Prefabricated for performance: incorporating LEED and SITES into modular housing and landscape design

by

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A REPORT

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Abstract

The design and construction industries play a critical role in shaping the built environment, yet they also significantly contribute to global emissions, resource depletion, and material consumption. Sustainable design innovation offers an opportunity to rethink these processes by introducing practical solutions that prioritize environmental responsibility. Techniques such as prefabrication and modular design have emerged as transformative approaches, enabling designers to create efficient, replicable systems that reduce waste and energy use.

Frameworks like LEED and SITES provide valuable metrics for evaluating sustainability, offering point-based systems to quantify environmental impact and guide its integration across projects. This research centers on the Intuitive Home Prefabricated Package, a modular design strategy that combines prefabricated housing components with modular site and landscape systems. Originally developed as part of Kansas State University's Gateway Decathlon (GWD) project, the Intuitive Home has evolved into a replicable framework supporting both architectural and landscape architectural sustainability.

The package explores modularity at multiple scales—ranging from indoor systems and structural housing components to site features such as a modular deck system, in-ground water cistern, and integrated green wall. These site elements were designed for adaptability, ease of installation, and performance tracking, aligning with both environmental and construction efficiency goals. By organizing its systems around LEED v4.1 Residential Single Family and SITES v2 certification criteria, and developing a custom checklist for evaluation, the project demonstrates how prefabricated strategies can be optimized for sustainability across disciplines.

The Salina Implementation of the Intuitive Home further applies these strategies—alongside additional best practices—in a real-world context, achieving LEED Platinum and SITES Platinum scores. These outcomes demonstrate the capacity of prefabricated systems to meet rigorous sustainability benchmarks even prior to on-site construction. Through this study, the integration of prefabrication and modularity with established sustainability frameworks reveals the potential for a broader shift within the design and construction industries—supporting future projects that prioritize long-term performance, environmental responsibility, and cross-disciplinary collaboration.

Cale Mueller
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Prefabricated for Performance:

Incorporating LEED and SITES into Modular Housing and Landscape Design

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And finally, to my family: thank you for your unwavering support in everything I have pursued. You constantly remind me of the joy and wonder in life, and I am so grateful for that.

ABSTRACT:

The design and construction industries play a critical role in shaping the built environment, yet they also significantly contribute to global emissions, resource depletion, and material consumption. Sustainable design innovation offers an opportunity to rethink these processes by introducing practical solutions that prioritize environmental responsibility. Techniques such as prefabrication and modular design have emerged as transformative approaches, enabling designers to create efficient, replicable systems that reduce waste and energy use. Frameworks like LEED and SITES provide valuable metrics for evaluating sustainability, offering point-based systems to quantify environmental impact and guide its integration across projects. This research centers on the Intuitive Home Prefabricated Package, a modular design strategy that combines prefabricated housing components with modular site and landscape systems. Originally developed as part of Kansas State University's Gateway Decathlon (GWD) project, the Intuitive Home has evolved into a replicable framework supporting both architectural and landscape architectural sustainability.

The package explores modularity at multiple scales—ranging from indoor systems and structural housing components to site features such as a modular deck system, in-ground water cistern, and integrated green wall. These site elements were designed for adaptability, ease of installation, and performance tracking, aligning with both environmental and construction efficiency goals. By organizing its systems around LEED v4.1 Residential Single Family and SITES v2 certification criteria, and developing a custom checklist for evaluation, the project demonstrates how prefabricated strategies can be optimized for sustainability across disciplines.

The Salina Implementation of the Intuitive Home further applies these strategies—alongside additional best practices—in a real-world context, achieving LEED Platinum and SITES Platinum scores. These outcomes demonstrate the capacity of prefabricated systems to meet rigorous sustainability benchmarks even prior to on-site construction. Through this study, the integration of prefabrication and modularity with established sustainability frameworks reveals the potential for a broader shift within the design and construction industries—supporting future projects that prioritize long-term performance, environmental responsibility, and cross-disciplinary collaboration.

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01 INTRODUCTION

INTRODUCTION

The design and construction industries play a critical role in shaping the built environment but are also major contributors to global emissions, resource depletion, and material consumption. In response to these environmental challenges, sustainable design innovations are increasingly necessary, emphasizing efficiency, environmental responsibility, and long-term resilience. Among these innovations, prefabrication and modular construction have emerged as effective strategies, enabling streamlined production, reduced waste, and lower energy use through the development of efficient, replicable systems.

To ensure these methods meet rigorous environmental standards, frameworks such as Leadership in Energy and Environmental Design (LEED) and the Sustainable SITES Initiative (SITES) provide comprehensive metrics for evaluating project performance. These systems assess key sustainability factors including energy efficiency, water use, material sourcing, and site development practices.

This research investigates the sustainable design strategies embedded in Kansas State University's Gateway Decathlon (GWD) project, The Intuitive Home Package—an affordable, modular housing prototype that integrates prefabricated construction with LEED v4.1 and SITES v2 certification criteria. By combining factory-built components with adaptable on-site systems, the project demonstrates how modular design can support environmental goals while remaining cost-effective and replicable.

RESEARCH QUESTION

How can the integration of LEED and SITES certification optimize the design and sustainability of modular housing and landscape design?

The project follows a holistic design process that embeds LEED and SITES requirements from the outset, using plug-and-place sustainable features to streamline implementation. This approach not only accelerates the certification process but also enhances the potential for higher sustainability scores and contributes to more environmentally responsive site and building designs.

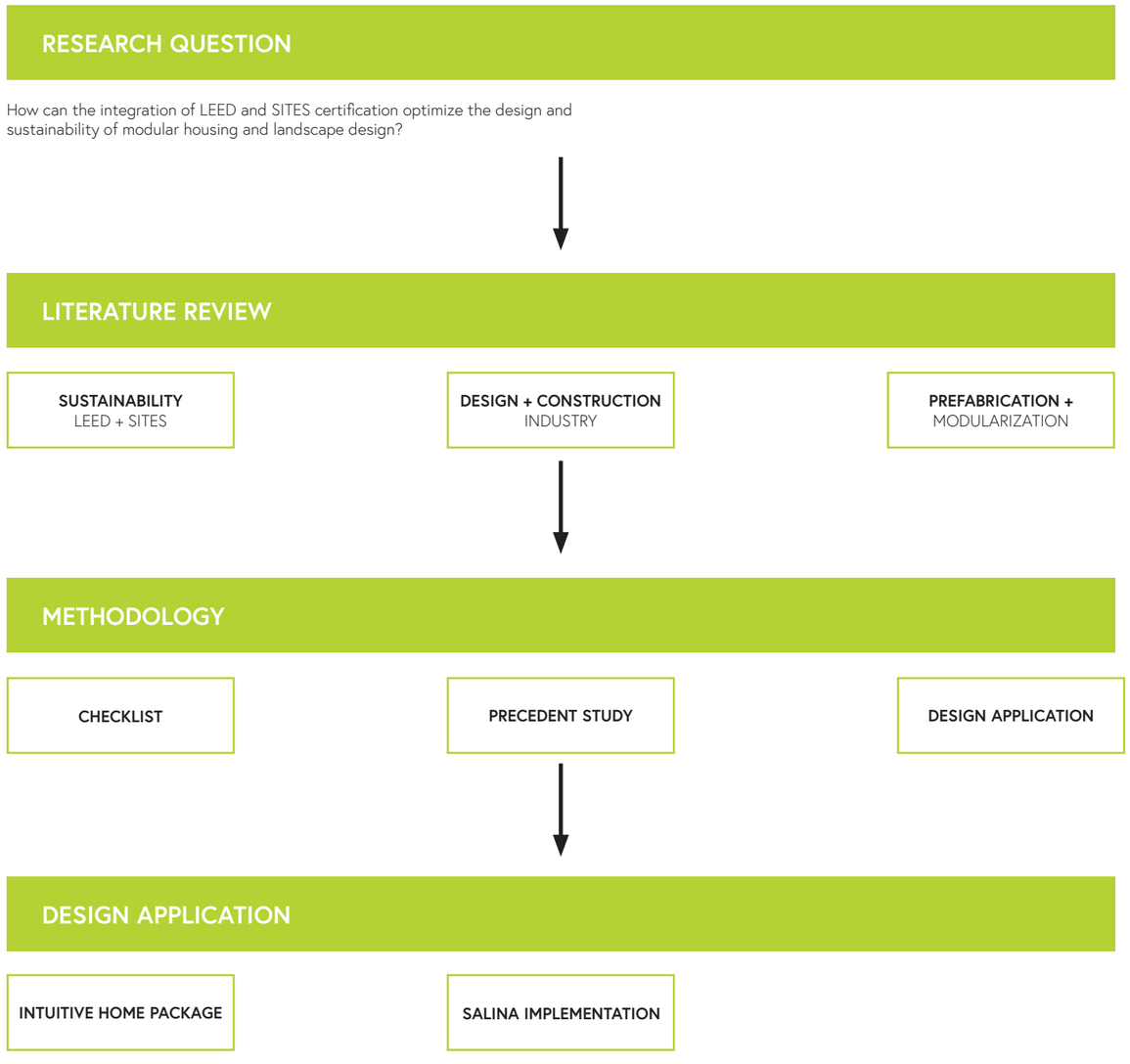


FIGURE 1.1 STUDY DIAGRAM

KEY CONTRIBUTORS

Gateway Decathlon Project

The Gateway Decathlon is a design-build competition based in St. Louis, Missouri, that challenges interdisciplinary teams to develop sustainable, off-site housing solutions. As part of the larger Gateway South redevelopment initiative, the event supports the creation of a Design & Construction Innovation District in downtown St. Louis. Competing teams are evaluated across ten categories—Design, Engineering, Materials, Livability, Energy Performance, Market Viability, among others—each emphasizing aspects such as energy efficiency, sustainable material use, and functionality in housing design.

The Decathlon serves not only as a platform to showcase advancements in prefabricated construction and sustainable design, but also as a catalyst for public engagement with these emerging technologies. The competition provided the foundation for this research, launching the Prefabricated for Performance project and offering a framework grounded in the Gateway Decathlon criteria. While the long-term direction of the competition remains uncertain, it established a full design-build mentality that shaped the conceptual and technical foundations of this project.

Intuitive Home Team

The Intuitive Home is Kansas State University's submission to the Gateway Decathlon competition. The interdisciplinary team consisted of fourth- and fifth-year students from architecture, interior architecture, landscape architecture, and engineering. Through close collaboration across these disciplines, the team developed a comprehensive design that included both the building and its associated outdoor amenity spaces. The project was created to fully meet the Gateway Decathlon criteria, with the explicit intent of moving from design to construction.

Intuitive Home Landscape Team

The Intuitive Home Landscape Team, composed of two landscape architecture students including myself, was responsible for the design and construction documentation of the project's outdoor amenity spaces. Our work also involved close coordination with adjacent teams to ensure integration across the broader Intuitive Home design. The primary objective of the landscape team was to develop a modular and prefabricated outdoor

system that addressed two key research areas. The first, which forms the basis of this report, explores the integration of prefabrication and modular design with sustainability frameworks. The second investigates the relationship between prefabricated systems and biophilic design. These two focus areas remained central to the project throughout its development and heavily informed both the design strategy and research direction.

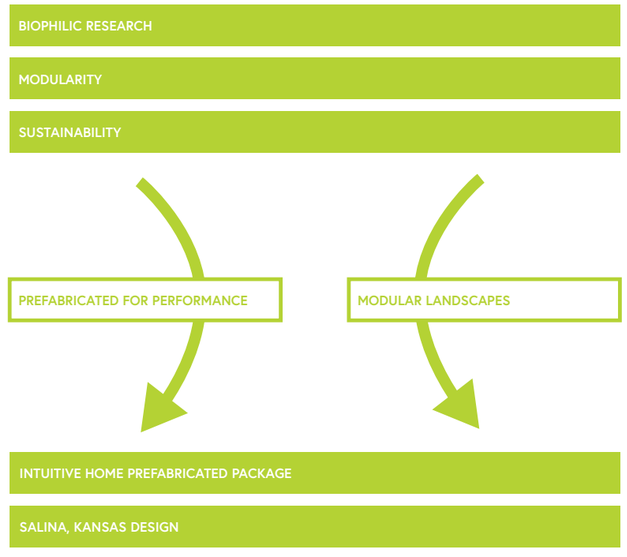


FIGURE 1.2 LANDSCAPE RESEARCH STUDY

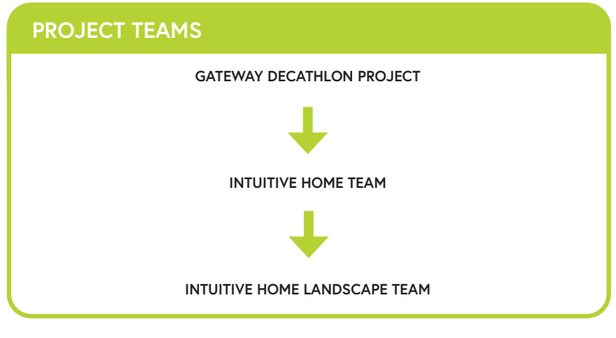


FIGURE 1.3 PROJECT TEAMS

OBJECTIVE OF STUDY

The primary objective of this research is to explore the potential of prefabrication and modular design to streamline and simplify the sustainable design process—specifically through the lens of LEED and SITES certification. Both systems involve complex, time-intensive procedures that require detailed documentation, design alignment, and coordination to meet a broad range of sustainability criteria. LEED v4.1 for Residential: Single Family includes 43 possible credits, while SITES v2 includes 66, each demanding varying levels of performance and documentation.

Certification follows several phases: registration, documentation, submission, and review. While the overall timeline varies depending on project complexity and team experience, the process typically spans several months. This extended duration can be particularly challenging for projects with tight deadlines, especially when additional time is needed to ensure that design decisions align with specific credit requirements. The misalignment of these requirement can lead to delays or even derail certification goals.

Beyond time, certification also carries notable financial costs. LEED certification includes a $225 registration fee and a $300 certification fee per home, in addition to estimated soft costs—such as consultants, energy modeling, and coordination—ranging from 1% to 6% of the total project cost. SITES certification can be bundled for a total of $9,500, with similar soft cost estimates ranging from 2% to 6%. These financial and logistical demands can make certification feel counterintuitive to the goals of accessible, sustainable design.

The Prefabricated for Performance project seeks to address these challenges by identifying opportunities to reduce both time and cost through strategic integration of prefabrication. The approach organizes LEED and SITES credits into distinct phases of design, creating a clearer understanding of when and where specific credits apply. Credits not tied to site-specific conditions are reframed as design guidelines that can be incorporated through prefabricated elements. Through the Intuitive Home Package, a modular building and landscape system was developed to target key LEED and SITES credits. This plug-and-place strategy enhances replicability and simplifies compliance by embedding sustainable features directly into modular components from the outset.

FIGURE 1.4 FACTORY PERCENTAGE

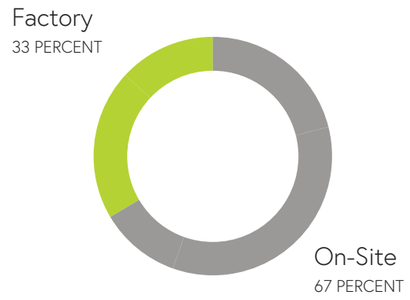


FIGURE 1.5 PREFABRICATION STEPS

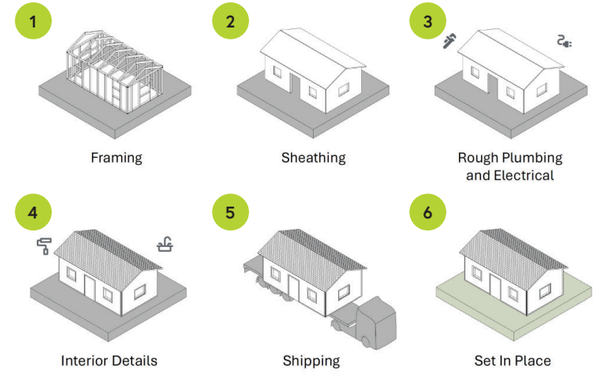


FIGURE 1.6 LEED AND SITES PROCESS

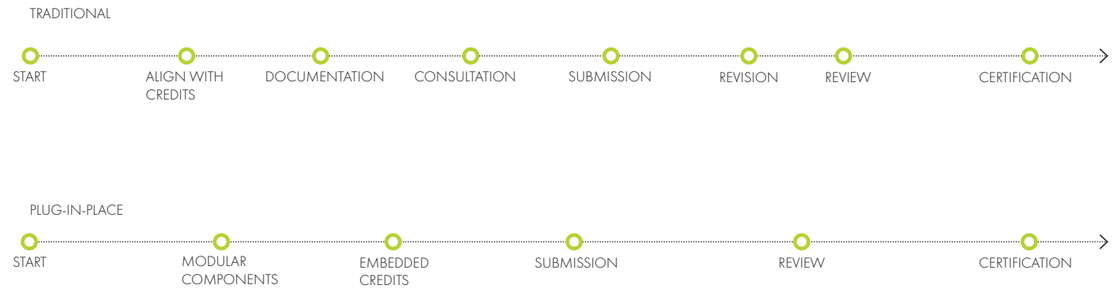
LEED AND SITES

LEED v4.1 Residential Single Family

Sustainable Site
Water Efficiency
Energy and Atmosphere
Materials and Resources
Indoor Environmental Quality
Location and Transportation
Innovation
Regional Priority

SITES v2

Site Selection
Pre-Design Assessment and Planning
Water Management
Soil and Vegetation Management
Materials Selection
Human Health and Well-Being
Operation and Maintenance
Sustainable Construction
Climate Resilience
Education and Performance



02 BACKGROUND

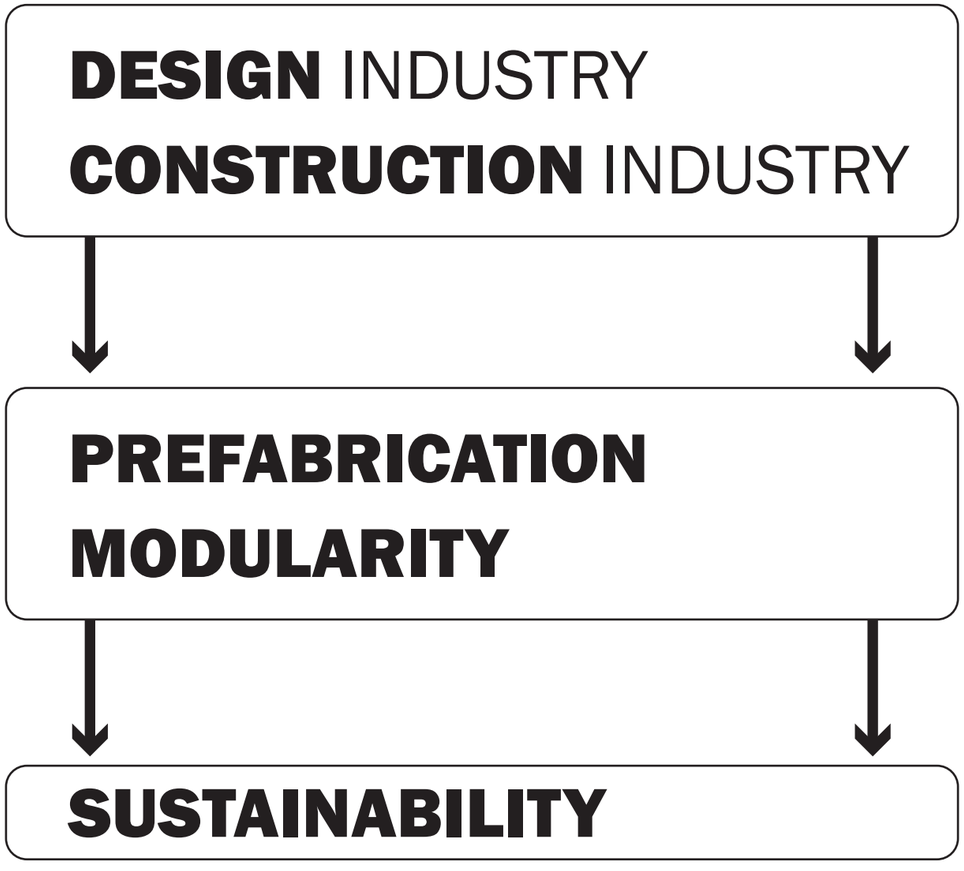
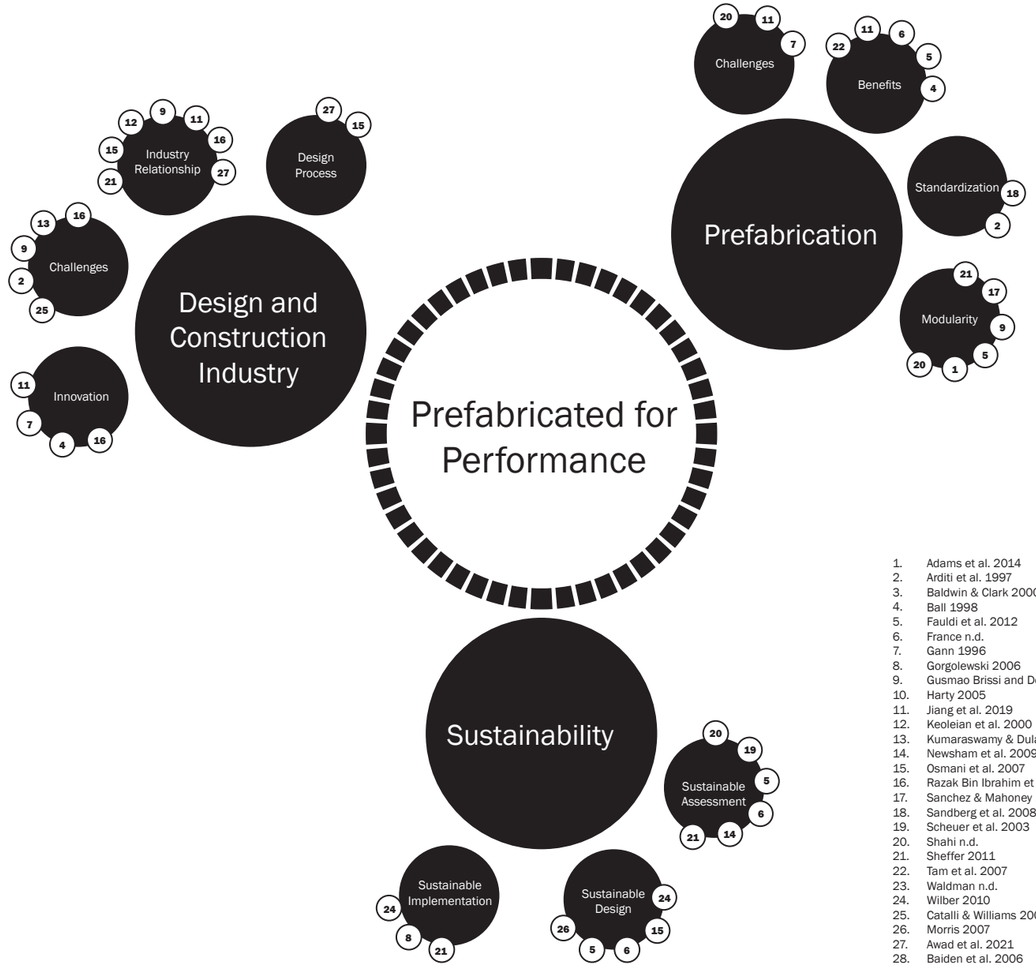


FIGURE 2.1 LITERATURE ORGANIZATION



1. Adams et al. 2014
2. Arditi et al. 1997
3. Baldwin & Clark 2000
4. Ball 1998
5. Fauldi et al. 2012
6. France n.d.
7. Gann 1996
8. Gorgolewski 2006
9. Gusmao Brissi and Debs 2019
10. Harty 2005
11. Jiang et al. 2019
12. Keoleian et al. 2000
13. Kumaraswamy & Dulaimi 2001
14. Newsham et al. 2009
15. Osmani et al. 2007
16. Razak Bin Ibrahim et al. 2010
17. Sanchez & Mahoney 1996
18. Sandberg et al. 2008
19. Scheuer et al. 2003
20. Shahi n.d.
21. Sheffer 2011
22. Tam et al. 2007
23. Waldman n.d.
24. Wilber 2010
25. Catalli & Williams 2001
26. Morris 2007
27. Awad et al. 2021
28. Baiden et al. 2006

FIGURE 2.2 LITERATURE MAP

DESIGN + CONSTRUCTION INDUSTRY

Design Process

The design process in the construction industry typically involves a step-by-step refinement of specifications, where initial needs and wishes are transformed into requirements and eventually into a detailed design (Awad et al. 2021). According to Awad et al. (2021), there are two primary stages of the design process: the conceptual design stage, where initial ideas and broad requirements are established, and the preliminary design stage, where these ideas are refined to form a more concrete and detailed plan (Awad et al. 2021). This comprises what is known as the initial conceptual phase of the design, and the more concrete realistic section of the design process.

Osmani et al. (2008) propose that the design process operates along three major axes: (1) design issues and construction techniques, (2) building materials specification, and (3) education. These axes encompass a range of considerations that designers must address to create sustainable and efficient designs. For instance, the choices made regarding building materials can significantly impact both the sustainability and cost-effectiveness of a project. Additionally, education plays a vital role in informing designers and other stakeholders about innovative technologies, materials, and methods that can be integrated into the design process (Osmani et al. 2008).

Design - Construction Relationship

Today, the design and construction industry are a major economic force. In the United States alone, it accounts for over $1.7 trillion in business value, representing more than 8% of the country's gross domestic product—second only to healthcare. The industry employs over 7.3 million people across approximately 730,000 establishments, with an annual payroll of $331 billion (Razak Bin Ibrahim et al. 2010; Sheffer 2011). A construction project's life cycle includes phases such as design, material production, construction, operation, maintenance, and demolition, with the construction phase being particularly critical due to its substantial environmental impact and the involvement of numerous stakeholders (Keoleian et al. 2000; Jiang et al. 2019). While the importance of the construction industry has certainly been widely acknowledged, it is crucial to understand the inner workings of the industry.

The construction industry has evolved from relying on expert builders proficient in all aspects of building and design—acting as architects, engineers, and superintendents—to a fragmented structure driven by technological advancements and specialized training. Today, architects and engineers typically oversee the design process, while contractors oversee construction (Sheffer n.d.). Although there is communication between design and construction, this division has created a complex industry with numerous specialized professions and trades that must collaborate within this intricate system to complete projects successfully (Sheffer 2011; Baiden et al. 2006).

Effective communication and coordination between design and construction teams are crucial for project success. However, this can be challenging, especially given the fragmented nature of the industry. Factors such as last-minute client requirements, increased design complexity, insufficient design information, limited experience in evaluating construction methods and sequencing, unforeseen ground conditions, and extended project durations often lead to variations during construction (Osmani et al. 2008). These variations can result in delays, cost overruns, reduced project quality, and a decline in overall efficiency (Awad et al. 2021). To address these challenges and improve integration between design and construction, the Design–Build approach has seen a resurgence in recent years. Design–Build is a project delivery method where the owner enters a single contract with an entity responsible for both design and construction (Sheffer n.d.). This integrated approach streamlines communication by placing responsibility for design and construction under one contract, thereby reducing the likelihood of misunderstandings and encouraging collaboration among stakeholders. As a result, the Design–Build method aims to create a more cohesive environment, diminishing the potential for variations and disputes during the project life-cycle (Baiden et al. 2006).

Implementing the Design–Build approach can lead to significant improvements in efficiency, cost-effectiveness, and overall project outcomes. By consolidating the responsibilities of design and construction, this model enhances the relationship between architects, engineers, contractors, and owners. As organizations continue to recognize the benefits of an integrated project delivery model, the construction industry moves toward a more collaborative environment, paving the way for innovation and enhanced performance. This

evolution towards integrated practices, combined with an understanding of the industry's historical context, economic impact, and labor dynamics, is crucial for identifying areas that require further innovation and improvement to achieve better sustainability, efficiency, and project outcomes (Morris 2007; Razak Bin Ibrahim et al. 2010).

Negative Aspects of Construction

The construction industry has historically suffered from a poor public image compared to other industrial sectors. It is often perceived as dirty, dangerous, dull, and environmentally insensitive regarding its relationship with the natural environment (Razak Bin Ibrahim et al. 2010). Projects are also seen as unpredictable in terms of timelines, profitability, and quality standards.

Despite investing significant resources to improve the overall quality of the built environment, the construction industry continues to have a substantial environmental impact due to the waste it produces. It is reported to generate approximately 40% of human-caused waste (Osmani et al. 2008; Razak Bin Ibrahim et al. 2010). This waste generation highlights a disconnect between the industry's goals for quality and its environmental responsibilities.

Another critical concern is the inflated costs associated with inefficiencies, mistakes, delays, and poor communication, accounting for 30% of total construction costs (Razak Bin Ibrahim et al. 2010). These inefficiencies underscore the need for better project management practices and improved collaboration among stakeholders.

Challenges Hindering Innovation and Productivity

Despite its importance, the architecture, engineering, and construction (AEC) industry has experienced a slowdown in growth and innovation with no signs of significant improvement (Gusmao Brissi & Debs 2019; Jiang et al. 2019). Early in its history, the industry witnessed rapid advancements in various construction methods. The now "mature industry," filled with intensified market competition and incremental innovations in products and processes in comparison to other sectors such as manufacturing or the automotive industry has significantly fallen behind (Porter 1980; Arditi et al. 1997; Gusmao Brissi & Debs 2019).

This fall-behind is particularly evident in the housing market, where numerous constraints limit what builders can achieve regarding design, quality, cost, and innovation. According to Ball (1998), these constraints are primarily related to:

1. Production Methods: The continued use of traditional and simple construction methods and building types.
2. Pricing Strategies: Identifying and operating at the most profitable pricing levels.
3. Land and Planning: Adopting appropriate land banking and planning permission strategies.

Furthermore, consumers in the industry are notoriously conservative when it comes to adopting new construction methods or innovative designs. This is primarily because of the concern about the future value of their properties, they often select conventional design choices for this reason. This reluctance hampers the industry's ability to embrace change and implement advancements, leading to conformity in design within the housing market (Ball 1998). This trend is aggravated by a perceived lack of consumer demand for innovative and sustainable concepts in the construction industry. While there is a niche market focusing on environmental awareness and sustainable performance, a substantial rise is needed to make a greater impact within the industry (Catalli & Williams, 2001).

Innovations from Other Industries

Implementing new methods for performing and managing construction processes presents unprecedented challenges for industry professionals. As competition intensifies, organizations are seeking ways to enhance productivity, quality, and efficiency (Razak Bin Ibrahim et al. 2010). One industry the construction sector has begun to look for inspiration is the automotive industry, particularly the work of Henry Ford. Ford is renowned for establishing the mass production line, enabling the production of high volumes of standardized products. This system was successful due to its subdivision of labor, allowing unskilled or semi-skilled workers to operate machinery at a faster rate (Gann 1996).

Unlike the automotive industry, however, construction is regarded as a fixed process where the product—the building or site—remains stationary, and resources move in and out to complete it. In contrast, industries like automotive or manufacturing have products moving

along assembly lines to stationary resources and workstations, with workers adding pieces as the product progresses, not allowing for total replication within the design-construction industry (Ballard & Howell 1998; Razak Bin Ibrahim et al. 2010).

These concepts have sparked discussions about integrating processes like labor division, machinery utilization, and mass-production techniques into the design and construction industry to achieve similar efficiencies. Key developments in this area include standardization, prefabrication, and system building. Standardization is a foundational requirement for factory production that enhances consistency and efficiency in manufacturing, enabling prefabrication and comprehensive system building within a design and construction industry approach (Gann 1996).

Furthermore, some production methods provide new examples of transferring knowledge between industrial sectors. This cross-industry collaboration allows for two-way learning, enabling the adoption of innovative practices and technologies that can advance the field (Gann 1996). Embracing such opportunities may help overcome the industry's traditional mindset allowing for change, growth, and innovation. Prefabrication and modular design are prime examples of this knowledge transfer, embodying manufacturing efficiencies within construction processes.

Modular and Prefabricated Design

When conducting a prefabricated design scheme, it is essential to establish clear design rules or guidelines that structure the entire process. According to Baldwin and Clark (2000), these rules typically include defining the overall architecture of the system, identifying the roles of each module, establishing interactive rules between modules, and outlining procedures for integrating modular components. This is all followed by evaluating their performance and adherence to these rules. Integrating such design rules ensures compatibility among modules by specifying how they will be connected. Once these rules are created, they must be rigorously followed throughout all phases of design and production to maintain system integrity, functionality, and efficiency.

Evaluating manufacturability during the initial design phase is also crucial when implementing prefabricated and modular design choices (Sandberg et al. 2008). This

involves assessing how easily and efficiently a design can be produced using modular or prefabricated methods, ensuring that the final product not only meets the established design rules but can also be constructed in a cost-effective and streamlined manner. By carefully considering manufacturability, designers can ensure that components are easy to assemble, and production processes are optimized for a modular approach.

Sustainability is another key factor in modular and prefabricated design. One of the top priorities for sustainable design in prefabricated projects is reducing energy impacts during the building's use phase through energy efficiency measures (Faludi et al. 2012). By focusing on strategies that decrease operational energy consumption and incorporating renewable energy systems, designers can create prefabricated structures that are both energy-efficient and eco-friendly throughout their life-cycle. Combining design rules with considerations for manufacturability and sustainability not only aids in producing high-quality modular buildings but also ensures that these structures meet contemporary environmental standards and support resource conservation.

PREFABRICATION + MODULARIZATION

Introduction to Prefabrication and Modularization

Prefabrication is a building and manufacturing process where materials and components are assembled off-site to create larger building elements that can be transported and installed on-site (Adams et al. 2014). These prefabricated components can serve various site-specific purposes, offering flexibility in application and potentially reducing on-site construction time. Modularity is closely related to prefabrication and involves creating fully integrated modules under controlled factory conditions. While both approaches share similarities, there are key distinctions between the two, in which prefabrication typically produces individual components for on-site assembly, and modularization refers to the creation of complete modules that combine several components into a single unit (Gusmao Brissi & Debs, 2019; Adams et al., 2014).

Modularization takes the benefits of off-site construction a step further by delivering modules that are ready for on-site assembly. This approach can significantly reduce the

amount of work required on-site, as entire sections of a building or site components, such as walls, flooring, or entire buildings, are constructed in a factory setting and then transported to the site for final installation. However, factors such as transportation logistics, site coordination, and adherence to local building codes must be carefully considered to ensure successful implementation (Shahi n.d.).

Modular design can be categorized into two main organizational structures: loosely coupled and tightly coupled components. In the context of product design, these structures assess how changes in one component affect others. Loosely coupled systems use standardized interfaces that promote flexibility, allowing individual parts to function independently while still fitting seamlessly into the overall system (Sanchez & Mahoney 1996; Sheffer 2011). This principle helps in creating designs where modules can be easily replaced, upgraded, or rearranged without impacting the entire system.

Standardization is crucial in both prefabrication and modular design. By establishing consistent parameters, dimensions, and connection interfaces, standardization ensures that individual modules or components are compatible and function efficiently across distinct stages of design and construction. This consistency enables manufacturers to produce components in bulk and with higher quality control, resulting in cost savings, reduced waste, streamlined production and assembly processes (Sandberg et al. 2008). Additionally, standardized modules can be more easily transported and assembled on-site, reducing construction times, and minimizing disruptions.

Benefits of Prefabrication and Modularization

The primary aim and benefits associated with prefabrication is to reduce construction costs, accelerate project timelines, improve overall quality, and minimize waste generation (Adams et al. 2014; Gann 1996; Jiang et al. 2019). Efficiency is achieved through optimized design strategies that enhance productivity. A report by McGraw-Hill (2011) supports this, finding that projects utilizing prefabrication saw schedule reductions of up to 35%, resulting in significant cost savings. These improvements are critical for drivers for companies seeking to deliver high-quality projects on time and within budget (Adams et al. 2014).

Beyond its efficiency benefits, prefabrication also contributes significantly to sustainability. The construction industry is a major contributor to waste generation at all stages of a project (Adams et al. 2014). Prefabrication helps mitigate this issue by reducing waste compared to traditional construction methods. This waste reduction supports sustainable design practices, encouraging the use of energy- and material-efficient solutions that can lead to long-term improvements within the industry (Faludi et al. 2012).

Prefabricated buildings also show lower energy consumption, water use, and emissions during production. As environmental regulations become more stringent and concerns about climate change intensify, prefabrication presents a pathway for long-term waste reduction and environmental impact mitigation (Tam et al. 2007). The method has been widely adopted in developed regions such as the United States, European Union, United Kingdom, Japan, and Singapore, where it is employed to shorten construction timelines, reduce waste and dust pollution, and enhance overall construction quality (Jiang et al. 2019).

Challenges and Limitations

While research highlights numerous benefits of prefabrication and modularization, there are notable drawbacks that hinder widespread adoption in the design and construction industries. One significant challenge is the size and immobility of prefabricated components, which must be carefully considered during the early design stages. These components, often large and heavy, can pose logistical challenges in terms of transportation and site coordination (Shahi n.d.).

Site assembly and installation also presents challenges. Though prefabrication aims to minimize on-site construction, some degree of site work remains unavoidable. Issues such as site preparation, foundation work, and coordination with other trades can still require significant effort, limiting the full potential of prefabrication in some contexts. (Gann 1996). Cost is another barrier. High initial costs have been identified as a significant challenge, often deterring stakeholders from adopting prefabrication despite its long-term benefits. Upfront investment in factory equipment, transportation, and specialized labor can be a

considerable deterrent, particularly for smaller companies or those with limited budgets (Jiang et al. 2019).

Material usage is also a critical consideration. While modular homes require 8% more materials than conventional homes due to the need for additional structural components to withstand transportation loads, they produce significantly less waste overall. Conventional construction generates 2.5 times more waste than modular design practices, highlighting the environmental benefits of modular construction despite the higher material usage (Faludi et al. 2012).

Additionally, concerns about complexity, the risk of failure, longevity, and durability contribute to resistance in adopting these methods at a larger scale. The newness and unfamiliarity with prefabricated systems can lead to hesitation in their widespread use, especially when compared to conventional methods that have been more established over time (Gann 1996).

