THE FRUITS OF LANDSCAPE: THE POWER OF LANDSCAPE IN PRESENTING SUSTAINABLE FOOD PRODUCTION

by

WILLIAM T. MANN

A REPORT

submitted in partial fulfillment of the requirements for the degree

MASTER OF LANDSCAPE ARCHITECTURE

Department of Landscape Architecture/Regional & Community Planning
College of Architecture, Planning, and Design

KANSAS STATE UNIVERSITY
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Approved by:

Major Professor
Laurence A. Clement Jr.

Abstract

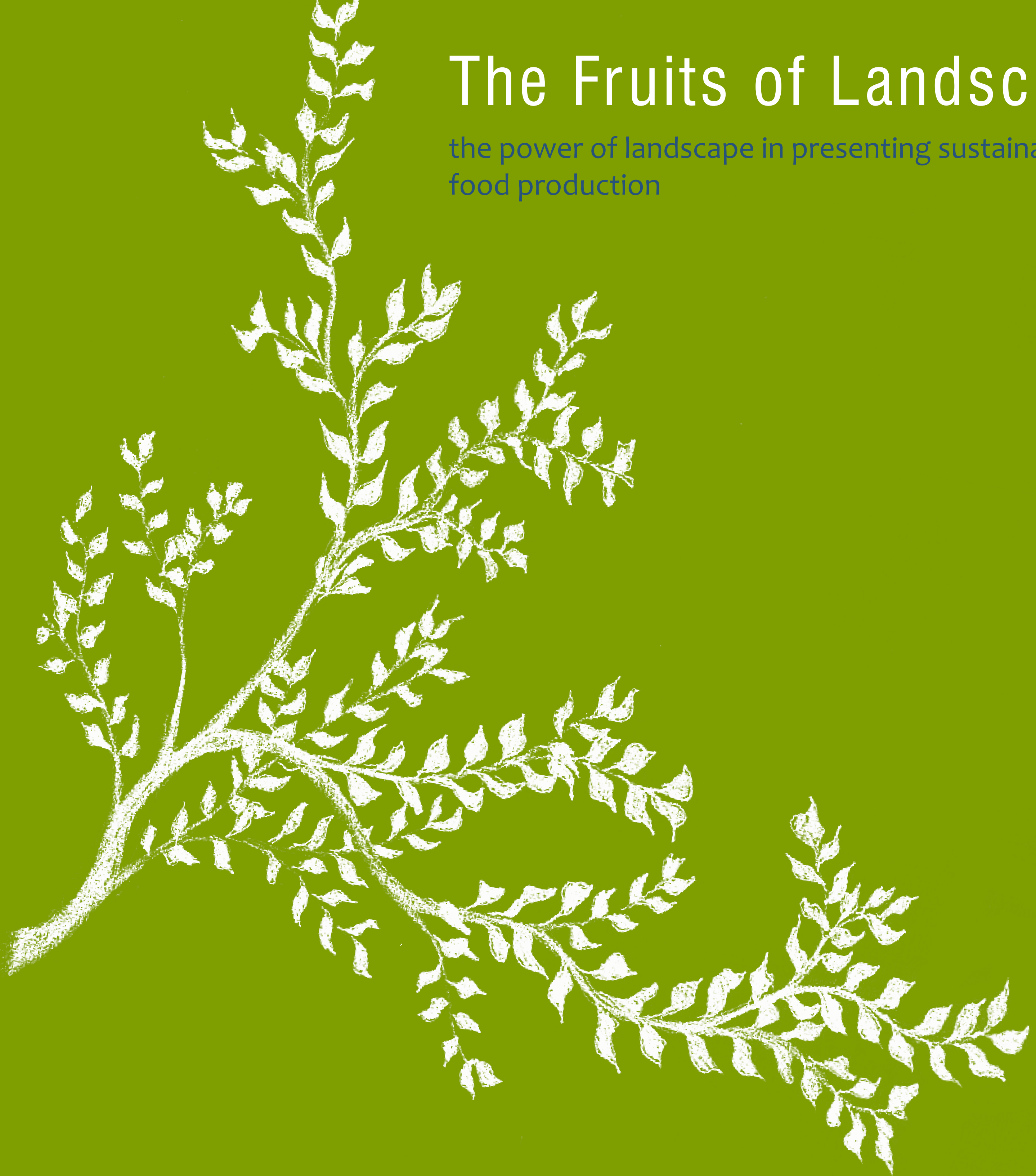
Our current agricultural system in the U.S. involves procedures that appear to maintain high levels of productivity. However, the long-term outlook regarding this system indicates an overall degradation of the ecological resources that generate the abundance of agricultural products to which we are accustomed (Lyle, 1994). This project applies sustainable food production strategies specifically addressed in permaculture as a regenerative alternative to industrial agriculture to a site on the Kansas State University campus. This research initiative quantifies the productive benefits of sustainable agriculture in providing for the Derby Dining Hall, and illustrates how sustainable food production strategies can be shaped through landscape form and space in ways that connect people with ecologically sound food production.

The literature review addressed landscape architecture theory and sustainable agriculture. In addition, a set of interviews as well as three precedent studies helped to focus project considerations and to inform design decision-making. The site design process comprised the primary method for exploration and subsequent development of conclusions. The first two design iterations were performed with a specific focus on garden productivity and then garden form, with the third acting as a synthesis of the first two.

The final plan suggests that there is a potential for a positive didactic experience of sustainable food production through the artful synthesis of landscape form, particularly with regard to carefully arranged circulation patterns. In addition it was found that, given the average growing season rainfall of 3 inches per month, the water harvested from the roofs of Moore and West residence halls can support over 7,300 square feet of intensive produce beds with a 1 inch per week application rate. In regard to food production, select non-bulk items on Derby Dining Hall’s menu (e.g. Parsley, Garlic, Basil, Kale, Radishes, Turnips, & Oregano) can be provided for or supplemented entirely, given the designed array of produce in the proposed gardens. It would appear that incorporating permaculture and organic farming strategies into the campus fabric would facilitate K-State Housing and Dining’s efforts to promote healthy food -- and sustainable thinking -- by increasing the variety, freshness and interest of its menu.

The Fruits of Landscape

the power of landscape in presenting sustainable food production



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the power of landscape in presenting sustainable food production

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Our current agricultural system in the U.S. involves procedures that appear to maintain high levels of productivity. However, the long-term outlook regarding this system indicates an overall degradation of the ecological resources that generate the abundance of agricultural products to which we are accustomed (Lyle, 1994). This project applies sustainable food production strategies specifically addressed in permaculture as a regenerative alternative to industrial agriculture to a site on the Kansas State University campus. This research initiative quantifies the productive benefits of sustainable agriculture in providing for the Derby Dining Hall, and illustrates how sustainable food production strategies can be shaped through landscape form and space in ways that connect people with ecologically sound food production.

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Acknowledgements

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Introduction

1

The United States is a land of plenty due partly to the power and success of modern industrial agriculture. The current agricultural system has been perfected in the realm of food production by streamlining processes, refining genetics, consolidating production centers, and capitalizing on relatively cheep natural resources. Given the rapid rate and focus of agricultural technology development, the assumption of our current agricultural system seems to be that no fundamental flaws in the construction of the system have been made throughout the many years of agricultural evolution. The process of developing technologies in the realm of agriculture today has been effective in making the traditional way things have been done in agriculture more efficient. For example, the plow was developed and used over four thousand years ago (Jones 2012). Since then, this simple tool has been continually improved and made more efficient. Presently it is a massive hydraulically powered contraption, cultivating swaths over sixty feet across (Case iH 2013). Improvements to chemical fertilizers, pesticides, herbicides and annual crop genetics are constantly being made in an effort to get as much benefit out of strategies that presently seem to be working. Thus, for thousands of years the assumption has been that it is necessary to cultivate the soil and that chemical applications are a requirement for competitive production. But, are these strategies fundamentally necessary to achieve that competitive level of production?

An increasing number of people in agriculture today are going back to the basics and making sure the fundamentals of our agricultural system make sense in light of natural ecology. The movement toward organic and sustainable agriculture has produced a much deeper understanding of the environmental impact of food production. Ecological design and permaculture take these sustainable and organic practices and tie them together in a whole-systems approach to the way we grow our food and sustain our livelihood. In this approach, the ecological resources on which agriculture has depended for thousands of years are beginning to be identified, understood, and managed in a sustainable and regenerative way.

Dilemma

The movements in our culture towards sustainable agriculture, organic farming, local produce, community and home gardening are gaining momentum. In 2008 the United States Department of Agriculture (USDA) reported nearly 13,000 certified organic farming operations and over 4,500 farmer's markets in the country (USDA 2010; USDA 2012). More people want fresh, chemical free, and responsibly produced food. However, this cultural shift still faces a few obstacles. Ecological and environmentally sustainable design projects are frequently misunderstood or negatively viewed because of the way they exhibit "un-manicured" or seemingly under-maintained landscapes (Nassauer 1995).

The danger is that the perception or first-impressions people have of certain landscapes they encounter affects their understanding and acceptance of the

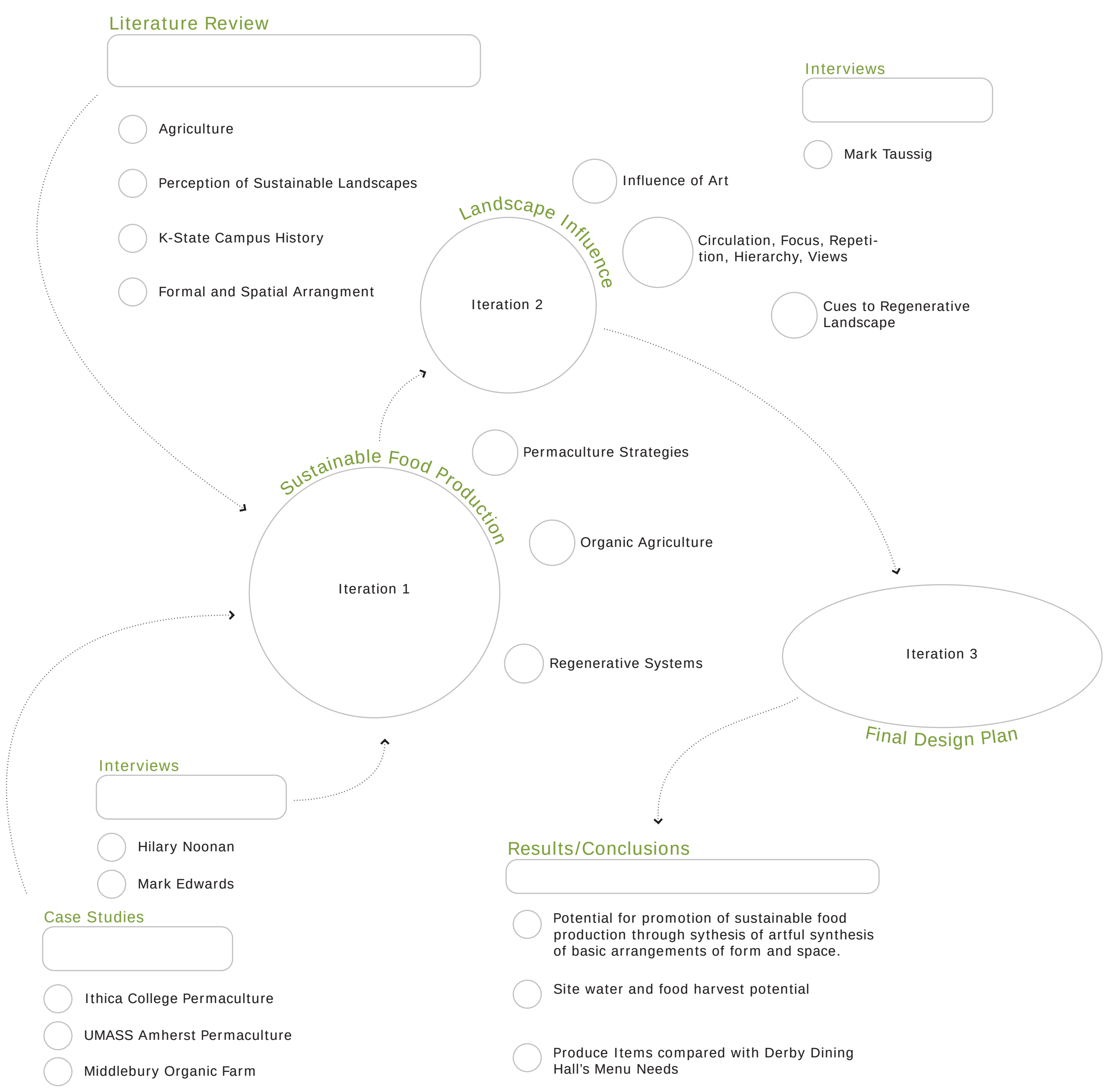


Figure 1.1 | Project Methodology Diagram

The project methodology includes literature review, design process & results, where design is the central method for exploring the project research question (diagram by author).

ecological functions of those landscapes, especially when they are close to home and integrated into one's every-day life.

This dilemma surfaces in the university environment as well. There seems to be a struggle between the traditional, pristine landscapes and landscapes that exhibit cutting edge ecological technologies and stewardship in centers for higher education. University campuses are landscapes in which students, faculty and staff spend large amounts of their "every-day lives." Thus, a campus provides an opportunity for influence toward sustainable landscape function through the careful combination of established landscape architectural strategies and ecological and regenerative design.

Research Question

Given the persistence of modern industrial agricultural traditions and the imperative to incorporate sustainable practices into agriculture, how can design strategies be employed on the Kansas State University campus to make apparent and understandable an alternative approach that is grounded in sustainable food production systems and practices as described in permaculture and organic farming?

"The Fruits of Landscape" studies the intricate strategies of sustainable and regenerative food production as expressed in the teachings of permaculture and organic farming, while also illustrating how landscapes can be designed to influence the observer to recognize, comprehend and to some extent, appreciate these technologies.

This project used the site design process as the primary method for integrating sustainable food production with influential arrangements of form and space in landscape architecture. Preliminary concepts sketches were formulated in two design iterations. Through the process of laying out the site with different sets of goals corresponding to each iteration, concepts for both sustainable food production and landscape influence were created for the site. The final phase in this design process was a synthesis of these two iterations, combining the strengths of both concepts in the final site design.

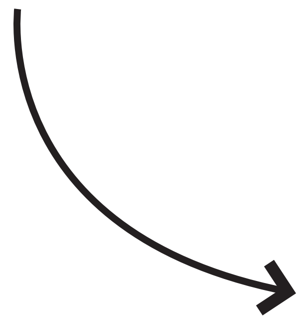
Project Overview

This report proceeds with a review of the project literature, discussions of the case studies and interviews, site analysis, design process, results and conclusions. The results show lessons learned from the synthesis of landscape architecture theory and sustainable agriculture. The design exemplifies how an observer can be informed, influenced, and persuaded in regard to a regenerative food production model. Two design scenarios are brought together to show a blend of the reality of an influential and comprehensive landscape design for the Kansas State University campus site with regenerative food production. The results of this project are design explanations of site features (including ecological and aesthetic functions), productivity potential, water harvesting strategies and potential, and integration of produce with Derby Dining Center menu and food needs.

The claim of this project is that landscape architecture can be used as a tool in presenting the sustainable and regenerative approach to food production causing the viewer to acknowledge, comprehend, and accept such strategies. Through designed landscape, connections between people and their dependence on ecological resources can be made. As people are connected with ecology, greater stewardship of the land is bound to result.

Dilemma

The long-term outlook on the current agricultural system in the U.S. projects an overall degradation of the ecological resources from which we derive the abundance of agricultural products to which we are accustomed (Lyle, 1994). Sustainable methods and strategies for agriculture are present and developing slowly. Yet, they still represent the minority in U.S. food production.



Question

Given the persistence of modern industrial agricultural traditions and the imperative to incorporate sustainable practices into agriculture, how can design strategies be employed on the Kansas State University campus to make apparent and understandable an alternative approach that is grounded in sustainable food production systems and practices as described in permaculture and organic farming?

Figure 1.2|Project Dilemma and Research Question
The dilemma of environmental degradation due to modern industrial agriculture gives rise to the research question of how landscape architecture can promote sustainable agriculture (diagram by author).

Background 2

There are several contexts that have informed this project. The first is the context of agriculture. A design for food production even at a small scale on a university campus necessitates an understanding of the evolution of the issues concerning agriculture in the United States. The second context is that of landscape influence. Authors such as Robert Thayer, Marc Treib, Joan Nassauer, Francis Ching and Laurie Olin, have written concerning the design of landscape and how spaces become legible and meaningful. Another integral context is that of campus food production. Several precedents involving permaculture and organic farming in the university setting will be discussed. In addition, peripheral literature regarding the theoretical framework for the site design, Kansas State campus history and specific practical considerations of the campus are employed. The project objectives benefit from a clear understanding of agriculture, landscape influence, and campus food production. See Literature Map (Figure 2.1).

Agriculture

Currently, Americans travel to the grocery store to buy food to meet their nutritional needs. According to a study conducted by Christopher L. Weber and H. Scott Matthews from the Department of Civil and Environmental Engineering and the Department of Engineering and Public Policy at Carnegie Mellon University, on average our food has a total life-cycle mileage of approximately 4,200 miles, not including our trips to the grocery store (Weber & Matthews 2008). Furthermore, Wes Jackson – founder of a perennial agriculture research operation; the Land Institute in Salina, Kansas – reminds his readers that even back in the late 1970's the United States exported up to 45 billion dollars worth of food to other countries (Jackson 2011). In the 2012 fiscal year the USDA calculated 137.4 billion dollars in the export of all U.S. agricultural products, while U.S. domestic farm net income was only 117.9 billion (USDA 2011; USDA 2012). A study on U.S. consumption of food imports versus domestic consumption reveals that imported food constitutes 17% or 358 pounds out of the 2,100 pounds of per-capita consumption (USDA "Import Share of Consumption" 2012). These numbers reflect the unavailability of certain food items in the U.S. due to climate conditions and the lower cost associated with imported items (USDA "Import Share of Consumption" 2012). The above data indicates that 1) the U.S. receives over half of its agricultural income through exports, 2) imported food makes up 17% of the average American's diet, and 3) that the food that we eat either imported or domestically produced has traveled around 4200 miles to get to the store from which the consumer buys it.

There is the potential through the local, small-scale and diverse production of food to make our agricultural model in the U.S. more efficient and sustainable in terms of transportation. The U.S. model currently involves negative impacts on freshness, fuel consumption costs, ecological resources (fragmented by transportation infrastructure), and clean air due to carbon emissions. Aside from the transportation of pro-

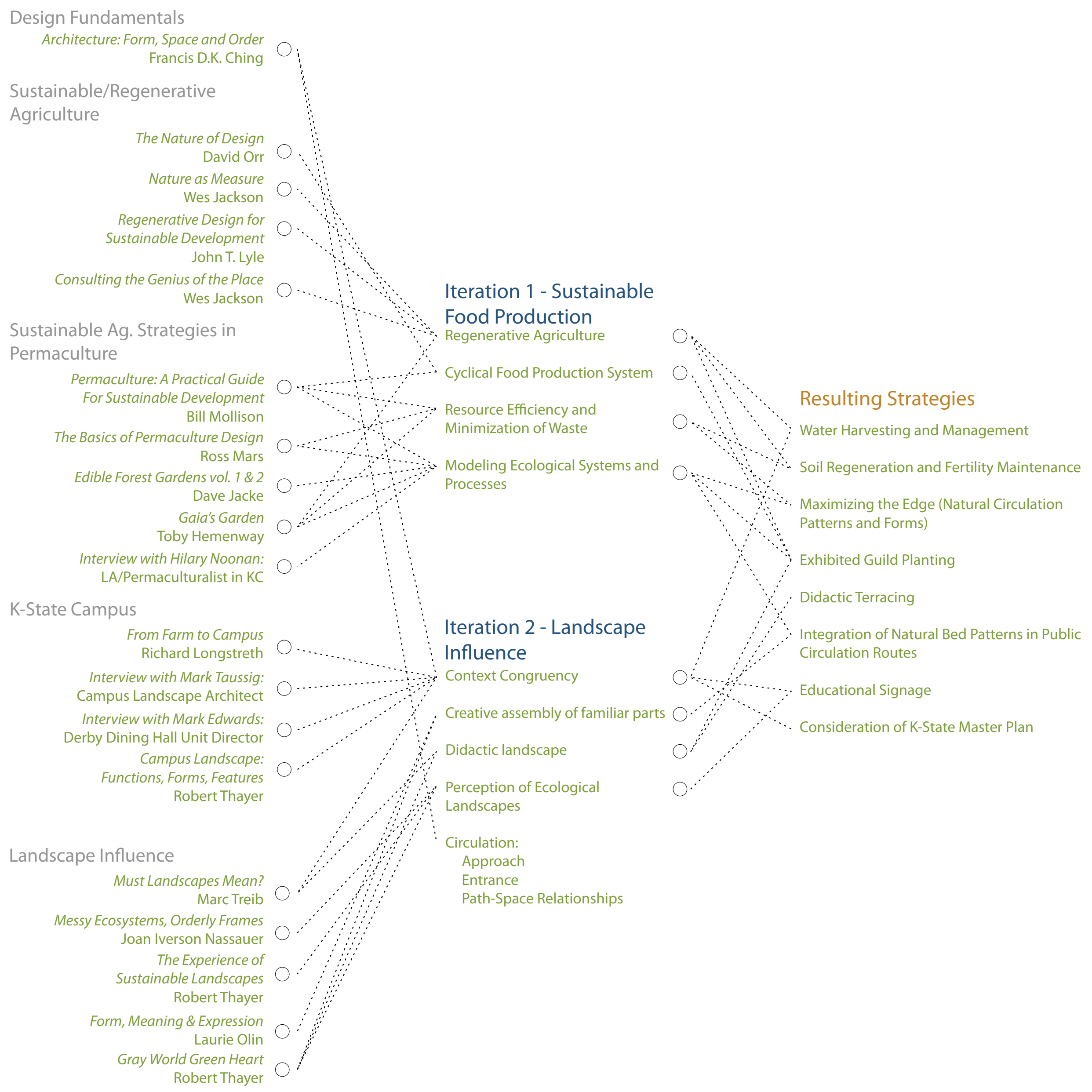


Figure 2.1 | Literature Map
The Literature Map shows the connection between concepts drawn from key sources and design iterations 1 and 2. The concepts are further synthesized through the design process producing a list of design strategies (diagram by author).

duced food, the production of food is a system of industrial technology where large amounts of ecological resources and services are used, discarded and often synthetically replaced in a linear system to produce a few types of useful products in enormous quantities. This system involves the depletion of natural resources and the overfilling of areas with often hazardous bi-products. John Tillman Lyle, former landscape architecture professor at California State University, Pomona, comments on this set of conditions identifying our current agricultural structure:

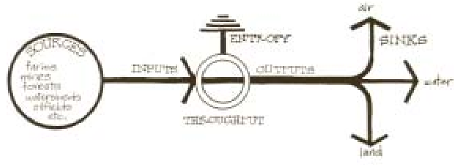
"What such situations are telling us is that the one-way throughput system, like most human inventions but unlike nature's recycling material flows, has a linear time dimension built in with a descending curve: Eventually a one-way system destroys the landscapes on which it depends" (Lyle 1994, 5). See Figure 2.2

The science of industry and the apparent power of new technologies are what currently drive most of the efforts of human enterprise including our food production. David Orr, the Paul Sears Distinguished Professor of Environmental Studies and Politics at Oberlin College, describes the present agricultural problem we face in this way: "The modern dilemma is that we find ourselves trapped between the growing cleverness of our science and technology and our seeming incapacity to act wisely" (Orr 2002, 29). Wes Jackson, well-known author and founder of the Land Institute, claims that the intrinsic actions of modern agriculture are to "Subdue or ignore nature; increase production; use agriculture as an instrument for the expansion of industry…" whereby, Jackson suggests that the hereditary information in the gene pool of crops and livestock is decreased and "nature is dominated or ignored with each plowing and chemical application" (Jackson 2011, 180).

In recent years, the sustainability movement has addressed part of the problem of our industrial mindset. It is now becoming widely understood that the resources being consumed in our linear systems of production will not last forever. By making our systems sustainable, efforts are made to continue to increase efficiency while recycling waste.

Sustainability involves inventing ways of using those resources that can be renewed (i.e. bio-fuel, wind, and solar energy). The intent of sustainability initiatives, however, is to create systems that can sustain themselves and continue producing indefinitely. Other than the fact that many environmental impacts are still overlooked even in what many would call sustainable or "green" energy systems (i.e. ethanol production), sustainability falls short in solving the intrinsic problem of environmental degradation that has already occurred (Pimentel & Patzek 2005).

There is a need for "regenerative" systems. Orr proposes ecological design as the engine for solving the problems imposed by our current industrial model: "Ecological design is an art by which we aim to restore and maintain the wholeness of the entire fabric of life increasingly fragmented by specialization, scientific reductionism, and



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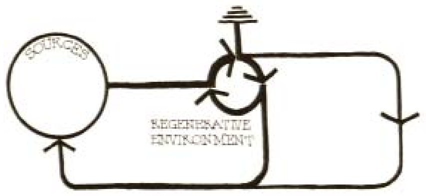


Figure 2.2 | Linear Versus Regenerative Environmental Systems.

John Lyle describes the difference between the industrial system (linear) and the regenerative system (cyclical). In the first system, resources are used producing waste which is left in sinks instead of returned to the system. The regenerative system, loses only a little energy in the process of cycling resources over and over again (Lyle 1994, 5, 10).

bureaucratic division" (Orr 2002, 29). In other words a better model requires a holistic approach that is informed by the processes in the natural environment on which we depend.

John Lyle in *Regenerative Design for Sustainable Development* gives his definition of a regenerative system: "A regenerative system provides for continuous replacement, through its own functional processes, of the energy and materials used in its operation" (Lyle 1994, 10). Refer back to Figure 2.2. A regenerative system, then, is one that recreates resources and/or makes degraded materials and resources useful again by virtue of its way of functioning. Regenerative systems can be thought of as essential components to truly sustainable systems in which no potential for resource degradation is overlooked. With this understanding the sources of problems are addressed rather than just the symptoms.

There are many examples for the design of regenerative systems that have already been developed and implemented. Some examples provide a theoretical basis for approaching productivity in the landscape while others are practical alternatives to currently linear production models.

