Regenerative Design Theory and Practice:

Demonstration of the Integrated Framework in a Resort Development at Mountain Lake, VA

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Abstract
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The purpose of this thesis is to investigate the theory and practice of regenerative design and how the concepts apply to scales of design. Ultimately, it examines the applicability and limitations of these principles in a non-traditional resort development. The theories of John Lyle, Robert Thayer, and William McDonough are examined to assist in the establishment of a new framework for regenerative design which is can be used in the design process or evaluation. Case studies of the Center for Regenerative Studies, the Ford Rouge Plant and the Loreto Bay Resort were under taken to evaluate the success of current built works utilizing the new framework. Finally, the development of a regenerative resort community at Mountain Lake, in Giles County, Virginia, is undertaken as a vehicle to demonstrate the process of development and evaluation under the integrated regenerative framework.

Regenerative design is a form of sustainable design which incorporates the interlocking of communities with the natural ecological cycles, the larger society and environmental costs. The overall goals for regenerative developments are to design communities which exist within natural limits and are interconnected to the regional society for needs outside the given site. Regenerative design incorporates diverse ecological, cultural, social and economical systems while maintaining their integrity within a dynamic whole. The integrated framework is an effort to direct site specific design through a flexible and extensive structure. There are two parts to this regenerative design framework. The first is a conceptual model for regenerative design, utilizing the existing idea of regenerative design rooted in sustainability, and overlays it with design driven elements of culture, experience, and education. The second element of the framework defines a set of strategies for the design process and a means of evaluating a design.

Mountain Lake is located in Giles County, Virginia. Currently the property is operated as a conservatory and seasonal Inn in the Appalachian Mountains. The Spa resort location is 2 miles down the mountain from the lake, yet remains nearly adjacent to the conservatory property. The objectives of the community are to develop eight cabins, spa and community center under the concept of a regenerative community. The development will employ renewable energy sources; recycle reuse and reduce wastes; supply, conserve, and clean water on site; promote education through experience; and select appropriate technologies to obtain these objectives. The resort facilities will embody a contemporary spa resort, situated in the Southern Appalachian region.

Dedication

Psalm 46:1-5

God is our refuge and strength,
an ever-present help in trouble.
Therefore we will not fear, though the earth give way
and the mountains fall into the heart of the sea,
though its waters roar and foam
and the mountains quake with their surging.
There is a river whose streams make glad the city of God,
the holy place where the Most High dwells.
God is within her, she will not fall;
God will help her at break of day.

To my beloved grandmother
Nancy Akers Wallace
who always encouraged and inspired
creativity, passion, and a love
for the great outdoors

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of your energy spreedsheets

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Introduction

"It would be worth while to ask ourselves weekly. Is our life innocent enough? Do we live inhumanly toward man or nature, in thought or act? To be serene and successful we must be one with the universe."

-Henry David Thoreau, 1854

This thesis investigates contemporary theories and practices of regenerative design and their application to various scales of environmental design. As an area of scholarly inquiry regenerative design strives to realize land development projects, communities and regions that are constructed, and maintained within the limits of the corresponding ecological framework. A truly regenerative built environment would thrive on an entirely sustainable supply of renewable energy and materials. *See Diagram I.1.* Implicit in this understanding is the observation that theories of regenerative design must be responsive to a comprehensive range of environmental design issues and applicable from the local to the global scale. While several significant theoretical perspectives on regenerative design exist in print, I contend that these individual theories address themselves to limited portions of this spectrum of scales and concerns.

My thesis attempts to integrate three of the more significant theories of regenerative design into a comprehensive framework. The framework serves as a guide to regenerative design process, but also as a robust mechanism for evaluating alternative planning and design proposals. The study is comprised of three parts: an investigation of regenerative design theories; case studies of built projects that strive in integrate regenerative design principles; and a site-specific design project based on a comprehensive regenerative design framework that I propose.

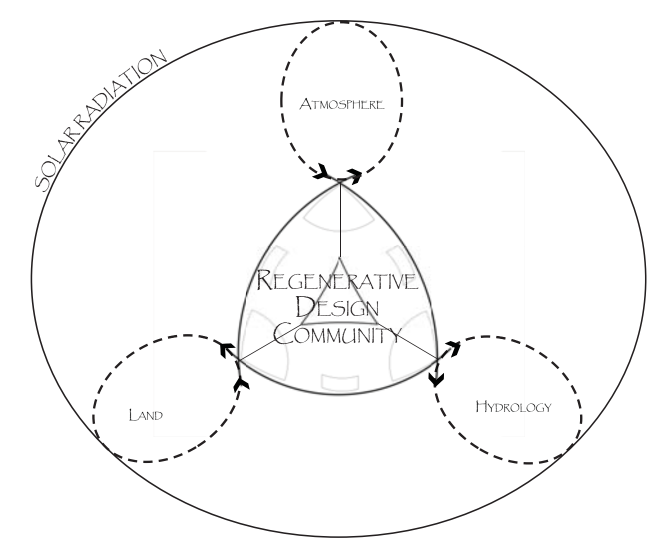


Diagram I.1: Regenerative Design Principles

Chapter One:

Regenerative Design Contemporary Theoretics

Regenerative design theories spring from earlier concepts of sustainable development. In 1987, the World Commission on Sustainable Development defined itself as seeking "development which meets the needs of the present without compromising the ability of the future to meet its own needs." (WCED, 1987). Sustainable development attempted to integrate environmental responsibility, social equity, and economic viability. *See Diagram 1.1.* While attempting to be ecological, most sustainable design projects proved to be simply examples of conservation design. Most sustainable design efforts tended to remain energy and resource consumptive – that is to say – they remained linear and degenerative rather than regenerative. These are early attempts at designing with ecological principles, however, served as stepping-stones between conventional approaches to design and contemporary regenerative design concepts and theories.

Landscape architects Robert Thayer and John T. Lyle, and architect William McDonough are proponents of regenerative design who have published significant works. Each of these authors shares a common vision of promoting truly regenerative design

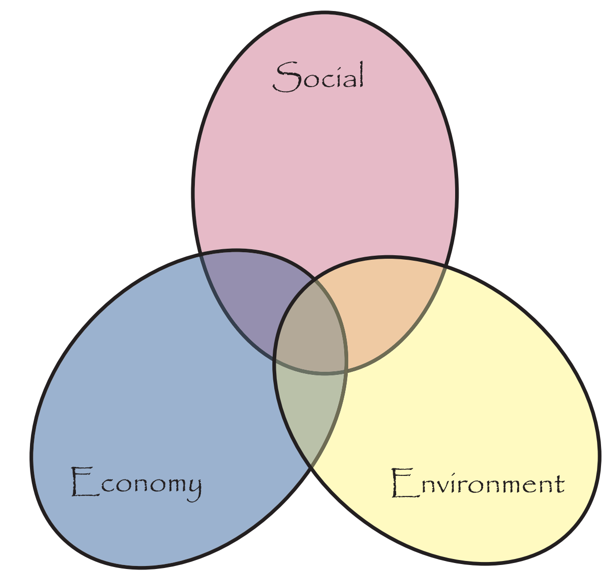


Diagram 1.1: Sustainable Design Principles

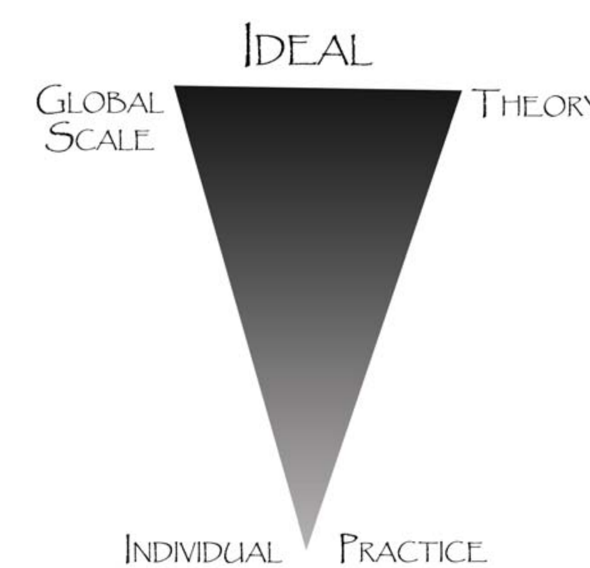


Diagram 1.2: Regenerative Design Theory vs. Practice

and consequently there is a significant degree of overlap between their respective works. However, each of them tends to emphasize some distinctive aspect of regenerative design perhaps because each focuses on a distinct landscape scale and the issues particularly salient to it. In other words, the authors are writing at a level intended to influence the contextually bounded practice of individual designers while operating under the umbrella of a shared global concept of regenerative planning and design. *See diagram 1.2.* It is also apparent that Lyle focuses on the ecological component of regenerative design, Thayer on the socio-cultural component and McDonough on the economic component. *See diagram 1.3.* A synthesis of the established principles found in the works of these authors leads us toward an integrated regenerative design framework that can cross boundaries of landscape scope and scale.

Lyle's theory of regenerative design focuses on the project and community scale and, as one might expect, his work contains a balance of theoretical principles and practical approaches. Lyle contends that with respect to a given population, "the landscape must be designed for supporting ongoing supplies of energy and materials for habitat, daily living and economic activity." (1994). Accomplishing this requires replacing the present linear system of material flow with cyclical flows at sources, consumption centers and sinks. A regenerative community or development provides for continuous replacement, through its own functional processes, of the energy and materials used in its operation. (Lyle, 1994). Lyle proposes six basic processes required to achieve this outcome: conversion, distribution, assimilation, filtration, storage and thought. (1994). *See Diagram 1.4.* Conversion is the mechanism by which energy is turned into usable energy, while distribution is the means by which the energy reaches community members. Assimilation is the collection and returning of materials to the landscape, while filtration is the process to maintain a clean and healthy ecosystem. Storage is a major component of the regenerative system, due to our stationary habitation we no longer migrate with the seasons, requiring the stabilization of products, such as water and food. (Lyle, 1994). Finally, regenerative design is guided by thought. (Lyle, 1994). Within the regenerative society thought, mind and nature join in partnership, where the human mind is nature's consciousness not its master. Lyle proposes twelve strategies for integrating processes within the regenerative design process. *See Diagram 1.4.*

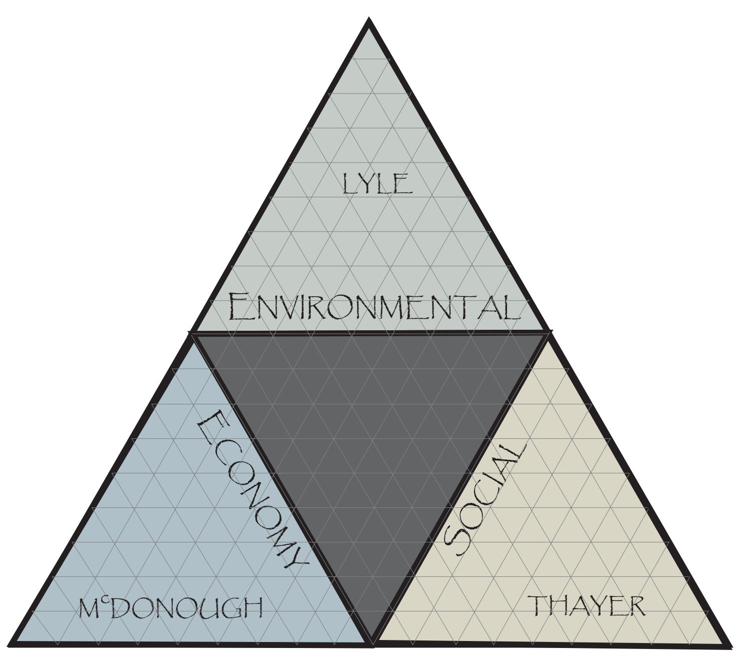


Diagram 1.3: Regenerative Design Theorist Influence

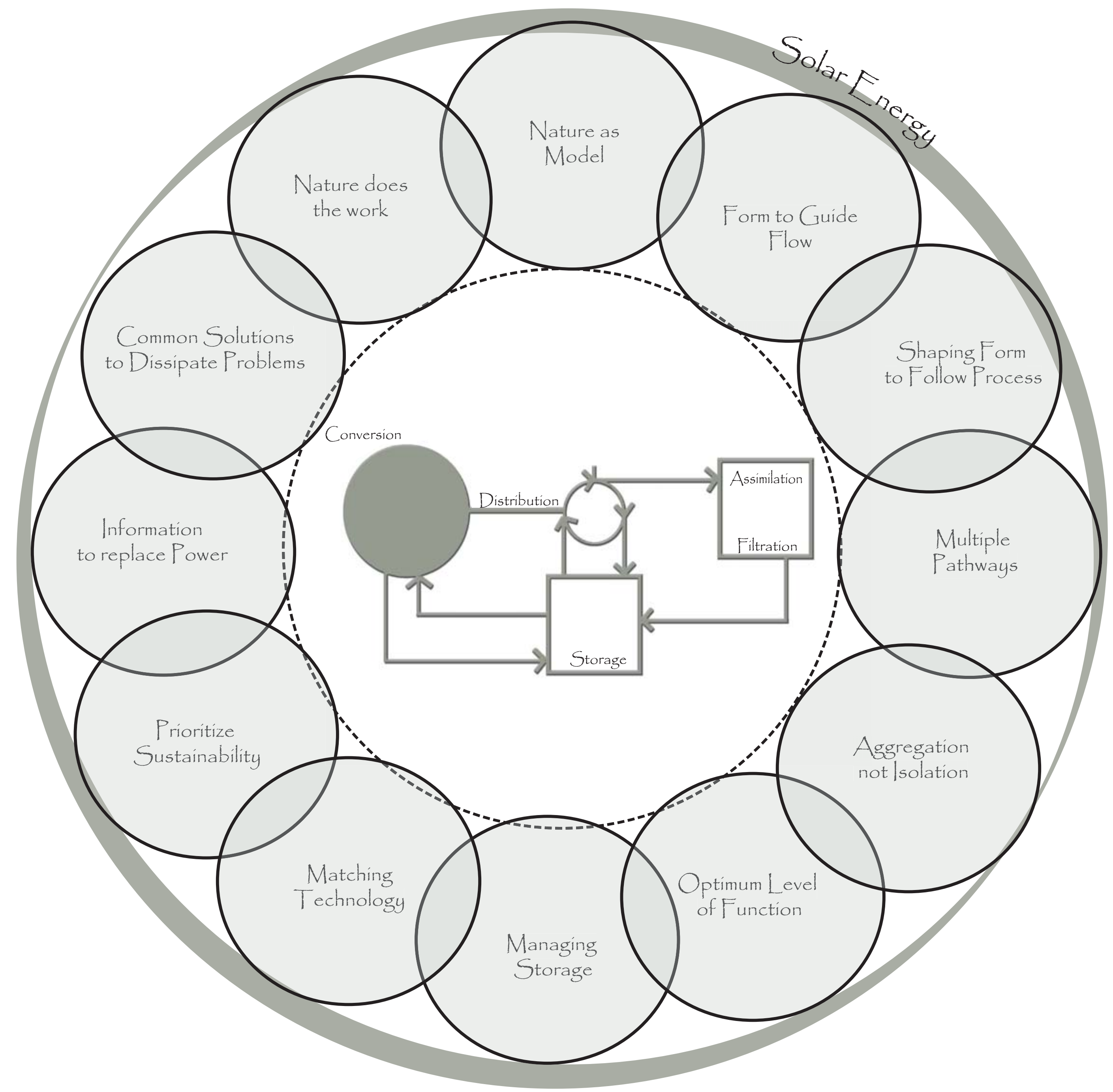


Diagram 1.4: John Lyle's Principles and Framework

Strategies for regenerative design:

1. **Letting Nature do the work**

   Many of the mechanism and processes of regenerative design are inherently performed by nature. Under conventional design these process are replaced by engineered systems which are costly in terms of energy requirements and environmental disturbance. Nature provides these services and with a little augmentation we can tap into these processes and utilize them for our benefit and reconnect to the environment.
2. **Considering Nature as both model and context**

   When developing a landscape, re-establishing the connectivity and continuity in nature is crucial. (Lyle, 1994.) Utilizing nature as a model for design allows insight into underlying connectivity and material flow through the ecosystem.
3. **Aggregating not isolating**

   Dismantling complex problems can reveal the characteristics of its individual parts, enabling design to recreate through understanding the processes involved. Aggregation leads to rich links, minimizing the energetic needs of production. Regenerative design has to be concerned with the interactions among the parts, the connections, as with the parts themselves to develop successfully. (Lyle, 1994).
4. **Seeking optimum levels for multiple functions not the maximum or minimum level for anyone**

   Regenerative systems will always have multiple goals. These goals can be in conflict, therefore manage the system to maximize the system, not an individual element. (Lyle, 1994). Managing the connectivity of the system to create the optimal outcome is equivalent to maximizing the system.
5. **Matching technology to need**

   This strategy is about applying appropriate technologies for the proper use. For example instead of using a conventional air conditioning system, we can use natural ventilation and other cooling techniques such as cooling tubes and sunshades. (Lyle, 1994).
6. **Using information to replace power**

   Maintaining open lines of communication and a feedback monitoring systems allow for greater information sharing and result in community based decision-making and management. (Lyle, 1994).
7. **Providing multiple pathways**

   Multiple pathways allow for a flexible response to changing market conditions, supply and demand alterations, and system malfunction. (Lyle, 1994).
8. **Seeking common solutions to dissipate problems**

   Instead of separating and compartmentalizing life-support systems, recognize and utilize the interconnectivity to create common solutions. Specifically recognize system interactions and solutions provided within the same system. (Lyle, 1994). An example is our water management system; conventionally water is managed in terms of supply, stormwater and sewer management. This system has the potential to be interconnected and effectively managed more efficiently, and resulting in reduced water use and sewer demand.
9. **Managing storage as a key to sustainability**

   Maintaining adequate storage and balancing the rate of replenishment with the rate of use are important keys to successful sustainable community. Nature has available storage devises in groundwater basins and the atmosphere for oxygen and other gases. (Lyle, 1994). Regenerative design incorporates natural storage mechanisms and develops its own.
10. **Shaping form to guide flow**

    Energy and material flow through system within the physical medium of the environment and determine the rate of flow. By shaping the environment, we can guide flow. “Flow follows form follows flow.” (Lyle, 1994).
11. **Shaping form to manifest process**

    In regenerative design technologies are more difficult to hide. (Lyle, 1994). Instead of cloaking the technologies in a façade we utilize them as a means for design, for many are integrated to their context and can be utilized for education secondarily. “Cultural habits and preconceptions change slowly, but if we can manifest the inherent elegance of ecological processes in visible forms, those forms will become symbols of the time.” (Lyle, 1994).
12. **Prioritizing for sustainability**

    There has been a slow increase in regenerative and sustainable design in the past decade, yet we are in a long period of transition in which our priorities must change. (Lyle, 1994). To succeed in sustainable design sustainability and regenerative design must take a high priority through all sectors of society, the environment, and government.