Furthermore, the sustainability benefits of prefabrication compared to conventional construction methods are not yet fully understood by practitioners or the public, which limits its broader integration into the industry. The perception that prefabrication is a costly or temporary solution continues to influence its acceptance, despite its potential for long-term environmental benefits (Jiang et al. 2019).

SUSTAINABILITY

LEED + SITES

Within the design and construction industry, several certifications function as sustainable guidelines to ensure that projects address environmental and sustainability concerns effectively. Two of the most prominent certifications are the Leadership in Energy and Environmental Design (LEED) and the Sustainable Sites Initiative (SITES) certifications. These frameworks provide structured criteria to guide professionals in creating environmentally responsible and resource-efficient buildings and landscapes. See Appendix III. Methods pg. 3-4 for more information about LEED and SITES.

The U.S. Green Building Council's LEED certification has become a widely recognized standard for verifying a project's environmental sustainability (France n.d.). LEED provides a comprehensive framework to guide decision-making throughout building design, construction, and operation, aiming to improve energy efficiency, reduce environmental impact, and enhance occupant well-being (Gorgolewski, 2006). To evaluate a project's sustainability, LEED focuses on several key categories: sustainable site development, water efficiency, energy efficiency, material selection, and indoor environmental quality. In addition, LEED also considers innovation in design processes. Each of these categories has a certain number of credits and prerequisites associated with them, and projects can achieve various levels of certification based on the number of credits earned (Shahi n.d.). Since its introduction in 1998, LEED has gained significant traction. Forty thousand building projects have been registered with the intent of certification, and almost 9,000 have obtained a LEED certification, illustrating its widespread adoption and influence in promoting sustainable building practices (Sheffer 2011).

Like LEED, the Sustainable Sites Initiative (SITES) certification provides guidelines, and a rating system specifically adapted to evaluate and improve the sustainability of land design and development projects. SITES was developed through collaboration among the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center at The University of Texas at Austin, and the United States Botanic Garden. This certification focuses on practices that protect and restore ecosystems, encourage sustainable land use and management, and enhance the site's overall value and function. By providing a set of performance-based benchmarks, SITES encourages project teams to understand their projects further and meet ambitious standards of sustainability and environmental stewardship.

Both LEED and SITES serve as critical tools for architects, engineers, contractors, and owners to ensure their projects align with sustainability goals and industry best practices. While LEED provides a framework for building design and construction with an emphasis on energy and resource efficiency, SITES complements this approach by focusing on the sustainability of the site and landscape. Together, these certifications help professionals

deliver projects that not only meet environmental standards but also create healthier, more resilient built environments.

Sustainable Assessment Process

Conducting a sustainable assessment is a multifaceted process that typically involves gathering detailed life cycle inventory data for various materials and processes used in a project. These inventories include information such as material quantities, transportation distances, and other relevant factors that, when input into specialized software tools, yield sustainability-related performance metrics (Faludi et al. 2012). This data collection and analysis process can be time-consuming and is often not undertaken directly by designers or contractors because of the time commitment and associated financial costs. Typically, a thorough sustainable assessment comprises four key phases: goal and scope definition, life cycle inventory analysis, impact assessment, and interpretation of results (Scheuer et al. 2003). These stages guide professionals in determining a project's overall environmental impact, addressing questions of resource use, pollution, waste generation, and more.

The integration of sustainable design elements and assessments varies widely and depends on a range of factors, including building type, project location, local climate, site conditions, and the familiarity of the project team with sustainable design principles (Morris 2007). Sustainable assessments break down into several topics or categories that address crucial environmental concerns. These categories typically include energy, water, material usage, site development, and construction processes. The specific focus and weighting of these categories can differ depending on the assessment tool or framework used. According to Faludi et al. (2012), energy performance often takes precedence in these evaluations; once energy-related goals are met, attention shifts to other critical areas such as building materials, which then become the dominant focus for reducing environmental impact.

Life Cycle Assessment (LCA) is a widely recognized framework for measuring the environmental, social, and economic impacts of a product, process, or system throughout its entire life span. By quantifying the inputs and outputs of all stages, from raw material extraction and manufacturing to distribution, use, and eventual disposal—LCAs provide a comprehensive picture of a project's environmental footprint (Faludi et al. 2012). This holistic view helps designers, builders, and stakeholders identify and implement strategies to mitigate negative environmental effects, optimize resource efficiency, and enhance overall sustainability. LCAs are instrumental in evaluating a project's long-term impact and guiding decision-making to minimize negative outcomes.

Post-Occupancy Evaluations (POEs) play another crucial role in understanding a building's sustainability performance. These evaluations occur after a building is occupied and functioning, aiming to diagnose any operational issues that arise and determine whether the project meets its projected performance goals (Newsham et al. 2009). POEs provide valuable insights into how buildings perform in real-world conditions, allowing stakeholders to compare modeled or anticipated performance with actual outcomes, which have usually seen inconsistencies between the two. However, POEs are not commonly conducted, and even when they are, their results are rarely published. This lack of widespread data hinders the industry's ability to refine simulation methods and performance models based on real-world evidence (Newsham et al. 2012).

Sustainable Design

Sustainable design in the early phases of a project offers numerous opportunities to significantly reduce environmental impact. During these initial stages, designers can identify areas with the greatest potential for improvement and target decisions that lead to reductions in those areas (Faludi et al. 2012). Implementing fundamental best practices for sustainability is crucial before introducing advanced materials and technologies to ensure a solid foundation for high-performance design. This includes establishing a baseline for sustainable achievements at a project's outset, using this baseline as a comparative goal for the project's environmental performance (France n.d.). Shahi (n.d.) introduces the concept of "smart design," which integrates core sustainable design principles such as minimizing resource usage, optimizing building sizes to actual needs, promoting natural cooling, heating, and ventilation, and designing for longevity and flexibility. Similarly, Wilber (2010) argues that both design methods and policies must evolve to fully support sustainable living and products, emphasizing the importance of adaptability and continuous improvement.

France (n.d.) outlines a framework to guide the selection of sustainable materials: recycle, reuse, recycled, resource, regional, and relax. This approach encourages choosing materials that are recyclable, reused or recycled, resource-efficient, sourced locally, and have minimal environmental impact. Despite these guidelines, many industry professionals hesitate to use recycled materials due to several concerns. According to Gorgolewski (2006), designers' reluctance stems from economic factors—like the cost of processing and certifying recycled materials that can exceed that of new materials—as well as technical and perceptual barriers. Technical uncertainties include questions about performance, durability, and compliance with building codes and standards, while perceptual barriers arise from a lack of information or clear guidance, leading to skepticism about the reliability and aesthetic appeal of recycled components.

Addressing these challenges requires increased awareness and clear guidelines for using recycled materials. Potential strategies include developing industry standards for recycled materials, providing education and training programs for designers and contractors, and offering financial incentives to encourage sustainable practices. By overcoming these obstacles, industry can integrate sustainable methods more fully into construction projects, benefiting both the environment and the economy. Ensuring material durability is also crucial; using long-lasting materials reduces the need for replacements and contributes to a project's overall sustainability (Sheffer n.d.). Material selection is a critical intersection between the design and construction industries and one of the most impactful areas where designers can influence a project's sustainability. By using fewer materials, incorporating recycled content, or substituting more sustainable materials, designers can significantly reduce a building's environmental impact (Faludi et al. 2012). For instance, materials like steel, aluminum, and concrete have substantial implications for life cycle impacts, including emissions, energy consumption, and waste generation (Faludi et al. 2012). Ensuring responsible material choice is essential for achieving holistic sustainability goals.

Waste reduction is a significant responsibility for designers aiming to create sustainable projects, as the building and construction sector generates substantial waste (Osmani et al. 2007). Innovative solutions include recycling materials and components from construction, demolition, and other industries for use in new projects (Gorgolewski 2006). Coventry and Guthrie (1998), as cited in Osmani et al. (2008), highlight three key roles architects should play to reduce waste: initiating waste reduction at the project level, improving design practices, and making informed material choices to limit unnecessary resource use. However, factors such as poor communication, overlapping design and construction phases, and limited knowledge about construction techniques can push waste prevention to the bottom of the priority list, leading to increased material waste (Osmani et al. 2008; Wilber 2010).

An additional concept related to waste reduction is designing for disassembly, which involves planning projects to facilitate future renovations and demolition. Addressing this concept during the design phase encourages designers and constructors to create buildings adaptable for change, further reducing environmental impact (Cataldi & Williams 2001). By integrating strategies such as ensuring versatility, durability, and simplicity in building components, making critical information explicit, exposing connections between materials, and making components with shorter life cycles more accessible for replacement, the traditional approach to design and construction can be adapted to better meet environmental priorities. These adaptations lead to improved waste management, resource conservation, and reduced atmospheric emissions (Cataldi & Williams 2001).

Energy consumption is another critical area in which designers can develop sustainable solutions (Faludi et al. 2012). Although the industry has been slow to adopt net-zero energy buildings, initiatives such as Architecture 2030 are encouraging broader implementation of energy-efficient designs and the use of green materials. As these efforts gain traction, prioritizing energy efficiency and sustainable manufacturing practices become increasingly important for achieving more environmentally responsible building projects. Improving energy performance not only reduces a building's operational costs but also significantly decreases its environmental footprint over its life-cycle.

By focusing on sustainability during the early phases of design, through appropriate material selection, energy efficiency, waste reduction, and designing for adaptability—

designers can significantly reduce the environmental impact of construction projects. This holistic approach not only helps preserve ecological systems but also aligns with industry-wide efforts to promote more sustainable building practices. As policies and design methods evolve, embracing these sustainability strategies is increasingly essential in creating buildings that are energy-efficient, resource-conserving, and adaptable to future needs. Overcoming challenges related to material selection, particularly the use of recycled materials, is crucial to fully integrating sustainable methods into construction projects and achieving both environmental and economic benefits.

CONCLUSION

This literature review highlights the evolution of the construction industry from a fragmented sector to one with specialized disciplines, emphasizing the need for improved communication and collaboration among key stakeholders. Despite advancements, the industry still faces challenges such as inefficient communication, material waste, and the necessity for sustainable practices to reduce environmental impacts. Prefabrication is identified as a vital strategy to enhance sustainability by reducing on-site labor, minimizing waste, and speeding up project timelines through off-site assembly. This approach not only improves productivity and quality control but also aligns with environmental regulations and climate goals by lowering energy consumption and emissions.

Additionally, robust sustainable assessment and design practices are crucial, however, barriers such as economic costs and technical uncertainties must be addressed through increased awareness, industry standards, education, and financial incentives. Certifications such as LEED and SITES further support the adoption of sustainable and resource-efficient practices. By prioritizing sustainability from the design phase and utilizing innovative construction methods, the industry can significantly reduce its environmental footprint, enhance efficiency, and contribute to sustainable development goals.

GLOSSARY

AEC (Architecture, Engineering, and Construction):
The integrated industry sector encompassing architecture, engineering, and construction disciplines that collaborate to design, construction, and maintenance of buildings and infrastructure.

Design - Build
A project delivery method in which a single entity is contractually responsible for both the design and construction of a project, streamlining communication and coordination to reduce costs, shorten timelines, and improve overall project outcomes.

LEED (Leadership in Energy and Environmental Design):
A globally recognized green building certification program developed by the U.S. Green Building Council, providing a framework for designing, constructing, and operating environmentally responsible and resource-efficient buildings.

Life Cycle Assessment (LCA):
A systematic method for evaluating the environmental impacts of a product, process, or system throughout its entire life cycle, from raw material extraction to disposal.

Modular Design:
A systematic approach where a project is divided into independent integrated units (modules) manufactured off-site. These modules are then transported and assembled on-site.

Post-Occupancy Evaluation (POE):
An assessment method that examines a building's performance and occupant satisfaction after it has been occupied and operational, helping to identify areas for improvement and ensure that sustainable design objectives are met in practice.

Prefabrication:
A building method where materials and components are assembled off-site in a controlled factory environment before being transported to and installed at a construction site.

SITES (Sustainable SITES Initiative):
A comprehensive rating system and framework designed to guide the planning, design, construction, and maintenance of sustainable landscapes, emphasizing environmental protection, resource conservation, and ecosystem benefits.

03 METHODS

METHODS INTRODUCTION

As part of the Prefabricated for Performance project, three primary methods are used to guide and respond to the central research question. These include: (1) the development of a reorganized and interpreted LEED + SITES checklist, (2) a precedent study analyzing modular landscape features and on-site landscape practices, and (3) a projective design phase involving both the Intuitive Home prefabricated package and its application to a realistic site context.

1. LEED + SITES Checklist

The LEED + SITES Checklist method restructures the two certification systems to align more effectively with the design process, identifying when each credit should be addressed and by whom. Organized into five project phases—pre-design, building, modular landscape, in-ground landscape, and post-design—this checklist framework improves coordination and accountability across disciplines. Using the LEED v4.1 Residential: Single Family and SITES v2 Rating System, the method identifies synergistic opportunities to enhance sustainability across both building and landscape. Though developed for the Prefabricated for Performance project, this adaptable structure can guide a broad range of sustainable design initiatives.

2. Precedent Studies

Precedent studies are used to guide the integration of modular landscape elements within the Intuitive Home Prefabricated Package, with a focus on sustainable design strategies that align with LEED and SITES goals. These case studies highlight real-world applications of prefabricated and modular construction in landscape design, including systems such as modular decking, green walls, cisterns, and native plantings. The insights gained from these examples ground design decisions in proven practices and measurable performance, ultimately supporting the feasibility and certification potential of the proposed system.

3. Design Application

The design application method is divided into two phases, each evaluating the Intuitive Home Prefabricated Package in relation to LEED and SITES certification. The first phase develops the prefabricated system—including the building, deck, green wall, and water cistern—designed for off-site fabrication and on-site assembly, and evaluates its performance using the Building and Modular Landscape checklists. The second phase applies this package to a real-world site in Salina, Kansas, integrating it into an existing neighborhood while addressing additional sustainability goals through Pre-Design, In-Ground Landscape, and Post-Design checklists. Together, both phases establish a holistic view of the project's certification potential.

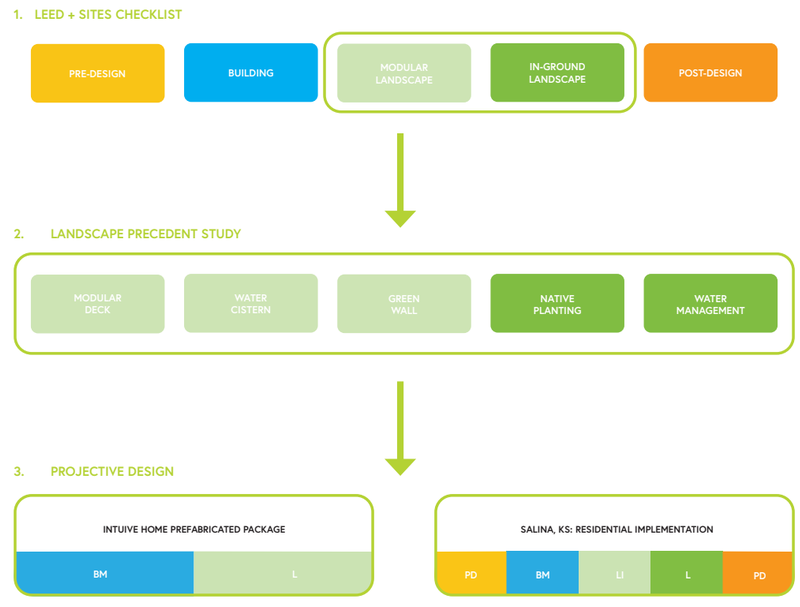


FIGURE 3.1 METHODS PROCESS

04

LEED + SITES CHECKLIST

INTRODUCTION TO CHECKLIST

The LEED + SITES Checklist method involves a comprehensive restructuring of both certification systems to better align with the design process. This approach identifies the design phase and responsible party for each credit, providing a clearer understanding of when and how each requirement should be addressed. The goal is to streamline the integration of LEED and SITES criteria, enabling more effective coordination, accountability, and prioritization throughout the project timeline.

The checklist is organized into five key phases found within design projects: pre-design, building, modular landscape, in-ground landscape, and post-design. These categories were established through an initial review and interpretation of both certification systems, with each credit placed according to the phase where it is most relevant. This organizational structure offers value beyond the Prefabricated for Performance project, serving as a flexible framework applicable to a wide range of project types.

For this study, the LEED v4.1 Residential: Single Family rating system is used, as it most closely aligns with the project's scale and objectives. In parallel, the SITES v2 Rating System is applied to evaluate the sustainability of landscape design and site development. By cross-referencing the two systems, the checklist identifies opportunities for synergy and optimization, maximizing sustainability across both building and site. While LEED primarily addresses building performance, SITES focuses on site-specific ecological and landscape strategies. Together, they offer a comprehensive framework for integrated architectural and landscape sustainability

FIGURE 4.1 CHECKLIST BREAKDOWN

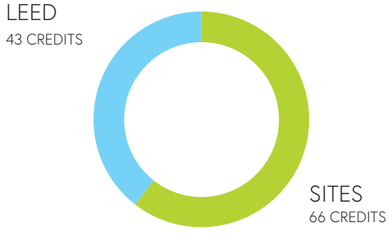


FIGURE 4.2 CHECKLIST BREAKDOWN

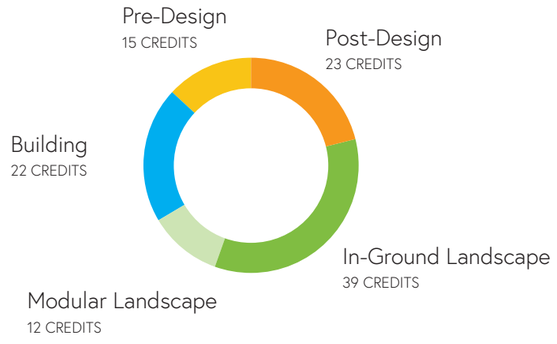


FIGURE 4.3 CHECKLIST DESIGN PROCESS

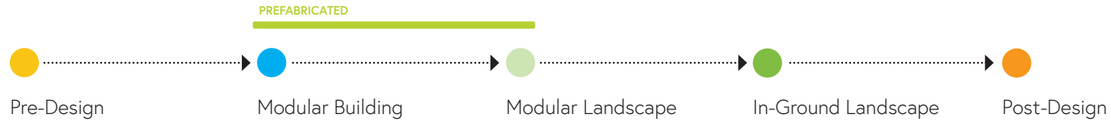
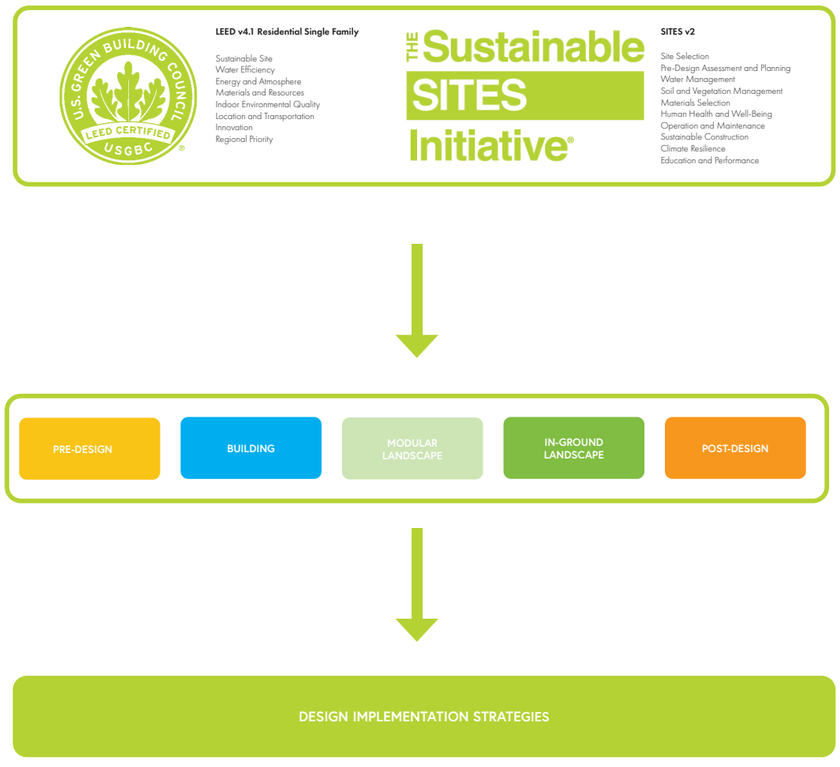


FIGURE 4.4 CHECKLIST PROCESS



PRE-DESIGN CHECKLIST

The Pre-Design Checklist addresses the foundational aspects of a project that takes place at its earliest stages. This includes the initial phases of the design process, site selection, and early assessment. Within this framework, particular emphasis is placed on understanding the contextual elements of the sites such as conducting a thorough site inventory and analysis. This due diligence helps identify the full impact of potential development while revealing opportunities to optimize site features for the greatest design potential. In the context of sustainable design, the pre-design phase is especially critical, as it focuses on understanding environmental processes, minimizing ecological disruption, and establishing meaningful connections between the site, its context, and its user groups.

Primary Users:
Designers, Project Developers or Owners, Sustainable Consultants

Pre-Design Checklist

(L) - LEED
(S) - SITES

DESIGN PROCESS CREDITS

☐ (L) Integrative Process	2 pts	☐ (S) Conduct a Pre-Design Assessment	Required
☐ (S) Use an Integrative Design Process	Required		

SITE SELECTION CREDITS

☐ (L) Flood Plain Avoidance	Required	☐ (S) Limit Development on Farmland	Required
☐ (L) LEED for Neighborhood	10 pts	☐ (S) Redevelop Degraded Sites	3 to 6 pts
☐ (L) Site Selection	6 pts	☐ (S) Locate Projects within Existing Developed Areas	4 pts

EARLY ASSESSMENT CREDITS

☐ (S) Protect Floodplain Functions	Required	☐ (S) Engage Users and Stakeholders	3 pts
☐ (S) Conserve Aquatic Ecosystems	Required	☐ (S) Maintain On-Site Structures and Paving	2 to 4 pts
☐ (S) Conserving Habitats for Threatened and Endangered Species	Required	☐ (S) Protect and Maintain Cultural and Historic Places	2 to 3 pts
☐ (S) Designate and Communicate VSPZs	Required	☐ (S) Create and Communicate Soil Management Plan	Required

POTENTIAL POINTS

LEED	16 pts
SITES	20 pts

FIGURE 4.6 PRE-DESIGN CATALOG

DESIGN PROCESS:

The design process is the early phase where teams set goals, assess the site, and guide sustainable design decisions.

2 PTS
Integrative Process
1

REQUIRED
Use an Integrative Process
2

REQUIRED
Conduct a Pre-Design Assessment
3

SITE SELECTION:

Site selection is the process of choosing a location based on its suitability for development, access to resources, and potential for sustainable design.

REQUIRED
Flood Plain Avoidance
4

REQUIRED
Limit Development on Farmland
7

10 PTS
LEED for Neighborhood
5

3 - 6 PTS
Redevelop Degraded Sites
8

6 PTS
Site Selection
6

4 PTS
Locate Projects within Existing Developed Areas
9

EARLY ASSESSMENT:

Early assessment involves analyzing existing conditions to identify opportunities and constraints that inform sustainable design strategies.

REQUIRED
Protect Floodplain Functions
10

REQUIRED
Designate and Communicate VSPZs
13

2 - 4 PTS
Maintain On-Site Structures and Paving
16

REQUIRED
Conserve Aquatic Ecosystems
11

3 PTS
Engage Users and Stakeholders
14

2 - 3 PTS
Protect and Maintain Cultural and Historic Places
17

REQUIRED
Conserving Habitats for Threatened and Endangered Species
12

REQUIRED
Create and Communicate Soil Management Plan
15

PRE-DESIGN: DESIGN PROCESS

1 **Integrative Design Process** is a credit worth up to 2 points for LEED certification. The intention of this credit is to maximize opportunities for cost-effective adoption of integrative green design and construction strategies. The requirements for this credit can be achieved by completing any two of the following options: forming an integrative project team, conducting a design charrette, and providing installation contractor training. The integrative project team must include professionals from at least three disciplines, such as architecture, mechanical engineering, building science, sustainable design, or landscape architecture, and involve them in at least three project phases while holding monthly meetings. The design charrette must occur by the design development phase and include a full-day (or two half-day) workshop focused on integrating sustainability across the project. Installation contractor training must include at least eight hours of instruction on green building practices for key trades and be overseen by the site supervisor. Documentation must include records of team composition, meeting summaries, workshop details, and training verification.
LEED v4.1 Residential Family Rating System pp. 5-6

2 **Use an Integrative Design Process** is a pre-requisite credit for SITES Certification. The intent of this credit is to promote collaboration among project team members and optimize sustainable site performance through a holistic, interdisciplinary design approach. The requirements for this prerequisite can be achieved by assembling an interdisciplinary project team that includes professionals from relevant fields such as landscape architecture, ecology, engineering, and construction. The team must conduct at least one design charrette or workshop to establish sustainability goals, identify site opportunities and constraints, and integrate strategies that enhance environmental performance. The process must include documentation of discussions, decisions, and strategies incorporated into the final design. Documentation must include meeting agendas, team member roles, sustainability goals, and verification of implemented strategies. *SITES v2 Rating System pp. 15-16*

3 **Conducting a Pre-design Assessment** is a pre-requisite credit for SITES certification. The intent of this credit is to ensure that project teams fully understand the site's existing conditions and ecological context before beginning design, allowing for informed and sustainable decision-making. The requirements for this prerequisite can be achieved by conducting a comprehensive site assessment before design work begins. The assessment must evaluate key site characteristics, including climate, topography, hydrology, vegetation, soils, human use, and existing infrastructure. Findings must be documented and used to inform design decisions that minimize environmental impact and enhance site sustainability. Documentation must include a site assessment report, maps, and verification of how the findings influenced the project's design strategy.
SITES v2 Rating System pp. 17-21

PRE-DESIGN: SITE SELECTION

4 **Flood Plain Avoidance** is a pre-requisite credit for LEED certification. The intention of this credit is to protect natural floodplain functions and minimize risks associated with flooding by ensuring responsible site selection. The requirements for this prerequisite can be achieved by avoiding development within a 100-year floodplain, as defined by the Federal Emergency Management Agency (FEMA) or an equivalent local authority. If development within a floodplain is unavoidable, projects must demonstrate that all structures are elevated or flood proofed and that the project does not negatively impact floodwater storage, flow, or adjacent properties. Documentation must include a site assessment, floodplain maps, and verification that the project complies with flood avoidance or mitigation strategies. *LEED v4.1 Residential Family Rating System pp. 7*

5 **LEED for Neighborhood Development** is a credit worth up to 10 points for LEED certification. The intention of this credit is to encourage smart growth and sustainable site selection by locating projects within certified LEED for Neighborhood Development (LEED-ND) communities. The requirements for this credit can be achieved by locating the project within a LEED for Neighborhood Development-certified community at the Certified, Silver, Gold, or Platinum level. The project must comply with the LEED-ND boundaries and requirements to ensure integration into a walkable, resource-efficient, and transit-accessible community. Points are awarded based on the certification level of the neighborhood development. Documentation must include verification of the LEED-ND certification, project location within the development, and compliance with LEED-ND criteria.
LEED v4.1 Residential Family Rating System pp. 8

6 **Site Selection** is a credit worth a maximum of 6 points for LEED certification. The intention behind this credit is to encourage responsible land use by selecting sites that minimize environmental impact and avoid sensitive ecological areas. The requirements for this credit can be achieved by avoiding the development of environmentally sensitive sites and prioritizing previously developed or disturbed land. Projects must not be located on prime farmland, floodplains, habitats for endangered species, wetlands, or land within 50 feet of water bodies unless appropriate mitigation measures are implemented. Additional points may be awarded for selecting brown-field sites and incorporating remediation efforts. Documentation must include a site assessment identifying potential environmental constraints and verification of compliance with site selection criteria.
LEED v4.1 Residential Family Rating System pp. 9-11

7 **Limit Development on Farmland** is a required credit for SITES Certification. The intent behind this credit is to protect prime agricultural land and prevent the unnecessary conversion of farmland into developed areas. The requirements for this prerequisite can be achieved by avoiding development on prime farmland, as defined by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) or an equivalent local authority. If development on farmland is unavoidable, projects must demonstrate that no other viable site was available and implement mitigation measures, such as preserving equal or greater amounts of farmland elsewhere or providing funding for agricultural conservation efforts. Documentation must include a site assessment, farmland classification verification, and justification or mitigation plan if farmland development is necessary. *SITES v2 Rating System pp. 2-3*

8 **Redevelop Degraded Sites** is a credit worth up to 6 points for SITES certification. The intent of this credit is to promote sustainable land use by encouraging the redevelopment of previously disturbed or contaminated sites instead of developing undisturbed land. The requirements for this credit can be achieved by selecting a site that is classified as a brown-field, greyfield, or other previously developed land that has been degraded due to human activity. If contamination is present, projects must implement remediation strategies such as soil restoration, hazardous material removal, or ecological rehabilitation. Additional points may be awarded for projects

that restore ecological functions or improve site conditions beyond regulatory requirements. Documentation must include a site assessment confirming degradation status, remediation plans if applicable, and verification of site redevelopment strategies.
SITES v2 Rating System pp. 11

9 **Locate Projects Within Existing Developed Areas** is a credit worth 4 points for SITES certification. The intent of this credit is to encourage responsible land use by situating projects in previously developed areas, reducing the need for new infrastructure and minimizing environmental impact. The requirements for this credit can be achieved by selecting a site that is within an existing developed area, defined as land that has been previously altered by human activity and has access to existing infrastructure such as roads, water, and utilities. Projects must demonstrate that at least 75% of the land within a half-mile radius is developed. Additional points may be awarded for projects that promote infill development or enhance community connectivity. Documentation must include a site assessment, mapping of surrounding development, and verification of infrastructure availability. *SITES v2 Rating System pp. 12*

PRE-DESIGN: EARLY ASSESSMENT

10 **Protect Floodplain Functions** is a required credit for SITES certification. The intent behind this credit is to prevent disruption of natural floodplain functions and reduce risks associated with flooding by ensuring responsible site selection and development. The requirements for this prerequisite can be achieved by avoiding development within the 100-year floodplain, as defined by the Federal Emergency Management Agency or an equivalent local authority. If development within a floodplain is unavoidable, projects must demonstrate that all structures are elevated or flood-proofed and that the project does not negatively impact floodwater storage, flow, or adjacent properties. Additional mitigation measures, such as restoring floodplain functions through habitat restoration or stormwater management strategies, may also be required. Documentation must include a site assessment, floodplain maps, and verification that the project complies with flood avoidance or mitigation strategies. *SITES v2 Rating System pp. 4-5*

11 **Conserve Aquatic Ecosystems** is a required credit for SITES certification. The intent behind this credit is to protect and maintain the ecological health of aquatic ecosystems by preventing degradation from development activities. The requirements for this prerequisite can be achieved by avoiding development within or near aquatic ecosystems, including wetlands, streams, rivers, and lakes, as defined by local, state, or federal regulations. If development impacts are unavoidable, projects must implement mitigation measures such as restoring degraded aquatic habitats, maintaining natural buffers, and minimizing impervious surfaces to reduce runoff and pollution. Documentation must include a site assessment identifying aquatic ecosystems, regulatory compliance records, and verification of conservation or mitigation strategies. *SITES v2 Rating System pp. 6-8*

12 **Conserving Habitats for Threatened and Endangered Species** is a required credit for SITES certification. The intent of this credit is to protect and preserve habitats that support threatened and endangered species, ensuring biodiversity and ecosystem resilience. The requirements for this prerequisite can be achieved by avoiding development in areas identified as habitats for threatened or endangered species, as designated by the U.S. Fish and Wildlife Service, state agencies, or an equivalent local authority. If avoidance is not possible, projects must develop and implement a habitat conservation plan that includes mitigation strategies such as habitat restoration, buffer zones, and long-term monitoring. Documentation must include a site assessment identifying protected species, regulatory compliance records, and verification of conservation or mitigation efforts. *SITES v2 Rating System pp. 9-10*

13 **Designate and Communicate Vegetation and Soil Protection Zones** is a required credit for SITES certification. The intent of this credit is to protect existing healthy vegetation and soils during construction by establishing designated protection areas and ensuring their preservation. The requirements for this prerequisite can be achieved by identifying and designating Vegetation and Soil Protection Zones (VSPZs) before construction begins. These zones must include existing trees, native vegetation, and healthy soils that are to be preserved. Protection measures must prevent soil compaction, erosion, and disturbance by using fencing, signage, and contractor training. The zones must be clearly marked on site plans and communicated to all construction personnel. Documentation must include a site plan identifying VSPZs, protection measures, and verification of compliance during construction. *SITES v2 Rating System pp. 22-24*

14 **Engage Users and Stakeholders** is a credit worth 3 points for SITES certification. The intent of this credit is to ensure that the project reflects community needs and priorities by actively involving users and stakeholders in the design process. The requirements for this credit can be achieved by engaging stakeholders, including community members, site users, local organizations, and project team members, through at least one public meeting, workshop, survey, or other participatory process. Feedback must be documented and incorporated into the design where feasible. Additional

points may be awarded for ongoing engagement efforts throughout the project life-cycle. Documentation must include records of engagement activities, stakeholder feedback summaries, and verification of how input influenced design decisions. *SITES v2 Rating System pp. 25*

15 **Maintain On-Site Structures and Paving** is a credit worth up to 4 points for SITES certification. The intent of this credit is to extend the life-cycle of building and infrastructure stock, conserve resources, and reduce waste by maintaining existing structures and paving in their existing form. The requirements for this credit mandate the reuse and maintenance of existing on-site structures and paving to reduce material consumption and environmental impact. Projects must retain and incorporate at least 50% of existing buildings, hardscapes, or paving surfaces into the site design. If modifications are necessary, materials must be reused in place or repurposed elsewhere on-site. Documentation must include a site assessment identifying retained structures, calculations verifying compliance, and evidence of reuse or integration into the new design. *SITES v2 Rating System pp. 56*

16 **Protect and Maintain Cultural and Historic Places** is a credit worth up to 3 points for SITES certification. The intent of this credit is to enhance a site's identity and meaning by protecting and maintaining significant historic buildings, structures, and objects, as well as cultural landscapes. The requirements for this credit mandate the protection, preservation, and maintenance of cultural and historic sites within the project boundary. Projects must identify and document culturally significant landscapes, archaeological sites, historic structures, or artifacts and integrate them into the site design. Preservation efforts may include restoration, adaptive reuse, protective buffers, or interpretive signage to educate users about the site's significance. Documentation must include a cultural or historical site assessment, a preservation or management plan, and verification of implementation measures. *SITES v2 Rating System pp. 70*

17 **Create and Communicate a Soil Management Plan** is a prerequisite for SITES certification. The intention of this prerequisite is to protect and restore soil health by planning for minimal disturbance during construction and outlining strategies for soil restoration. The requirements can be met by preparing a soil management plan (SMP) before construction that identifies healthy soils and protection zones, outlines how soil disturbance will be minimized, and describes treatment methods for re-vegetation and restoration areas. The plan must be shared with contractors through drawings and specifications, and all disturbed soils must be restored to a minimum depth of 12 inches. Topsoil may not be sourced from greenfields or protected farmland unless it is a byproduct of construction. SITES v2 Rating System pp. 38-39

MODULAR BUILDING CHECKLIST

The Building Checklist outlines key systems and design elements that are critical to the building's overall sustainability performance. It focuses on components such as indoor water use efficiency, energy consumption and HVAC performance, responsible material selection, and sustainable approaches to structural construction. The checklist serves as a guide for aligning design and construction practices with LEED certification requirements, ensuring thorough and consistent documentation throughout the project life-cycle. By emphasizing best practices for each system, this framework not only supports high-performance building design but also helps project teams make informed decisions that contribute to long-term operational efficiency, occupant well-being, and environmental responsibility. Ultimately, it ensures that sustainability is embedded into the foundational aspects of the building's design, construction, and ongoing performance

Primary Users:
Architects, Mechanical, Electrical, and Plumbing (MEP) Engineers, Structural Engineers, Contractors, Builders, Sustainable Consultants

Modular Building Checklist

(L) - LEED
(S) - SITES
* - DEPENDENT

WATER USE CREDITS

☐	(L) Indoor Water Use	11 pts	☐	(L) Water Metering*	Required
☐	(L) Water Use*	Required	☐	(L) Total Water Use*	15 pts

ENERGY USE + HVAC CREDITS

☐	(L) Minimum Energy Performance	Required	☐	(L) Garage Pollutant Protection	Required
☐	(L) Energy Metering	Required	☐	(L) Air Filtering	Required
☐	(L) Efficient Hot Water Distribution System	2 pts	☐	(L) Compartmentalization	Required
☐	(L) HVAC Start-Up Credentialing	1 pt	☐	(L) Enhanced Ventilation	3 pts
☐	(L) Refrigerant Management	1 pt	☐	(L) Containment Control	3 pts
☐	(L) Ventilation	Required	☐	(L) Annual Energy Use	36 pts
☐	(L) Combustion Venting	Required			

MATERIAL CREDITS

☐	(L) Certified Tropical Wood	Required	☐	(L) Durability Management	Required
☐	(L) Environmentally Preferable Products*	5 pts			

CONSTRUCTION CREDITS

☐	(L) Construction Waste Management*	2 pts	☐	(L) Material Efficient Framing	2 pts
☐	(L) Radon Resistant Construction*	Required			

POTENTIAL POINTS

LEED	81 pts
SITES	0 pts

FIGURE 4.8 MODULAR BUILDING CATALOG

WATER USE:

Water use in the building focuses on reducing potable water through efficient fixtures, alternative sources, and monitoring systems.

- REQUIRED — Indoor Water Use — 1
- REQUIRED — Water Use — 2
- REQUIRED — Water Metering — 3
- 10 PTS — Total Water Use — 4

ENERGY USE + HVAC:

Energy and HVAC systems aim to reduce consumption and improve performance through passive strategies, efficient equipment, and long-term monitoring.