In 1994 Lyle proposed twelve strategies for creating regenerative systems that can be applied as an overarching economic model. A different solution to problems than a "bigger hammer" (or plow as the case may be) comes to mind here (Lyle 1994, 48):

- Considering nature as both model and context
- Aggregating not isolating
- Seeking optimum levels for multiple functions instead of the maximum or minimum level for any one
- Matching technology to need
- Using information to replace power
- Providing multiple pathways
- Seeking common solutions to disparate problems
- Managing storage as a key to sustainability
- Shaping form to guide flow
- Shaping form to manifest process
- Prioritizing for sustainability

An example of the practical out workings of the above principles exists in the development of a "perennial agriculture." In late September of 2012 at the annual Prairie Festival by the Land Institute in Salina Kansas, staff researchers reported on their progress in developing methods and species to be used in a perennial agriculture (Cruz, et. Al 2012). Through a process of growing and cross-pollinating thousands of plants on site, the Land Institute has made exciting progress in developing perennial forms of milo, sunflowers and wheat (See Figure 2.3-5). With perennial agriculture, soil is less prone to erosion, water is accessed at greater depths (increasing plant hardiness in drought), and carefully selected production and support species are grown in close proximity to one another for symbiosis. In addition, by virtue of being a perennial agriculture, labor and investments like replanting, cultivating, spraying and irrigating can in some cases be completely eliminated. Though no doubt unpopular with the major seed companies , this research has the potential to transform the entire American agricultural system that for so long has invested in various forms of annual crop production.

Permaculture is a regenerative design model that encapsulates regenerative agricultural strategies along with all aspects of sustainable human living and function through a similar set of twelve principles for action. Permaculture was developed by Australian Bill Mollison and his colleague David Holmgren in 1978. Mollison and other proponents of permaculture, describe the specific practices and skills in permaculture (such as water catchment strategies, the zone/sector principle, creating edge and microclimates, and symbiotic pest control techniques), Holmgren approaches permaculture from a more theoretical perspective. Each skill, concept or principle is present in his book *Permaculture: Principles and Pathways Beyond Sustainability*, but each is dissected in terms of its theoretical reasoning and significance in the overall intention of a sustainable lifestyle. In his conclusions, Holmgren describes the permaculture way as,

"…a dynamic interplay between two phases: on the one hand, sustaining life within the cycle of the seasons, and on the other, conceptual abstraction and emotional intensity of creativity and design… It is the steady, cyclical and humble engagement with nature that provides the sustenance for the spark of insight and integration (integrity), which, in turn, informs and transforms the practice" (Holmgren 2002, 271).

In other words, permaculture is a framework that informs and guides a whole systems approach to productive landscapes. It is not static, but dynamic, changing and site specific. Permaculture shows that every element within the landscape whether designed or natural is connected with every other element and often succeeds or fails based on that relationship. It not only teaches food production, but a way of life that is sensitive and responsible in regard to the sustainability of the earth.

Although permaculture is becoming somewhat of a buzzword these days, it does provide a system under which numerous sustainable and regenerative agriculture and landscaping strategies are tied together. Holmgren organizes the principles of permaculture under twelve points:

- Observe and interact,
- Catch and store energy,
- Obtain a yield,
- Apply self-regulation and accept feedback,
- Use and value renewable resources and services,
- Produce no waste,
- Design from patterns to details,
- Integrate rather than segregate,
- Use small and slow solutions,
- Use and value diversity,
- Use edges and value the marginal,
- Creatively use and respond to change.

This set of principles was born out of the intention of a better way of producing food and living sustainably at the homestead scale, whereas John Lyle's twelve principles are more broadly

Figure 2.3 | Intermediate Wheatgrass
(photo courtesy of the Land Institute).

Figure 2.4 | Development of Perennial Sorghum
(photo courtesy of the Land Institute).

Figure 2.5 | Perennial Sunflowers
(photo courtesy of the Land Institute).

applicable in ecological design and environmental planning.

Informing this project are several manuals on permaculture that describe practical strategies stemming from the above 12 principles. Bill Mollison's *Permaculture: A Practical Guide for a Sustainable Future*, Dave Jacke's *Edible Forest Gardens Volumes 1 and 2, The Basics of Permaculture Design* by Ross Mars, and *Gaia's Garden: A Guide to Home-Scale Peramculture* by Toby Hemenway all describe strategies under the following four categories.

- Water Harvesting and Management (*Gaia's Garden* p. 96, *Edible Forest Gardens, The Basics of Permaculture Design* p. 84, *Permaculture* p. 152, 336, 413.)
- Soil Regeneration and Maintenance (*Edible Forest Gardens* p. 75, *The Basics of Permaculture Design* p. 51, *Gaia's Garden* p. 71.)
- Maximizing the Edge, Natural Circulation Patterns and Forms (*Gaia's Garden* p. 96, *Edible Forest Gardens, The Basicsof Permaculture Design* p. 84, *Permaculture* p. 152, 336, 413.)
- Guild Planting (*Gaia's Garden* 192, *The Basics of Permaculture Design* p. 62, *Edible Forest Gardens* p. 121).

These four categories of strategies were utilized in conjunction with strategies drawn from literature on landscape architecture theory. Refer to Literature Map (See Figure 2.1).

Landscape Influence

The second part of this project is concerned with landscape influence. The project is a design for a highly sustainable and productive edible landscape. However, the other half of the design problem involves displaying the power of landscape form in presenting sustainable food production strategies in the campus setting of Kansas State University (K-State). The following is a discussion of how the perception of sustainable landscapes can be affected and improved by landscape form.

There are several fundamental ways landscape form and space influences the occupant. Francis Ching, Professor Emeritus in the department of architecture at the University of Washington, in *Architecture: Form, Space, And Order* illustrates the fundamental definitions of space and form and how order is created by these elements. Ching's fundamental design principles can translate easily into landscape architecture, particularly in regard to circulation. Ching notes that the approach, the entrance, the configuration of the path, path-space relationships, and the form of the circulation space, all affect the experience of the viewer and how the occupant perceives his/her surroundings (Ching 2007, 241).

In the simplest terms, attention to circulation configurations can influence the viewer to a certain end. For example an axial or frontal approach to a certain site gives the viewer time to perceive and understand what is at the terminus of the path (See Figure 2.4). Another example is the use of an entrance, which Ching defines as that which "involves the act of penetrating a vertical plane that distinguishes one space from another and separates 'here' from 'there'" (Ching 2007, 250). The entrance to a space promotes particular attention in the viewer to the character of the space being entered (See Figure 2.5). Path-Space relationships are influential in guiding the occupant of a site through (See Figure 2.6). If the path is curvilinear, opportunities to guide view arise when the path bends. The occupant's line of site is directed first to one point, and then another as the path undulates back and forth. These views along a path to adjacent or related spaces can be described as tangential views. Thus, fundamental understanding of form and space and their relationships to one-another yields opportunities for directing the experience of the viewer in intentional ways.

Landscape has the potential to intentionally guide the occupant. However, a specific message must be in mind. Unintentional, negative messages remove the opportunity for effective landscape influence. The strategies underlying permaculture as well as other sustainable landscape applications may be considered visually chaotic and messy. Efforts must be made to convince the occupant of the intentionality of such landscapes.

Bill Mollison expresses order in the landscape in terms of function rather than form. He claims,

"Order is found in things working beneficially together. It is not the forced condition of neatness, tidiness, and straightness all of which are, in design or energy terms, disordered... Thus the seemingly-wild and naturally-functioning garden of a New Guinea villager is beautifully ordered and in harmony, while the clipped lawns and pruned roses of the pseudo-aristocrat are nature in wild disarray" (Mollison 1978, 31).

Although speaking in ecological terms, Mollison is consistent with the "form follows function" philosophy of design coined by Louis Sullivan in reference to aesthetics for skyscrapers in Chicago (Sullivan 1896). In regard to the function of natural ecology, function is beautiful and there is an ever increasing need for the implementation of ecologically functional and productive landscapes. However, Robert Thayer– Professor Emeritus in landscape architecture at the University of California Davis – in "The Experience of Sustainable Landscapes" cautions landscape designers working under the philosophy of sustainability not to neglect concern over the form of those landscapes. Thayer claims that if designers leave the formation of landscape entirely up to utility and function, sustainable outdoor environments are at risk of being misunderstood (Thayer 1989, 105).

The university campus landscape is one of the arenas in which this dilemma surfaces. In terms of the campus landscape, although there is support in certain departments and administrations within universities for sustainable landscapes, there still seems to be a desire for the formal, manicured quadrangles and plazas exhibited in many of our nation's centers for higher education. Understandably, reasons for such landscapes include creating environments consistent with the culture of prestigious academia and scholarship. Yet, with such commitment to higher learning and research, it could be argued that the landscapes surrounding such activity should display cutting edge environmental technology and ecological stewardship integrated within formal, manicured design. The reason for reluctance in this integration may be because of the perception of sustainable landscapes as unattractive and informal.

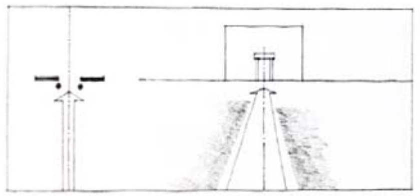


Figure 2.6 | Frontal Approach
Approaching an element on axis from the front directs the viewer's attention of that element over the duration of the journey (Ching 2007, 243).

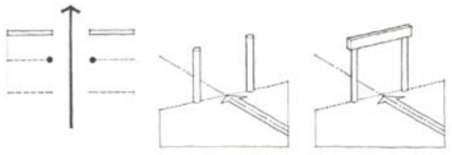


Figure 2.7 | Entrance
Entrances are real or implied vertical planes through which the occupant passes, traveling from one space to another (Ching 2007, 250).

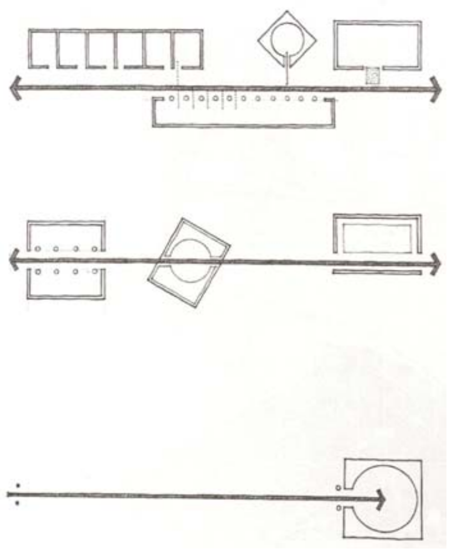


Figure 2.8 | Path-Space Relationship
Path-Space Relationships include scenarios in which the occupant passes by, passes through, or comes to a stop in a space (Ching 2007, 278).

Landscapes are being perceived in many different ways and have varying degrees of influence on their occupants. A popular type of landscape observed in any suburb or formal campus in our modern society is one that indicates constant and meticulous care, one that is cleanly manicured, one that offers the resemblance of nature and yet remains under strict human control. Joan Iverson Nassauer – a professor of landscape architecture in the school of Natural Resources and Environment at the University of Michigan – refers to this kind of landscape as one that we have accepted as more than just a product of culture. Nassauer claims that people are mistaking the pristine and well maintained landscapes for the long forgotten, healthy functioning natural environment, labeling them "picturesque" (Nassauer 1995). Since not everyone is educated in ecological function, plant material, ecosystem composition, sustainable landscapes such as prairies, rain gardens, constructed wetlands, or permaculture food forests, can easily be perceived as overgrown or unattractive.

Nassauer's *Messy Ecosystems, Orderly Frames* explains the dilemma of the perception of landscapes that exhibit a lot of ecological functionality. People tend to perceive a naturally functioning ecosystem as unkempt, disorganized and informal. It is a unique opportunity, however, when we see the potential of landscape architecture to give perceivable form and beauty to a "messy" ecosystem. Nassauer claims that the design problem for landscape architects in making natural processes recognizable and acceptable "...requires the translation of ecological patterns into cultural language" (Nassauer 1995).

Nassauer offers further insight into this dilemma by pointing out the need for the perception of human intention or in her words, "cues to care" such as mown turf, flowering plants and trees, wildlife feeders and houses, bold patterns, trimmed shrubs, plants in rows, linear planting designs, fences, architectural details, lawn ornaments, painting, and foundation planting. She claims that people are more likely to see ecologically sustainable landscapes as aesthetically pleasing if they can recognize the mark of human intention upon those landscapes. For, example, in the case of a few acres of naturally diverse prairie, one might perceive it as such in a positive light if, for example, there is a mown strip edging around the outside. Because of this the observer – being familiar with the maintenance activity of mowing – has a way of knowing that the apparently vacant, overgrown grassy area is intended to be there and is serving a specific function. Nassauer explains this issue further:

"… we might assume that a nature preserve represents the absence of human influence when in fact the existence of intact remnants of indigenous ecosystems depends upon human protection and management" (Nassauer 1995, 161).

On the other hand Nassauer also warns against the assumption that landscape design only deceives people about what is really happening ecologically. Nassauer argues, "Equating design with deceit leaves no room to acknowledge how design is necessary to represent and maintain ecological function" (Nassauer 1995, 162).

Robert Thayer also discusses the issue of the perception of sustainable landscapes and their functions in *Gray World, Green Heart*. The author laments the fact that in spite of the ecological awareness of the 1970s, sustainable landscapes were starting to fall back into a counter cultural status (Thayer 1994). This was written more than twenty years ago and still landscaping companies are offering what Thayer calls "token service to environmental stewardship values" (Thayer 1994, 102). Landscape architects are to act to make our landscapes sustainable. But sustainability is not divorced from visual, tangible order. The solution isn't in changing our desire for beauty by making do with what many might perceive as the "ugliness" of sustainable landscapes. The literature indicates that there is a need for care, creativity and art in the design of our sustainable and regenerative landscapes, not excluding the realm of food production.

There is a need for sustainable landscapes to communicate design strategies with their observers through form how do we make our landscapes legible, meaningful and influential? Marc Treib – retired professor from the University of California at Berkley – in his well-known article *Must Landscapes Mean: Approaches to Significance in Recent Landscape Architecture* discusses several different ways landscapes have expressed meaningful historically and in the present. Treib identifies five approaches for creating significance in landscapes: the Neoarchaic, the Genius of the Place, the Zeitgeist, the Vernacular Landscape, and the Didactic (Treib 1995, 49). Treib's premise in this article is that ultimately landscapes are not given meaning by their designers, but that meaning develops through interactions, i.e. "the intersection of people and place" and "like a patina, significance is acquired only with time. And like a patina, it emerges only if the conditions are right" (Treib 1995, 60).

This project studies the way in which landscape form can resent ecological principles in food production to the observer. Thus, keeping in mind that a landscape designer has limited ability to create meaning instantaneously through the construction of a designed landscape, Treib's discussion of the Didactic is helpful in illuminating the opportunity to confront observers with lessons in ecological design. Treib defines didactic landscapes in this way. "A Didactic landscape is supposedly an aesthetic textbook on natural, or in some cases urban, processes" (Treib 1995, 53). In other words, through the creation of experiences either visual, or

otherwise, certain things can be taught through landscapes.

However, Treib goes on to suggest that a landscape that teaches you something through creating intentional forms and experiences cannot make a landscape success, significant or meaningful on its own. A didactic landscape can be a powerful tool in educating people about certain processes, ideas and even philosophies of life, but is limited to attempts to communicating specific teaching agendas. Treib claims the Didactic landscape will fall short of becoming meaningful in and of itself. In other words, a landscape can be designed with didactic intention, yet the success of the landscape in terms of it's resulting significance and meaning depends not only on the message the designer attempts to communicate, but the skill with which the project is designed and implemented. The experience that actually occurs during the interaction of people with the place is still slightly outside the designer's control.

Laurie Olin – landscape architect, teacher, and author – offers insights in landscape architecture regarding meaningful landscape form and composition in *Form Meaning and Expression in Landscape Architecture*. Olin addresses the issue of creativity. Designers in all fields are constantly facing the struggle to create spaces, objects, solutions that are unique and new. Olin provides some insight into this struggle specifically with landscape form by stating,

"In nature are all the forms. In our imagination is their discernment and abstraction."… "To make something new we must start with what is or has been and change it in some way to make it fresh in some way" (Olin 1988, 155).

In the article, Olin references the seminal works of Andrê Le Nôtre and Lancelot Brown. The author identifies visual scale and creative assemblage as two of the major strategies evident in these designers' works. Olin argues that landscapes do become meaningful and successful through the materials and objects with which they are built, through the "expression of the relationship of society to nature" and the premise that nature is "the ur-metaphor of art" and thus is the key source of ideas that might be expressed through the art of landscape architecture (Olin 1988, 156). See Literature Map for summary of the literature distillation into the following design strategies.

- Didactic Terracing (presentation of food production terraces along major circulation paths)
- Integration of Natural Bed Patterns in Public Circulation Routes
- Educational Signage
- Consideration of K-State Master Plan

Summary

In summary, landscapes become meaningful in various ways. Though instant meaning is very difficult, if possible, to bestow on a space through design, landscape architect can create the opportunity for the interaction of people and place in a way that conveys a certain message. Strategies to accomplish this include creating context congruency (appealing to the vernacular), reassembling familiar parts, providing cues to sustainability, and providing a clear message that confronts the user through the positioning of design elements for a direct approach and clear views in the landscape. There is need for the promotion of regenerative agricultural systems that utilize ecological functions. Potential exists in designed landscape to encourage this message through creating positive and didactic experiences that immerse the occupant in messages of sustainable food production.

Pecedents & Interviews

3

Agriculture systems in the U.S. are slowly evolving from linear and industrial systems to sustainable and regenerative ones particularly in movements toward organic farming and permaculture. At the cutting edge of this agricultural revolution are centers for higher education. Food production on college and university campuses is not unprecedented. Many projects display this initiative on campuses across the country. Projects that employ specifically permacultural methodologies are relatively new, but have already been exemplified in a few U.S. universities.

Precedent Projects

One such example is the permaculture initiative at the University of Massachusetts Amherst. Starting in 2009, several students taking a sustainable agriculture class at the university along with graduate student Ryan Harb, offered a proposal to transform an open lawn near the Franklin Dining Hall into a quarter acre permaculture garden (See Figure 3.1). The first school year was spent preparing the soil horizons through a layering of rich organic compost, mulch and cardboard. With the help of 1,000 volunteers, after the first growing season, the garden produced 1,000 pounds of produce from 1,500 plants of 150 different species. In addition, the food was used by the dining halls to feed UMASS students. Since then, the class in sustainable agriculture has started two other permaculture projects on campus and plan to continue the tradition year after year with each new senior class (Anon 2012).

The garden has five components: the vegetable garden, the orchard, the woodland edge, edible landscapes, and herbs and medicinal species (See Figure 3.2). Each of these garden realms includes species that serve some function for the benefit of other parts of the garden. Nitrogen fixation, pest-insect repulsion, pollinator attraction, reduction of weed competition, and nutrient uptake are functions of the Franklin garden plant list and garden composition (Harb 2012).

The produce from the Franklin permaculture garden is used in the dining halls at UMASS Amherst. The school has a policy in place that requires the incorporation of local produce to be 30% of the entire fresh produce diet for campus dining halls. Collaboration exists between the UMASS Permaculture organization and the UMASS Food Subcommittee to get fresh produce from the campus gardens into the menu at the university dining halls (Harb 2012).

Another similar project exists at Ithaca College in Ithaca, NY nestled in the Finger Lakes. Located at the southeast corner of Williams Hall, the garden has been a success particularly in terms of its educational influence and its ability to draw passersby (See Figure 3.3). Forest gardening, education, serving as a gateway, sustainable landscaping and accessibility were all design considerations at the birth of this productive space (Our Goals, 2012). The garden effectively establishes itself through form, circulation and the abundance of life found within. Though permaculture strategies involve dense plantings, generous preliminary mulching, and

Figure 3.1 | Franklin Permaculture Garden

The Franklin Permaculture Garden at UMASS Amherst was a collaborative effort initiated by a group of students in 2009 with the involvement of professors, and volunteers ("UMASS Permaculture" 2012).

Figure 3.2 | Franklin Permaculture Garden Aerial

The Franklin Permaculture Garden exhibits natural bed patterns, symbiotic relationships, and ecological food production ("UMASS Permaculture" 2012).

Figure 3.3 | Franklin Permaculture Garden Plantings

Intensive planting integration at the Franklin Permaculture garden provides for a highly productive and supportive ecological environment (Harb 2012).

Figure 3.4 | IC Permaculture Site

Ithaca College Permaculture garden is located adjacent to Williams Hall along a major circulation path in the campus. The garden promotes permacultural strategies by inviting people with seating and enclosure ("Garden Gallery" 2013).

somewhat organic and seemly chaotic growth patterns, the garden's design has dealt with the visual elements of permaculture in a way that positively affects the perception of this sustainable landscape. This was accomplished by a design that was oriented toward multiple uses that included not only food production and plant growth, but a place to sit or space to wander through.

Another helpful precedent is the organic farm at Middlebury College in central Vermont (See Figure 3.4). Middlebury staff and students maintain this thriving 3 acre organic farm off campus that produces food for farmers markets and other local businesses (Farm Report 2010). The farm has been in existence since 2002 and is now a well developed and functioning organic garden. The mission of the organic farm indicates the desire to make organic produce more accessible, affordable and more delicious (Mission 2013). Middlebury organic farm has offered full-time summer internship programs, volunteer opportunities, and numerous community and university events and presentations. The farm produces a variety of fresh vegetables, herbs, fruit and honey. The majority of the space at the farm is dedicated to maximizing food production in order to continue to meet the needs of their current local clients. However, some of the garden is designated for experimental use. Other sustainable strategies at Middlebury organic farm include cover-cropping, attracting beneficial insect predators and pollinators, production of biofuel, and composting.

K-State also has a student organic farm located about 10 miles from campus. The Student Farm was started by Horticulture faculty member Rhonda Janke, Ph.D. and graduate student Lani Meyer. Like Middlebury, the farm includes many organic agriculture strategies such as cover crop planting, composting, and crop rotation. Student internships and part-time paid positions as well as volunteer work have kept the farm going since its birth. However, funding has come almost entirely from grants which have not always been abundant. In additions, because of the farms distance from campus, maintenance and labor in the garden has created more expense due to travel time and fuel costs. The farm has sold produce to K-State Dining at times, but the constraint has been the price at which their produce has to be set. Derby Dining Hall can buy produce and other food at much lower prices than that at which the student farm has to set theirs. According to Unit Director Mark Edwards (See interview discussion below), the dining service is willing to buy these foods for higher prices since they are produced by K-State, but it would be unrealistic to think that the bulk of the produce would be bought from the student farm or other local vendors (Edwards, 2012).

Several learning outcomes from this case are evident. The first concerns the soil. UMASS Permaculture is in the process of designing and implementing another permaculture garden near the Berkshire dining hall. The site they are working with is characterized by incredibly compact soil conditions. The organization is implementing soil remediation strategies such as bio-swales, erosion control techniques, and deep-rooted perennial species that will aerate the soil over time. The site on Kansas State's campus with which this Master's project is concerned, includes areas of fill soil which have the potential of being very compact and low quality. Strategies including those listed above inform the implementation and maintenance structure of "The Fruits of Landscape."

Another learning point has to do with support from educational institution. The long-term vitality of this project depends on consistent and informed maintenance and management. The three case studies above illustrate the integral relationship of university/college faculty and students in the creation and maintenance of their gardens. This suggests that for this kind of a project to be just as successful as these precedents, a solid labor and educational structure needs to be in place for the garden to be effectively implemented, maintained, and expanded in its educational, cultural and economic value.

In both the Ithaca and UMASS permaculture projects, outstanding student body and faculty support has been evident (Harb 2012; Home 2013). This could be in part because of the location each of these garden project being on the campuses and visible to all from day to day.

There are a few lessons to be learned from Middlebury Organic farm specifically. First, the produce species list of the project should include both commercial production types and species with higher educational value. This diversity will allow for the garden to function as a productive benefit to the Derby Dining Hall and as an educational tool for different academic departments such as the department of Landscape Architecture and Horticulture as well as the college of Agriculture.

Middlebury Dining Services has successfully contracted with the organic farm in regard to certain produce they know they will be able to use in their menus. Apparently, Middlebury Dining Services deems the price for its very own locally grown produce worth serving it on its menu. This displays some promise in similar integration of locally grown food with the menu at the K-State Dining Halls.

Interviews

Interviewing was a technique employed to ground this project initiative in terms of the K-State Campus landscape, Derby Dining Hall, and practical permaculture. Three informants provided substantive responses in face to face interviews conducted towards the end of the fall semester of 2012. See Appendix A for entire interview framework.

The first respondent, Hilary Noonan, was chosen for her expertise in the realm of permaculture. Noonan has a degree in Landscape architecture as well as a certificate in permaculture. This respondent was approached in the hope of gaining information in regard to practical design strategies for accomplishing both the aesthetic and productivity goals of this project. Several insights were gained from this

Figure 3.5 | IC Permaculture Garden Plantings
The garden exhibits a diverse planting scheme, including not only food production species, but other supportive perennials ("Garden Gallery 2013).

Figure 3.6 | Middlebury Organic Farm Aerial View
The 3 acre Middlebury Organic Farm is a well established, highly productive space providing fresh produce, education, and employment for Middlebury students ("Organic Farm" 2013).

Figure 3.7 | Middlebury Organic Farm: Kitchen Garden
Detail view of plantings at the Middlebury kitchen garden ("Photos" 2013).

interview. Noonan expressed through her explanation of specific projects that she has worked on that permaculture projects take a long time to mature. She indicated that this is often an obstacle in promoting projects like this because of people's desire for immediate results. Another concept she emphasized was, when approaching a project in which your intention is to employ permaculture strategies, think in terms of what specific things you can do. In other words, by understanding what resources you have available you can propose only those permaculture strategies that make the most sense given the existing conditions. Every permaculture strategy ever conceived doesn't have to be a part of the design. Finally, she stressed the importance of soil and water management. Noonan mentioned that the first thing she looks for in approaching a site for design alternatives is where the water is coming from and going. In addition, she emphasized the vital importance of the plants you choose to use and how their arrangement and combination effectively use and maintain soil nutrients.

The second informant was chosen from the K-State Campus Master Plan Update Task Force in an effort to gain an understanding of the vision for the campus in the future. The intent was to increase the viability of the project by enabling complementation rather than confliction with the proposed campus master plan update. This interview was also intended to provide an expert opinion on landscape design issues specific to K-State.

Mark Taussig, the K-State campus landscape architect, offered several specific insights during the interview. Taussig explained the history of the site in terms of previous use of the landscape. He noted that the site was historically used for a tree nursery and exhibition garden for the Horticulture department. He also, discussed the facets of the K-State Master Plan Update talking about circulation and infrastructure improvements as well as the exploration of public transit and the research expansion goals of the university. Taussig mentioned that K-State Housing and Dining was recently added to the Master Plan scope and would be a part of the campus master plan update.

In speaking specifically about the goals of this project he noted that there is opportunity for learning through hands on maintenance and up-keep of the garden. He also, made mention of existing site conditions to consider in proposing a design. These conditions included fill material existing under site parking lots (whatever that might be), utilities traversing the site, and the potential for existing soil and water contamination.

Finally, an informant was chosen to represent the Derby Food Center and K-State Housing and Dining. This interview was conducted with the Unit Director at Derby Dining Hall, Mark Edwards. Edwards was sought out with questions concerning specific information on the produce needs of the dining hall and how a permaculture garden could fit within their system of food service.