A major theme in Robert Thayer's work is the relationship between our visual perception of the landscape and technology. He argues that we must bring back elements of transparency, congruency, and visual ecology by making deliberate attempts to merge the natural with the technological in such a way that the line between them is blurred. Thayer claims that creating these positive associations between the natural and the technical within the perceptual field will have sufficient impact to change the behaviors of our culture. *See Diagram 1.5.*

Although Thayer's tends to use the term sustainable community it is clear that his ideas are indeed based in a regenerative context. An examination of his five characteristics of sustainable design makes this apparent. They are:

1. Renewable energy generated without ecological destabilization.
2. Maximize the recycling resources, nutrients, and by-products, and produce minimum waster.
3. Maintain local structure and function without reducing the diversity or stability of the surrounding ecosystem.
4. Preserve and serve local human communities rather than change or destroy them.
5. Incorporate technologies which support these goals. In the sustainable landscape technology is secondary and subservient. (Thayer, 1994).

At the practical level Thayer depicts the sustainable (regenerative) community and landscape as the proper relationship between a set of specified program elements. *See Diagram 1.6.*

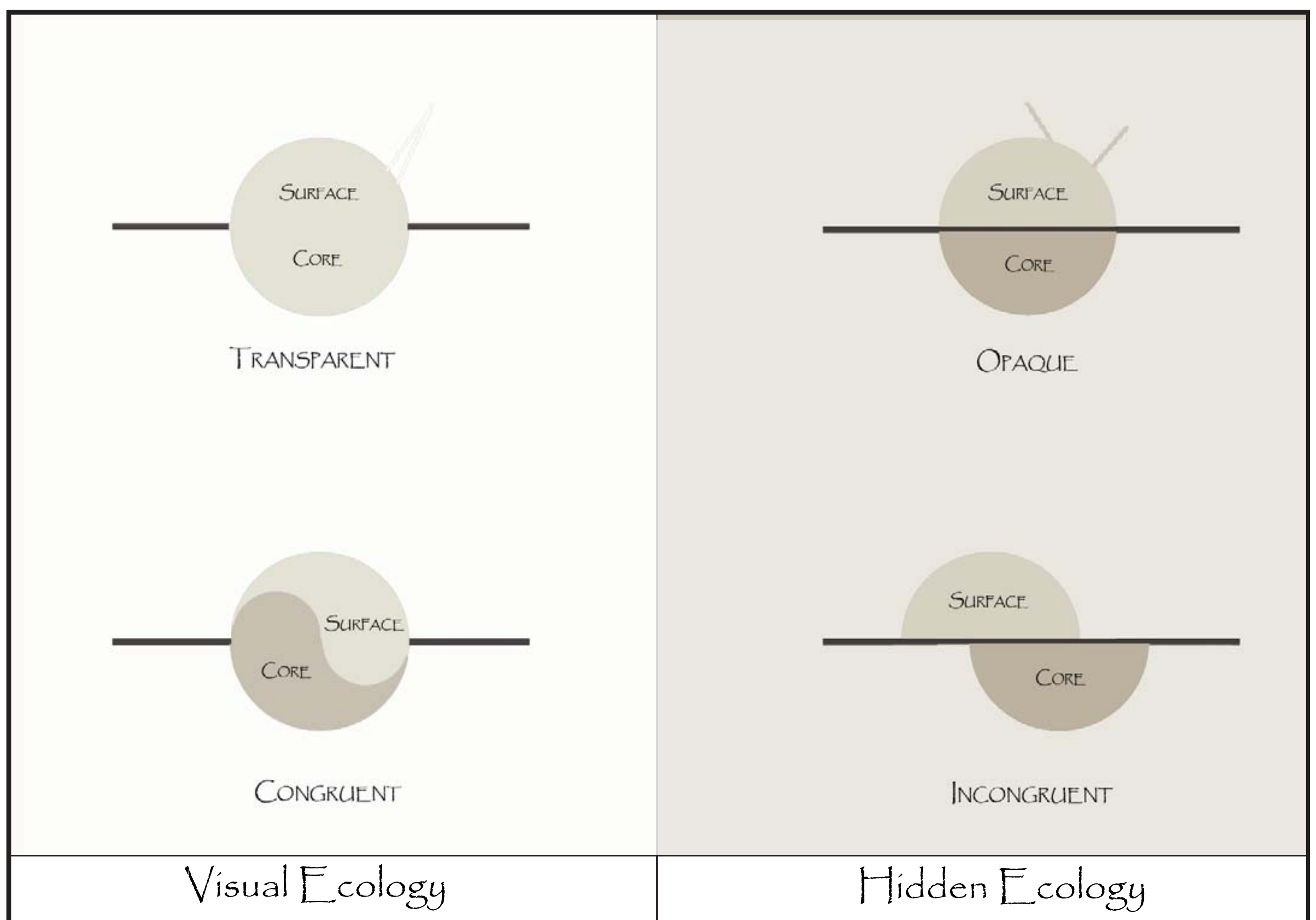


Diagram 1.5: Robert Thayer's Principle of Visual Ecology

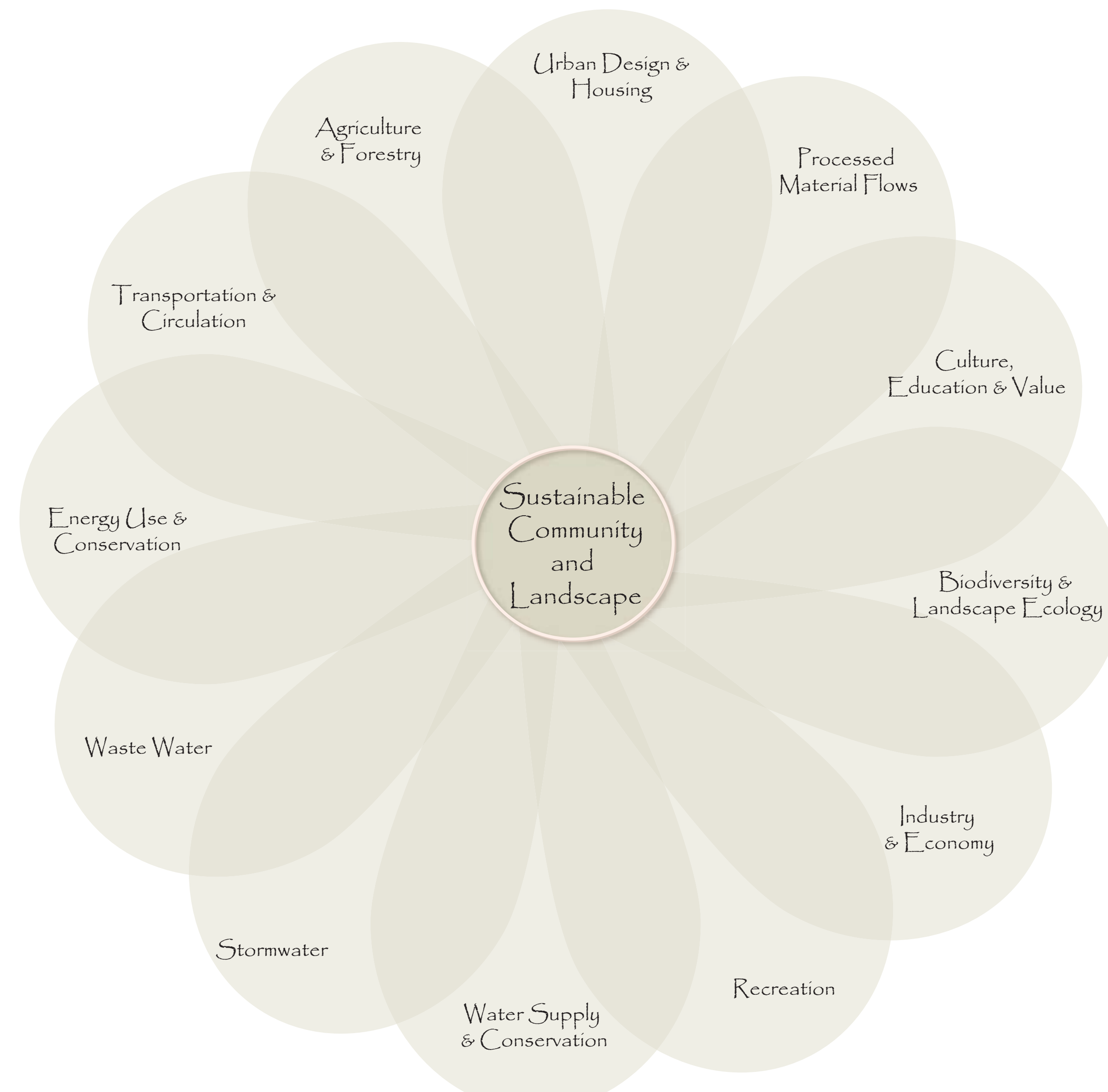


Diagram 1.6: Robert Thayer's Principles and Framework

William McDonough brings one of the primary issues underpinning regenerative design theory to the forefront - namely, the economy and the recognition that there are alternative means for economy based in a regenerative system (McDonough and Braungart, *Cradle to Cradle*, 2001). He views the design process very broadly and describes it as including creation, production, social relations, and business planning.

McDonough and chemist Michael Braungart cooperatively developed the McDonough-Braungart principles for regenerative design. *See diagram 1.7.* They content that a regenerative economy can result our global society will:

1. recognize that waste equals food
2. respect diversity
3. reconcile energy consumption to current solar income

The first principle "waste equals food" embodies the concept that in nature nothing is produced uselessly. The authors intend this ecological efficiency to serve as a model for the human economy where the loop between resource and energy input and wastes are closed to the highest degree possible. The second principle is to respect diversity. McDonough stresses diversity not only among species but also in the business realm. While acknowledging that the application of this principle would require significant change in current business structure, he argues that the result will yield more choices for production means and a greater variety of products for consumers. Utilizing current solar income is the third principle. It recognizes that the earth is a massive ingenious cyclical system to which the only additive is sunlight. (McDonough and Braungart, *The Next Industrial Revolution*, 2001). Applying these principles of growth and re-growth to development and design as a whole establishes a framework for regenerative design.

While McDonough's principles are applicable at the site level, their greatest significance relates to the global market place. Since no community or design project exists in isolation, the emergence of a sustainable economic framework at a global scale is crucial to the ultimate success of any local application of regenerative design theory.

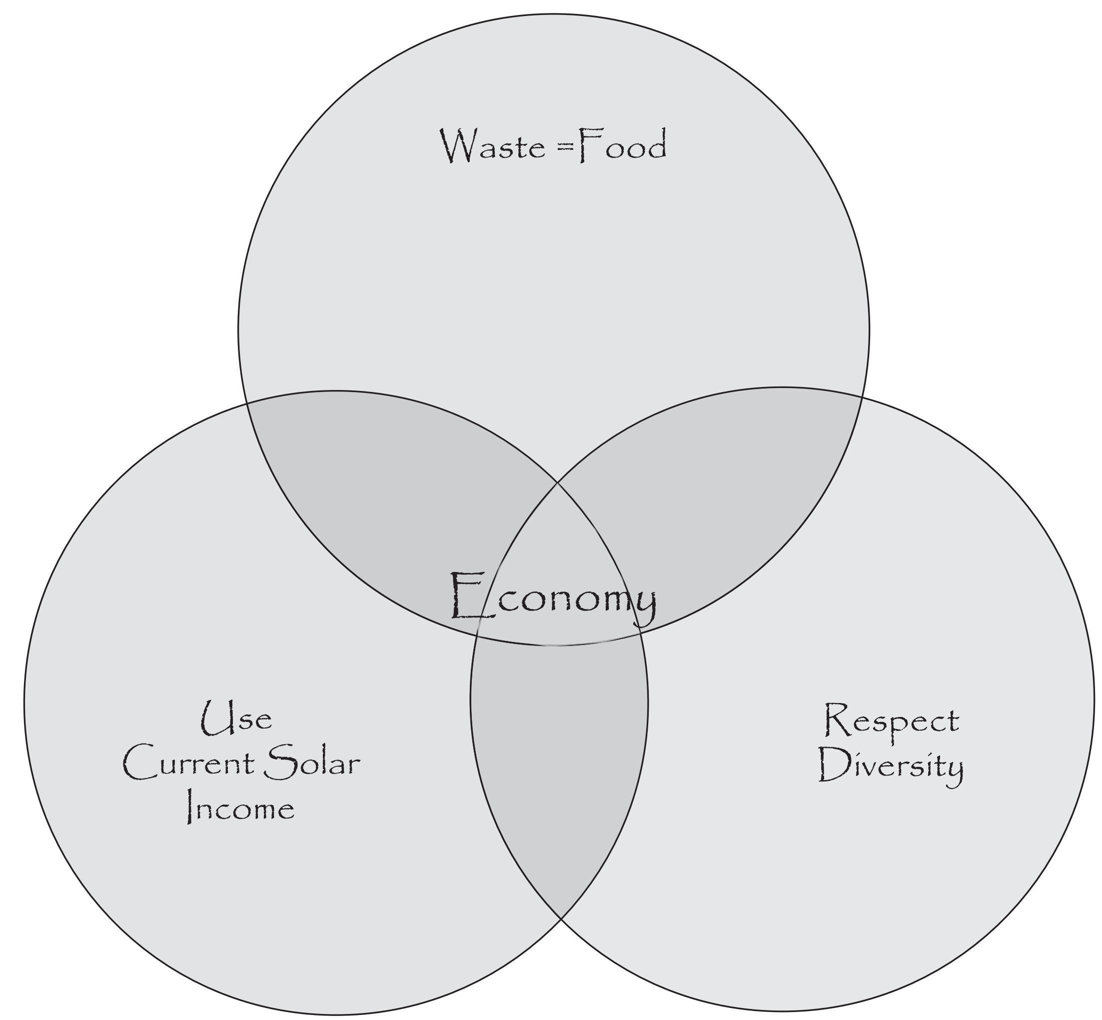


Diagram 1.7: McDonough and Braungart Principles and Framework

Chapter Two:

Framework for Integrated Regenerative Design

	John Lyle	Robert Thayer	William McDonough
Nature as a Model	●	●	●
Prioritize Sustainable Design	●	●	●
Site Characteristics and Environmental Components	●	●	◗
Utilizing and Enhance Natural Systems	●	●	●
Conservation and Recycling	●	●	●
Maintain Cultural Identity and Social Fabric		●	
Minimize Conventional Transportation			◗
Design for People and Human Health	◗	●	●
Connectivity to the Great Whole	◗	◗	
Integrated Communities and Social Units			
Information based Decision-making	●		●
Convergence of Appropriate Technologies to the Vernacular Landscape		●	●
Multiple Use and Diversified Systems	●	●	●
Economics and Appropriate Technological Selection	●	●	●
Promote Storage	●		●

Diagram 2.1: Theoretical Framework Comparison Matrix

Framework for Integrated Regenerative Design

The Theoretical Framework Comparative Matrix may be viewed in two ways. *See Diagram 2.1.* The matrix supports the findings of the literature review when viewed as an assessment of the scope and focus of the three theories of regenerative design under consideration. When taken in the aggregate the matrix defines the scope of considerations that must be embraced by any attempt to describe regenerative design holistically.

Six major categories of concern, or thematic areas, are identifiable when one assumes this holistic point of view. In diagram 2.2 each of these thematic areas is given an identifying color code. The result, graphically, is a comprehensive spectrum of regenerative design considerations. When assembled in an interconnected fashion these themes constitute a sufficient and comprehensive conceptual field that embraces all three theories of regenerative design.

The tenants of regenerative design described previously can now be appreciated with a greater degree of clarity. *See Diagram 1.2.* The practice of regenerative design, even at the site and community scale, must include and simultaneously respond to environmental, human and economic considerations. Diagram 2.3 is an attempt to depict a holistic framework for regenerative

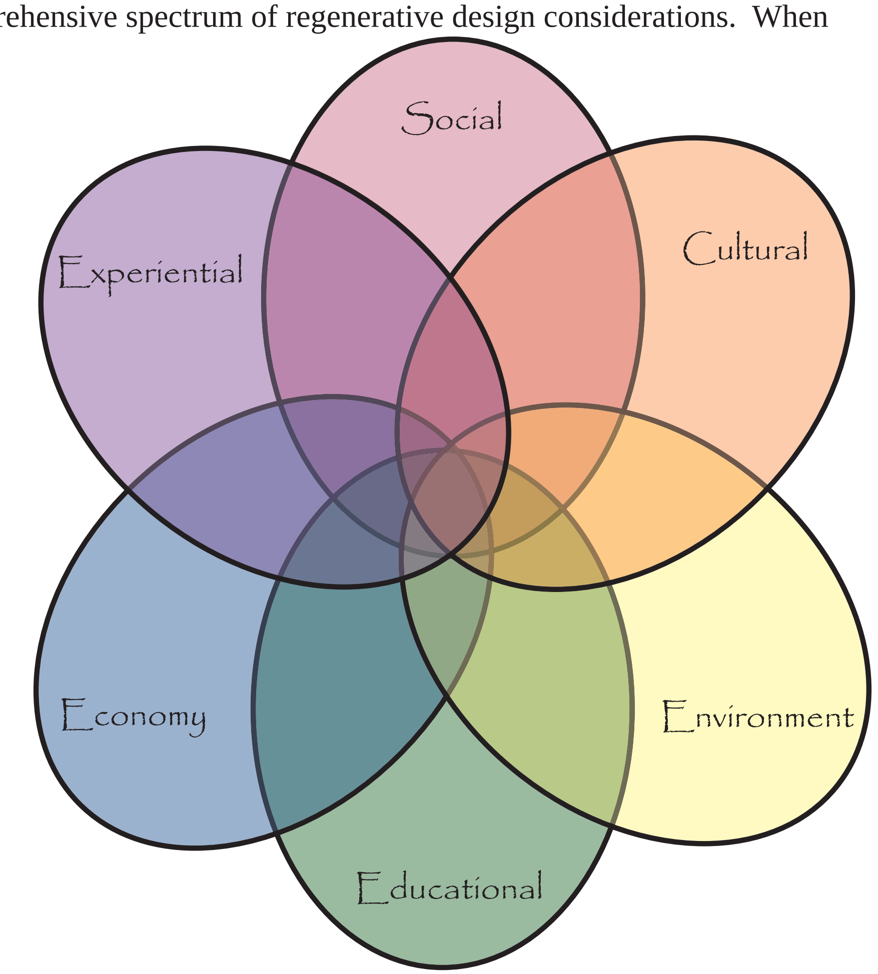


Diagram 2.2: Integrated Regenerative Design Theory

design practice derived from this broad conceptual foundation. The framework, if successful, will guide regenerative design processes and serve as a mechanism for evaluating the comprehensiveness of specific regenerative design projects.

