grid, or private systems connected to the grid through a participating subscriber of a commercial provider (connected to a commercial subscriber's meter).
- **Outdoor site electricity** is all electricity consumed outside of the building on the site.
- A **renewable energy source** includes nonpolluting renewable energy generation methods, such as solar, wind, geothermal, small-scale or micro hydroelectric, and biomass. Purchased renewables must meet the Center for Resource Solutions (CRS) Green-e products certification requirements. Other sources of green power are eligible if they satisfy the Green-e program's technical requirements.
- **Scope 1** emissions are direct greenhouse gas emissions from sources owned or controlled by the entity (Green-e program, Center for Resource Solutions).
- **Scope 2** emissions are indirect, and associated with the generation of electricity, heating/cooling, or steam purchased for the entity's own consumption (Green-e program, Center for Resource Solutions).
- A **solar garden** is a cluster of solar arrays set up as a community renewable energy system (www.solargardens.org).

C8.6

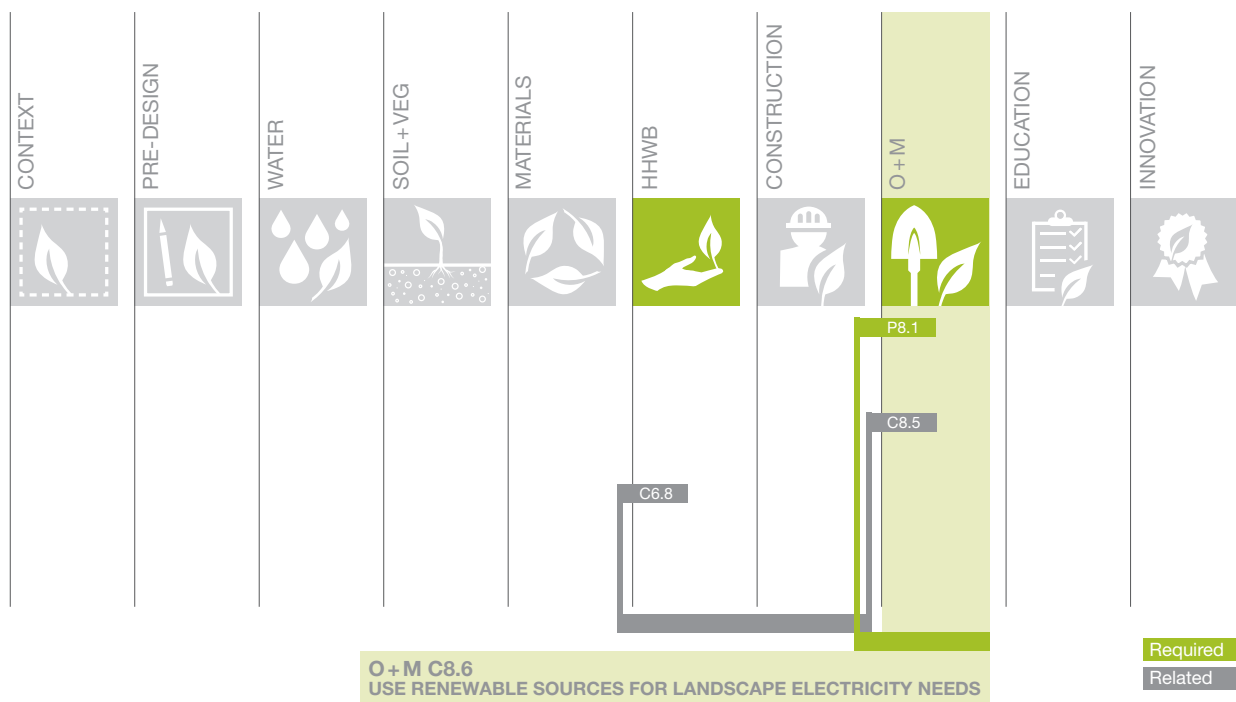


Section 8: Operations + Maintenance

RESOURCES

- Components of this credit were adapted from the U.S. Green Building Council's LEED credits:
 - LEED BD+C v2009 *EA Credit 2: On-site renewable energy*
 - LEED BD+C v2009 *EA Credit 6: Green power*
 - LEED BD+C v4 *EA Credit 5: Renewable energy production*
 - LEED BD+C v4: *EA Credit 7: Green power and carbon offsets*
- For more information about carbon offsets certification, see the Green-e program at www.green-e.org
- For more information about resources and human needs, consult The World Resources Institute at www.wri.org.
- For U.S. Green Building Council rating systems and reference guides, go to www.usgbc.org.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C8.6



Credit 8.7: Protect air quality during landscape maintenance

2–4 points

INTENT

Protect air quality and reduce pollution by minimizing the use of powered landscape maintenance equipment that exposes site users to localized air pollutants and generates greenhouse gasses.

REQUIREMENTS

These requirements apply to all powered equipment used for landscape maintenance on site. Sites that require no powered maintenance equipment are eligible for this credit.

Option 1: Scheduled maintenance

2 points

- Plan for the use of powered maintenance equipment only during hours when the site is closed for use or during periods when the lowest percentage of site users are potentially exposed to landscape maintenance emissions
- For sites with constant use (e.g., college and university settings), designate times for powered maintenance equipment use to occur when the number of site users is typically at its lowest.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete. It must describe how the use of powered maintenance equipment will be limited to hours when the site is closed for use or during periods when the lowest percentage of site users are present.

Option 2: Low-emitting equipment

3 points

- Specify a 50 percent reduction in hydrocarbon (HC) and nitrogen oxide (NO_x) emissions and a 75 percent reduction in carbon monoxide (CO) emissions from baseline conditions.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and specifies equipment allowed for use on site.

Option 3: Manual or electric powered maintenance equipment

4 points

- Use only manual and/or electric-powered maintenance equipment.
- Ensure the section of the site maintenance plan (see *O+M P8.1: Plan for sustainable site maintenance*) is complete and specifies equipment allowed for use on site.

C8.7



Section 8: Operations + Maintenance

SUBMITTAL DOCUMENTATION

Option 1: Scheduled maintenance

- Total site users and times of peak site use
- List of all powered maintenance equipment anticipated to be used on site

Option 2: Low-emitting equipment

- Complete the *Emissions Reduction Worksheet* to demonstrate the required reduction in HC, NOx, and CO emissions from baseline conditions.
- List of all powered maintenance equipment anticipated to be used on site, including indication of which equipment meets the requirements

Option 3: Manual or electric powered maintenance equipment

- List of all maintenance equipment (e.g., hand tools, electric powered tools) anticipated to be used on site

RECOMMENDED STRATEGIES

- Design the site to minimize requirements for gasoline-powered maintenance equipment.
- Select plants that require minimal maintenance or can be maintained with hand tools.
- Select equipment that minimizes emissions of air pollutants and meets or exceeds U.S. EPA standards (or local equivalent for projects outside the United States). Focus on reducing the use of 2-stroke engine equipment (e.g., line trimmers, blowers).
- Convert turf areas to ground cover or shrubs in areas that adjoin walks and curbs. Large lawn areas can be converted to meadows or naturalized into restored habitats.

ECONOMIC AND SOCIAL BENEFITS

Emissions from lawn mowers, snow blowers, chain saws, and similar outdoor power equipment are a significant source of pollution. Today's small engines emit high levels of carbon monoxide, hydrocarbons, and nitrogen oxides, pollutants that contribute to the formation of ozone, which at ground level is a noxious pollutant. Ground-level ozone impairs lung function, inhibits plant growth, and is a key ingredient of smog.¹

Cleaner air is linked to reduced health-care costs. The estimated annual economic value of avoiding the effects of ozone and particulate matter in the air is nearly \$10 billion in a four-county area of Southern California (the South Coast Air Quality Management District) alone.²

1. U.S. Environmental Protection Agency, "At Home and in the Garden: Your Yard and Clean Air," Office of Mobile Sources, EPA 420-F-94-002 (May, 1996), www.epa.gov/epahome/home.htm (accessed March 19, 2013).
2. JV Hall, AM Winer, MT Kleinman, et al. "Valuing the Health Benefits of Clean Air," *Science* 255, no. 5046 (1992): pp.812-17.

DEFINITIONS

- A **site user** is an individual who is expected to occupy, work at, or pass through the site. Users may visit the site regularly or periodically. Site users will range in age, ethnicity, and socio-economic status, but all users' needs should be considered.