Edwards discussed sustainable initiatives currently going on at Derby including composting & recycling programs as well as obtaining meat and dairy products locally from the K-State Farm. Edwards also mentioned the dilemma regarding the purchase of local produce versus that which is available from mass production farms hundreds of miles away. He talked about the price difference between the two options, local produce being a lot more expensive than the produce that is available for industrial vendors. However, he indicated that Derby would be interested in buying specialty items or vintage varieties for certain themed dinners or seasons in order to substantiate the advertising efforts of K-State Dining Services.

Figure 3.8 | Grant Park Kitchen Garden, Chicago, IL
Photo courtesy of Lee Skabelund, 2009.

Figure 3.9 | Grant Park Kitchen Garden, Chicago, IL
Photo courtesy of Lee Skabelund, 2009.

Site Selection & Analysis

4

The project site was located on the Kansas State University Campus (K-State) for several reasons. The campus environment was chosen for this project because of opportunities regarding educational use, wide diversity of influence, and for its convenient proximity for site visits. In addition, K-State was originally an agricultural college. Craftsmanship, hands-on education, and food production were essentials in K-State's early curriculum. In promoting small-scale land management technologies and sustainable agriculture, this project fits within the historic context of K-State.

Site Suitability Analysis

Within the K-State campus, the project site was chosen based on principles from permaculture. Five factors were chosen from the literature on permaculture to determine the optimal location for a sustainable and productive food garden (See Figure 4.1). The K-State campus was rated based on these factors on a scale of 1-5 (least suitable to most suitable). In addition, each factor was assigned a weight of influence based on level of importance (See Table 4.1). The results of this analysis indicated sites near the Kramer, Van Zile and Derby dining complexes. Through on-site investigation it was determined that the current land-use adjacent to Derby on the west side of the complex provided the best opportunity for this project (See Figure 4.2). Further explanation and enlarged versions of the suitability factor maps can be found in Appendix C.

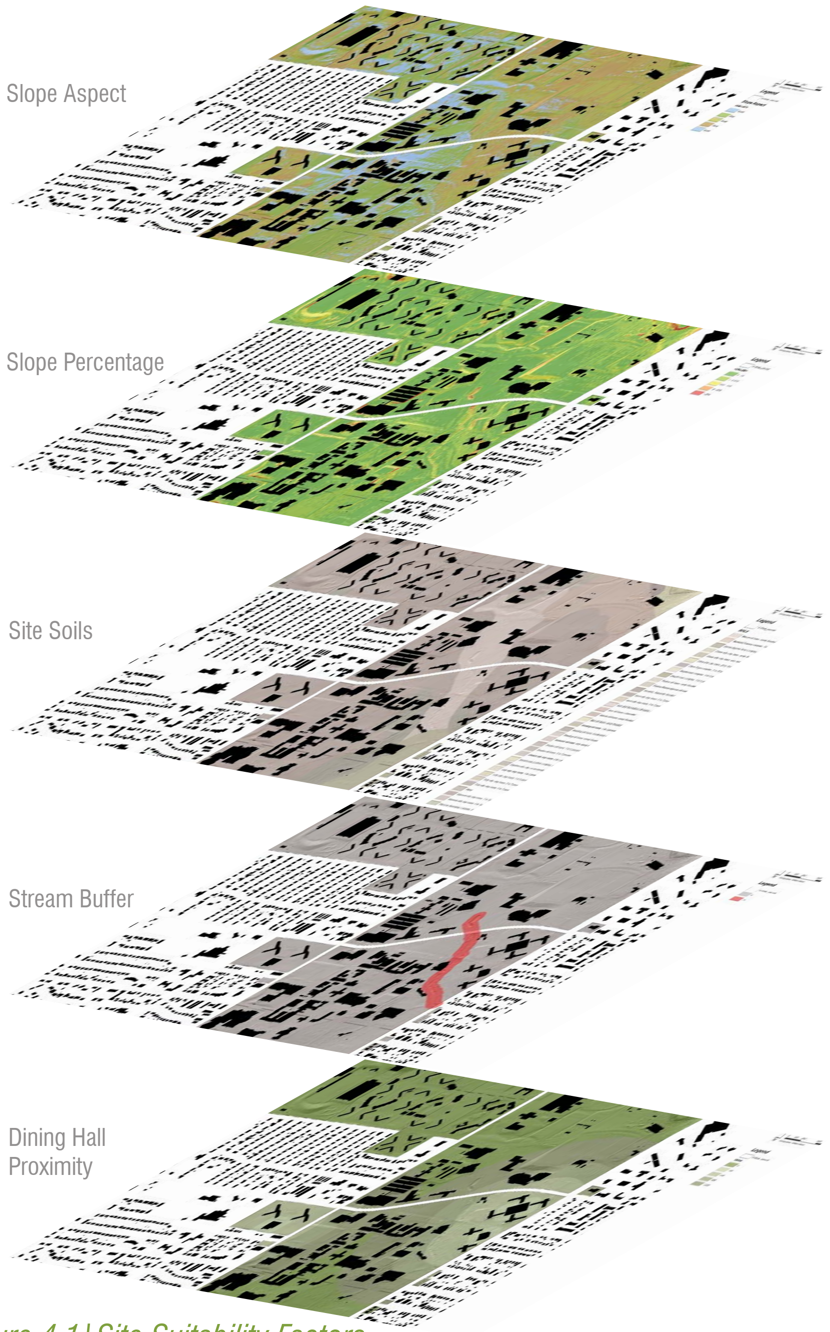


Figure 4.1 | Site Suitability Factors
Suitability of a permaculture garden on the K-State Campus was chosen based on the above factors (analysis by author). See Appendix C.

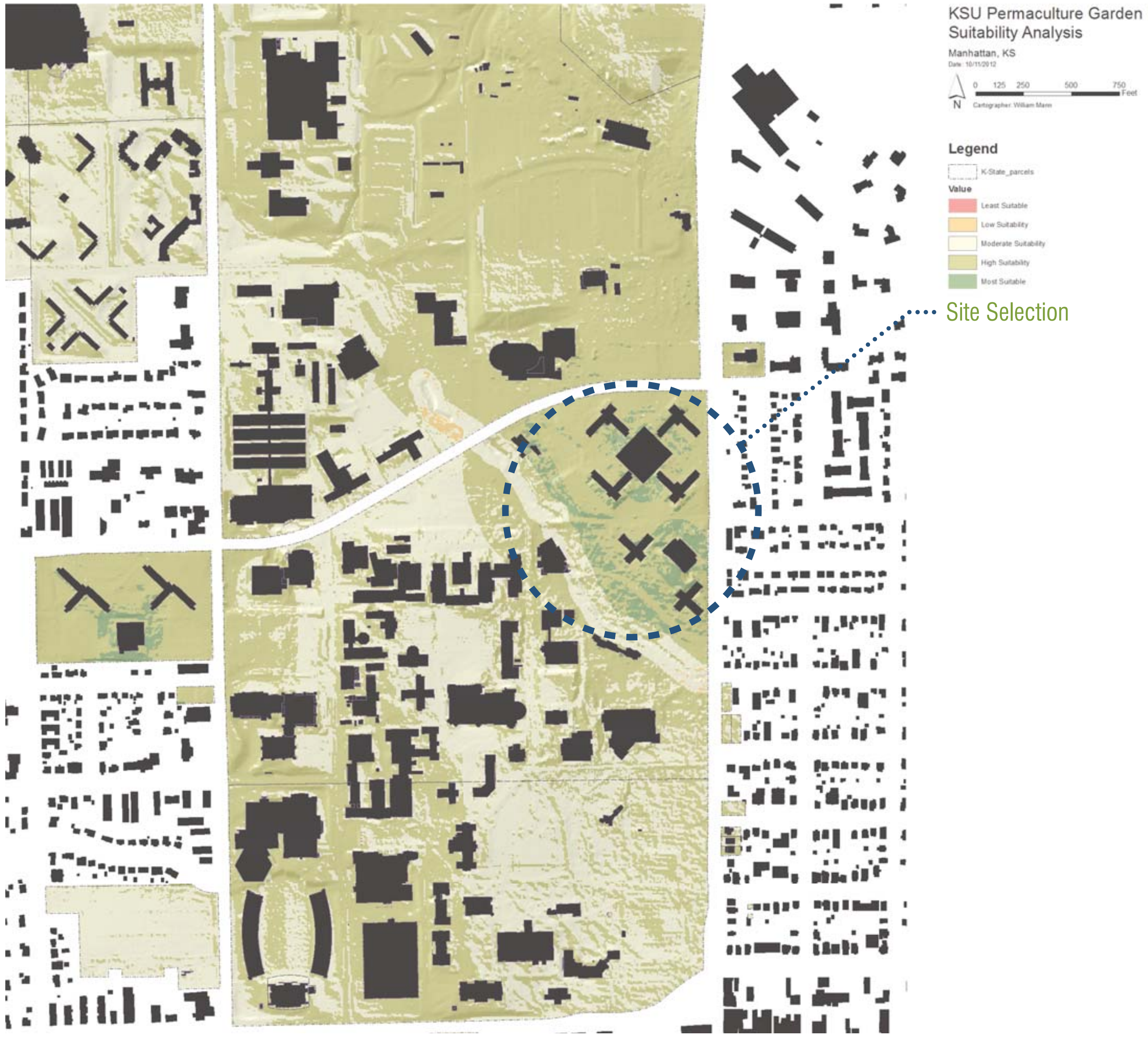
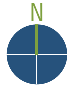


Figure 4.2 | Suitability Analysis Results
Areas around Derby, Van Zile and Kramer Dining Hall indicated suitability for this project type. However, space adjacent to Derby was chosen for opportunities regarding existing site usage (analysis by author). See Appendix C.



Existing Conditions

The project site consists of approximately 3.5 acres between the Derby Dining Hall Complex (adjacent to Moore Hall, West Hall and Derby Dining Hall) to the east and the International Student Center and Campus Creek to the West (See Figure 4.3). Claflin Road serves as the northern border of the site while Mid-Campus Drive and Old Claflin Road boarder the site on the western and southern sides respectively. The majority of campus educational buildings are located to the west and south. The campus decreases in density to the north of the project site including the K-State Agriculture, Horticulture and Veterinary Medicine buildings and K-State Farmland beyond. The Derby Residence Hall Complex resides on the eastern boarder of campus adjacent to Manhattan Avenue and residential neighborhoods.

The site topography is characterized by a general east to west slope with maximum existing slopes in certain areas of 39.5%. The maximum elevation change across the site is 27 feet with an elevation of 1064 feet at the residence hall plaza surrounded by Moore and West Hall and 1037 feet at the lowest point of Campus Creek on the project site (See Figure 4.4).

Campus Creek flows from northwest to southeast through the site and is the only natural surface water source. The residence hall plaza drains to its center and outlets in a grassy area to the northwest. Some runoff occurs from one of the existing parking lots immediately southwest of West Hall directly onto the project site to the southwest.

Site Suitability Factors	Suitability Rating*	Factor Weight
Slope Percentage		**10%**
Percentage Ranges		
0 - 3%	4	
3 - 8.83%	5	
8.83 - 15%	3	
15 - 25%	2	
> 25%	1	
Poximity to Dining Hall		**20%**
Distance From Dining Hall		
0 - 100 ft	5	
101 - 500 ft	4	
501 - 800 ft	3	
801 ft - 1/4 Mile	2	
> 1/4 Mile	1	
Campus Creek Buffer		**25%**
Distance From Creek Centerline		
0 - 75 ft	1	
> 75 ft	5	
Slope Aspect		**30%**
Sun Quadrants		
North	2	
East	3	
South	5	
West	4	
Soils		**15%**
Organic Material Content		
4.50%	5	
3.50%	4	
3.00%	3	
2.50%	2	
2.00%	1	

*In Suitability Rating System, 5 is most suitable and 1 is least suitable

Table 4.1 | Suitability Analysis Calculations
Each factor had ranges that were ranked based on suitability for a permaculture garden (table created by author).

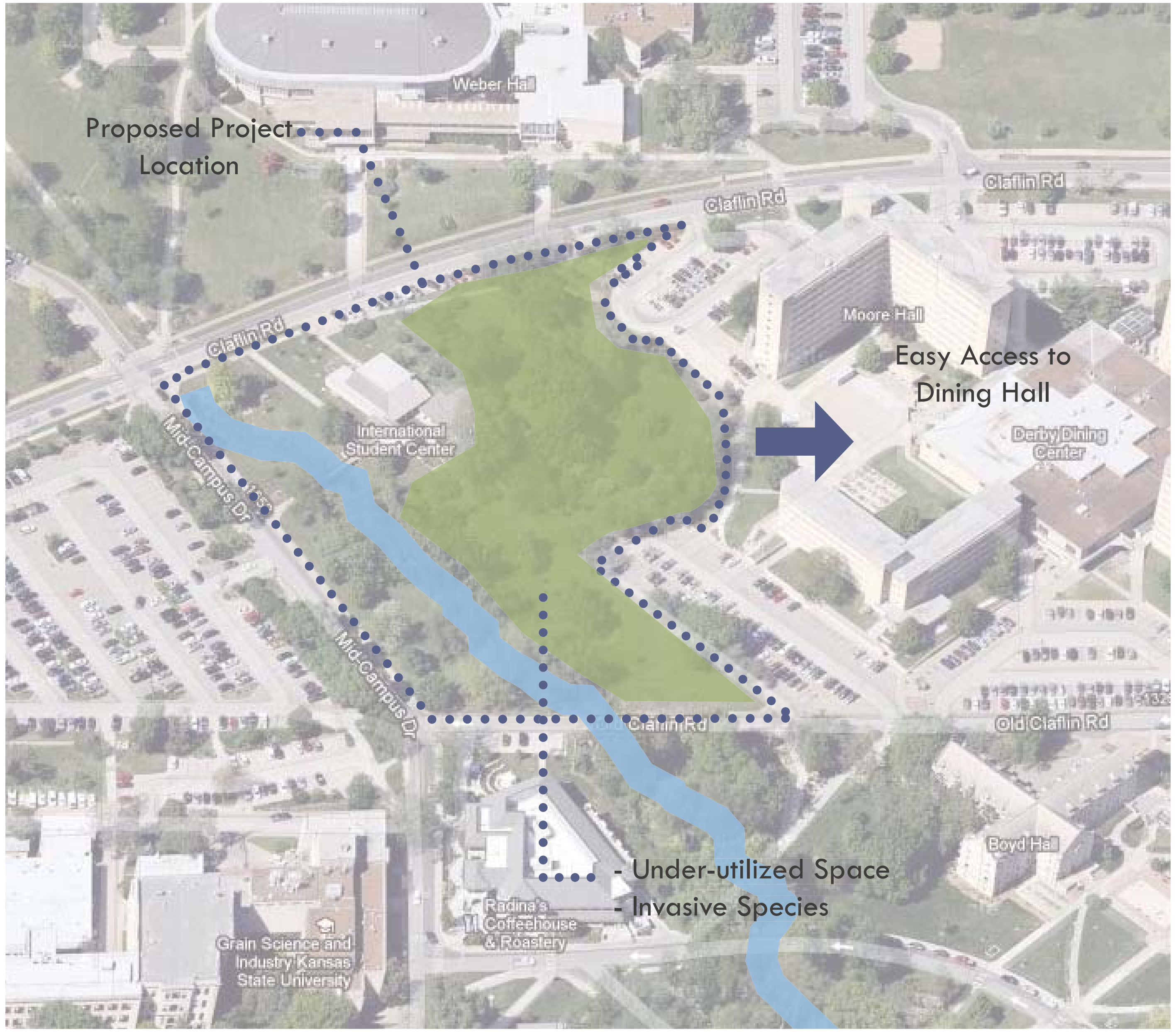


Figure 4.3 | Site Location
The site was chosen between the Derby Housing Complex and the International Student Center (graphic by author over a Google Maps image).

N

Rainwater falling on the residence hall buildings flows directly into the storm sewer system with an internal drainage system.

Based on a soil survey of Riley County, the site contains two different soil types. "Ivan and Kennebec Silt Loam" exists in the Campus Creek corridor; while "Smolan Silt Loam" characterizes the remaining portions of the site. It was noted that this soil data reflected regional soil conditions and did not take into account recent, site level soil amendments, contamination or degradation (i.e. fill dirt under West Hall parking lot and possible down-slope contaminations from parking lot).

Numerous underground utility lines cross the site including Storm and Sanitary Sewer, Electric, Natural Gas, Water and TV lines (See Figure 4.4). Several garden hydrants exist in the northern portion of the site and are currently used for irrigation of temporary nursery trees on site. A large trash dumpster and compactor are located immediately southwest of Moore Hall. In addition, recycling bins are currently located on the periphery of the central plaza space on the west side of Derby dining hall.

The site contains a variety of trees in regard to age, quality, and species. Exemplary of existing tree species are three large American Lindens directly east of the International Student Center and a large, mature Sycamore just south of the same building. The site exhibits numerous clumps of invasive Japanese Honeysuckle and White Mulberry. Several Siberian Elms border the eastern edge of the site.

Figure 4.4 | Existing Mature Trees
The site contains some large, high-quality trees (photos by author).

Figure 4.5 | Existing Invasive Honeysuckle
Japanese Honeysuckle is firmly established in several overgrown areas on site (photo by author).

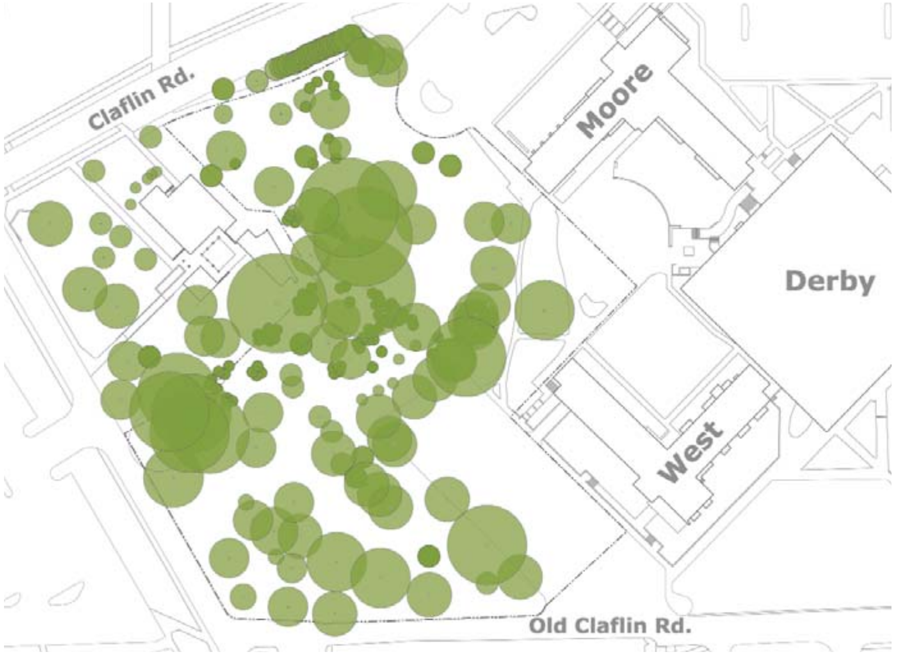


Figure 4.6 | Existing Trees.
The left diagram shows all existing trees (image created by author over a CAD base provided by KSU).

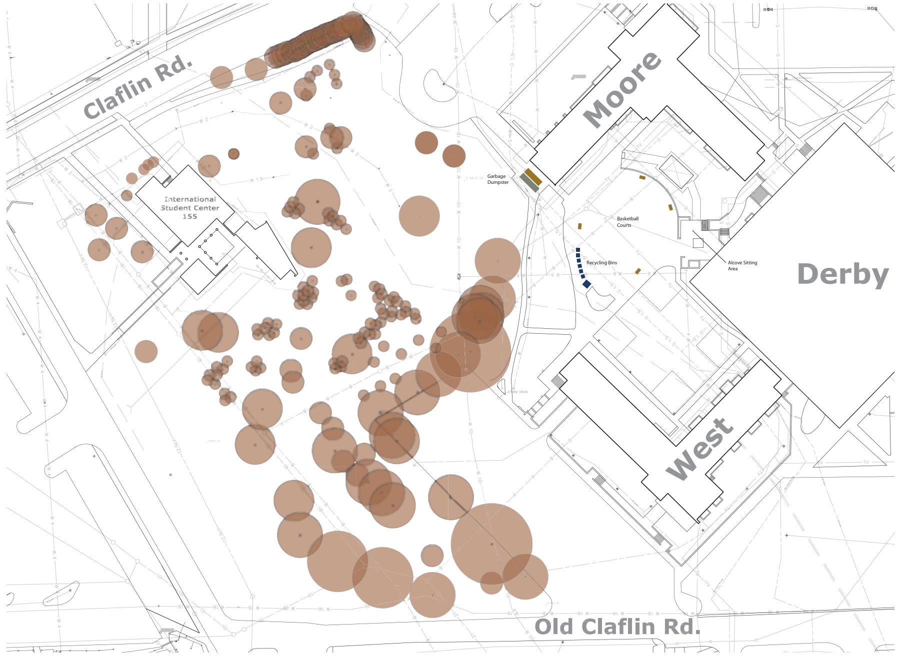


Figure 4.7 | Low Quality Trees
The diagram to the left shows trees on site that were deemed poor quality from site observation based on heath, species type and location (image created by author over a CAD base provided by KSU).

Currently the site is used for very little more than a temporary location for nursery trees and a walk through space. A rain-garden exists adjacent to the International Student Center court yard capturing water off the building roof.

Concerning future use and planning for the site, the Kansas State Master Plan Update Task Force recently put together two master plans for the campus. In the 2012 KSU Master Plan the site exhibits park-like characteristics with several major circulation paths proposed (See Figure 4.16). Additional square footage is proposed for the International Student Center. Another version of the 2012 plan was created specifically for K-State Housing and Dining in January of 2013 (See Figure 4.17). This plan indicates massive expansions to the Derby residential complex with three new residence halls proposed within the project boundaries.

It was determined that this project would reflect the campus development scenarios indicated in the first of the two proposed master plans, in order to preserve valuable tree specimens, effectively respond to the current channelized state of Campus Creek and given the opportunity for food production adjacent to K-State's largest dining hall. As seen in the next chapter the final design plan reflects sensitivity to existing mature trees, the International Student Center rain-garden and the ecological health of Campus Creek. The proposed Master Plan for K-State Housing and Dining undermines all of these goals. The 2012 KSU Master Plan displays a less intrusive program for

Figure 4.8 | Existing Hydrants
Photo by author.

Figure 4.11 | Outlet Below Derby Plaza. Photo by author.

Figure 4.9 | Existing Parking Lot
Photo by author.

Figure 4.12 | Trash Compactor
Photo by author.

Figure 4.10 | Sewer Manhole
Photo by author.

Figure 4.13 | Recycle Bins
Photo by author.

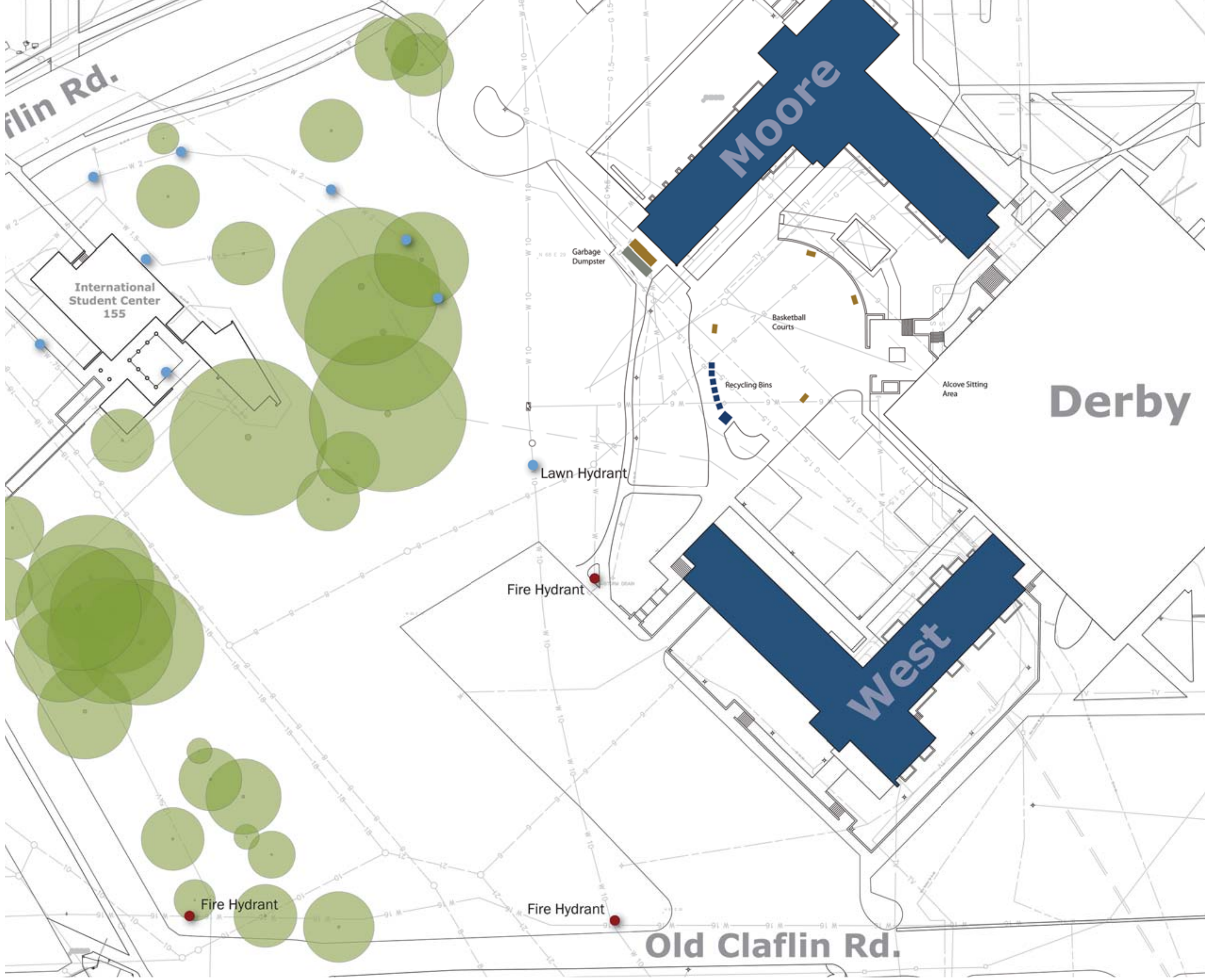


Figure 4.14 | Existing Conditions Summary
The above map is a summary of the major existing site conditions (Image adapted from KSU-provided base information).

Scale: 1 in = 90 feet
0' 45' 90'
N

this site including only an expansion on the south side of the International Student Center building. As shown in the final design plan it was determined that, in order to preserve an valuable, mature Sycamore tree, the expansion should occur on the north side of the building on less ecologically valuable real estate.