At the center of the diagram is the primary strategy of using "Nature as a Model" taken directly from John Lyle. Surrounding this core are the six principles of regenerative design. Specific strategies for regenerative design are indicated as relating to the intersection, overlapping or interlacing of these principles.

John Lyle's approach to identifying site characteristics and environmental opportunities is the key strategy within the environmental domain of the framework. To Lyle's approach, which if focused at the site scale, this model adds the strategy of connecting to the whole. This is done in recognition of the fact that all communities are dependent on each other at a regional and global scale.

Maintaining the cultural identity and the social fabric of a community assists in the creation of sense of place while enhancing the experience and perception of sustainable living. Strategies within the social and cultural domains of the framework include:

- prioritizing sustainable design
- maintaining cultural identity and social fabric
- integrating communities and social units
- emphasizing conservation and recycling
- designing for people and human health

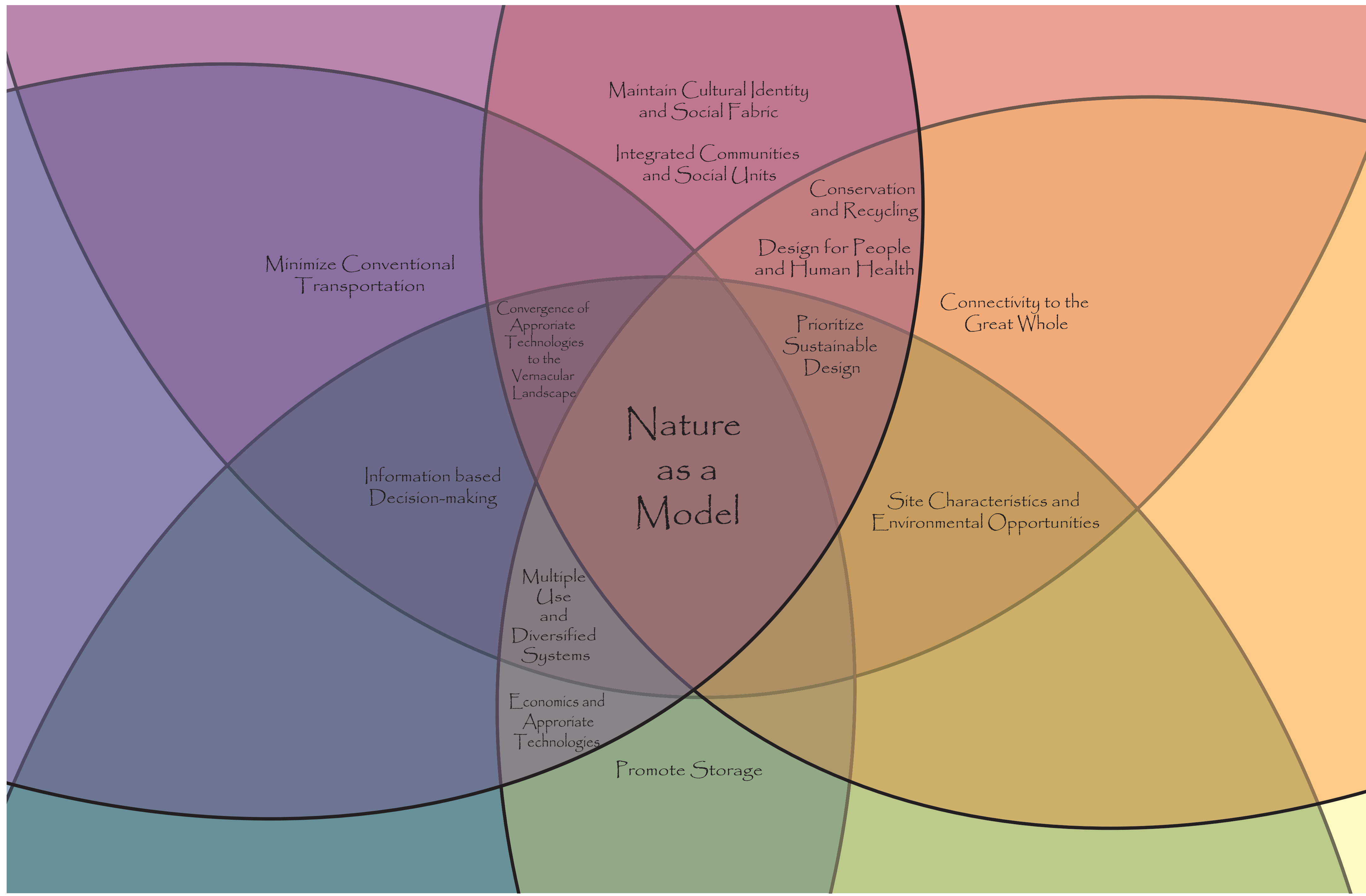


Diagram 2.3: Integrated Regenerative Design Principle and Strategies

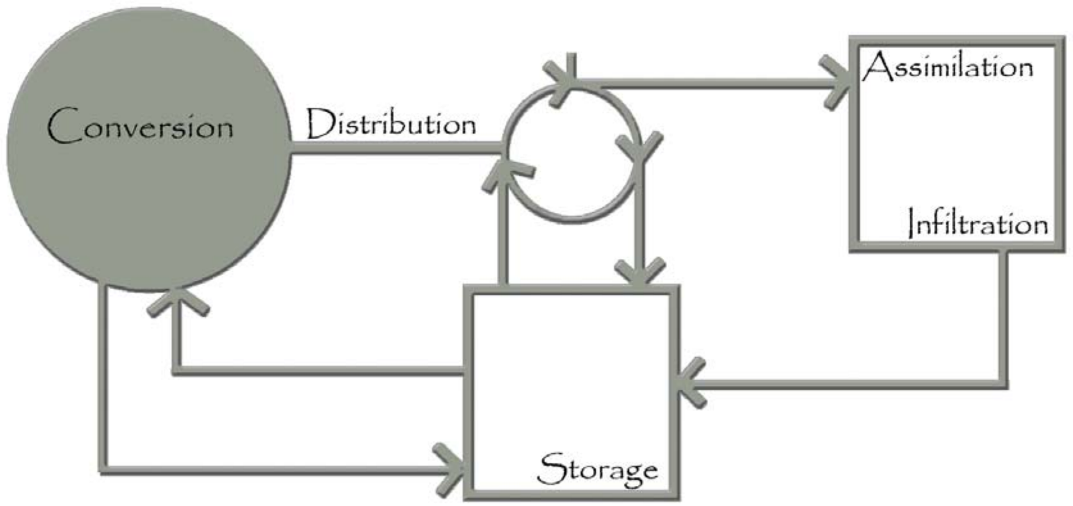


Diagram 2.5: John Lyle's Nature as a Model

The final domain in the framework addresses utilization of appropriate technologies and strategies for economic viability. Since a regenerative economy is dependent on the flow of solar energy, storage is crucial to achieving successful regenerative design solutions. *See diagram 2.5.* Beyond storage, as outlined by John Lyle, the framework includes the following strategies related to a regenerative economics:

- Minimize conventional transportation
- Stress convergence of appropriate technologies to the Vernacular Landscape
- Promote information based decision making
- Develop multiple use and diversified systems

The integrated regenerative design framework derived predominately from the work of John Lyle, yet Thayer's concepts add crucial depth and clarity within the sociological and cultural domain, while McDonough influences economic principles and contributes important ideas of connectivity.

Chapter Three:

Case Studies in Regenerative Design

With a comprehensive outlook on regenerative design in place, this thesis turns its attention to the current state of regenerative design practice. How close do current built works come to realizing the ideas of regenerative design theory? What practical limitations to success exist, if any?

In the context of this thesis case studies serve to document the current status of Regenerative Design in professional practice. In addition, for the purposes of the thesis work, the review of case studies for proved useful in establishing the need for an integrated framework to guide practice. The limitations of the built work studied point towards gaps in the overall theory base. The case studies also present an opportunity to compare built projects to the integrated regenerative design framework to establish its comprehensiveness and process orientation.

Three case studies were selected based on the designer, type of development and extent of regenerative design goals. The first two case studies, the Center for Regenerative Studies, and the Rouge Ford Plant were developed by Lyle and McDonough respectively. The examination of these projects will show the difference in theory and practice aiding our understanding of how we bring them together. The third case study is of a resort community in Loreto, Baja Mexico. This development permits an examination of the flexibility of the integrated framework and how it might apply within non-resident developments, such as the one that will be explored in the final section of this thesis.

Case Study 1:
Center for Regenerative Studies, John Tillman Lyle

The Center for Regenerative Studies is a 16 acre site at California Polytechnic University in Pomona, California. Envisioned by John T. Lyle in the late 1960s, the facility is designed for the study of practices and technologies dealing with energy, water, shelter, food, and waste. The three primary goals for the development are education, demonstration, and interdisciplinary research. The designers and engineers were charged with developing a community within the regenerative design strategies that grows food, generates energy, regulates its own thermal environment, and recycles waste. The Center attempts to provide regeneration into the indefinite future and the capability to add new components on a selective basis. (Lyle, 1994). The regenerative design strategy unifies the concept of a human ecosystem, where the landscape serves human purposes, but also the ecological system with life supporting processes functioning as do natural systems. (Center for Regenerative Studies, CRS, 2004).

Lyle's process for development began by studying the natural components of the site. *See Image 3.2.* From this understanding he established suitability for the programmatic elements of the Center. *See Table 3.1.*

Table 3.1: Topographical site utilization:
Varied situations on the site represent small scale topographic conditions

Area	Slope	Use
Valley Bottom	0-10%	Aquaculture and water related crops, sewage treatment, irrigating crops, water for main reservoir
Knoll tops	0-10%	Energy generation, dominant visual features of site, Grain growing, contour plowed agriculture
Flatter knoll sides	0-10%	Relatively flat where they spread towards valleys. Used for vegetable production
Knollsides	10-40%	Between bases and tops of knolls, Terraced agriculture
South facing knollsides	10-40%	Village, energy production.
Steepslopes	40+%	Agroforestry, planting permanent perennial vegetation. Remain in natural forms

Source: Lyle, John T. 1994.

The detail of the site was fairly programmatic and goal oriented. To develop the regenerative campus Lyle selected passive solar heating and cooling building designs, and planted for microclimates to utilize the natural system and functions on site. The provisions for aquaculture also offer natural cooling for the buildings. Natural drainage was determined for water management systems with above and below ground storage, while green roofs reduced runoff and provided insulation and cooling of the buildings.

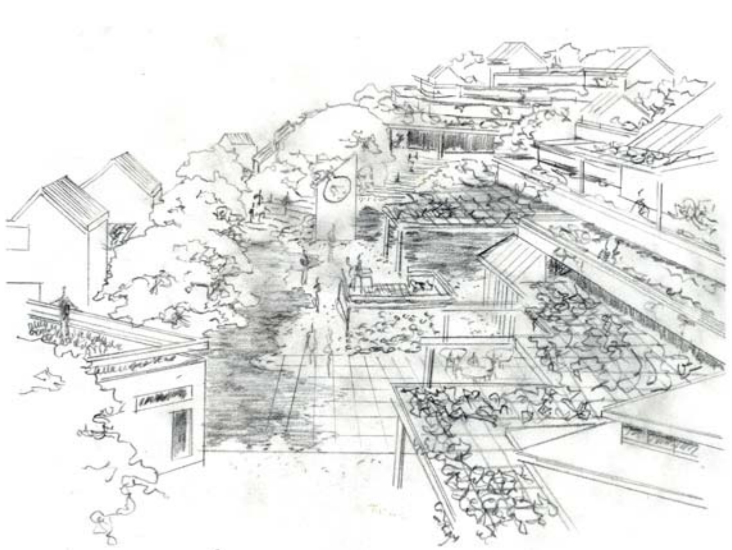


Image 3.1: Center for Regenerative Studies - Community Area

Multiple pathways and back-up systems are implemented through maximizing the potential benefits from the technologies of green-roofs, storage, and aquaculture. The community is directly connected to the natural

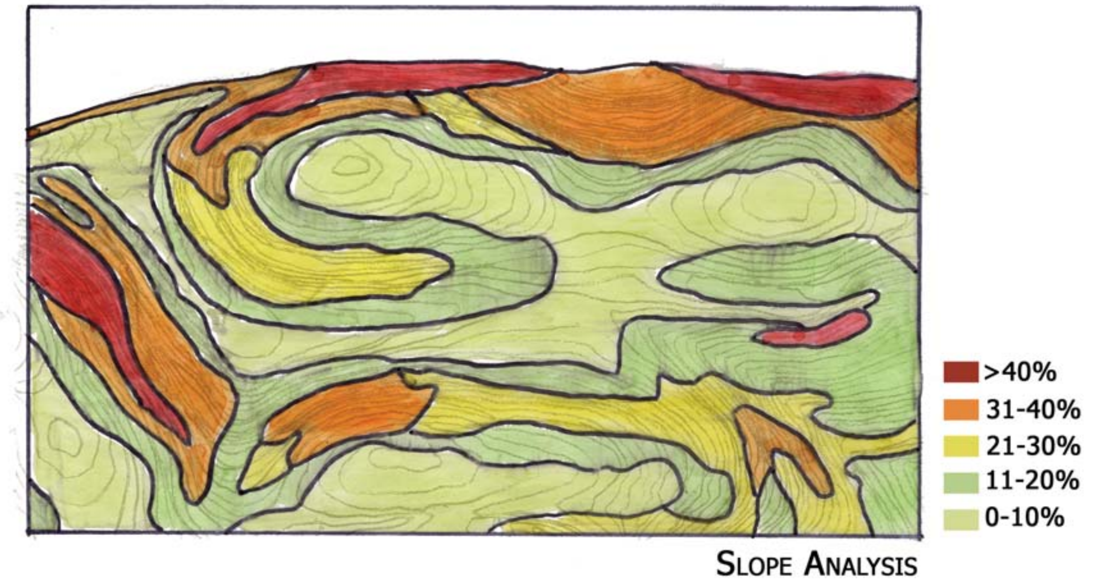


Image 3.2: Slope Analysis and Landform Analysis
Drawings derived from Lyle's Analysis drawings

systems, yet is disjointed from the university and local social communities.

Cultural components and designing for people and health are not directly addressed. The daily management of the facility was through continuous monitoring and research by students and faculty. Since the Center for Regenerative Studies is on University property, it minimizes the opportunity for community driven management and this may have caused the recent decline of the center since Lyle's passing.

The Center has accomplished a fully integrated systems development through interdisciplinary research and education of students and faculty. The research component is interdisciplinary - studying the social aspects of the community, aquaculture and engineered systems. The Center has developed programs which collect data that is mad available to all visitors. Strategically placed informational kiosks further explain the technologies and function of the community. Prioritizing regenerative

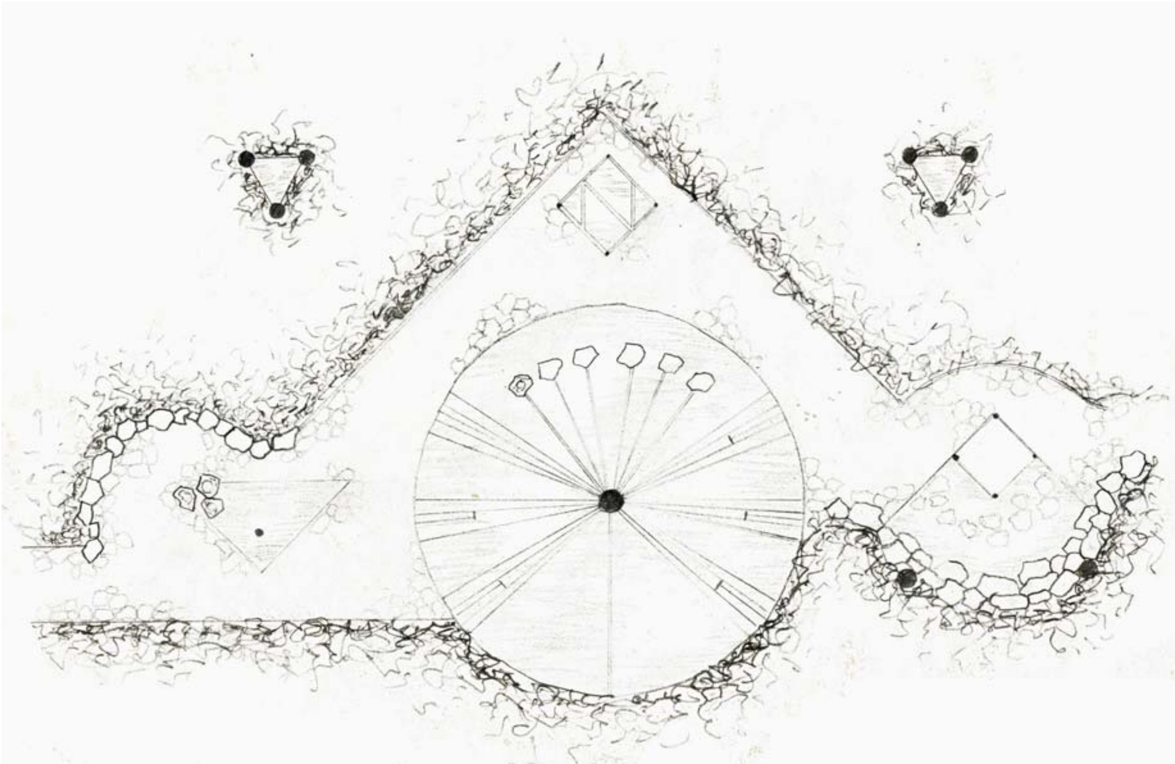


Image 3.3: Center for Regenerative Studies - Solar Park

development was met through research and education, and is a major component throughout the design.

The economics of the center are based on research grants and the University. This puts limits on the development of a sustainable economy. The economies of site are best represented through solar access, agriculture, and the employment of the multitude of systems on site.