C8.7

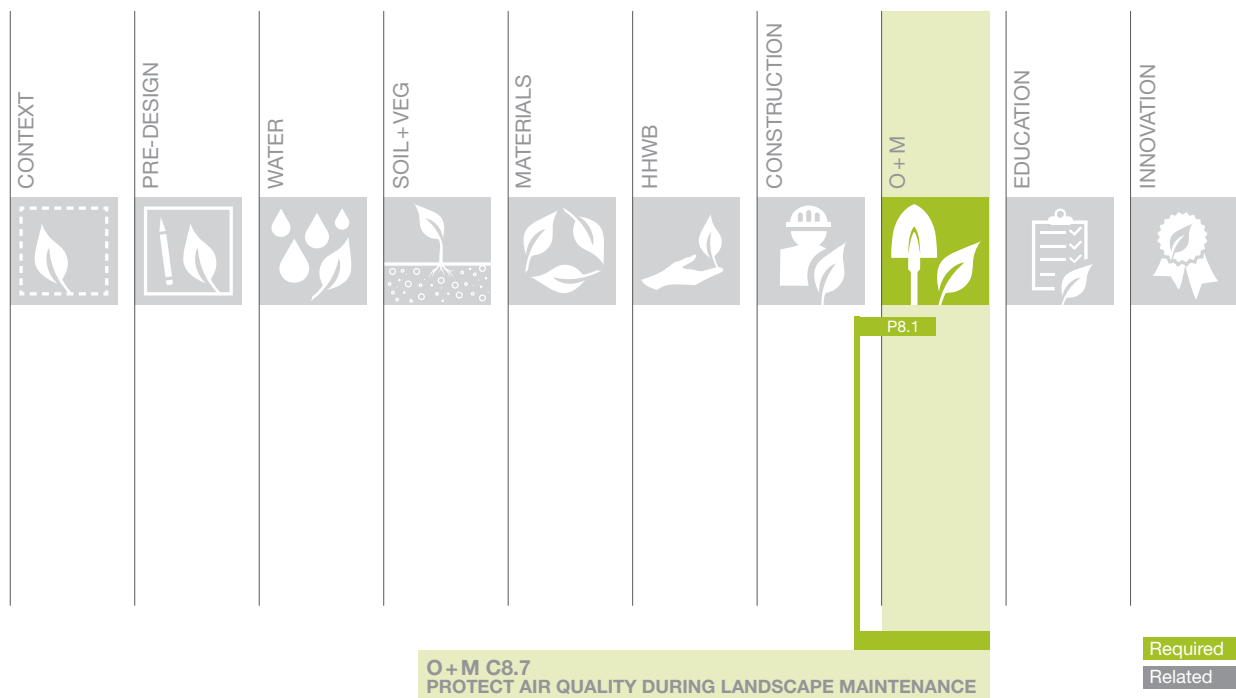


Section 8: Operations + Maintenance

RESOURCES

- For techniques to minimize emissions during landscape maintenance, consult the U.S. EPA at www.epa.gov/iaq/schools/tfs/guidei.html.
- For a comparison of emission reductions from alternative fuels, see the Triangle Clean Cities Coalition Alternative Fuel Comparison factsheet at www.trianglecleancities.org/data/sites/4/media/facts/compare.pdf.
- For a comprehensive look at the research supporting Clean Diesel, go to www.grasshoppermower.com/diesel.php.
- For U.S. EPA emissions standards for landscape gasoline engines, see www.epa.gov/otaq/smallsi.htm.
- For a tool to compare and contrast fuel consumption, cost, emissions, and profitability data for different types of equipment used on site, see The Grasshopper Company fuel and emissions calculator at www.grasshopperfuelsavings.com.

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C8.7





SECTION 9

EDUCATION + PERFORMANCE MONITORING

PREREQUISITE / CREDIT	TITLE	POINTS
Education C9.1	Promote sustainability awareness and education	3-4 points
Education C9.2	Develop and communicate a case study	3 points
Education C9.3	Plan to monitor and report site performance	4 points

Credit 9.1: Promote sustainability awareness and education

3–4 points

INTENT

Promote understanding of sustainability in ways that positively influence user behavior by interpreting on-site features and processes.

REQUIREMENTS

Educational content and elements must relate to SITES prerequisites or the credits a project is pursuing.

Option 1: Educational and interpretive elements

3 points

- Provide a minimum of three educational or interpretive elements that draw attention to and explain sustainable features or processes of the site design, construction, operations, or maintenance. Demonstrate how the educational elements represent environmentally responsible behavior.

Option 2: Additional education

4 points

Complete Option 1 and one of the following:

- **Interactive educational or interpretive elements**
 - Design a minimum of 30 percent of educational elements on site to be interactive.
- **Programming**
 - Provide programming that welcomes, encourages, and expands sustainability learning and understanding on the site.
- **Partnerships**
 - Create partnerships to extend sustainability education to local community groups.

SUBMITTAL DOCUMENTATION

Option 1: Educational and interpretive elements

- Site plan and any supporting materials (e.g., photos, drawings) that indicate the locations and illustrate the character of the educational and interpretive elements
- Narrative describing the content of the interpretive elements and how it integrates the project's approach to implementing SITES credits in the site design
- List of SITES prerequisites and credits conveyed in educational elements

Option 2: Additional education

Include the following interactive educational or interpretive elements:

- Site plan and any supporting materials (e.g., photos, drawings) that indicate locations and illustrate the character of all the educational or interpretive elements. Indicate which elements are interactive.
- Narrative describing the content of the interactive elements and how it integrates the project's approach to SITES prerequisites or credits
- Copies of the narration, educational materials, and a schedule for any guided tours or technology-based interpretative elements

C9.1



Section 9: Education + Performance Monitoring

Programming:

- Narrative that describes the programming intentions, goals or outcomes, staffing plan, expected audience and participants, and how the site's features will facilitate the programming

Partnerships:

- Narrative that describes the community partnerships and their predicted contributions or applications. It should also describe how these partnerships promote sustainability awareness and education.
- Copies of agreements, contracts, or letters of support

RECOMMENDED STRATEGIES

- Follow these guidelines for educational or interpretive elements:
 - Deliver one focused message.
 - Make educational messages compelling.
 - Use visual illustrations to convey the educational message.
- Design educational and interpretive elements with potential audiences in mind.
- Provide information in a variety of formats (e.g., maps, models, brochures, electronic kiosks, MP3-based or cell phone tours).
- Use natural elements provided to improve environmental conditions and include opportunity for user education and understanding. For example, raingardens for stormwater management can be designed to provide a restorative setting, or a roof garden can serve as a break room.
- Identify those sustainability features that can be easily applied to off-site situations and design interpretive elements based on these applications.
- Tie programming to state standards and local school district goals and learning initiatives.
- Consider including interpretative descriptions in multiple languages to meet a broader audience based on visitor and population demographics.
- Incorporate interactive elements that encourage site users and visitors to integrate understanding of on-site examples of sustainability practices with experiences and behaviors that extend beyond the site. Signage is not considered interactive.
- Design activities and programs to welcome diverse participants.

ECONOMIC AND SOCIAL BENEFITS

Human behavior is an important component of solving environmental problems. Examples of more responsible and efficient ways of living can help people to understand sustainability in everyday places and make more responsible choices. The application of educational and interpretive elements is an integral strategy in conveying the message of sustainability—a message that may otherwise go unnoticed.

DEFINITIONS

- An **interactive element** can be a website, electronic kiosk, on-site demonstration, or tour.
- An **interpretive element** can be a map, model, brochure, sign, or video.
- A **local community group** can be a school, youth organization, workforce commission, church group, NGO, or informal learning circle.

C9.1

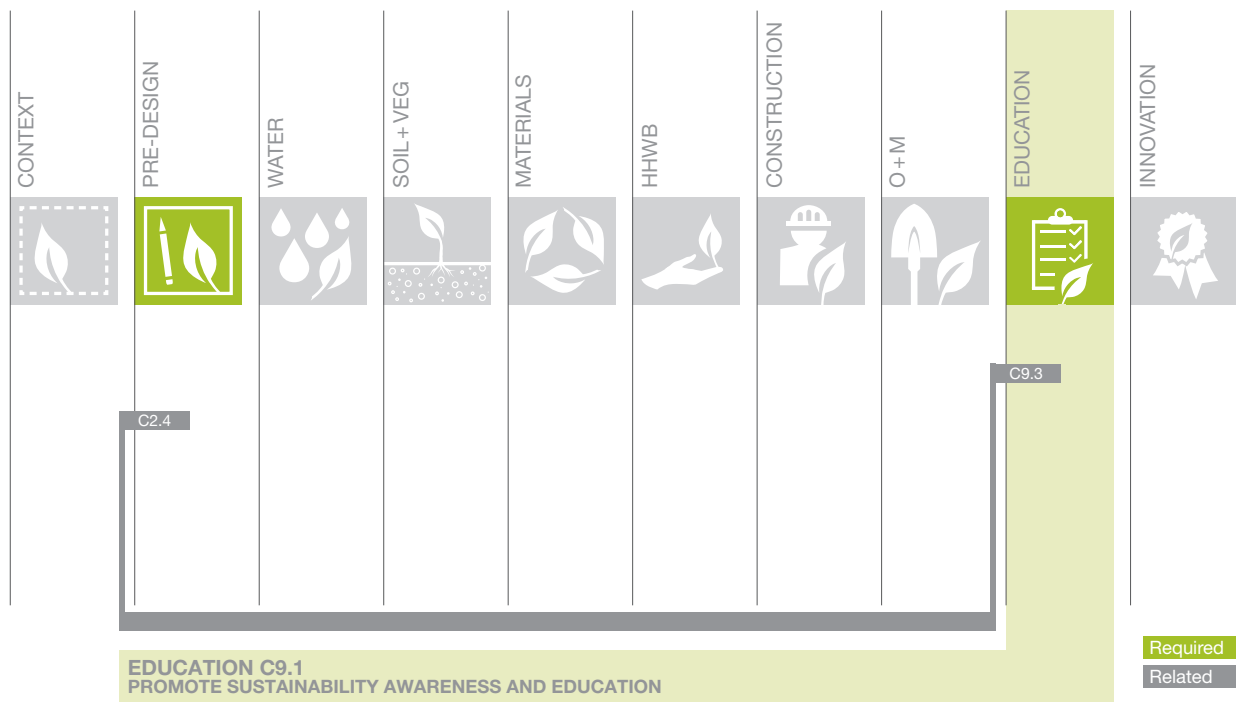


Section 9: Education + Performance Monitoring

RESOURCES

- For more information about on-site interpretation, consult the following resources:
 - National Association for Interpretation, www.interpnet.com
 - University of Wisconsin-Stevens Point *Interpreter's Handbook* series, www.uwsp.edu/cnr/Schmeeckle/Handbooks
 - L Beck and T Cable, *Interpretation for the 21st Century: Fifteen Guiding Principles for Interpreting Nature and Culture* (Champaign, IL: Sagamore Publishing, 2002).
 - SH Ham, *Environmental Interpretation: A Practical Guide for People with Big Ideas and Small Budgets* (Golden, CO: Fulcrum Publishing, 1993).
 - D Knudson, T Cable, and L Beck, *Interpreting Cultural and Natural Resources, 2nd ed.* (State College, PA: Venture Publishing, 20002).
 - North American Association for Environmental Education, www.naaee.org
 - National Academies of Science, National Science Standards, www.educationworld.com/standards/national/science/index.html

LINKS TO OTHER SITES PREREQUISITES AND CREDITS



C9.1



Credit 9.2: Develop and communicate a case study

3 points

INTENT

Inspire and educate the public on the value of sustainable landscapes by describing and communicating a thoughtful and informative summary of the SITES project.

REQUIREMENTS

- Use the SITES project to clearly and effectively illustrate the approaches, strategies, and benefits of implementing sustainability at the site scale. Work with the project's integrated design team to develop a case study that, at a minimum, addresses the following criteria:
 - Project details (e.g., name, size, project type, former land use, terrestrial biome, budget for landscape and site portion only)
 - Project summary
 - Project team
 - Site context (i.e., location, climate, pre-design site constraints and opportunities)
 - Challenges and solutions
 - Sustainable features
 - Environmental, social, and economic performance benefits
 - Cost comparison of sustainable vs. conventional strategies
 - Lessons learned
 - Maintenance and monitoring (i.e., description of how the project promotes long-term sustainability)
- Share the completed case study and project images with the public in at least two locations by making them available to the Sustainable Sites Initiative™ and other related organizations and conferences for the purposes of increasing the knowledge base on site sustainability.