- 6 PTS — Minimum Energy Performance — 5
- REQUIRED — Energy Metering — 6
- 3 - 6 PTS — Efficient Hot Water Distribution — 7
- 4 PTS — HVAC Start-Up Credentialing — 8
- REQUIRED — Refrigerant Management — 9
- REQUIRED — Ventilation — 10
- REQUIRED — Combustion Venting — 11
- 3 PTS — Garage Pollutant Protection — 12
- 2 - 4 PTS — Air Filtering — 13
- 2 - 3 PTS — Compartmentalization — 14
- 2 - 3 PTS — Enhanced Ventilation — 15
- 2 - 3 PTS — Containment Control — 16
- REQUIRED — Annual Energy Use — 17

MATERIALS:

Materials are selected for durability, sustainability, and local sourcing to reduce environmental impact and support long-term performance.

- 2 - 3 PTS — Certified Tropical Wood — 18
- 2 - 3 PTS — Durability Management — 19

CONSTRUCTION:

Building construction focuses on efficient methods, material use, and reducing environmental impact.

- REQUIRED — Construction Waste Management — 20
- REQUIRED — Radon Resistant Construction — 21
- REQUIRED — Material Efficient Framing — 22

BUILDING: WATER

1 **Indoor Water Use** is a credit worth up to 11 points for LEED certification. The intention of this credit is to reduce potable water consumption by promoting the use of high-efficiency indoor plumbing fixtures and fittings. The requirements for this credit can be achieved by demonstrating a reduction in indoor potable water use compared to a baseline scenario. Projects must achieve at least a 20% reduction in water use, with additional points awarded for greater reductions. Strategies to achieve compliance include installing EPA WaterSense-certified fixtures, using high-efficiency toilets and faucets, and incorporating alternative water sources such as rainwater or gray-water for non-potable uses. Documentation must include water use calculations, fixture specifications, and verification of implemented water-saving measures. *LEED v4.1 Residential Family Rating System pp. 26*

2 **Water Use** is a pre-requisite credit for LEED certification. The intention of this credit is to reduce potable water consumption by promoting efficient water use and sustainable management strategies. The requirements for this prerequisite can be achieved by establishing a baseline for water consumption and implementing measures to reduce overall water use. Projects must demonstrate a reduction in indoor and outdoor potable water use compared to a standard baseline, using water-efficient fixtures, appliances, irrigation systems, and alternative water sources such as rainwater or gray-water. Indoor plumbing fixtures must meet EPA WaterSense or equivalent efficiency standards, and outdoor irrigation must be optimized to minimize potable water demand. Documentation must include water use calculations, fixture specifications, and verification of efficiency measures
LEED v4.1 Residential Family Rating System pp. 21-22

3 **Water Metering** is a pre-requisite credit for LEED certification. The intention of this credit is to track and manage water consumption by requiring metering systems that allow for monitoring and optimization of water use. The requirements for this prerequisite can be achieved by installing permanent water meters to measure total potable water consumption for the project. Meters must be capable of tracking indoor and outdoor water use separately where applicable. For projects with irrigation systems, sub-metering of outdoor water use is required to monitor efficiency. Data collected must be recorded and made available for performance tracking and maintenance adjustments. Documentation must include meter specifications, a site plan indicating meter location, and verification of data tracking procedures. *LEED v4.1 Residential Family Rating System pp. 23*

4 **Total Water Use** is a credit worth up to 15 points for LEED Certification. The intention of this credit is to promote water conservation by reducing overall potable water consumption for both indoor and outdoor uses. The requirements for this credit can be achieved by demonstrating a reduction in total water use compared to a baseline scenario. Projects must achieve at least a 20% reduction in combined indoor and outdoor potable water consumption, with additional points awarded for higher reductions. Strategies to achieve compliance include installing water-efficient plumbing fixtures, optimizing irrigation systems, using drought-tolerant landscaping, and incorporating alternative water sources such as rainwater or gray-water reuse. Documentation must include water use calculations, fixture and irrigation system specifications, and verification of water-saving measures.
LEED v4.1 Residential Family Rating System pp. 24-25

BUILDING: ENERGY + HVAC

5 **Minimum Energy Performance** is a pre-requisite for LEED certification. The intent of this credit is to establish a baseline for energy efficiency and ensure that buildings meet minimum performance standards. The requirements for this prerequisite can be achieved by demonstrating compliance with energy efficiency standards for the building's design and operation. Projects must meet or exceed the ASHRAE 90.1-2010 standard (or a locally equivalent energy code) and achieve a minimum level of energy efficiency through high-performance insulation, efficient HVAC systems, lighting, and appliances. Energy modeling or prescriptive compliance pathways may be used to verify performance. Documentation must include energy models, calculations, or compliance reports demonstrating that the project meets minimum efficiency requirements. *LEED v4.1 Residential Family Rating System pp. 28-29*

6 **Annual Energy Use** is a credit worth up to 36 points for LEED certification. The intent of this credit is to improve overall energy efficiency by reducing the project's total annual energy consumption. The requirements for this credit can be achieved by demonstrating a reduction in annual energy use compared to a baseline through energy modeling or performance-based compliance pathways. Projects can earn points by meeting a LEED Energy Budget based on ENERGY STAR for Homes or by achieving a HERS Index rating that demonstrates improved efficiency. Additional considerations include accounting for all major energy loads, such as pools, spas, and heated garages, and ensuring that homes undergoing major renovations achieve a HERS Index of 85 or better. Documentation must include energy modeling reports, utility data (if applicable), and verification of efficiency improvements. *LEED v4.1 Residential Family Rating System pp. 32-34*

7 **Energy Metering** is a pre-requisite for LEED certification. The intent of this credit is to ensure energy performance tracking by requiring metering systems that allow for monitoring and optimization of energy use. The requirements for this prerequisite can be achieved by installing permanent energy meters to measure the total building energy consumption, including electricity, gas, and other fuel sources. Meters must be capable of tracking and recording energy use data for ongoing performance evaluation. For multi-unit projects, individual unit metering or sub-metering is encouraged to promote occupant awareness and efficiency. Documentation must include meter specifications, a site plan indicating meter location, and verification of data tracking procedures. *LEED v4.1 Residential Family Rating System pp. 30*

8 **Efficient Hot Water Distribution System** is a credit worth up to 2 points for LEED certification. The intent of this credit is to reduce water and energy waste by improving the efficiency of the hot water distribution system. The requirements for this credit can be achieved through one of three compliance pathways. The Efficient Hot Water Distribution option limits pipe length or water volume between the hot water source and fixtures to ensure quick hot water delivery. The Performance Test option verifies that no more than 0.5 gallons of water is wasted before hot water reaches the fixture in standard systems or 0.25 gallons in circulation loop or heat-traced pipe systems. The Pipe Insulation option requires installing at least R-4 insulation on all domestic hot water piping, including sub slab pipes, to minimize heat loss. Circulating hot water systems must include demand-activated pumps with automatic shutoff controls to prevent continuous operation. Documentation must include system specifications, performance test results (if applicable), and verification of installed efficiency measures.
LEED v4.1 Residential Family Rating System pp. 35-38

9 **HVAC Start-Up Credentialing** is a credit worth 1 point for LEED certification. The intent of this credit is to ensure the proper installation, performance, and efficiency of HVAC systems through professional commissioning and verification. The requirements for this credit can be achieved by having all heating, cooling, and ventilation systems commissioned by a qualified technician. The technician must hold a North American Technician Excellence (NATE) certification, an EPA-recognized HVAC Quality Installation Training and Oversight Organization (H-QUITO) credential, or an equivalent USGBC-

approved qualification. The technician must complete the ENERGY STAR for Homes, version 3, HVAC System Quality Installation Contractor Checklist or an equivalent checklist defined by USGBC. Documentation must include verification of technician credentials, a completed installation checklist, and confirmation of system commissioning.
LEED v4.1 Residential Family Rating System pp. 39

10 **Refrigerant Management** is a credit worth 1 point for LEED certification. The intent is to minimize environmental harm by reducing the use of refrigerants with high ozone depletion and global warming potential. The requirements for this credit can be achieved through one of two approaches. The Refrigerant Selection option requires that all refrigerants used in HVAC&R systems have an ozone depletion potential (ODP) of zero and a global warming potential (GWP) equal to or less than R-410A (1890). The Calculation Approach allows projects to use refrigerants with higher GWP values if the system's refrigerant charge is within the allowable limits to minimize environmental impact. Small HVAC&R units containing less than 0.5 pounds (225 grams) of refrigerant, such as household refrigerators and water coolers, are exempt from these requirements. Projects can earn exemplary performance credit by using refrigerants with both an ODP of zero and a GWP of less than 50. Documentation must include refrigerant specifications, system charge calculations (if applicable), and verification of compliance with refrigerant selection criteria.
LEED v4.1 Residential Family Rating System pp. 40-41

11 **Ventilation** is a pre-requisite for LEED certification. The intent of this credit is to ensure adequate indoor air quality by providing proper ventilation that meets or exceeds industry standards. The requirements for this prerequisite can be achieved by designing and installing a mechanical or natural ventilation system that meets the requirements of ASHRAE 62.2-2010 (or a locally equivalent standard). The system must provide sufficient outdoor air exchange rates to maintain indoor air quality and occupant

health. If a mechanical system is used, it must include continuously operating or automatic controls to maintain proper airflow. Natural ventilation strategies must be designed to ensure effective air distribution throughout occupied spaces. Documentation must include system specifications, airflow calculations, and verification of compliance with ventilation standards.
LEED v4.1 Residential Family Rating System pp. 51-52

12 **Combustion Venting** is a pre-requisite for LEED certification. The intent behind this credit is to minimize indoor air pollution and occupant exposure to harmful combustion gases by ensuring proper venting of fuel-burning appliances. The requirements for this prerequisite can be achieved by properly venting all combustion appliances and preventing backdrafting. Unvented combustion appliances are not permitted within the project. Fireplaces and wood stoves must be sealed combustion, have doors that close tightly, or meet EPA emission standards. All fireplaces, furnaces, and water heaters must be direct-vent or power-vented to the outdoors. Garages must include air sealing measures to prevent the infiltration of vehicle exhaust into occupied spaces. Documentation must include appliance specifications, venting details, and verification of compliance with combustion safety standards.
LEED v4.1 Residential Family Rating System pp. 53

13 **Garage Pollutant Protection** is a pre-requisite for LEED certification. The intent of this credit is to prevent indoor air contamination by limiting the infiltration of pollutants from attached garages into occupied spaces. The requirements for this prerequisite can be achieved by implementing air-sealing and ventilation strategies to minimize the migration of pollutants from the garage into living areas. All air barriers between the garage and conditioned spaces must be fully sealed at walls, ceilings, and floors. Doors leading from the garage to occupied spaces must be weather-stripped and self-closing. If the garage is mechanically ventilated, it must operate at a minimum of 100 cfm (cubic feet per minute) of exhaust with direct venting to

the outdoors. Documentation must include air sealing verification, ventilation system specifications (if applicable), and confirmation of compliance with pollutant protection measures.
LEED v4.1 Residential Family Rating System pp. 54

14 **Air Filtering** is a pre-requisite for LEED certification. The intent of this credit is to improve indoor air quality by ensuring effective filtration of airborne contaminants. The requirements for this prerequisite can be achieved by installing air filtration systems that meet minimum efficiency standards. All mechanically ventilated systems must use filters with a minimum efficiency reporting value (MERV) of 8 or higher, as rated by ASHRAE 52.2-2007 (or an equivalent standard). Filters must be installed before occupancy and properly sealed to prevent bypass leakage. If a central forced-air system is used, it must be designed to accommodate the required filter type without negatively impacting airflow. Documentation must include filter specifications, system design verification, and confirmation of proper installation. *LEED v4.1 Residential Family Rating System pp. 56*

15 **Compartmentalization** is a pre-requisite for LEED certification. The intent of this credit is to prevent the transfer of airborne contaminants between dwelling units in multifamily buildings, ensuring better indoor air quality. The requirements for this prerequisite can be achieved by sealing all penetrations, gaps, and openings between residential units to limit air leakage. Projects must demonstrate that air leakage rates between units do not exceed 0.30 cfm per square foot of enclosure area when tested using a blower door at 50 Pascals. Acceptable strategies include sealing wall, ceiling, and floor penetrations, using weather-stripped doors, and ensuring continuous air barriers between units. Documentation must include blower door test results, a compartmentalization plan, and verification of implemented air-sealing measures.
LEED v4.1 Residential Family Rating System pp. 57

16 **Enhanced Ventilation** is a credit worth up to 3 points for LEED certification. The intent of this credit is to improve indoor air quality beyond the minimum ventilation requirements by increasing outdoor air supply and distribution efficiency. The requirements for this credit can be achieved by exceeding the baseline ventilation rates established in ASHRAE 62.2-2010 (or an equivalent standard). Projects must provide at least 30% more outdoor air than required for mechanically ventilated spaces. Natural ventilation strategies must be demonstrated through computational fluid dynamics (CFD) modeling or an approved ventilation design method to ensure effective airflow. Additional strategies include heat recovery ventilation (HRV), energy recovery ventilation (ERV), or demand-controlled ventilation (DCV) to optimize air exchange and energy efficiency. Documentation must include ventilation rate calculations, system specifications, and verification of enhanced ventilation strategies. *LEED v4.1 Residential Family Rating System pp. 58*

17 **Containment Control** is a credit worth up to 3 points for LEED certification. The intent of this credit is to minimize indoor exposure to pollutants by implementing measures that reduce contaminant entry and distribution within the home. The requirements for this credit can be achieved by installing entryway systems, sealing pollutant sources, and providing adequate exhaust ventilation. Strategies include using walk-off mats or grates at primary entryways, sealing penetrations in walls and floors to prevent contaminant migration, and exhausting high-pollutant areas such as garages, laundry rooms, and kitchens directly to the outdoors. Additional measures may include controlling moisture and dust accumulation through proper HVAC filtration and air-sealing. Documentation must include a site plan showing contaminant control feature, system specifications, and verification of implementation.
LEED v4.1 Residential Family Rating System pp. 59

BUILDING: MATERIALS

18 **Certified Tropical Wood** is a pre-requisite for LEED certification. The intent of this credit is to prevent the use of unsustainably harvested tropical wood and promote responsible forestry practices. The requirements for this prerequisite can be achieved by ensuring that all tropical wood used in the project is sourced from certified, sustainably managed forests. Acceptable certification must be provided by the Forest Stewardship Council (FSC) or an equivalent third-party certification recognized by LEED. Projects must document the country of harvest, chain of custody, and certification status for all tropical wood materials. If certified tropical wood is not available, projects must use alternative materials or reclaimed wood. Documentation must include purchase records, certification details, and verification of compliance with sustainable sourcing requirements.
LEED v4.1 Residential Family Rating System pp. 42

19 **Durability Management** is a pre-requisite for LEED Certification.
The intent of this credit is to ensure the long-term performance and resilience of building materials and assemblies by implementing durability management strategies. The requirements for this prerequisite can be achieved by developing and implementing a durability management plan that addresses key building components vulnerable to moisture, pests, and other degradation risks. The plan must identify critical assemblies (such as roofing, foundations, and exterior walls) and outline strategies for moisture control, material protection, and long-term maintenance. Construction teams must verify the implementation of these strategies through inspections and quality control measures. Documentation must include a written durability management plan, verification checklists, and inspection records demonstrating compliance.
LEED v4.1 Residential Family Rating System pp. 43

BUILDING: CONSTRUCTION

20 **Construction Waste Management** is a credit worth up to 2 points for LEED certification. The intent of this credit is to reduce construction and demolition waste sent to landfills by promoting material reuse, recycling, and responsible disposal. The requirements for this credit can be achieved by developing and implementing a Construction Waste Management Plan that diverts at least 50% of total construction and demolition waste from landfill disposal. Acceptable strategies include on-site material reuse, recycling, and donation of materials such as wood, metal, concrete, and drywall. Additional points may be awarded for achieving higher diversion rates. Documentation must include waste diversion calculations, receipts from recycling or reuse facilities, and verification of compliance with the waste management plan.
LEED v4.1 Residential Family Rating System pp. 47-49

21 **Radon-Resistant Construction** is a pre-requisite for LEED certification. The intent of this credit is to reduce occupant exposure to radon gas by implementing radon-resistant construction techniques in high-risk areas. The requirements for this prerequisite can be achieved by installing a passive or active radon mitigation system in homes located in EPA Zone 1 (high-risk areas) or where local jurisdiction requires radon protection. Passive systems must include a gas-permeable layer, a polyethylene soil-gas retarder, and a vent pipe routed through the building to safely vent radon outdoors. If post-construction radon testing reveals elevated levels (4.0 pCi/L or higher), an active mitigation system with a fan-powered vent must be installed. Documentation must include site-specific radon risk assessment, system design details, and verification of installation.
LEED v4.1 Residential Family Rating System pp. 55

22 **Material-Efficient Framing** is a credit worth up to 2 points for LEED certification. The intent of this credit is to reduce material waste and optimize resource use by implementing efficient framing techniques. The requirements for this credit can be achieved by using advanced framing techniques that minimize material use while maintaining structural integrity.

Strategies include optimal value engineering (OVE), spacing studs and joists at 24 inches on center, using single top plates, reducing headers where unnecessary, and prefabricating framing components to decrease waste. Projects may also use engineered wood products or alternative framing materials that improve efficiency. Documentation must include construction drawings, framing material calculations, and verification of implemented material-efficient techniques.
LEED v4.1 Residential Family Rating System pp. 50

MODULAR LANDSCAPE CHECKLIST

The Modular Landscape Checklist identifies opportunities to implement prefabricated and modular strategies within the landscape, specifically targeting criteria outlined in LEED and SITES certification systems. This checklist emphasizes areas where modular solutions can enhance environmental performance, including sustainable material selection, efficient water use, and adaptive vegetation management. By introducing a structured framework, it supports the integration of repeatable, scalable, and easily maintained systems that can reduce on-site construction impacts, streamline installation processes, and support long-term sustainability goals. The checklist also encourages innovation in modular landscape design, promoting flexibility and adaptability for future site changes or programmatic needs.

Primary Users:
Architects, Landscape Architects, Engineers, Contractors, Builders, Sustainable Consultants

Modular Landscape Checklist

(L) - LEED
(S) - SITES

MATERIAL CREDITS:

☐	(S) Eliminate the Use of Wood from Threatened Species	Required	
☐	(S) Design for Adaptability and Disassembly	3 to 4 pts	
☐	(S) Reuse Salvaged Materials and Plants	3 to 4 pts	
☐	(S) Use Regional Materials	3 to 5 pts	
☐	(S) Support Responsible Extraction of Raw Materials		1 to 5 pts
☐	(S) Support Transparency and Safer Chemistry		1 to 5 pts
☐	(S) Support Sustainability in Materials Manufacturing		5 pts

WATER CREDITS

☐	(L) Rainwater Management*	2 pts	
☐	(S) Manage Precipitation on Site*	Required	
☐	(S) Manage Precipitation Beyond Baseline*		4 to 6 pts
☐	(S) Reduce Outdoor Water Use*		4 to 6 pts

VEGETATION CREDITS

☐	(S) Use Vegetation to Minimize Building Energy Use	1 to 4 pts

POTENTIAL POINTS

LEED	8 pts
SITES	21 pts

FIGURE 4.10 MODULAR LANDSCAPE CATALOG

MATERIALS:

Materials in modular landscapes are chosen for durability, adaptability, and sustainability to support flexible, low-impact site design.

3 - 4 PTS
Eliminate the Use of Wood from Threatened Species
1

3 - 5 PTS
Use Regional Materials
4

1 - 5 PTS
Support Sustainability in Materials Manufacturing
7

1 - 5 PTS
Design for Adaptability and Disassembly
2

5 PTS
Support Responsible Extraction of Raw Materials
5

REQUIRED
Reuse of Salvaged Materials and Plants
3

3 - 4 PTS
Support Transparency and Safer Chemistry
6

WATER:

Water management in modular landscapes focuses on collecting, reusing, and directing water efficiently to reduce runoff and support sustainable planting.

REQUIRED
Rainwater Management
8

REQUIRED
Manage Precipitation Beyond Baseline
10

6 PTS
Manage Precipitation on Site
9

3 - 6 PTS
Reduce Outdoor Water Use
11

VEGETATION

Vegetation to minimize building energy use provides shade and passive cooling to reduce heat gain and improve efficiency.

REQUIRED
Use Vegetation to Minimize Building Energy Use
12

MODULAR LANDSCAPE: MATERIALS

1 **Eliminate the Use of Wood from Threatened Tree Species** is a pre-requisite for SITES certification. The intent of this credit is to minimize negative effects on ecosystems by purchasing wood products extracted only from non-threatened tree species. The requirements for this prerequisite ensure that no wood from threatened or endangered tree species is used in the project unless it is reclaimed or certified by the Forest Stewardship Council (FSC) or an equivalent third-party certification. Projects must verify that all wood products, including lumber, veneers, and finishes, do not come from species listed on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendices I and II or the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. If using certified or reclaimed wood, documentation must be provided to confirm compliance. *SITES v2 Rating System pp. 55*

2 **Design for Adaptability and Disassembly** is a credit worth up to 4 points for SITES certification. The intent of this credit is to 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. The requirements for this credit focus on designing site elements to be easily adapted, disassembled, and reused to minimize waste and support long-term sustainability. Projects must incorporate at least one adaptive design strategy that allows materials, structures, or site elements to be modified, relocated, or repurposed with minimal waste. Strategies may include modular design, reversible connections (such as bolts instead of adhesives), and the use of standardized components that can be easily replaced or upgraded. Documentation must demonstrate how the selected strategy supports future adaptability and material recovery, extending the functional lifespan of site elements. Points are awarded based on the percentage of site materials designed for adaptability and disassembly. *SITES v2 Rating System pp. 57*

3 **Reuse Salvaged Materials and Plants** is a credit worth up to 4 points for SITES certification. The intent of this credit is to conserve resources and avoid landfilling useful materials by reusing salvaged materials and appropriate plants. The requirements for this credit encourage the reuse of salvaged materials and plants to reduce waste and environmental impact. Projects must incorporate previously used or salvaged materials for at least 5% of the total material cost or reuse existing plants on-site to minimize resource consumption. Salvaged materials can include wood, stone, metal, pavers, and other structural or decorative elements, while plant reuse involves transplanting existing vegetation rather than removing and replacing it. Documentation must provide evidence of material sources, quantities, and their contribution to the project's sustainability goals. Points are awarded based on the percentage of salvaged materials and plants integrated into the site design. *SITES v2 Rating System pp. 58*

4 **Use Regional Materials** is a credit worth up to 5 points for SITES certification. The intent of this credit is to reduce energy use for transportation; increase demand for regional materials, plants, and soils; and promote regional identity by supporting the use of local resources. The requirements for this credit encourage the use of regionally sourced materials to reduce environmental impacts associated with transportation and support the local economy. Projects must ensure that at least 30% of the total material cost comes from materials that are extracted, harvested, recovered, or manufactured a varied linear distance from the site depending on material. Eligible materials include stone, soil, plants, wood, and other site construction materials. Documentation must include material source locations and transportation distances to verify compliance. Points are awarded based on the percentage of regional materials used, with higher percentages earning more points. 60

5 **Support Responsible Extraction of Raw Materials** is a credit worth up to 5 points for SITES certification. The intent of this credit is to Protect ecosystems, respect cultural and community values, and improve land use through responsible extraction of raw materials for site design and construction. The requirements for this credit encourage the use of materials that are extracted or harvested in an environmentally and socially responsible manner. Projects must ensure that at least 20% of the total material cost comes from responsibly sourced materials, including certified wood from the Forest Stewardship Council (FSC) or an equivalent certification, recycled content materials that reduce the demand for virgin resources, and rapidly renewable materials such as bamboo, cork, or wool that regenerate within ten years or less. Additionally, materials sourced from operations that minimize environmental harm, such as those with verified sustainable extraction practices or ethical labor standards, also contribute to compliance. Documentation must include certifications, chain-of-custody records, or third-party verifications to confirm compliance, with points awarded based on the percentage of responsibly extracted materials used.
SITES v2 Rating System pp. 61-62

6 **Support Transparency and Safer Chemistry** is a credit worth up to 5 points for SITES certification. The intent of this credit is to 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. The requirements for this credit promote the use of materials with disclosed chemical ingredients and verified low-toxicity profiles to support human and environmental health. Projects must ensure that at least 20% of the total material cost consists of products that have been transparently reported and assessed for safer chemistry. Eligible materials include those with Health Product Declarations (HPDs), Cradle to Cradle certifications, Declare labels, or other third-party verified ingredient disclosures. Additional credit may be earned if materials are certified to meet low-emission and non-toxic standards, such as GreenScreen benchmarks or Cradle to Cradle Material Health criteria. Documentation must include verified certifications or disclosures, with points awarded based on the percentage of materials meeting these transparency and safety criteria.
SITES v2 Rating System pp. 63-64

7 **Support Sustainability in Materials Manufacturing** is a credit worth up to 5 points for SITES certification. The intent of this credit is to 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. The requirements for this credit encourage the use of materials sourced from manufacturers that demonstrate environmentally and socially responsible production practices. Projects must ensure that at least 10% of the total material cost comes from manufacturers that have adopted sustainable practices, such as third-party environmental certifications, corporate sustainability reports (CSRs), or verified responsible labor policies. Eligible certifications include ISO 14001, Environmental Product Declarations (EPDs), Cradle to Cradle, or other recognized sustainability standards. Additional credit may be earned if manufacturers implement energy-efficient processes, waste reduction programs, or water conservation measures. Documentation must include certifications or reports verifying the manufacturer's sustainability commitments, with points awarded based on the percentage of compliant materials used.
SITES v2 Rating System pp. 65-66

MODULAR LANDSCAPE: WATER

8 **Rainwater Management** is a credit worth up to 2 points for LEED certification. The intent of this credit is to reduce rainwater runoff volume from the site. The requirements for this credit can be achieved through one of two options. The Rainwater Management option requires projects to use low-impact development (LID) techniques to minimize stormwater runoff by incorporating strategies such as permeable paving, vegetated roofs, rain gardens, or rainwater harvesting systems. Points are awarded based on the percentage of the site designed to manage runoff from a two-year, 24-hour storm event, with 50–64% permeability earning 1 point and 65% or more earning 2 points. The National Pollutant Discharge Elimination System (NPDES) Compliance option requires projects to retain and manage on-site stormwater runoff for at least the 80th percentile rainfall event for 1 point or the 85th percentile rainfall event for 2 points. Alternatively, projects can achieve 1 point by implementing basic landscape design strategies, such as eliminating turf in shaded and steep-slope areas, avoiding invasive plant species, adding mulch or soil amendments based on soil testing, and tilling compacted soil to a depth of at least 6 inches.
LEED v4.1 Residential Family Rating System pp. 18-19

9 **Manage Precipitation on Site** is a pre-requisite of SITES certification. The intent of this credit is to reduce negative impacts to aquatic ecosystems, channel morphology, and dry weather base flow by replicating natural hydrologic conditions and retaining precipitation on site. The requirements for this prerequisite focus on managing stormwater on-site to reduce runoff and minimize negative impacts on natural water systems. Projects must capture and retain precipitation from the 60th percentile regional storm event using strategies such as bio retention areas, green infrastructure, permeable surfaces, and rainwater harvesting systems. Stormwater management techniques should promote infiltration, evapotranspiration, or reuse to reduce reliance on municipal drainage systems. Documentation must include stormwater calculations and a site plan demonstrating how runoff is managed in compliance with the requirements.
SITES v2 Rating System pp. 27-28

10 **Manage Precipitation Beyond Baseline** is a credit worth up to 6 points for SITES certification. The intent of this credit is to 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. The requirements for this credit focus on enhancing stormwater management by capturing and retaining precipitation beyond the baseline requirement. Projects must manage stormwater from at least the 80th percentile regional storm event through strategies such as bio-retention, permeable paving, green roofs, and rainwater harvesting. Additional points can be earned by increasing retention capacity to the 90th or 95th percentile storm event. Stormwater management must prioritize infiltration, evapotranspiration, or on-site reuse to reduce runoff and support site hydrology. Documentation must include stormwater calculations and a site plan demonstrating compliance with the selected retention threshold.
SITES v2 Rating System pp. 31

11 **Reduce Outdoor Water Use** is a credit worth up to 6 points for SITES certification. The intent of this credit is to 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. The requirements for this credit focus on reducing potable water consumption for landscape irrigation by implementing efficient water management strategies. Projects must demonstrate at least a 50% reduction in outdoor water use compared to a baseline, with additional points available for achieving 75% or 100% reductions. Strategies include using drought-tolerant or native plants, installing high-efficiency irrigation systems, incorporating rainwater or gray-water reuse, and optimizing soil moisture retention. Documentation must include a landscape water budget and calculations verifying the percentage reduction in water use. *SITES v2 Rating System pp. 32-33*

MODULAR LANDSCAPE: VEGETATION

12

Use Vegetation to Minimize Building Energy Use is a credit worth up to 4 points for SITES certification. The intent of this credit is to place vegetation or vegetated structures in strategic locations around regularly occupied buildings to reduce energy consumption and costs associated with indoor climate control. The requirements for this credit mandate the strategic use of vegetation to reduce building energy consumption by providing shade, wind protection, or insulation. Projects must incorporate trees, green roofs, green walls, or vegetative buffers to minimize heating and cooling loads. Vegetation must be placed to shade at least 30% of building facades or outdoor paved areas within ten years of planting or to reduce wind exposure for at least 30% of the building's perimeter. Documentation must include a site plan showing vegetation placement, shade or wind reduction calculations, and verification of implementation.
SITES v2 Rating System pp. 51-52

IN-GROUND LANDSCAPE CHECKLIST

The In-Ground Landscape Checklist outlines key strategies and design elements essential to the long-term sustainability of site development. It focuses on areas such as site layout and grading, sustainable construction practices, water management systems, and vegetation strategies that promote ecological resilience. The checklist is designed for use by landscape architects, civil engineers, contractors, and builders—each contributing to the implementation of sustainable practices across the site. It aligns closely with LEED and SITES certification goals, offering a structured approach to documentation and performance tracking. By integrating sustainability into the foundational aspects of site design and development, this framework supports improved environmental function, reduced resource consumption, and enhanced landscape performance over time.

Primary Users:
Landscape Architects, Civil Engineers, Contractors, Builders, Sustainable Consultants

In-Ground Landscape Checklist

(L) - LEED

(S) - SITES

SITE DESIGN CREDITS

☐ (S) Provide Optimum Site Accessibility	2 pts
☐ (S) Promote Equitable Site Use	2 pts
☐ (S) Support Mental Restoration	2 pts
☐ (S) Support Physical Activity	2 pts
☐ (S) Support Social Connection	2 pts
☐ (S) Provide On Site Food Production	3 to 4 pts
☐ (S) Reduce Light Pollution	1 to 2 pts
☐ (S) Encourage Fuel Efficient and Multi Modal Transportation	2 to 3 pts
☐ (S) Minimize Exposure to Environmental Tobacco Smoke	4 pts
☐ (S) Connecting to Multi Modal Transit Networks	4 pts

CONSTRUCTION CREDITS

☐ (S) Protect Air Quality	2 pts
☐ (S) Provide Storage and Collection of Recyclables	2 pts
☐ (S) Communication and Verify Sustainable Construction	2 pts
☐ (S) Control and Retain Construction Pollutions	2 pts
☐ (S) Divert Construction and Demolition of Materials	2 pts
☐ (S) Support Local Economy	2 pts
☐ (S) Restore Soils Disturbed During Construction	2 pts

VEGETATION CREDITS

☐ (L) Heat Island Reduction*	1 pt
☐ (S) Control and Manage Invasive Plants	Required
☐ (S) Use Appropriate Plants	Required
☐ (S) Conserve and Use Native Plants	3 to 6 pts
☐ (S) Conserve and Restore Native Plant Communities	4 to 6 pts
☐ (S) Create and Communicate a Soil Management Plan	Required
☐ (S) Optimize Biomass	1 to 6 pts
☐ (S) Reduce Urban Heat Island	4 pts
☐ (S) Reduce Risk of Catastrophic Wildfire	4 pts
☐ (S) Support Sustainability in Plant Production	5 pts
☐ (S) Divert Reusable Vegetation	3 to 4 pts

WATER CREDITS

☐ (L) Outdoor Water Use	4 pts
☐ (L) Water Use*	Required
☐ (L) Water Metering*	Required
☐ (L) Total Water Use*	15 pts
☐ (L) Rainwater Management*	2 pts
☐ (S) Restore Aquatic Ecosystems	4 to 6 pts
☐ (S) Reduce Water Use for Landscape Irrigation*	Required
☐ (S) Manage Precipitation on Site*	Required
☐ (S) Manage Precipitation Beyond Baseline*	4 to 6 pts
☐ (S) Reduce Outdoor Water Use*	4 to 6 pts
☐ (S) Design Functional Stormwater Features as Amenities*	4 to 5 pts

POTENTIAL POINTS

LEED	22 pts
SITES	99 pts

FIGURE 4.12 IN-GROUND LANDSCAPE CATALOG

SITE DESIGN:

Site design organizes spaces to support user experience, sustainability, and environmental performance.

2 PTS
Provide Optimum Site Accessibility
1

6 PTS
Support Social Connection
5

4 PTS
Minimize Exposure to Environmental Tobacco Smoke
9

REQUIRED
Promote Equitable Site Use
2

REQUIRED
Provide On-Site Food Production
6

4 PTS
Connecting to Multi Modal Transit Networks
10

REQUIRED
Support Mental Restoration
3

REQUIRED
Reduce Light Pollution
7

10 PTS
Support Physical Activity
4

3 - 6 PTS
Encourage Fuel Efficient and Multi Modal Transportation
8

CONSTRUCTION:

Construction focuses on efficient building practices that reduce waste, protect the site, and support long-term performance.

4 PTS
Communication and Verify Sustainable Construction
11

4 PTS
Divert Construction and Demolition of Materials
14

4 PTS
Protect Air Quality
17

4 PTS
Control and Retain Construction Pollutions
12

4 PTS
Support Local Economy
15

REQUIRED
Provide Storage and Collection of Recyclables
13

4 PTS
Restore Soils Disturbed During Construction
16

FIGURE 4.13 IN-GROUND LANDSCAPE CATALOG

VEGETATION:

Vegetation is carefully selected and placed to suit site conditions, enhance ecology, support resilience, and reduce maintenance needs.

REQUIRED
Heat Island Reduction
18

10 PTS
Conserve and Use Native Plants
23

4 PTS
Support Sustainability in Plant Production
28

REQUIRED
Control and Manage Invasive Plants
19

4 PTS
Conserve and Restore Native Plant Communities
24

4 PTS
Diver Reusable Vegetation
29

REQUIRED
Use Appropriate Plants
20

REQUIRED
Optimize Biomass
25

4 PTS
Restore Soils Disturbed by Previous Development
30

4 -6 PTS
Conserve Healthy Soils and Appropriate Vegetation
21

3 - 6 PTS
Reduce Urban Heat Island
26

4 -6 PTS
Conserve Special Status Vegetation
22

4 PTS
Reduce Risk of Catastrophic Wildfire
27

WATER MANAGEMENT:

Water management uses collection, reuse, and infiltration strategies to conserve resources and reduce site runoff.