The Center for Regenerative Studies exemplifies many of the concepts of the integrated regenerative design framework. This is most evidently due to the use of Lyle's six principles that define the concept of "Nature as a model." The Center successfully provides for the majority of its own energy needs through the ample solar isolation and agricultural opportunities on site. From the placement of the buildings to the material use the design proceeded in a conscious fashion to maintain a regenerative community.

A few elements overlooked in the design for the Center of Regenerative Studies that cause the system to fall short of its intended goals. This includes transportation, manufacturing processes, and daily material needs. It is also evident that there is a tendency towards self-sufficiency. There are construction materials and production mechanisms that are not completely regenerative. However, many of the materials were selected for environmental sensitivity, durability, and transportation cost. Some additional materials were developed on site through agro-forestry and recycling.

Although this example is one of the most successful regenerative developments it shows that there is still room for improvement. It gives light to complications of supplying materials for everyday use and construction materials in regenerative manner. This development also is ideally sited therefore does not examine issues dealing with complicated or less than perfect sites. Due to the potential limitations of any site the integrated regenerative framework works towards ameliorating this through connectivity to the local community.

Case Study 2:
Rouge Ford Plant, William McDonough and Partners

William McDonough's visionary influence on regenerative economics is evident at the Ford Rouge Plant in Dearborn, Michigan. The project features development of a green-roof system and site renovations at one of the Ford Motor Company production facilities.

In 1999, William McDonough and Michael Braungart entered into an agreement to redesign the 85-year-old facility. The center of this revitalization was the effort to reduce the ecological footprint, which in turn resulted in a 10.4 acre living roof that serves as a stormwater management system. (Hammonds, 2004). The roof system has the capacity to hold half the annual rainfall, reduces the energy cost of the buildings and provides habitat for many birds. Skylights and daylight monitors are built into the roof systems, while additional trellises and plantings around the exterior shade the buildings, and provide additional habitat. (McDonough Braungart video, 2004).

Collectively, this system addresses the reduction of energy requirements for the facility, promotes human health through daylighting, utilizes natural systems to reduce the ecological footprint of the buildings, and promotes economic sustainability through decreasing overhead costs, and staging the implementation over the course of the next decade. This is a step forward in the manufacturing industry towards sustainability although the system is not entirely regenerative.

The largest impact McDonough and Braungart have made is to influence the ecological perspective of the Ford Motor Company. William Ford Jr. the current CEO of the Ford Motor company has recently unveiled the "Pirquette Project." This project aims at developing a recyclable vehicle and effectively changes the business structure of the company. The goal is to "help us do with the products what we did with the Rouge Manufacturing plant." (Hoffman, 2006). Within this project you can hear the influence of McDonough on Ford's thinking about how to do business. The hope of Ford is to develop and provide, "renewable clean and safe vehicles that would be both socially conscious and provide a competitive edge in the marketplace." (Hoffman, 2006).

The master plan for the Ford Rouge plant is not completely constructed. Even if it were, the plan does not address the greater needs of a regenerative community. However, the project itself, and its apparent influence on Ford, provides a foreshadowing of the potential for regenerative communities that have an industrial economic base. This enables regenerative communities to maintain connectivity to the greater society, which is a requirement for success.

Case Study 3:
Loreto Bay, Dunany Plater-Zyberk and Company

The Loreto Bay Community Development was selected to examine the issues and manifestation of regenerative design principles as applied to resort communities. Loreto Bay is an

8000 acre planned resort community located in Baja California Sur, Mexico which will consist of 6000 mixed use buildings, projected to be constructed over the next 12 years. (Loreto Bay, 2004). The community sits on the Sea of Cortes, below the Sierra de la Giganta Mountains. Programmatically, the Loreto Bay is designed with many common beach community amenities including the town center, beach resort areas, spas, two golf courses, a 5000 acre nature park, two historical missions, and open courtyards. (Loreto Bay, 2004). The Loreto Bay Company, part of The Trust for Sustainable Development and in partnership with FONATUR, Mexico's tourism development agency, is developing Loreto Bay. The development is backed by a strong team of professionals including Dunany Plater-Zyberk and Company, First Solar, William McDonough and Partners, Ocean Alliance, EcosScapes, and Econergy. (Loreto Bay, 2004). The primary concept behind the development of the community is to create a resort village which has all the comforts of home, while developing in a regenerative means. The primary goals of the Loreto Bay Company for the community are to produce more energy from renewable sources than the community consumes, to harvest and produce more potable water than the community consumes, and to enhance habitat and nurture biodiversity.

Within the integrated regenerative framework the over arching principle is to develop a community utilizing "Nature as a model." This becomes evident through the design process, yet is utilized more as a strategy in the case of Loreto Bay.

The community utilizes natural systems in the solar orientation of buildings, central courtyards for cooling, harvesting rainwater, installation of roof gardens and reclaiming and recycling water through a central center. The two golf courses on site also use natural topography in design and water treatment lagoons to filter and clean runoff from the fertilized turf areas. The community is connected to the greater whole through these elements linking the natural systems to the site.

In terms of societal connectivity Loreto Bay is not a regenerative community. The project is adjacent to the historic town of Loreto and relies on the town for supplies and many employees. More obviously, the project is a second home community a programmatic intent that, at least, stretches the limit of reducing consumption.

The cultural identity of the community is an important element to the design. The town was founded in 1697 by an Italian Jesuit, Juan Maria de Salvatierra. He developed and built the first of California's historical mission, the Mission of Our Lady of Loreto, named for our lady of Loreto in Italy. The 300 year old Mission houses a museum which recounts the history of the native peoples, the colonization and Jesuit missionaries. (Loreto Bay, 2004).

The architecture of Loreto Bay is based on Spanish colonial architecture and remains somewhat authentic to the cultural history of the area, blending the old village with the resort development into one continuous community. The general management of the community is through the Loreto Bay Development Company and local government. Due to the mobility of the guests there is minimal

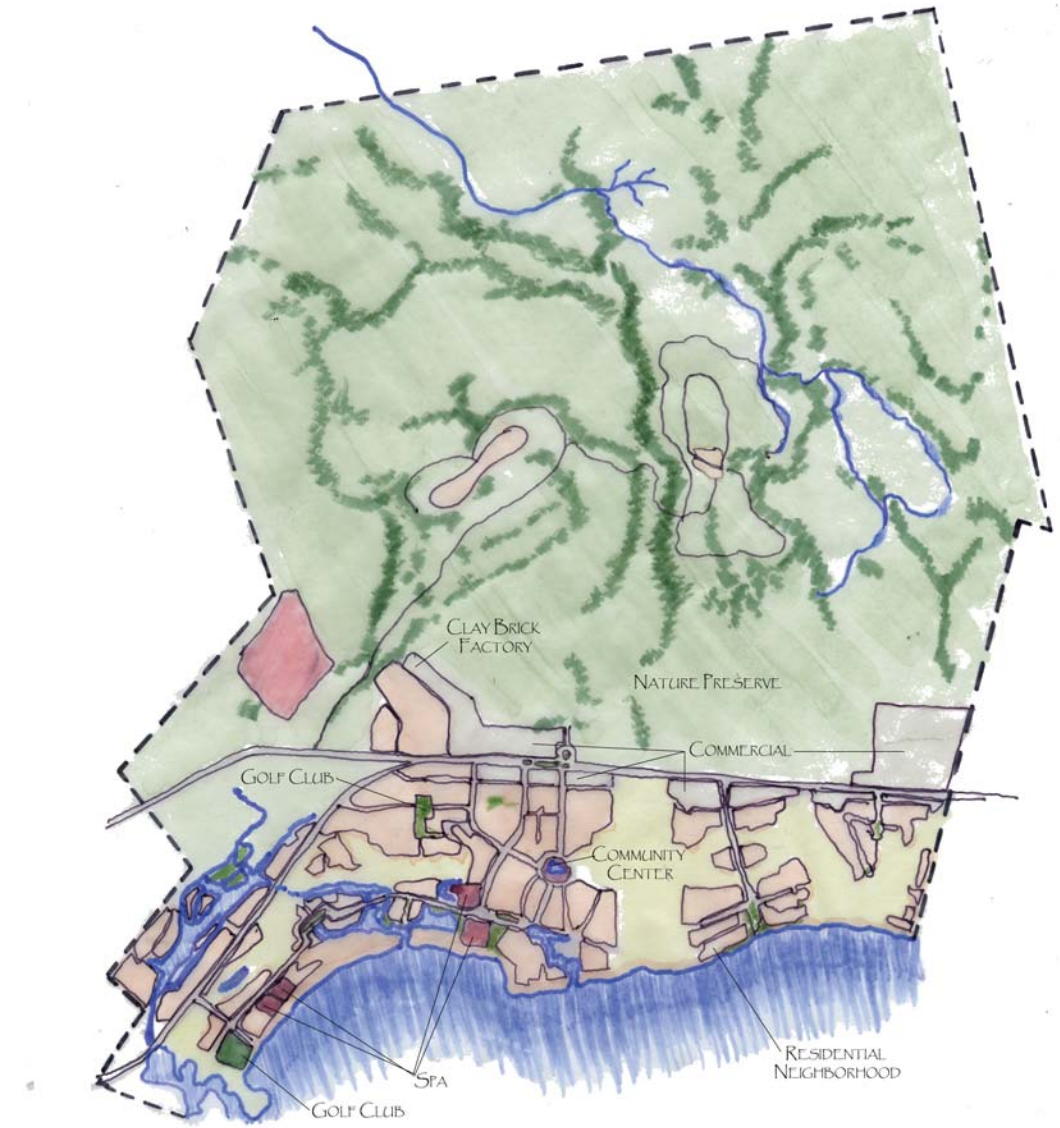


Image 3.4: Loreto Bay Master Plan

community involvement in the management of the community. There have been major efforts to integrate the community at the social level in order to improve the health and welfare of the region.

The development includes numerous housing unit types, within a range of affordable prices. In cooperation with FONATUR, local and federal governments, and established the Loreto Bay Community Foundation to assist local investors in purchasing homes. The Loreto Bay Community Foundation also dedicates 1% of all sales and re-sales in perpetuity to assist in sustainability issues. (Loreto Bay, 2004). The Loreto Bay Foundation also sponsors a micro-lending and training for local entrepreneurs, and job training for local residents to work with new technologies, infrastructure, and systems. (Loreto Bay, 2004). This allowed for local residents to be successful with the new development, through business training and micro-loans, as well as job training to work within the new community. The range of affordable homes and condos also allow for people to live and work within the same local area, reducing the dependency of residents and business owners on automobiles.

The economic stability indicates the development be profitable and maintain a healthy rate of return to investors, homeowners, and local business entrepreneurs. All construction and renovation projects will be completed through utilizing local labor and as many local materials as feasible. The Loreto Bay Company is marketing homes and condos for sale, with a rental program option for vacationers and tourists. The marketing mechanisms which the company uses are grounded in the rich history and beauty, the environmental sensitivity of the development and the numerous activities available. Art, culture, tranquil beauty, local artisans, restaurants, local shops, peaceful courtyards, and narrow laurel lined streets are marketed as the primary drawing aspect to the community as a whole. Envisioning local musicians gathered in the courtyards on warm evenings filling the air with joyous melody. The amenities of this sunny village are the main draw for tourism and development.

There was little or no discussion of minimizing traditional transportation with the exception of promoting walkability. The development also does not specifically speak to storage systems, incorporating the use appropriate technologies, or prioritizing regenerative design consciousness. The downfall of this is the sense of the elite, which many of these developments portray. There are a few major concerns which become apparent through this examination. These include an expression of the necessary interconnectivity to the larger community, social equity questions, and issues that correspond to the temporary population and employees within the development. Being a tourist community the question of transportation to, from, and around Loreto Bay is not sustainable and does not promote utilization of alterative fuel vehicles. The design layout does promote alternative forms of local transportation, but promoting alternative fuels for longer range transportation could influence choices made outside the community. Currently mass long distance travel does not promote energy efficiency or alternative fuels at the societal level. New transportation mechanisms are emerging and we can design for change. Linked to the transportation issue and linkage to the greater community there is a lack in the availability of sustainably produced and manufactured materials and products. One of the few down falls of the community is the lack of recognition and supplies all products which will be utilized by the amenities on a daily basis. As you would find in most communities there is no means for control, nor should there be, but question the transportation cost for these products to examine if there are means to produce them on site, or access to them within a regional range. Compounding transportation issues even further, questions about the effectiveness of the social equity programs providing training, jobs, multiple housing types, and assistance for the homes. This effort has been a better than typical developments, yet many of the employees in the low income bracket still may not be able to afford to live in the community. It was reported that many of these people reside in an adjacent town and commute in each day. Social equity is a major component of sustainable development success, even within resort communities there is a population necessary to the functioning of the area. Overall Loreto Bay has developed with few avoidable problems conflicting with the sustainable nature of the design. This case study provides examples of the demand for healthy, active and ecologically sensitive tourism, specifically in areas where the natural environment is of particularly beauty and economic architect. It also inspires the primary principle of all design, be creative.

These case studies give rise to many of the discrepancies between theory and practice under the regenerative design concept. The underpinning of this is that in general humans are a reactionary species and until recently there was little focus on living within the limits of the natural environment. As this has become more apparent through mass media we can begin to design more successfully within regenerative principles, one site at a time. There are a few major issues which socially and economically must be addressed to accomplish regenerative design ideals. The major issue is transportation, followed by manufacturing and social equity. The integrated regenerative framework develops mechanisms which can work in service to these issues, or at least be a catalyst for change.

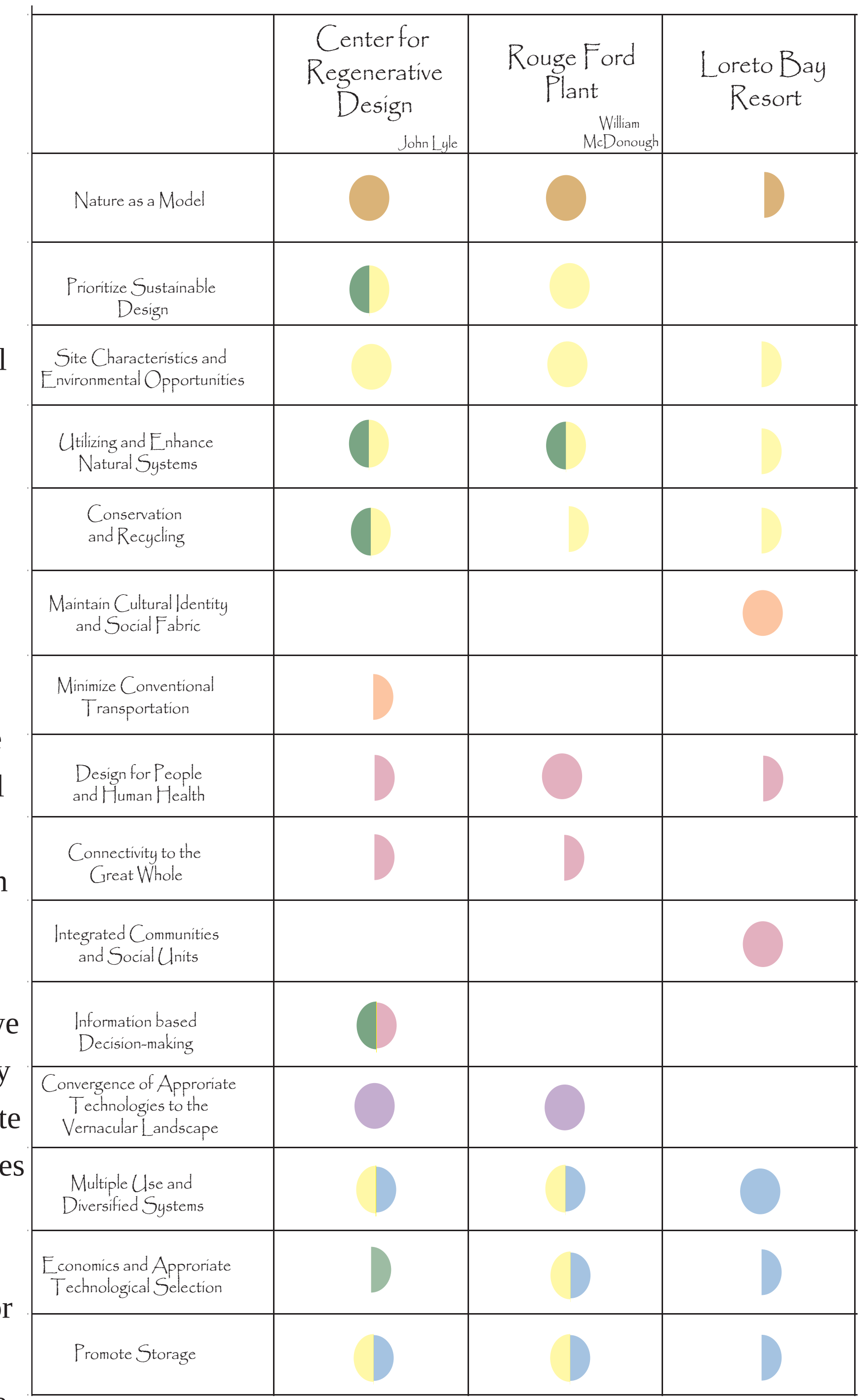


Image 3.5: Comparison Matrix of Frameworks in Practice

Chapter Four:
Demonstration of the Design Development Process and Evaluation for the EcoSpa Resort at Mountain Lake Giles County, Virginia

"Climb the mountains and get their good tidings
Nature's peace will flow into you as
sunshine flows into trees.
The winds will blow their freshness and
the storms their energy,
while cares will drop off like falling leaves."
- John Muir

Demonstration of the Design Development Process and Evaluation for the EcoSpa Resort Community at Mountain Lake, Giles County VA

The development of the EcoSpa at the Miles Horton Center at Mountain Lake demonstrates the design process supported by, and evaluation potential established by, the integrated regenerative framework. "Nature as a Model" is the primary development principle of this site design. The key concept of the design is of a human ecosystem, which concentrates on weaving the natural and built environment together through experience and education maintaining the regenerative goals of the community. This manifests through the development of interconnected layers in the design and landscape. The primary strategies for development are understanding of the environmental opportunities and limitations; social and cultural context; and utilizing appropriate technologies and economic stability. Major concerns within this design are energy sources, water supply, food production, social responsibility, and economic stability. The design program was defined by the client, Mountain Lake Company, and regenerative design goals.