SUBMITTAL DOCUMENTATION

- Completed case study
- At least three high-resolution images
 - All images must be in digital format (jpeg preferred) with resolution of at least 2592 x 1944 (5 megapixels)
 - Before and after images of the site area and perspective, if possible
- Documentation of at least two locations or occasions (e.g., websites, conferences) where the case study was communicated and the date it was shared (other than the SITES website)

C9.2



Section 9: Education + Performance Monitoring

RECOMMENDED STRATEGIES

- Capture many “before” photos of the site prior to construction in addition to “after” (completed) photos.
- Communicate the case study needs to the entire team early in the design process.
- Provide guidelines for setting sustainability principles and performance goals.
- Develop and communicate methodologies that help to define performance benefits (economic, social, and environmental). Consult with related disciplines to identify the most appropriate metrics.
- Derive quantifiable benefits from tools such as monitoring data, post-occupancy evaluations, and design calculations.
- Describe limitations and lessons learned to advance the knowledge base of site sustainability.

DEFINITIONS

- An **integrated design team** includes the owner, client, and professionals knowledgeable in design, construction, and maintenance. Team members should be selected to meet the unique constraints and opportunities of the site.
- A **performance benefit** refers to the measurable economic, environmental, and social benefits derived from SITES efforts.
- **Terrestrial biome** is the largest unit of vegetation type within the biosphere, with similar plant architecture and character, community structure, and climate (e.g., tropical rain forest, coral reef).

RESOURCES

- For more information about using case studies, consult M Francis, *A Case Study Method for Landscape Architecture* (Landscape Architecture Foundation, 1999).
- For examples for case studies, consult the following resources:
 - Sustainable Sites Initiative, SITES-certified projects, www.sustainablesites.org/cert_projects
 - Landscape Architecture Foundation’s “Landscape Performance Series,” www.lafoundation.org/research/landscape-performance-series/case-studies
 - American Society of Landscape Architects stormwater case studies, www.asla.org/stormwatercasestudies.aspx

C9.2



Credit 9.3: Plan to monitor and report site performance

4 points

INTENT

Improve the body of knowledge on long-term site sustainability by monitoring and documenting sustainable design practices to evaluate their performance over time.

REQUIREMENTS

- Develop a plan or policy to demonstrate ongoing performance monitoring and reporting of at least three SITES prerequisites or credits included in Table 9.3-A (see the Submittal documentation section).
 - Monitoring must be done by a third party or qualified person on the design team for independent peer review.
 - Achievement is based having a monitoring plan or policy in place to report the performance monitoring evaluation; negative findings will not affect achievement of this or other prerequisites or credits.
- Provide proof of initial start-up funding (25 percent of total funding requirements) and staffing needs to begin the monitoring. Provide a plan for raising funds for the entire monitoring timeline as stated in the plan or policy.
- Develop three separate summary reports, including one for each of the prerequisites or credits that include the following components:
 - Describe the site feature or program that was implemented for the selected prerequisite or credit, and define the performance or outcome that is being evaluated.
 - Describe the methodology used to assess performance (i.e., sampling, measures or instruments, frequency, procedures).
 - Describe the corrective action to be taken if the design does not perform as intended.
- Develop a plan to increase the body of knowledge on long-term site sustainability by widely communicating the results in a discipline-wide professional magazine (e.g., *Planning*, *Landscape Architecture Magazine*), peer-reviewed scientific journal, professional national or international conference, or national or international public database (e.g., Landscape Architecture Foundation's "Landscape Performance Series").

Note: A separate summary report is not necessary if monitoring results are submitted to the U.S. National Stormwater BMP Database (or local equivalent for projects outside the United States).

SUBMITTAL DOCUMENTATION

- Plan or policy that demonstrates the ongoing performance monitoring and reporting of at least three prerequisites or credits included in Table 9.3-A. The client or owner of the property and the qualified individuals in charge of the monitoring must sign this policy.
- List of the third party (name and company or organization) in charge of performance monitoring and documentation demonstrating the third party's expertise in the specific area for evaluation
- Proof of funding and staffing to fulfill the initial start-up of the monitoring plan or policy
- Fundraising plan that fulfills the entire monitoring timeline stated in the plan or policy
- At least three summary reports including one for each prerequisite/credit being monitored:

C9.3



Section 9: Education + Performance Monitoring

- Site feature or program and the performance or outcome being evaluated
- Methodology used to assess performance (i.e., sampling, measures or instruments, frequency, procedures)
- Corrective action to be taken if the design does not perform as intended
- Narrative or plan for how the results will be widely communicated to increase the body of knowledge on long-term site sustainability

TABLE 9.3-A: Eligible Prerequisites / Credits for Performance Monitoring*

Prerequisite / Credit	Monitoring Requirements	Time Frame
Water P3.1: Manage precipitation on site Water C3.3: Manage precipitation beyond baseline	<p>Review of monitoring and submittal of data to the U.S. National Stormwater BMP Database (or local equivalent for projects outside the United States). Use the <i>Urban Stormwater BMP Performance Monitoring: A Guidance for Meeting the National Stormwater BMP Database Requirements</i> to design and implement the monitoring program.</p> <p>Format collected data according to Section 3.4.3.2 of the requirements ("Standard Format Examples"). Monitoring should include completion of the following components:</p> <ul style="list-style-type: none"> • General test site information • Watershed information • BMP information (structural or non-structural) • BMP design data (choose appropriate form) • Monitoring station information • Precipitation Data • Flow Data 	<p>Monitoring program (including frequency and total number of samples) should be adequate to meet the U.S. National Stormwater BMP Database Requirements regarding statistical confidence (Section 3.2.2) (or local equivalent for projects outside the United States).</p>
Water P3.2: Reduce water use for landscape irrigation Water C3.4: Reduce outdoor water use	<ul style="list-style-type: none"> • Third-party review of annual flow monitoring data compared to the mid-summer baseline estimate of irrigation water needs • Documentation of water sources other than potable water supply (source and available quantity) • Documentation of plant composition, mortality rates, and plant replacement rates • Review of annual flow monitoring data for water features. Include documentation of water sources other than potable water supply (source and available quantity) 	<p>Provide annual data for at least three years.</p>

continued



Section 9: Education + Performance Monitoring

Prerequisite / Credit	Monitoring Requirements	Time Frame
Water C3.6: Restore aquatic ecosystems	Review of annual monitoring using the Habitat Assessment (Chapter 5) and completed Habitat Assessment Field Data Sheet (Appendix A) in <i>Rapid Bioassessment Protocol for use in Streams and Wadable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, 2nd ed.</i>	Provide baseline data from site assessment and annual monitoring data for at least four years. Extended monitoring (every two years) for up to 10 years is encouraged.
Soil+Veg P4.2: Control and manage invasive plants	<ul style="list-style-type: none"> • Third-party review of biannual monitoring (spring and fall, at a minimum) data of invasives to determine effectiveness of control and management plan on the selected invasive species • Provide vegetation-monitoring data indicating species occurrences and percent cover. • Monitoring methodology should include repeatable, accepted scientific standard monitoring procedures. 	Provide baseline data from site assessment and biannual monitoring data for at least three years.
Soil+Veg C4.7: Conserve and restore native plant communities	<ul style="list-style-type: none"> • Third-party review of biannual monitoring (spring and fall, at a minimum) of native plant communities to determine success of conservation and/or restoration activities • Monitoring methodology should include repeatable, accepted scientific standard monitoring procedures and measures for dominance and frequency. Example accepted forms of data collection include time-meander sampling, transect sampling, hoop/quadrant sampling, stem counts, etc. 	Provide baseline data from site assessment and biannual monitoring data for at least three years.
HHWB C6.2: Provide optimum site accessibility, safety, and wayfinding	Review of site accessibility, safety, and wayfinding using research methods that include, but are not limited to, questionnaire surveys, interviews, and walk-throughs of the site during peak periods.	A minimum of six months up to one year after substantial project completion and site occupation AND monitoring program (frequency and total number of samples) should be adequate to report results with statistical confidence or other accepted forms of validation.
HHWB C6.4: Support mental restoration	Review of which site features users prefer for mental restoration and why. Assess whether or not the spaces are successful at providing rejuvenating and restful experiences, and the extent to which the spaces are used for this purpose. Evaluate other ways the spaces are used	A minimum of six months up to one year after substantial project completion and site occupation AND monitoring program (frequency and total number of samples) should be adequate to report results with statistical confidence or other accepted forms of validation.



Section 9: Education + Performance Monitoring

Prerequisite / Credit	Monitoring Requirements	Time Frame
HHWB C6.5: Support physical activity	Review of how the site features are used (e.g., frequency, user characteristics, types of activities other than as the intended physical activity feature). Address the reasons why people use or do not use the site and features intended for physical activity.	A minimum of six months up to one year after substantial project completion and site occupation AND monitoring program (frequency and total number of samples) should be adequate to report results with statistical confidence or other accepted forms of validation.
HHWB C6.6: Support social connection	Review of the extent to which social interaction occurs across the site. Document the different kinds of interaction (e.g., one on one, spontaneous, and informal interaction among independent users, small groups, and large gatherings) occurring in different places. Assess why people use or do not use the site and features intended for social interaction.	A minimum of six months up to one year after substantial project completion and site occupation AND monitoring program (frequency and total number of samples) should be adequate to report results with statistical confidence or other accepted forms of validation.
Construction P7.3: Restore soils disturbed by construction OR Construction C7.4: Restore soils disturbed by previous development	Review of annual soil tests for the five categories included in the soil restoration criteria: organic matter, compaction, infiltration rates, soil biological function, and soil chemistry. Document techniques used to restore soil and any changes in soil characteristics over time.	Provide annual data for at least five years.
Education C9.1: Promote sustainability awareness and education	Review of the level of education and sustainability awareness that was experienced from visiting the site including how an individual might change his/her behavior and put knowledge into action for off-site purposes. Monitoring must: <ul style="list-style-type: none"> • Take place at least once per season • Be conducted at both peak and non-peak times • Surveys must include at least 30 respondents over the entire monitoring period 	A minimum of six months up to one year after substantial project completion and site occupation AND monitoring program (frequency and total number of samples) should be adequate to report results with statistical confidence or other accepted forms of validation.