REQUIRED
Outdoor Water Use
31

REQUIRED
Restore Aquatic Ecosystems
34

4 PTS
Mange Precipitation Beyond Baseline
37

REQUIRED
Water Use
32

3 - 6 PTS
Reduce Water Use for Landscape Irrigation
35

4 PTS
Reduce Outdoor Water Use
38

6 PTS
Rainwater Management
33

4 PTS
Manage Precipitation on Site
36

4 PTS
Design Functional Stormwater Features as Amenities
39

IN-GROUND LANDSCAPE: SITE DESIGN

1 **Provide Optimum Site Accessibility** is a credit worth 2 points for SITES certification. The intent of this credit is to increase site users' ability to understand and access outdoor spaces by incorporating elements of accessibility, safety, and way-finding into the site design. The requirements for this credit mandate the design of an accessible, safe, and navigable site to accommodate users of all abilities. Projects must incorporate universal design principles, ensuring that pathways, entrances, and site features comply with accessibility standards such as the ADA (Americans with Disabilities Act) or local equivalents. Way-finding must be enhanced with clear signage, lighting, and visual or tactile cues to assist users in navigating the site safely and efficiently. Documentation must include a site plan demonstrating accessible routes, safety features, and way-finding elements, along with verification of implementation. *SITES v2 Rating System pp. 71*

2 **Promote Equitable Site Use** is a credit worth 2 points for SITES certification. The intent of this credit is to provide economic and social benefits to the local community by providing publicly available on-site events, facilities, amenities, or programming. The requirements for this credit mandate the creation of an inclusive and welcoming site that accommodates people of all backgrounds, abilities, and socioeconomic statuses. Projects must provide accessible and culturally relevant spaces that encourage diverse community engagement. Strategies include offering a variety of seating and gathering areas, ensuring ADA-compliant access, incorporating multilingual signage, and designing spaces that reflect local cultural identities. Documentation must include a site plan demonstrating inclusive design elements, a narrative describing how equity was considered, and verification of implementation. *SITES v2 Rating System pp. 72*

3 **Support Mental Restoration** is a credit worth 2 points for SITES certification. The intent of this credit is to improve human health and well-being by providing visual and physical connections to restorative outdoor spaces. The requirements for this credit mandate the integration of design elements that promote mental restoration and stress reduction by providing opportunities for quiet reflection, sensory engagement, and connection with nature. Projects must include at least one dedicated restorative space, such as gardens, shaded seating areas, water features, or natural landscapes, designed to encourage relaxation and well-being. These spaces should be easily accessible, free from excessive noise, and incorporate natural elements that enhance the user experience. Documentation must include a site plan identifying restorative space, a description of design strategies, and verification of implementation. *SITES v2 Rating System pp. 73*

4 **Support Physical Activity** is a credit worth 2 points for SITES certification. The intent of this credit is to improve human health by providing on-site opportunities that encourage outdoor physical activity. The requirements for this credit mandate the design of outdoor spaces that encourage physical activity by incorporating features that promote movement and exercise. Projects must provide at least one dedicated space or feature that supports active use, such as walking or biking trails, exercise stations, open play areas, or sports facilities. These spaces must be safe, accessible, and appropriately sized for their intended use. Additional points may be earned for integrating multiple activity options. Documentation must include a site plan identifying physical activity area, a description of their intended use, and verification of implementation. *SITES v2 Rating System pp. 74*

5 **Support Social Connection** is a credit worth 2 points for SITES certification. The intent of this credit is to strengthen community and encourage social connections by providing outdoor gathering spaces to support people gathering, eating, working, and playing together. The requirements for this credit mandate the design of outdoor spaces that foster social interaction and community engagement. Projects must provide at least one dedicated gathering space that encourages group activities, such as plazas, picnic areas, amphitheaters, community gardens, or multipurpose open spaces. These spaces must be accessible, appropriately sized, and

equipped with seating, shade, or other amenities that support social interaction. Documentation must include a site plan identifying social space, a description of how they facilitate connection, and verification of implementation. *SITES v2 Rating System pp.* 75

6 **Provide On-Site Food Production** is a credit worth up to 4 points for SITES certification. The intent of this credit is to improve human health and well-being, community involvement, and education about food production and nutrition by designing and managing food production on site. The requirements for this credit mandate the integration of on-site food production areas to promote local food access and sustainable agriculture. Projects must dedicate space for edible plants, community gardens, orchards, or urban farming, ensuring that at least 5% of the total site area is allocated for food production. These areas must be accessible, maintained with sustainable practices, and provide necessary resources such as irrigation, soil amendments, and composting options. Documentation must include a site plan showing designated food production areas, a maintenance plan, and verification of implementation. *SITES v2 Rating System pp. 76-77*

7 **Reduce Light Pollution** is a credit worth 4 points for SITES certification. The intent of this credit is to minimize negative effects on nocturnal environments and human health and functioning, reduce sky-glow, and increase nighttime visibility by reducing light trespass on site. The requirements for this credit mandate the reduction of light pollution to minimize environmental and human health impacts. Projects must implement outdoor lighting strategies that reduce skyglow, glare, and light trespass by using shielded, downward-facing fixtures, minimizing excessive brightness, and ensuring lighting is only used where necessary. Outdoor lighting must comply with International Dark-Sky Association (IDA) guidelines or equivalent standards. Additional measures include using motion sensors, timers, and warm-colored lighting to limit disruption to wildlife and night skies. Documentation must include a lighting plan, fixture specifications, and verification of compliance with light pollution reduction standards. *SITES v2 Rating System pp. 78-81*

8 **Encourage Fuel Efficient and Multi-Modal Transportation** is a credit worth 4 points for SITES certification. The intent of this credit is to reduce greenhouse gas emissions and traffic congestion by promoting the use of fuel-efficient vehicles and alternative transportation options. The requirements for this credit mandate the promotion of fuel-efficient and multi-modal transportation options to reduce environmental impact and encourage sustainable mobility. Projects must provide at least one transportation-supportive strategy, such as dedicated parking for fuel-efficient or low-emission vehicles, electric vehicle (EV) charging stations, bicycle parking, or access to public transit. Additional points may be earned for implementing multiple strategies or exceeding minimum requirements. Documentation must include a site plan identifying transportation feature, descriptions of provided amenities, and verification of implementation. *SITES v2 Rating System pp. 82*

9 **Minimize Exposure to Environmental Tobacco Smoke** is a credit worth up to 2 points for SITES certification. The intent of this credit is to improve human health by minimizing site users' exposure to environmental tobacco smoke (i.e., secondhand smoke). The requirements for this credit mandate the reduction of exposure to environmental tobacco smoke (ETS) on-site to protect public health. Projects must prohibit smoking in all outdoor spaces or establish designated smoking areas that are located at least 25 feet (7.5 meters) away from building entrances, operable windows, air intakes, and regularly occupied outdoor spaces. Clear signage must be installed to communicate smoking policies. Documentation must include a site plan indicating smoking areas (if applicable), a copy of the smoking policy, and verification of signage installation. *SITES v2 Rating System pp. 83*

10

Connecting to Multi-modal Transit Networks is a credit worth up to 3 points for SITES certification. The intent of this credit is to reduce dependence on single-occupancy vehicles by providing convenient access to multiple modes of public and alternative transportation. The requirements for this credit can be achieved by locating the project within walking distance of a multi-modal transit network that includes at least two transportation options such as bus, rail, bicycle infrastructure, or pedestrian pathways. The project must be within a quarter-mile of a bus or streetcar stop or within a half-mile of a rail, ferry, or bus rapid transit station. Additional points may be awarded for projects that include transit-supportive infrastructure, such as bike racks, pedestrian-friendly pathways, or dedicated shuttle services. Documentation must include a site plan showing transit access points, route maps, and verification of transit frequency and availability.
SITES v2 Rating System pp. 13

IN-GROUND LANDSCAPE: CONSTRUCTION

11 **Communicate and Verify Sustainable Construction Practices** is a pre-requisite for SITES certification. The intent of this credit is to ensure site performance by communicating and verifying the implementation of sustainable practices throughout the construction process. The requirements for this prerequisite ensure that sustainable construction practices are clearly communicated and verified throughout the project. Before construction begins, the project team must develop a SITES Punch-list, which outlines specific sustainability goals, responsible parties, and verification procedures. This list must be shared with contractors and construction teams to ensure alignment with the project's sustainability objectives. Additionally, a pre-construction meeting must be held to review sustainability requirements, and regular site inspections must be conducted to verify compliance. Documentation must include the punch list, meeting records, and verification reports to confirm that all sustainable construction practices were properly implemented. *SITES v2 Rating System pp. 86*

12 **Control and Retain Construction Pollutants** is a pre-requisite for SITES certification. The intent of this credit is to 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. The requirements for this credit mandate the development and enforcement of a Construction Pollution Prevention Plan that includes measures to prevent erosion, sedimentation, and airborne dust from leaving the site. Strategies must be implemented to protect stormwater systems, nearby water bodies, and air quality, including silt fences, sediment basins, stabilized construction entrances, and dust suppression techniques. Materials and chemicals must be stored and handled properly to prevent contamination. Documentation must include a site-specific plan and verification reports demonstrating compliance with these pollution prevention measures. *SITES v2 Rating System pp. 87-88*

13 **Provide for Storage and Collection of Recyclables** is a required credit for SITES certification. The intent of this credit is to reduce waste sent to landfills by ensuring the proper storage and collection of recyclable materials. The requirements for this prerequisite can be achieved by providing dedicated, accessible areas for the storage and collection of recyclables. These areas must accommodate materials commonly generated on-site, such as paper, cardboard, plastics, glass, metals, and organic waste, as applicable. The collection system must be designed to support regular recycling operations, with clear signage and easy access for occupants and waste haulers. Documentation must include a site plan showing designated recycling storage locations and a description of the recycling collection process. *SITES v2 Rating System pp. 104*

14 **Divert Construction and Demolition of Materials** is a credit worth up to 4 points for SITES certification. The intent of this credit is to 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. The requirements for this credit mandate the diversion of construction and demolition materials from disposal in landfills or incinerators by reusing, recycling, or salvaging materials. Projects must develop and implement a Construction Waste Management Plan that outlines strategies for material recovery and diversion. At least 50% of total construction and demolition waste (by weight or volume) must be diverted to earn points, with additional points awarded for higher diversion rates. Materials that can be salvaged or recycled include wood, concrete, metals, asphalt, and packaging materials. Documentation must include records of waste diversion, such as receipts, weight tickets, or recycling facility reports, to verify compliance. *SITES v2 Rating System pp. 96*

15 **Support Local Economy** is a credit worth 3 points for SITES certification. The intent of this credit is to provide economic and social benefits to the local community during site construction by providing employment

opportunities and purchasing local materials and services. The requirements for this credit mandate the support of the local economy by sourcing materials, labor, and services from local businesses and suppliers. Projects must ensure that at least 20% of total project expenditure is allocated to local businesses, workforce, or materials sourced within 100 miles (160 km) of the site. Eligible expenditures include construction materials, site furnishings, plants, and professional services. Additional points may be earned to exceed the minimum percentage. Documentation must include procurement records, supplier locations, and verification of compliance with local sourcing requirements. *SITES v2 Rating System pp. 84*

16 **Restore Soils Disturbed During Construction** is a required credit for SITES certification. The intent of this credit is to support healthy plants, biological communities, water storage, and infiltration by restoring soils disturbed during construction. The requirements for this prerequisite mandate the restoration of soils disturbed during construction to support healthy vegetation, stormwater infiltration, and ecosystem functions. Projects must restore all disturbed soils by addressing soil compaction, fertility, and biological health using techniques such as aeration, soil amendments, organic matter addition, and decompaction to a minimum depth of 12 inches (30 cm). Restored soils must meet performance standards for organic matter content, infiltration rates, and biological activity. Documentation must include a soil restoration plan, site assessment, and verification of implemented restoration measures. *SITES v2 Rating System pp. 93-95*

17 **Protect Air Quality** is a credit worth 3 points for SITES certification. The intent of this credit is to protect air quality and reduce pollution by using construction equipment that reduces emissions of localized air pollutants and greenhouse gases. The requirements for this credit mandate the implementation of measures to protect air quality during construction by minimizing dust, emissions, and airborne pollutants. Projects must develop and enforce an Air Quality Management Plan that includes strategies such as dust suppression (e.g., water spraying, mulching), erosion control, proper material storage, and reducing emissions from construction equipment by using low-emission vehicles, idle reduction policies, and exhaust filtration systems. Documentation must include a site-specific air quality management plan, implementation records, and verification of compliance with air quality protection measures. *SITES v2 Rating System pp. 98*

IN-GROUND LANDSCAPE: VEGETATION

18 **Heat Island Reduction** is a credit worth 1 point for LEED certification. The intent of this credit is to minimize effects on micro climates and human and wildlife habitats by reducing heat islands. The requirements for this credit can be achieved through one of two options. The Non-roof and Roof Measures option requires that at least 50% of hardscapes and roofs (excluding common roads) meet heat-reducing strategies such as using high-albedo materials, installing vegetated roofs, providing shading with trees or structures, or using open-grid pavement systems. Roofing materials must meet specific Solar Reflectance Index (SRI) values based on slope, with low-sloped roofs requiring an aged SRI of 64 or higher and steep-sloped roofs requiring an aged SRI of 32 or higher. The Tree Planting option requires installing trees that will provide at least 20 feet of canopy width or a cumulative shading area of 315 square feet within ten years. Shading calculations must be based on midday sun exposure at the summer solstice**.** *LEED v4.1 Residential Family Rating System pp. 16-17*

19 **Control and Manage Invasive Plants** is a pre-requisite for SITES certification. The intent of this credit is to 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. The requirements for this prerequisite mandate the control and management of invasive plant species to prevent ecological harm and support native biodiversity. Projects must identify and remove existing invasive species on-site and implement measures to prevent their introduction and spread. Acceptable strategies include manual removal, targeted herbicide application, and habitat restoration with native or non-invasive plants. Ongoing monitoring and maintenance must be included to ensure long-term control. Documentation must include a site assessment identifying invasive species, a management plan detailing removal and prevention strategies, and verification of implementation. *SITES v2 Rating System pp. 40-41*

20 **Use Appropriate Plants** is a pre-requisite for SITES certification. The intent of this credit is to improve landscape performance and reduce resource use by installing only plants that are appropriate for site conditions, climate, and design intent. The requirements for this prerequisite mandate the use of appropriate, site-adapted plants to support ecological function and reduce resource consumption. Projects must prioritize native and non-invasive species suited to the site's climate, soil, and hydrology while avoiding plants listed as invasive. Additionally, projects must minimize the use of turf grass and limit its placement to areas designated for active recreation. Documentation must include a plant list with scientific names, an assessment of site suitability, and verification that invasive species are not used. *SITES v2 Rating System pp. 42*

21 **Conserve Healthy Soils and Appropriate Vegetation** is a credit worth up to 6 points for SITES certification. The intention of this credit is to protect soil health and reduce resource use by preserving existing vegetation and healthy soils that are suited to the site's conditions and design goals. The requirements for this credit can be met by conserving healthy soils and appropriate plants within designated Vegetation and Soil Protection Zones (VSPZs) that cover at least 50%, 75%, or 95% of the site's existing vegetated area, earning 4, 5, or 6 points respectively. The site assessment must document and locate the preserved soils and vegetation. Limited restoration activities, such as removing invasive species, are permitted within VSPZs. *SITES v2 Rating System pp. 43-44*

22 **Conserve Special Status Vegetation Conserve Special Status Vegetation** is a credit worth 4 points for SITES certification. The intent of this credit is to protect ecosystem services by identifying and conserving vegetation on-site that has been designated as special status by local, state, or federal entities. These may include heritage or legacy trees, rare or endangered species, specimen trees, and plants with unique genetic traits. To meet the requirements, projects must establish Vegetation and Soil

Protection Zones (VSPZs) around these plants, document their location in the pre-design site assessment, and include long-term management strategies in the site maintenance plan. These strategies must ensure the ongoing protection of each plant's critical growing conditions, such as hydrology, associated species, and sun exposure. *SITES v2 Rating System pp. 45*

23 **Conserve and Use Native Plants** is a credit worth up to 6 points for SITES certification. The intent of this credit is to foster habitat for native wildlife that is necessary for plant reproduction by conserving or installing plants that are native to the site's ecoregion. The requirements for this credit mandate the use and conservation of native plants to support local ecosystems and reduce resource inputs. Projects must ensure that at least 75% of total planted vegetation (excluding turf-grass) consists of native or adapted plant species that thrive in the site's climate, soil, and hydrology. Existing native vegetation should be protected and incorporated into the design whenever possible. Documentation must include a plant species list, percentage calculations of native plant coverage, and verification of preservation or planting efforts. *SITES v2 Rating System pp. 46*

24 **Conserve and Restore Native Plant Communities** is a credit worth up to 6 points for SITES certification. The intent of this credit is to 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. The requirements for this credit mandate the conservation and restoration of native plant communities to enhance biodiversity and ecosystem services. Projects must protect at least 50% of existing native plant communities on-site or, if preservation is not feasible, restore a minimum of 25% of the total site area with native vegetation. Restoration efforts must use regionally appropriate plant species and mimic natural plant communities. Documentation must include a site assessment identifying existing native vegetation, a conservation or restoration plan, and verification of implementation.
SITES v2 Rating System pp. 47

25 **Optimize Biomass** is a credit worth up to 6 points for SITES certification. The intent of this credit is to 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. The requirements for this credit mandate the enhancement of site biomass to improve ecological function and carbon sequestration. Projects must increase the total site biomass compared to pre-development conditions by preserving existing vegetation, planting new vegetation, or restoring degraded areas. Biomass calculations must account for plant species, size, and projected growth over time. Additional points can be earned for achieving higher biomass increases. Documentation must include a site assessment of existing biomass, calculations demonstrating the net gain, and verification of implemented strategies. *SITES v2 Rating System pp. 48*

26 **Reduce Urban Heat Island** is a credit worth up to 4 points for SITES certification. The intent of this credit is to minimize effects on micro-climate and human and wildlife habitat by using vegetation and reflective materials to reduce heat island effects. The requirements for this credit can be achieved by implementing strategies that reduce heat island effects and mitigate temperature increases caused by built surfaces. Projects must apply heat-reducing materials or design techniques to at least 50% of site hardscapes, including pavements, parking areas, and other impervious surfaces. Strategies include using high-albedo materials, installing vegetative covers such as green roofs or tree canopies, and incorporating permeable pavements that reduce heat absorption. Shade structures and reflective coatings can also be used to further minimize heat retention. Points are awarded based on the percentage of the site area that meets these requirements. *SITES v2 Rating System pp. 49-50*

27 **Reduce the Risk of Catastrophic Wildfire** is a credit worth 4 points for SITES certification. The intent of this credit is to reduce the risk of catastrophic wildfire on site and in adjacent landscapes by designing,

building, and maintaining sites to manage fuels. The requirements for this credit mandate the implementation of fire-resistant landscape design strategies to minimize wildfire risk. Projects must establish defensible space zones around structures by using fire-resistant vegetation, fuel breaks, and low-combustibility materials. Additional strategies include removing dead plant material, maintaining proper plant spacing, and creating fire-resistant buffer zones. The design must follow regional wildfire management guidelines and incorporate ongoing maintenance to reduce fuel loads. Documentation must include a wildfire risk assessment, a defensible space plan, and verification of implemented fire mitigation measures.
SITES v2 Rating System pp. 53

28 **Support Sustainability in Plant Production** is a credit worth up to 5 points for SITES certification. The intent of this credit is to 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. The requirements for this credit mandate the use of sustainably grown and harvested plants to support environmentally responsible plant production. Projects must source at least 50% of total plants (by cost or quantity) from nurseries or suppliers that implement sustainable practices, such as reducing synthetic fertilizers and pesticides, conserving water, and using environmentally responsible growing media. Additional points can be earned for sourcing a higher percentage of sustainably grown plants. Documentation must include supplier certifications, procurement records, and verification that the plants meet sustainability criteria. *SITES v2 Rating System pp. 67-68*

29 **Divert Reusable Vegetation** is a credit worth 3 points for SITES certification. The intent of this credit is to support a net-zero waste site by diverting from disposal vegetation, mineral and rock waste, and soils generated during construction. The requirements for this credit mandate the reuse or re-purposing of vegetation, rocks, and soil to minimize waste and reduce the environmental impact of disposal. Projects must salvage and reuse at least 50% of site-sourced vegetation, rocks, and soil either on-site or through redistribution to other projects or facilities. Acceptable strategies include transplanting trees and plants, reusing excavated soil for grading or restoration, and re-purposing rocks for landscape features or erosion control. Documentation must include a materials inventory, records of salvaged and reused materials, and verification of implementation.
SITES v2 Rating System pp. 97

30 **Restore Soils Disturbed by Previous Development** is a credit worth up to 5 points for SITES certification. The intent of this credit is to support healthy plants, biological communities, water storage, and infiltration by restoring soils in areas disturbed by previous development. The requirements for this credit mandate the restoration of soils previously disturbed by development to improve soil health, support vegetation, and enhance ecosystem functions. Projects must restore at least 50% of the total disturbed area by addressing soil compaction, organic matter content, and infiltration capacity using techniques such as aeration, soil amendments, organic matter addition, and decompaction to a minimum depth of 12 inches (30 cm). Restored soils must meet performance standards for organic content, permeability, and biological activity. Documentation must include a soil restoration plan, site assessment, and verification of implemented restoration measures.
SITES v2 Rating System pp. 93-95

IN-GROUND LANDSCAPE: WATER

31 **Outdoor Water Use** is a credit worth up to 4 points for LEED certification. The intent of this credit is to reduce outdoor water consumption through efficient landscaping practices. The requirements for this credit focus on reducing outdoor water consumption through efficient irrigation and sustainable landscaping practices. Projects must either eliminate the need for permanent irrigation after the establishment period or demonstrate a 50% reduction in water use compared to a baseline. Strategies to achieve compliance include using drought-tolerant or native plants, installing high-efficiency irrigation systems, incorporating rainwater or gray-water reuse, and implementing soil moisture sensors. Documentation must include a landscape water budget and calculations verifying the reduction or elimination of potable water use for irrigation.
LEED v4.1 Residential Family Rating System pp. 27

32 **Water Use** is a pre-requisite credit for LEED certification. The intention of this credit is to reduce potable water consumption by promoting efficient water use and sustainable management strategies. The requirements for this prerequisite can be achieved by establishing a baseline for water consumption and implementing measures to reduce overall water use. Projects must demonstrate a reduction in indoor and outdoor potable water use compared to a standard baseline, using water-efficient fixtures, appliances, irrigation systems, and alternative water sources such as rainwater or gray-water. Indoor plumbing fixtures must meet EPA WaterSense or equivalent efficiency standards, and outdoor irrigation must be optimized to minimize potable water demand. Documentation must include water use calculations, fixture specifications, and verification of efficiency measures
LEED v4.1 Residential Family Rating System pp. 21

33 **Rainwater Management** is a credit worth up to 2 points for LEED certification. The intent of this credit is to reduce rainwater runoff volume from the site. The requirements for this credit can be achieved through one of two options. The Rainwater Management option requires projects to use low-impact development (LID) techniques to minimize stormwater runoff by incorporating strategies such as permeable paving, vegetated roofs, rain gardens, or rainwater harvesting systems. Points are awarded based on the percentage of the site designed to manage runoff from a two-year, 24-hour storm event, with 50–64% permeability earning 1 point and 65% or more earning 2 points. The National Pollutant Discharge Elimination System (NPDES) Compliance option requires projects to retain and manage on-site stormwater runoff for at least the 80th percentile rainfall event for 1 point or the 85th percentile rainfall event for 2 points. Alternatively, projects can achieve 1 point by implementing basic landscape design strategies, such as eliminating turf in shaded and steep-slope areas, avoiding invasive plant species, adding mulch or soil amendments based on soil testing, and tilling compacted soil to a depth of at least 6 inches.
LEED v4.1 Residential Family Rating System pp. 18-19

34 **Restore Aquatic Ecosystems** is a credit worth up to 6 points for SITES certification. The intent of this credit is to 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. The requirements for this credit mandate the protection, rehabilitation, or reintroduction of natural aquatic features such as wetlands, streams, ponds, or riparian buffers using ecological restoration techniques. Strategies include removing invasive species, stabilizing banks, improving water flow, and enhancing native vegetation to support biodiversity and ecosystem function. Documentation must include a restoration plan, site assessment, and monitoring strategy demonstrating how the project improves or sustains aquatic ecosystem health. *SITES v2 Rating System pp. 35-36*

35 **Reduce Water Use for Landscape Irrigation** is a pre-requisite for SITES certification. The intent of this credit is to 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. The requirements for this prerequisite focus on reducing outdoor water consumption by implementing efficient irrigation strategies. Projects must design landscapes that use no potable water for irrigation beyond an initial establishment period or demonstrate a 50% reduction in landscape water use compared to a baseline case. This can be achieved through strategies such as selecting drought-tolerant or native plants, using non-potable water sources like rainwater or recycled water, and installing high-efficiency irrigation systems with smart controllers. If an irrigation system is installed, it must include water-efficient technology such as drip irrigation, moisture sensors, or weather-based controllers to optimize water use. *SITES v2 Rating System pp. 29-30*

36 **Manage Precipitation on Site** is a pre-requisite of SITES certification. The intent of this credit is to reduce negative impacts to aquatic ecosystems, channel morphology, and dry weather base flow by replicating natural hydrologic conditions and retaining precipitation on site. The requirements for this prerequisite focus on managing stormwater on-site to reduce runoff and minimize negative impacts on natural water systems. Projects must capture and retain precipitation from the 60th percentile regional storm event using strategies such as bio-retention areas, green infrastructure, permeable surfaces, and rainwater harvesting systems. Stormwater management techniques should promote infiltration, evapotranspiration, or reuse to reduce reliance on municipal drainage systems. Documentation must include stormwater calculations and a site plan demonstrating how runoff is managed in compliance with the requirements.
SITES v2 Rating System pp. 27-28

37 **Manage Precipitation Beyond Baseline** is a credit worth up to 6 points for SITES certification. The intent of this credit is to 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. The requirements for this credit focus on enhancing stormwater management by capturing and retaining precipitation beyond the baseline requirement. Projects must manage stormwater from at least the 80th percentile regional storm event through strategies such as bio-retention, permeable paving, green roofs, and rainwater harvesting. Additional points can be earned by increasing retention capacity to the 90th or 95th percentile storm event. Stormwater management must prioritize infiltration, evapotranspiration, or on-site reuse to reduce runoff and support site hydrology. Documentation must include stormwater calculations and a site plan demonstrating compliance with the selected retention threshold.
SITES v2 Rating System pp. 31

38 **Reduce Outdoor Water Use** is a credit worth up to 6 points for SITES certification. The intent of this credit is to 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. The requirements for this credit focus on reducing potable water consumption for landscape irrigation by implementing efficient water management strategies. Projects must demonstrate at least a 50% reduction in outdoor water use compared to a baseline, with additional points available for achieving 75% or 100% reductions. Strategies include using drought-tolerant or native plants, installing high-efficiency irrigation systems, incorporating rainwater or gray-water reuse, and optimizing soil moisture retention. Documentation must include a landscape water budget and calculations verifying the percentage reduction in water use.
SITES v2 Rating System pp. 32-33

39

Design Functional Stormwater Features as Amenities is a credit worth up to 5 points for SITES certification. The intent of this credit is to 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. The requirements for this credit focus on integrating stormwater management features into the site design as functional and aesthetic amenities. Projects must incorporate stormwater strategies such as bio-retention areas, rain gardens, wetlands, bioswales, or permeable pavements that provide both stormwater control and user benefits like recreation, education, or habitat creation. These features should be visible, accessible, and enhance the site's ecological and social value. Documentation must include a site plan and narrative demonstrating how the stormwater features serve both hydrological and amenity functions.
SITES v2 Rating System pp. 34

POST-DESIGN

The Post-Design Checklist focuses on the long-term performance, maintenance, and operational strategies necessary to sustain the project's environmental goals after construction is complete. This checklist supports the transition from design intent to real-world application by emphasizing practices such as performance monitoring, adaptive maintenance planning, material durability, and occupant education. It ensures that both building and landscape systems continue to function efficiently and sustainably over time. The checklist aligns with LEED and SITES operations-related credits, helping project teams track post-occupancy metrics and uphold sustainability commitments throughout the life-cycle of the site and structure. By incorporating forward-thinking strategies, the Post-Design Checklist promotes resilience, resource conservation, and continued environmental stewardship.

Primary Users:
Facility Managers, Property Owners and Developers, Landscape Maintenance Team, Building Operations Staff, Sustainability Consultants

Post-Design Checklist

(L) - LEED

(S) - SITES

OPERATIONS + MAINTENANCE CREDITS

☐	(L) Education of Homeowner	Required	
☐	(S) Plan for Sustainable Site Maintenance	Required	
☐	(S) Recycle Organic Matter	3 to 5 pts	
☐	(S) Minimize Pesticides and Fertilizer Use	4 to 5 pts	
☐	(S) Reduce Outdoor Energy Consumption	2 to 4 pts	
☐	(S) Use Renewable Sources for Landscape Electricity Needs	3 to 4 pts	
☐	(S) Protect Air Quality During Landscape Maintenance	2 to 4 pts	

PERFORMANCE + INNOVATION CREDITS

☐	(L) Preliminary Rating	Required	
☐	(L) Innovation	5 pts	
☐	(L) LEED Accredited Professional	1 pt	
☐	(S) Promote Sustainability Awareness and Education	3 to 4 pts	
☐	(S) Develop and Communicate a Case Study	3 pts	
☐	(S) Plan to Monitor and Report Site Performance	4 pts	
☐	(S) Innovation or Exemplary Performance	3 to 9 pts	

POTENTIAL POINTS

LEED	42 pts
SITES	6 pts

FIGURE 4.15 POST-DESIGN CATALOG

OPERATIONS + MAINTENANCE

Site Design describes the time period in which you are selecting the site in which you are potentially developing. This period is crucial for ...

REQUIRED
Education of Homeowner
1

6 PTS
Reduce Outdoor Energy Consumption
5

REQUIRED
Plan for Sustainable Site Maintenance
2

REQUIRED
Use Renewable Sources for Landscape Electricity Needs
6

REQUIRED
Recycle Organic Matter
3

REQUIRED
Protect Air Quality During Landscape Maintenance
7

10 PTS
Minimize Pesticides and Fertilizer Use
4

PERFORMANCE + INNOVATION:

Site Design describes the time period in which you are selecting the site in which you are potentially developing. This period is crucial for ...

REQUIRED
Preliminary Rating
17

4 PTS
Develop and Communicate a Case Study
21

REQUIRED
Innovation
18

REQUIRED
Plan to Monitor and Report Site Performance
22

REQUIRED
LEED Accredited Professional
19

3 - 6 PTS
Innovation or Exemplary Performance
23

10 PTS
Promote Sustainability Awareness Education
20

POST DESIGN: OPERATIONS + MAINTENANCE

1 **Education of Homeowner** is a pre-requisite for LEED certification. The intent of this credit is to ensure that building occupants and managers understand how to operate and maintain the home efficiently to maximize energy performance and sustainability. The requirements for this prerequisite can be achieved by providing an Operations & Maintenance (O&M) manual and conducting a walk through of the home or building to educate occupants on energy-efficient features and best practices. The manual must include a completed LEED checklist, ENERGY STAR checklists, manufacturers' manuals for installed equipment, guidance on energy and water efficiency, maintenance instructions, and information on local green power options. The walk through must cover identification of installed systems, instructions for use, and maintenance requirements. Documentation must include a copy of the O&M manual, records of the walk through, and verification of occupant education efforts. *LEED v4.1 Residential Family Rating System pp. 31*

2 **Plan for Sustainable Site Maintenance** is a pre-requisite credit for SITES certification. The intent of this credit is to ensure long-term sustainability by developing a maintenance plan that preserves the site's environmental, social, and economic benefits. The requirements for this prerequisite can be achieved by developing a site maintenance plan that outlines sustainable management practices for the long-term upkeep of the site. The plan must address strategies for soil health, water management, vegetation care, material maintenance, pest control, and waste management. It should prioritize non-toxic, resource-efficient, and climate-adaptive approaches while minimizing environmental impacts. The plan must be communicated to site managers and maintenance personnel to ensure its proper implementation. Documentation must include the written maintenance plan and verification that has been integrated into the site's management procedures. *SITES v2 Rating System pp. 100-103*

3 **Recycle Organic Matter** is a credit worth up to 5 points for SITES certification. The intent for this credit is to reduce organic waste sent to landfills and promote soil health by recycling organic materials on-site or through an off-site composting program. The requirements for this credit can be achieved by implementing a system for collecting and recycling organic matter, such as landscape debris, food scraps, and biodegradable materials. Projects must compost at least 50% of organic waste generated on-site or participate in a municipal or commercial composting program. Acceptable strategies include on-site composting, mulching, or anaerobic digestion. Documentation must include a waste management plan, records of organic waste diversion, and verification of composting or recycling efforts. *SITES v2 Rating System pp. 105*

4 **Minimize Pesticides and Fertilizer Use** is a credit worth up to 5 points for SITES certification. The intent of this credit is to reduce environmental and human health risks associated with pesticide and fertilizer use by promoting sustainable landscape management practices. The requirements for this credit can be achieved by implementing an integrated pest management (IPM) and sustainable fertilization plan that minimizes the use of synthetic chemicals. Projects must prioritize organic, slow-release, or low-toxicity fertilizers and adopt biological, mechanical, or cultural pest control methods instead of conventional pesticides. If chemical treatments are necessary, they must be targeted, applied in limited quantities, and aligned with best management practices to reduce runoff and contamination. Documentation must include a site maintenance plan detailing pesticide and fertilizer use, application methods, and verification of sustainable management practices. *SITES v2 Rating System pp. 106-108*

5 **Reduce Outdoor Energy Consumption** is a credit worth up to 4 points for SITES certification. The intent for this credit is to minimize energy use associated with outdoor lighting, irrigation, and other site-related systems, reducing environmental impact and operational costs. The requirements

for this credit can be achieved by implementing energy-efficient strategies for outdoor systems. Projects must reduce outdoor energy consumption by at least 30% compared to a baseline scenario. Strategies may include high-efficiency lighting with motion sensors or timers, solar-powered fixtures, energy-efficient irrigation pumps, and the use of renewable energy sources. Additional points may be awarded for achieving higher reductions. Documentation must include energy consumption calculations, a site plan identifying energy-saving measures, and verification of implementation. *SITES v2 Rating System pp. 109*

6 **Use Renewable Sources for Landscape Electricity Needs** is a credit worth up to 4 points for SITES certification. The intent for this credit is to reduce reliance on nonrenewable energy sources by incorporating renewable energy systems for landscape electricity needs. The requirements for this credit can be achieved by ensuring that at least 50% of the electricity used for landscape-related operations comes from on-site or off-site renewable energy sources. Acceptable strategies include solar-powered lighting and irrigation systems, wind or hydropower, and purchasing renewable energy credits (RECs) from a certified provider. Additional points may be awarded for achieving higher percentages of renewable energy use. Documentation must include energy sourcing records, system specifications, and verification of renewable energy integration. *SITES v2 Rating System pp. 110-111*

7 **Protect Air Quality During Landscape Maintenance** is a credit worth up to 4 points for SITES certification. The intent for this credit is to minimize air pollution and greenhouse gas emissions from landscape maintenance activities by using low-emission and non-polluting equipment and practices. The requirements for this credit can be achieved by implementing strategies that reduce emissions from landscape maintenance. Projects must use electric, battery-powered, or low-emission equipment for at least 50% of routine landscape maintenance activities. Additional measures include restricting the use of gas-powered equipment, adopting manual or mechanical alternatives, and establishing no-idling policies for maintenance vehicles. Documentation must include a landscape maintenance plan, records of equipment use, and verification of air quality protection measures.
SITES v2 Rating System pp. 112

POST DESIGN: PERFORMANCE + INNOVATION

8 **Preliminary Rating** is a pre-requisite credit for LEED certification. The intent of this credit is to ensure that project teams establish sustainability goals early in the design process by evaluating potential LEED certification outcomes. The requirements for this prerequisite can be achieved by conducting a preliminary LEED assessment during the early design phase. The project team must review the rating system requirements, identify achievable credits, and determine the target certification level. This assessment must be documented in a preliminary LEED checklist or equivalent report, outlining strategies for meeting prerequisites and credits. Documentation must include the completed preliminary rating evaluation and confirmation that sustainability goals were integrated into the project planning process. *LEED v4.1 Residential Family Rating System pp. 66*

9 **Innovation** is a credit worth up to 5 points for LEED certification. The intent for this credit is to encourage exceptional performance for current credits and promote innovative performance in pioneering areas. The requirements for this credit can be achieved through one of three approaches. The Innovative Performance approach allows projects to implement a sustainable strategy not addressed by existing LEED credits, provided it delivers measurable environmental benefits. The Exemplary Performance approach rewards projects that exceed the highest performance threshold of an existing LEED credit, demonstrating superior achievement in sustainability. Lastly, the Pilot Credit approach allows projects to earn points by achieving a credit from the LEED Pilot Credit Library, which includes new and experimental sustainability strategies. Documentation must include a detailed narrative, performance data, and verification of implementation. *LEED v4.1 Residential Family Rating System pp. 67*

10 **LEED Accredited Professional** is a credit worth 1 point for LEED certification. The intent of this credit is to encourage project teams to integrate sustainability principles by including a LEED Accredited Professional (LEED AP) with expertise relevant to the project's certification goals. The requirements for this credit can be achieved by having at least one LEED Accredited Professional (LEED AP) as an active member of the project team. The LEED AP must hold a credential specific to the rating system being pursued, ensuring they provide expertise and guidance throughout the certification process. Documentation must include verification of the team member's accreditation and their role in the project. *LEED v4.1 Residential Family Rating System pp. 68*

11 **Promote Sustainability Awareness and Education** is a credit worth up to 4 points for SITES certification. The intent of this credit is to increase public awareness and understanding of the site's sustainability features, encouraging responsible environmental stewardship. The requirements for this credit can be achieved by developing and implementing educational programs or interpretive elements that communicate the project's sustainability strategies. Projects must include at least one form of public engagement, such as informational signage, guided tours, digital resources, workshops, or educational partnerships. The content should highlight key sustainability features, such as stormwater management, native landscaping, renewable energy, or habitat restoration. Documentation must include a description of the educational components, a site plan identifying their locations, and verification of implementation. *SITES v2 Rating System pp. 114-115*

12 **Develop and Communicate a Case Study** is a credit worth 3 points for SITES certification. The intent of this credit is to document and share the project's sustainability achievements, contributing to industry knowledge and inspiring future sustainable site development. The requirements for this credit can be achieved by developing a case study that highlights the project's sustainability goals, strategies, challenges, and outcomes. The case study must include quantifiable benefits, such as water or energy savings, biodiversity improvements, or community engagement impacts. It must

be made publicly accessible through a website, publication, conference presentation, or educational program. Documentation must include the completed case study, details on how it is being shared, and verification of its publication or distribution. *SITES v2 Rating System pp. 116*

13

Plan to Monitor and Report Site Performance is a credit worth 4 points for SITES certification. The intent of this credit is to ensure the long-term success of sustainable site strategies by establishing a system for monitoring and reporting key performance metrics. The requirements for this credit can be achieved by developing a site performance monitoring plan that tracks environmental, social, and economic benefits over time. The plan must include metrics related to water use, energy consumption, vegetation health, soil quality, biodiversity, and human engagement, as applicable. Projects must outline monitoring methods, data collection frequency, and responsible parties. A reporting framework must be established to share findings with stakeholders through annual reports, public dashboards, or research collaborations. Documentation must include a written monitoring plan, identified performance metrics, and verification of reporting methods. *SITES v2 Rating System pp. 117-118*

14

Innovation or Exemplary Performance is a credit worth up to 9 points for SITES certification. The intent of this credit is to encourage projects to achieve exceptional performance beyond existing SITES requirements or implement innovative sustainability strategies that demonstrate significant environmental benefits. The requirements for this credit can be achieved through one of two approaches. The Innovation approach allows projects to develop and implement a unique sustainability strategy not covered by existing SITES credits, provided it delivers measurable environmental benefits. The Exemplary Performance approach rewards projects that surpass the highest performance threshold of an existing SITES credit, demonstrating superior achievement in sustainability. Documentation must include a detailed narrative, performance data, and verification of implementation. *SITES v2 Rating System pp. 120*

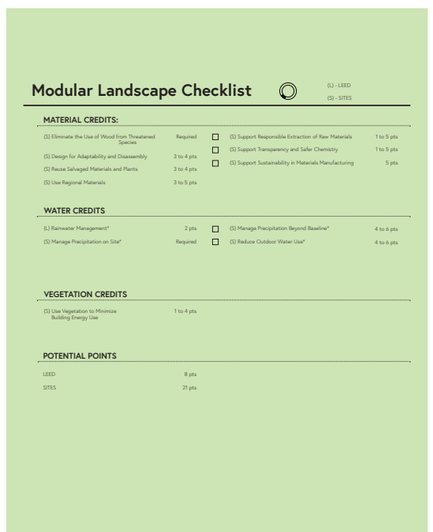
05 PRECEDENTS

INTRODUCTION TO PRECEDENTS

Precedent studies serve as a critical method for informing design decisions related to the integration of modular landscape elements within the Intuitive Home Prefabricated Package. These studies focus on two primary areas: (1) the application of modular and prefabricated construction strategies in landscape design, and (2) sustainable design opportunities that align with LEED and SITES criteria, as outlined in the Modular Landscape Checklist. Additional emphasis is placed on identifying on-site opportunities that can contribute to certification goals.