The objectives of the community are to develop eight cabins, spa and community center under the concept of a regenerative community. The development will employ renewable energy sources; recycle reuse and reduce wastes; supply, conserve, and clean water on site; promote education through experience; and select appropriate technologies to obtain these objectives. The resort facilities will embody a contemporary spa resort, situated in the Southern Appalachian region. The Spa will offer many natural treatments ranging from aromatherapy and hot stone massage to standard manicures and pedicures. The landscape is designed to manifest the regenerative design concepts through function, education, and experience. These elements include activities in the community from hiking and bicycling to organic gardening, wetland lagoons, a solar terrace, and vegetated sundial.

Mountain Lake and the Ecospa are located in Giles County, Virginia, about sixty miles west of Roanoke. The Ecospa is 2 miles down from Mountain Lake Inn. *See Image 4.1 and 4.2.* The site is 140 acres on the northwest side of Salt Pond Mountain. Only 10 acres are slated for development. *See Image 4.3.* Currently there are three buildings: a cinderblock art studio, the original home, and a research station for Virginia Polytechnic Institute and State University. The Horton's home was selected to be renovated to a community center housing the dining facilities, a library, lounge, greenhouse, gift shop, and caretaker residence. This decision was based on the opportunities available

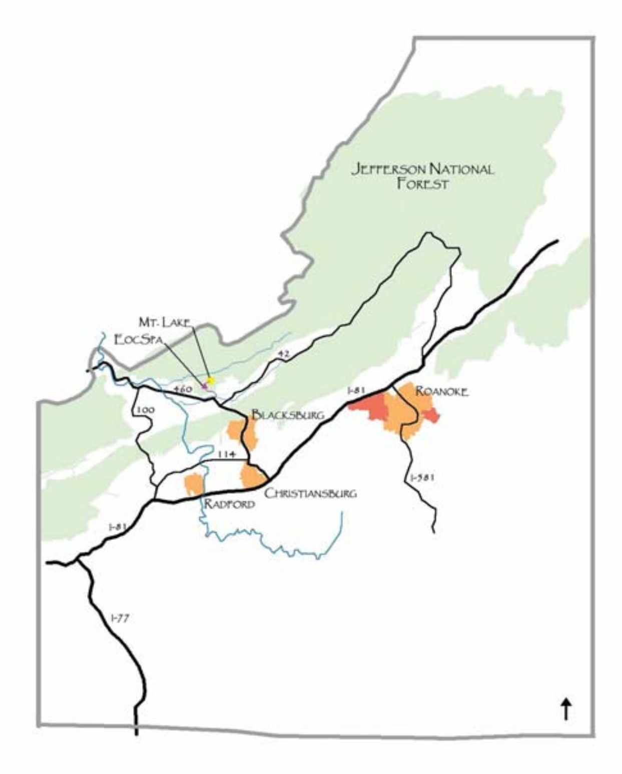


Image 4.1: Locality Map
Eco Spa and Mt. Lake

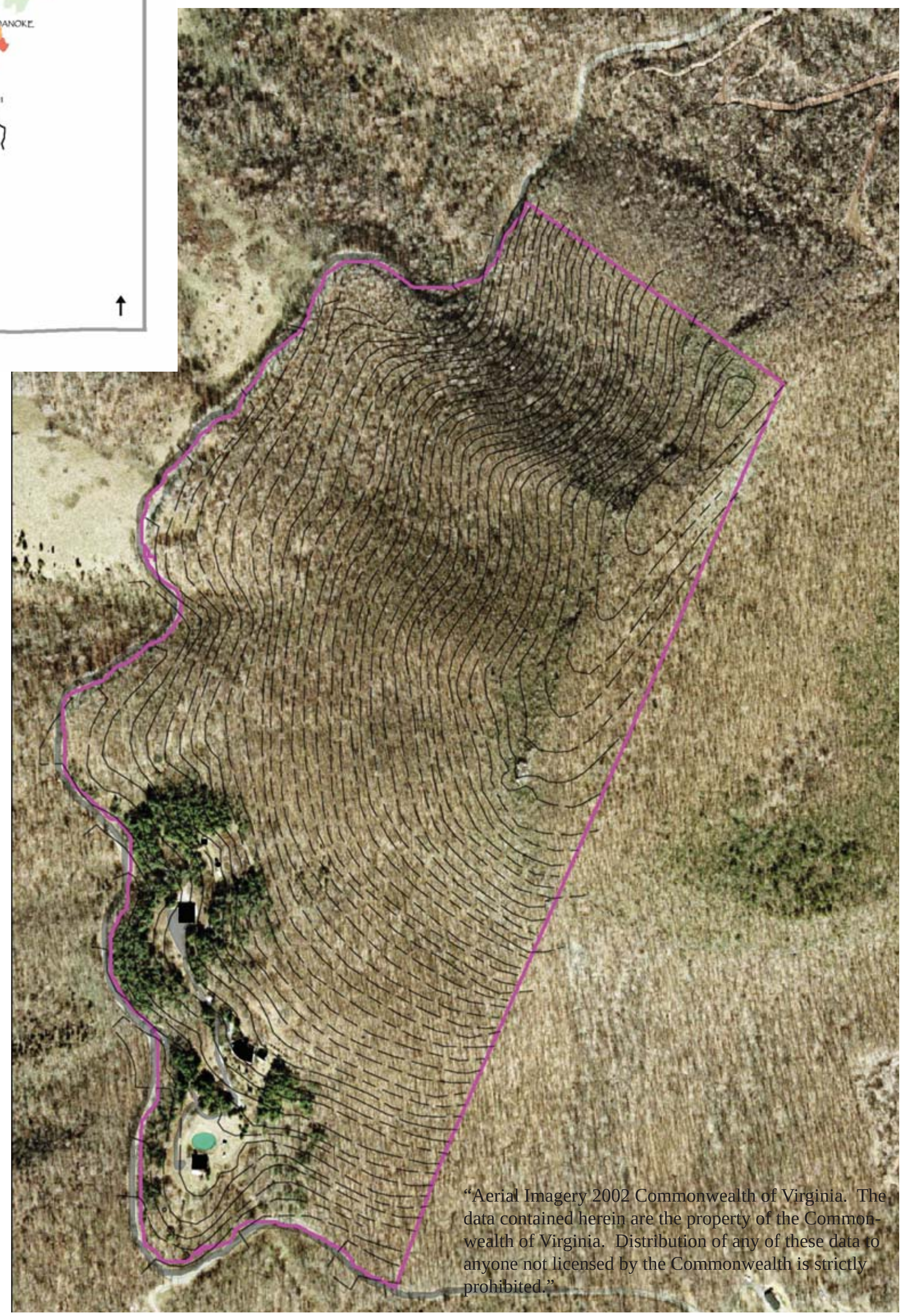


Image 4.2: Aerial of Property

Image 4.3: Aerial of Property Close-up showing Existing Conditions

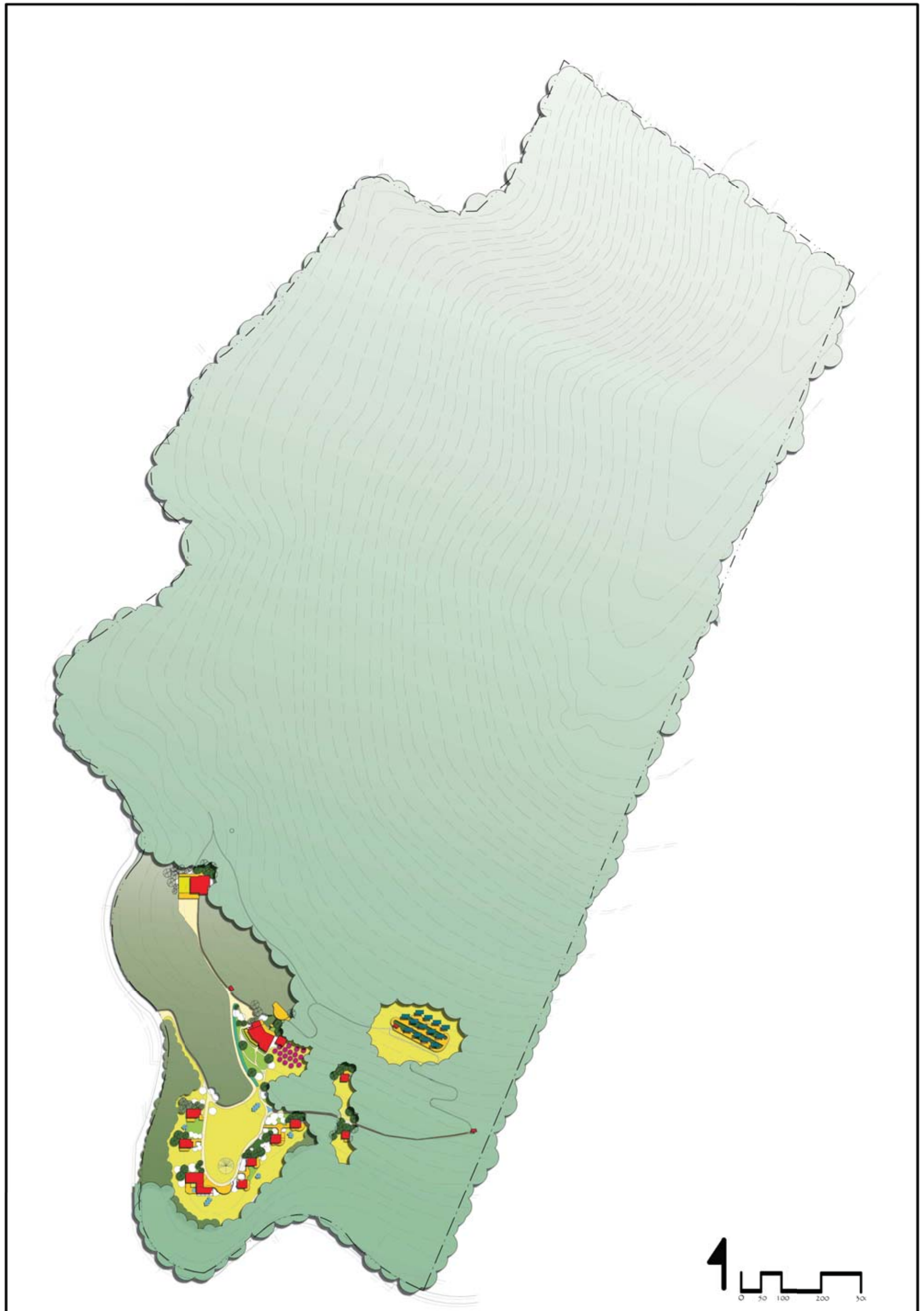


Image 4.4: Master Plan

Existing Conditions:
from top left, Art Studio, Horton Home, VT Research Center

based on the layout, placement and efforts to minimize the material use and promote recycling. The research center will be removed and materials will be reused and recycled to the best of our ability. This is based on the limited buildable area of the site, with solar access. The art studio will be renovated to apartments for a few spa employees. The addition of a green-roof over a garage will supply herbs and food, while shading the guest vehicles. There are at least two natural springs that currently serve the existing buildings and a man-made pond in front of the research center. The man-made pond will house water cisterns and be filled based on the high permeability of the soil and placement. *See Image 4.4.*

The design process began with an examination of existing conditions and environmental qualities. Assessment of the slopes, soils, hydrology, and vegetation on site give rise to opportunities for buildability, solar and wind power generation and waste treatment processes. The site has a majority of very steep slopes and unstable soils minimizing the area appropriate for building, forest management or waste treatment.

A sun and shadow analysis determined the available solar access based on optimal solar aspect, which is due south to 30 degrees east or west of due south. The southeastern ridge of Salt Pond Mountain is most favorable for the production of solar energy. Wind generation is an opportunity for this site, yet due to costs of the systems and efforts to maintain the viewshed from Bald Knob we elected to design for only solar system.

The site analysis established the opportunities and constraints of the site for development. *See Image 4.5.* Based on the northwest aspect of the site and high slopes this site is not ideal for development, but through careful planning a regenerative community can be established with minimal impact. Beginning with a McHargian "layer cake" analysis informs us much about the opportunities of the site and the general design planning. Yet this is not specific enough for the development of design

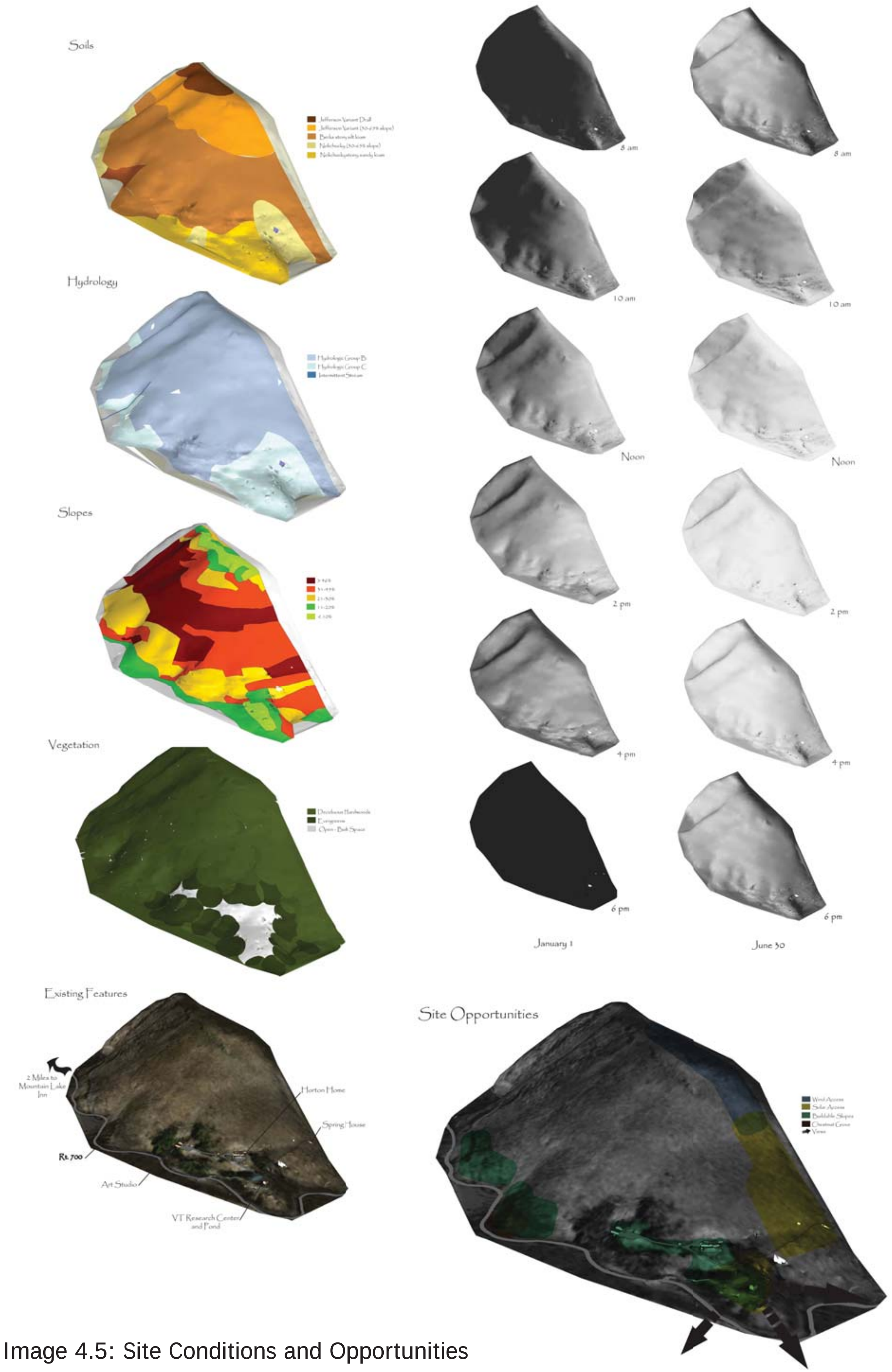


Image 4.5: Site Conditions and Opportunities

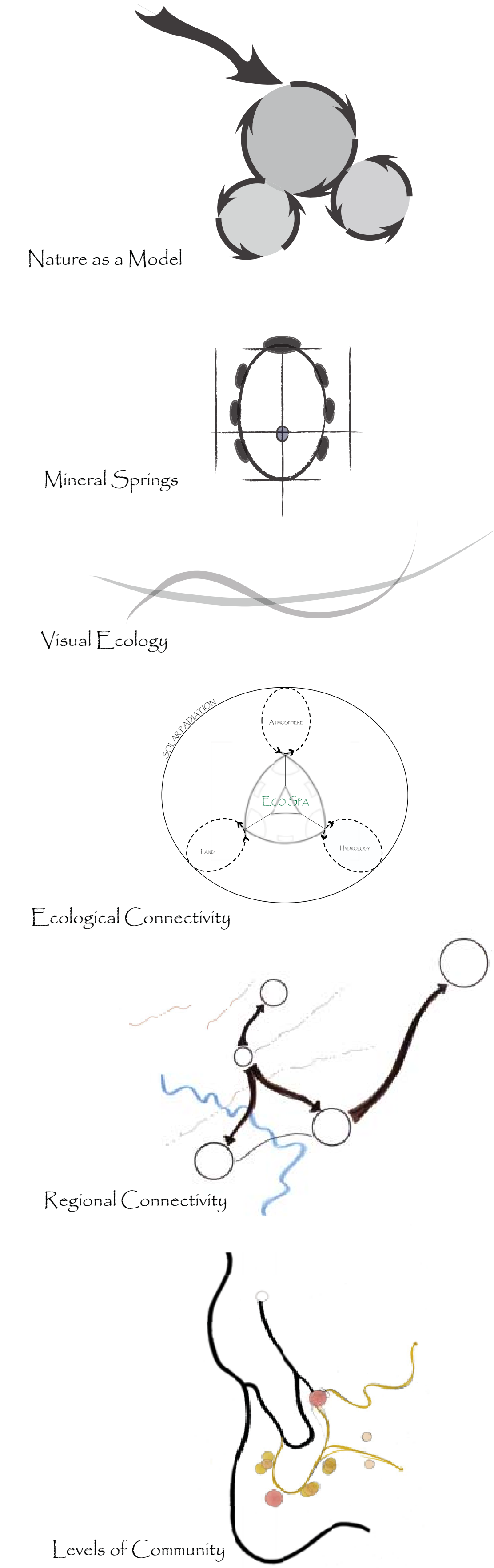


Image 4.6: Process Drawings

layout and details. Therefore we employ design-driven and regenerative principles to further the development process utilizing nature as a model. *See Image 4.6.*