**Note:* If a project seeks to monitor SITES prerequisites or credits not listed in Table 9.3-A, a proposal must be made to SITES outlining any planned monitoring requirements and a timeframe.

C9.3



Section 9: Education + Performance Monitoring

RECOMMENDED STRATEGIES

- Communicate early in the design process that monitoring is a goal of the project.
- Set aside additional funding to ensure that monitoring will be conducted.
- Research peer-reviewed journals and professional magazines to understand requirements for submission and associated time frames.

RESOURCES

- For information on related tools, research, and case studies that evaluate landscape performance, see Landscape Architecture Foundation's "Landscape Performance Series" at www.lafoundation.org/research/landscape-performance-series.
- For information on stormwater monitoring, see the following guides:
 - International Stormwater Best Management Practices (BMP) Database, a database of over 300 BMP studies, performance analysis results, tools for use in BMP performance studies, monitoring guidance and other study-related publications, www.bmpdatabase.org
 - U.S. EPA "Urban Stormwater BMP Performance Monitoring: A Guidance Manual for Meeting the National Stormwater BMP Database Requirements" (EPA-821-B-02-001, April 2002), water.epa.gov/scitech/wastetech/guide/stormwater/upload/2006_10_31_guide_stormwater_montcomplete.pdf
- For information on post-occupancy evaluations, consult the following publications:
 - *Learning from Our Buildings: A State-of-the-Practice Summary of Post-Occupancy Evaluation* (Washington, DC: National Academy Press, 2001).
 - J Gray, CG Watson, J Daish, and D Kernohan, "Putting POE to Work: A Case Study of POE in a Participatory Programming Process," *Proceedings of the Sixteenth Annual Conference of the Environmental Design Research Association*, 16 (1985): pp 275-286.
 - W Preiser, HZ Rabinowitz, and ET White, *Post-Occupancy Evaluation* (New York: Van Nostrand Reinhold, 1988).
- For information on research methods, see C Robson, *Real World Research: A Resource for Social Scientists and Practitioner-Researchers*, 2nd ed. (Malden, MA: Blackwell, 2007).
- For information on behavioral observation and behavior mapping techniques, see *How to Turn a Place Around: A Handbook for Creating Successful Public Spaces* (New York: Project for Public Spaces, Inc., 2000).
- For information on survey research and sampling, see ER Babbie, *The Basics of Social Research*, 4th ed. (Belmont, CA: Wadsworth, 2008).
- For information on case study research, see these publications:
 - M Francis, "A Case Study Method for Landscape Architecture," *Landscape Journal*, 20, no.1 (2001): pp. 15-29.
 - RK Yin, *Case Study Research: Design and Methods*. 4th ed. (Thousand Oaks, CA: Sage, 2009).
- For information on general text on behavior and environment research techniques, read J Zeisel, *Inquiry by Design: Environment/Behaviors/Neuroscience in Architecture, Interiors, Landscape, and Planning* (New York: W.W. Norton, 2006).
- For information on measuring physical activity, consult the System for Observing Play and Leisure Activity in Youth (SO PLAY) at www.activelivingresearch.org/node/10642.

C9.3





SECTION 10

INNOVATION OR EXEMPLARY PERFORMANCE

PREREQUISITE / CREDIT	TITLE	POINTS
Innovation C10.1	Innovation or exemplary performance (bonus points)	3-9 points

Credit 10.1: Innovation or exemplary performance

3–9 bonus points

INTENT

Encourage and reward innovation and exemplary performance in site design, construction, and maintenance by providing examples and performance criteria outside the current SITES v2 Rating System.

REQUIREMENTS

This credit allows for up to three innovations or exemplary performance achievements (9 points total) for projects that successfully complete the following steps:

Option 1: Exemplary performance

3 points

- Achieve significant, measurable exemplary performance above requirements outlined in the SITES v2 Rating System. An exemplary performance point is typically earned for achieving double the credit requirements or achieving the next incremental percentage threshold of an existing credit in SITES.

Option 2: Innovation outside the SITES v2 Rating System

3 points

- Apply and document innovative site practices and performance benefits in areas not specifically addressed by the SITES v2 Rating System.
 - Develop a new credit based on the proposed innovations including the following components:
 - > Intent
 - > Requirement for compliance
 - > Submittal documentation to demonstrate compliance
 - > An approach or strategy that might be used to meet the requirements
 - > Relevant resources and associated benefits

SUBMITTAL DOCUMENTATION

Option 1: Exemplary performance

- SITES v2 Rating System credits the project used as the basis for demonstrating exemplary performance
- Site plans, construction drawings, exhibits, and photographs that will serve to illustrate the project's approach to the credit
- Narrative and/or calculations describing how the project performed above requirements outlined in the current SITES v2 Rating System credits

C10.1



Section 10: Innovation or Exemplary Performance

Option 2: Innovation outside the SITES v2 Rating System

- A developed credit that outlines the proposed innovation with the following components:
 - Narrative statement of the credit intent
 - Narrative statement describing the credit requirements
 - Outline of submittal documentation needed to demonstrate compliance
 - Strategies that might be used to meet the requirements
 - Description of the innovation's quantifiable environmental, social, and economic benefits
 - Relevant resources to substantiate the purpose and claims of the innovation
 - Narrative with quantifiable data describing the project's approach to achievement of the credit
- Site plans, construction drawings, exhibits, and photographs that will serve to illustrate the project's approach to the credit

RECOMMENDED STRATEGIES

- Substantially exceed a SITES performance credit that addresses water, soils, vegetation, materials selection, or human health and well-being.
- Apply strategies or measures that demonstrate a comprehensive approach and quantifiable environmental or human health benefits.
- Consider how the performance of a particular set of strategies can greatly exceed the intent of two or more credits in combination.

C10.1



Glossary

100-year floodplain includes all areas below the 100-year flood elevation of waterways of all sizes, including depressional areas, wetlands, areas behind levees, ephemeral and intermittent streams, rivers, lakes and shorelines, and coastal areas. These areas are generally depicted on the current FEMA Flood Insurance Rate Map as Zones A, AE, A1-A30, AH, AO, AR, A99, V, and VE, however, in some areas they may need to be calculated by the site development team.

P1.2, P2.2, P2.3

Action threshold is a point at which pest populations or environmental conditions indicate that pest control action must be taken. A single pest, or even a small population of a pest species, does not necessarily require any action for removal. The threshold level is reached when a pest becomes a threat to plant, soil or human health or causes severe economic damage.

C8.4

Agricultural conservation easement (ACE) is a voluntary, legally recorded deed restricting development on farmland. Land subjected to an ACE is generally restricted to farming and open space use. While other benefits may accrue because the land is not developed (scenic and habitat values, for example), the easement must stipulate that the primary use of the land is agricultural. Such an easement prohibits practices that would damage or interfere with the agricultural use of the land. Because the easement is a restriction on the deed of the property, the easement remains in effect even when the land changes ownership (is designated in perpetuity).

P1.1

An **appropriate plant species** is vegetation adapted to site conditions, climate, and design intent. The following attributes should be considered in determining whether plants are appropriate for the site: cold hardiness, heat tolerance, salt tolerance, soil moisture range, plant water use requirements, soil volume requirements, soil pH requirements, sun and shade requirements, pest susceptibility, and maintenance requirements. Native and non-native plants are

appropriate if they meet the above criteria.

P2.2, P4.3, C4.4, C4.6, C6.7, P7.3, P8.1, C8.4

An **assembly** is an arrangement of more than one material or component to serve specific overall purposes.

C5.3

An **athletic field** includes land that is dedicated to organized team sports (e.g., football, soccer) that involves high intensity use and is defined by distinct dimensions. Fields that are used for occasional recreational sports are not included. (LEED v4.)

P3.2, P7.3, C7.4

Baseline is the amount of water required by a site if watered at 100 percent of local reference evapotranspiration (ET).

P3.2, C3.4

A **basic service** includes, but is not limited to: a bank, child-care facility (licensed), community or civic center, convenience store, farmers' market, food store with produce, hair care establishment, hardware store, health club or recreation facility, laundromat or /dry cleaner, library, medical or dental office, museum, park, stand-alone pharmacy, place of worship, police or fire station, post office, restaurant, school, senior-care facility, social services center, supermarket, and theater.

C1.6, P2.2

A **bicycle lane** is a striped lane designated for one-way travel by a bicycle on a street or highway. The standard bicycle lane width measured from the face of curb to the painted boundary should be at least four feet (1.22 meters) wide. If on-street parking is allowed, the minimum lane width is five feet (1.52 meters).

C1.7, P2.2

A **bicycle network** is a continuous path consisting of any of the following: physically designated in-street bicycle lanes at least five feet (1.52 meters) wide, off-street bicycle paths or trails at least eight feet (2.44 meters) wide for a two-way path and at least 5 feet (1.52 meters) wide for a one-way path,

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or streets designed for a target speed of 25 miles (40.23 kilometers) per hour or slower.

C1.7, P2.2

A **bicycle rack** is a device consistent with industry standards that is capable of supporting a bicycle in a stable position, is made of durable materials, is no less than 36 inches (91.44 centimeters) tall from base to top of rack, and no less than 1.5 feet (0.30 meters) in length. It permits the securing of the bicycle frame and one wheel with a U-shaped lock, and is of a character and color that adds aesthetically to the immediate environment.

P2.2, C6.9

A **bicycle-share program** is a network of bicycles distributed around a city for public use at a low cost. Users can pick up bicycles at any designated self-serve station and return them to any other such station. This functionality makes bicycle-shares ideal for Point-A-to-Point-B transportation. (Adapted from the New York City Government, www.nyc.gov.)

C6.9

Biomass density index (BDI) is the density of plant layers covering the ground. It is calculated by summing the existing or proposed biomass value as a proportion of total site area (not including water or invasive species) for all on-site structural vegetation types.

C4.8

A **bioswale** is a linear stormwater runoff conveyance system that is used as an alternative to storm sewers to partially treat water quality, attenuate flooding potential, and convey stormwater away from critical infrastructure.

P3.1, C3.5

A **brownfield** is an abandoned, idled, or underused industrial and commercial facility or site where expansion or redevelopment is complicated by real or perceived environmental contamination; a site documented as contaminated by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local voluntary cleanup program, or a site defined as a brownfield by a local, state, or federal government agency.