Opportunities

Several opportunities were determined concerning stormwater management. The roofs of Moore and West Hall currently capture relatively clean water across nearly 27,000 square feet. It was found that this water could be harvested and used to irrigate proposed food production beds on site. In addition, it was discovered that since the buildings are both over 60 feet high, the potential exists for gravity fed irrigation through the implementation of rain water cistern towers. Opportunities exist for stormwater management in the restoration of campus creek as well. Ample space was observed on site for the expansion of the Campus Creek channel in creating an adjacent wetland.

Existing mature trees on site were identified as valuable assets to the design. In subsequent design iterations the value of several large, high-quality trees were assessed in regard to the creation of desirable experience throughout the site and guiding circulation patterns (See Figure 4.4).

Figure 4.15 | Existing Site Character
The site exhibits under-utilized space , steep slopes , and mature trees (photos by author).

Constraints

Several project constraints were identified based on the existing conditions of the site. It was noted that since one of the major components of this project is food production there is a requirement for unhindered solar access to the fruit and vegetable plants for optimum productivity. The site contains a significant amount of tree canopy cover with some trees (as mentioned previously) being large, mature and of high quality (See Figure 4.12). Thus, to some degree, design decisions were constrained to preliminary assessments of tree value.

Sanitary sewer line and other utility lines pose issues in terms of the feasibility of relocating them due to design interventions. In particular, the storm sewer pipe line buried along the eastern edge of campus creek as noted in plan was noted as a constraint to certain types of stream restoration (such as creating a wetland by expanding the east bank).

Existing site parking lots are constraints in terms of soil quality underneath and around them. Both versions of the K-State Master Plan propose the removal of both the northern and southern parking lots. However, it was acknowledged that significant soil amendments may need to occur in those locations for future vegetation growth (especially food production).

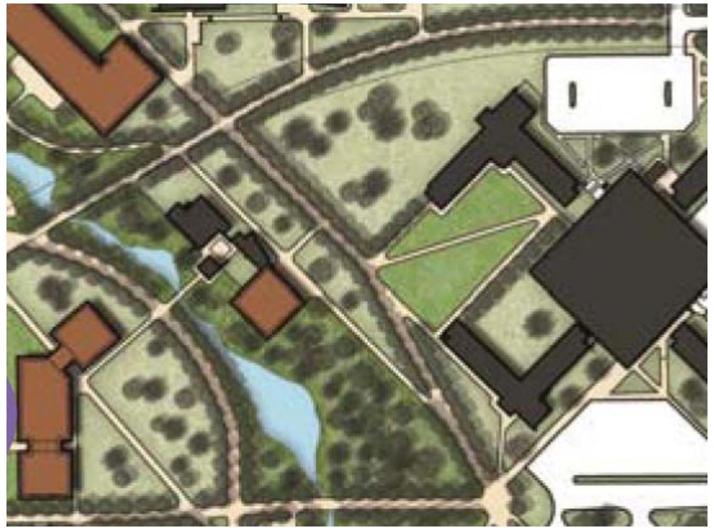


Figure 4.16 | 2012 K-State Master Plan

The above diagram shows the KSU Master Plan update without the Housing & Dining Expansion Component. Image provided by KSU.

Figure 4.17 | 2013 K-State Housing & Dining Master Plan

KSU Housing & Dining Master Plan proposes new residence halls with little regard for existing high quality trees (image provided by KSU).

Summary

In summary, the location of the project site was chosen for its suitability for permaculture strategies. Site conditions and issues included under-utilized space, invasive species, a diverse array of tree cover and quality, steep slopes, potential utility constraints, soil quality issues, and general future design concepts from the K-State Master Plan. It was observed that the site offers opportunities for this project type in regard to stormwater harvesting, tree preservation, and historic continuity. The design process took into consideration these conditions and site issues by carefully responding to the major site concerns in all design iterations.

Figure 4.18 | International Student Center Rain-Garden Plantings

The rain-garden currently serves an ecological function by accelerating the infiltration and transpiration of water run-off from the International Student Center roof (photo courtesy of Lee Skabelund).

Figure 4.19 | International Student Center Rain-Garden

The rain-garden provides an engaging space next to a mature spreading Sycamore (Photo courtesy of Lee Skabelund).

Design Process 5

The primary method in exploring the project thesis was design. The design process was used to apply concepts regarding the creation of meaningful experiences through landscape to the chosen K-State campus site in order that concepts in sustainable food production would be promoted through these experiences created by the landscape (See Figure 5.1). Thus, sustainable food production was the message and basic arrangements of landscape form and space were used as the medium through which the message was intended to be conveyed. By exploring the sustainable food production as implemented in this particular landscape at K-State and the medium of landscape form and space, the intent was for concepts to emerge through the process of design.

These concepts showed the potential for integration of sustainable food production with the experiential power of landscape form and space. It was anticipated that by this exercise, ways of promoting sustainable food production through designed landscape would emerge. The design iterations were short, conceptualizations of ideas drawn from the literature. They both illustrated preliminary site program and layout.

Iteration 1 – Sustainable Food Production – incorporated a list of sustainable strategies commonly used in organic farming and permaculture (See Figure 5.1). In this iteration, general concepts from the literature included the ideas of regenerative agriculture, cyclical food production systems, resource efficiency, minimization of waste, and modeling ecological systems and processes (Lyle 1994; Mollison 1990; Holmgren 2011; Jacke 2005; Hemenway 2009).

Iteration 1 – Sustainable Food Production

In Iteration 1 the site was divided into zones based on proximity to the Derby Dining Hall. Areas in the site design that required more maintenance such as vegetable gardens are located close to Derby while areas that are designed to require less maintenance such food forest guilds are located farther from Derby.

Regenerative Agriculture was identified as that system of food production that not only sustains itself, but becomes more productive, rich, and efficient over time (John Lyle 1995). Referring back to the list of characteristics under which John Lyle organizes regenerative systems, regenerative agriculture exhibits diversity, combination of functions, storage management, and connections between form and process. One example of regenerative agriculture is a plant guild (Hemenway 2009, 192; Mars 2005, 62; Jacke 2005, 121). Toby Hemenway defines a guild as "a group of plants and animals harmoniously interwoven into a pattern of mutual support, often centered around one major species, that benefits humans while creating habitat (Hemenway 2000, 183)." In this kind of regenerative system resources are distributed and recycled, organic material is built up, and plants benefit from

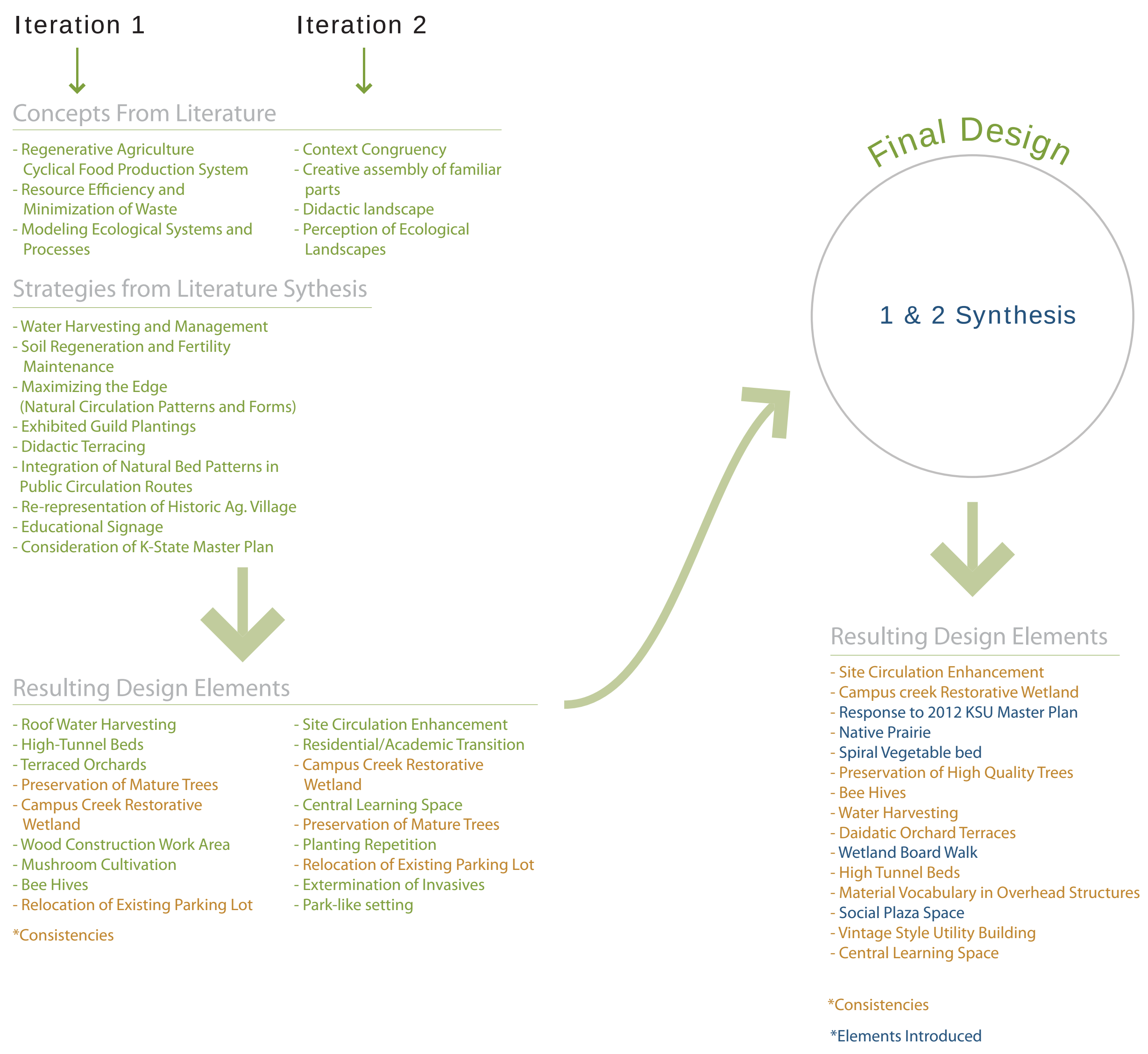


Figure 5.1 | Design Process Diagram
The design process uses strategies drawn from the literature to inform two preliminary design iterations. These iterations explore two distinct concepts. The final design is a synthesis of the previous iterations, utilizing the effectiveness of both in influencing the observer and regenerating the environment through food production (diagram by author).

Figure 5.2 | Iteration 1: Section A-A' looking northwest

Vertical Exaggeration x2 (drawing by author).

0' 15' 30' 60'

Figure 5.3 | Iteration 1: Section B-B' looking south.

Vertical Exaggeration x2 (drawing by author).

0' 15' 30' 60'

Figure 5.4 | Iteration 1 - Sustainable Food Production

The site is laid out with particular regard for slope and water runoff (drawing by author).

Scale: 1 in = 90 feet

0' 45' 90'

N

each other. Resources aren't just taken from the soil by food producing plants. Other plants, whose primary functions are not food production, provide the composition with ecological function to bring nutrients back into the cycle. A balance occurs between production and regeneration such that resources are not depleted, but maintained and increased.

There are various strategies along with plant guilds that include the modeling of ecological systems and processes. Though the composition of plant guilds are created outside the normal ecological process of nature, guilds are intended to mimic functions in natural ecosystems. This strategy is consistent with John Lyle's first principle on regenerative systems: "Considering nature as both model and context." Other strategies such as maximizing edge area and on site pollination systems are techniques explored in iteration 1.

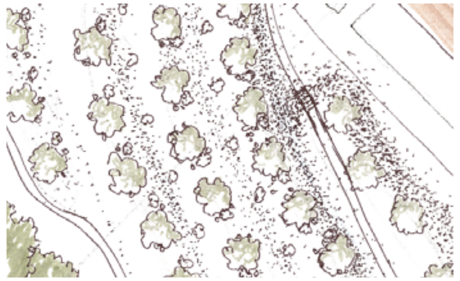
Maximizing the edge of planting beds in the garden is a strategy that gains from the natural properties of ecosystem edges (Hemenway 2000, 96; Edible Forest Gardens, The Basics of Permaculture Design p. 84, Permaculture p. 152, 336, 413). These areas in an ecosystem often referred to as ecotones are extremely fertile due to the accumulation of organic material, species diversity, access to sunlight, and the shared nutrients of two ecosystems (Mars 1996, 10). Iteration 1 explored this concept by implementing curvilinear beds with smaller widths surrounded by paths. In this way the edge space in the planting scheme was increased, thus promoting fertility and species richness (See Figure 5.6).

Creation of habitat for pollinators and other beneficial animals and insects was another concept explored in Iteration 1. Two design elements in this iteration offer specific habitat for beneficial species. Honey Bee hives were proposed in an accessible yet protected location to encourage pollination of vegetable and fruit producers on site. While addressing stream contamination and stability issues, the wetland or "wet-meadow" extension of Campus Creek offers another realm of habitat for desirable insects.

Iteration 1 also developed on the premise of efficient use of resources and the minimization of waste. In food production, the primary resources include water, air, sunlight, and soil nutrients. Sunlight and air are less controllable than water and soil nutrients. Management of sunlight included strategies to avoid shaded areas for planted vegetable beds and high-tunnel structures to extend the growing season. Increasing the efficient use of nutrients found in the air depends on the type of plants in the garden, the spacing and the site terrain. Water and soil, however, can be highly and meticulously managed.

Water harvesting and management was vital in the development of iteration 1. Capturing and managing site water resources involved strategies such as terracing, cisterns, and wetland creation (Hemenway 2009, 96; Jacke 2005; Mars 2005, 84; Mollison 1990, 152, 336, 413).

Vegetable Beds with High Tunnels



Terraced Orchard

Pollination and Honey Production

Figure 5.5 | Site Food Production
Site food production areas include terraced annual beds, high tunnels, terraced orchard guilds, and honey production (enlargements by author).

Figure 5.6 | Iteration 1 Design Elements
Iteration 2 uses existing site topography to layout the orientation of food production beds and orchards. All food production areas are oriented around Derby Dining Hall. Existing mature trees are preserved. A wetland is proposed to expand the Campus Creek channel (diagram by author).

Preliminary ideas for soil management and fertility maintenance involved the implementation of plant guilds, soil organism cultivation, decreasing opportunity for soil compaction, and mulch protection (*Edible Forest Gardens* p. 75, *The Basics of Permaculture Design* p. 51, *Gaia's Garden* p. 71). As noted in chapter 4, there are a few specific areas on site that require soil rebuilding. These areas are located on the southern and northern portions of the site were the design proposes the removal of existing parking lots. Sheet mulching will be employed to mitigate poor soil quality and to jump-start preliminary plan growth.

Iteration 2 – Landscape Influence

Iteration 2 – Landscape Influence – was focused on the basic formal and spatial elements of landscape and the power they have in influencing the observer to notice and experience certain concepts (See Figures 5.7, 8, 9). The conceptual design proposes the use of circulation as the driver for directing the user's attention and focus. Basic design elements in this iteration included entry, tangential views, repetition, directional views, framing, and creating a transition zone (See Figure 5.10).

The above design strategies arose from the following concepts derived from the literature: context congruency, creative assembly of familiar parts, didactic landscapes, perceivable ecology in landscape, and types of circulation (approach, entrance, and path-space

Figure 5.7 | Iteration 2: Section A-A' looking northwest
Vertical Exaggeration x2 (drawing by author).

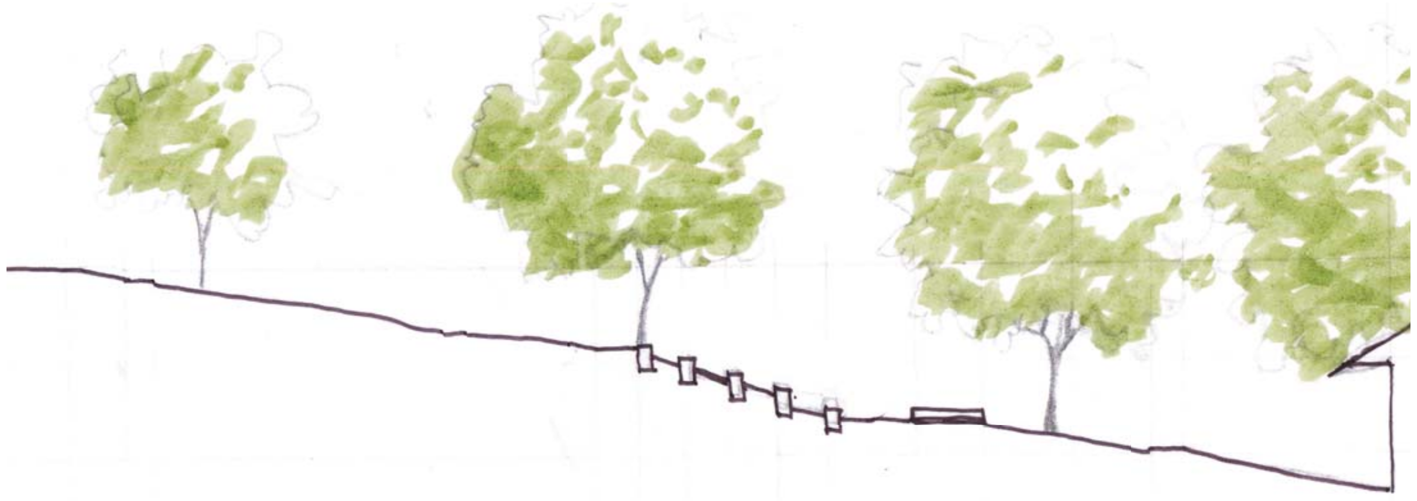


Figure 5.8 | Iteration 2: Section B-B' looking south
Vertical Exaggeration x2 (drawing by author).

Figure 5.9 | Iteration 2: Landscape Influence
Iteration 2 explored the concepts from the literature regarding landscape influence. Circulation was specifically explored as a mode of direction for the occupants of the site in regard to views and experience (drawing by author).

Scale: 1 in = 90 feet
0' 45' 90'
N

relationships) (Refer to Figure 2.10). Authors describing these basic elements of landscape influence discuss fundamental arrangements of form and space, how the perception of sustainability is improved, how landscapes become meaningful, and how meaning is expressed through landscape design.

Iteration 2 explored the concept of context congruency discovered in the literature. Creating a meaningful experience through context congruency reflects back to Francis Ching's acknowledgement of a design context as well as Mark Treib's description of the "Vernacular Landscape" in his article, "Must Landscapes Mean?: Approaches to Significance in Recent Landscape Architecture" (Francis Ching, Mark Treib). Treib defines the Vernacular Landscape as follows: "The vernacular is a rich source of materials and forms; after all, it constitutes the "real" world in which we dwell (Treib 1993, 52)." Treib describes this type of landscape as one that is connected to the context in terms of materials and forms. The buildings at K-State have a material style of limestone construction and a history built upon education in agriculture. This is one of the concepts driving iteration 2.

In speaking of strictly architectural projects Francis Ching in *Architecture: Form, Space, and Order* expresses the idea of context as something that encompasses and illuminates the design details within (Ching 2007, XIII). The generality with which he depicts this concept promotes the application of the idea of context to landscape architecture projects. The context of a landscape means essentially the same as was expressed above, and can be physical, theoretical, historical, and cultural. In terms of the K-State campus, there is a historical context of agriculture associated with the university enforcing the appropriateness of food production on campus. This was identified as a context that the promotion of sustainable food production should tap into.

As noted in chapter 2, Laurie Olin discusses the concept of re-assembling familiar parts in creating something new and meaningful (Olin 1995). Changes in scale, spatial relationship, and function in certain design elements can lead to an entirely different experience. In iteration 2, paths traverse the site in curvilinear, indirect patterns. An amphitheater was centrally located to provide a programmatic element that signals the transition from residential space to academic space. In addition, mature trees are preserved and a wetland extension of Campus Creek is proposed similar to the first iteration.

Paths and amphitheaters are familiar elements of landscape architecture. However, the amphitheater in iteration 2 resides within the network of paths such that users are directed toward this space of learning rather than given the easiest "point A to point B" path across the site (See Figure 5.10). Users' attentions are directed to the wetland, the amphitheater, the existing rain garden, and the mature trees the design preserves through a series of designed entrances, approaches and spatial relationships along the paths. This simple re-assemblage of familiar

Figure 5.10 | Basic Elements of Landscape Influence
The elements of landscape influence present in iteration 2 are directing view from site paths, framing views, guiding repetition, and site entrances (diagram by author).

parts promotes an experience involving the integral parts of the site.

The agenda of the above-mentioned re-assemblage was didactic in exploring landscape influence. Shaping views and experience through site circulation has the potential of conveying a message to the occupant. As we see in the final design, food production is the focal point of didactic site elements.

Synthesis and Revision Process

The first two iterations were conducted with lists of concepts distinct from one another in order to allow the effective elements of each iteration to complement one another in the final synthesis of the two. The resulting design concepts were brought together, undergoing revisions and refinement (See Figures 5.11, 12). The results included a final design based on this iterative process from which final concepts and design details emerged. The synthesis of the results from iteration 1 and 2 showed how this space on the K-State campus can enlighten student and other users to the reality of a regenerative food production system.

The design process involved a revision process after iteration 1 and 2 that focused on the combination of design ideas from "Sustainable Food Production" and "Landscape Influence." As shown in Figures 5.11, 12 the preliminary site plan syntheses of Iterations 1 and 2 involved both a combination of site strategies and programmatic elements as well as circulation pattern layout and site configuration. Combinations manifested themselves in the following ways: didactic terraced orchards, central garden learning space, direction of view toward sustainable site functions, integration of vernacular elements with sustainable food production, and immersion of observers in sustainable food production and site ecology. Further design revisions were conducted in producing the final design discussed in chapter 6 (See Figure 5.13).

Figure 5.11 | Preliminary Design Synthesis
Iterations 1 and 2 were synthesized to create a new concept (drawing by author).

Figure 5.12 | Revision of Preliminary Design Synthesis
The new concept was further refined, especially in terms of layout and design details (drawing by author).

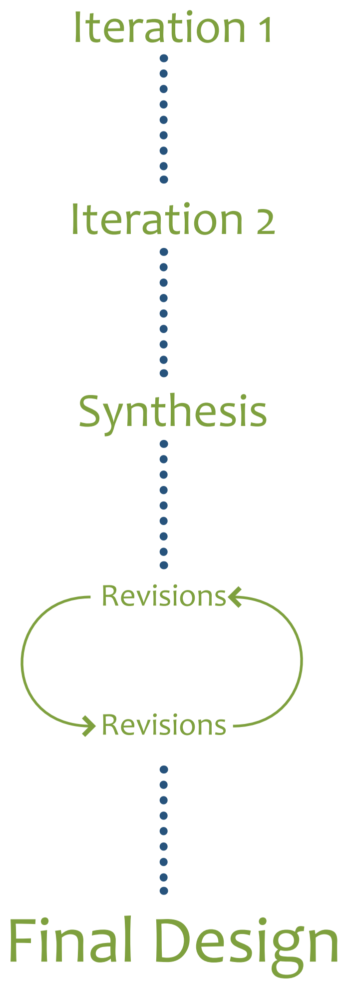


Figure 5.13 | Design Process Flow
The project built on each design iteration emphasizing sustainable food production and artful landscape influence. Iterations 1 and 2 were synthesized in a third design plan to mesh concepts from each in the same layout. The final design resulted after various revisions.

Results 6

In the previous chapter, the design process was discussed as iterations 1 and 2 were developed, synthesized and revised (See Figure 6.1). This chapter describes the final design showing how the design process has accomplished the preliminary project intentions. The final design shows strengths and weaknesses in the approach used in discovering the power of landscape architecture in presenting sustainable food production on the K-State Campus

Design Structure

There are several fundamental design moves influencing the layout of the final site plan shown in Figure 6.2. Desired site circulation, existing topography and the position of adjacent buildings and valuable mature trees were major factors in the composition of the final overall layout. The site employs a major circulation path traversing the site roughly northwest to southeast. Arranged in relation to this central element are three outer regions around a central node of activity. These region's physical positions in relation to one another and the site correlate to the intensity of their function as well. The outer regions exhibit lower intensity sustainable functions and food production than that of the center. Referring back to the "Zone Theory" discussed in chapter 5, the design assumes Derby Dining Hall as the project center. Thus, the site is organized with landscapes with higher intensity food production and maintenance located closer to Derby while lower intensity landscapes are located farther away.

Figure 6.1 | Link from Iterations to Final Design
Iteration 1 and 2 explored separate intentions that were synthesized in the final site design (drawings by author) .

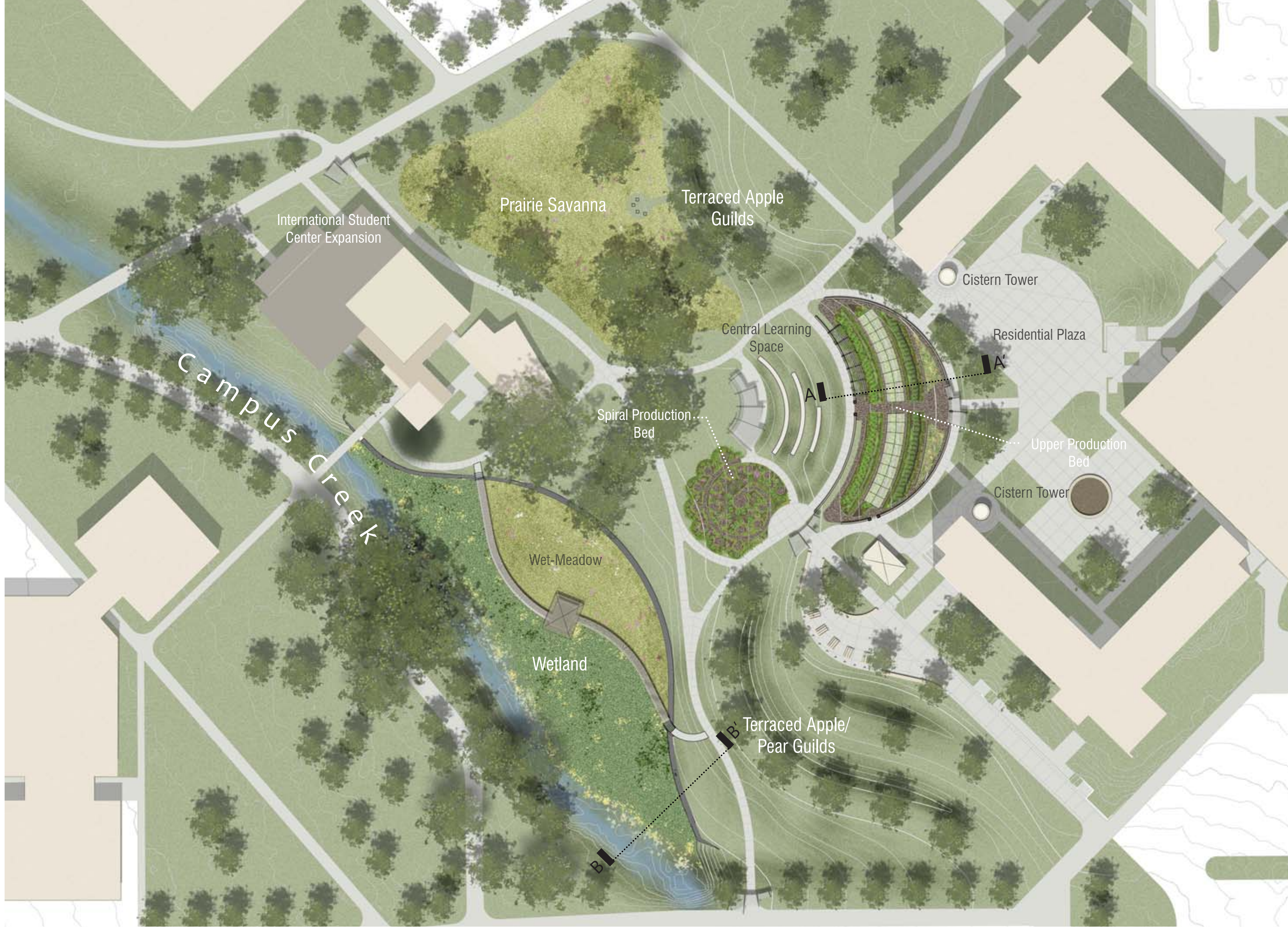


Figure 6.2 | Final Design Site Plan
The site plan resulting from the iterative design process displays the combination of sustainable food production with basic elements of landscape form and space (image by author).