The Virginia historical mineral springs served as a cultural precedent for the design of the EcoSpa Community. Historically, Mineral Springs of Virginia were important landscape places of convergence, rejuvenation, contemplation, and a place to experience nature. (Katen, 2004). The springs are the precursors to the spa resorts around the country today, the few still in existence have been upgraded to contemporary spas. The primary structuring features of these landscapes is a central green, “the quad.” This element along with a series of trails assisted in the structuring and developing the experience in the layout of the Mountain Lake Spa cabins. The cabins are developed around the central green associated with either the spa or the community center, with exception of the honeymoon cabins which are located with individual relation to the landscape. Historically, these greens where imposed on the landscape. This goes against designing within the natural context. Therefore, the central green of the EcoSpa is created as a meadow and employ the essence of developing an underlying community structure for the development. The layout consists of multiple layers of community level, from the individual cabins, to the cabin groupings, up to the entire development as a community itself. Secondarily solar hot water infrastructure was a factor in orientation of the buildings. Lastly, the architecture of the buildings utilizes the topography to assist in natural heating, cooling, and insulation through earth-berming the

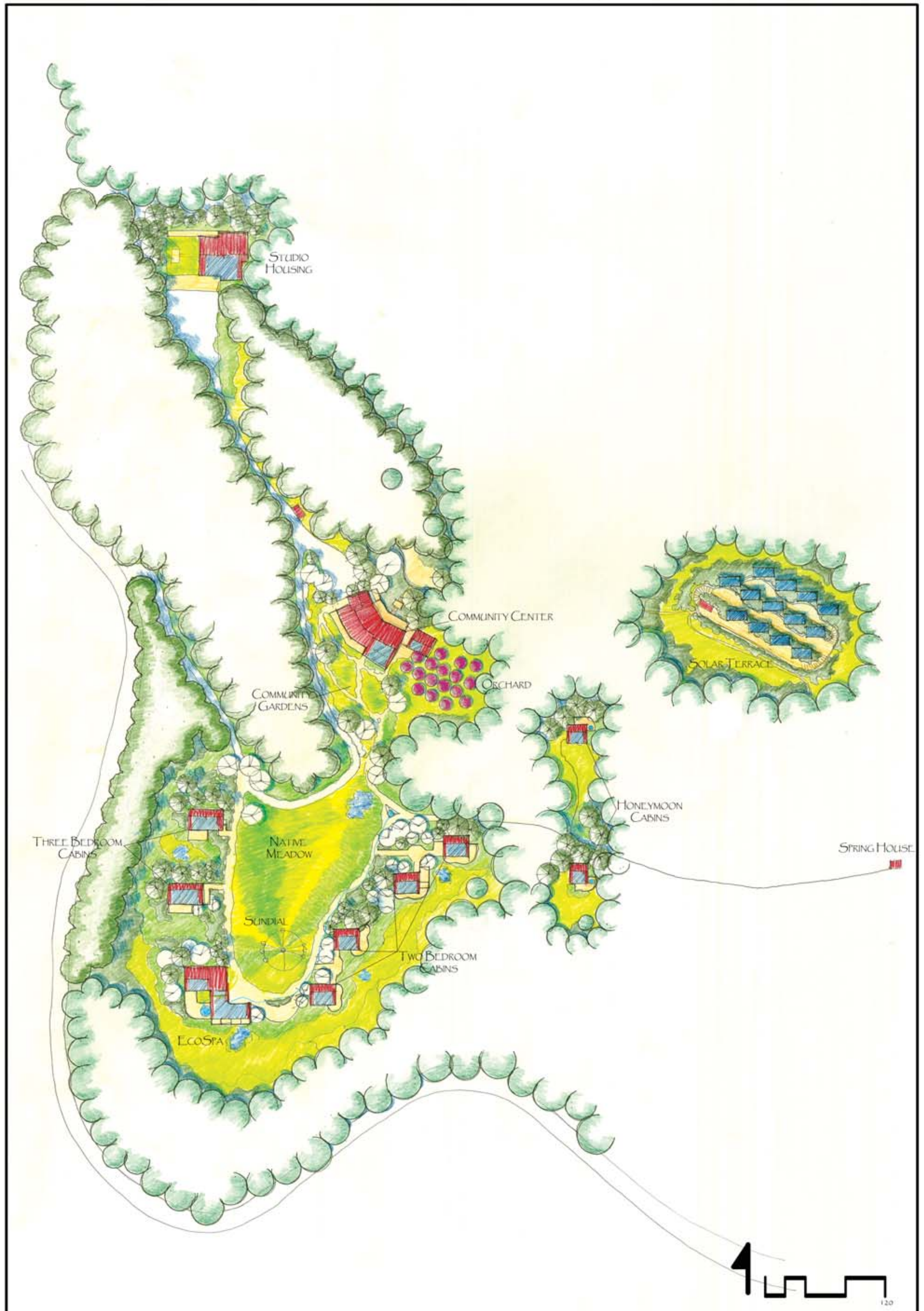
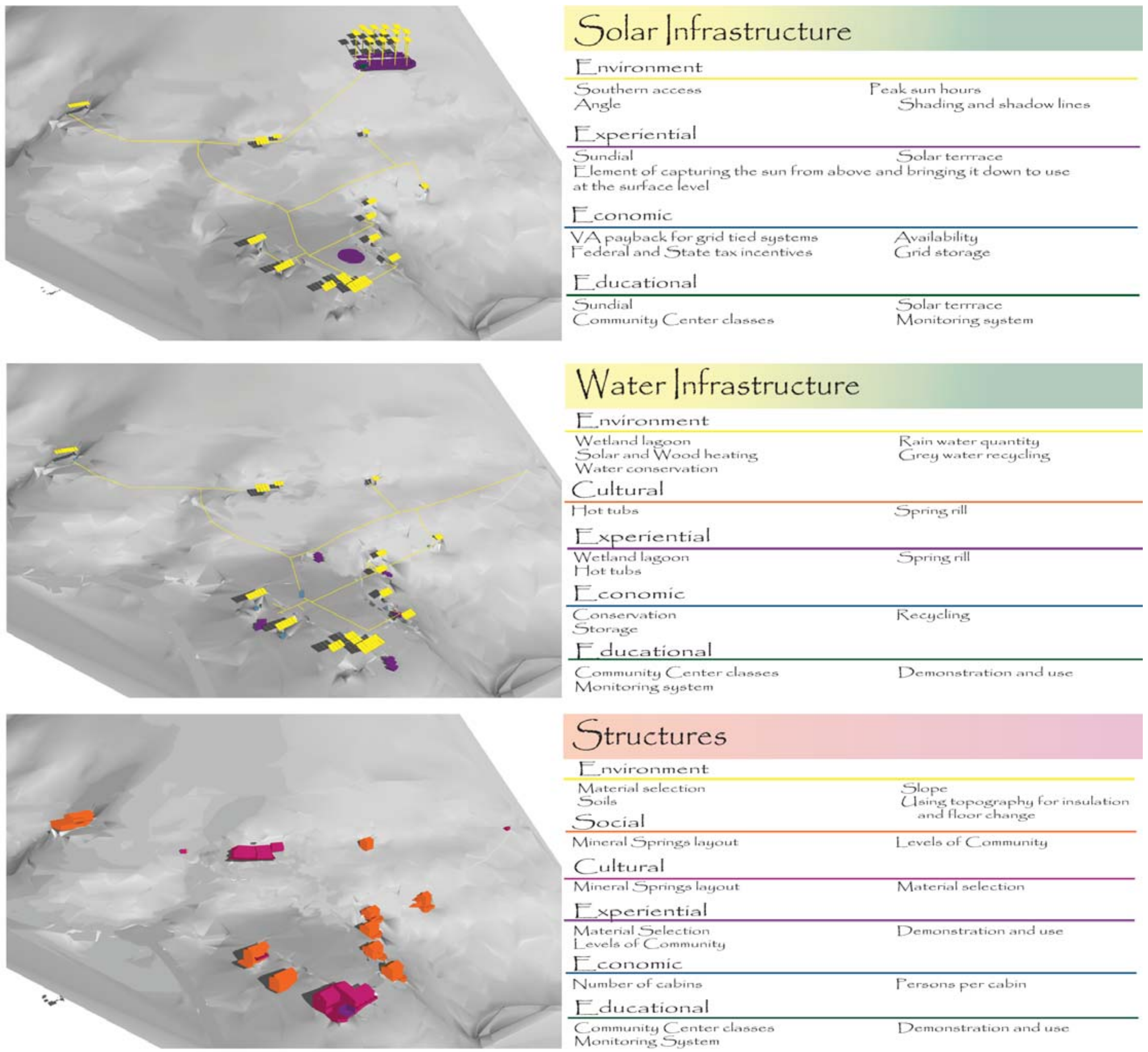


Image 4.7: Community Master Plan

lower levels of the structures. *See image 4.7*.

The selection of this landscape as a structuring feature was based on the ideas of these landscapes as places of convergence, rejuvenation and being one with and experiencing nature. Through these elements, the Mountain Lake Spa develops to express the human ecosystem in that in certain elements are built on the land, many are built from the land and others a weaved with the natural environment. Each intervention of the built environment is carefully developed to express our relationship and interconnectivity with the natural environment.

Image 4.8: Sections



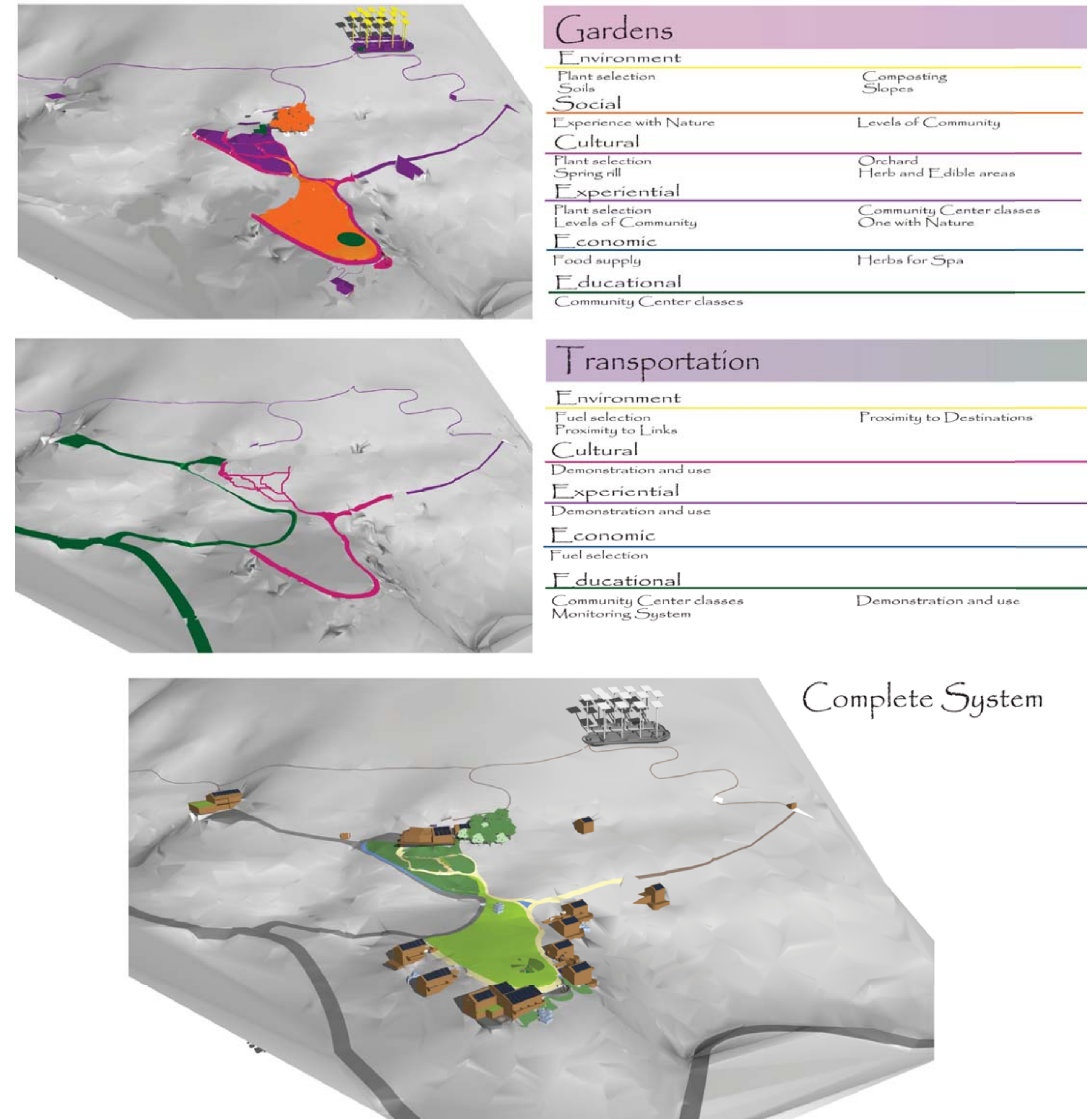


Image 4.9: Axonometric Systems Design

Energy Infrastructure:

The energy systems for the site are driven by solar power. The goal of the community is to have a net zero energy use. Multiple aspects of the framework where utilize collectively to meet energy requirements of the community. *See Appendix A.* The system is grid tied based on the inefficiency of batteries, and Virginia offers a buy-back system and tax incentives which will assist in lowering the capital cost of installation. The solar panels will be tied into the vernacular through the development of a solar terrace area accessed by a trail system. Placing the panels above the living surface represents the tree canopy directly tying the natural process of energy absorption through plants, with then mechanical version produced by man. While the paving pattern of the terraces will reflect the circuitry of the photovoltaic arrays. *See Image 4.9 and 4.10.* Solar hot water systems will be installed on the individual cabins for direct supply. This system will supply hot water needs for general use and the radiant floor heating system. *See Appendix B.* The back-up for this system is wood heating through masonry stove units.

Integrated Regenerative Design Framework

Nature as a Model

Environment

Prioritize Sustainable Design
Multiple Use and Diversified Systems
Utilizing and Enhance Natural Systems
Site Characteristics and Environmental Opportunities
Conservation and Recycling
Promote Storage

Cultural

Maintain Cultural Identity and Social Fabric
Design for People and Human Health
Integrated Communities and Social Units
Convergence of Approriate Technologies to the Vernacular Landscape
Conservation and Recycling
Prioritize Sustainable Design

Social

Integrated Communities and Social Units
Minimize Conventional Transportation
Design for People and Human Health
Information based Decision-making
Connectivity to the Great Whole

Experiential

Multiple Use and Diversified Systems
Utilizing and Enhance Natural Systems
Convergence of Approriate Technologies to the Vernacular Landscape
Prioritize Sustainable Design
Conservation and Recycling

Economic

Minimize Conventional Transportation
Utilizing and Enhance Natural Systems
Multiple Use and Diversified Systems
Economics and Approriate Technological Selection
Promote Storage

Educational

Economics and Approriate Technological Selection
Minimize Conventional Transportation
Convergence of Approriate Technologies to the Vernacular Landscape
Prioritize Sustainable Design

Water Infrastructure:

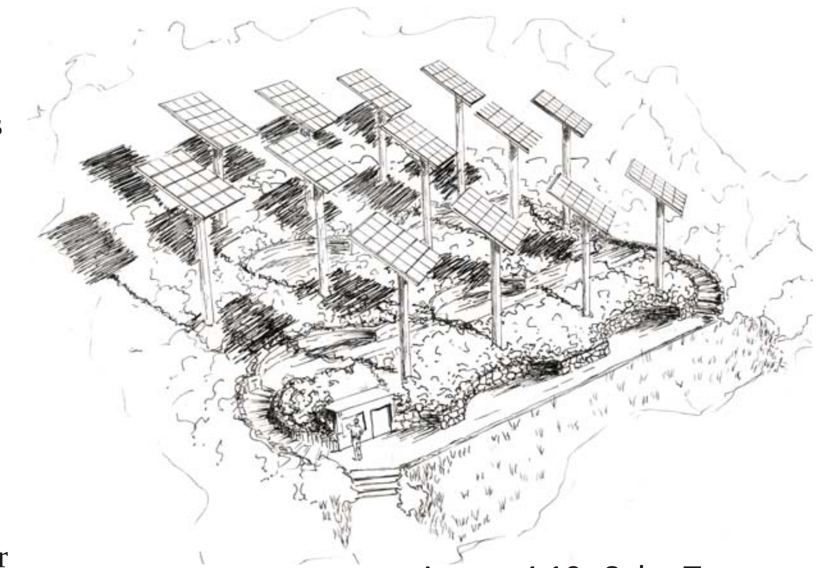
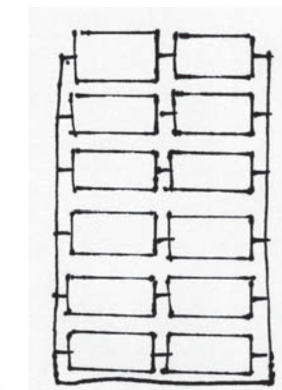


Image 4.10: Solar Terrace

Providing ample water supply links the community to the hydrologic system, harnesses solar energy to provide a heat source, and utilizes the natural cleansing systems to treat waste water. Within the water management systems we will utilize the efficient natural drainage due to few hydrological concerns and minimal additions to impervious surface area, due to a rainwater harvesting system. All water from the roof surfaces will be collected within local and centralized cisterns to supplement the potable water supply from the springs and provide a source for the hot tubs and radiant heating system. There will be a natural imbalance between utilization of the cabins and resources available from the individual building. Therefore the central cistern will provide back up potable water supply. It was also thought that many of these roofs could be green roof system providing insulation. Yet based on annual rain and snow fall it is necessary to harvest from the entire roof area to meet community water requirements. The greywater recycling system will reduce the water needs within individual buildings, and any irrigation requirements. *See Image 4.9 and 4.11.* The solar hot water system requires solar access from the roof top directly connecting the functions of the community with the natural environment.