P1.2, P1.4, C1.5, P2.2, P2.3, C6.7

Carpool is an arrangement in which two or more people share a vehicle for transportation.

C6.9

A **car-share program** allows an individual who is a registered member of a car share organization to use vehicles on an as-needed basis, typically by the hour. A member has access to a variety of vehicles that are maintained by the car share organization and stored at dispersed locations. (New York City government, www.nyc.gov.)

C6.9

A **chemical hazard assessment** refers to the process of identifying product constituents; collecting, developing, and evaluating data on human health and environmental endpoints such as carcinogenicity, reproductive toxicity, neurotoxicity, aquatic toxicity, and persistence; and identifying potential hazards. This process allows for comparisons of alternatives to determine relative “greenness” and safety. The process also identifies areas for improvement. Chemical hazard assessments, focused on inherent risks of chemicals, do not take into account exposure scenarios as a more in-depth and lengthy risk assessment would.

C5.8

Chemical inventory refers to the listing of all chemicals associated with the manufacturing of a material and should include, to the extent known or reasonably ascertainable, all chemicals intentionally added by the manufacturer, any intermediate chemicals that may be wholly or partially consumed during the manufacturing process, and any process chemicals that may end up in manufacturing effluent or be otherwise released.

C5.8

A **community garden** is a single piece of land cultivated collectively by members of a neighborhood or likeminded group.

6.7

A **community renewable energy system** is a system that relies on a renewable energy source such as solar or wind power and that is interconnected and shared by neighbors or larger communities. For SITES purposes, they can include private systems shared by two or more properties and unconnected to a commercial grid, stand-alone systems that are connected to a commercial electricity provider’s grid, or private systems connected to the grid through a participating subscriber of a commercial provider (connected to a commercial subscriber’s meter). (Adapted from LEED v4.)

C8.6

Glossary

A **component** is any distinct, identifiable part of an assembly or landscape construction.

C5.3

Control of invasives is the appropriate eradication, suppression, reduction, or management of invasive species populations, prevention of the spread of invasive species from areas where they are present, and taking of steps such as restoration of native or appropriate species and habitats to reduce the effects of invasive species and to prevent further invasion.

P4.2, P8.1

A **conveyance feature** is a network of gutters and pipes designed to move water from a surface to a storage container.

C3.5

A **created water feature** is a human-made object or feature that uses water for aesthetic purposes. Features include constructed wetlands (ornamental or water cleansing), ponds, streams, pools, fountains, and water gardens. Created water features can include those intended for limited human contact or for full human contact. Note that water intended for human contact must meet local and state health requirements.

P2.2, C3.4

A **cultural landscape** is a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person, or exhibiting other cultural or aesthetic values. The quality of significance in history, architecture, archeology, engineering, landscape architecture, and culture is present in cultural landscapes that possess integrity of location, design, setting, materials, workmanship, feeling, association and:

- That are associated with events that have made a significant contribution to the broad patterns of history; or
- That are associated with the lives of significant persons in the past; or
- That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master craftsman or designer, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- That has yielded, or may be likely to yield, information important in history or prehistory.

(U.S. National Park Service, www.nps.gov/nr/publications/bulletins/nrb15/nrb15_2.htm.)

P2.2, C4.5, C6.1

A **deepwater habitat** is permanently flooded land lying below the deepwater boundary of wetlands.

P1.3

Design for disassembly is the design of buildings or products to facilitate future change and the eventual dismantlement (in part or whole) for recovery of systems, components, and materials. This design process includes developing the assemblies, components, materials, construction techniques, and information and management systems to accomplish this goal.

C5.3

Diameter at breast height (DBH) is a standard method for determining the trunk diameter of a standing tree. In the United States, DBH is typically measured in inches at 4.5 feet (1.37 meters) off the ground on the uphill side. Wounds, branches, multiple stems, and defects may change how diameter is measured. For guidance, see the International Society for Arboriculture website, www.isa-arbor.com/publications/tree-ord/measuringdbh.aspx.

P2.2, P2.3, C4.5

Disassembly is a process of carefully taking apart constructed elements with the intention of either reusing or recycling the materials. It may be undertaken during redevelopment, adaptation, or at the end of use on a site.

C5.3

Discharge rate limit is met if one of the following is accomplished:

- The discharge of the design storm occurring over a period of not less than 36-48 hours
- The discharge flow duration curve matches the greenfield flow duration curve for channel forming discharges
- For infill and redevelopment projects, the project's discharge flow duration curve must match the pre-project flow duration curve for channel forming discharges (as opposed to matching the greenfield flow duration curve).

C3.3

Disturbed soils are all areas of soils disturbed by human development activities, such as those that have been affected by grading, excavation,

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or compaction. Indicators of disturbed soils may include one or more of the following:

- Soil horizons that differ significantly in either depth, texture, or physical or chemical properties from the reference soil
- Bulk densities that exceed the maximum allowable bulk densities shown in *Construction P7.3: Restore soils during construction* Figure 7.3-A
- Organic matter content lower than that of the reference soil
- Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) different from that of the reference soil
- Presence of compounds toxic to the intended plants
- Presence of weedy, opportunistic, or invasive plant species

P2.2, P4.1, C4.4, P7.3, C7.4

An **environmental product declaration (EPD)** is a manufacturer declaration providing quantified environmental data [based on an ISO 14040 LCA] using pre-defined parameters, and, where relevant, additional environmental information. (ISO 14025, 2006a.)

C5.9

Equitable is a publicly acknowledged commitment that the site and its use elements are available to and accessible by as many people as possible (including users, residents, and visitors); that barriers to access are identified and removed; and that this commitment to social inclusion is not limited by cultural, physical, or socio-economic considerations.

C6.3

Equivalent desired function measures the task that an appliance is meant to perform without taking energy consumption into account. For example, lighting elements should be compared using an equivalent desired function that is measured in lumens, not watts. A lumen measures the total amount of visible light emitted by a source, while a watt is a unit of power used to measure the rate of energy conversion used by that source.

C8.5

An **establishment period** begins at the time that vegetation is planted and is considered to be a maximum of three years for trees, two years for shrubs, and one year for herbaceous cover.

Establishment period must be appropriate for plant species and site's climate and soil.

P3.2, C3.4

A **farmers' market** is a public market place where the people that have grown or gathered the produce within 150 miles (241.40 kilometers) of the distribution site sell fresh produce. The market runs annually at least once a week for at least five months.

C6.7

Farmland of local importance refers to soils important to the local economy due to their productivity and which may include tracts of land that have been designated for agriculture by local ordinance. Each state Natural Resources Conservation Service or local ordinance designates which soils qualify.

P1.1, P2.2, P2.3, P4.1, P7.3, C7.4

Farmland of statewide importance refers to soils that do not meet all of the prime farmland criteria but that are still able to economically produce high yields of crops when treated and managed according to acceptable farming methods. Each state Natural Resources Conservation Service designates which soils qualify.

P1.1, P2.2, P2.3, P4.1, P7.3, C7.4

Fertilizer is any organic or inorganic material of natural or synthetic origin that is added to a soil to supply one or more plant nutrients essential to the growth of plants.

C8.4

A **floodplain** is flat or nearly flat land adjacent to a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and that experiences flooding during periods of high discharge. Floodplains are subject to geomorphic (land-shaping) and hydrologic (water flow) processes.

P1.2, C3.6

Food waste is any food substance, raw or cooked, that is either discarded or intended to be discarded. This does not include vegetation trimmings from food-bearing plants before the consumer receives them.

C8.3

Free public site access includes free parking, free admission to events, and being regularly open to the public.

C6.3

Glossary

Geographic extent refers to the measure of spatial extent bounded by a polygon with X and Y coordinates. It is described as the range, magnitude, or distance over which an aquatic ecosystem extends (i.e., the full area measurement from north to south and east to west).

P1.3, C3.6

Graywater is domestic wash water from kitchen, bathroom, and laundry sinks, tubs, and washers, conventionally thought of as wastewater.

P3.2, C3.4, P8.1

A **greenfield** is a site that has not been previously developed or graded, including previous agricultural fields.

P2.3

Habitat is the area or natural environment in which an organism or population normally lives. A habitat is made up of physical factors such as soil, moisture, range of temperature, and availability of light as well as biotic factors such as the availability of food and the presence of predators.

P1.4, P2.3

A **habitat assessment** is the visual, spatial, and temporal analysis of environmental data to determine types, distribution, and amount of habitat on a given site. This information includes an inventory of the geology, soils, water resources, and plant communities, which is used to identify the potential habitat for species of concern on site.

P1.4

Healthy soils have not been significantly disturbed by previous human development activities. Healthy soils may include one or more of the following indicators:

- Soil horizons that are similar to the reference soil
- Bulk densities that do not exceed the maximum allowable bulk densities shown in *P7.3: Restore soils disturbed during construction*
- Organic matter content similar to that of the reference soil
- Soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) similar to that of the reference soil
- Absence of compounds toxic to the intended plants
- Presence of vegetation that is representative of native plant communities

P1.1, P2.2, P2.3, P4.1, C4.4, P7.3, C7.4

Heat islands are thermal gradient differences between developed and undeveloped areas. (LEED v4.)

C4.9

A **hydrozone** is a grouping of plants with similar water and environmental requirements for irrigation with one or more common station or zone valves.

P3.2

An **infill site** is a property that meets any of the following four conditions:*

- At least 75 percent of its boundary borders land parcels that individually are at least 50 percent previously developed, and that in aggregate are at least 75 percent previously developed.
 - The site and bordering parcels form an aggregate parcel whose perimeter is 75 percent bordered by parcels that each are at least 50 percent previously developed, and that all together are at least 75 percent previously developed.
 - At least 75 percent of the land area, exclusive of rights-of-way, within a 0.5 mile (0.8 kilometer) distance from the SITES project boundary is previously developed.
 - The lands within a 0.5 mile (0.8 kilometer) distance from the project boundary have a pre-project connectivity of at least 140 intersections per square mile (or 54 intersections per square kilometer).
- * A street or other right-of-way does not constitute previously developed land; it is the status of the property on the other side of the right-of-way or the street that matters. For the first two conditions above, any fraction of the perimeter that borders waterfront is excluded from the calculation.

(Adapted from LEED v4.)

P1.1, C1.6

An **integrated design team** includes the owner, client, and professionals knowledgeable in design, construction, and maintenance. Team members should be selected to meet the unique constraints and opportunities of the site.