The selected precedents offer contextual insight into a variety of modular and sustainable features, including systems for decking, green walls, water cisterns, native planting strategies, and on-site water management. These precedent studies provide tangible examples of best practices and performance outcomes, directly informing the development of the Intuitive Home Prefabricated Package as well as its implementation on a realistic site. By grounding the project in proven, real-world applications, the precedent studies ensure that proposed solutions are both feasible and aligned with certification objectives.

FIGURE 5.1 LANDSCAPE CHECKLISTS



Modular Landscape Checklist

(L) - LEED
(S) - SITES

MATERIAL CREDITS:

(S) Eliminate the Use of Wood from Threatened Species	Required	(S) Support Responsible Extraction of Raw Materials	1 to 5 pts
(S) Design for Adaptability and Disassembly	3 to 4 pts	(S) Support Transparency and Safer Chemistry	1 to 5 pts
(S) Reuse Salvaged Materials and Plants	3 to 4 pts	(S) Support Sustainability in Materials Manufacturing	5 pts
(S) Use Regional Materials	3 to 5 pts		

WATER CREDITS

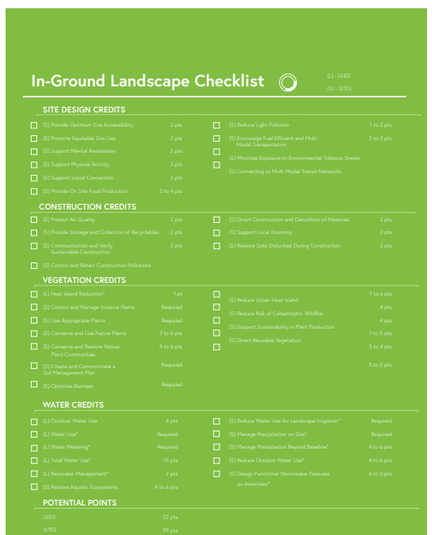
(L) Rainwater Management*	2 pts	(S) Manage Precipitation Beyond Baseline*	4 to 6 pts
(S) Manage Precipitation on Site*	Required	(S) Reduce Outdoor Water Use*	4 to 6 pts

VEGETATION CREDITS

(S) Use Vegetation to Minimize Building Energy Use	1 to 4 pts

POTENTIAL POINTS

LEED	8 pts
SITES	21 pts



In-Ground Landscape Checklist

(L) - LEED
(S) - SITES

SITE DESIGN CREDITS

(S) Provide Optimum Site Accessibility	2 pts	(S) Reduce Light Pollution	1 to 2 pts
(S) Promote Equitable Site Use	2 pts	(S) Encourage Fuel Efficient and Multi Modal Transportation	2 to 3 pts
(S) Support Mental Restoration	2 pts	(S) Minimize Exposure to Environmental Tobacco Smoke	
(S) Support Physical Activity	2 pts	(S) Connecting to Multi Modal Transit Networks	
(S) Support Social Connection	2 pts		
(S) Provide On Site Food Production	3 to 4 pts		

CONSTRUCTION CREDITS

(S) Protect Air Quality	2 pts	(S) Divert Construction and Demolition of Materials	2 pts
(S) Provide Storage and Collection of Recyclables	2 pts	(S) Support Local Economy	2 pts
(S) Communication and Verify Sustainable Construction	2 pts	(S) Restore Soils Disturbed During Construction	2 pts
(S) Control and Retain Construction Pollutions			

VEGETATION CREDITS

(L) Heat Island Reduction*	1 pt	(S) Reduce Urban Heat Island	1 to 6 pts
(S) Control and Manage Invasive Plants	Required	(S) Reduce Risk of Catastrophic Wildfire	4 pts
(S) Use Appropriate Plants	Required	(S) Support Sustainability in Plant Production	1 to 5 pts
(S) Conserve and Use Native Plants	3 to 6 pts	(S) Divert Reusable Vegetation	3 to 4 pts
(S) Conserve and Restore Native Plant Communities	4 to 6 pts		3 to 5 pts
(S) Create and Communicate a Soil Management Plan	Required		
(S) Optimize Biomass	Required		

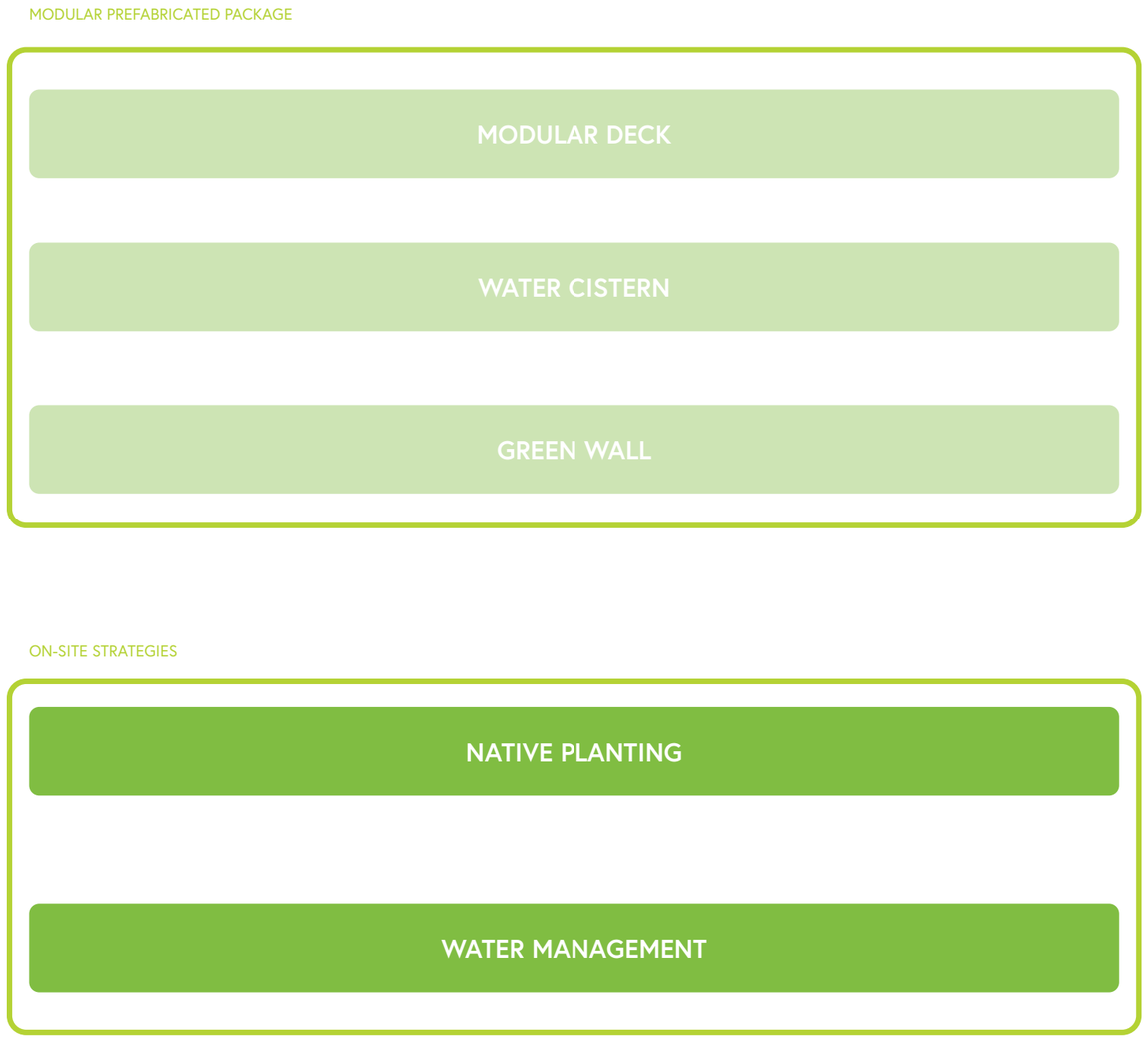
WATER CREDITS

(L) Outdoor Water Use	4 pts	(S) Reduce Water Use for Landscape Irrigation*	Required
(L) Water Use*	Required	(S) Manage Precipitation on Site*	Required
(L) Water Metering*	Required	(S) Manage Precipitation Beyond Baseline*	4 to 6 pts
(L) Total Water Use*	15 pts	(S) Reduce Outdoor Water Use*	4 to 6 pts
(L) Rainwater Management*	2 pts	(S) Design Functional Stormwater Features as Amenities*	4 to 5 pts
(S) Restore Aquatic Ecosystems	4 to 6 pts		

POTENTIAL POINTS

LEED	22 pts
SITES	99 pts

FIGURE 5.2 LANDSCAPE DESIGN COMPONENTS



75TH STREET BOARDWALK

Chicago, Illinois

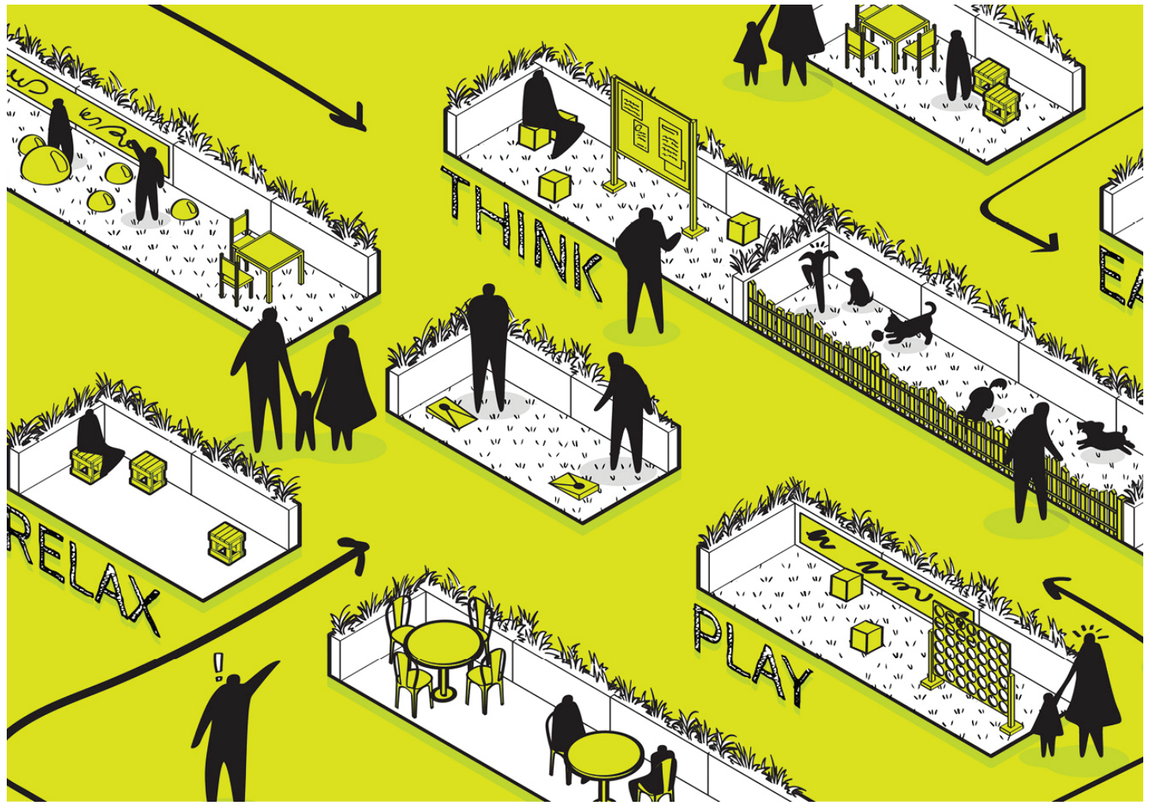


FIGURE 5.3 75TH STREET BOARDWALK GRAPHIC

LOCATION:
Chicago, Illinois

CONTEXT:
Parklet, Temporary Design

DESIGN TEAM:
site design group, ltd.

Modular Landscape - Modular Deck

FIGURE 5.4 75TH STREET BOARDWALK CONSTRUCTION

PROJECT DESCRIPTION:
The 75th Street Boardwalk, located in the Chatham neighborhood on Chicago's South Side, transforms underutilized on-street parking spaces into dynamic outdoor environments that directly support and uplift Black-owned businesses. Conceived as a series of modular "rooms" for dining, seating, fitness, and recreation, the project reclaims plywood from 2020 business board-ups, turning symbols of unrest into tools for renewal. The initiative also incorporates workforce development by connecting Black contractors with local youth in hands-on carpentry training, fostering both economic opportunity and skill-building. Through ongoing engagement with community members and stakeholders, the Boardwalk stands as a powerful example of tactical urbanism—demonstrating how small-scale, community-led interventions can catalyze broader social, spatial, and economic revitalization (site design group ltd. n.d.).

ENVIRONMENTAL AND NATURAL RESOURCES 2 BUILDING

Tucson, Arizona

FIGURE 5.5 ENVIRONMENTAL AND NATURAL RESOURCE BUILDING

LOCATION:
Tucson, Arizona

CONTEXT:
Courtyard/Plaza | School/University

DESIGN TEAM:
Colwell Shelor Landscape

Modular Landscape - Water Cistern

FIGURE 5.6 ENVIRONMENTAL AND NATURAL RESOURCE BUILDING

FIGURE 5.7 ENVIRONMENTAL AND NATURAL RESOURCE BUILDING

PROJECT DESCRIPTION:
ENR2, located on the south edge of the University of Arizona's Tucson campus, reinterprets natural systems to tackle environmental challenges. Centered around a slot canyon design inspired by the region's landscapes, this LEED Platinum-certified, five-story building was transformed from a parking lot into a model of holistic sustainability. Its vertical ecosystem of native flora and fauna relies solely on stormwater, condensate, and reclaimed water, while the integrated structure and landscape mitigate summer heat, lower energy costs, and create shaded micro-climates. Serving as a hub for research, administration, and instruction, ENR2 exemplifies the fusion of human and natural systems in a high-performing landscape (Dimond and Gilliam 2023).

LIVING WALL AT TEXAS A&M

College Station, Texas

Modular Landscape - Green Wall

PROJECT DESCRIPTION:
Students in landscape and architecture programs collaborated on a multi-year project to design, build, and evaluate a custom living wall system aimed at optimizing a micro-climate for plants. Constructed from sheet metal by-products, the system supports a circular economy while accommodating native vegetation. Key challenges included ensuring low maintenance and adapting to a hot, south-facing micro-climate. Research on metal surface colors led to the design of modules that reduce heat gain, secured by a steel support system and arranged diagonally to provide vertical space for plant growth. The orientation of the modules allows for increased shading and efficient water distribution, minimizing stress on the plants while maximizing surface coverage.

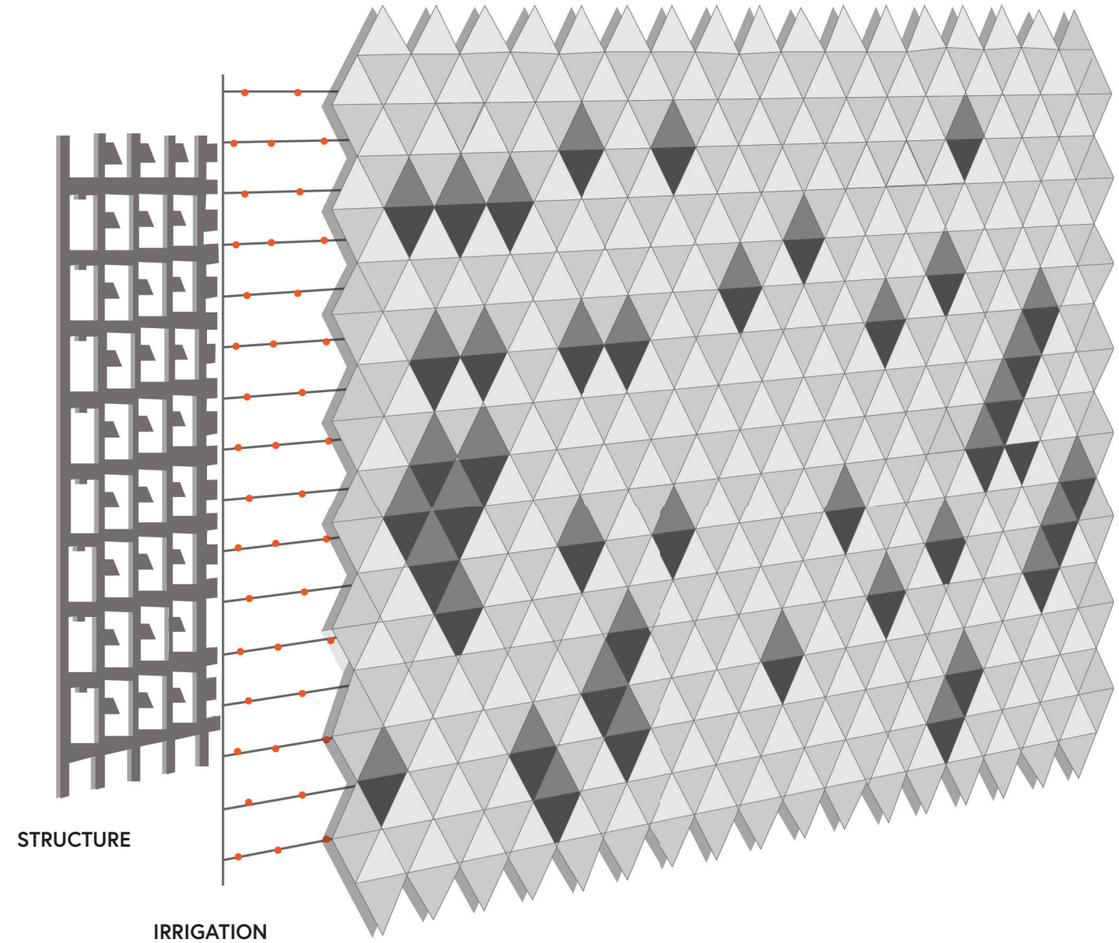
The modular layout also enhances airflow around the vegetation, supporting healthy growth in tight vertical spaces. By blending material reuse with ecological sensitivity, the project offers a forward-thinking approach to designing sustainable, low-maintenance green infrastructure within challenging environmental conditions (Henkhaus 2022).

LOCATION:
College Station, Texas

CONTEXT:
Green Wall

DESIGN TEAM:
Texas A&M University, College of Architecture

FIGURE 5.8 LIVING WALL TEXAS A&M



BETH CHATTO'S GRAVEL GARDEN

Colchester, United Kingdom

FIGURE 5.9 BETH CHATTO'S GRAVEL GARDEN

LOCATION:
Colchester, United Kingdom

CONTEXT:
Native Planting Garden

DESIGN TEAM:
Beth Chatto

In-Ground Landscape - Native Planting

FIGURE 5.10 BETH CHATTO'S GRAVEL GARDEN

PROJECT DESCRIPTION:
Beth Chatto's Gravel Garden, located in Elmstead Market near Colchester, is a widely recognized model for sustainable, low-water planting design. Established without irrigation on poor, free-draining soil, the garden demonstrates how careful plant selection and spatial organization can support long-term resilience in drought-prone environments. Over 300 drought-tolerant species are arranged using a layered planting strategy—combining low ground covers, mounding perennials, and upright structural forms to create visual depth, minimize competition, and support ecological diversity. Gravel mulch further reduces evaporation and suppresses weeds, allowing the planting to thrive with minimal maintenance. The garden continues to influence dry land planting practices worldwide, offering a compelling example of design rooted in ecological function (Beth Chatto Gardens n.d.)

One Drop At A Time

Elmhurst, Illinois

In-Ground Landscape - Bio-Swale

PROJECT DESCRIPTION:

One Drop at a Time is a pioneering residential retrofit in the Chicago suburbs that combines green infrastructure with public education. Designed by a resident landscape architect in collaboration with the homeowner and local non-profits, the project replaces turf and concrete with layered stormwater systems—including a green roof, permeable pavement, bioswales, rain gardens, barrels, and a cistern. A native prairie planting reinforces ecological function, while interpretive signage, a dedicated website, and guided tours engage the community. Together, these elements demonstrate how residential landscapes can be transformed into self-sustaining, educational environments that manage water responsibly and promote environmental awareness. The project also serves as a replicable model for other homeowners, proving that even small-scale sites can have a measurable ecological impact. By reframing the suburban yard as a functioning piece of green infrastructure, the design challenges traditional landscaping norms and encourages a more resilient, community-oriented approach (Kim and Whalen 2013).

Image Disclaimer: *The image featured on this spread is not a direct photograph of One Drop at a Time, but is intended to represent comparable planting strategies and spatial qualities.*

LOCATION:

Elmhurst, Illinois

CONTEXT:

Single-Family Residential

DESIGN TEAM:

De La Fleur LLC

FIGURE 5.11 HABITAT WALL AND FLOWER BORDER

06

DESIGN APPLICATION

INTRODUCTION TO DESIGN APPLICATION

The design application method for this research is divided into two key phases, each exploring different applications of the Intuitive Home Prefabricated Package and its relationship to LEED and SITES certification.

The first phase centers on the development of the Intuitive Home Prefabricated Package itself. This phase emphasizes the integration of prefabricated and modular construction techniques for both the building and its associated landscape elements. The goal is to produce a design that can be manufactured off-site in a controlled factory environment and later transported to a permanent location. Key components of the system include the primary building structure, a modular deck, green wall, and water cistern—each selected for its potential to contribute to certification criteria. This phase will be evaluated using the Building and Modular Landscape checklists to determine credit achievement under LEED and SITES, with the aim of reaching a measurable certification score prior to on-site installation.

The second phase applies the prefabricated package to a realistic site context—specifically, a residential neighborhood in Salina, Kansas. This phase demonstrates how the system can be effectively integrated into a real-world environment while addressing additional site-specific sustainability opportunities. It also examines how LEED and SITES credits can be pursued across multiple phases of design. The Pre-Design, In-Ground Landscape, and Post-Design checklists will be used to assess certification potential for this implementation. The resulting score will then be combined with the prefabricated package score to determine the overall certification potential of the project.

FIGURE 6.1 DESIGN APPLICATION PROCESS

FIGURE 6.2 INTUITIVE HOME PACKAGE

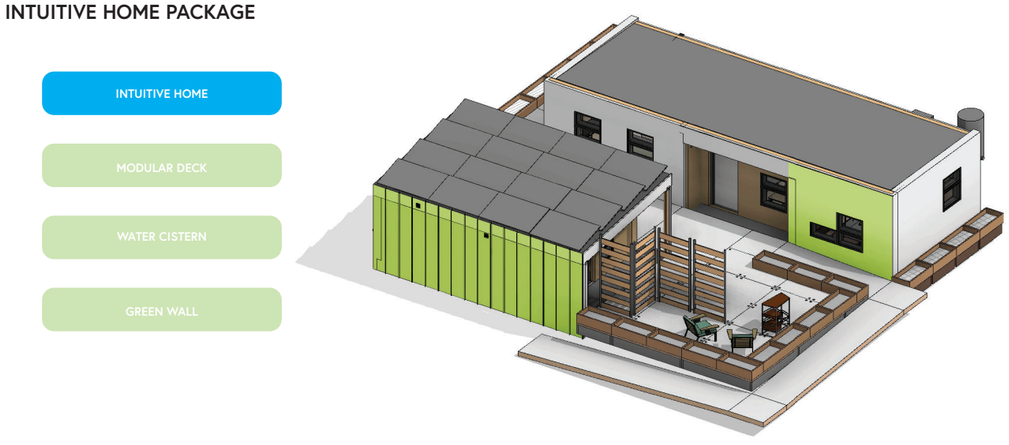


FIGURE 6.3 SALINA IMPLEMENTATION

INTUITIVE HOME PREFABRICATED PACKAGE

The Intuitive Home Prefabricated Package focuses on prefabricated and modular techniques to explore a range of achievable opportunities. This project was developed through a collaborative, multi-disciplinary team of Kansas State University students, including those from architecture, landscape architecture, and engineering. The team followed a structured design process like professional projects, beginning with conceptual design and progressing toward full construction documentation and shop drawings for installation.

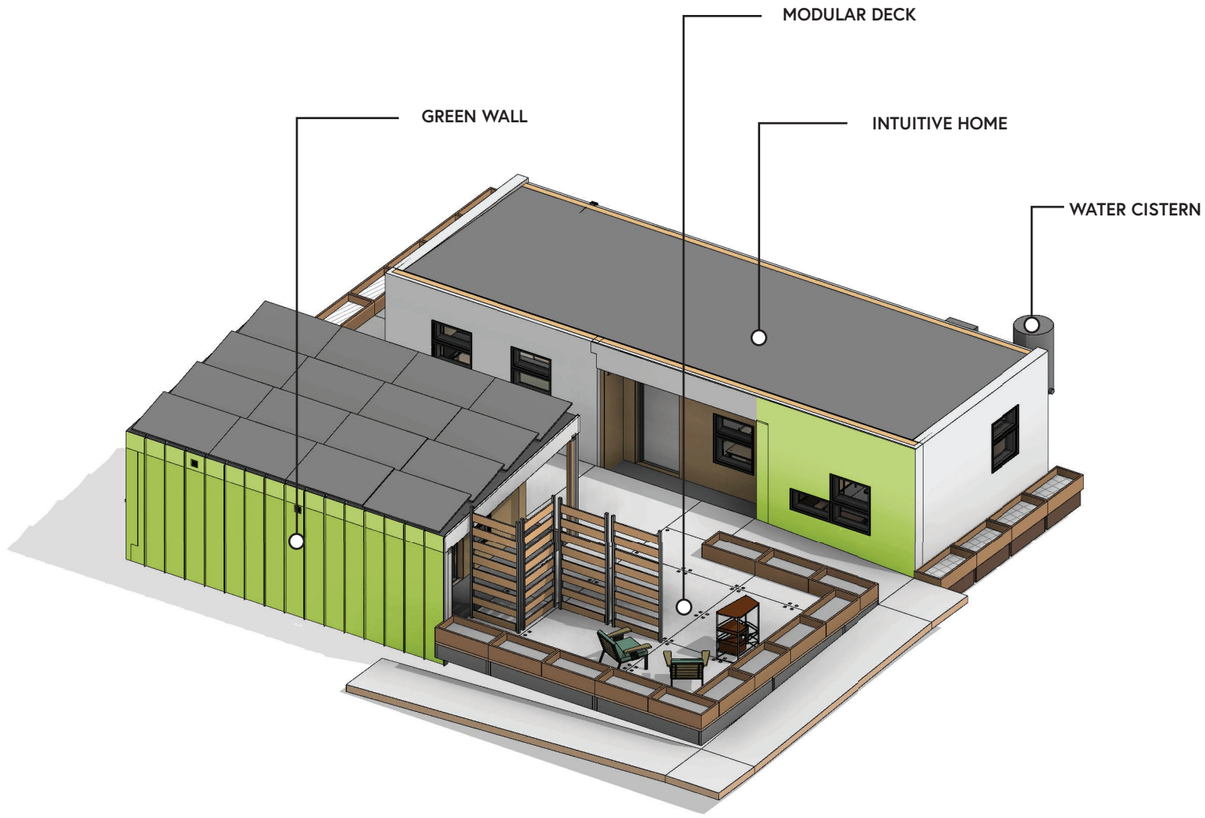
A key focus of the project was the development of both the building and modular site components, enhancing overall site design quality while improving sustainable performance. The Prefabricated for Performance project aimed to align with LEED and SITES certification criteria during pre-installation. Specifically, the LEED and SITES checklist for this phase emphasized sustainability strategies related to both the building and modular landscape elements, including a modular deck, water cistern, and green wall integration.

FIGURE 6.4 INTUITIVE HOME PACKAGE BREAKDOWN

INTUITIVE HOME PREFABRICATED PACKAGE:

INTUITIVE HOME	MODULAR BUILDING
MODULAR DECK	MODULAR LANDSCAPE
WATER CISTERN	MODULAR LANDSCAPE
GREEN WALL	MODULAR LANDSCAPE

FIGURE 6.5 INTUITIVE HOME PACKAGE BREAKDOWN



INTUITIVE HOME BUILDING PROTOTYPE

INTUITIVE HOME | MODULAR BUILDING

The Intuitive Home is a residential prototype developed by a team of architecture students at Kansas State University, designed to explore sustainable prefabricated construction. The project emphasizes modular home design, integrating prefabrication techniques to align with the Gateway Decathlon Design Competition requirements.

As part of the Prefabricated for Performance project, the Intuitive Home is evaluated using the LEED building checklist, focusing on four key sustainability criteria: water consumption, energy use, material selection, and construction methods. Each of these elements is strategically implemented to enhance environmental performance and contribute toward LEED certification goals.

DESIGN & CONSTRUCTION APPROACH

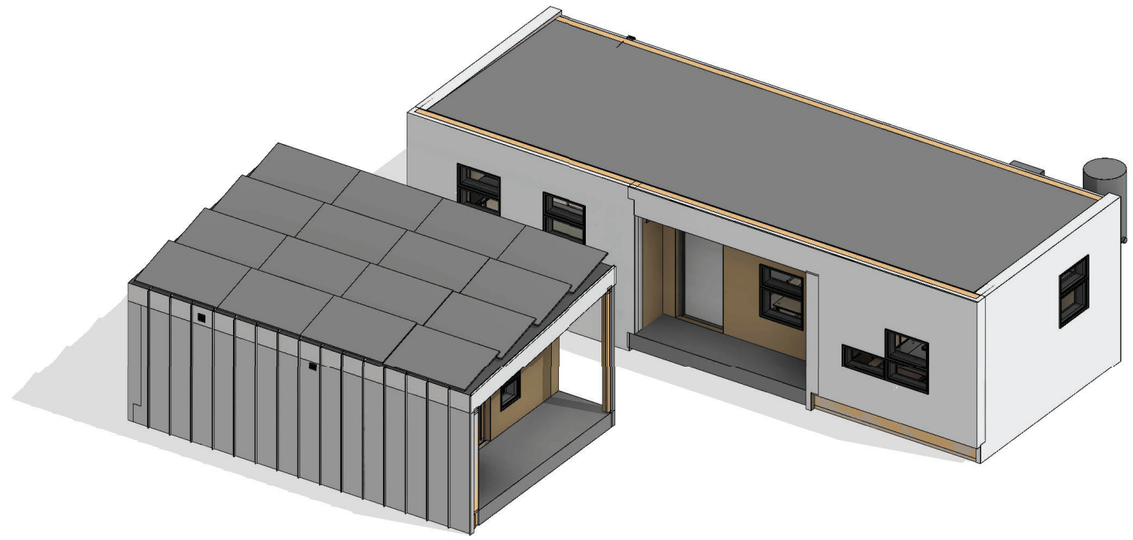
The Intuitive Home follows a modular prefabrication approach, ensuring that major construction elements—framing, sheathing, rough plumbing, electrical systems, and interior finishes—are completed off-site before transportation. This process minimizes on-site labor costs, improves construction efficiency, and reduces environmental impact.
The home is designed for spatial efficiency, flexibility, and adaptability, making it suitable for rural, suburban, and urban settings across Kansas. The modular system allows for multiple configurations while maintaining a strong connection between interior and exterior environments. The floor plan consists of two primary modular units: a larger module (40' x 15'), which includes a bedroom, bathroom, mechanical room, kitchen/dining area, laundry, and living space, and a smaller module (20' x 15'), which features a bedroom/workspace, bathroom, mechanical room, and kitchen. These modules can function independently or be combined, providing flexibility for different residential needs.

FIGURE 6.6 INTUITIVE HOME MODULAR BUILDING BREAKDOWN

CRITERIA:

WATER | ENERGY | MATERIALS | CONSTRUCTION

FIGURE 6.7 INTUITIVE HOME MODULAR BUILDING



The wall system is constructed using 2x6 wood studs, allowing for wider stud spacing to accommodate larger insulation cavities for increased thermal performance. The system targets an R-30 insulation value, using fiberglass or rock wool insulation to improve energy efficiency. The ZIP System R-12 insulated panels are used for sheathing, enhancing durability and thermal resistance. The fiber cement cladding is chosen for its durability, aesthetic quality, fire resistance, and ease of installation, ensuring long-term resilience and minimal maintenance.

LEED & SITES: SUSTAINABILITY STRATEGIES

Water Consumption & Efficiency

The Intuitive Home optimizes potable water use by incorporating high-efficiency fixtures and alternative water sources. The primary LEED credit addressed in this category is Indoor Water Use Reduction, which minimizes consumption through strategic fixture selection and sustainable water management.

Within the Intuitive Home Prototype, all 11 water fixtures meet U.S. EPA WaterSense standards, contributing to LEED certification:

- Lavatory faucets: 1.2 gpm (gallons per minute) → 2 LEED points
- Shower heads: 1.5 gpm → 3 LEED points
- Toilets: 1.1 gpf (gallons per flush) → 2 LEED points
- Clothes washers: ENERGY STAR qualified → 2 LEED points

Some water-related LEED credits require both building and landscape integration, preventing a complete point calculation until post-installation. However, the home includes water meters to track indoor water consumption, ensuring accurate data collection for future LEED assessment and point allocation.

Energy & HVAC Efficiency

The Intuitive Home prioritizes energy efficiency and HVAC performance through a combination of passive and active strategies to enhance thermal comfort while minimizing mechanical energy consumption. Passive strategies include sun-shading windows, natural ventilation cooling, passive solar direct gain (low mass), and wind protection for outdoor spaces. Additionally, optimized insulation and solar shading further improve thermal performance by reducing heat gain and increasing occupant comfort.

To ensure LEED compliance, the Intuitive Home meets the Minimum Energy Performance pre-requisite by adhering to ASHRAE 90.1-2010 standards and achieving ENERGY STAR for Homes v3 certification, with all appliances ENERGY STAR-rated. The home also pursues Annual Energy Use Reduction, contributing up to 36 LEED points, using energy modeling, a HERS Index of 85 or better, and other performance-based compliance measures. Permanent energy meters will track energy usage throughout the home's lifetime, fulfilling the Energy Metering pre-requisite. Additional LEED points are achieved through an Efficient Hot Water Distribution System, HVAC Start-Up Credentialing, and Refrigerant Management, all contributing to energy efficiency and low environmental impact.

Beyond energy efficiency, the Intuitive Home prioritizes indoor air quality and ventilation by integrating ASHRAE 62.2-2010 mechanical ventilation systems and combustion venting measures. Additional strategies—such as Garage Pollutant Protection, air filtration (MERV 8+), and air compartmentalization—reduce pollutants, minimize air leakage, and improve overall indoor environmental quality.

Materials & Construction Strategies

The Intuitive Home ensures material sustainability and durability by adhering to two key LEED prerequisites. While the project does not require tropical wood, it incorporates Red Cedar harvested within Kansas, promoting a regional material cycle that minimizes environmental impact. The home also follows a durability management plan, ensuring moisture control, material protection, and long-term maintenance across roofing, foundations, and exterior walls. This plan is verified through quality control measures during construction, ensuring that materials and methods align with high-performance building standards.

The Construction Waste Management plan diverts at least 50% of construction and demolition waste from landfills, earning one LEED point. This is accomplished by sorting materials into three waste streams:

- Wood: Salvaged for reuse in framing or repurposed into wood chips.

- Metal: Sent to recycling plants for reprocessing.
- Drywall: Recycled into new drywall or used for patching in other buildings.

Additionally, Material-Efficient Framing strategies contribute two LEED points through modular construction techniques. The Intuitive Home utilizes structural insulated panels (SIPs) for improved insulation and reduced thermal bridging, while stud spacing is increased to 24 inches on center, reducing material waste while maintaining structural integrity.

CONCLUSION: A MODEL FOR SUSTAINABLE RESIDENTIAL DESIGN

By integrating modular prefabrication, high-performance materials, and LEED-compliant strategies, the Intuitive Home demonstrates a comprehensive approach to sustainability. The home successfully balances energy efficiency, water conservation, indoor air quality, and material durability, making it a strong candidate for LEED certification. Its waste-conscious construction methods, adaptable design, and resource-efficient systems position it as a scalable model for sustainable residential development, showcasing the potential of prefabricated housing in high-performance building design.

FIGURE 6.8 INTUITIVE HOME MODULAR BUILDING CERTIFICATION

BUILDING CERTIFICATION

Water	**Indoor Water Use**	LEED	9 PTS	ACHIEVED
	Water Use*	LEED	Required	
	Water Metering*	LEED	Required	
	Total Water Use*	LEED	15 PTS	
Energy + HVAC	**Minimum Energy Performance**	LEED	Required	ACHIEVED
	Energy Metering	LEED	Required	ACHIEVED
	Efficient Hot Water Distribution	LEED	2 PTS	ACHIEVED
	HVAC Start-Up Credentialing	LEED	1 PT	ACHIEVED
	Refrigerant Management	LEED	1 PT	ACHIEVED
	Ventilation	LEED	Required	ACHIEVED
	Combustion Venting	LEED	Required	ACHIEVED
	Garage Pollutant Protection	LEED	Required	ACHIEVED
	Air Filtering	LEED	Required	ACHIEVED
	Compartmentalization	LEED	Required	ACHIEVED
	Enhanced Ventilation	LEED	3 PTS	ACHIEVED
	Containment Control	LEED	3 PTS	ACHIEVED
	Annual Energy Use	LEED	36 PTS	ACHIEVED
Materials	**Certified Tropical Wood**	LEED	Required	ACHIEVED
	Environmentally Preferable Products	LEED	5 PTS	ACHIEVED
	Durability Management	LEED	Required	ACHIEVED
Construction	**Construction Waste Management**	LEED	1 PT	ACHIEVED
	Radon Resistant Construction	LEED	Required	ACHIEVED
	Material Efficient Framing	LEED	2 PTS	ACHIEVED

TOTAL POINTS:

LEED:	63/78 PTS
SITES:	0 PTS

INTUITIVE HOME MODULAR DECK

MODULAR DECK

MODULAR LANDSCAPE

The Intuitive Home Modular Deck integrates modular and prefabrication strategies while enhancing the functionality and diversity of outdoor spaces. Designed to accommodate various types of outdoor gatherings, the deck system creates versatile spaces within a single footprint, allowing for flexible configurations. Prefabrication techniques ensure ease of transportation and installation, while modular attachments allow for further customization and spatial adaptability.