Paving pattern

Structures:

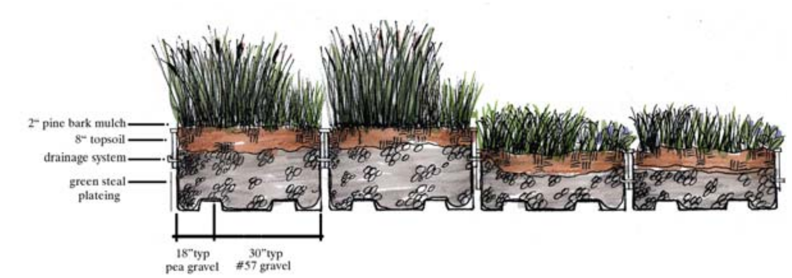


Image 4.11: Wetland Treatment

Earthberming the buildings and using the slope for structure and insulation, as well as material selection incorporated the environmental components. *See image 4.8.* The social, cultural, and experiential elements of design were incorporates through material selection, developing levels of community and lifestyle demonstration through utilization. *See Image 4.9 and 4.12.* The material selection for the cabins consist of a variety of traditional, non-toxic, natural, and innovative resources maintaining a rustic contemporary atmosphere. The primary means of heat to these homes is wood heat, and radiant floor heating. The wood furnaces are coupled with water heating

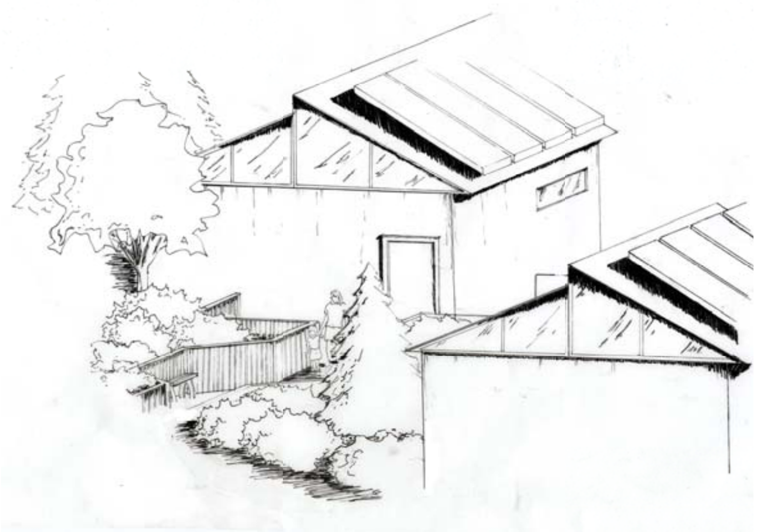


Image 4.12: 2-Bedroom Cabin Community Area

Image 4.13: Eco-Spa Reception

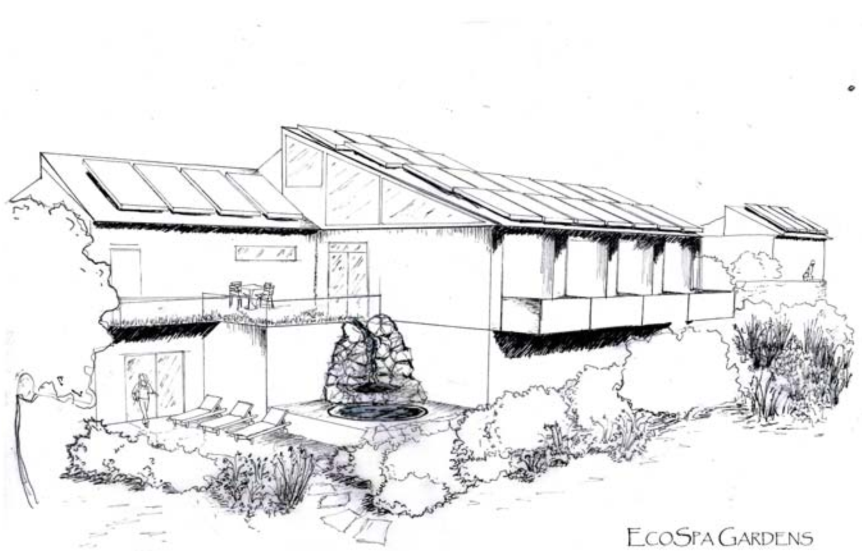


Image 4.14: Eco-Spa Reception

elements, which serve as the primary heat source for the water in the radiant floor system. Based on the dependence on wood a forest management program must be a factor of this design. Based on the erosiveness, slope and limited fertility of the soils, wood production is not recommended on site. This requires the fuel to come from another source. Mountain Lake has much property and can provide the wood from other local areas. The Wilderness Conservancy at Mountain Lake will develop the forest management program to supply the wood for the EcoSpa.

The EcoSpa is a place of relaxation, pamper and rejuvenation. The two story spa greets you with a sunsoaked reception area leading out onto a green-roof patio, where you could relax with water or juice before your spa treatment. The upper level is divided into two wings. The east wing is more private with individual treatment rooms and private balcony. The west wing is more open for small group and couple treatments as well as medical procedures such as micro-dermabrasion. The lower level is open, housing the general maintenance treatments, such as manicures and pedicures. The locker rooms, showers, and saunas are also located to the north side of this level. The central open area of the lower level is set up, so that all equipment can be moved out. This allows the area to be used as a party and reception space. The green-roof and lower patio are available for guest use for relaxing, reading, or having a cocktail and snacks during the majority of the day. *See Image 4. 13 and 4.14.*

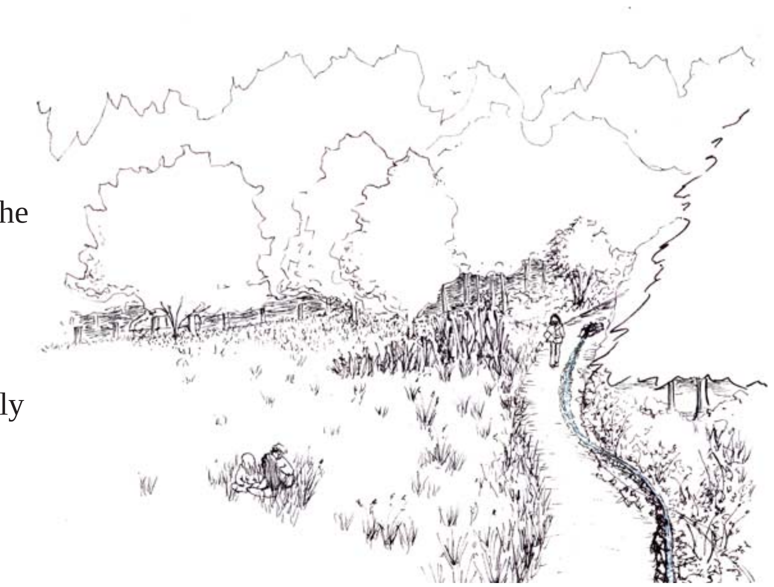


Image 4.15: Meadow Path around the Native Green

Gardens:

The gardens at the EcoSpa are mainly for enjoyment and the experience of being in nature. There are multiple trail systems which take you around the community and link to the spring house, solar terrace, and chestnut research grove. The solar terraces develop the element of education which is continued through the vegetated sundial in the central meadow. There is a rill of water which emerges like a spring at the convergence of the spring house trail and meadow path. This rill meanders along the meadow path leading the guest to the spa. *See Image 4.9 and 4.15.* Following the path to the north of the convergence will lead you through the community gardens and orchard surrounding the community center. *See Image 4. 16.* These gardens are intermixed with native and edible plantings. Collectively these gardens along with the two roof-gardens and green house supply a majority of the herbs used in the spa, and supplement the community food source. This element bring is the educational and economic elements into the gardens, when examined as a resource and utilized in community programs. *See Image 4.9.*

Image 4.16: Rill in Meadow Path

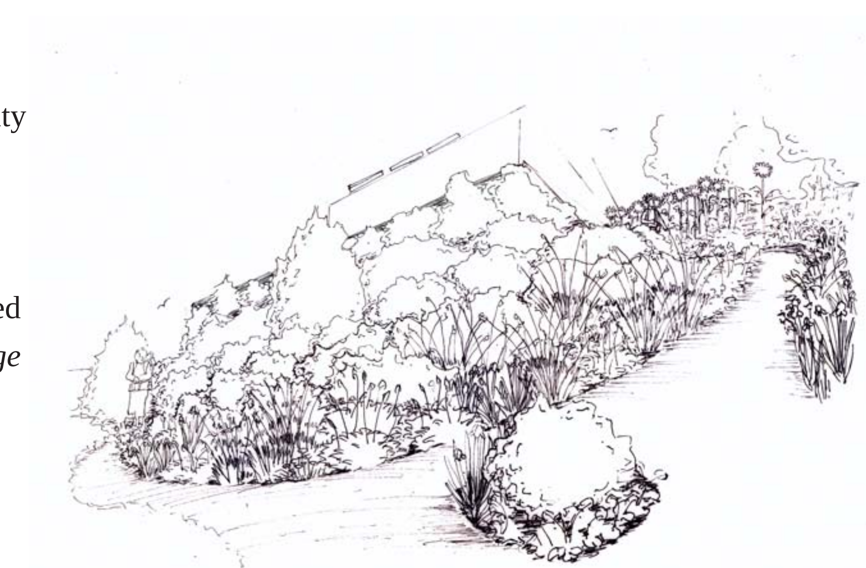


Image 4.17: Gardens around Community Center

Image 4.18: Gardens to Spring House

Transportation:

The transportation around the site is predominately passive, in term that guests can walk everywhere. When a guest arrives their car is unpacked and packed into a solar powered vehicle and driven to their cabin. Then the guest's car is taken and parked for the entire stay under the green-roof addition to the art studio. The solar cars are available for guest use during their stay, particularly for trips to the Mountain Lake and local trailheads in Jefferson National Forest. There are also a couple of natural gas vehicles available for traveling longer distances. *See Image 4.9.* The effort of this system is to demonstrate and experience the alternative fuel choices.

Material Selection:

The materials utilized in the design are wide ranging due to the scope of the project. Yet in material selection there was effort toward environmentally sensitivity in production and use, while maintaining the local character. The site offers opportunities for material use; this includes utilizing the ample stones in the landscape patios and walkways. Wood removed during staged construction could be utilized, yet this would be minimal and could also provide as a heat source for the cabins. In efforts to reduce transportation and utilize local materials I've designated use of the LEED standards definition for local materials. This limits the access to materials within 500 miles from the site. (USGBC, 2005).

Community Evaluation:

The entire design is based on the principle of creating a human based ecosystem utilizing "Nature as a model." This is revealed through the elements designed within the integrated regenerative design framework. *See Image 4.19 and 4.20.* Under the first strategy of design which speaks more to the evaluation of the site for suitability the design has met this framework through reuse of the community center, and siting of the community, the solar energy generation, and hot water collectors. These elements also assist in meeting criteria two, utilizing the natural systems on site, as well as sighting the cabins to utilize the challenging topography of the site to collect solar hot water, insulation of buildings, and natural cooling. A variety of plantings are also utilized to promote natural heating and cooling, through evergreen windbreaks on the north and west sides of buildings, and shading by deciduous plants on the east side. Water management is accomplished by natural drainage and bioswales, and through the utilization of waste treatment wetland lagoons. All of these aspects connect the community to the greater natural cycles inclusive of solar, wind, hydrologic, and nutrients cycles through minimal gardening. The resort community is also connecting to the great social context through dependence on local organic farms for food supply and local suppliers for material goods. The community is also directly tied to the Mountain Lake community for additional amenities and also for management and maintenance of the community. A system of multiple pathways is developed on a number of levels. In terms of the energy systems there are back-up systems through maintaining a grid tied system, and utilizing plantings and wood heat for climate control within the buildings, and hot water supply. Spring water is designated as a back-up supply to rainwater harvesting, while the grey water system will assist in the reduction of water requirements on site.

In terms of the social and cultural premise, human health is promoted through the walkability of the site and promoting immersing oneself in nature through hiking and biking. Materials and ventilation of the buildings are selected for low VOC emmitance, natural, and non-toxic criteria. The spa will also promote human health through the treatments and use of all natural materials within the treatments. These elements also promote the historical precedent of the historic mineral springs. Although this was an element of building placement, it is also to promote the enhancement of the man-nature relationship and foster a growth in consciousness of our connection to nature. The material use of the buildings was selected in the rustic cabin design and use of stones from on site to maintain the cultural heritage and traditional social fabric of the area. The sighting of the buildings also accomplishes the criteria on multiple housing units, through the multiple levels of cabin units and assortment of places for gathering. The development of the community center to house the caretakers and conversion of the art studio to employee apartments also allows for guests and employees to commingle at multiple levels. The management of the resort at the community level is not directly applicable based of the type of development, although the caretakers and employees should be included in the management of this facility through Mountain Lake.

In terms of economic viability for this resort is a priority, yet due to the current economic structure of Mountain Lake Inc. this aspect is not thoroughly evaluated in this design. Although, the systems on site are selected base on their economic viability due to tax incentives and Virginia AEP energy buy back program. The solar system can also be staged in implementation based on popularity of the EcoSpa resort. The solar system and water systems connect to the economies of the site conditions based on their placement and utilization of the natural systems existing on site, and through efficiency. This also ties into the storage of materials and resources. Within the resort community there is adequate storage for rainwater harvesting and greywater recycling. The solar energy is stored through tying to the grid system. There will also be storage of food through drying and canning the excess of these materials. The resort will promote the use of alternative vehicles during a guests stay through supplying access to a natural gas or eclectic vehicle. Providing housing for some employees will also promote alternative forms of transportation and living close to work to reduce commutes. Although there is a major down fall in the transportation facet of this design. A majority of the guests, employees, materials and supplies will utilize standard transportation mechanism to access the resort.

The technologies selected for the site serve multiple purposes and therefore are designed into the vernacular to accomplish these goals. The technological systems where designed to promote regenerative design through education and experience, as a major goals of design. This is accomplished through the solar terrace, wetland lagoons, ad green roof systems which also provide social and landscape amenities. There is also a monitoring system within each building, community center and the solar park which allows the guests to track the systems during their stay. Based on the goal of education and experience to effect social consciousness the final premise of promoting regenerative design can be seen through the entire development from the use of native planting and the sundial to the solar terrace and monitoring systems.

	Power	Transportation	Community Layout	Recycling	Conservation	Waster Treatment	Space Heating	Water Heating	Community Center	Rain Harvesting	Trails and Paths	Solar Terraces	Cabins	Gardens and Orchard	Spa	Sundial
Environmental	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Social		●	●						●		●	●	●	●	●	●
Economic	●	●		●	●		●	●		●			●	●	●	
Cultural			●						●		●		●	●	●	
Experiential	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Educational	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●

Image 4.19: Application of Site Elements to the Regenerative Design Framework Matrix

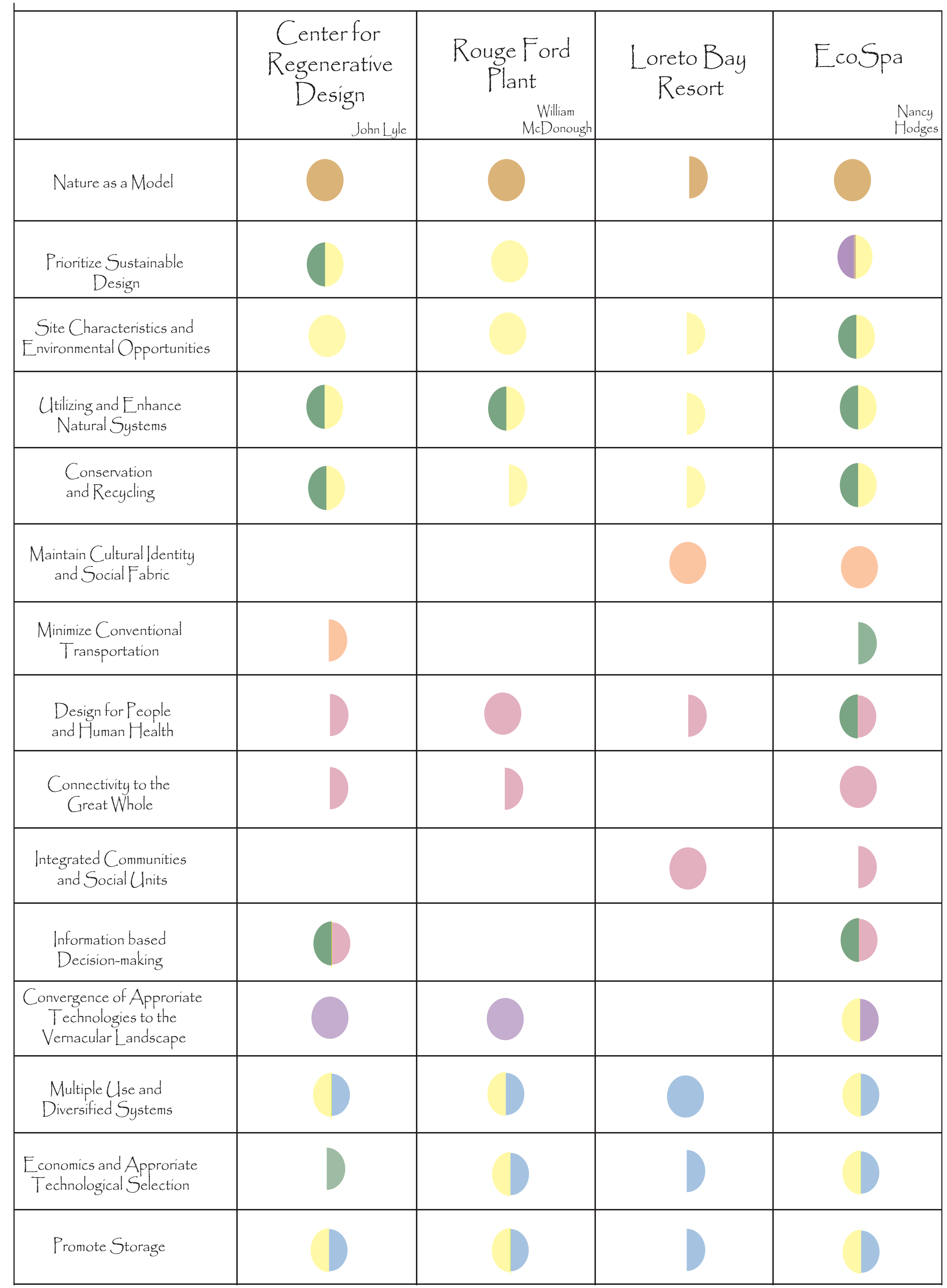


Image 4.20: Comparison Matrix of Frameworks in Practice

Chapter Five:

Conclusion and Reflections:

The EcoSpa at Mountain Lake successfully developed with a resort community based on the integrated regenerative design framework. Utilizing the new strategies allowed for flexibility in the development of the community base on site conditions, incorporated social and culture components, and established an economically viable resort.