P2.1, P2.2, P7.1, P8.1, C9.2

Integrated pest management (IPM) is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. IPM is site-specific in nature, with individual

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tactics determined by the particular crop/pest/environment scenario. The IPM approach places an emphasis on the reduction of pesticide use and the implementation of preventative and alternative control measures.

P3.1, P4.2, C5.10, C8.4

An **interactive element** can be a website, electronic kiosk, on-site demonstration, or tour.
C9.1

An **interpretive element** can be a map, model, brochure, sign, or video.
C9.1

An **invasive species** is a plant or animal that is not native to the ecosystem under consideration and that causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health.

P2.2, C3.6, P4.2, P4.3, C5.10, C7.6, P8.1

An **isolated wetland** is a wetland with no surface water connections to other aquatic resources.
P1.3

Land-clearing materials are plant materials, mineral and rock waste, and soils generated during all phases of construction and demolition.
C7.5, C7.6

Landscape coefficient (K_L) is a constant used to modify the reference evapotranspiration. It takes into account the species factor, density factor, and microclimate factor. To reduce the complexity of the calculations for the purposes of the irrigation calculator, the density factor and microclimate factor are both assumed to equal approximately one. In general, a high landscape coefficient value is used for plants that need considerable amounts of water, and a low value is used for plants that need little water.

P3.2, C3.4

Landscape Water Allowance (LWA) is the volume of water allocated to the entire landscape area over a specified period of time.

P3.2, C3.4

Landscape Water Requirement (LWR) is the amount of water required by the landscape over a specified period of time.

P3.2, C3.4

Life-cycle assessment (LCA) is a “cradle-to-grave” approach for assessing industrial systems. “Cradle-to-grave” begins with the gathering of raw materials from the earth to create the product and ends at the point when all materials are returned to the earth. Specifically, it is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service, by:

- Compiling an inventory of relevant energy and material inputs and environmental releases
- Evaluating the potential environmental impacts associated with identified inputs and releases
- Interpreting the results to help you make a more informed decision

C5.9

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

C6.8

Living wage is the hourly rate that an individual must earn to support his or her family, if he/she is the sole provider and is working full-time (2080 hours per year). The state minimum wage is the same for all individuals, regardless of how many dependents they may have. The poverty rate is typically quoted as gross annual income (Living Wage Calculator, MIT).

C6.11

A **local community group** can be a school, youth organization, workforce commission, church group, NGO, or informal learning circle.

C9.1

A **local food source** produces food on site and/or distributes food grown within 150 miles (241.40 kilometers) of the site and may include, but is not limited to, farmers’ markets, community supported agriculture (CSA) initiatives, community gardens, and home gardens that provide fresh produce to any number of people.

C6.7

Long-term bicycle parking is the provision of bicycle storage (e.g., basic racks, bicycle corrals, hanging racks, lockers) that is indoor or sheltered, with semi-passive security (achieved by locks or surveillance) that is primarily intended for bicyclists who need bicycle parking for more than two hours at a time.

C6.9

Glossary

Lowest-cost comparable item is the most inexpensive item that provides an equivalent desired function.

C8.5

Low-income is defined by the poverty guidelines established by the U.S. Department of Health and Human Services in the Federal Register, Vol. 77, No. 17, January 26, 2012, pp. 4034-4035 (www2.ed.gov/about/offices/list/ope/trio/incomelevels.html).

C6.11

Management of invasives is the implementation of control measures to prevent the spread of invasive species or lessen their impacts when they appear to be permanently established. Control and management of invasive species encompasses diverse objectives such as eradication within an area, population suppression, limiting spread, and reducing effects. Complete eradication is not generally feasible for widespread invasive species or where adequate control methods are not available.

P4.2, C8.1

Mature, stable compost is an important amendment for healthy plant growth. Stability refers to the rate of biological breakdown, measured by carbon dioxide release. Maturity refers to completeness of the aerobic composting process and suitability (lack of plant toxicity) as a plant growth media, often measured by ammonia release or by plant growth tests. For information on compost quality standards and test methods, see the Resources section of *Construction P7.3: Restore soils disturbed during construction*.

P4.1, P7.3, C7.4, C8.4

Mature tree canopy refers to the aboveground portion of a tree at its mature size, often measured as “crown projection area” in square feet or square meters. Trees without adequate soil volume for their roots will decline and die before reaching mature size. A guideline for adequate soil volume for mature tree health is 1.5 cubic feet (0.04 cubic meters) of soil volume for each square foot (0.09 square meters) of mature crown projection. If there is any doubt that adequate soil volume is available, consult an arborist, urban forester, or horticulturist for recommendations specific to the site and intended species.

P7.3, C7.4

Minimal impact site development is development (e.g., a trail, picnic area, or boardwalk) that does not significantly alter the existing vegetation and hydrology of the Vegetation and Soil Protection Zones (VSPZs).

P1.2, P1.3, P1.4, P2.3

A **native plant** is vegetation native to the EPA Level III ecoregion of the site or known to naturally occur within 200 miles (321.87 kilometers) of the site. Naturally occurring hybrids, varieties, and cultivars of species native to the ecoregion are acceptable.

P2.2, P2.3, C3.5, C4.3, C4.4, C4.6, C4.7

A **native plant community** is an assemblage of plant species whose composition and structure are typical of native plant communities mapped at the EPA Level III ecoregion or are known to naturally occur within 200 miles (321.87 kilometers) of the site. Native plant communities include but are not limited to wetlands, woodlands, grasslands, riparian buffers, and habitat for wildlife species of concern within the region. A reference from a local plant list, local reference site, or published plant community description is needed to determine the dominant plant species, relative species abundances, and other characteristic elements of the plant community/communities to be preserved or restored.

P2.2, P2.3, C3.5, C3.6, P4.3, C4.5, C4.6, C4.7

Natural surveillance is the placement of physical features, activities, people, and amenities that maximize visibility and provide and encourage informal monitoring of the site.

C6.2

A **non-potable water source** can be harvested rainwater, surplus water from building or site operations that has been appropriately cleansed and cooled, or surplus site water that is not needed to maintain existing or restored site ecology. It does not include natural surface or subsurface water resources.

P2.2, C3.4

Non-toxic maintenance involves practices that eliminate the use of chemicals that are known to cause physiological harm to any living organism.

C8.4

An **ongoing consumable** is a material that is regularly used and replaced through the course of

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business. Such materials can include but are not limited to paper, glass, plastics, cardboard, and metals.

C5.10

Open-grid pavement is pavement that is less than 50 percent impervious and contains vegetation in the open cells.

C4.9

Organic matter in soil is carbon-containing material composed of both living organisms and formerly living decomposing plant and animal matter. Soil organic matter (SOM) content can be supplemented with compost or other partially decomposed plant and animal material. SOM content is commonly measured using “loss on ignition” tests that measure the amount of the element carbon, a key constituent of all organic matter.

P2.2, P3.1, P3.2, P4.1, P7.3, C7.4

Outdoor site electricity is all electricity consumed outside of the building on the site.

C8.6

Peak watering month is the period with the greatest deficit between evapotranspiration and rainfall. This is the month when the plants in the site’s region potentially require the most supplemental water.

P3.2, C3.4

A **performance benefit** refers to the measurable economic, environmental, and social benefits derived from SITES efforts.

C9.2

A **pest** is an insect, plant, animal, pathogen, or any other undesirable living organism that threatens the health, structure, or safety of other living organisms.

C8.4

A **pesticide** is a chemical used to control or eradicate insects, plants, animals, pathogens, and any other undesirable living organisms.

P2.2, C8.4

Phenology is the relationship between climate and physiological events, such as bud break, bloom, and leafing-out in plants.

C8.4

Physical activity includes moderate-intensity activities in a usual week (e.g., brisk walking, bicycling, gardening, or anything else that causes small increases in breathing or heart rate) for greater than or equal to 30 minutes per day, five or more days per week; vigorous-intensity activities in a usual week (e.g., running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate) for greater than or equal to 20 minutes per day, three or more days per week; or both.

C6.5

Plant health care (PHC) is a process of scheduled preventative maintenance based on monitoring and use of cultural and chemical tactics to enhance plant vitality. The plant and its requirements become the central focus of activities, rather than responding to symptoms caused by pest presence, physical agents, or nutritional deficiencies. A plant health care practice addresses the basic causes of the reduction in plant health and provides corrective measures to promote plant health.

P4.2, P8.1, C8.4

Post-consumer material is waste material generated by households or by commercial, industrial, or institutional facilities in their role as end-users of a product that can no longer be used for its intended purpose.

C5.5

Potable water is water that meets the standards for drinking purposes of the state or local authority having jurisdiction, or water that meets the standards prescribed by the U.S. Environmental Protection Agency’s National Primary Water Regulations (40 CFR 141).

P3.2, C3.4, C5.9, C5.10

Pre-consumer material is material diverted from the waste stream during the manufacturing process that is used in a separate and different manufacturing process (e.g., reuse of flue gas desulfurization gypsum in drywall production). Excluded are materials such as rework, regrind, or scrap generated during processing that are capable of being reclaimed within the same process that generated them.