As part of the Prefabricated for Performance project, the Intuitive Home Modular Deck System is evaluated using the LEED + SITES Modular Landscape Checklist. Its primary focus aligns with the materials section, assessing the selection and sourcing of materials to ensure sustainable practices in its construction and integration with the broader modular landscape framework.

DESIGN AND CONSTRUCTION APPROACH

The Intuitive Home Modular Deck System is designed as a prefabricated, easy-to-install outdoor space, offering flexibility in spatial configurations. Utilizing a modular design approach, the deck system consists of 8' x 8', 4' x 8', and 4' x 4' modules, allowing for customizable layouts and interchangeable connections. Each deck module integrates beams, joists, and decking attachments, streamlining assembly once the site is prepared.

To ensure seamless installation, the deck system incorporates built-in post connections, enabling X, T, and L configurations, allowing modules to attach in multiple directions, creating endless layout possibilities. Additionally, metal sleeve inlets embedded in each corner support removable modular attachments, further enhancing spatial flexibility. These attachments include planters, wall partitions, seating elements, and other customizable components, providing diverse outdoor experiences tailored to different functional needs.

FIGURE 6.9 INTUITIVE HOME MODULAR DECK BREAKDOWN

CRITERIA:

MATERIALS

FIGURE 6.10 INTUITIVE HOME MODULAR DECK

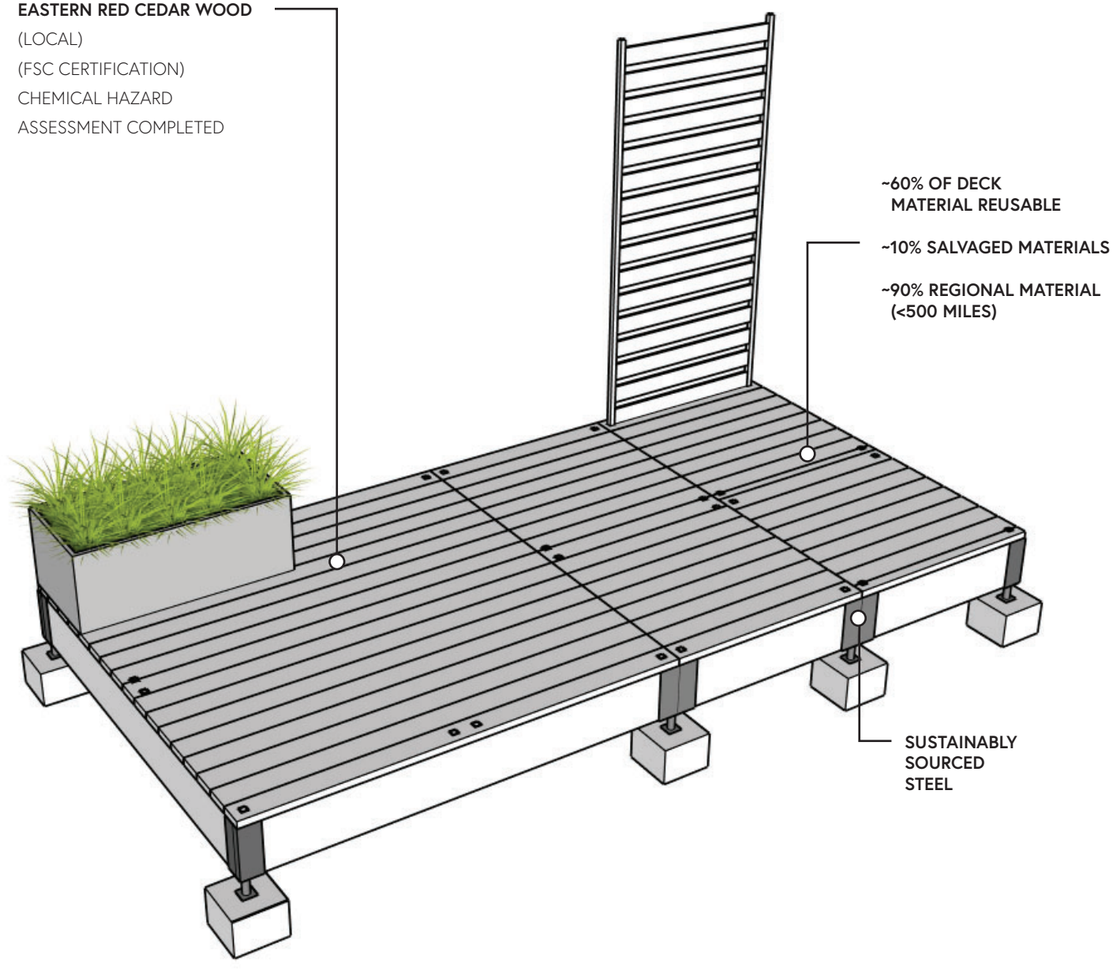
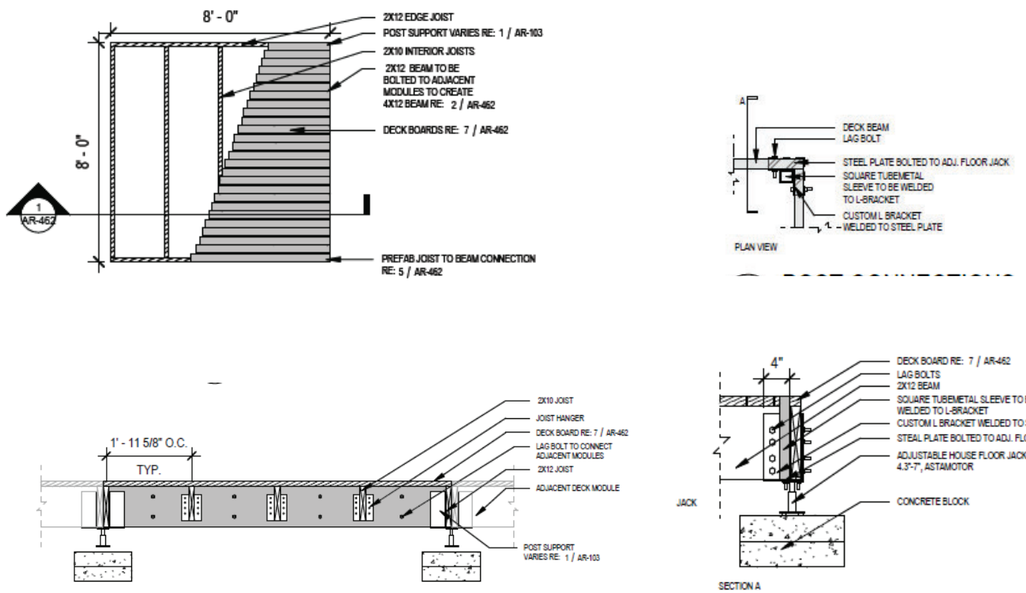


FIGURE 6.11 INTUITIVE HOME MODULAR DECK CONSTRUCTION

CONSTRUCTION DOCUMENTATION



LEED & SITES: SUSTAINABILITY STRATEGIES

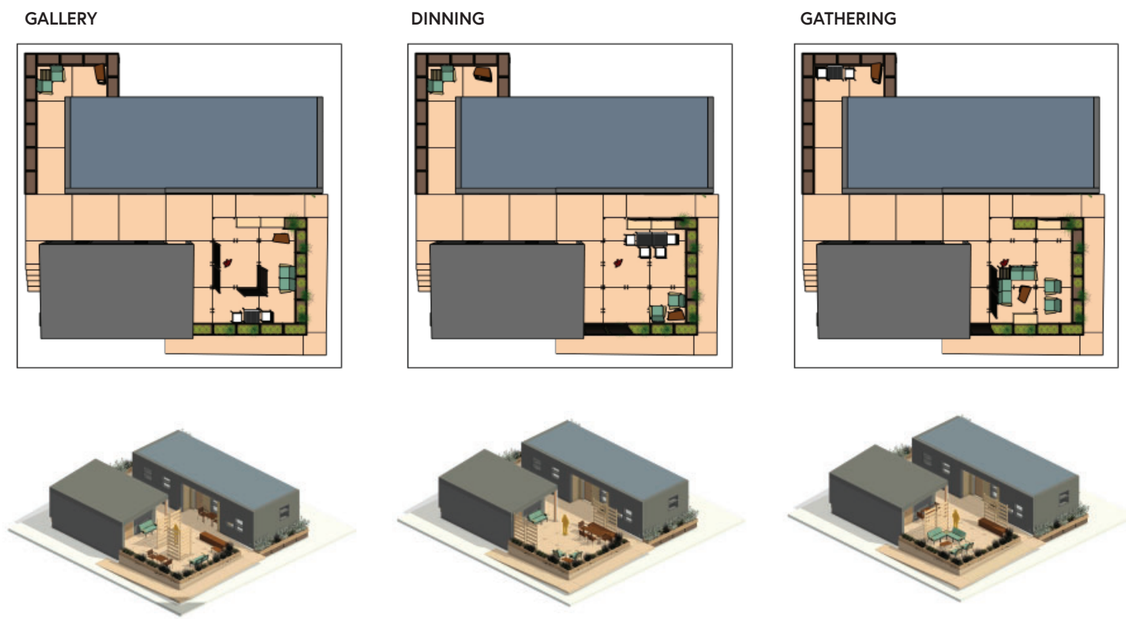
Materials and Responsible Sourcing

The Intuitive Home Modular Deck System is designed with sustainability in mind, incorporating responsible material sourcing and efficient resource management to meet seven SITES credits. The system complies with the SITES pre-requisite for Eliminating the Use of Wood from Threatened Tree Species by utilizing Eastern Red Cedar, a regionally sourced wood from an FSC (Forest Stewardship Council)-certified lumber distributor in Kansas.

Beyond meeting this pre-requisite, the deck system integrates several strategies to ensure material efficiency and environmental responsibility. Its prefabricated nature allows for 100% of its materials to be reused for future wood-based projects or site applications,

FIGURE 6.12 INTUITIVE HOME MODULAR DECK FLEXIBILITY

FLEXIBILITY OF SPACES



supporting Design for Adaptability and Disassembly and contributing four points toward SITES certification. Additionally, the deck system prioritizes regional material sourcing, ensuring that at least 90% of harvested wood comes from within 500 linear miles of the site, earning an additional five points. To further reinforce sustainability, the system aligns with an FSC-certified manufacturer, meeting responsible raw material extraction standards and securing another five points toward certification.

In addition to material efficiency, the deck system promotes transparency and environmental safety by sourcing wood from manufacturers that conduct complete chemical hazard assessments, fulfilling the Support Transparency and Safer Chemistry credit and earning five more points. Lastly, the Supporting Sustainability in Materials Manufacturing credit is pursued through an advocacy-based approach, in which a

FIGURE 6.13 INTUITIVE HOME MODULAR DECK IMPLEMENTATION

formal request is submitted to the manufacturer for a performance review assessing their sustainable manufacturing practices, contributing an additional one point to the certification total.

By integrating these sustainability strategies, the Intuitive Home Modular Deck System achieves 20 points toward SITES certification prior to installation. This demonstrates a strong commitment to sustainable material use, responsible sourcing, and modular adaptability, reinforcing the project's role as an innovative model for sustainable landscape integration and a scalable approach to eco-conscious prefabricated design.

CONCLUSION: INTUITIVE HOME MODULAR DECK SYSTEM

The Intuitive Home Modular Deck System exemplifies a sustainable, prefabricated approach to outdoor space design, integrating flexibility, adaptability, and responsible material sourcing. Through modular construction techniques, the system enhances spatial

versatility, allowing for diverse outdoor experiences while maintaining ease of installation and transportability. Its LEED + SITES-driven sustainability strategies ensure that the deck system not only meets high environmental standards but also supports long-term resource efficiency through re-usability, responsible material sourcing, and minimized environmental impact. By achieving 20 points toward SITES certification, the Intuitive Home Modular Deck System establishes itself as a scalable, environmentally responsible model for integrating prefabricated landscapes into sustainable residential development. Through this innovative design, the project reinforces the potential of modular solutions in creating resilient, adaptable, and ecologically responsible spaces for the future.

FIGURE 6.14 INTUITIVE HOME MODULAR DECK CERTIFICATION

MODULAR DECK CERTIFICATION

Materials	**Eliminate the Use of Wood from Threatened Species**	SITES	Required	ACHIEVED
	Design for Adaptability and Disassembly	SITES	4 PTS	ACHIEVED
	Use Regional Materials	SITES	5 PTS	ACHIEVED
	Support Responsible Extraction of Raw Materials	SITES	5 PTS	ACHIEVED
	Support Transparency and Safer Chemistry	SITES	5 PTS	ACHIEVED
	Support Sustainability in Materials Manufacturing	SITES	1 PTS	ACHIEVED

TOTAL POINTS:

LEED:	0 PTS / 0 PTS
SITES:	20 PTS / 20 PTS

INTUITIVE HOME WATER CISTERN

WATER CISTERN

MODULAR LANDSCAPE

The Intuitive Home Water Cistern applies modular and prefabricated strategies to enhance water conservation and management within the landscape. Designed to collect, store, and recycle water, the system reduces reliance on potable water by redirecting captured rainwater for irrigation purposes. By integrating into the broader modular landscape framework, the cistern supports efficient water use, ensuring that collected and recycled water contributes to landscape irrigation and green infrastructure, including features such as a modular green wall. The overarching goal of this system is to maximize water efficiency while minimizing waste, reinforcing a sustainable approach to site water management.

As part of the Prefabricated for Performance project, the Intuitive Home Water Cistern is evaluated and optimized using the LEED + SITES Modular Landscape Checklist. Its primary focus aligns with the water section, assessing water collection, precipitation management, and overall water usage. By integrating effective collection, storage, and distribution systems, the cistern enhances site sustainability, supporting environmental responsibility and long-term water resilience.

DESIGN AND CONSTRUCTION APPROACH:

The Intuitive Home Water Cistern is designed to seamlessly integrate with various design elements within the Intuitive Home package, ensuring efficient water management and sustainable site practices. This system connects directly to the building's closed-gutter system, which channels roof runoff into a below-ground cistern strategically positioned beneath the Modular Deck System for easy access and maintenance. The cistern is designed to hold approximately 500 gallons of collected rainwater, primarily used for irrigating plantings and landscape features.

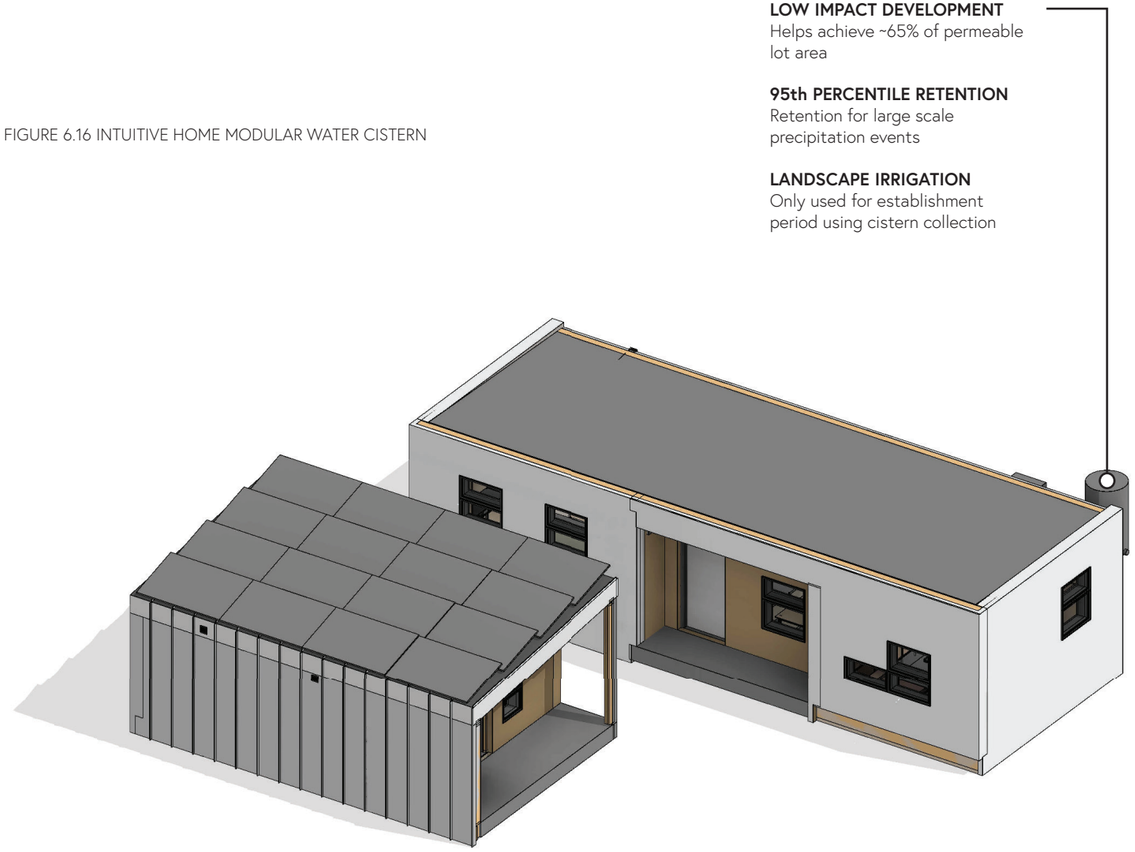
The system relies on a gravity-fed water flow, allowing the gutter system to naturally direct collected rainwater into storage, reducing

FIGURE 6.15 INTUITIVE HOME WATER CISTERN BREAKDOWN

CRITERIA:

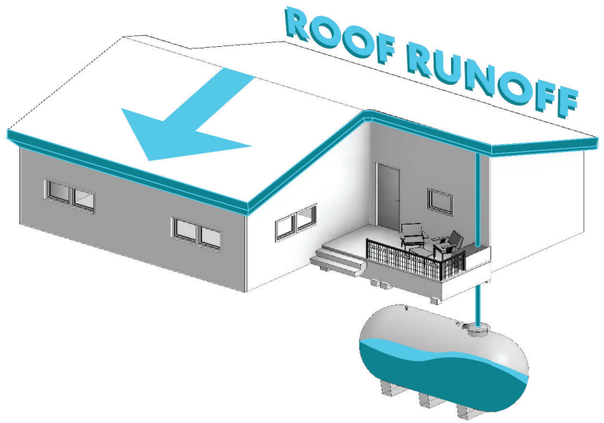
WATER

FIGURE 6.16 INTUITIVE HOME MODULAR WATER CISTERN



the need for mechanical pumps and enhancing overall water efficiency. Once stored, the harvested water is repurposed for irrigation, supplying adjacent landscape areas with a sustainable water source. The system is particularly optimized for the Modular Green Wall, where water is distributed through a drip irrigation system, ensuring consistent moisture levels while minimizing evaporation and water waste. This integrated approach enhances resource efficiency, promotes plant health, and reinforces the Intuitive Home's commitment to sustainable water management.

FIGURE 6.17 INTUITIVE HOME WATER COLLECTION ON-SITE



LEED & SITES: SUSTAINABILITY STRATEGIES

Water Management
The Intuitive Home Water Cistern aligns with six water management credits across LEED and SITES certification—one LEED credit and five SITES credits. These credits focus on the proper collection, storage, and use of water for irrigation within the building and site. The primary objective is to capture roof runoff, store it efficiently, and reuse it for landscape irrigation, reducing overall water consumption.

For LEED certification, the Rainwater Management credit is pursued through a low-impact development strategy, incorporating strategic planters, planting beds, and the cistern system. This approach exceeds the 65% threshold for managing rainfall events, ultimately earning two LEED points.

For SITES certification, two pre-requisites must be met. The first is Reducing Water Use for Landscape Irrigation, which requires demonstrating a minimum 50% reduction in water usage beyond baseline. With the integration of the cistern and complementary water management strategies, this requirement is successfully met. The second pre-requisite is Managing Precipitation On-Site, which ensures the ability to withstand precipitation volumes equivalent to a 60th percentile precipitation event. The cistern, alongside additional stormwater mitigation strategies, contributes to fulfilling this requirement. Beyond the pre-requisites, the Intuitive Home Water Cistern also contributes to three additional SITES credits. The first, Managing Precipitation Beyond Baseline, requires a site-specific evaluation to determine the true scoring of this credit. However, regardless of the site placement, the cistern will aid in achieving this credit by reducing runoff and increasing stormwater retention. Similarly, the Reducing Outdoor Water Use credit aims to eliminate outdoor potable water use. While the water cistern alone cannot fully achieve this credit without a designated site, it will play a significant role in earning points once the full irrigation and water management strategies are implemented.

The final SITES credit pursued is Designing Functional Water Features as Amenities, which highlights the aesthetic and functional benefits of integrated water features. The cistern serves a dual purpose, not only managing water resources but also contributing

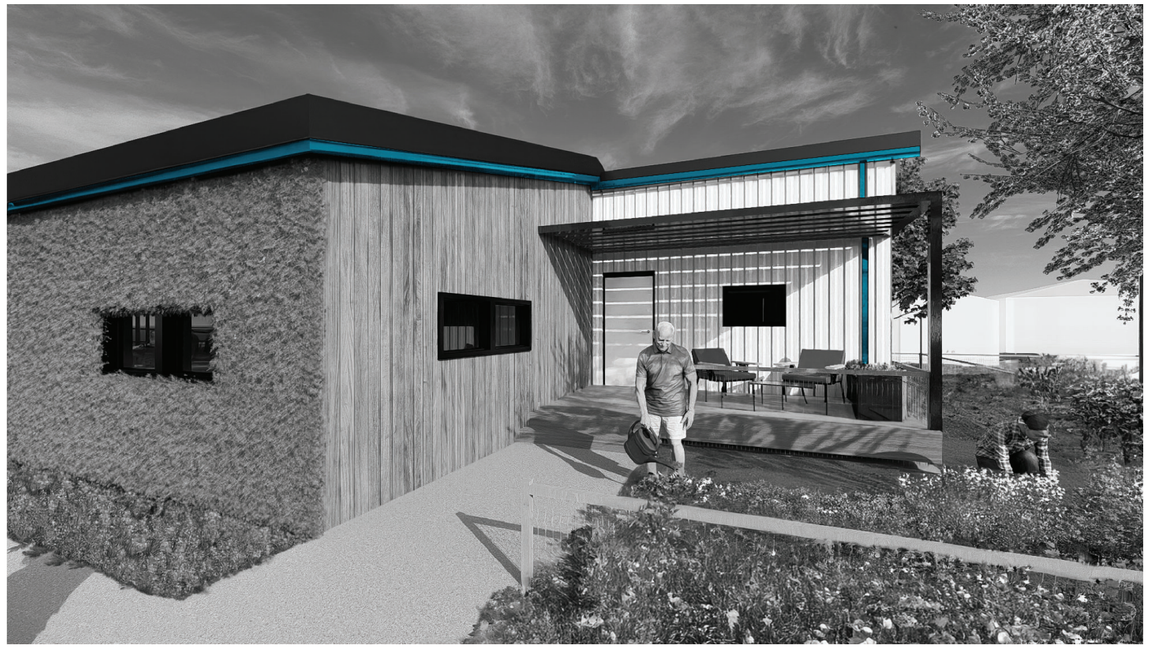


FIGURE 6.18 INTUITIVE HOME WATER CISTERN IMPLEMENTATION

to the ecological and visual enhancement of the site. By promoting water conservation while serving as an interactive educational feature, the Intuitive Home Water Cistern strengthens the project's alignment with SITES principles for sustainable landscape design.

CONCLUSION: INTUITIVE HOME WATER CISTERN

The Intuitive Home Water Cistern exemplifies a sustainable and integrated approach to modular water management, reinforcing the project's commitment to efficiency, conservation, and responsible site design. By capturing, storing, and re-purposing rainwater, the system reduces potable water reliance, supports landscape irrigation, and enhances stormwater management. Its seamless integration with the Intuitive Home's modular design elements, including the Modular Deck and Green Wall, highlights its flexibility and environmental impact. Furthermore, its alignment with LEED and SITES certification standards ensures that it meets and exceeds water efficiency benchmarks, contributing to long-term site sustainability. As an adaptable and scalable solution, the Intuitive Home Water Cistern sets a precedent for innovative water conservation strategies, offering a model for sustainable residential and landscape integration.

FIGURE 6.19 INTUITIVE HOME WATER CISTERN CERTIFICATION

WATER CISTERN CERTIFICATION

Water	**Rainwater Management***	LEED	2 PTS	PARTIAL
	Manage Precipitation on Site*	SITES	Required	ACHIEVED
	Manage Precipitation Beyond Baseline*	SITES	6 PTS	PARTIAL
	Reduce Outdoor Water Use*	SITES	6 PTS	PARTIAL

TOTAL POINTS:

LEED: 0 PTS / 2PTS*

SITES: 0 PTS / 12 PTS*

* While the application of these credits supports the achievement of LEED and SITES certification, the water cistern alone does not fully earn points until it is implemented on-site and supported by additional complementary strategies.

INTUITIVE HOME GREEN WALL

GREEN WALL

MODULAR LANDSCAPE

The Intuitive Home Green Wall is a living wall system that serves as a key component of the Intuitive Home package, integrating energy-saving strategies, biophilic design principles, and natural aesthetics. This system follows a modular and prefabricated approach, allowing for efficient installation on-site and seamless attachment to the building. By incorporating vegetation as a functional design element, the Green Wall enhances building performance by reducing energy consumption, improving air quality, and contributing to overall sustainability. The system promotes alternative construction methods, demonstrating how integrating plant life into architectural design can lead to environmental and operational benefits while enhancing occupant well-being.

As part of the Prefabricated for Performance project, the Intuitive Home Green Wall is evaluated and optimized using the LEED + SITES Modular Checklist. Its primary focus aligns with the vegetation section, assessing strategies for heat island reduction and vegetative integration for improved building energy efficiency. By leveraging vegetation as a passive cooling and insulating element, the system provides opportunities to minimize energy consumption and reduce operational costs. Through strategic plant selection, optimized placement, and modular adaptability, the Green Wall contributes to a more resilient, energy-efficient, and visually engaging built environment.

DESIGN AND CONSTRUCTION APPROACH:

The Intuitive Home Green Wall is designed to seamlessly integrate within the wall structure of the Intuitive Home Building, enhancing energy efficiency, biophilic design, and environmental performance. The system is composed of three primary components—planting material, structural framework, and irrigation system—all working together to create a functional and adaptable living wall.

FIGURE 6.21 INTUITIVE HOME GREEN WALL

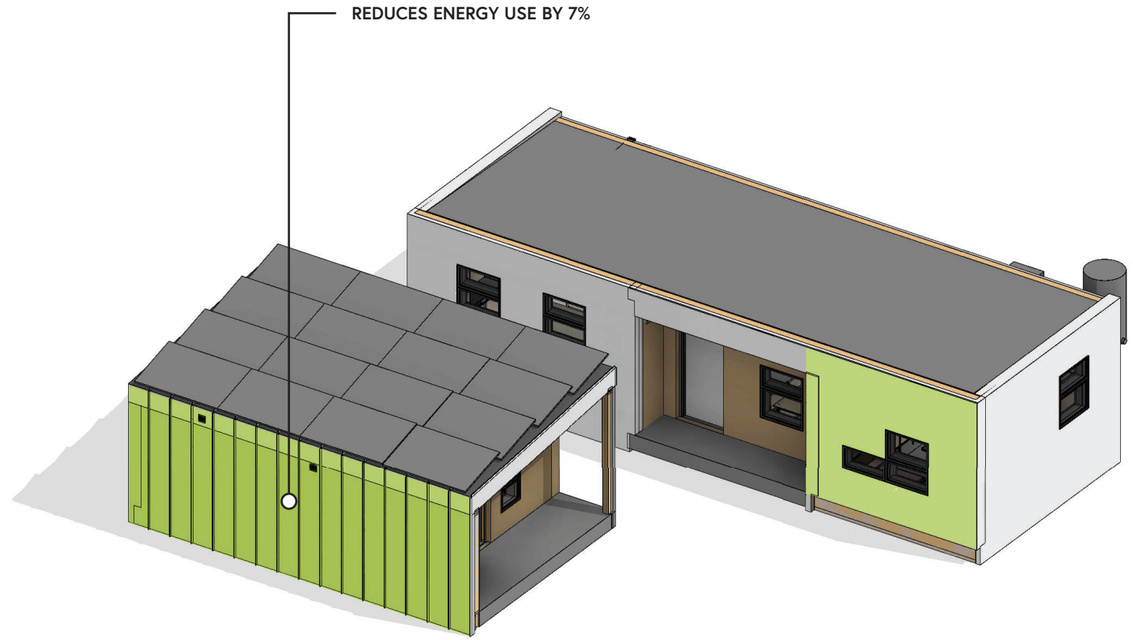


FIGURE 6.20 INTUITIVE HOME GREEN WALL BREAKDOWN

CRITERIA:

VEGETATION

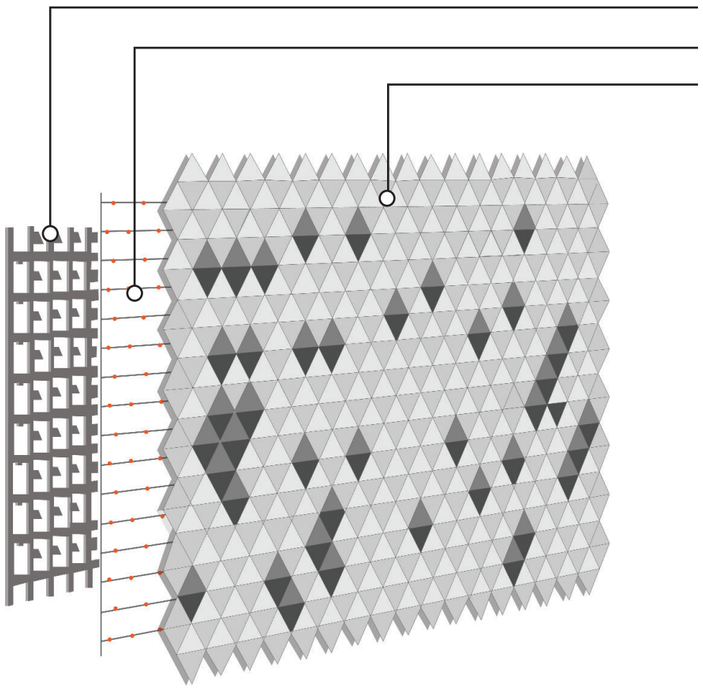


FIGURE 6.22 INTUITIVE HOME GREEN WALL CONSTRUCTION

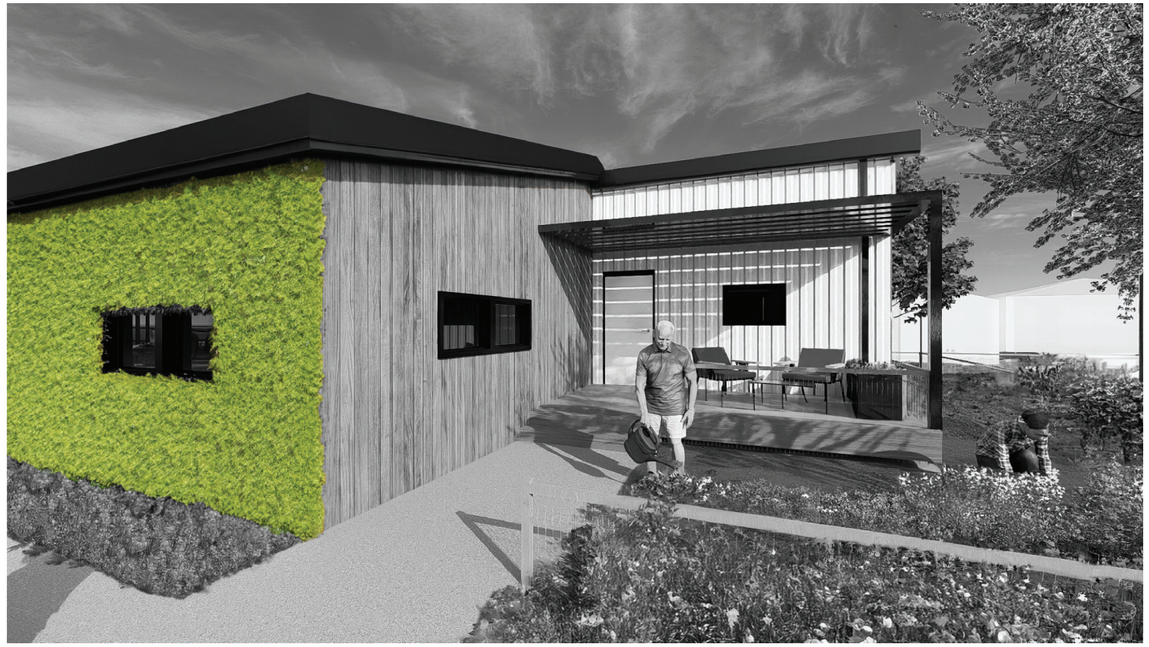


FIGURE 6.23 INTUITIVE HOME GREEN WALL IMPLEMENTATION

Each plant is placed within an individual planting container, which is then securely attached to the structural framework, ensuring that plants can grow naturally in an upright position without being forced into unnatural angles. This modular planting system not only promotes healthy root expansion but also allows for easy replacement and maintenance. The structural component, inspired by resource-efficient design principles, is designed to support both plant growth and irrigation distribution while maintaining durability and ease of installation.

A drip irrigation system, concealed behind the structural layer, ensures efficient water distribution by delivering precise amounts of moisture to each plant. Water is sourced directly from the below-ground cistern, utilizing a pump system to distribute water as needed. Due to the modular nature of the irrigation system, each planter can receive customized watering levels, optimizing water conservation and minimizing waste. To further enhance sustainability, plant selection is strategically tailored to each site location, prioritizing drought-tolerant species that require minimal irrigation, making the system more resilient to varying climate conditions.

LEED + SITES: SUSTAINABILITY STRATEGIES

Use Vegetation to Minimize Building Energy Use

The Intuitive Home Green Wall is designed to contribute to building energy efficiency by strategically integrating vegetation to reduce heat gain and optimize thermal performance. This system aligns with SITES certification by pursuing the Use of Vegetation to Minimize Building Energy Use credit, which focuses on the placement and function of vegetative

systems to enhance passive cooling and reduce reliance on mechanical HVAC systems.
By positioning the Green Wall in optimal locations, the system provides natural shading, reducing the amount of direct solar radiation absorbed by the building's exterior. This helps maintain indoor temperature stability, lowering cooling demands and improving overall energy efficiency. The vegetation also contributes to evaporative cooling, further mitigating heat buildup around the building. As a result, the Green Wall system offers a 7% reduction in total annual building energy use, directly supporting HVAC efficiency and earning 4 points toward SITES certification.

CONCLUSION: INTUITIVE HOME GREEN WALL

The Intuitive Home Green Wall exemplifies the integration of modular, prefabricated, and sustainable design to enhance building performance, energy efficiency, and occupant well-being. By incorporating vegetation as a functional architectural element, the system reduces heat gain, minimizes energy consumption, and improves indoor air quality, all while contributing to biophilic design and natural aesthetics. Its strategic placement and passive cooling benefits help achieve a 7% reduction in annual building energy use, directly supporting HVAC efficiency and operational cost savings. Through innovative structural solutions, efficient irrigation systems, and site-adaptable plant selection, the Green Wall seamlessly integrates with the Intuitive Home package, demonstrating how vegetation can be leveraged to create a more resilient, adaptable, and energy-efficient built environment. With its alignment to SITES certification goals, the Intuitive Home Green Wall serves as a scalable model for sustainable living systems, reinforcing the potential of prefabricated solutions in modern, eco-conscious architecture

FIGURE 6.24 INTUITIVE HOME GREEN WALL CERTIFICATION

GREEN WALL CERTIFICATION

Veg.	**Use Vegetation to Minimize Building Energy Use**	SITES	4 PTS	ACHIEVED

TOTAL POINTS:

LEED:	0 PTS / 0PTS
SITES:	4 PTS / 4 PTS

GATEWAY DECATHLON: INTUITIVE HOME PACKAGE TOTAL SCORE

The Intuitive Home Package currently achieves 63 points under LEED, qualifying the project for LEED Gold certification, and 23 points under SITES. While the SITES score does not meet the full certification threshold, it does fulfill several prerequisites and significantly reduces the number of additional credits needed—only 47 more are required to qualify for SITES certification. The primary objective of this package is to address LEED and SITES criteria prior to on-site installation, streamlining the overall certification process. This approach presents a valuable opportunity to earn substantial credit toward sustainability goals even before the project is tied to a permanent site.