Scale: 1 in = 90 feet
0' 45' 90'
N

The site program includes: the restorative wetland and wet-meadow, the native prairie savanna, vegetable and fruit production beds, a central learning space, social and residential plaza spaces, terraced orchard gardens, meandering paths, and uniform site entrances (refer to Figure 6.2). The site responds programmatically and spatially to the existing site topography as well as the locations of existing mature trees. The selection of these programmatic elements shows a level integration between spatial uses, promoting the confrontation of site users with sustainable food production. For example, locating social and residential plaza spaces beside areas of organic and sustainable food production within a small three and a half acre site forces the blending of cultural experiences. Areas for social activity are mixed with the presence of food production. Inversely, food-growing is integrated with social activity within a university campus culture and setting.

Landscape Influence

Stemming from concepts discussed in iteration two of the previous chapter, the final site design exhibits several means of landscape influence. As noted above these conceptual means include context congruency, creative assembly of familiar parts, perceivable sustainability, and didactic landscape.

The final site plan explores several ways of becoming congruent with its context. The first has to do with the historical context. An appeal is made to K-State's agricultural history through the use of native materials (i.e. limestone, steel, and wood timbers), in the overhead structures as well as the proposed building, water towers, and amphitheater. These material elements place the site in its familiar and reasonable context. K-State is still very much an agricultural university. A short trip a few miles north of the campus will illuminate that fact. The site, with its focus on food production, connects with the agricultural values and history while promoting sustainability in food production.

The site design is also sensitive toward the immediate physical context. Buffer space is provided between the residential area around Derby Dining Hall and the Upper Food Production bed. The sight rapidly transitions from residential to learning space with a slight blending of the two around the proposed social plaza (refer to Figure 6.2).

The second conceptual means of influence in this proposed landscape is in the creative assembly of familiar parts. The design assembles paths, open lawn, gardens, topography, amphitheater and plaza space. The assembly of these elements promotes the integration of food production into the circulation and formal spaces of the site. The food production gardens are located adjacent to the amphitheater and the site's two social plaza spaces. Major circulation routes exist through and adjacent to the gardens. Axial relationships are present between elements in this central region of the site and paths to this area (See Figure 6.4). This idea of physical integration of spaces merges the activities of everyday life with the activity of sustainable food production.

Figure 6.3 | Entry

Entrances to the site are located on the north, south and east sides. Each is marked by an overhead structure that gives the occupant a greater awareness of the landscape beyond (image by author).

The pedestrian paths traversing the site are curvilinear in form. This curvature, as discussed in chapter 2, promotes the opportunity for tangential views to spaces in the landscape with visual relationships to the path. Several of these tangential views have been created intentionally on site to focus the viewer's attention on site elements including the wetland and wet-meadow and the spiral bed (See Figure 6.5).

Another aspect of landscape influence in this design involves Joan Nassauer and Robert Thayer's concept of making sustainable landscapes perceivable and improving perception and appreciation. The prairie savanna on the northern area of the site exhibits an edge that is offset from peripheral paths (See Figure 6.6). This marginal space will be mown turf while the prairie grass will rise taller. This gives, as Nassauer puts it, a "cue to care." The observer will recognize the care of a mown lawn and a maintained edge, thus influencing their perception of the prairie itself. This cue gives the observer assurance that the tall grassy area has a purpose and is meant to be there. Similar strategies are present in the proposed wetland, wet-meadow, and apple guilds. A strong edge is established with the modular stone retaining wall along the proposed wetland and mown turf partway up the slope along the apple guilds.

In making this landscape didactic, the design proposes the concept of emersion and education. Site paths flow through or along ecologically functioning site elements (i.e. the production

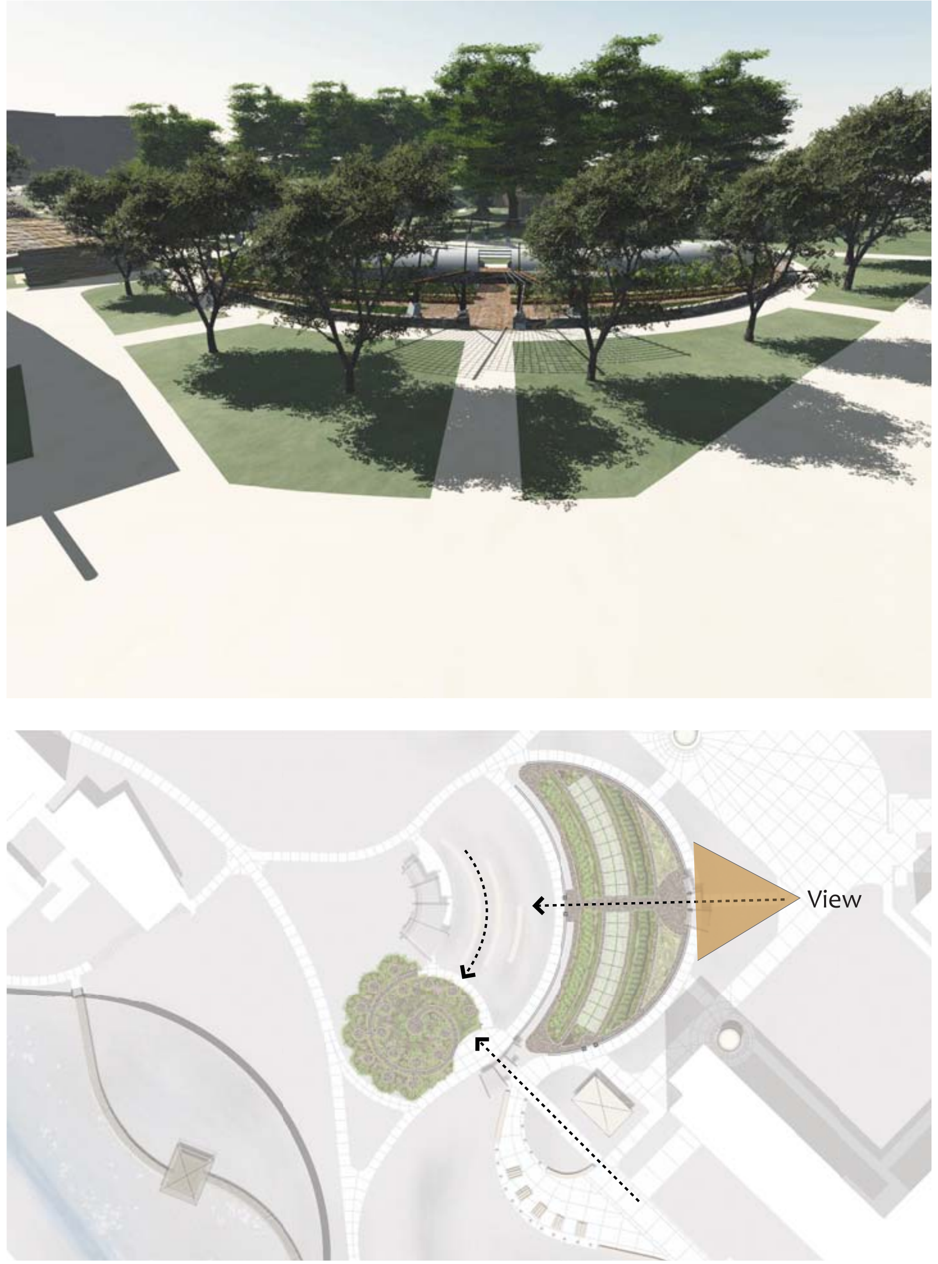


Figure 6.4 | Axial Approach and Learning Space Integration
The site organized three outer areas around a central intensive learning and production space along the major pedestrian corridor (image & diagram by author).

Figure 6.5 | Views through Path-Space Relationships
The bend in the path away from the wetland creates a moment where the viewer's focus is placed on the wetland (image & diagram by author).

Figure 6.6 | Perceiving Intentional Ecology
Mown strip along the native Prairie Savanna communicates to the observer that the prairie is intentional and managed (image & diagram by author).

gardens, the prairie savanna, and the wetland/wet-meadow). Educational signage is positioned in three locations along pathways to inform the observer of the ecological functions that are taking place.

Materials & Technologies

The final design incorporates a material pallet that responds to some of the more recent projects on campus such as the new Leadership Studies Building, new campus Kiosks, and improved wood seating. These material consistencies occur in the construction of the overhead structures proposed at site entrances and the stage area of the central learning space amphitheater (See Figure 6.7). Limestone masonry provides an visually solid base to each pillar in the overhead structures. Concrete-filled black painted steel piers rise 14.5' high supporting the cantilevered lattice structure. Highly finished and treated planks extend horizontally supported by cables attached to the top of the piers and by angular steel braces underneath. These planks serve as the skeleton for the overhead lattice providing a mottled shade for the space below. Other site features include similar material composition. The utility building will be constructed with limestone masonry walls. The wall around the Upper Production bed is also proposed as limestone masonry. Finally, the two cisterns (discussed below) are constructed with a limestone masonry veneer with black painted steel bands, downspouts and overflow piping (See Figure 6.8).

The design also, exhibits water management techniques. Water harvesting and management occurs on site in several specific ways. Rain water falling on the roofs of Moore and West residence halls is captured in two storage towers adjacent to each building (See Figure 6.9). Water that falls on the roof drains into each tower. When full the towers overflow through a pipe directing the excess water to the nearby orchard terraces. Surface water run-off from areas above the terraces is also collected to irrigate the apple guilds along the top of the terraces.

The water harvested from the roofs of Moore and West Hall is used to irrigate the upper and spiral production beds. These beds will be equipped with drip-line irrigation. Table 6.2 describes the process by which the towers were sized. Tower sizing was based on the amount of water required by the production beds (.62 gallons/s.f./week) as well as the average monthly rainfall during the growing season for this region of the country (Markham 2010). It was determined that each tower needed to be approximately 13,000 gallons in order to store one month's worth of average rainfall (3 inches of rain). For example, if the garden received a 1.86 inch rainfall on the first of the month, garden could rely entirely on the towers to provide more than sufficient irrigation for the rest of the month give the irrigation requirement of .62 gallons per square foot per week.

Site Prep & Maintenance

Certain strategies in preparing the site for intensive sustainable food production are proposed as well as longer term maintenance plan. The vegetable and fruit production beds will require

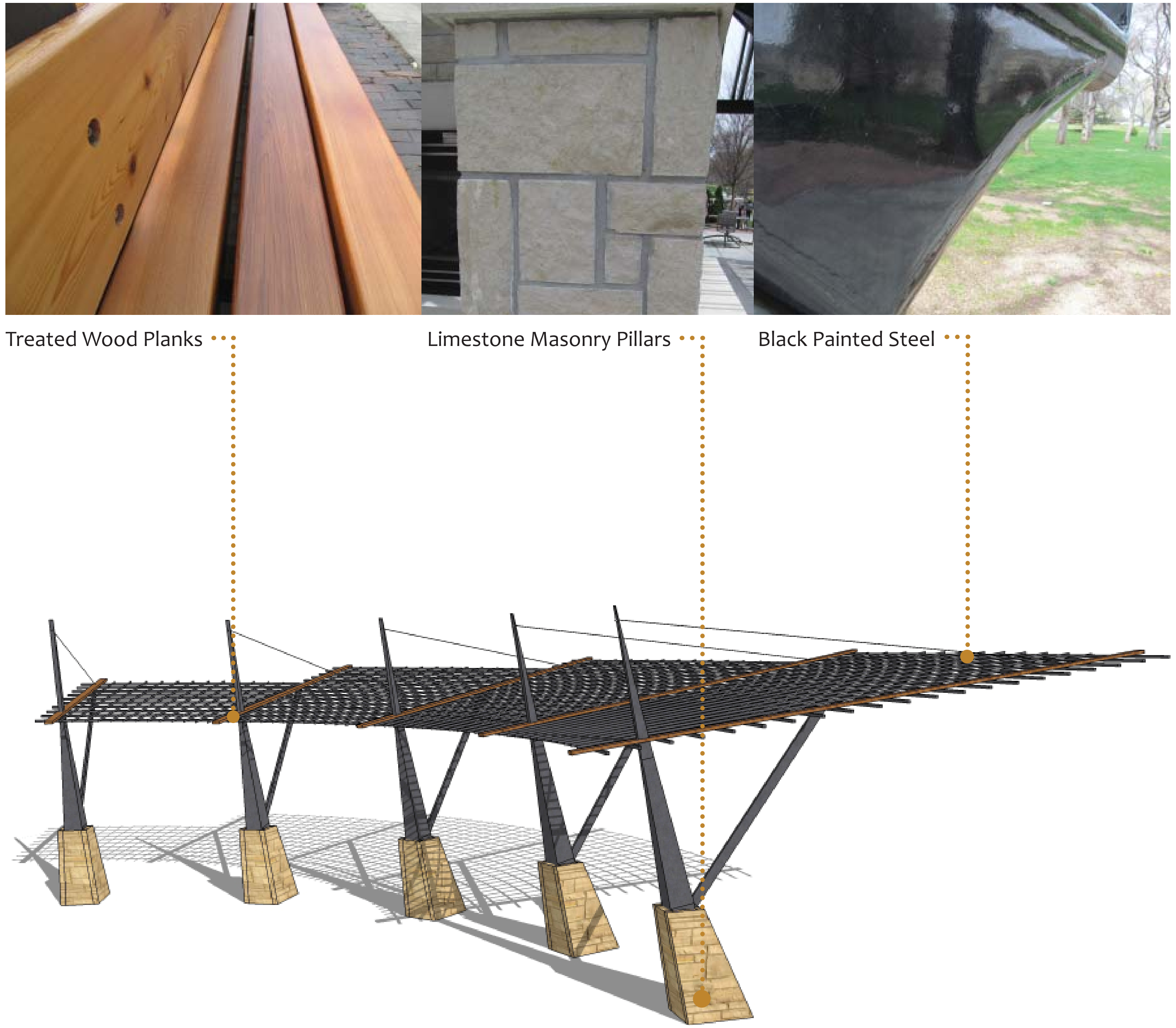


Figure 6.7 | Stage and Entrance Structures
Overhead structures on the edges of the site as well as internally frame elements of sustainable ecological function in the design. The materiality of these overhead structures connects the design with the campus aesthetic using limestone, black painted steel, and high-quality wood planking (photos and drawing by author).

optimal soil conditions at the outset for the garden to get established. Sheet mulching is a technology that involves the layering of organic material that are implemented on top of existing site soils or turf. The process involves aerating the existing surface, layering the area with 6 inches of organic compost, a weed barrier layer of cardboard or straw and then a layer of wood chip mulch (See Figure 6.10). After the layering is complete the site must lay undisturbed for a season (usually over the winter) to allow for the breakdown of the organic layers. After this period the resulting grow medium will be ready for planting. This process combats compacted or unbalanced soil conditions that may be present on site.

In addition, as noted in chapter 4, preparation of the site for design implementation will involve removal of invasive species. These will include primarily Japanese Honeysuckle and Siberian Elm. Both of these species have a tendency to establish and grow very rapidly with strong root systems that are hard to eradicate. Complete removal of invasive species will require initial removal of plants, stumps and roots, as well as a long term monitoring and maintenance of susceptible areas in the design. These areas include the wetland and wet-meadow, the prairie savanna and the fruit guilds and production beds. Areas that are not designated as mown turf grass will be prone to the reestablishment of these invasive species and will require consistent weeding. Annual or biannual controlled burns is a management tool that should be used on the prairie savanna. Regular burning of this area will enrich the soil

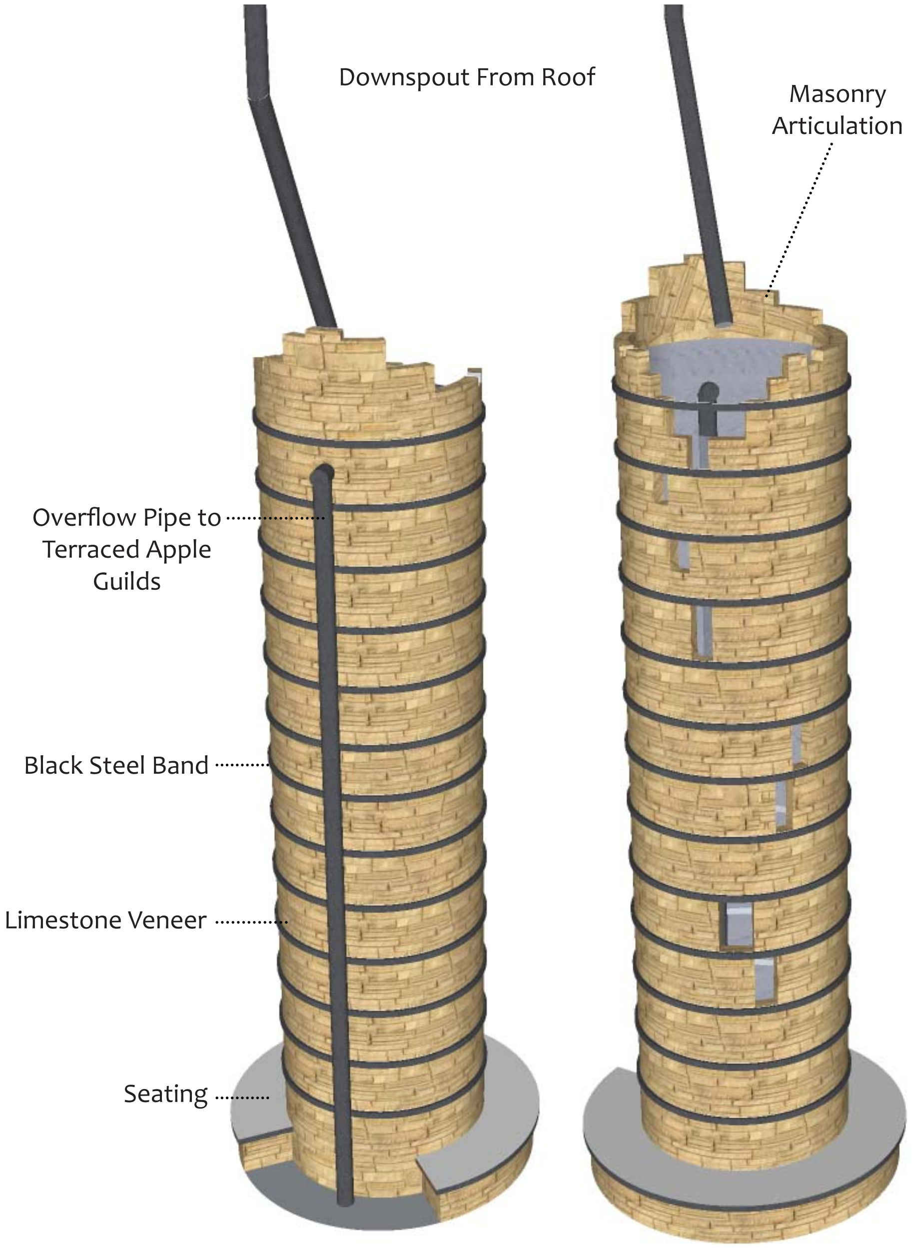


Figure 6.8 | Water Tower Detail
The water towers capture and store roof runoff providing 1 month's worth of irrigation with a 1.86 inch rainfall event. Both Towers are approximately 34.5 feet high (detail by author).

Moore Roof Area (s.f.)	14370.41		
West Roof Area (s.f.)	12414.33		
Total Area (s.f.)	26784.74		
	Annual	Growing-Season Average/Month	
Manhattan Average Rainfall	34.8	3.72125	
A x R / 12 = W cubic feet			
Gallons of Water Harvested (Moore Hall)	312,556.4	33,422.4	
Gallons of Water Harvested (West Hall)	270,011.7	28,873.0	
Total Harvest Potential	582,568.1	62,295.4	
	Upper Bed	Spiral Bed	Total
Planting Bed Area (s.f.)	7,361.58	2859.7826	10,221.36
Water Requirement per (s.f.)/week (Markham 2010)	0.62		
Weekly Water Requirement	4,564.18	1,773.07	6,337.24
Monthly Water Requirement	18,256.72	7,092.26	25,348.98
Annual Water Requirement	237,337.34	92,199.39	329,536.73
Assumed Monthly Rainfall (in)	3		
Moore Hall Monthly Harvest Potential (gal)	26,944.5		
West Hall Monthly Harvest Potential (gal)	23,276.9		

Table 6.1 | Cistern Capacity Calculations:
Cistern size is based on a maximum holding capacity for a 3.72 inch rainfall event . This allows the harvest potential of the roof of Moore Hall to provide water for a little over one month of irrigation requirements for both planting beds (25,348.98 gallons).

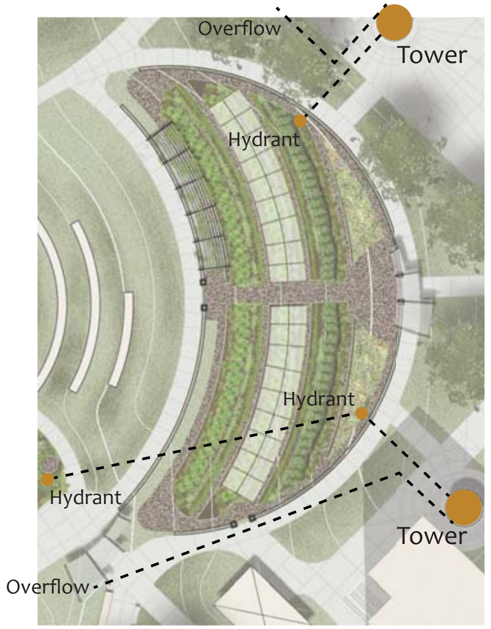


Figure 6.9 | Water Tower Locations
The water towers are located just east of the Upper Production Bed. They irrigate the vegetable beds to the west and when overflowing outlet to the orchard terraces.

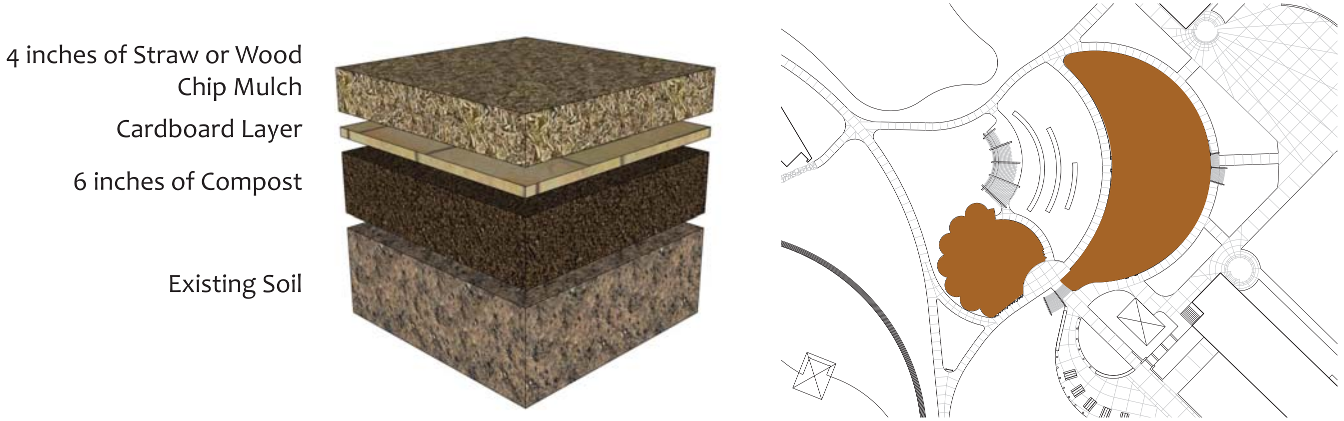


Figure 6.10 | Sheet Mulching
Production beds will be mulched with layers of compost, cardboard, and straw or wood chips. Sheet mulching will occur were the primary food production bed are proposed.

and prevent woody invasive species from getting reestablished.

To ensure the long-term viability of this project, it is imperative that a full-time faculty and/or staff position be created for the management of the site food production and ecological functions. Hiring a certified permaculturalist in conjunction with the horticulture or natural resources and environmental studies programs could become a specialized extension of the curriculum. In addition, student internships would provide incentive for using the educational benefits the site provides and would further ensure the long-term maintenance and productivity of the site's ecological functions.

Food Production

The site design proposes the attraction of beneficial insects for pollination and pest predation. Insects are integral in the health and productivity of a food garden and any other ecologically flourishing landscape. Toby Hemenway in *Gaia's Garden* claims, "Without insects, there would be very little for us to eat, no compost or topsoil, few birds, fewer mammals – they're an essential, major thread in the web of life (Hemenway 2000, 151). Hemenway identifies four types of beneficial insects that healthily functioning ecological gardens should attract: predators, parasitic insects, pollinators, and weed feeders (Hemenway 2000, 153). These insects provide a balance that suppresses blooms of harmful and destructive plants and other insects.