C5.5

Glossary

Preferred parking includes the parking spots that are closest to the main entrance of the project (exclusive of spaces designated for handicapped) or parking passes provided at a discounted price.
C6.9

A **previously developed site** consists of at least 75 percent of the site area that has been altered by preexisting paving, construction, or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural areas are considered undeveloped land.
P1.1, P1.2, P1.3, P1.4, C1.5, C1.6, P2.2, P2.3, C6.7

Prime farmland refers to a designation of specific soils by the state or U.S. Natural Resources Conservation Service. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. The land could be cropland, pastureland, rangeland, forestland, or other land, but cannot be urban built-up land or water. Prime farmland has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.
P1.1, P2.2, P2.3, P4.1, P7.3, C7.4

Principles and performance goals are, respectively, the guiding overarching concepts and the observable and measurable end results of having one or more objectives achieved within a relatively fixed time frame.
P2.1, P7.1

A **program plan** is a narrative or written design that provides a mechanism for clearly stating the vision and desired outcomes of the project and setting the direction of the design team.
P2.1, C2.4

A **raingarden** is a depression formed on a natural slope and planted with deep-rooted native plants and grasses designed to hold and absorb rainwater from nearby impervious services such as roofs, drives, walkways, parking lots, or compacted lawn areas.
P3.1, C3.5

Receiving waters include groundwater, creeks, streams, rivers, lakes, or other water bodies that receive treated or untreated wastewater or stormwater. They also include water from combined sewer systems (CSOs) and storm drains.
P3.1, C3.3, C3.4, P7.2

Reclaimed water is effluent derived from sewage from a wastewater-treatment system that has been adequately and reliably treated. As a result of that treatment, it is no longer considered wastewater and is suitable for a beneficial use or a controlled use that would not otherwise occur.
C3.4

Recycled content is the proportion, by mass, of pre-consumer or post-consumer recycled material in a product (ISO 14021). Salvaged materials do not qualify.
C5.4, C5.5, C5.6, C5.7

A **regularly occupied building** is a building where occupants (e.g. workers, students, residents) are inside for extended periods of time.
C4.10, C5.2, C6.4, C6.6, C6.10

A **reference soil** falls into at least one of the following categories:

- Soils native to a site as described in Natural Resources Conservation Service Soil Surveys (refer to soils within the region if the site soils are not mapped or labeled as Urban Land Complex, Urban Fill, etc.)
- For sites that have no undisturbed native soils, use undisturbed native soils within the site's region that have native vegetation, topography, and soil textures similar to the site.
- For sites that have no existing soil, use undisturbed native soils within the site's region that support appropriate native plants or appropriate plant species similar to those intended for the new site.
P2.2, P4.1, P7.3, C7.4

A **renewable energy source** includes nonpolluting renewable energy generation methods, such as solar, wind, geothermal,

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small-scale or micro hydroelectric, and biomass. Purchased renewables must meet the Center for Resource Solutions (CRS) Green-e products certification requirements. Other sources of green power are eligible if they satisfy the Green-e program's technical requirements.

P2.2, C5.9, C5.10, C8.6

Replacement value can be determined by pricing a comparable material in the local market.

C5.3, C5.4, C5.5, C5.6

Reuse is a process of utilizing a used product or material in a manner that generally retains its original form and identity with minor refurbishments. Materials reusable in whole form might include sand-set pavers, segmental retaining walls, or mechanical fasteners, connections, or joinery (e.g., avoidance of adhesives and mortar).

C5.3, C5.4, C5.7, C5.8, C5.9, C7.5

A **riparian buffer** is the portion of the adjacent terrestrial ecosystem that directly affects or is affected by the aquatic environment (including streams, rivers, lakes, tidewaters, and bays and their adjacent side channels, floodplain, and wetlands). In specific cases, the riparian buffer may also include a portion of the hillslope that directly serves as streamside habitats for wildlife. A riparian buffer provides shade, intercepts runoff, and helps prevent erosion.

P2.2, C3.6

A **salvaged or reused material** is recovered from an existing building or site and employed on site without change to its condition. Structures, materials, plants, and rocks preserved in situ and new materials with recycled content do not qualify.

P2.2, C5.4, C5.5, C5.6, C5.7, C5.8, C5.9, C7.5, C7.6

Schematic design is the phase during which the concept and basic framework for the design of the project are completed.

C2.4

Scope 1 emissions are direct greenhouse gas emissions from sources owned or controlled by the entity (Green-e program, Center for Resource Solutions).

C8.6

Scope 2 emissions are indirect, and associated with the generation of electricity, heating/

cooling, or steam purchased for the entity's own consumption (Green-e program, Center for Resource Solutions).

C8.6

Severely disturbed soils are soils in which topsoil is removed or is not present; subsoils compacted such that compaction levels exceed the maximum allowable bulk densities shown in *Construction P7.3: Restore soils disturbed during construction* Figure 7.3-A; or topsoil or subsoil that has been chemically contaminated or is covered with impervious material. Examples of soils that are severely disturbed include areas that are covered with buildings or paved surfaces and areas that are defined as brownfields by local, state, or federal agencies.

P2.2, P4.1, C7.4

A **shared lane marking (SLM)** is a marking on a street (typically with a speed limit below 35 miles, or 56.33 kilometers, per hour) that indicates bicyclists are allowed to travel in a roadway too narrow for separate motor vehicle and bicycle lanes. These markings encourage safe passing of bicyclists by motorists, reduce the chance of a bicyclist hitting the open door of a parked vehicle in a shared lane with on-street parallel parking, alert road users of the lateral location bicyclists may occupy, and reduce the incidence of wrong-way bicycling.

C1.7, P2.2

Short-term bicycle parking is the provision of secure, well-designed bicycle racks or a bicycle corral that is conveniently located on the site or at the building entry and is highly visible. It is intended for bicyclists who need parking for fewer than two hours.

C6.9

A **SITES Punchlist** is a set of line items to be carried out by a contractor in order to achieve SITES prerequisites and credits.

P7.1

A **site user** is an individual who is expected to occupy, work at, or pass through the site. Users may visit the site regularly or periodically. Site users will range in age, ethnicity, and socio-economic status, but all users' needs should be considered.

C1.7, P2.1, C2.4, C6.2, C6.4, C6.5, C6.6, C6.7, C6.9

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Special status vegetation is designated as important by local, state, or federal entities. Designations may be for size, species, age, rare or special status collections, ecological and environmental value, unique genetic resources, aesthetics, location, or other unique characteristics (e.g. heritage or legacy trees). Groves and clusters may also be given special status.

P2.2, P2.3, C4.5

A **specific pollutant of concern** is a pollutant listed in the U.S. Clean Water Act Cause of Impairment for 303(d) Listed Waters. See *iaspub.epa.gov/waters10/attains_nation_cy.control?p_report_type=T-causes_303d*.

P3.1, C3.3

A **soil restoration treatment zone** is any area of the site that is not protected in a Vegetation and Soil Protection Zone (VSPZ); not covered at project's end by buildings or pavement; and is re-vegetated as part of the project. Soil restoration treatment zones must be shown on the soil management plan (*Soil+Veg P4.1: Create and communicate a soil management plan*) and must be restored as required by *Construction P7.3: Restore soils disturbed during construction*.

P4.1, P7.3, C7.4

A **solar garden** is a cluster of solar arrays set up as a community renewable energy system. (www.solargardens.org.)

C8.6

Solar reflectance (SR) is the fraction of solar energy that is reflected by a surface on a scale of 0 to 1. Black paint has a solar reflectance of 0; white paint (titanium dioxide) has a solar reflectance of 1. The standard technique for its determination uses spectrophotometric measurements, with an integrating sphere to determine the reflectance at each wavelength. The average reflectance is then determined by an averaging process, using a standard solar spectrum, as documented by ASTM Standards E903 and E892. (LEED v4.)

C4.9

Solar reflectance index (SRI) is a measure of a material's ability to reject solar heat, as shown by a small temperature rise. Standard black (reflectance 0.05, emittance 0.90) is 0 and standard white (reflectance 0.80, emittance 0.90) is 100. For example, a standard black surface has

a temperature rise of 90°F (50°C) in full sun, and a standard white surface has a temperature rise of 14.6°F (8.1°C). Once the maximum temperature rise of a given material has been computed, the SRI can be calculated by interpolating between the values for white and black. Materials with the highest SRI values are the coolest choices for paving. Because of the way SRI is defined, particularly hot materials can take slightly negative values, and particularly cool materials can exceed 100. (LEED v4.)

C4.9

A **stakeholder** is an individual or group who has a vested interest in the project and may be a neighbor, public official from a local jurisdiction, community leader, local community group, or business organization.

P2.1, C2.4, C6.7

A **stormwater feature** uses precipitation as its sole source and function as an element to manage stormwater. Examples include pools, fountains, stormwater BMPs, water gardens, channels for local conveyance, raingardens, and water art.

P3.1, C3.3, C3.5

A **targeted chemical control** is the limited use of chemical substances, carefully and deliberately administered to specific species or otherwise small areas or populations, for the control of unwanted insects, plants, or other harmful biota.

C8.4

Terrestrial biome is the largest unit of vegetation type within the biosphere, with similar plant architecture and character, community structure, and climate (e.g., tropical rain forest or coral reef).

P2.2, C4.8, C9.2

Tobacco smoke is produced by the burning of any type of lighted pipe, cigar, cigarette, or other smoking equipment, whether filled with tobacco or any other type of material.

C6.10

Unique farmland refers to land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of a specific crop when treated and managed according to acceptable farming

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methods. The state or U.S. Natural Resources Conservation Service designates which soils qualify.

P1.1, P2.2, P2.3, P4.1, P7.3, C7.4

Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. (Center for Universal Design, www.ncsu.edu/ncsu/design/cud)
C6.2

User group is a distinct group of individuals who are expected to occupy, work at, or pass through the site, and may range in age, ethnicity and socio-economic status.
C6.5

Vegetated area describes all portions of the site that will support vegetation.
P3.2, C4.4, C4.6, C4.7, C6.7, P7.3, C7.4

Vegetation and Soil Protection Zones (VSPZs) are areas identified during the pre-design phase that will be protected from all disturbances throughout the construction process to prevent damage to vegetation, soil structure, and function. *Pre-design P2.3 Designate and communicate Vegetation and Soil Protection Zones (VSPZs)* describes the requirements for VSPZs.
P1.1, P1.2, P1.3, P1.4, P2.3, P4.1, P4.2, C4.4, C4.5, C4.6, C4.7, P7.2, P8.1

Vegetation trimmings include only non-invasive plant material free of disease and herbicide residues.
C5.10, C6.7, C8.3

A vehicle that has reduced emissions and/or high fuel-efficiency is a vehicle classified as a zero emission vehicles (ZEV) by the California Air Resources Board or has achieved a minimum green score of 40 on the American Council for an Energy Efficient Economy (ACEEE) annual vehicle-rating guide.
C6.9

A walkability audit is a tool designed to broadly assess pedestrian facilities, destinations, and surroundings along and near a walking route and identify specific improvements that would make the route more attractive, safe, and convenient to pedestrians. (U.S. Centers for Disease Control and

Prevention, www.cdc.gov/nccdphp/dnpao/hwi/toolkits/walkability.)
C6.5

Walking distance is the distance that a pedestrian must travel between origins and destinations without obstruction, in a safe and comfortable environment such as on a continuous network of sidewalks, all-weather surface footpaths, crosswalks, pedestrian transit malls, or equivalent pedestrian facilities in dedicated right-of-ways (ROWs). A ROW may be privately owned as long as it is deeded in perpetuity for general public use.
C1.6, C1.7, P2.2