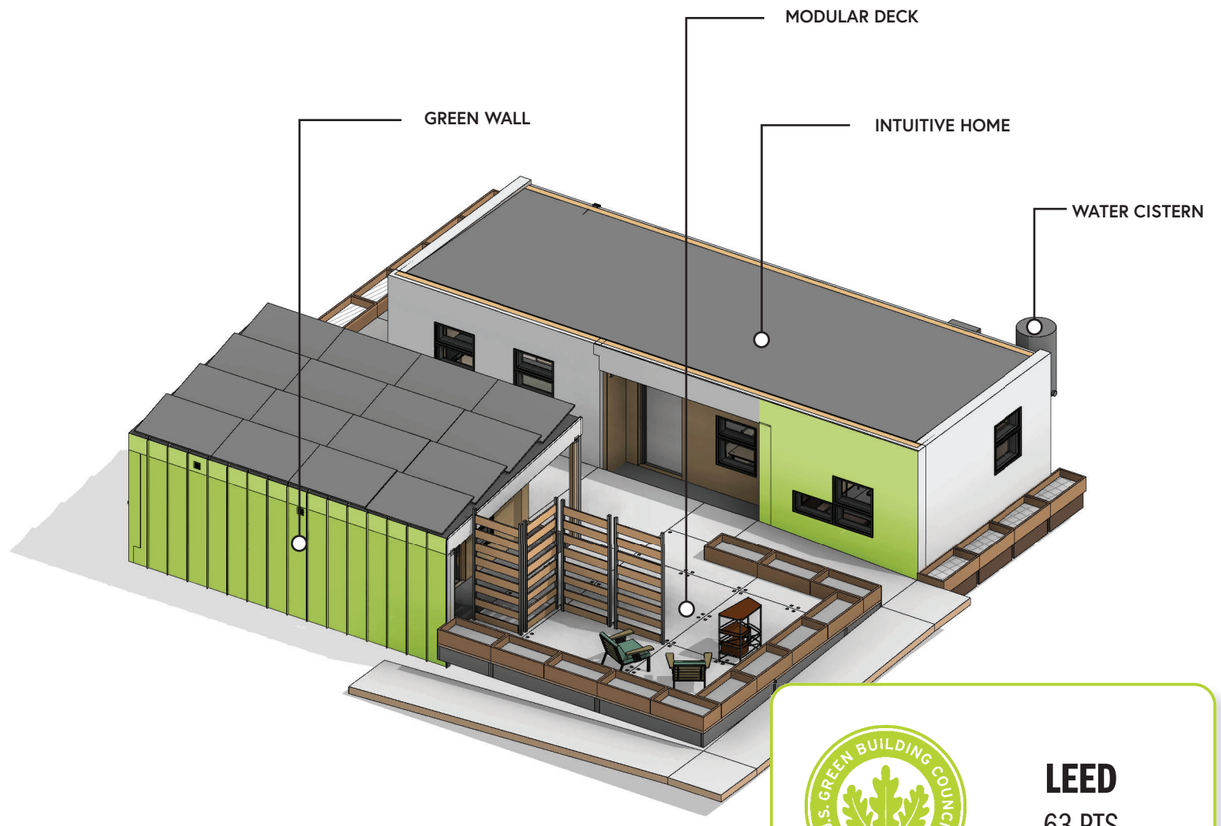
FIGURE 6.25 LEED CERTIFICATION

LEED CERTIFICATION	
CERTIFIED	40 to 49 points
SILVER	50 to 59 points
GOLD	60 to 79 points
PLATINUM	80+ points

FIGURE 6.26 SITES CERTIFICATION

SITES CERTIFICATION	
CERTIFIED	70 to 84 points
SILVER	85 to 99 points
GOLD	100 to 134 points
PLATINUM	135+ points

FIGURE 6.27 INTUITIVE HOME CERTIFICATION



SALINA IMPLEMENTATION

The Salina Implementation focuses on the real-world application of the Intuitive Home Prototype, exploring how the building, deck system, water cistern, and green wall are integrated into a neighborhood setting in Salina, Kansas. This phase provides an opportunity to evaluate and refine the full-scale implementation of the Intuitive Home package, addressing the challenges and opportunities associated with sustainable design integration in a realistic suburban and ecological context. Additionally, this process introduces other necessary site-based sustainability strategies, aligning with LEED and SITES requirements to develop a comprehensive framework for sustainable site development.

This section of the design process mirrors full-scale professional and academic design projects, applying a holistic approach from pre-design analysis to implementation and post-design considerations. The Salina Implementation is structured into three key phases: pre-design site analysis, in-ground landscape and implementation strategies, and post-design planning. Each phase incorporates LEED and SITES sustainability strategies, ensuring that every design decision aligns with long-term environmental performance goals.

The pre-design phase includes a site analysis checklist, evaluating existing conditions, environmental factors, and sustainability opportunities. The site design phase focuses on strategic opportunities to enhance landscape integration, native planting selection, and water management systems, ensuring climate adaptability and ecological resilience. Finally, the post-design plan establishes a framework for future site development, ensuring that sustainability initiatives continue beyond initial construction, reinforcing the long-term viability of the Intuitive Home Prototype in real-world settings.

FIGURE 6.28 SALINA IMPLEMENTATION BREAKDOWN

COMPONENTS:

PRE-DESIGN CHECKLIST	PRE-DESIGN
SITE DESIGN	IN-GROUND LANDSCAPE
NATIVE PLANTING	IN-GROUND LANDSCAPE
WATER MANAGEMENT	IN-GROUND LANDSCAPE
POST-DESIGN PLAN	POST-DESIGN

FIGURE 6.29 SALINA, KANSAS DESIGN

By approaching the Salina Implementation as a comprehensive and adaptive process, the project effectively demonstrates how sustainable strategies can transition from conceptual frameworks to tangible, high-performance developments. Through thoughtful integration of LEED and SITES principles, this phase ensures that the Intuitive Home Prototype not only meets sustainability benchmarks but also serves as a model for future environmentally conscious design solutions.

SALINA: PRE-DESIGN CHECKLIST

PRE-DESIGN CHECKLIST

PRE-DESIGN

The Pre-Design Checklist serves as a critical foundation for the Salina Implementation, guiding the design process, site selection, and early assessment. This phase ensures that the Intuitive Home Prototype is strategically integrated into the built environment by thoroughly evaluating site conditions, sustainability challenges, and design opportunities. By establishing a clear framework for decision-making, the checklist enables designers and developers to navigate potential obstacles while maximizing site potential.
This process revolves around understanding the design methodology and the approach taken in relation to site inventory and analysis. A successful implementation requires an in-depth evaluation of site-specific constraints, environmental conditions, and resource availability, allowing the design team to make informed choices that align with sustainability goals and contextual adaptability.

As part of the Prefabricated for Performance project, the Pre-Design Checklist is assessed using the LEED + SITES Pre-Design Checklist, optimizing each key phase of early design development. By systematically evaluating design intent, site selection, and pre-construction feasibility, this approach requires that sustainable strategies are embedded into the project from the outset, reinforcing the long-term environmental, functional, and performance-based goals of the Salina Implementation.

SALINA: PRE-DESIGN APPROACH:

FIGURE 6.30 PRE-DESIGN BREAKDOWN

CRITERIA:

DESIGN PROCESS

SITE SELECTION

EARLY ASSESSMENT

The pre-design phase for the Intuitive Home Implementation in Salina, Kansas is structured around three key segments of the Pre-Design Checklist: design process, site selection, and early assessment. These elements form the foundation for a holistic, sustainability-driven approach, ensuring that site design and implementation

FIGURE 6.31 SALINA, KANSAS PRE-DESIGN

align with LEED and SITES certification goals. By emphasizing sustainability as a core design principle, this phase enables a comprehensive evaluation of both the built and natural environments, allowing for strategic decision-making that maximizes the project's long-term environmental impact and adaptability. Fully integrated with the LEED + SITES Pre-Design Checklist, the Salina Implementation follows a structured framework that synthesizes design and sustainability strategies from the earliest stages of development. This approach ensures the project remains on track toward achieving sustainable site integration, leveraging best practices in green infrastructure, site responsiveness, and resource efficiency. By maintaining a holistic perspective, the pre-design phase sets the stage for a thoughtful, well-executed implementation, fully optimizing the potential of the Intuitive Home Prototype within a real-world setting.

LEED + SITES: SUSTAINABILITY STRATEGIES

Design Process:
The design process for the Salina Implementation aligns with two primary SITES pre-requisite credits: Using an Integrative Design Process and Conducting a Pre-Design Assessment. Meeting these pre-requisites ensures that sustainability is embedded into the project's planning, collaboration, and site evaluation, laying a strong foundation for efficient site development and long-term environmental performance.

The Integrative Design Process is achieved by following the SITES v2 Rating System, which outlines key steps including forming an integrative design team, developing a collaborative communication process, identifying project sustainability principles and performance goals, incorporating sustainability strategies, engaging stakeholders and user groups, planning for construction oversight, and developing a site maintenance strategy. Many of these steps were addressed in the early stages of the project, particularly in the formation of a multi-disciplinary design team, which included students and professors who acted as project overseers, providing critical design and construction feedback. Sustainability remained a core project principle, aligning with the Gateway Decathlon objectives and guiding the building's performance goals throughout its development. The site selection process focused on open lots in Salina, Kansas, prioritizing affordable housing opportunities and ensuring accessible outdoor spaces for the surrounding community. The remaining steps of this credit—including construction oversight and post-design site maintenance planning—will be completed during the Construction & Implementation and Post-Design phases of the project.

The second pre-requisite, Conducting a Pre-Design Assessment, involves a comprehensive site inventory and analysis, which identifies existing conditions, environmental challenges, and opportunities for sustainable site development. This assessment ensures that all site characteristics are thoroughly understood before moving into the design and implementation phases, allowing for strategic decision-making that maximizes sustainability outcomes.

Site Selection:
The Site Selection category evaluates the physical location of a project to determine its alignment with LEED and SITES sustainability principles. This category consists of six relevant credits—Flood Plain Avoidance, LEED for Neighborhood, Site Selection, Limit Development on Farmland, Redevelop Degraded Sites, and Locate Projects within Existing Developed Areas. However, not all credits apply to every project, as site-specific conditions influence eligibility. For the Salina Implementation, four of these credits—Flood Plain Avoidance, LEED for Neighborhood, Limit Development on Farmland, and Redevelop Degraded Sites—are not achievable due to the project's context and existing site conditions.

The Site Selection LEED credit is pursued through five key criteria: Open Space, Existing Infrastructure, Sidewalks, Bicycle Network, and Storage. The Open Space criterion is met due to the site's proximity to Centennial Park, located just 0.16 miles away, and the creation of two additional communal spaces within the site, fostering private and public outdoor connections. The Existing Infrastructure criterion is achieved as the site has existing water and sewer service lines, eliminating the need for new utility development. The Sidewalk criterion is met through the presence of existing sidewalks on-site and the integration of new pedestrian pathways into the design. Collectively, these strategies contribute to earning 4 LEED points for Site Selection.

The Locate Projects within Existing Developed Areas credit is also pursued, ensuring that the Salina Implementation is situated within an already developed site, reducing the need for new infrastructure expansion. This credit closely aligns with the Existing Infrastructure criterion, as the project site is located within 500 feet of publicly provided water and wastewater infrastructure. Additionally, to fully achieve this credit, the site must be within 0.5 miles of at least seven publicly available basic services, a requirement that this site meets. These factors contribute to an additional 4 SITES points, reinforcing the project's alignment with sustainable urban development principles.

Early Assessment:
The Early Assessment category ensures that critical environmental and design factors are considered in the initial stages of project development, guiding the design team's decision-making process. This category consists of seven LEED + SITES credits, including Protecting Floodplain Functions, Conserving Aquatic Ecosystems, Conserving Habitats for Threatened and Endangered Species, Designating and Communicating Vegetation and Soil Protection Zones, Engaging Users and Stakeholders, Maintaining On-Site Structures and Paving, and Protecting and Maintaining Cultural and Historic Places. However, similar to the Site Selection category, not all credits are applicable to every project. In the case of the Salina Implementation, the site does not allow for the pursuit of Floodplain Protection, Aquatic Ecosystem Conservation, Habitat Conservation, Structure and Paving Maintenance, or Cultural and Historic Site Protection, making these credits unattainable.

One key pre-requisite that must be met is Designate and Communicate Vegetation and Soil Protection Zones, which allows for the preservation of existing trees and healthy soils before any design or construction takes place. This will be enforced through fencing, signage, and contractor training, ensuring that designated protection zones remain undisturbed throughout the project's development.

The Engage Users and Stakeholders credit, while applicable in a real-world scenario, is pursued only at a conceptual level in the Salina Implementation. This credit follows a three-step process involving a site assessment and program plan, a design development presentation and review, and a final design presentation to the public. Although the project materials have been developed to align with this process, the actual implementation of stakeholder engagement and iterative feedback integration has not been conducted due to the academic and conceptual nature of the project. If fully pursued in a real-world context, this credit could earn 3 points toward SITES certification.

CONCLUSION: SALINA PRE-DESIGN CHECKLIST

The Pre-Design phase of the Salina Implementation establishes a strong foundation for integrating sustainability, site responsiveness, and strategic planning into the project. By following the LEED + SITES Pre-Design Checklist, this phase ensures that design intent, site selection, and early assessment align with long-term environmental and functional goals. Through stakeholder engagement, resource-efficient site selection, and proactive sustainability strategies, the pre-design process optimizes the project's potential for sustainable development while addressing site-specific opportunities and constraints. By embedding sustainability considerations early in the planning process, the Pre-Design phase ensures that the Intuitive Home Prototype is positioned for successful implementation, reinforcing its role as a scalable model for environmentally conscious housing solutions.

FIGURE 6.32 SALINA PRE-DESIGN CERTIFICATION

PRE-DESIGN CERTIFICATION

Design	**Integrative Process**	LEED	2 PTS	ACHIEVED
	Use an Integrative Design Process	SITES	Required	ACHIEVED
	Conduct a Pre-Design Assessment	SITES	Required	ACHIEVED
Site Selection	**Flood Plain Avoidance**	LEED	Required	
	LEED for Neighborhood	LEED	10 PTS	
	Site Selection	LEED	4 / 6 PTS	ACHIEVED
	Limit Development on Farmland	SITES	Required	ACHIEVED
	Redevelop Degraded Sites	SITES	6 PTS	
	Locate Projects within Existing Developed Areas	SITES	4 PTS	ACHIEVED
Early Assessment	**Protect Floodplain Functions**	SITES	Required	ACHIEVED
	Conserve Aquatic Ecosystems	SITES	Required	ACHIEVED
	Conserving Habitats for Threatened and Endangered Species	SITES	Required	ACHIEVED
	Designate and Communicate VSPZs	SITES	Required	ACHIEVED
	Engage Users and Stakeholders	SITES	3 PTS	ACHIEVED
	Maintain On-Site Structures and Paving	SITES	4 PTS	
	Protect and Maintain Cultural and Historic Places	SITES	3 PTS	ACHIEVED
	Create and Communicate Soil Management Plan	SITES	Required	ACHIEVED

TOTAL POINTS:

LEED: 6PTS / 18PTS

SITES: 10 PTS / 20 PTS

SALINA: SITE DESIGN

SITE DESIGN

IN-GROUND LANDSCAPE

The Site Design for the Salina Implementation focuses on intentional design decisions that enhance user experience, sustainable development, and functional site integration. This phase prioritizes creating spaces that serve site user groups, fostering a sense of community and accessibility while promoting environmental responsibility. By emphasizing communal environments and user-centric design, the site layout is carefully planned to enhance engagement, connectivity, and usability while aligning with sustainable site development principles. Each design element contributes to a cohesive, efficient, and ecologically responsible environment, reinforcing the project's commitment to social and environmental well-being.

As part of the LEED + SITES integration, the Salina site design follows the In-Ground: Site Design Checklist, which provides a structured approach to implementing site design strategies that prioritize sustainability, functionality, and human experience. This checklist ensures that every design decision supports ecological resilience, promotes environmental stewardship, and enhances the quality of life for site users, reinforcing the project's commitment to sustainable development.

DESIGN APPROACH

The Salina Implementation adopts a community-driven approach inspired by affordable housing strategies, such as cottage courts, to promote higher-density living while maintaining a strong sense of communal engagement. The site design integrates 11 Intuitive Home buildings within a 1.28-acre lot, prioritizing shared spaces, accessibility, and user-centered functionality.

Two primary communal zones are established on-site. The northern communal space serves as a multi-functional hub, featuring storage areas, gathering spaces, and a communal food production garden for residents. The southern communal space incorporates an open-air pavilion, surrounded by four existing shade trees and green space, offering a relaxed, shaded environment for social interaction.

FIGURE 6.33 SALINA SITE DESIGN BREAKDOWN

CRITERIA:

SITE DESIGN

FIGURE 6.34 SALINA, KANSAS SITE DESIGN

FIGURE 6.35 SALINA, KANSAS GATHERING AREAS

FIGURE 6.36 SALINA, KANSAS FOOD PRODUCTION

Each residential unit is designed to support both private and communal living, providing front and back deck spaces that allow for personal outdoor use while fostering neighborly connections. A continuous sidewalk network weaves through the site, ensuring walk-ability and seamless integration with the surrounding community. Additionally, strategically placed seating areas throughout the site enhance accessibility, comfort, and user experience, reinforcing the project's commitment to sustainable, people-centered design.

LEED + SITES: SUSTAINABILITY STRATEGIES

Site Design

The overall site design of the Salina Implementation prioritizes communal well-being, environmental sustainability, and accessibility. This is achieved by integrating 10 different SITES credits, each contributing to a more inclusive, resilient, and user-friendly environment.

Provide Optimum Site Accessibility is pursued by ensuring ADA compliance, clearly defined spaces, good sight lines, multiple access options, and natural surveillance opportunities. Additionally, way-finding elements are incorporated to enhance navigation throughout the site, contributing 2 points toward SITES certification.

Promote Equitable Site Use is also addressed by integrating site amenities, activities, and programming that create inclusive spaces. This credit is directly linked to Supporting Mental Restoration, Supporting Physical Activity, and Supporting Social Connection, of which at least two must be achieved to earn an additional 2 points. In the Salina

Implementation, Support for Mental Restoration is pursued by incorporating quiet outdoor spaces and ensuring unobstructed views of vegetation from at least 50% of common spaces, earning 2 SITES points. Additionally, Support for Social Connection is achieved through the two primary gathering spaces on-site, adding another 2 points toward certification. Support for Physical Activity is not pursued within this project.

Provide On-Site Food Production is incorporated through a neighborhood garden in the northern communal space, contributing 3 points toward SITES certification. Reduce Light Pollution is also addressed using the BUG rating method, ensuring that site lighting meets regulatory requirements while minimizing light spillover and nighttime disruption, earning 4 additional SITES points.

To Encourage Fuel-Efficient and Multi-Modal Transportation, the site includes an electric vehicle charging station, short-term bicycle parking, and preferred parking for carpools and vanpools, achieving 4 points for SITES certification. Additionally, Minimize Exposure to Environmental Tobacco Smoke is pursued by implementing a smoke-free policy, prohibiting smoking throughout the entire site, earning 2 more points.

CONCLUSION: SALINA SITE DESIGN

The Salina Implementation Site Design exemplifies a community-centered and sustainability-driven approach, integrating intentional design decisions that enhance user experience, environmental responsibility, and site functionality. By incorporating LEED + SITES strategies, the project ensures that communal well-being, accessibility, and ecological resilience remain at the forefront of development. The design approach, inspired by affordable housing models like cottage courts, balances private and shared spaces, fostering connectivity and engagement among residents.

Through sustainable site strategies, the project effectively integrates accessibility enhancements, social and mental well-being considerations, on-site food production, and light pollution reduction, while also encouraging multi-modal transportation and air quality improvements. These initiatives collectively contribute to creating an inclusive, adaptable, and environmentally responsible community. By prioritizing long-term sustainability and livability, the Salina Implementation serves as a model for integrating high-performance site design with social and environmental well-being.

FIGURE 6.37 SALINA SITE DESIGN CERTIFICATION

SITE DESIGN CERTIFICATION

Site Design	**Provide Optimum Site Accessibility**	SITES	2 PTS	ACHIEVED
	Promote Equitable Site Use	SITES	2 PTS	ACHIEVED
	Support Mental Restoration	SITES	2 PTS	ACHIEVED
	Support Physical Activity	SITES	2 PTS	
	Provide On Site Food Production	SITES	2 PTS	ACHIEVED
	Reduce Light Pollution	SITES	2 PTS	ACHIEVED
	Encourage Fuel Efficient and Multi Modal Transportation	SITES	4 PTS	ACHIEVED
	Minimize Exposure to Environmental Tobacco Smoke	SITES	2 PTS	ACHIEVED
	Connecting Multi Modal Transit Networks	SITES	3 PTS	ACHIEVED

TOTAL POINTS:

LEED:	0 PTS / 0 PTS
SITES:	19 PTS / 21 PTS

SALINA: NATIVE PLANTING

NATIVE PLANTING

IN-GROUND LANDSCAPE

The Native Planting Design for the Salina Implementation focuses on strategic plant selection and sustainable planting methods to create a resilient, low-maintenance landscape that thrives within the site's environmental conditions. Drawing inspiration from *Planting in a Post-Wild World: Designing Plant Communities for Resilient Landscapes*, this approach emphasizes ecologically driven planting strategies, ensuring that plant communities are adapted to the local climate, promote biodiversity, and enhance site sustainability.

As part of the LEED + SITES integration, the Salina site's native planting strategy follows the In-Ground: Vegetation Checklist, which provides guidelines for sustainable landscape design through a focus on vegetation selection, soil health, and ecological functionality. This checklist ensures that planting strategies not only support site aesthetics and functionality but also contribute to soil stability, water conservation, and long-term ecosystem resilience. By implementing native plant species and layered plant communities, the Salina Implementation enhances habitat creation, stormwater management, and overall site sustainability, reinforcing the project's commitment to environmentally responsible landscape design.

DESIGN APPROACH

The Salina Site applies a native planting strategy focusing on planting archetypes and layered design to create a resilient and ecologically functional landscape (Rainer & West, 2015). The planting design is based on a prairie grassland/shrub land mix native to the Central Great Plains, requiring plant selections are climate-adapted, bio-diverse, and low-maintenance.

The planting strategy consists of four distinct layers, each serving a unique ecological and aesthetic function. The structural layer

FIGURE 6.38 NATIVE PLANTING BREAKDOWN

CRITERIA:

VEGETATION

FIGURE 6.39 SALINA, KANSAS NATIVE PLANTING STRATEGY

FIGURE 6.40 SALINA, KANSAS PLANTING STRATEGY

PLANTING LAYERING

PLANTING ARCHETYPE: **PRAIRIE GRASSLAND/CENTRAL GREAT PLAINS**

STRUCTURAL:

SEASONAL:

GROUND COVERING:

FILLER:

establishes the vertical framework of the planting design, consisting of ornamental trees, shrubs, and prairie grasses, which provide height, stability, and long-term ecological function. The seasonal layer introduces color and visual interest, ensuring that the landscape remains dynamic and engaging throughout the year. The ground cover layer enhances biodiversity and biomass, filling spaces to create a fuller, healthier plant community while also suppressing weeds and reducing soil erosion. Lastly, the filler layer consists of temporary plantings that provide immediate aesthetic value during the early stages of landscape

FIGURE 6.41 NATIVE PLANTING LAYERING STRATEGY

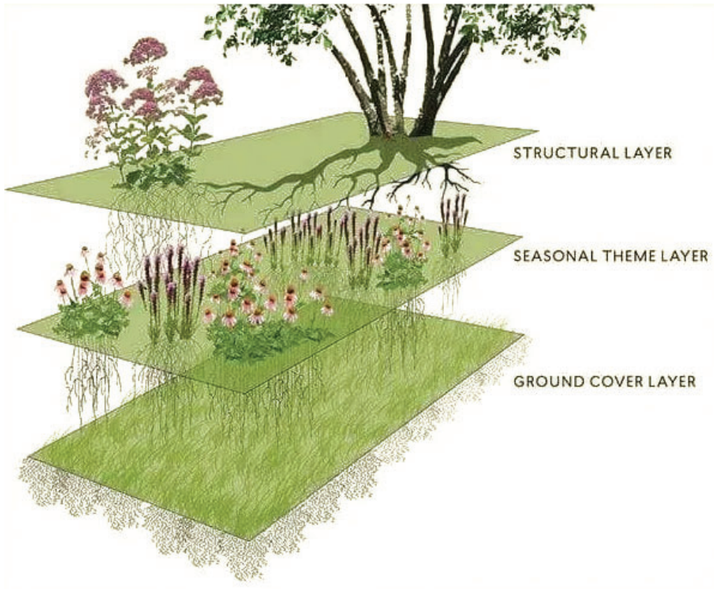


FIGURE 6.42 SALINA, KANSAS NATIVE PLANTING IMPLEMENTATION

establishment. These plants act as a short-term solution until the rest of the plant community matures and naturally fills out the space.

LEED + SITES: SUSTAINABILITY STRATEGIES

Vegetation

The native planting strategy for the Salina Implementation draws heavily from the ecological principles outlined in Planting in a Post-Wild World, while aligning with 14 relevant LEED and SITES credits identified in the In-Ground Landscape: Vegetation Checklist. This strategy supports the development of a resilient, regionally appropriate planting system that promotes biodiversity, protects existing site ecology, and contributes to long-term sustainability goals.

Under LEED, the Heat Island Reduction credit is pursued through the tree planting option,

which includes the installation of native tree species that provide shade for at least 315 square feet of site area. This strategy contributes 1 point toward LEED certification by reducing surface temperatures and mitigating heat retention.

Several SITES pre-requisites are also addressed. Control and Manage Invasive Plants is met by ensuring no invasive species are included in the design and that any existing invasive plants are removed during site preparation. Use Appropriate Plants is fulfilled by selecting exclusively native and regionally adapted plant species, all of which will be sourced from nursery-grown or legally harvested sources, considering site-specific conditions like climate, soil health, and water needs.

The Conserve Healthy Soils and Appropriate Vegetation credit is actively pursued by retaining 12 of the 15 existing trees on the site—preserving 80% of pre-existing vegetation. This commitment to conserving the site's natural assets contributes 5 points toward SITES certification.

Although Conserve Special Status Vegetation and Conserve and Restore Native Plant Communities are not applicable due to the site's limited existing ecological diversity, the project does pursue the Conserve and Use Native Plants credit. While the SITES Native Plants Calculator is required for an official score—unavailable for this academic project—an estimated evaluation suggests that the site would likely meet or exceed the 60% native plant threshold, potentially earning 6 points.

The project also pursues the Optimize Biomass credit, supporting the development of a diverse planting palette with layered vegetation to enhance ecological productivity and site function. While Reduce Urban Heat Island Effect is not pursued as a formal credit, the overall planting approach still contributes to mitigating localized heat buildup.

To address wildfire risk, the design adheres to the SITES v2 guidelines for Reducing the Risk of Catastrophic Wildfire, implementing defensible planting zones and selecting fire-resistant native species. Additionally, Support Sustainability in Plant Production is pursued through Option 2, partnering with producers who disclose sustainability data, earning 3 SITES points.

Credits such as Divert Reusable Vegetation and Restore Disturbed Soils from Previous Development are not pursued in this project.

CONCLUSION: SALINA NATIVE PLANTING

The native planting strategy for the Salina Implementation reinforces the project's commitment to ecologically responsible and climate-adapted landscape design. Grounded in the principles of Planting in a Post-Wild World and aligned with the LEED + SITES In-Ground Vegetation Checklist, the approach combines layered planting structures, native species, and sustainability-driven management practices to create a resilient, bio-diverse, and low-maintenance planting system.

By integrating key credits—such as Heat Island Reduction, Invasive Species Control, Soil Conservation, Native Plant Use, and Biomass Optimization—the project not only enhances habitat and ecosystem services, but also supports long-term site performance and community well-being. While some credits are not applicable due to site limitations, the strategy's strong emphasis on native species, ecological layering, and soil preservation ensures that the Salina site is both environmentally functional and visually rich.

Ultimately, this planting strategy serves as a model for sustainable vegetation design, demonstrating how thoughtful plant community planning can contribute to LEED + SITES certification goals, while building a resilient landscape rooted in place, ecology, and long-term sustainability.

FIGURE 6.43 SALINA NATIVE PLANTING CERTIFICATION

NATIVE PLANTING CERTIFICATION

Vegetation	**Heat Island Reduction**	LEED	1 PT	ACHIEVED
	Control and Manage Invasive Plants	SITES	Required	ACHIEVED
	Use Appropriate Plants	SITES	Required	ACHIEVED
	Conserve and Use Native Plants	SITES	6 PTS	ACHIEVED
	Conserve and Restore Native Plant Communities	SITES	6 PTS	ACHIEVED
	Conserve and Restore Native Plant Communities	SITES	Required	ACHIEVED
	Create and Communicate a Soil Management Plan	SITES	6 PTS	ACHIEVED
	Optimize Biomass	SITES	4 PTS	ACHIEVED
	Reduce Urban Heat Island	SITES	4 PTS	ACHIEVED
	Reduce Risk for Catastrophic Wildfire	SITES	4 PTS	ACHIEVED
	Support Sustainability in Plant Production	SITES	5 PTS	ACHIEVED
	Divert Reusable Vegetation	SITES	5 PTS	

TOTAL POINTS:

LEED: 1 PT / 1 PT

SITES: 35 PTS / 40 PTS

SALINA: WATER MANAGEMENT

WATER MANAGEMENT

IN-GROUND LANDSCAPE

The water management strategy for the Salina Implementation takes a comprehensive and integrated approach to addressing all aspects of water use across the site. Central to this strategy is the goal of reducing potable water consumption while enhancing the site's ability to manage, collect, and reuse water efficiently. By focusing on water usage, rainwater collection, and the functional role of stormwater features, the design promotes both ecological and infrastructural resilience. The intent is not only to conserve water but also to develop a deeper understanding of how water interacts with the site and contributes to the broader environmental system.

As part of the LEED + SITES integration, the Salina site employs a series of Low-Impact Development (LID) strategies tailored to its specific conditions. These include the use of bio-swales to capture and filter stormwater runoff, reducing erosion and promoting infiltration. Each Intuitive Home building is integrated with a water cistern that collects roof runoff, which is then reused for irrigating native vegetation and the modular green wall system—further reducing the demand for potable water. The native planting strategy supports this effort by selecting drought-tolerant, regionally adapted species that thrive with minimal irrigation. Additionally, water metering systems are included to track consumption and provide valuable data for evaluating long-term water efficiency.

DESIGN APPROACH

The water management strategy for the Salina Implementation is centered around a comprehensive suite of sustainable techniques aimed at reducing potable water use, enhancing stormwater management, and supporting long-term site resilience. The core strategies include native low-water planting, rainwater harvesting and reuse, LID features such as bio-swales and rain gardens, and site-wide water use monitoring.
Several of these strategies are directly integrated with other project components—particularly the Intuitive Home Water

FIGURE 6.44 WATER MANAGEMENT BREAKDOWN

CRITERIA:

WATER MANAGEMENT

FIGURE 6.45 SALINA, KANSAS WATER MANAGEMENT DESIGN

WATER MANAGEMENT DESIGN:

FIGURE 6.46 SALINA, KANSAS WATER MANAGEMENT BIO-SWALE

Cistern system and the native planting design—ensuring consistency across site-wide sustainability goals. These systems work in tandem to reduce irrigation needs, support plant establishment, and manage rainfall efficiently.

Bio-swales and rain gardens are strategically located throughout the site, particularly along internal roadways, between buildings and communal spaces, and along green corridors. These vegetated, concave features are designed with gentle slopes to capture and slow runoff during heavy rain events, allowing for natural filtration and groundwater recharge while enhancing the ecological and visual quality of the landscape
.
To ensure responsible long-term water use, water meters will be installed throughout communal zones and building systems, as well as at all irrigation points. Irrigation will be limited to the plant establishment period. After this phase, only non-potable water

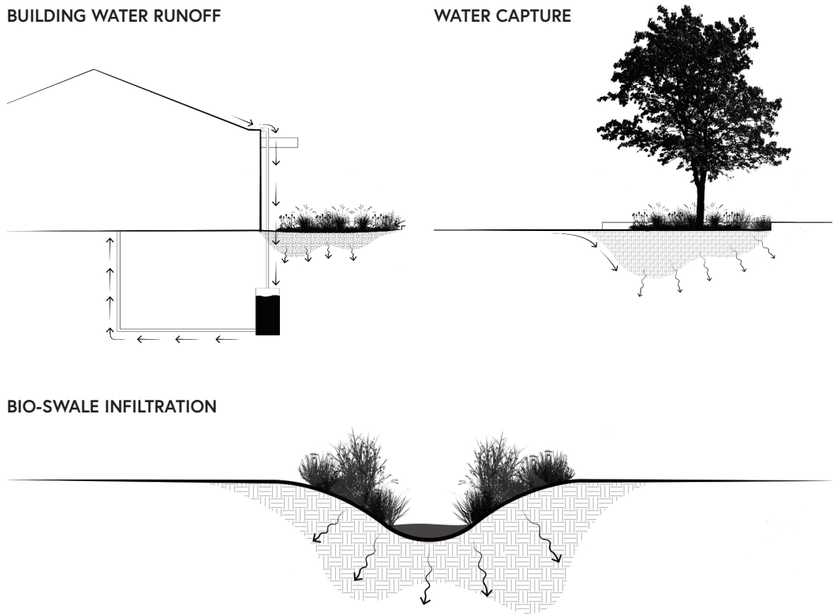


FIGURE 6.47 BIO-SWALE DESIGN STRATEGY

sourced from on-site cisterns will be used—primarily for the green wall systems integrated into the facades of the Intuitive Homes. This closed-loop approach minimizes resource consumption while supporting the project's LEED + SITES water management goals.

LEED + SITES: SUSTAINABILITY STRATEGIES

Water Management
The Salina Implementation's water management strategy aligns with the 11 LEED + SITES credits outlined in the In-Ground Landscape: Water Management checklist, incorporating a comprehensive approach to Low-Impact Development (LID), water conservation, and stormwater control. These strategies are rooted in site-wide integration of efficient water use, natural systems, and reuse practices that ensure both functional and ecological performance.

As part of the LEED certification, the Outdoor Water Use Reduction credit is pursued through Option 1, which rewards the use of 100% native planting strategies throughout the site. As detailed in the Salina: Native Planting section, this approach significantly reduces irrigation demands and earns 4 LEED points. In addition, the Rainwater Management credit is pursued through Option 1, which focuses on minimizing stormwater runoff using LID strategies such as native vegetation, bio-swales, rain gardens, and the Intuitive Home water cistern system. These systems help detain, infiltrate, and filter stormwater on site.

The Water Use Reduction pre-requisite for LEED is also met by the Salina Implementation through combined efforts between the Intuitive Home prototype and overall site systems. By earning at least 3 points across Indoor and Outdoor Water Use categories, the project satisfies the pre-requisite necessary for certification.

From the SITES certification perspective, multiple pre-requisites and credits are actively pursued. The Manage Precipitation on Site pre-requisite is met by implementing LID features and cistern storage that manage runoff from a 60th percentile precipitation event, while the Reduce Water Use for Landscape Irrigation pre-requisite is achieved through a combination of native planting, water collection, and no permanent irrigation system, exceeding the required 50% water reduction baseline.

Beyond these minimum requirements, the project also pursues several water-related SITES credits. The Manage Precipitation Beyond Baseline credit is achieved by retaining stormwater on site during 80th percentile rainfall events, contributing 4 SITES points. The Reduce Outdoor Water Use credit is also met through Option 2, which allows potable water use only during the plant establishment period. After establishment, all irrigation—including for features like the green wall system—will rely solely on captured water from on-site cisterns, awarding an additional 5 points.

The project also embraces the Design Functional Stormwater Features as Amenities credit, with 100% of stormwater features—such as rain gardens and bio-swales—serving both ecological and aesthetic purposes. These elements are integrated throughout the site not only for water retention and filtration but also as visible, inviting landscape features, contributing another 5 SITES points.
The Restore Aquatic Ecosystems credit is not pursued due to the absence of existing water bodies or aquatic environments on the site.

CONCLUSION: SALINA WATER MANAGEMENT

The water management strategy for the Salina Implementation demonstrates a holistic and integrated approach to sustainable site design. By combining native planting, rainwater harvesting, LID features, and water use monitoring, the project not only reduces reliance on potable water but also enhances the site's ability to manage stormwater naturally and effectively. These strategies work together to support both LEED and SITES certification goals, contributing to long-term environmental resilience, resource conservation, and user well-being. Through thoughtful integration of infrastructure and ecology, the Salina site sets a strong precedent for responsible water stewardship in residential development.

FIGURE 6.48 SALINA WATER MANAGEMENT CERTIFICATION

WATER MANAGEMENT CERTIFICATION

Water Management	**Outdoor Water Use**	LEED	4 PTS	ACHIEVED
	Water Use	LEED	Required	ACHIEVED
	Water Metering	LEED	Required	ACHIEVED
	Total Water Use	LEED	10/15 PTS	ACHIEVED
	Rainwater Management	LEED	2 PTS	ACHIEVED
	Restore Aquatic Ecosystems	SITES	6 PTS	
	Reduce Water Use for Landscape Irrigation	SITES	Required	ACHIEVED
	Manage Precipitation on Site	SITES	Required	ACHIEVED
	Manage Precipitation Beyond Baseline	SITES	6 PTS	ACHIEVED
	Reduce Outdoor Water Use	SITES	6 PTS	ACHIEVED
	Design Functional Stormwater Features as Amenities	SITES	5 PTS	ACHIEVED

TOTAL POINTS:

LEED:	16 PTS / 21 PTS
SITES:	17 PTS / 23 PTS

SALINA: CONSTRUCTION + IMPLEMENTATION

CONSTRUCTION + IMPLEMENTATION

IN-GROUND LANDSCAPE

The Construction and Implementation approach for the Salina site emphasizes minimizing site disturbance, increasing construction efficiency, and reducing labor intensity and timeline through the integration of prefabricated systems. This approach centers on the installation of the Intuitive Home package—including the building, modular deck, water cistern, and green wall—while also incorporating custom in-ground landscape strategies tailored specifically to the Salina context.

Aligned with the LEED + SITES In-Ground Landscape: Construction + Implementation checklist, the project follows best practices for sustainable construction. Much of the LEED-related point allocation for the building itself is detailed in the Intuitive Home Building Prototype section; however, this portion focuses on the on-site construction practices specific to the Salina implementation.

CONSTRUCTION APPROACH

The construction and implementation strategy for the Salina site is grounded in two primary goals: the installation of the prefabricated Intuitive Home package and the execution of customized, on-site landscape and infrastructure elements. Together, these efforts aim to reduce site disturbance, streamline construction timelines, and enhance overall efficiency.

The use of prefabrication is central to the project's construction approach. Major components—including the Intuitive Home building, modular deck system, water cistern, and green wall—are fabricated off-site. This reduces on-site labor and noise, minimizes material waste, and improves quality control. Prefabrication also enables more accurate material separation for recycling, salvaging, or reuse, helping limit construction-related impacts once the components are brought to the site for final assembly.