In order to attract this conglomeration of predators, parasitic insects, pollinators, and weed feeders, both specifically attractive plant species and appropriate habitat are implemented on-site. The prairie savanna, wetland/wet-meadow and designated insectary plantings in the orchard guilds and the upper production bed all contain plants that attract beneficial insects to accomplish these functions. A sample of these types of species can be seen in the plant list of the insectary areas in the Upper Production Bed as well as the apple guilds (see Figure 6.13, 15). The insectary in the Upper Production Bed and other insect attracting plants are essential for the health and productivity of these gardens since over 50% of the vegetables and fruit grown need to be pollinated by insects. All of these areas provide, sheltered, and climate controlled habitat for spiders, beetles and other predator insects. Plant species that attract native pollinators as well as a node for honey bee hives are proposed to promote this vital function in plant productivity. Honey bees, though not native to the U.S., are excellent pollinators given their propensity to pollinate a wide variety of flowering plant species instead of select few. Their value for pollination as well as their honey production ability makes them a well advised addition to any food production operation.

The final design proposes four main areas of fruit and vegetable production: the upper production bed, the spiral bed, and the northern and southern terraced fruit tree guilds. These areas of food production exhibit various sustainable food production techniques at varying degrees of intensity.

Figure 6.11 | Juxtaposition and Recombination
The site design integrates sustainable food production with learning and social space using topography and circulation.

Central Learning Space

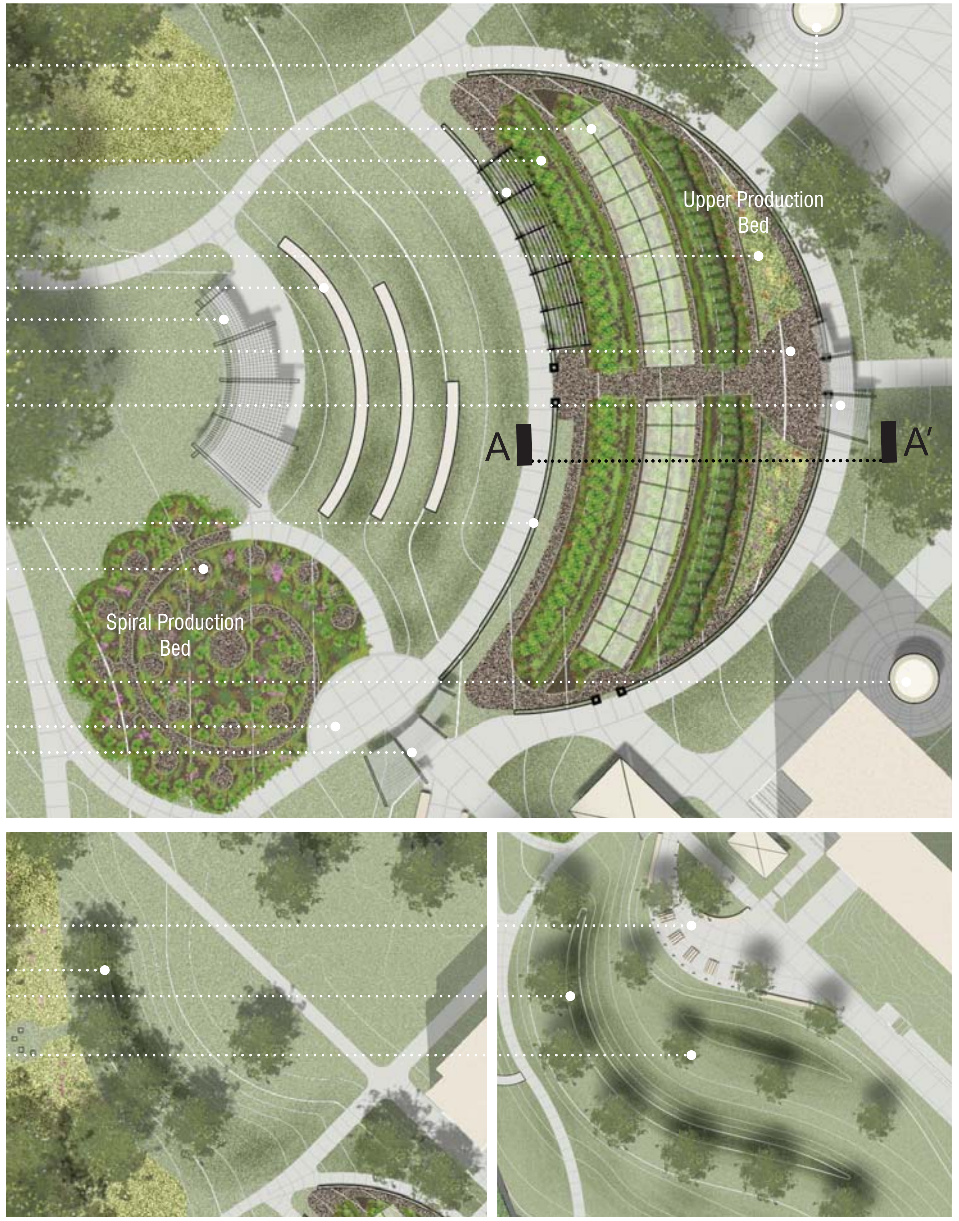


Figure 6.12 | Productive Central Learning Space
The Central Learning Space's major elements includes the Upper Bed, the Spiral Bed, an amphitheater for outdoor classes, two peripheral orchards to the north and south and rainwater cisterns (images by author).

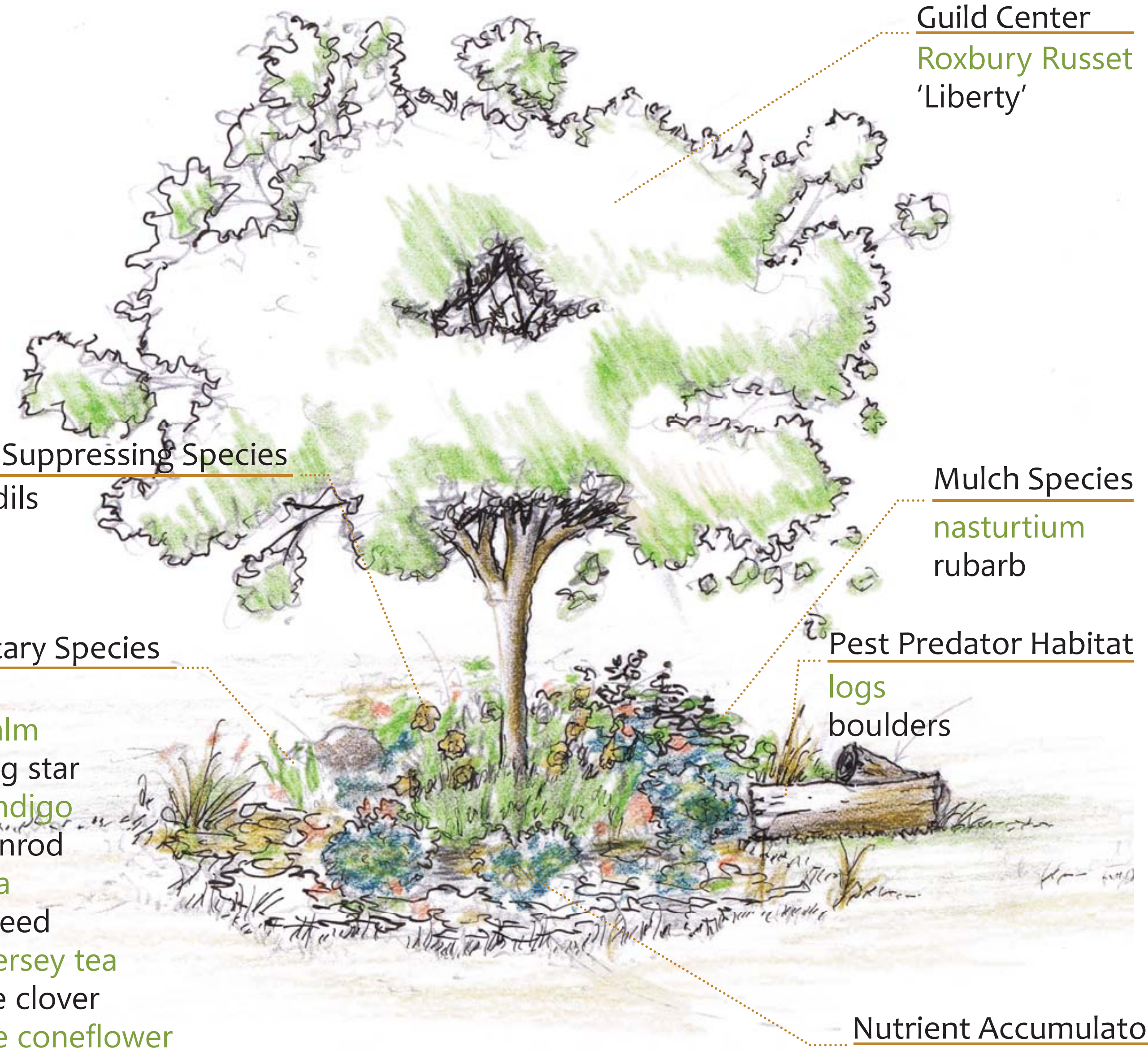


Figure 6.13 | Apple Guild Scheme
Plant Species are planted in beneficial relationships in order to achieve long-term productivity and regeneration (drawing by author).

The upper bed form responds to the curvature of the central learning space to the northwest and the enclosure of the resident halls: Moore and West (refer to Figure 6.2). An overhead shade structure, similar to structures at other major site entry points is located at the top of the upper bed off of the plaza between the residence halls. A three foot wall is proposed surrounding the majority of the upper bed to enhance entrance into the garden and provide the potential for regulating pedestrian traffic through the garden.

The upper bed, illustrated in Figure 6.11, contains rows of annual crops integrated with some nutrient accumulating perennials. The two planting areas on the east portion of the upper bed are designated for a naturalized pallet of insect attracting plants as discussed above. In addition, a few logs and boulders are proposed in this location to provide habitat for other predators that will prey on destructive insect pests (i.e. lizards and snakes). The upper production bed represents the most intensive planting scheme in the design. These areas of high intensity food production are accomplished by annual crops within each swath arranged based on companionship. A few perennial species such as false indigo, prairie turnip and sweet clover are integrated within the annual plant combinations to provide consistent nitrogen fixation. Several examples of companion planting and perennial integration include the "tomato-basil" combination, garlic, lettuce and carrot planted in neighboring rows and perennial false indigo and prairie turnip planted with broccoli and radishes. These combinations work

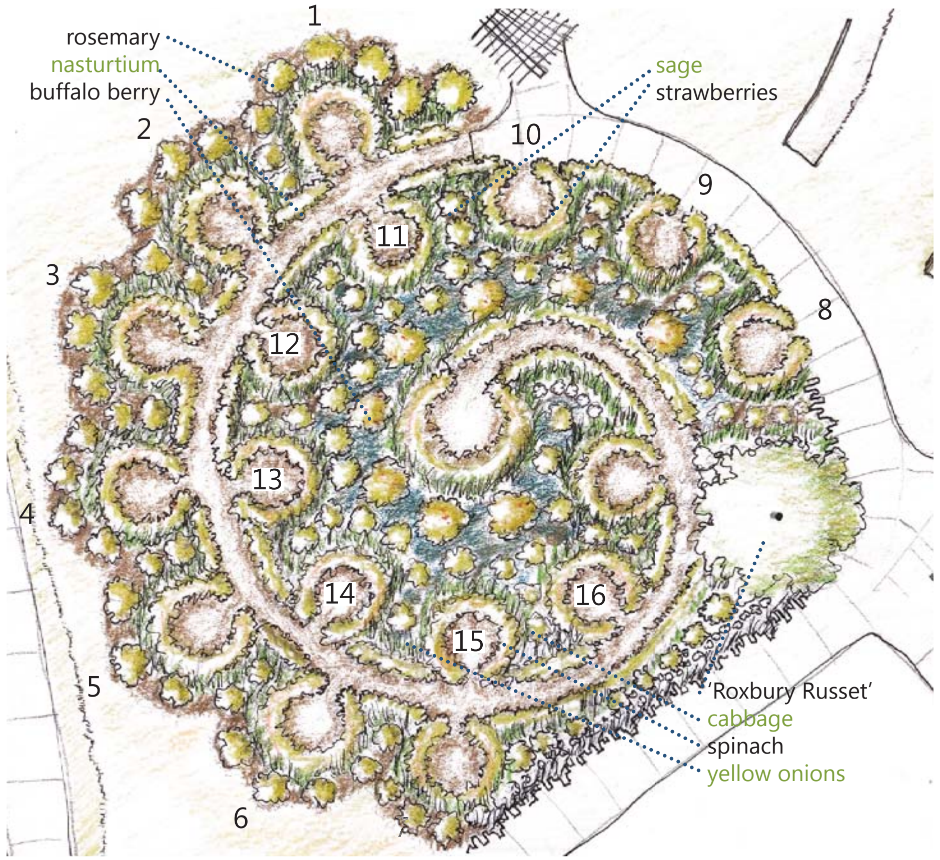


Figure 6.14 | Spiral Bed
The spiral bed offers natural form and increase of edge space, while providing numbered nodes for experimentation (drawing by author).

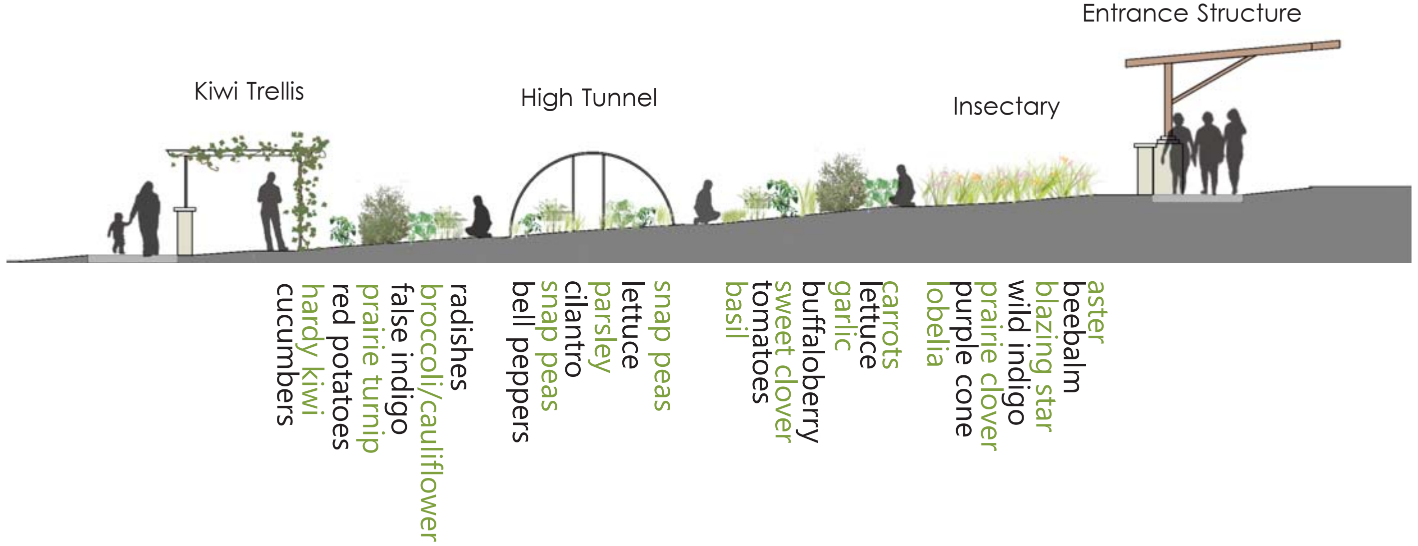


Figure 6.15 | Section A-A' - Upper Production Bed
Section A-A' shows the planting row scheme for the upper bed exhibiting a mixture of nutrient accumulators and annual vegetables (See section cut line in Figure 6.12).

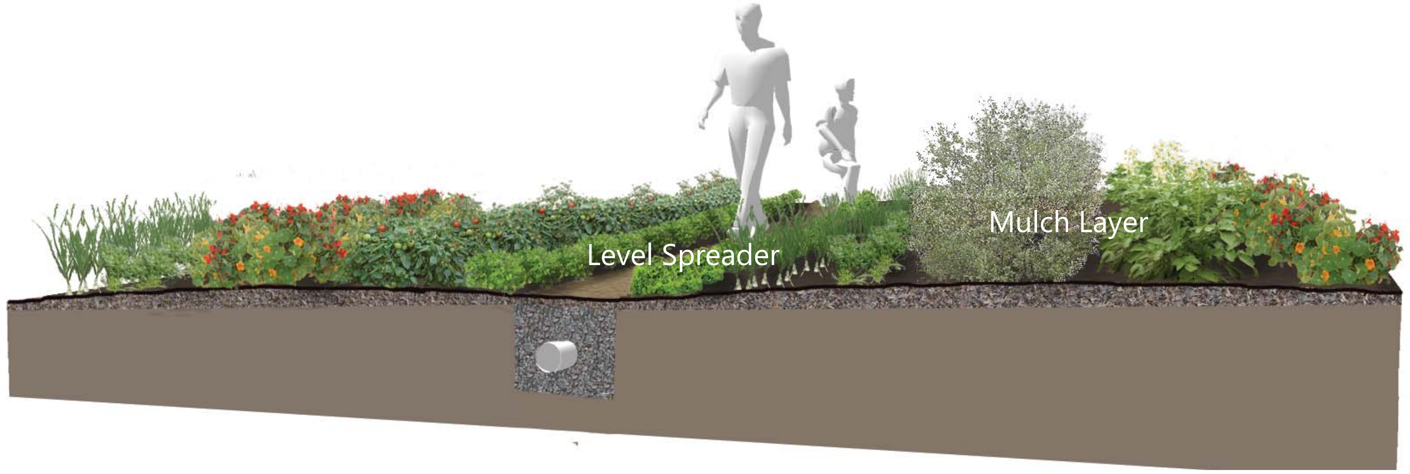


Figure 6.16 | Bed Row Detail Section Perspective
The upper bed rows are slightly mounded with mulch. Lateral drains are proposed under the paths to move water flowing down-slope laterally decreasing erosion and maximizing water harvesting and storage (image by author).

together due to complimentary root structure and nutrient requirements and accumulation (Hemenway 2000).

The rows are laid out with the contours to allow for the percolation of water at each mulch path between beds (See Figure 6.15). Water is diverted perpendicular to the slope to decrease erosion potential and to capture valuable water runoff. A perforated pipe is buried 12 inches below the path surface within a layer of gravel to allow free water movement and filtration as well as structural stability for the path.

The fruit tree guilds to the north and south of the central learning space are composed along water-capturing terraces (refer to Figure 6.2) Water runoff from the areas above these terraces is captured in close proximity to the guilds. Water is stored in a lens under the terrace from which the guild above can have continued access to water after a rain event. The northern guilds are specifically apple tree centered guilds, while the southern terraces exhibit both apple guilds and pear guilds. The planting scheme surrounding the central fruit trees are the same in the pear and apple guilds. As shown in Figure 6.12 and discussed in chapter 5, the guilds include plant species offering the following functions: nutrient accumulation, mulching, insect attraction, grass suppression, and fruit production.

Table 6.2 and 6.3 show the analysis of on-site food production potential in comparison with the menu requirements at Derby Dining Hall. The analysis compares the plant list quantities and productivity estimates (Table 6.2) with the food requirements of the Derby

Plant Name	Production Rate	Quantity Planted	Potential Yield
Apple, Liberty (each)	1296 apples/tree	7	2880
Apple, Roxbury Russet (each)	720 apples/tree	4	9072
Basil (lbs)	0.28 lbs/plant	140	39.2
Broccoli (lbs)	1.3 lbs/plant	66	85.8
Cabbage (lbs)	2.5 lbs/plant	33	82.5
Cantaloupe/Muskmelon (lbs)	.46 lbs/s.f.	312	143.52
Carrots (lbs)	1.125 lbs/s.f.	284	319.5
Coriander/Cilantro (lbs)	0.39 lbs/s.f.	132	51.48
Cucumbers (lbs)	8 lbs/plant	33	264
Garlic Cloves (lbs)	.125 lbs/bulb	152	19
Kale (lbs)	5 lbs/4 foot row	33	165
Kiwi, Hardy (lbs)	125 lbs/vine	44	5500
Lettuce (lbs)	.46 lbs/s.f.	312	143
Mint			-
Onions, Red/Yellow (lbs)	1.12 lbs/s.f.	888	994.56
Oregano (lbs)	.14 lbs/s.f.	132	18.48
Parsley (lbs)	.46 lbs/s.f.	132	60.72
Pears (lbs)	580	4	2320
Peppers, Bell (lbs)	2 lbs /plant	132	264
Potato, Red (each)	5 lbs/plant	108	540
Radishes (lbs)	10 lbs/30ft row	13.2	132
Rosemary			-
Sage			-
Snap Peas (lbs)	.23lbs/s. f.	132	30.36
Spinach (lbs)	6 lbs/6ft row	22	132
Squash (lbs)	.34 lbs/s.f.	132	44.88
Strawberries (pints)	4 pints/plant	320	1280
Tomatos (lbs)	20 lbs/plant	64	1280
Turnips (lbs)	.69lb/s. f.	168	115.92
Watermelon (lbs)	20 lbs/plant	9	180

Table 6.2 | Plant Production List

The table above shows the list of plants (chosen based on Derby's current produce requirements), their rate of production, the quantity of each type planted, and the potential yield (based on production averages). Table by author. See Appendix A.

Percent of Menu Needs (Annual Average)	Percent of Menu Needs (Monthly Average)	Number of Meals Provided of Menu Needs (Mon, Feb 25)	Number of Meals Provided of Menu Needs (Tues, Feb 26)
9%	103%	10.93	160.54
27%	325%	34.44	505.69
178%	2138%	NR	NR
1%	13%	5.38	42.06
5%	57%	15.00	NR
2%	18%	NR	NR
2%	28%	8.41	4.78
22%	259%	NR	93.60
3%	40%	66.00	24.47
1508%	18095%	28.79	59.38
725%	8696%	NR	NR
408%	4898%	NR	NR
5%	56%	0.41	2.42
-	-	NR	NR
7%	82%	15.30	214.81
391%	4688%	NR	NR
27%	328%	43.68	1518.00
81%	975%	NR	128.89
4%	42%	10.86	43.28
5%	57%	5.63	5.63
156%	1870%	NR	NR
-	-	NR	NR
-	-	NR	NR
7%	84%	NR	NR
35%	420%	57.39	264.00
1%	13%	1.30	44.88
56%	675%	98.16	162.64
10%	115%	27.71	64.22
422%	5058%	NR	NR
5%	58%	NR	NR

Table 6.3 | Derby Menu Requirement Comparison

This table shows the percentage of the Derby menu requirements that are met by the plant productivity potentials (table on previous page). Values are shown for annual and monthly needs as well as the menu requirements for two specific meals in February of 2013 (table by author).

Dining Hall menu in terms of annual, monthly and daily needs (Table 6.3). Percentages of these requirements are given for the annual and monthly menu needs. Two example evening dinner menu scenarios (February 25th & 26th Evening Meals) are given to show the number of these kind of meals for which the garden could provide. The productivity estimates for each plant type were derived from a variety of on-line sources including gardening forums and organic agriculture organizations. These estimates were based on average production per unit of space or the productivity of each plant per season. It was acknowledge that these estimates are subject to extreme variation regionally, seasonally, and in terms of specific variety or hybrid used.

Restorative Wetland

A wetland is proposed adjacent to Campus Creek, providing stability to the previously channelized stream, and provides residence time for the water to allow contaminants to be broken down (See Figure 6.19). The proposed wetland is made of up of two parts the wetland and the wet-meadow. The wetland is composed of species adapted to consistently wet conditions where areas are frequently flooded. Species included in the wetland are categorized as rushes, cat tails, sedges, and wetland grasses. The wet-meadow plant list includes species that are adapted to long periods of dry conditions in the categories of tall grasses and forbs. These species can handle wet conditions, but are resistant to drought (See Appendix B).

As mentioned in Chapter 4, two existing sewer line resides along the eastern bank of campus creek (See Figure 6.19). It was discovered that the larger of the two pipes is below the stream bed and thus poses no immediate obstacle for the proposed wetland expansion. However, the smaller sewer line is potential buried at a depth shallow enough to be exposed given the proposed excavation for the wetland. This sewer line would have to be relocated outside the proposed retaining wall to allow adiquate space for the proposed wetland (See Figures 6.17, 18).

True to the permaculture model of a whole systems approach to design, the wetland, though not directly part of site food production, plays an important role in the management of the site's natural resources. The wetland works as a component of the whole by providing a final catchment for site runoff, cleaning water coming onto the site from upstream, and using existing moisture to create habitat for beneficial insects as discussed above.

Summary

The results illustrate the integration of sustainable food production with landscape elements in a way that creates an influential experience. Site potential for water harvesting and management is projected with the discovery opportunities for roof water harvesting and restoration of Campus Creek. Food production potential is estimated based on the proposed garden layout and included plants. This production potential was analyzed in comparison with the menu requirements of Derby Dining Hall in exploring the potential viability of providing Derby with food items from the garden. Site preparation and maintenance structures were discussed as essential parts of the project's viability. The following chapter offers conclusions regarding the entire process of this project, including lessons learned and areas for further study.

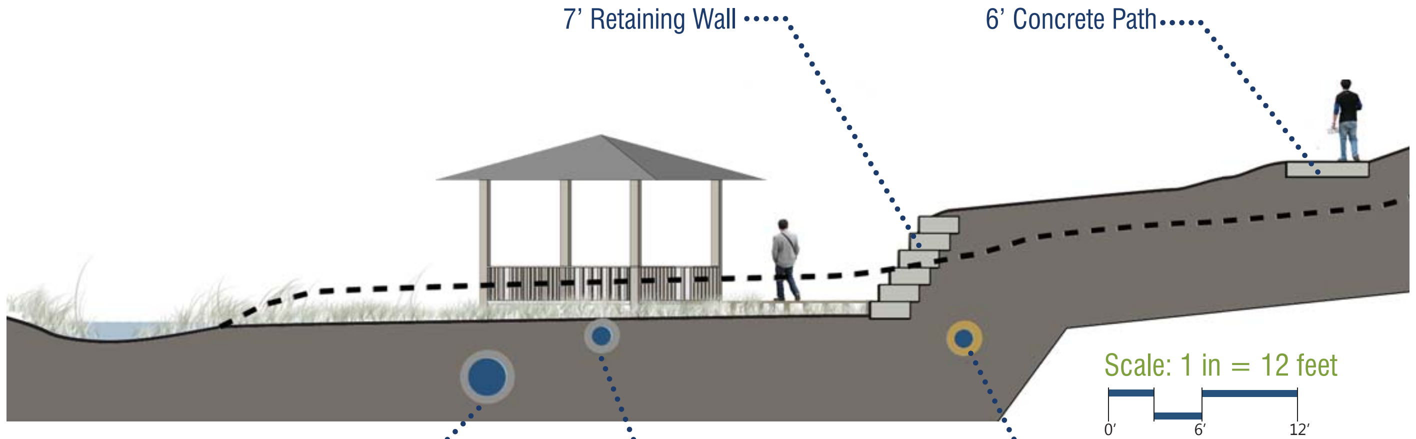


Figure 6.17 | Section B-B' Wetland & Sewer
8" Sanitary sewer line is moved east behind wetland retaining wall (image by author).