A waste stream study is a systematic review of a site and its operations to quantify the types and amounts of waste generated, estimate waste that will be generated, and study management practices that impact that waste generation. It includes an assessment of purchasing practices and identifies the areas and materials in which waste reduction efforts will be most effective. A waste stream study also sets a baseline for measuring future progress of waste reduction efforts.
P8.2, C8.3

A water budget is used to calculate the amount of water a landscape needs, taking into account the inputs and outputs of water to and from the root zone. Inputs, such as precipitation, are subtracted from outputs, such as evapotranspiration, to calculate the water needs of the landscape. Many factors are taken into consideration when calculating a water budget, such as plant type and irrigation system efficiencies. (U.S. EPA WaterSense WaterBudget Approach)
P3.2, C3.4

Water meter is an instrument or device for measuring and registering the quantity of water flowing through a pipe.
P3.2, C3.4

Wetlands are areas that are inundated or saturated by surface or ground water (e.g., swamps, marshes, bogs) at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated conditions (Clean Water Act, U.S. Code of Federal Regulations 40 CFR 230.3).
P1.3, P2.2, P2.3, C3.6

Acknowledgments

EXECUTIVE COMMITTEE

Susan Rieff
Executive Director
Lady Bird Johnson Wildflower Center
The University of Texas at Austin

Holly Shimizu
Executive Director
United States Botanic Garden

Nancy C. Somerville, Hon. ASLA
Executive Vice President / CEO
American Society of Landscape Architects

Fritz Steiner, Ph.D., FASLA
Dean, School of Architecture
Center for Sustainable Development
The University of Texas at Austin

TECHNICAL CORE COMMITTEE

José Almiñana, FASLA, LEED AP
Principal
Andropogon Associates, Ltd.

Nina Bassuk, Ph.D.
Professor and Program Leader
Urban Horticulture Institute, Cornell University

Steve Benz, P.E., LEED Fellow, Hon. ASLA
Partner/ Director of Green Infrastructure
Services
Olin

Jacob Blue, RLA, ASLA
Landscape Architect/ Ecosystem Services
Project Manager
SAA Design Group

Meg Calkins, ASLA, LEED AP
Associate Professor of Landscape Architecture
Ball State University

Jenny Carney, LEED Fellow, LEED AP O+M
Principal
YR&G

Michael Clar, P.E., DWRE, CFM
Principal Engineer, President
Ecosite, Inc

Sandy Dymale, ASLA, LEED AP BD+C
Associate Principal
Mithun

Nora Goldstein
Executive Editor
BioCycle Magazine

Robert Goo
Environmental Protection Specialist
Office of Wetlands, Oceans and Watersheds,
Office of Water, U.S. Environmental Protection
Agency

Liz Guthrie, ASLA
Manager, Professional Practice Programs
American Society of Landscape Architects

Frances (Ming) Kuo, Ph.D.
Associate Professor and Director
Landscape and Human Health Laboratory
Department of Natural Resources
and Environmental Sciences Department of
Psychology
University of Illinois, Urbana-Champaign

David McDonald
Resource Conservation Planner
Seattle Public Utilities

Ray Mims
Conservation & Sustainability
United States Botanic Garden

Danielle Pieranunzi, LEED AP BD+C
Director, Sustainable Sites Initiative
Lady Bird Johnson Wildflower Center
The University of Texas at Austin

Mark Simmons, Ph.D.
Director, Research and Consulting
Ecosystem Design Group
Lady Bird Johnson Wildflower Center
The University of Texas at Austin

Jerry Smith, FASLA, EDAC, LEED AP
Principal
SMITH | GreenHealth Consulting, LLC

John C. Swallow, Ph.D., LSP
President and Director of Environmental
Sciences
Pine & Swallow Environmental

Steve Windhager, Ph.D.
Executive Director
Santa Barbara Botanic Garden

David J. Yocca, RLA, FASLA, AICP, LEED AP
Principal Landscape Architect/Planner
Conservation Design Forum

Acknowledgments

HUMAN HEALTH + WELL-BEING TECHNICAL SUBCOMMITTEE

Len Hopper, RLA, FASLA LEED AP, BSCP, ISA

Director of Production and Construction Services
Mark K. Morrison Landscape Architecture, PC

Frances (Ming) Kuo, Ph.D.

Associate Professor and Director
Landscape and Human Health Laboratory
Department of Natural Resources and Environmental Sciences Department of Psychology
University of Illinois, Urbana-Champaign

Karen R. Nikolai, M.P.H., M.C.P.

Health Community Planning Manager
Housing, Community Works and Transit Development
Hennepin County (MN)

Robert Ryan, Ph.D.

Professor of Landscape Architecture
University of Massachusetts, Amherst

Jerry Smith, FASLA, EDAC, LEED AP Principal

SMITH | GreenHealth Consulting, LLC

Rodney Swink, FASLA, PLA

Office of Rodney Swink

Kathleen L. Wolf, Ph.D.

Research Social Scientist
College of the Environment
University of Washington

MATERIALS TECHNICAL SUBCOMMITTEE

Meg Calkins, ASLA, LEED AP

Associate Professor of Landscape Architecture
Ball State University

Stephen Cook, ASLA, LEED AP+

Senior Landscape Architect
VIKA Maryland, LLC

Nora Goldstein

Executive Editor
BioCycle Magazine

Bradley Guy

Assistant Professor
School of Architecture and Planning
The Catholic University of America

Alison Kinn Bennett

Senior Advisor
Office of Pollution Prevention and Toxics
U.S. Environmental Protection Agency

SOILS TECHNICAL SUBCOMMITTEE

Fred Cowett, Ph.D.

Department of Horticulture
Cornell University

Susan D. Day, Ph.D.

Assistant Professor of Urban Forestry
Department of Forestry & Environmental Conservation
Department of Horticulture
Virginia Tech

David McDonald

Resource Conservation Planner
Seattle Public Utilities

John C. Swallow, Ph.D., LSP

President and Director of Environmental Sciences
Pine & Swallow Environmental

James Urban, FASLA

Consultant, Lecturer
Owner, Urban Trees + Soil

VEGETATION TECHNICAL SUBCOMMITTEE

Nina Bassuk, Ph.D.

Professor and Program Leader
Urban Horticulture Institute, Cornell University

Jacob Blue, RLA, ASLA

Landscape Architect/ Ecosystem Services
Project Manager
SAA Design Group

Nick Kuhn

Community Forestry Coordinator
Missouri Department of Conservation

Chris Martin, Ph.D.

Professor
Science and Mathematics Faculty
School of Letter and Sciences
Arizona State University

Melanie Sifton

Vice President, Horticulture & Facilities
Brooklyn Botanic Garden

Mark Simmons, Ph.D.

Director, Research and Consulting
Ecosystem Design Group
Lady Bird Johnson Wildflower Center
The University of Texas at Austin

John Peter Thompson

Bioeconomic Policy Analyst
Horticulture & Invasive Species Consultant
National Agricultural Research Alliance

Valerie Vartanian

Natural Resource Specialist
United States Navy (Ventura County)

Acknowledgments

WATER TECHNICAL SUBCOMMITTEE

Michael Barrett, Ph.D., P.E., D.WRE

Research Professor
Center for Research in Water Resources
The University of Texas at Austin

Steve Benz, P.E., LEED Fellow, Hon. ASLA

Partner/ Director of Green Infrastructure
Services
Olin

Keith Bowers, RLA, PWS

Landscape Architect/ Restoration Ecologist
President and Founder
Biohabitats, Inc.

Michael Clar, P.E., DWRE, CFM

Principal Engineer, President
Ecosite, Inc.

Robert Goo

Environmental Protection Specialist
Office of Wetlands, Oceans and Watersheds
Office of Water, U.S. Environmental Protection
Agency

Tom Liptan, RLA, FASLA

Landscape Architect/ Environmental Specialist

Edward MacMullan

Senior Economist
ECONorthwest

Michael Ogden, P.E., LEED AP

Principal Engineer
Biohabitats, Inc.

Eric Strecker, P.E., BCEE

Principal Engineer
Geosyntec Consultants

Megan Turnock, M.S., MLA

Associate
Lees & Associates Landscape Architects

Steve Windhager, Ph.D.

Executive Director
Santa Barbara Botanic Garden

**David J. Yocca, RLA, FASLA, AICP,
LEED AP**

Principal Landscape Architect/Planner
Conservation Design Forum

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STAFF

LADY BIRD JOHNSON WILDFLOWER CENTER
AT THE UNIVERSITY OF TEXAS AT AUSTIN

Danielle Pieranunzi, LEED AP BD+C

Director, Sustainable Sites Initiative

Lisa Storer, LEED AP BD+C

Senior Program Coordinator, Sustainable Sites
Initiative

Lana Denkeler, MLA, Associate ASLA

Program Coordinator, Sustainable Sites
Initiative

Jonathan Garner, MLA, ASLA

Program Coordinator, Sustainable Sites
Initiative

Michelle Bright, MLA, Associate ASLA

Research Assistant, Sustainable Sites Initiative

Regina Ramos

Research Assistant, Sustainable Sites Initiative

AMERICAN SOCIETY OF LANDSCAPE
ARCHITECTS

Liz Guthrie, ASLA

Manager, Professional Practice Programs
ASLA Staff Liaison, Sustainable Sites Initiative

UNITED STATES BOTANIC GARDEN

Ray Mims

Conservation & Sustainability
USBG Staff Liaison, Sustainable Sites Initiative

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Site Plans of Project Examples (Sumac Nature Center and Live Oak Place) developed by
Susan Grantham

Proofreading/Copyediting services by **Kim McCormick**

The Sustainable Sites Initiative™ (SITES™) is a program dedicated to fostering resiliency and transforming land development and management practices towards regenerative design. The SITES v2 Rating System is a voluntary set of guidelines and performance benchmarks for assessing sustainable site design, construction, and maintenance. The central message of the SITES program is that any project—whether the site of a university campus, large subdivision, shopping mall, park, commercial center, or even a home—holds the potential to protect, improve, and regenerate the natural benefits and services provided by healthy ecosystems. The SITES program is a collaborative effort led by the United States Botanic Garden, the Lady Bird Johnson Wildflower Center at The University of Texas at Austin, and the American Society of Landscape Architects.



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