FIGURE 6.49 CONSTRUCTION AND IMPLEMENTATION BREAKDOWN

CRITERIA:

CONSTRUCTION + IMPLEMENTATION

FIGURE 6.50 SALINA, KANSAS CONSTRUCTION DESIGN

LEED + SITES: SUSTAINABILITY STRATEGIES

Construction
The construction phase of the Salina Implementation aligns with the In-Ground Landscape: Construction and Vegetation Checklist from the SITES certification system, which emphasizes sustainable on-site construction practices and environmental responsibility. This section focuses on the strategies and protocols used during the Salina project's construction process to meet these certification requirements, particularly for site-specific implementation of the Intuitive Home package and related landscape components.

To meet the Communicate and Verify Sustainable Construction Practices pre-requisite, the project will designate a team member responsible for overseeing and verifying the implementation of construction drawings, maintaining clear communication between design and construction teams, and facilitating pre-construction meetings and final punch lists. This ensures that the project's sustainability intentions are upheld throughout the construction timeline.

The Control and Retain Construction Pollutants requirement will be met through the development and enforcement of an Erosion and Sedimentation Control (ESC) Plan. This plan will incorporate Best Management Practices (BMPs) to prevent soil loss, minimize sediment discharge, reduce air pollution from dust and emissions, and protect Vegetation and Soil Protection Zones (VSPZs).

To fulfill the Restore Soils Disturbed During Construction requirement, all disturbed soils will be tested and restored to meet site-specific targets for organic matter content, compaction levels, and chemical composition, based on pre-construction assessments. This ensures that site health is preserved and that planting areas are fully prepared to support long-term landscape performance.

The project will also pursue the Divert Construction and Demolition Materials from Disposal credit through the use of prefabrication. Much of the Intuitive Home package will be constructed off-site, allowing for efficient material separation and increased opportunities to recycle, salvage, or reuse structural components. On-site waste will be managed through a formal Construction Waste Management Plan. Since the site involves vacant lots, demolition materials will be minimal, but any materials encountered will be properly diverted. The project anticipates diverting at least 75% of structural materials and 95% of road and infrastructure materials, earning up to 4 points toward SITES certification. To meet the Protect Air Quality During Construction credit, the project will require that at least 50% of all diesel-powered equipment used on-site meet Tier 2 or higher emissions standards, minimizing the environmental and health impacts of airborne pollutants. This initiative qualifies the project for an additional 2 SITES points.

Finally, the project will pursue the Support Local Economy credit by prioritizing the hiring of a local workforce and sourcing materials and services from regional businesses for both on-site and off-site prefabricated construction. This strategy not only strengthens the community connection but also reduces the environmental impact associated with long-distance transportation of materials and labor.

CONCLUSION: SALINA CONSTRUCTION + IMPLEMENTATION

The construction and implementation strategy for the Salina site demonstrates a thoughtful balance between innovation, efficiency, and environmental responsibility. By leveraging prefabrication for the Intuitive Home package and applying careful on-site practices, the project minimizes disruption, streamlines labor, and ensures high-quality outcomes. This integrated approach not only supports faster and more precise construction but also reinforces the project's broader goals of sustainable development and long-term site resilience.

FIGURE 6.51 SALINA CONSTRUCTION AND IMPLEMENTATION CERTIFICATION

CONSTRUCTION + IMPLEMENTATION CERTIFICATION

Construction	**Communicate and Verify Sustainable Construction**	SITES	Required	ACHIEVED
	Control and Retain Construction Pollution	SITES	Required	ACHIEVED
	Provide Storage and Collection of Recyclables	SITES	Required	ACHIEVED
	Divert Construction and Demolition of Materials	SITES	2/4 PTS	ACHIEVED
	Support Local Economy	SITES	3 PTS	ACHIEVED
	Restore Soils Disturbed During Construction	SITES	Required	ACHIEVED
	Restore Soils Disturbed by Previous Development	SITES	5 PTS	
	Protect Air Quality	SITES	4 PTS	ACHIEVED

TOTAL POINTS:

LEED: 0 PTS / 0 PTS

SITES: 9 PTS / 16 PTS

SALINA: POST-DESIGN PLAN

POST-DESIGN PLAN

POST-DESIGN

The Post-Design Plan serves as a long-term strategy to ensure that sustainability remains a guiding principle even after the design and construction phases of the Salina Implementation are complete. Its primary goal is to support the continued performance and impact of both the Intuitive Home and the Salina site through two key focus areas: operations and maintenance, and performance tracking.

This phase outlines how the site and building will be managed to uphold design intent, reduce environmental impact, and ensure that systems function effectively over time. A strong emphasis is placed on defining maintenance protocols that align with the sustainable features of the project—such as native planting areas, modular systems, and water reuse infrastructure. Collaboration with operations and maintenance teams is essential to ensure they understand and can carry out the care required to maintain the project's ecological performance and functional longevity.

To support this framework, the Post-Design Checklist will be used as a tool to evaluate and reinforce two main aspects of post-construction sustainability: Operations and Maintenance, and Performance and Innovation. These elements ensure that the site not only meets its original goals but also adapts and improves through continued monitoring, innovation, and stakeholder engagement.

SALINA: POST-DESIGN APPROACH

The post-design phase for the Intuitive Home Implementation in Salina, Kansas is centered around the Post-Design Checklist, specifically focusing on Operations + Maintenance and Performance + Innovation. These elements form the foundation for how post-construction strategies will be integrated into the Salina site to ensure long-term success and alignment with the original design goals. This phase

FIGURE 6.52 POST-DESIGN PLAN BREAKDOWN

CRITERIA:

OPERATIONS + MANAGEMENT

PERFORMANCE

FIGURE 6.53 SALINA POST-DESIGN PLAN

emphasizes the importance of continued care, monitoring, and adaptation of sustainable systems after construction is complete. By applying the Post-Design Checklist, the project ensures that key building and landscape features remain high-performing, resilient, and visually engaging—supporting both environmental function and user experience well into the future.

LEED + SITES: SUSTAINABILITY STRATEGIES

Operations + Maintenance

The Operations and Maintenance strategy for the Salina site is focused on ensuring that sustainability continues beyond construction, supporting the long-term performance of both the Intuitive Home and its surrounding landscape. This phase is guided by a clear post-design plan that emphasizes education, responsible site care, and alignment with sustainable design intentions. It draws from seven key categories outlined in the Post-Design: Operations + Maintenance Checklist.

Within the LEED framework, the Education of Homeowners credit is a foundational requirement. This is achieved through the creation of an Operations and Maintenance manual and a thorough building walk through, both designed to educate residents on energy-efficient systems, sustainable site features, and best practices for continued performance.

In alignment with broader landscape goals, a Sustainable Maintenance Plan has been developed to guide ongoing care for the site. This plan includes detailed strategies for soil health, water use, vegetation care, material upkeep, pest control, and waste management. It will be shared with site managers and maintenance personnel to ensure consistency and accountability in managing the site after implementation.

The project also pursues the Recycle Organic Matter credit by establishing on-site composting systems for landscape waste. All vegetation trimmings from maintenance activities will be collected, stored, and reused as compost to enrich planting areas—allowing the site to recycle 100% of organic landscape waste and reduce landfill contributions.

To promote ecological health, the project implements a Minimized Use of Pesticides and Fertilizers policy. This includes a ban on "weed and feed" products, a prohibition on pesticides used for cosmetic purposes, and restricted fertilizer use during rainy seasons and plant establishment periods. Buffer zones will also be established, and pre-emergent pesticides will not be used. These practices reduce harmful runoff and improve soil and plant health.

In efforts to reduce outdoor energy consumption, the site incorporates efficient outdoor lighting and irrigation technologies, resulting in a 30% reduction in energy use compared to baseline. While the project does not pursue renewable energy for landscape electricity needs, these savings contribute meaningfully to overall site efficiency.

Lastly, the site will pursue Protecting Air Quality During Landscape Maintenance by coordinating scheduled maintenance that uses low-emission equipment. Where possible, this will transition toward manual or electric-powered maintenance tools, further reducing environmental impact and promoting healthier site conditions.

Innovation + Performance

The Performance and Innovation phase of the Salina Implementation serves as a final evaluation of the project's sustainable design goals, focusing on both the Intuitive Home package and the overall site. The use of modular and prefabricated systems introduces a unique opportunity for dual scoring—addressing both building-level and site-level sustainability strategies. This section aligns with the Post-Design: Performance + Innovation Checklist, referencing seven LEED and SITES criteria that guide post-construction innovation and performance tracking.

To fulfill the Preliminary Rating pre-requisite for LEED certification, the project provides a comprehensive assessment of anticipated performance during the design phase. The content developed in the Design Application portion of this document meets this requirement by aligning design strategies with LEED goals and establishing a formal sustainability framework for the project.

The project will pursue the Innovation credit under LEED through three pathways: innovation, pilot, and exemplary performance. Central to this credit is the modular and prefabricated design of the Intuitive Home package, which introduces scalable solutions for sustainable construction. Documentation will include intent, submittals, and design process details. The project also expects to earn points through Exemplary Performance by exceeding standard credit thresholds in both building and site components—contributing up to 5 LEED points.

Although the team will not pursue the LEED Accredited Professional credit in this academic phase, the project acknowledges that this credit could be easily achieved in a professional setting through the inclusion of a certified LEED AP as part of the design or construction team.

To achieve the Promote Sustainability Awareness and Education credit under SITES, the project documents its research-based and academic approach, highlighting educational opportunities tied to prefabrication, landscape performance, and affordable housing. These efforts foster public understanding of sustainable practices and qualify the project for 4 SITES points.

The project also addresses the Develop and Communicate Case Study credit by using the Salina Implementation as a real-world application of the Intuitive Home package. While this report forms the foundation of the case study, future formalization of the content into a full case study format will fulfill the remaining requirements and contribute 3 SITES points.

A plan has been created to satisfy the Plan to Monitor and Report Site Performance credit under SITES. This includes tracking the water performance of the cistern system, evaluating native plant community health, and assessing the social impact of outdoor communal spaces. A third-party reviewer will help support this process, making recommendations and collecting feedback over time. This performance strategy qualifies the project for 4 SITES points.

Finally, the project will pursue the Innovation credit under SITES by highlighting the prefabricated and modular strategies used throughout the Intuitive Home package. These systems support low-impact construction, scalable housing solutions, and long-term resource efficiency. Final point values for this credit will be determined during the project's concluding documentation phase.

CONCLUSION: SALINA POST DESIGN PLAN

The Post-Design Plan for the Salina Implementation ensures that sustainability is not only embedded in the initial design and construction phases but also maintained and enhanced throughout the life of the project. By integrating structured operations, maintenance protocols, and ongoing performance evaluation, the project is equipped to adapt to changing conditions while upholding its environmental goals. Through continued education, efficient resource management, and innovation in modular systems, the Salina Implementation demonstrates a forward-thinking approach to long-term sustainability. This commitment to post-occupancy performance ensures that both the Intuitive Home and its surrounding landscape remain high-performing, resilient, and supportive of the community well into the future.

FIGURE 6.54 SALINA POST-DESIGN CERTIFICATION

POST-DESIGN CERTIFICATION

Operations + Maintenance	**Education of Homeowner**	LEED	Required	ACHIEVED
	Plan for Sustainable Site Maintenance	SITES	Required	ACHIEVED
	Recycle Organic Matter	SITES	5 PTS	ACHIEVED
	Minimize Pesticides and Fertilizer Use	SITES	5 PTS	ACHIEVED
	Reduce Outdoor Energy Consumption	SITES	4 PTS	ACHIEVED
	Use Renewable Sources for Landscape Electricity Needs	SITES	4 PTS	ACHIEVED
	Protect Air Quality During Landscape Maintenance	SITES	4 PTS	ACHIEVED
Innovation + Performance	**Preliminary Rating**	LEED	Required	ACHIEVED
	Innovation	LEED	5 PTS	ACHIEVED
	LEED Accredited Professional	LEED	1 PT	
	Promote Sustainability Awareness	SITES	4 PTS	ACHIEVED
	Develop and Communicate a Case Study	SITES	3 PTS	ACHIEVED
	Plan to Monitor and Report Site Performance	SITES	4 PTS	ACHIEVED
	Innovation or Exemplary Performance	SITES	9 PTS	ACHIEVED

TOTAL POINTS:

LEED:	5 PTS / 6 PTS
SITES:	42 PTS /42 PTS

SALINA, KANSAS: INTUITIVE HOME TOTAL SCORE

The Salina Implementation of the Intuitive Home Package demonstrates a significant advancement in sustainable performance by achieving 91 points under the LEED v4.1 Residential Single Family rating system and 156 points under the SITES v2 Rating System. These scores not only meet the criteria for certification but actually qualify the project for Platinum-level certification in both systems—the highest level possible. This outcome reflects a highly integrated design approach that successfully aligns building strategies with site-level sustainability practices. By meeting the top certification thresholds, the Salina Implementation serves as a model for how prefabricated and modular systems can be optimized to deliver both environmental and performance benefits at scale.

FIGURE 6.55 LEED CERTIFICATION

LEED CERTIFICATION	
CERTIFIED	40 to 49 points
SILVER	50 to 59 points
GOLD	60 to 79 points
PLATINUM	80+ points

FIGURE 6.56 SITES CERTIFICATION

SITES CERTIFICATION	
CERTIFIED	70 to 84 points
SILVER	85 to 99 points
GOLD	100 to 134 points
PLATINUM	135+ points

FIGURE 6.57 SALINA IMPLEMENTATION CERTIFICATION

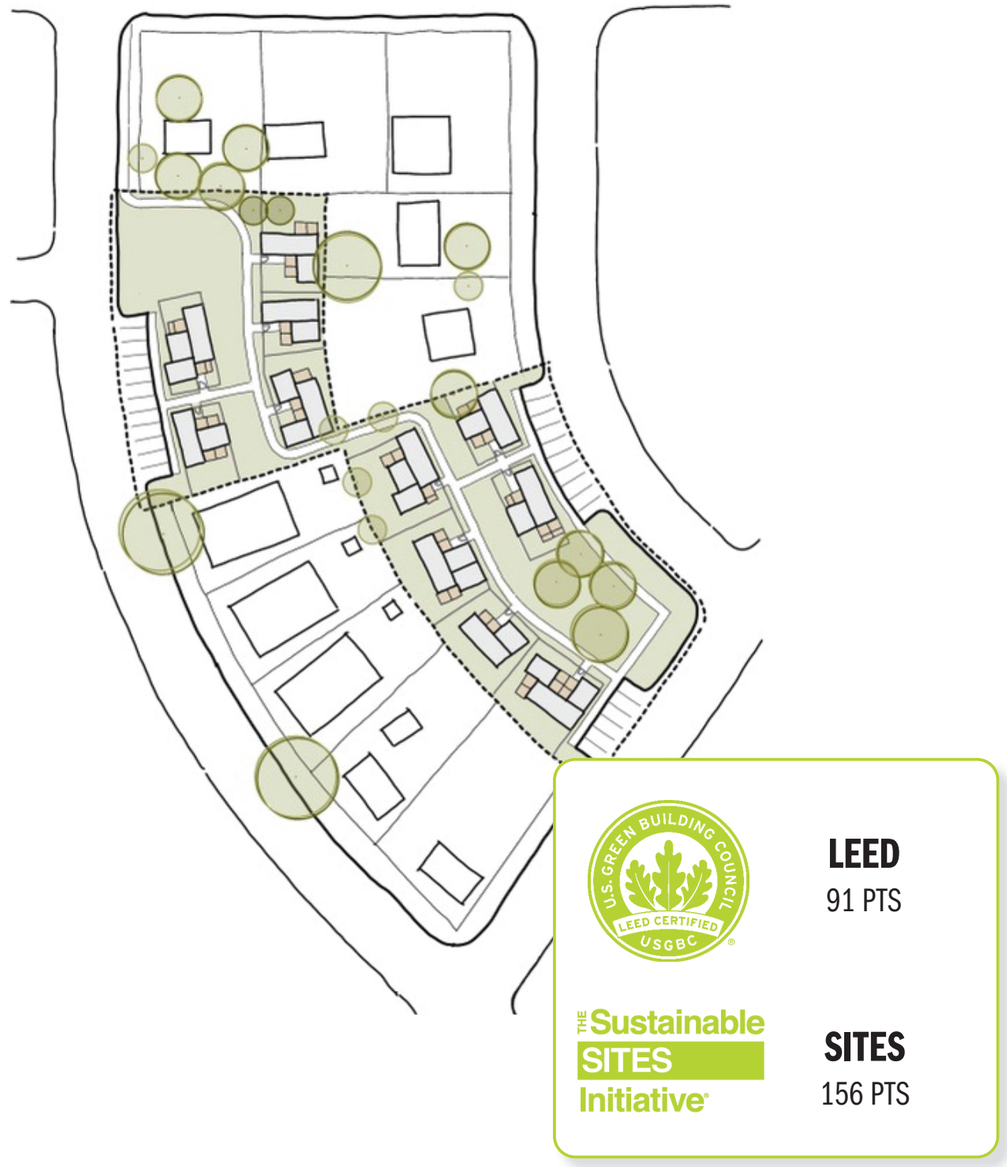
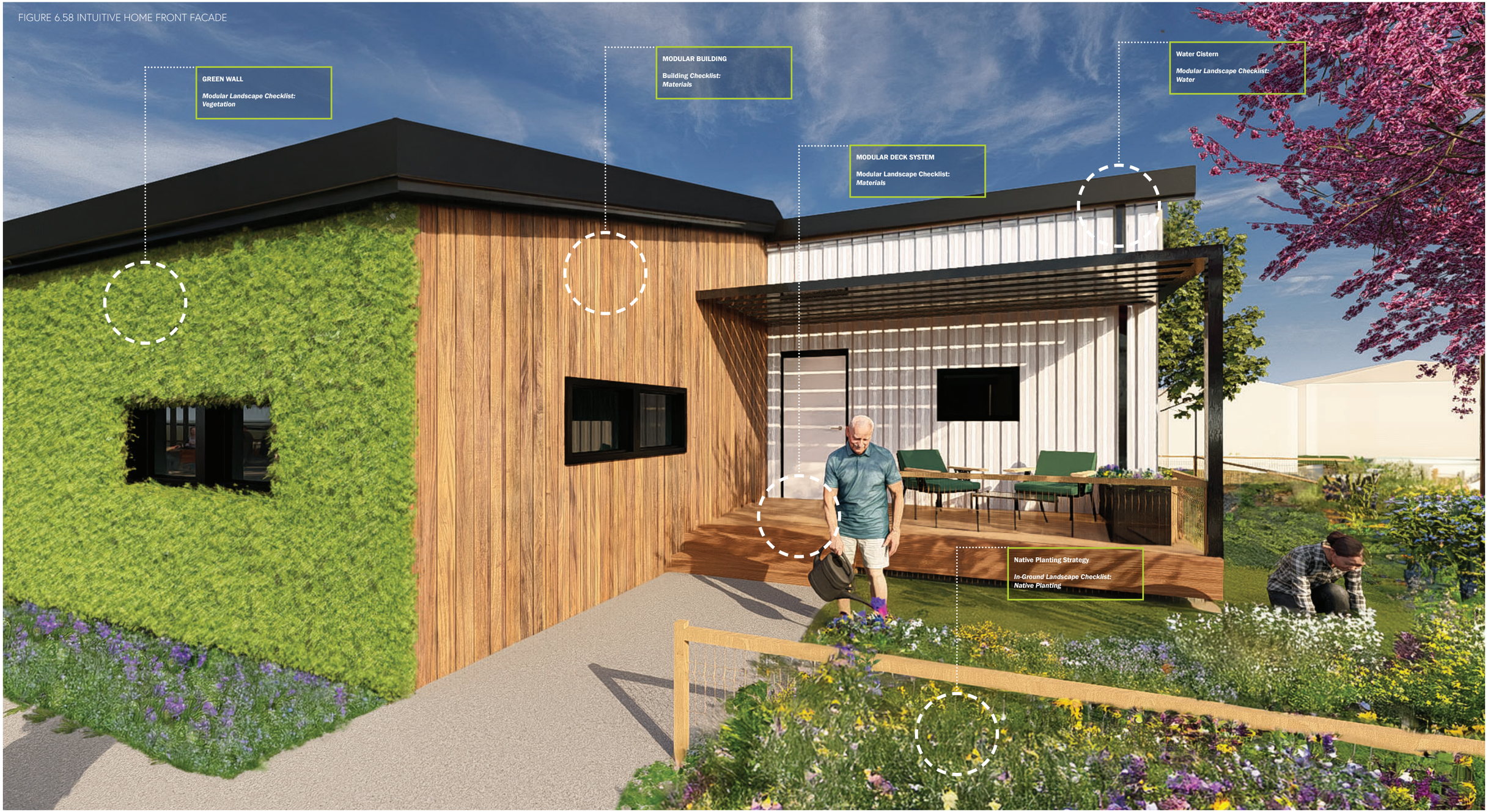


FIGURE 6.58 INTUITIVE HOME FRONT FACADE



SITE PROGRAMMING
In-Ground Landscape Checklist: Site Design
BIO-SWALE
In-Ground Landscape Checklist: Water Management

MODULAR BUILDING
Building Checklist: Materials
SOCIAL CONNECTION
In-Ground Landscape Checklist: Site Design

FIGURE 6.61 INTUITIVE HOME FOOD PRODUCTION

NATIVE PLANTING STRATEGY
In-Ground Landscape Checklist: Vegetation
MODULAR DECK SYSTEM
Modular Landscape Checklist: Materiality

07 CONCLUSION

FINDINGS

One of the most significant findings of this research is the considerable time investment required to pursue sustainable design through LEED and SITES certification frameworks. These systems involve detailed documentation, precise coordination, and a strong working knowledge of sustainability criteria. Especially when layered onto the complexities of prefabricated or modular design, the certification process can extend project timelines and introduce additional costs. As such, early integration of sustainability goals into the design process is critical. Without a proactive approach, certification efforts can become reactive, inefficient, and difficult to manage.

Equally important is the need for strict organization throughout the project lifecycle. Coordinating the various sustainability credits—especially across building and landscape systems—requires clearly defined roles, responsibilities, and timelines. When working with prefabricated strategies, this coordination becomes even more complex, as modular elements must be designed and produced in a way that supports specific sustainability goals. Identifying who is accountable for implementing each credit, and when those efforts should take place, is essential to maintaining momentum and ensuring successful outcomes.

Finally, this research reinforces the importance of viewing certification frameworks not as end goals, but as tools for deeper engagement with sustainable design. While LEED and SITES provide valuable benchmarks and structure, long-term success depends on a mindset of continual improvement. Sustainable design should adapt to new knowledge, shifting site conditions, and evolving user needs. By using certification as a foundation—rather than a finish line—designers and project teams can create more resilient, innovative, and environmentally responsive solutions that continue to evolve well beyond project completion.

FUTURE CONSIDERATIONS

A valuable direction for future exploration is the integration of form-based codes into new construction and prefabricated developments. These regulatory frameworks, which focus on physical form rather than land use, offer a promising pathway for embedding sustainability into the planning process. By aligning modular and prefabricated strategies with form-based principles, municipalities and developers could streamline zoning and approval processes while encouraging more environmentally responsive outcomes. Investigating how local planning policies might standardize and incentivize sustainable prefabrication could lead to more consistent and scalable implementation across different development contexts.

Another area for further research lies in applying modular systems within a fully realized design-build process. While this project aimed to generate complete construction documentation for the Intuitive Home Prefabricated Package, shifts in team structure and the constraints of the Gateway Decathlon limited the extent to which the strategies could be carried through to construction. Future projects that bring prefabricated components from concept to build form would provide critical insights into the practical challenges and benefits of these systems—particularly in terms of coordination, quality control, and cost efficiency within sustainable construction practices.

Finally, although LEED and SITES offer comprehensive frameworks, the evolving nature of sustainable design presents ongoing opportunities for deeper study. Each credit category within these systems represents a potential area for focused innovation, whether through materials research, energy performance, or ecosystem services. Treating individual credits as research prompts rather than compliance checkboxes can generate more nuanced design strategies and advance the broader goals of environmental performance. Future studies might build upon these certification systems while pushing beyond them, contributing to a more adaptive and forward-thinking approach to sustainable design.

08 APPENDICES

REFERENCES

Adams, Dominic, Anoop Sattineni, and Jacquelin Thompson. 2014. "Using Prefabricated Building Component to Obtain LEED Credits." 50th ASC Annual International Conference Proceedings.

Arditi, David, Serdar Kale, and Martino Tangkar. 1997. "Innovation in Construction Equipment and Its Flow into the Construction Industry." Journal of Construction Engineering and Management, 123(4): 371-378 https://doi.org/10.1061/(ASCE)0733-9364

Baiden, B.K., A.D.F. Price, and A.R.J. Dainty. 2006. "The Extent of Team Integration within Construction Projects." International Journal of Project Management, 24(1): 13-23. https://doi.org/10.3390/su132413877.

Baldwin, Carliss Y., and Kim B. Clark. 2000. "Design Rules, Volume 1: The Power of Modularity," The Academy of Management Review, 26(1): 130-133. https://www.jstor.org/stable/259400

Ball, Michael. 1999. "Chasing a Snail: Innovation and Housebuilding Firms' Strategies." Housing Studies, 14(1): 9-22.

Beth Chatto Gardens. n.d. "Gravel Garden." Accessed April 14, 2025. https://www.bethchatto.co.uk/garden-nursery/gallery/gravel-garden.htm.

Catalli, Vince and Maria Williams. 2001. "Designing for Disassembly [An Innovative Strategy for Attaining Environmental Goals and Building Adaptability]." The Canadian Architect; Toronto, 46(1): 27-29.

Dimond, Kirk, and Olivia Gilliam. 2023. "Environment and Natural Resources 2 Building (ENR2)." Landscape Performance Series. Landscape Architecture Foundation. https://www.landscapeperformance.org/case-study-briefs/ENR2.

Faludi, Jeremy, Michael D. Lepech, and George Loisos. 2012. "Using Life Cycle Assessment Methods to Guide Architectural Decision-Making for Sustainable Prefabricated Modular Buildings." Journal of Green Building, 7(3): 151-170. https://doi.org/10.3992/jgb.7.3.151

France, Courtney. n.d. "How to Successfully Implement LEED: Documentation Challenges and Solutions." Journal of Green Building, 2(4): 3-13.

Gann, David M. 1996. "Construction as a Manufacturing Process? Similarities and Differences between Industrialized Housing and Car Production in Japan." Construction Management and Economics, 14(5): 437-450.

Gorgolewski, Mark. 2006. "The Implications of Reuse and Recycling for the Design of Steel Buildings." Canadian Journal of Civil Engineering, 33(4): 489-496. https://doi.org/10.1139/l06-006

Gusmão Brissi, Sara, and Luciana Debs. 2019. "Lean, Automation and Modularization in Construction." 27th Annual Conference of the International Group for Lean Construction (IGLC): Dublin, Ireland, 711-722. https://doi.org/10.24928/2019/0177.

Henkhaus, Luke. 2022. "A 'Living Wall' at Texas A&M Could Be the Key to Smarter Cities." Texas A&M Today, July 26, 2022. https://stories.tamu.edu/news/2022/07/26/a-living-wall-at-texas-am-could-be-the-key-to-smarter-cities/.

Jiang, Yongsheng, Dong Zhao, Dedong Wang, and Yudong Xing. 2019. "Sustainable Performance of Buildings through Modular Prefabrication in the Construction Phase: A Comparative Study." Sustainability, 11(20): 5658. https://doi.org/10.3390/su11205658

Keoleian, Gregory A., Steven Blanchard, and Peter Reppe. 2000. "Life-Cycle Energy, Costs, and Strategies for Improving a Single-Family House." Journal of Industrial Ecology, 4(2): 135-156. https://doi.org/10.1162/108819800569726

Kim, Jinki, and John Whalen. 2013. "One Drop at a Time." Landscape Performance Series. Landscape Architecture Foundation. https://www.landscapeperformance.org/case-study-briefs/one-drop-at-a-time.

Kumaraswamy, Mohan, and Mohammed Dulaimi. 2001. "Empowering Innovative Improvements through Creative Construction Procurement." Engineering Construction and Architectural Management, 8(5-6): 325-334. https://doi.org/10.1046/j.1365-232X.2001.00215.x.

Landscape Architecture Foundation. n.d. Environment and Natural Resources 2 Building (ENR2). Landscape Performance Series. Accessed April 14, 2025. https://www.landscapeperformance.org/case-study-briefs/ENR2.

Morris, Peter. 2007. "What Does Green Really Cost?" PREA Quarterly, Summer, 55-60.

Newsham, Guy R., Sandra Mancini, and Benjamin J. Birt. 2009. "Do LEED-certified Buildings Save Energy? Yes, but…" Energy and Buildings, 41(8): 897-905. https://doi.org/10.1016/j.enbuild.2009.03.014

Osmani, M, J. Glass, and A.D.F. Price. 2008. "Architects' Perspective on Construction Waste Reduction by Design." Waste Management, 28(7): 1147-1158. https://doi.org/10.1016/j.wasman.2007.05.011

Rainer, Thomas, and Claudia West. 2015. *Planting in a Post-Wild World: Designing Plant Communities for Resilient Landscapes*. Portland, OR: Timber Press.

Razak Bin Ibrahim, Abdul, Matthew Roy, Zafar Ahmed and Ghaffar Imtiaz. 2010. "Analyzing the Dynamics of the Global Construction Industry: Past, Present and Future." Benchmarking: An International Journal, 17(2): 232-252. https://doi.org/10.1108/14635771011036320

Sanchez, Ron, and Joseph T. Mahoney. 1996. "Modularity, Flexibility, and Knowledge Management in Product and Organization Design." Strategic Management Journal, 17(S2): 63-76. https://doi.org/10.1002/smj.4250171107

Sandberg, Marcus, Helena Johnsson, and Tobias Larsson. 2008. "Knowledge-Based Engineering in Construction: The Prefabricated Timber Housing Case." ITcon, 13: 408-420.

Scheuer, Chris, Gregory A. Keoleian, and Peter Reppe. 2003. "Life Cycle Energy and Environmental Performance of a New University Building: Modeling Challenges and Design Implementations." Energy and Buildings, 35(10): 1049-1064. https://doi.org/10.1016/S0378-7788(03)00066-5

Shahi, Amir. 2012. "Prefabricated Housing and LEED." Master Theses and Dissertation., Ryerson University.

Sheffer, Dana Alice. 2011. "Innovation in Modular Industries: Implementing Energy-Efficient Innovations in US Buildings." PhD dissertation., Stanford University.

site design group ltd. n.d. 75th Street Boardwalk. Accessed April 14, 2025. https://www.site-design.com/75th-street-boardwalk.

Tam, Vivian W. Y., C.M. Tam, S. X. Zeng, and William C. Y. Ng. "Towards Adoption of Prefabrication in Construction." Building and Environment, 42(10): 3642-3654. https://doi.org/10.1016/j.buildenv.2006.10.003

Waldman, Phillip. N.d. "Utilizing Prefabrication in Order to Achieve LEED Credits" PhD Diss., California Polytechnic University, San Luis Obispo, CA.

Wilber, Dolores. 2010, "Book Review: Cradle to Cradle: Remaking the Way We Make Things." Environmental Practice, 12(1): 92-94. https://doi.org/10.1017/S1466046609990494

FIGURE CITATIONS

CHAPTER 1

FIGURE 1.1 Mueller, Cale. 2025. *STUDY DIAGRAM.* Graphic in Adobe Creative Suite

FIGURE 1.2 Mueller, Cale. 2025. *LANDSCAPE RESEARCH STUDY.* Graphic in Adobe Creative Suite

FIGURE 1.3 Mueller, Cale. 2025. *PROJECT TEAMS.* Graphic in Adobe Creative Suite

FIGURE 1.4 Mueller, Cale. 2025. *FACTORY PERCENTAGE.* Graphic in Adobe Creative Suite

FIGURE 1.5 Mueller, Cale. 2025. *PREFABRICATION STEPS.* Graphic in Adobe Creative Suite

FIGURE 1.6 Mueller, Cale. 2025. *LEED AND SITES PROCESS.* Graphic in Adobe Creative Suite

CHAPTER 2

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FIGURE 4.5 Mueller, Cale. 2025. *PRE-DESIGN CHECKLIST.* Graphic in Adobe Creative Suite

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FIGURE 4.7 Mueller, Cale. 2025. *MODULAR BUILIDNG CHECKLIST.* Graphic in Adobe Creative Suite

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FIGURE 4.9 Mueller, Cale. 2025. *MODULAR LANDSCAPE CHECKLIST.* Graphic in Adobe Creative Suite

FIGURE 4.10 Mueller, Cale. 2025. *MODULAR LANDSCAPE CATALOG.* Graphic in Adobe Creative Suite

FIGURE 4.11 Mueller, Cale. 2025. *IN-GROUND LANDSCAPE CHECKLIST.* Graphic in Adobe Creative Suite

FIGURE 4.12 Mueller, Cale. 2025. *IN-GROUND LANDSCAPE CATALOG.* Graphic in Adobe Creative Suite

FIGURE 4.13 Mueller, Cale. 2025. I*N-GROUND LANDSCAPE CATALOG.* Graphic in Adobe Creative Suite

FIGURE 4.14 Mueller, Cale. 2025. *POST-DESIGN CHECKLIST.* Graphic in Adobe Creative Suite

FIGURE 4.15 Mueller, Cale. 2025. *POST-DESIGN CATALOG.* Graphic in Adobe Creative Suite

CHAPTER 5

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FIGURE 5.2 Mueller, Cale. 2025. *LANDSCAPE DESIGN COMPONENTS.* Graphic in Adobe Creative Suite

FIGURE 5.3 Shigley, Scott. *75TH STREET BOARDWALK DIAGRAM.* digital graphic. 2021. Accessed 26 August 2022. https://greatlakesbydesign.com/2022/08/26/the-boardwalk-connection/. (used with permission)

FIGURE 5.4 Shigley, Scott. *75TH STREET BOARDWALK CONSTRUCTION.* Photographic collage. 2021. Accessed 10 April 2025. https://www.site-design.com/75th-street-boardwalk. (used with permission)

FIGURE 5.5 Brenner, Marion. *ENVIRONMENTAL AND NATURAL RESOURCE BUILDING.* Photograph. 2015. Accessed 10 April 2025. https://www.landscapeperformance.org/case-study-briefs/ENR2. (used with permission)

FIGURE 5.6 Brenner, Marion. *ENVIRONMENTAL AND NATURAL RESOURCE BUILDING.* Photograph. 2015. Accessed 10 April 2025. https://www.landscapeperformance.org/case-study-briefs/ENR2. (used with permission)

FIGURE 5.7 Brenner, Marion. *ENVIRONMENTAL AND NATURAL RESOURCE BUILDING.* Photograph. 2015. Accessed 10 April 2025. https://www.landscapeperformance.org/case-study-briefs/ENR2. (used with permission)

FIGURE 5.8 Mueller, Cale. 2025. *LIVING WALL AT TEXAS A&M.* Graphic in Adobe Creative Suite.

FIGURE 5.9 Beth Chatto's Plants & Gardens. *BETH CHATTO'S GRAVEL GARDEN.* Photograph. N.d. Accessed 10 April 2025. https://www.bethchatto.co.uk/garden-nursery/gallery/gravel-garden.htm. (used with permission)

FIGURE 5.10 Beth Chatto's Plants & Gardens. *BETH CHATTO'S GRAVEL GARDEN.* Photograph. N.d. Accessed 10 April 2025. https://www.bethchatto.co.uk/garden-nursery/gallery/gravel-garden.htm. (used with permission)

FIGURE 5.11 Garden Guru. *HABITAT WALL AND FLOWER BORDER.* Photograph. N.d. Accessed 10 April 2025. https://stock.adobe.com/images/id/275117769. (used under terms of license subscription)

CHAPTER 6

FIGURE 6.1 Mueller, Cale. 2025. *DESIGN APPLICATION PROCESS.* Graphic in Adobe Creative Suite

FIGURE 6.2 Mueller, Cale and Simon Worthley. 2025. *INTUITIVE HOME PACKAGE.* Rendering. Revit, Lumion, and Photoshop.

FIGURE 6.3 Mueller, Cale and Simon Worthley. 2025. *SALINA IMPLEMENTATION.* Graphic in Adobe Creative Suite and Morpholio Trace.

FIGURE 6.4 Mueller, Cale. *INTUITIVE HOME PACKAGE BREAKDOWN.* Graphic in Adobe Creative Suite

FIGURE 6.5 Mueller, Cale and Simon Worthley. 2025. *INTUITIVE HOME PACKAGE.* Rendering. Revit.

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FIGURE 6.8 Mueller, Cale. 2025. *INTUITIVE HOME MODULAR BUILDING CERTIFICATION.* Graphic in Adobe Creative Suite.

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FIGURE 6.19 Mueller, Cale. 2025. *INTUITIVE HOME WATER CISTERN CERTIFICATION.* Graphic in Adobe Creative Suite

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FIGURE 6.23 Mueller, Cale and Simon Worthley. 2025. *INTUITIVE HOME GREEN WALL IMPLEMENTATION.* Rendering. Revit, Lumion, and Photoshop.

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FIGURE 6.62 Mueller, Cale and Simon Worthley. 2025. *INTUITIVE HOME PRIVATE SPACE.* Rendering. Revit, Lumion, and Photoshop.

IMAGE PERMISSION

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MS Michele Shelor<mshelor@colwellshelor.com>
To: Cale Mueller

Cale,
Yes, you can use these images Please give credit to Marion Brenner Photography for the hanging gardens image and the University of Arizona for the water harves

We would love to read the final document and good luck with your final semester.

BTW both my parents graduated from K-State. My dad in Architecture and my mom in Education. I'm a wildcat at heart. 😊

Thanks,
Michele

Michele Shelor, FASLA
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LC Leanne Crozier<leanne@bethchatto.co.uk>
To: Cale Mueller

Hi Cale,

Yes of course, that's absolutely fine.

Kind Regards

Leanne

Leanne Crozier
Media & Communications Manager

From: Scott Shigley <scott@shigleyphoto.com>
Sent: Wednesday, February 19, 2025 3:12 PM
To: Simon Worthley <nomis2@ksu.edu>
Subject: Re: Imagery Permission

Hi Simon,

It is fine to use the 75th Street images for your project!

All Best,
Scott

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