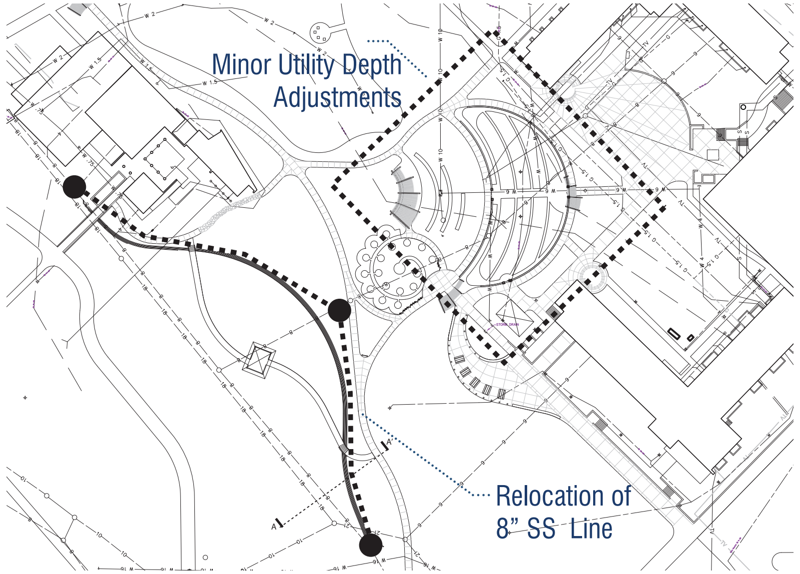


Figure 6.18 | Utility Relocations
Sewer line relocation and minor electric and water line adjustments are proposed on site (image by author).

Figure 6.19 | Campus Creek Existing Conditions (looking south).
Constructing the proposed wetland pushes the high left bank back to provide more area for the water with associated benefits (image by author).

Conclusions 7

After employing strategies found in the literature on permaculture and organic farming, and applying strategies that enhance the experience of movement and perception in the landscape, several conclusions were drawn (See Figure 7.1).

First, the final plan suggests that there is a potential for a positive didactic experience of sustainable food production through the artful synthesis of landscape form, particularly with regard to carefully arranged circulation patterns. These arrangements can aid in presenting sustainable food production to the observer through structuring views, creating entrances and approaches, and integrating spaces and circulation paths.

Second, there is an opportunity for water harvesting and management based on the current conditions of Campus Creek and the existing roof area atop Moore and West Hall with convenient proximity to the site.

Third, it was determined through the design of the sustainable food production scenario that the majority of fresh produce items served at Derby Dining Hall cannot be completely provided for by the proposed intensive produce garden. However, select non-bulk items (i.e. Parsley, Garlic, Basil, Kale, Radishes, Turnips, & Oregano) can be provided for or supplemented entirely, given the designed array of produce.

Finally, it would appear that incorporating permaculture and organic farming strategies into the campus fabric would facilitate K-State Housing and Dining's efforts to promote healthy food -- and sustainable thinking -- by increasing the variety, freshness and interest of its menu.

Landscape Influence

Concerning the influence of landscape on site in promoting sustainable food production, the primary strategies exhibited in the design focus on the visual and spatial relationships and experiences created. The design offers a resulting scenario of what it looks like to integrate sustainable food production on a university campus in a way that promotes the value of this approach to agriculture. This concept of immersion is one strategy that resulted from the design process of this project. In addition, vernacular materiality is mentioned as one of the ways in which the site design is made congruent with K-State's historically agricultural context. These strategies have the potential to capture people's attention and influence them toward a better understanding and appreciation for sustainable landscape functions.

This study is limited with regard to quantitative measurement of the success or failure of these design strategies. A survey was not conducted to illuminate how students currently using campus spaces are influenced by landscape form and space. This project would benefit from a better understanding of the psyche of university campus users in regard to landscape elements.

Site Water Management

The project also concluded that the site design illuminates ample opportunity

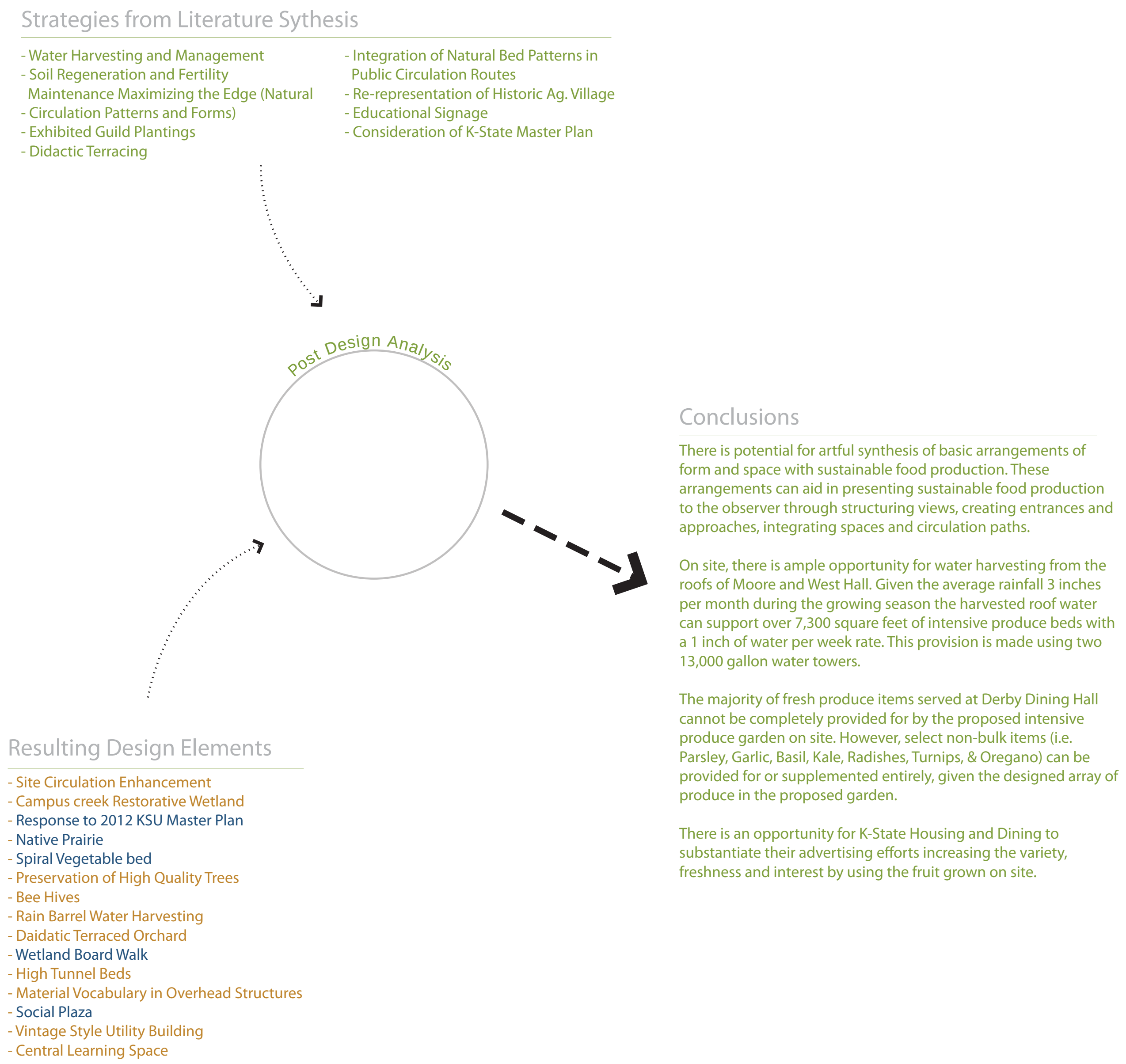


Figure 7.1 | Project Summary Diagram
The project conclusions are drawn from accessing the efficacy of strategies found in the literature of permaculture, organic farming and landscape design (diagram by author).

for water harvesting from the roofs of Moore and West Hall. Given the average rainfall of 3 inches per month during the growing season the harvested roof water can support over 7,300 square feet of intensive produce beds with a 1 inch of water per week rate. This provision is made using two 13,000 gallon water towers. An opportunity also exists given the height of the residence halls. From a design standpoint, it was appropriate for the water towers to be tall structures giving rise to the opportunity for gravity fed irrigation. The water in the towers is pressurized by gravity requiring no extra energy for pumping the water onto the gardens. This creates a cycle of resources where waste is minimized and available moisture is efficiently stored and used.

With regard to Campus Creek. it was discovered that the creek exhibits channelized and contaminated conditions. However, these can be mitigated by the proposed wetland. The wetland provides longer residence time and holding capacity for the stream water. This allows contaminants a place to breakdown over time. In addition, because of the extra storage capacity of the stream due to the wetland expansion, damaging peak flows downstream are decreased.

Food Production

The results from the productivity analysis of the proposed food garden, indicates several things about the garden design and about the potential for supplementation of the Derby Dining Hall Menu. Tables 6.2 and 6.3 Indicate that some proposed species planted have the potential to provide a lot more than what is required at Derby. Other items produce only a fraction of the menu need. Revisions to the planting plan could allow for the arrival of the garden at a more balanced and efficient planting scheme in terms of provision for Derby's menu. The results show clearly, however, that there are certain items that Derby does not buy and serve as much of as others. Solutions to this imbalance, therefore, could also include both revisions to the planting scheme and revisions to the Derby Menu. Although some items on the menu have few substitutes, others such as oranges and kiwis could be replaced with other similarly sized fruit containing a similar array of nutrients such as the Hardy Kiwi proposed in the upper production bed.

Further Study

Several areas of further study are triggered by this project. The first is a study on the actual psychological perception of sustainable food production and general ecological function in the landscape. How people view sustainable and productive landscapes in new and unfamiliar settings is a question that would benefit the design and planning of sustainable, food-producing landscapes particularly if done on the K-State Campus.

Another area of study is the atmosphere of agriculture that currently exists at K-State. A better understanding of the agriculture curriculum and goals of that College would illuminate opportunities for the blending of these types of campus food production projects with the current agricultural academic programs.

In terms of food production, further analysis of perennial crops versus annual crops and the integration of the two in the same area is an extension of the technologies explored in this study. The actual viability of perennial crops interplanted with annuals is debatable and the practice of it can be problematic. Perennial species offer nutritional and resource stability by the way that they draw out and fix beneficial nutrients in the soil and are able to tap into water resources with well developed root systems. However, they can become a source of tough competition for establishing annuals planted in the same bed.

Lastly, further study of the influences of artistic approaches to landscape design, beyond the realms of the visual and spatial, as emphasized in this project, would be helpful. The analysis and development of design elements that stimulate all five senses in creating powerful and moving experiences for the user would enrich the design proposals.

Summary

This project brings together the powerful influences of landscape form and space in an effort to promote a better model for agriculture on a major university campus. A regenerative system is proposed, in which resources are efficiently stored and cycled, waste is minimized, natural ecology is modeled, and long-term productivity is maintained. Through the design, the negative connotations of "messy ecosystems" are diminished by the artful integration of sustainable ecological functions within the campus landscape. This landscape connects people with the production of their food, providing multiple opportunities to understand and appreciate the land upon which they depend.

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Glossary

Permaculture:

"Consciously designed landscapes which mimic the patterns and relationships found in nature, while yielding an abundance of food, fibre and energy for provision of local needs (Mollison 1979)."

Landscape Influence:

The effectiveness of the outdoor spaces and forms in gaining the attention of an audience, communicated a message, or creating an experience.

Guild:

"A group of plants and animals harmoniously interwoven into a pattern of mutual support, often centered around one major species, that benefits humans while creating habitat (Hemenway 2000, 183)."

Insectary:

A planted zone in a landscape that incorporates plants that attract insects for their value in pollination, pest control, and the decomposition of organic material.

Wetland:

A low lying area along a stream corridor exhibiting riparian vegetation and frequent standing water.

Wet-Meadow:

A low gradual sloping grassy area that is frequently moist and exhibits vegetation that tolerate both extended wet and dry periods.

Sector Theory:

A strategy for site layout in which certain climatic factors such as wind, sun, and water are spatially identified informing the appropriate location for garden or homestead elements.

Zone Theory:

A strategies for site programming in which site elements involving more frequent maintenance and higher levels of activity are located closer to the designated center (i.e. a house or work building) and elements requiring less maintenance are placed farther away.

Sustainable Food Production:

A method of growing raising edible crops and livestock that utilizes strategies that efficiently manage and regenerate resources and recycle waste.

Nutrient Accumulators:

Certain plant species that draw specific nutrients from deep in the soil and concentrate them in their leaves. The fallen foliage of these plants builds the topsoil around them rich with the accumulated nutrients.

Master Plant List

Botanical Name	Common Name	Edible	Companion Plants/Guild Species	Harvest Total	Harvest rate	Qty	Harvest rate	Source
Nitrogen Fixers								
Trifolium spp.	Clover	no						*Gaia's Garden: A Guide to Home-Scale Permaculture,* Toby Hemenway, 2009.
Shepherdia argetnea	Buffaloberry	yes						
Amorpha fruticosa	False Indigo	no						
Psoralea esculenta	Prairie Turnip	yes						
Ceanothus spp.	Wild Lilac	no						
Produce Species								
Malus ' Roxbury Russet'	Apple, Roxbury Russet	yes	(Mulch: clover, rubarb, nasturtium, comfrey), (Bulbs: daffodils, camas, garlic chives), (Nutrient Accumulartors: yarrow, chicory, plantain), (Insectary: dill, fennel, beebalm).	2880	720	4	5 bushels (240 lbs)	http://www.grit.com/fruit/heirloom-apple-varieties-you-can-grow.aspx?page=2 https://www.digthedirt.com/plants/15344-apples-malus-pumila-roxbury-russet
Malus ' Liberty'	Apple, Liberty	yes	See Above	9072	1296	7	6-9 bushels (288-432 lbs)	http://www.gurneys.com/product.asp?pn=12958
Lycopersicon esculentum	Tomatos	yes	Asparagus, Basil, Beans, Borage, Carrots, Celery, Dill, Lettuce, Melons, Onions, Parsley, Peppers, Radishes, Spinach, Thyme.	1280	20	64	10-20 lbs/plant	http://www.almanac.com/content/plant-companions-list-ten-common-vegetables; http://www.hightunnels.org/ForEducators/TomatoProduction/Versus.htm
Ocimum	Basil	yes		39.2	0.28	140	.28 lbs/s.f. (fresh weight) 1 plant/s.f.	http://www.ces.ncsu.edu/hil/hil-125.html
Solanum tuberosum'Viking'	Potato, Red	yes		540	5	108	3-5 lbs/plant	http://www.almanac.com/plant/potatoes; http://homeguides.sfgate.com/average-potato-yield-per-plant-48132.html
Brassica oleracea	Broccoli	yes		85.8	1.3	66	.4-1.3 lbs/plant	
Daucus carota	Carrots	yes	Beans, Lettuce, Onions, Peas, Radishes, Rosemary, Sage, Tomatoes.	319.5	1.125	284	1.125 lbs/s.f.	http://www.almanac.com/content/plant-companions-list-ten-common-vegetables; http://www.countryfarm-lifestyles.com/growing-carrots.html
Coriandrum sativum	Coriander/Cilantro	yes		51.48	0.39	132	.39 lbs/s.f.	http://anrcatalog.ucdavis.edu/pdf/7236.pdf

Botanical Name	Common Name	Edible	Companion Plants/Guild Species	Harvest Total	Harvest rate	Qty	Harvest rate	Source
Produce Species								
Cucumis Sativus	Cucumbers	yes	Beans, Cabbage, Cauliflower, Corn, Lettuce, Peas, Radishes, Sunflowers.	264	8	33	8 lbs/plant	http://www.almanac.com/content/plant-companions-list-ten-common-vegetables; http://www.sparkpeople.com/resource/nutrition_articles.asp?id=1311
Allium sativum	Garlic	yes		19	0.125	152	.125 lbs/bulb	http://www.filareefarm.com/growing.html
Actinidia aruguta	Hardy Kiwi	yes		5500	125	44	75-125 lbs/vine	http://www.fruit.cornell.edu/mfruit/kiwifruit.html; http://www.luvnpeas.org/edibility/edible7.html
Brassica oleracea acephala	Kale	yes		165	5	33	5 lbs/4 foot row	http://www.sparkpeople.com/resource/nutrition_articles.asp?id=1314
Lactuca sativa	Lettuce	yes	Asparagus, Beets, Brussels sprouts, Cabbage, Carrots, Corn, Cucumbers, Eggplant, Onions, Peas, Potatoes, Radishes, Spinach, Strawberries, Sunflowers, Tomatoes.	143.52	0.46	312	.46 lbs/s.f.	http://www.almanac.com/content/plant-companions-list-ten-common-vegetables; http://www.ipmcenters.org/cropprofiles/docs/Walettuce.html
Cucumis melo	Cantaloupe/Muskmelon	yes		143.52	0.46	312	.46lbs/s.f.	
Citrullus lanatus	Watermelon	yes		180	20	9	20 lbs/plant	
Allium cepa	Onions, Yellow	yes	Beets, Broccoli, Cabbage, Carrots, Lettuce, Peppers, Potatoes, Spinach, Tomatoes.	994.56	1.12	888	489 cwt/acre	http://www.almanac.com/content/plant-companions-list-ten-common-vegetables
Origanum	Oregano	yes		18.48	0.14	132	.14 lbs/s.f.	http://www.leopold.iastate.edu/sites/default/files/pubs-and-papers/2009-01-high-tunnel-greek-oregano-production-2008.pdf
Petroselinum crispum	Parsley	yes		60.72	0.46	132	.46 lbs/s.f.	http://www.extension.purdue.edu/extmedia/HO/HO-202.html
Pyrus 'Anjou'	Pears	yes		2320	580	4	580 lbs/tree	http://www.extension.umn.edu/distribution/horticulture/M1157.html
Capsicum annuum	Bell Peppers	yes	Basil, Coriander, Onions, Spinach, Tomatoes.	264	2	132	2 lbs /plant	http://www.almanac.com/content/plant-companions-list-ten-common-vegetables; http://www.sparkpeople.com/resource/nutrition_articles.asp?id=1318

Botanical Name	Common Name	Edible	Companion Plants/Guild Species	Harvest Total	Harvest rate	Qty	Harvest rate	Source
Raphanus sativus	Radishes	yes	Basil, Coriander, Onions, Spinach, Tomatoes.	132	10	13	10 lbs/30ft row	http://www.almanac.com/content/plant-companions-list-ten-common-vegetables; http://www.ces.ncsu.edu/hil/hil-25.html
Rosmarinus officinalis	Rosemary	yes		0				
Salvia officinalis	Sage	yes		0				
Spinacia oleracea	Spinach	yes		132	6	22	5-6 lbs/6ft row	http://www.sparkpeople.com/resource/nutrition_articles.asp?id=1320
Cucurbita	Squash	yes		44.88	0.34	132	.34 lbs/s.f.	http://bioengr.ag.utk.edu/ExtProg/Vegetable/year/VegInitReport07/Squash/Performance%20of%20Butternut%20Squash%20Cultivars.pdf
Fragaria	Strawberries	yes		1280	4	320	2-4 pints/plant	http://www.sparkpeople.com/resource/nutrition_articles.asp?id=1322
Brassica rapa Rapifera Group	Prairie Turnips	yes		115.92	0.69	168	.69lb/s. f.	http://www.ces.ncsu.edu/hil/hil-26.html
Pisum macrocarpon	Snap Peas	yes		30.36	0.23	132	.14-.23lbs/s. f.	http://nwrec.hort.oregonstate.edu/snowpea.html
Brassica oleracea var. capitata	Cabbage	yes	Beans, Celery, Cucumbers, Dill, Kale, Lettuce, Onions, Potatoes, Sage, Spinach, Thyme.	82.5	2.5	33	2.5 lbs/plant	http://www.almanac.com/content/plant-companions-list-ten-common-vegetables; http://www.ces.ncsu.edu/hil/hil-7.html
Mentha	Mint	yes	Tomatoes, Cabbage					http://www.almanac.com/plant/mint; http://www.almanac.com/content/plant-companions-list-ten-common-vegetables
Pest Repellents								
Tropaeolum majus	Nasturtium	no						*Gaia's Garden*
Fagopyrum esculentum	Buckwheat	no						
Melissa officinalis	Lemon Balm	no						
Allium sativum	Garlic	no						
Baptisia australis	False Indigo	no						
Pollinators								
Aster	Aster	no						www.xerces.org
Monarda	Beebalm	no						
Liatris	Blazing star	no						
Baptisia	Wild indigo	no						
Lobelia	Lobelia	no						
Ascelpias	Milkweed	no						
Dalea	Prairie clover	no						
Echinacea	Purple coneflower	no						

Botanical Name	Common Name	Edible	Companion Plants/Guild Species	Harvest Total	Harvest rate	Qty	Harvest rate	Source
Wetland Species								
Asclepias incarnata	Swamp Milkweed							
Asclepias tuberosa	Butterfly Milkweed							http://www.missouribotanicalgarden.org/garden
Aster novae-angliae	New England Aster							s-gardening/your-garden/plant-finder.aspx;
Eupatorium perfoliatum	Common Boneset							
Glandularia canadensis	Rose Verbena/Vervain							
Lobelia cardinalis	Cardinal Flower							
Lobelia siphilitica	Great Blue Lobelia							
Carex vulpinoidea	Fox Sedge							
Carex lupulina	Hop Sedge							
Rudbeckia hirta	Black-eyed Susan							
Solidago rigida	Stiff Goldenrod							
Zizia aurea	Golden Alexanders/Zizia							
Typha latifolia	Cattail							
Carex muskingumensis	Muskingum Sedge							
Carex stricta	Tussock Sedge							
Carex stipata	Awl-Fruited Sedge							
Wet-Prairie Species								
Sporobolus heterolopsis	Prairie Dropseed							
Schizachyrium scoparium	Little Bluestem							http://www.missouribotanicalgarden.org/garden
Sorghastrum nutans	Indian Grass							s-gardening/your-garden/plant-finder.aspx;
Elymus canadensis	Canada Wild Rye							
Elymus virginicus	Virginia Wild Rye							
Panicum virgatum	Switchgrass							
Andropogon gerardii	Big Bluestem							
Liatris spicata	Gayfeather							
Carex hystericina	Bottle Brush Sedge							
Juncus effusus	Soft Rush							
Salvia azurea	Pitcher Sage							
Liatris pycnostachya	Prairie Blazing Star							
Liatris spicata	Blazing Star							
Ratibida columnifera	Prairie Coneflower							
Baptisia australis	Blue Wild Indigo							
Baptisia bracteata	Plains Wild Indigo							
Dalea candida	White Prairie Clover							

Human Subjects Waiver Form

By participating in this interview, the informant is contributing to the research effort of this Master's Project and Report. This project is intended to propose a design for a food garden that uses permaculture strategies and techniques, located near the Derby Dining Hall on the KSU Campus. There are two main goals for the project. The first is to forecast the productivity of the designed garden in order to discern the extent to which it would be able to provide for the Dining Hall's food needs. The other goal is to create a garden using the sustainable and regenerative practices of permaculture in a way that fits within the existing aesthetics and future vision of the K-State Campus.

The method of interviewing is the only research method utilized in this project that will involve human subjects. The project proposes 5-7 semi-qualitative interviews. 5-7 informants will been chosen for their expertise under the following headings: Permaculture, K-State Campus Landscape Evolution and Current Function, K-State Campus Master Plan Update Task Force, and Derby Food Center Operations. Each interview will be conducted either face to face or over the phone. A list of questions (attached) tailored to each interviewee's expertise and experience will be provided in advance of the interview and the consent of the interviewee. The questions will provide the basic structure of the interview. However, follow-up questions are expected during each interview to pursue elaboration on the basic questions and topics covered in the interview outline. Each interview will be a maximum of 45 minutes. Each interview will be subject to audio recording with consent of the interviewee. All the information gathered during the interviews will be used to inform the design phase of this project. With the information gained from the experts in permaculture, interviewees with experience concerning the landscape of the Kansas State Campus, a landscape design professional and an informant representing the Derby Dining Hall, design decisions in the actual programming and conceptualization of the permaculture garden. Information concerning the interviewees name, job title, and job description, will be used in identifying them in the resulting report with their formal consent.

The interview will invovle questions pertaining to the informant's occupation. The informant reserves the right to withhold any information that would put him/her at risk in regard to his/her occupation. No information regarding the occupation of the informant will be used to put the informant at risk in regard to their occupation, but only to inform and substanciate the design of the proposed campus garden.

All interviews will be audio recorded only with the particpants knowledge and consent. Participants will be assured that their responses will be accurately used and that due credit will be given in the final research report.

In the case of questions regarding the research, the right's of the research participants, or to report a research related injury contact the following people emediately:

Laurence Clement (Principal Investigator)

- Phone: 785.532.5961
- Email: lacjr@k-state.edu

William Mann (Student Research Colaborator)

- Phone 913.526.5313
- Email: mann14@ksu.edu

In the case of segnificant new findings during the interview process, the participant may be asked to participate in a followup interview and/or further collaboration to investigate those new findings.

Participation is voluntary, refusal to participate will involve no penalty or loss of benefits to which the subject is otherwise entitled, and the subject may discontinue participation at any time without penalty or loss of benefits, to which the subject is otherwise entitled.

Signature of Participant: ________________________________ Date: ___________

Interview Material

Semi-Qualitative Interviews

Informants For: *K-State Campus Permaculture: Master's Project and Report*

Preliminary Fact Sheet:

Name:

Education:

Current Occupation

Employer:

Job Title:

Summary of Job Description:

Orientation for Interviewee:

1. Definition of Project
    a. Urban/Organic (Sustainable Agriculture) Food Garden on the K-State Campus
    b. Location: K-State University Campus – Derby Dining Hall
    c. Goals:
        i. Estimate the potential to provide food for Derby
        ii. Contribute to the campus function and aesthetic
2. Interviewees
    a. Hilary Noonan and Steve Moring: Permaculture Specialists
    b. Joseph Meyer: KSU Landscape Installation and Maintenance Manager
    c. K-State Master Plan Update Task Force Member
    d. Dining Hall Representative
3. How I want to use the information and how I will protect it?
    a. Informants will be quoted to substantiate and inform the Master's Project and Report
    b. Informing the structure and methods of my project
    c. Informing the continuing formulation for questions and search for literature
    d. All responses will be audio recorded with formal consent of interviewee
    e. All information will be used accurately with due credit given to the informants

Interview Material

For the Permaculture Expert: Hilary Noonan

Introduction Questions:

1. How did you get involved in Permaculture?
    a. Why are you interested in permaculture?
    b. How did you find out about it?
    c. Where did you receive your training?
    d. How long have you been involved in permaculture?