There are similar issues to the case study examples which arose through the development including transportation of guests, employees and material goods, social equity, and connectivity to degenerative systems. In all cases there has been an effort to promote a change in perspective through innovative technologies and structural components. Transportation of material goods and guest to the site is and issue attributed to our current state of society and available means of transportation. To encourage the utilization of alternative means of transportation the design focuses on walking, biking, and hiking on site. For longer distances there is a supply of alternative fueled vehicle available for use. The transportation of employees and general management of the site introduce social issues seen in Loreto Bay. The EcoSpa must employ personnel to provide spa treatments and caretakers for the general management of the site throughout the year. One solution to subside some of these issues is to provide residences for two primary caretakers, as well as a few apartments for a few of the full time employees. From this the decision to transform the art studio and secondary building outside the community center into apartments. The primary caretaker residence will be within the community center. The custodians, maids, linen services, and general maintenance will be linked to the Mountain Lake Inn. In this develops an issue with connectivity, the predominate issue of regenerative developments today. The EcoSpa resort community relies on connectivity to a society which is not sustainable in nature, compromising the goals of the development. This is one of the most defeating issues with regenerative design because we desire for these communities to be connected to the larger society, often very little within that community is sustainable. Therefore regenerative design breaks down in practice based on connectivity and dependence on a global society. McDonough's approach influencing production and business structure is affecting the global economy to promote regenerative systems, assisting in the amelioration of this issue. The success of regenerative systems does not depend on a fully regenerative world, but simply on enough production and transportation systems which follow these design principles. Ideally we will reach a time are regenerative design is dominant, yet with our world energy requirements this is impossible. Only through reuse, recycling, new business strategies, design methods and innovative efficient energy production mechanisms and product efficiencies we can begin to approach this ideal.

Appendix A:

Solar Sizing

Energy Requirements for the Mountain Lake Mile Horton Center Resort Development										
Community	**watts**	**quantity**		**hrs/day**		**day/wk**			**wh/day**	
Refrigerator		1							5000	
Freezer		1							8000	
Convection Oven	9500	1	x	5	x	7	/	7	47500	
	3500									
	2500									
	3500									
Cooktop	7400	1	x	5	x	7	/	7	37000	
small	1200									
med	2000									
large	2100									
TV	300	3	x	3	x	7	/	7	2700	
standby	0.5	2	x	21	x	7	/	7	21	
Stereo	60	2	x	4	x	4	/	7	274	
standby	0.5	2	x	20	x	7	/	7	20	
Alarm Clock	5	2	x	24	x	7	/	7	240	
Dishwasher		2							2200	
Clothes washer	550	1	x	2	x	6	/	7	943	
Dryer	4000	1	x	2	x	6	/	7	6857	200 kwh/52 load
Computer	200	3	x	8	x	6	/	7	4114	
standby	4	2	x	16	x	7	/	7	128	
Fax/printer	4	1	x	1	x	7	/	7	4	
standby	4	1	x	11	x	7	/	7	44	
Coffeemaker	800	2	x	1	x	7	/	7	1600	
Expresso	800	1	x	1	x	7	/	7	800	
Fans	80	8	x	12	x	7	/	7	7680	
Lighting	9.5	48	x	4	x	7	/	7	1824	
	9.5	12	x	12	x	7	/	7	1368	
estimation	4.5	48	x	6	x	7	/	7	1296	
	2	68	x	6	x	7	/	7	816	
total									130430	wh/day
									130	**kwh/day**

Spa	**watts**	**quantity**		**hrs/day**		**day/wk**			**wh/day**	
Fridge		2							1400	241kwh/yr
Clothes washer	550	1	x	2	x	6	/	7	943	
Dryer	4000	1	x	2	x	6	/	7	6857	
Microwave	800	2	x	0.5	x	6	/	7	686	
Stereo	60	4	x	6	x	6	/	7	1234	
standby	0.5	1	x	18	x	7	/	7	9	
Computer	200	2	x	8	x	6	/	7	2743	
standby	4	2	x	16	x	7	/	7	128	
Fax/printer	4	1	x	2	x	6	/	7	7	
standby	4	1	x	22	x	7	/	7	88	
Lighting	9.5	48	x	4	x	7	/	7	1824	
	9.5	12	x	4	x	7	/	7	456	
estimation	4.5	48	x	6	x	7	/	7	1296	
	2	68	x	6	x	7	/	7	816	
Duct Fans	1000	1		5		7		7	5000	
Spa equipment	3000	1		10		6		7	25714	
Water pump	1000	1		4		6		7	3429	
total									52630	wh/day
									53	**kwh/day**
Cabins single	**watts**	**quantity**		**hrs/day**		**day/wk**			**wh/day**	
Fridge		1	x	24	x	7	/	7	700	
Convection/microv	1550	1	x	1	x	7	/	7	1550	
DVD	11	1	x	1	x	2	/	7	3	
TV	120	1	x	1	x	7	/	7	120	
standby	0.5	2	x	21	x	7	/	7	21	
Stereo	60	1	x	4	x	4	/	7	137.14	
standby	0.5	1	x	20	x	7	/	7	10	
Alarm Clock	5	1	x	24	x	7	/	7	120	
Coffeemaker	800	1	x	1	x	7	/	7	800	
Fans	80	3	x	12	x	7	/	7	2880	
Lighting	9.5	10	x	3	x	7	/	7	285	
	9.5	2	x	2	x	7	/	7	38	
estimation	4.5	4	x	4	x	7	/	7	72	
	2	8	x	4	x	7	/	7	64	
total									6800	wh/day
									x2	
total									13601	wh/day
									14	**kwh/day**

Cabins doubles	watts	quantity		hrs/day		day/wk			wh/day	
Fridge		1	x	24	x	7	/	7	700	
Convection/microv	1550	1	x	1	x	7	/	7	1550	
DVD	11	1	x	1	x	2	/	7	3.142857	
TV	120	1	x	1	x	7	/	7	120	
standby	0.5	2	x	23	x	7	/	7	23	
Stereo	60	1	x	4	x	4	/	7	137.14	
standby	0.5	1	x	20	x	7	/	7	10	
Alarm Clock	5	2	x	24	x	7	/	7	240	
Computer	200	1	x	4	x	7	/	7	800	
standby	4	1	x	6	x	7	/	7	24	
Coffeemaker	800	1	x	1	x	7	/	7	800	
Fans	80	5	x	12	x	7	/	7	4800	
Lighting	9.5	16	x	3	x	7	/	7	456	
	9.5	2	x	2	x	7	/	7	38	
estimation	4.5	6	x	4	x	7	/	7	108	
	2	8	x	4	x	7	/	7	64	
total									9873	wh/day
									x4	
total									39493	wh/day
									39	**kwh/day**
Cabins triples	**watts**	**quantity**		**hrs/day**		**day/wk**			**wh/day**	
Fridge		1	x	24	x	7	/	7	700	
Convection/microv	1550	1	x	1	x	7	/	7	1550	
DVD	11	1	x	1	x	2	/	7	3	
TV	120	1	x	1	x	7	/	7	120	
standby	0.5	2	x	21	x	7	/	7	21	
Stereo	60	1	x	4	x	4	/	7	137.14	
standby	0.5	1	x	20	x	7	/	7	10	
Alarm Clock	5	2	x	24	x	7	/	7	240	
Computer	200	1	x	4	x	7	/	7	800	
standby	4	1	x	6	x	7	/	7	24	
Coffeemaker	800	1	x	1	x	7	/	7	800	
Fans	80	5	x	12	x	7	/	7	4800	
Lighting	9.5	21	x	3	x	7	/	7	598.5	
	9.5	4	x	2	x	7	/	7	76	
estimation	4.5	8	x	4	x	7	/	7	144	
	2	8	x	4	x	7	/	7	64	
total									10088	wh/day
									x2	
									20176	wh/day
total									**20**	kwh/day
Resort systems	**watts**	**quantity**		**hrs/day**		**day/wk**			**wh/day**	
Water pumps									3000	wh/day
Electrical systems									400	wh/day
Solar Cars		6		22.4		7			22400	wh/day
filters etc.									50	wh/day
									282578	wh/day
									283	**kwh/day**
Total resort energy needs									**102859**	**kwh/yr**

Photovoltaic Analysis

kw/day:	**285**	**kw/day**	
collector area:	**1980**	**sq. ft.**	**603.504 sq. meter**
system efficiency:	0.75	ns	0.1125
collector tilt:	37.5	deg	
system cost:	176	$/sq. ft.	
cost	350,000	$	
electricity rate:	0.08	$/kWh	

SOLAR RADIATION FOR FLAT-PLATE COLLECTORS FACING SOUTH AT A FIXED-TILT (kWh/m2/day)
Roanoke, VA

	Average	**Average**	**Average**	**Average**	
Insolation		South	South	South	
MONTH	0	lat -15	lat	lat +15	90
Jan	2.3	3.3	3.7	3.9	3.6
Feb	3.1	4	4.3	4.5	3.7
Mar	4.1	4.8	5	4.9	3.6
Apr	5.2	5.6	5.5	5.1	3.1
May	5.8	5.8	5.5	4.9	2.5
Jun	6.2	6	5.6	4.8	2.3
Jul	5.9	5.9	5.5	4.8	2.4
Aug	5.5	5.7	5.5	5	2.8
Sep	4.5	5.1	5.1	4.9	3.3
Oct	3.6	4.6	4.9	4.9	3.9
Nov	2.5	3.5	3.9	4.1	3.6
Dec	2	2.9	3.4	3.6	3.3
Year	4.2	4.8	4.8	4.6	3.2

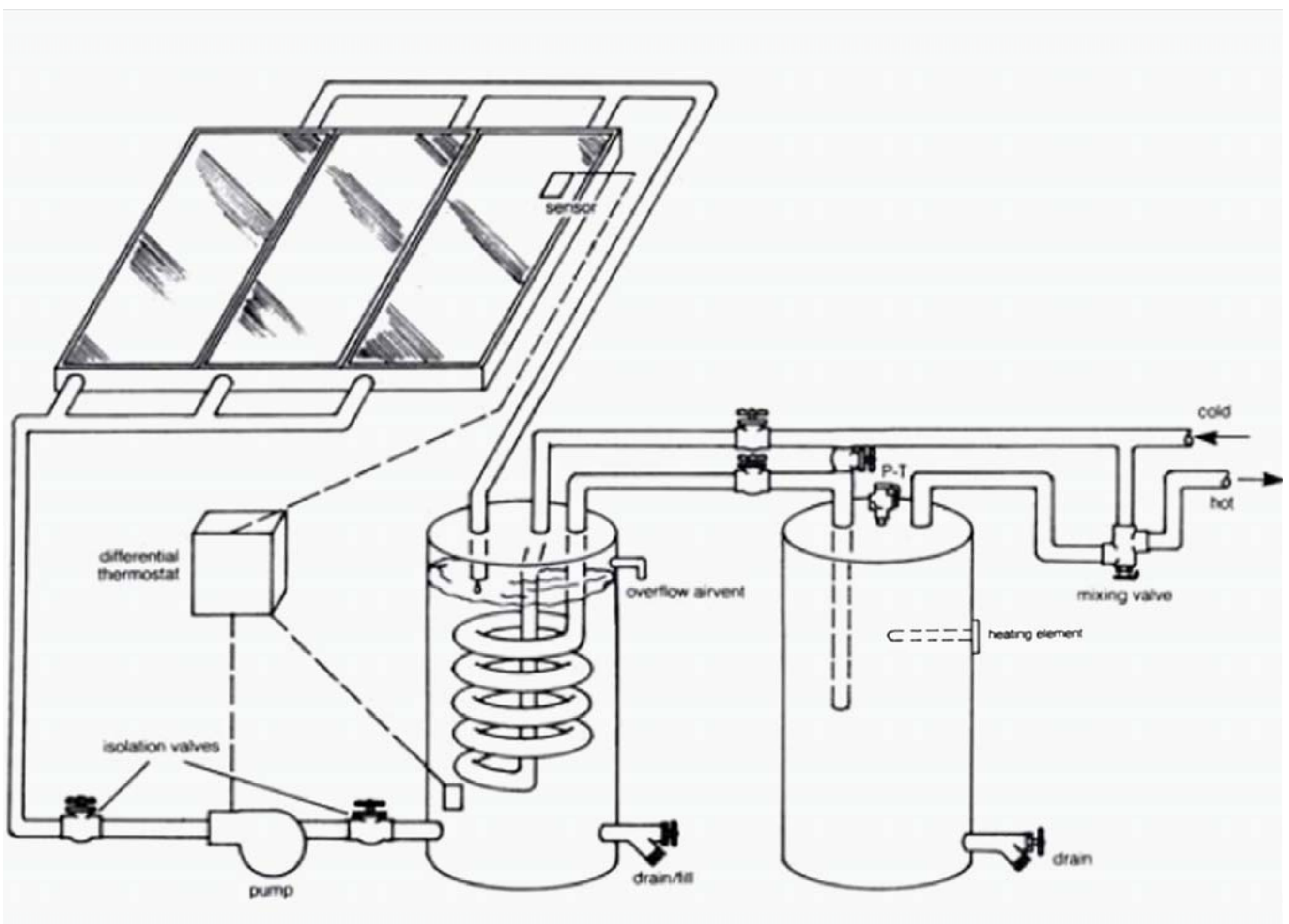
Month	**#days**	**Demand**	**It**	**Solar Coll.**	**Dem-Sol**	**Aux. en**	**%solar**
January	31	8835	3.7	7787	1048	1048	0.88
Feburary	28	7980	4.3	8174	-194	0	1.00
March	31	8835	5	10524	-1689	0	1.00
April	30	8550	5.5	11203	-2653	0	1.00
May	31	8835	5.5	11576	-2741	0	1.00
June	30	8550	5.6	11406	-2856	0	1.00
July	31	8835	5.5	11576	-2741	0	1.00
August	31	8835	5.5	11576	-2741	0	1.00
September	30	8550	5.1	10388	-1838	0	1.00
October	31	8835	4.9	10313	-1478	0	1.00
November	30	8550	3.9	7944	606	606	0.93
December	31	8835	3.4	7156	1679	1679	0.81
Year		104025	4.8	119623		3333	

units= kw/sq. m.

Annual Sum Solar	96.8%	
$Savings elec.	8,055.37	$/yr.
SPP elec	43.26	years

Appendix B:

Solar Hot Water Sizing:



Randolph, and Masters: Drainback Solar hot water system with auxillary heater, or an on demand back-up heater.

EcoSpa Resort at Mountain Lake

Cabins:	persons	gallons	Total		
1 bedroom	2	40	80		
hot tubs	2	700	1400		
2 bedroom	6	120	480		
3 bedroom	8	160	320		
spa			400	Hot tubs:	1 cu. Ft. =7.48 gallons
hot tubs			1000		
Total:	184		3680		2*500

gal/day:	3680	gal/day
collector area:	**3128**	**sq. ft.**
Th:	130	deg F
Tc:	55	deg F
system efficiency:	0.4	ns
collector tilt:	37.5	deg
system cost:	40	$/sq. ft.
cost	125120	$
electricity rate:	0.11	$/kWh

(actual cost per kWh on last AEP bill * includes tax and services)

Month	#days	Demand	It	Solar Coll.	Dem-Sol	Aux. en	%solar
January	31	71357040	1404	54439128	16917912	16917912	0.76
February	28	64451520	1631	57144473	7307047	7307047	0.89
March	31	71357040	1897	73566389	-2209349	0	1.00
April	30	69055200	2086	78312608	-9257408	0	1.00
May	31	71357040	2086	80923028	-9565988	0	1.00
June	30	69055200	2124	79736474	-10681274	0	1.00
July	31	71357040	2086	80923028	-9565988	0	1.00
August	31	71357040	2086	80923028	-9565988	0	1.00
September	30	69055200	1935	72617146	-3561946	0	1.00
October	31	71357040	1859	72095062	-738022	0	1.00
November	30	69055200	1479	55530758	13524442	13524442	0.80
December	31	71357040	1290	50025145	21331895	21331895	0.70
Year		8.4E+08	1821	836236267		59081296	

units= BTU/sq. ft.

Annual Sum	93.0%	
$Savings elec.	25,166.94	$/yr.
SPP elec	4.97	years

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VITA:
Nancy Akers Hodges

"I believe we can accomplish great and profitable things within a new conceptual framework—one that values our legacy, honors diversity, and feeds ecosystems and societies . . . It is time for designs that are creative, abundant, prosperous, and intelligent from the start."

-William McDonough

Academic History:

1997-2001 University of North Carolina at Asheville — Asheville, NC
Bachelors of Science in Environmental Science — G.P.A: 3.1

2003 - exp. 5/06 Virginia Polytechnic Institute and State University — Blacksburg, VA
Masters of Landscape Architecture — G.P.A: 3.8

Professional Experience:

Teaching Assistant: Hydrology — 8/05-12/05

Assist Professor in teaching and grading of the Hydrology technical course within the Department of Landscape Architecture. Assist students in structure and design of their projects and give specific lectures of expertise, i.e: wetlands.

Coordinator Solar Decathlon Landscape Division — 5/05-11/05

Develop design and implementation of modular wastewater treatment wetland system for the Virginia Tech solar decathlon entry. Coordination of students, volunteers, and sponsors of the implementation and construction for the event.

Landscape Designer — 1/05-until

Free lance designer focusing on local residential native and low maintenance designs and installation.

Community Design Assistance Center (CDAC) — 5/04-10/04

Project work developing an educational outdoor classroom for Craig County, VA elementary school. Assisted planning student in developing a greenway for the City of Blacksburg and Montgomery County linking the southern area of town to the University.

Snow Creek Nursery and Landscaping Inc. — 5/02-8/03

Assistant nursery manager and private gardener for design-build firm in Asheville, NC. Key role in inventory, watering, transplanting, and propagation plants, as well as develop and employ integrated pest management at the nursery. Prepare needs, of maintenance and landscaping crews, loading and un-load trucks with materials and plants. Design and create new garden areas as well as maintain and improve current garden areas, specifically designing a native waterscapes

Awards and Certifications.

2nd place Moseley Architects LEED design competition, working in a group of five other students of variable talent levels, 2005
5th place over all in the Solar Decathlon with collaborative team, 1st place in architecture and dwelling unit contests
North Carolina Certified Plant Professional, 2003
Vice President, Sigma Lambda Alpha, 2005-2006
ASLA Merit Award, 2006

Skills.

AutoCAD 2002/2004
Adobe Photoshop CS
Arc GIS 9.0
Microsoft Office
Sketchup 5.0
Sketching / Drafting
Photography
Hydroflow / Hydragraph 2004
Plant Identification

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Nancy Hodges has taken a position at Kimley Horn and Associates in Cary, NC with the position of Landscape Analyst and Sustainability Coordinator.