Current practice Questions:

2. How are you involved in permaculture now?
    a. What projects have you or are you currently working on?
    b. What is one principle or strategy of permaculture that has impacted you and your work the most?
    c. How does permaculture fit into the realm of landscape architecture and vice versa?
    d. (Steve Moring) What are some of the key teaching points on permaculture that you specifically emphasize to your students?
    e. In your opinion, what are the essential programmatic elements in a permaculture design (i.e. swales, paths, staging areas, animals, species combinations, etc?

Project Specific Questions:

3. What are your recommendations for me as I endeavor to begin a design of a permaculture garden on campus?
    a. What might be the productivity potential of a 3.5 acre site?
        i. Sources or Precedents?
    b. What should be the first steps?
    c. What social issues/opportunities are present with a project on campus like this?
    d. What are your recommendations for forecasting the productivity of this site?
    e. Have you worked on projects of similar size and context?

Anecdotal Questions:

1. Tell me about your favorite permaculture project you've worked on and why it was your favorite?
2. What were the positive/negative real life outcomes of the project ecologically, socially, and/or economically?
3. Does a permaculture garden have a place on the campus at Kansas State University?

Interview Material

K-State Campus Master Plan Update Task Force Representative: Mark Taussig

1. What has been your role in the Kansas State Campus Master Plan Update Task Force?
2. Could you give a summary of the current master plan?
    a. What are the aesthetic goals (is there a common vocabulary of form, materiality, or layout)?
    b. What are the functional goals (i.e. circulation, outdoor spatial usage, access roads, etc.)?
    c. What are some dilemmas that you are seeking to solve with the updated master plan?
3. What are some current landscape projects (specific renovations or expansions of certain campus spaces) that are in the design phase or that are already under construction?
4. What have been specifically *sustainable* landscape projects on campus that have occurred during your time here? Explain the degrees of successful or failure each one exhibited.
5. Does the proposal of a permaculture garden fit within the k-state master plan? What are some opportunities/challenges?
6. What are some opportunities and constraints specific to the project site?
    a. Physical barriers
    b. Administrative obstacles
    c. Conflict in visions for that space: Does this idea conflict with the updated Master Plan?

Anecdotal Questions:

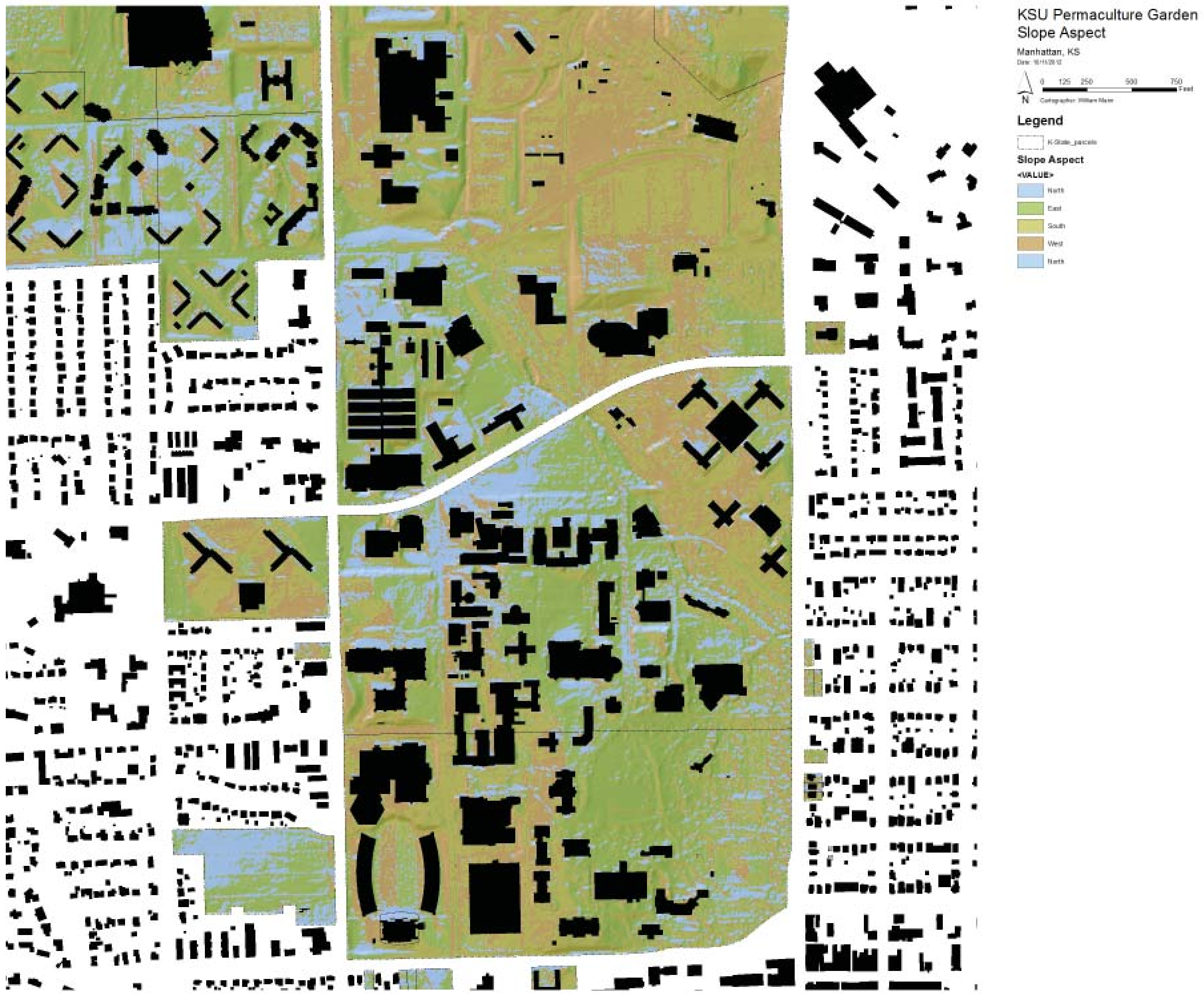
1. What has been your personal vision for the K-State campus since you started work as the campus Landscape Architect?
2. What are some of your hopes for the K-State campus 10 years from now in terms of the evolution of the landscape?
3. Would you consider the K-State campus as a leader in landscape sustainability? If not, what has impeded K-State's progress in becoming a front runner of campus sustainability?
4. Does a permaculture garden have a place on the campus at Kansas State University?

Interview Material

For the Derby Dining Hall Representative: Mark Edwards

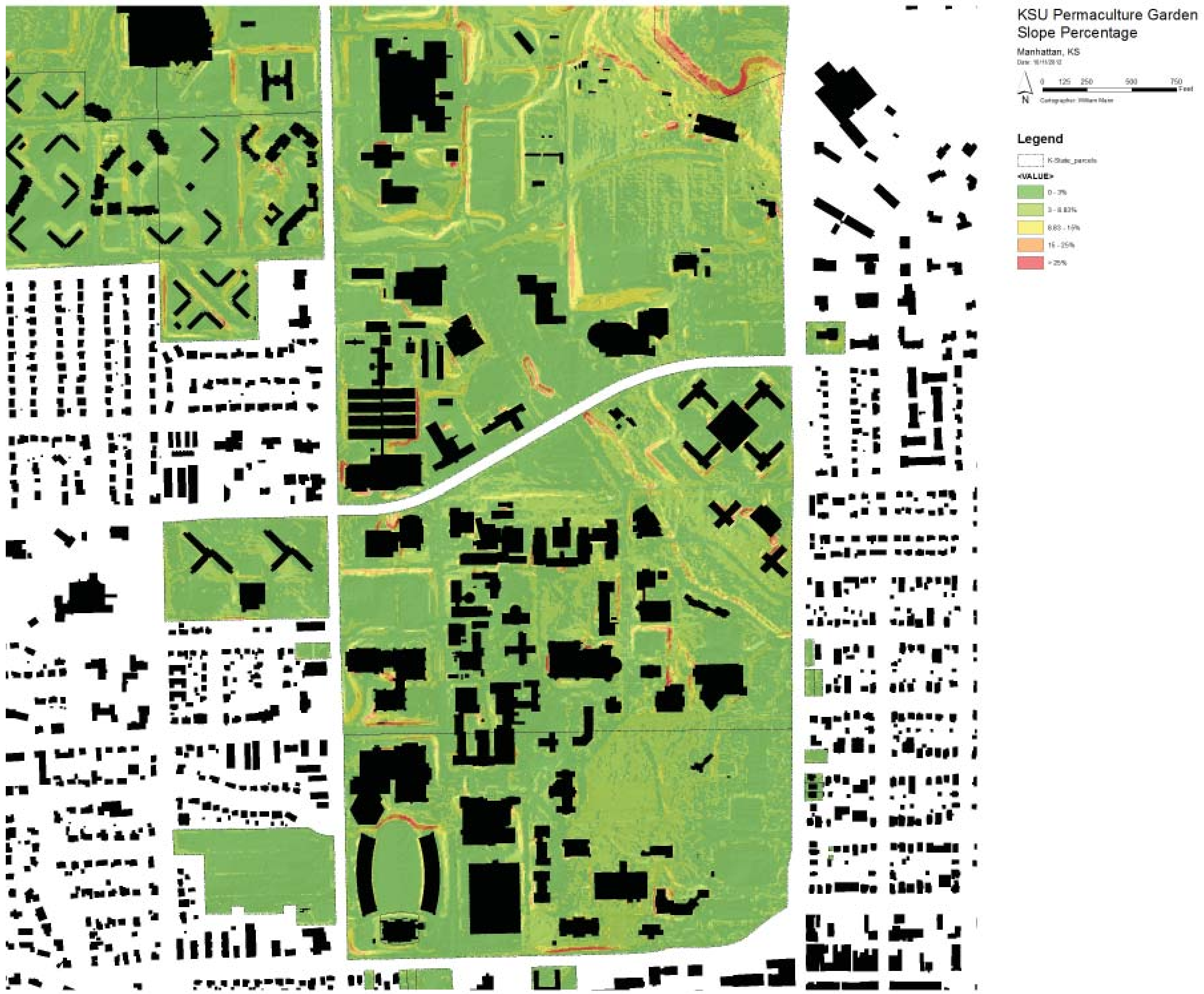
1. What sustainable initiatives are going on right now with K-State Housing and Dining?
    a. Composting
    b. Green Roofs
    c. Recycling
2. What are Derby Dining Halls needs
    a. Food Inventory
        i. Food groups commonly ordered
        ii. What are your most expensive food items that are bought on a regular basis?
        iii. Is there a nutritional agenda, if so what does it consist of?
3. Consumption and Production?
    a. How much food do you go through?
        i. Grains and Nuts
        ii. Fruits and Vegetables
        iii. Meat
        iv. Dairy and Eggs?
    b. Where do you get your food?
    c. How much compost do you produce?
    d. Do you any food in your inventory from local vendors currently?
4. Does a permaculture garden have a place on the Campus at Kansas State University?
    a. How do you think Derby could benefit from a food garden on campus?
    b. What are the opportunities?
    c. What would be the challenges?
5. Would using locally grown food in this way require major changes in the operations at Derby? If so, what might the changes be?

Suitability Analysis



Slope Aspect

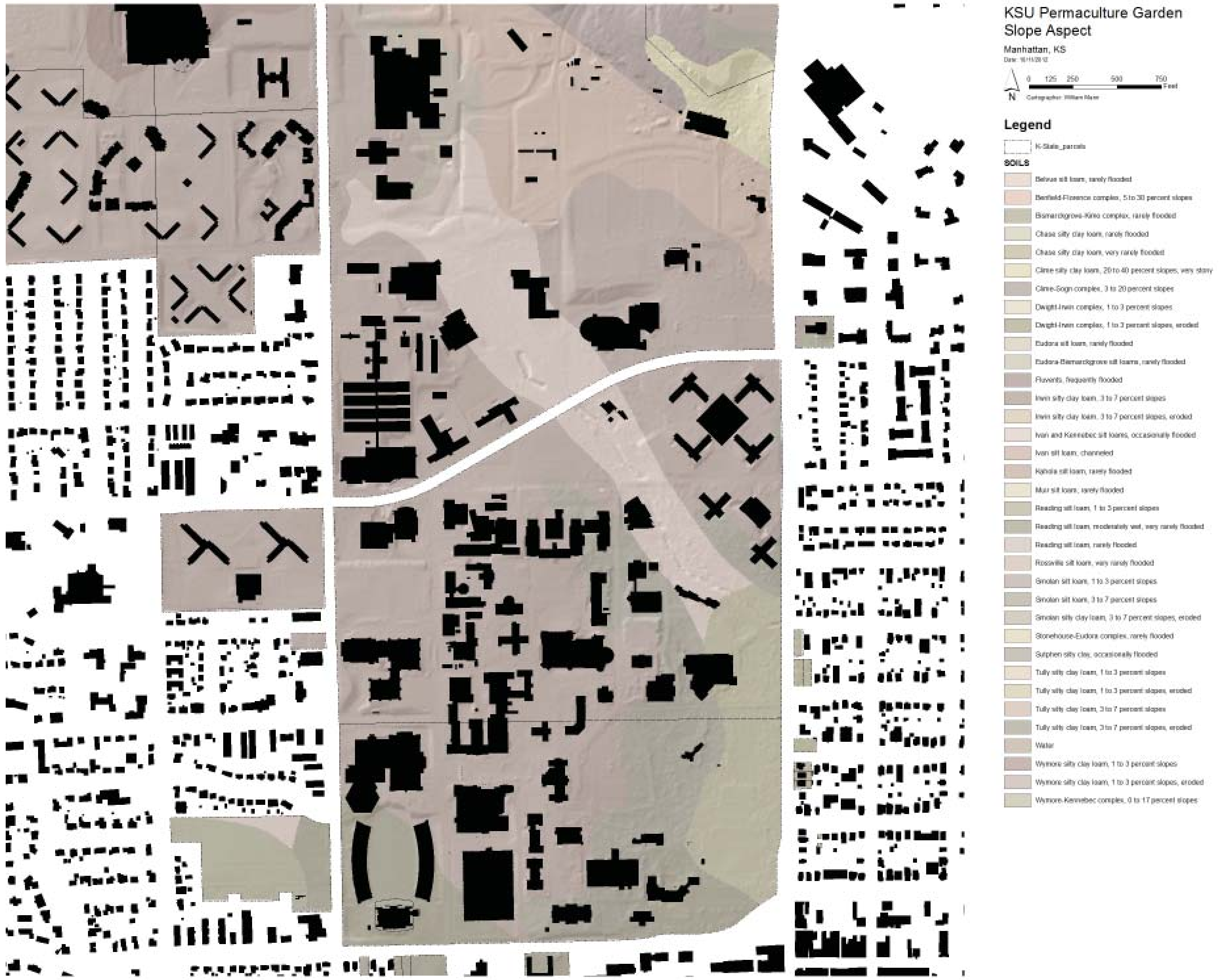
To increase solar access for maximum plant production, slopes facing south are optimal for a permaculture garden.



Slope Percentage

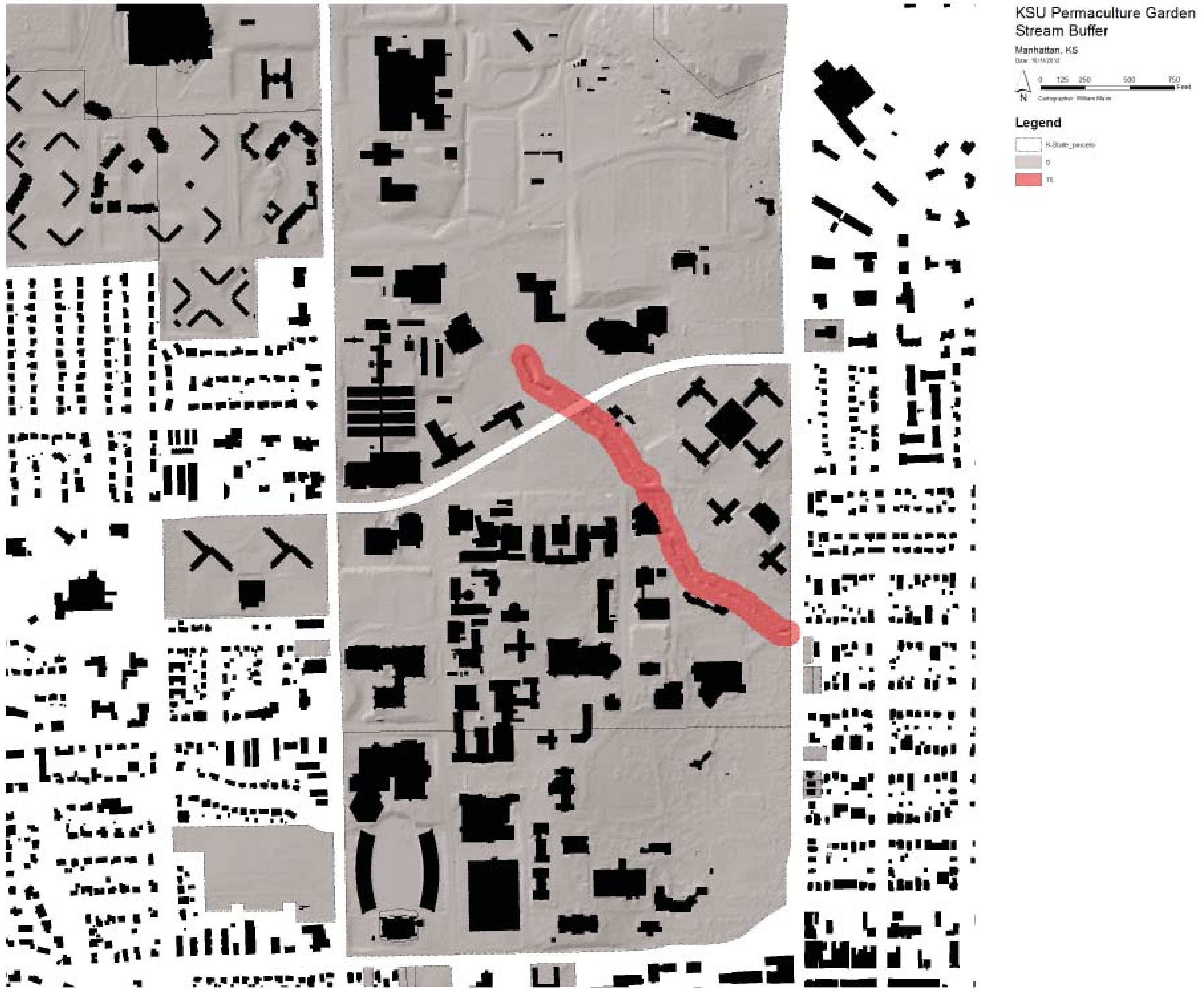
Water harvesting and management is key for a permaculture site. Sites with a gently sloping grade are optimal for water harvesting in a permaculture garden.

Suitability Analysis (cont.)



Site Soils

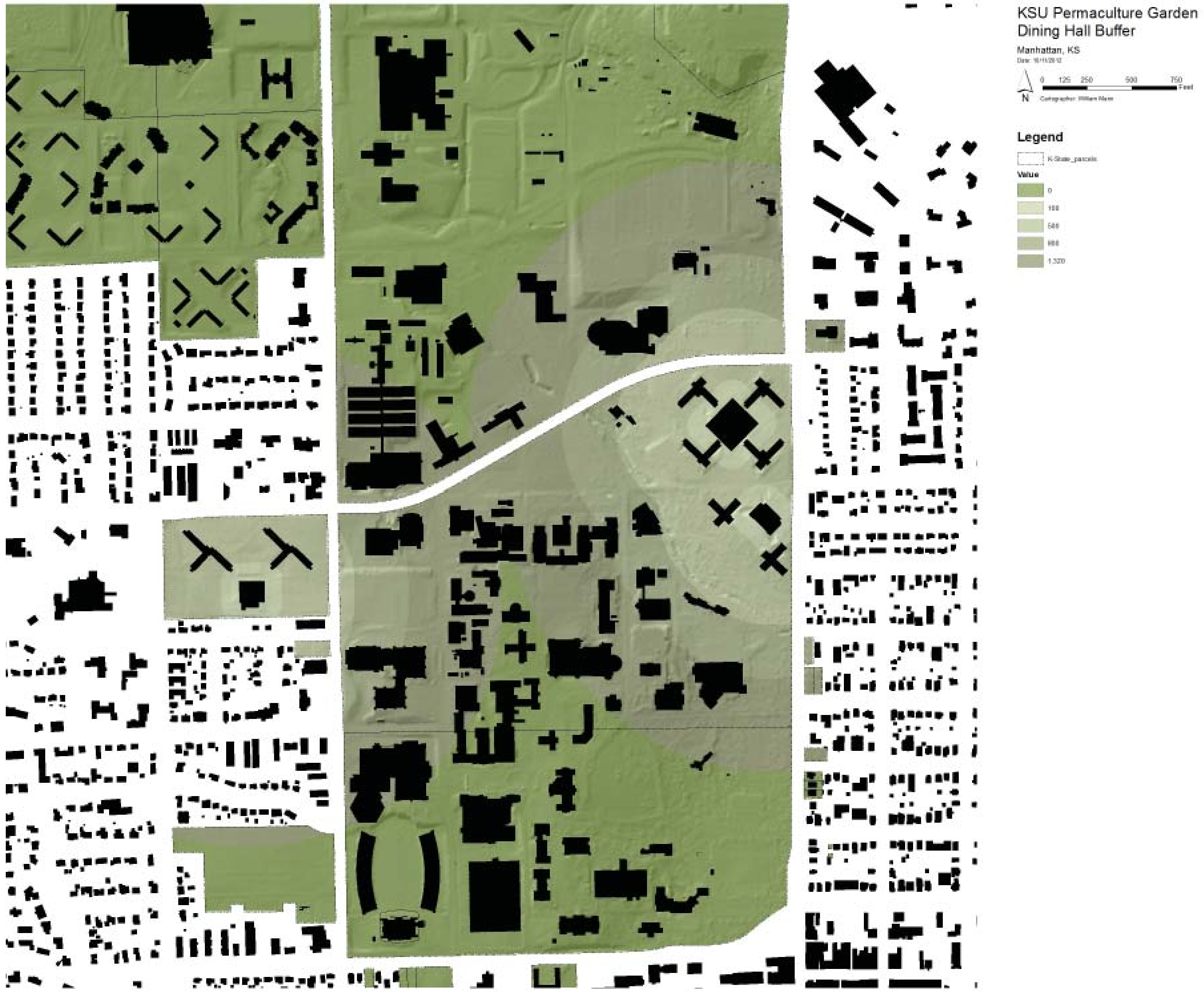
Soils with higher organic material compositions were chosen as most appropriate for food production.



Stream Buffer Zone

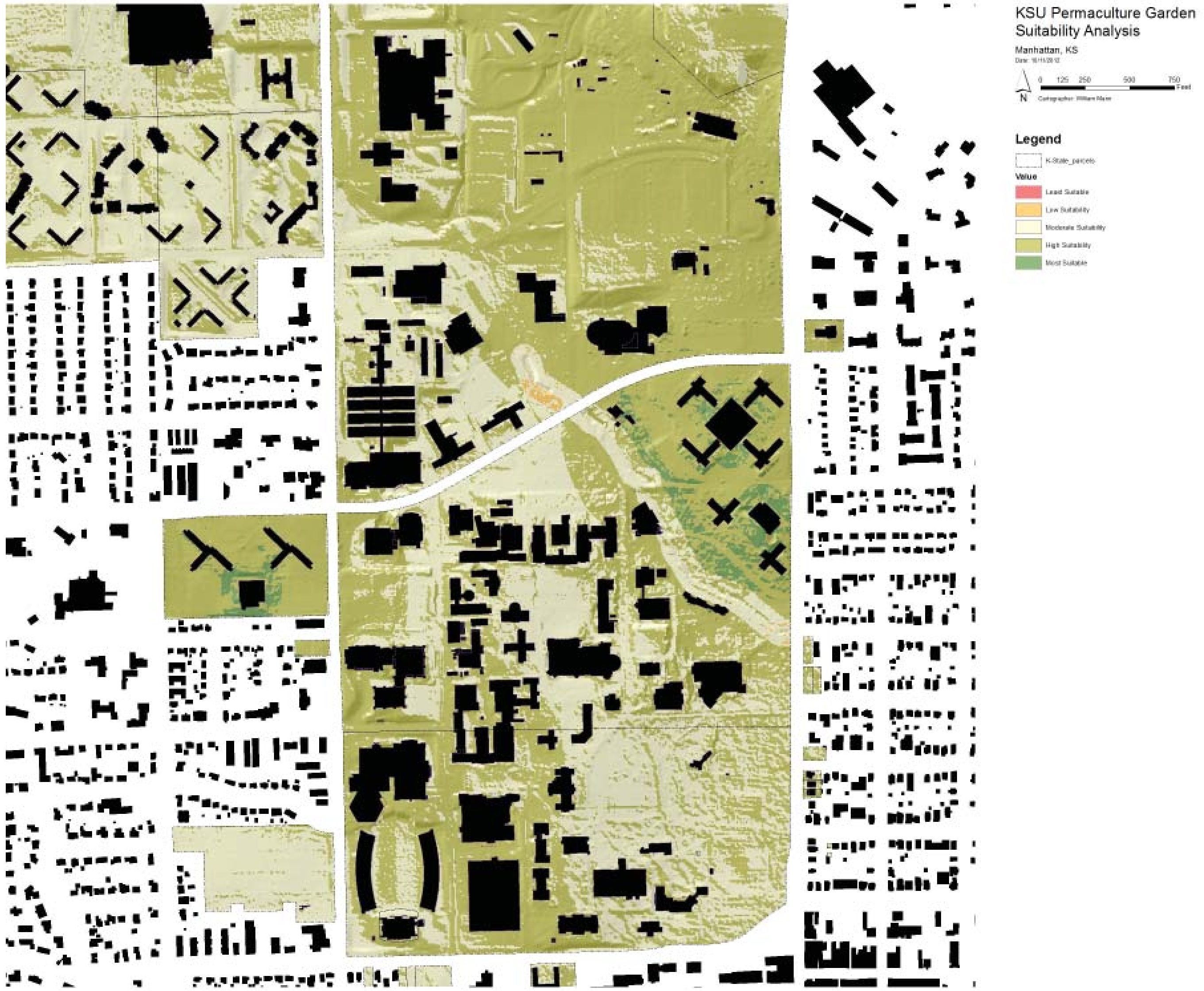
A 75 foot stream buffer area was zoned along Campus Creek to protect delicate riparian habitat and to avoid the ingestion of contaminants by the food garden species from the creek.

Suitability Analysis (cont.)



Dining Hall Proximity

Areas closest to the dining halls are most suitable for permaculture according to the Zone/Sector Theory. The place with the most activity or the origin of maintenance and garden care should be at the center of the design.



Final Suitability Analysis Map

Shows areas were a permaculture garden would be most suitable on the K-State Campus.