Fighting to keep Indiana’s parks alive: Defending our lands within sustainable boundaries

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Fighting to keep Indiana’s parks alive: Defending our lands within sustainable boundaries

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America’s parks, especially at the state and national level, are experiencing environmental deterioration due to visitors, automobiles, and pollution. At the Grand Canyon for instance 6,500 cars search for 2,200 available parking spots while the traffic is backed up 2 miles outside of the park (Whitman 118). Noise pollution from motorboats, aerial tours, buses, and cars also detract from a park experience. The very people that cherish these parklands are contributing to their destruction by stepping foot on their soil. The key to preserving these lands for future generations is sustainable design. Sustainable design includes facets of a landscape that deal with, but are not limited to, environmental, historic, cultural, and social factors. Sustainable design, “requires a change in mind-set, (and) a change in values toward less consumptive lifestyles. These changes must embrace global interdependence, environmental stewardship, social responsibility, and economic viability” (www.nps.gov).

Sustainable design has been present in natural systems since the beginning of time, but humans have become increasingly aware of the benefits and necessity of this practice over the past 35 years as environmental issues, political policies, and pollution effects have become evident. Emerging trends and technologies in this field are abundant and have caused sustainability to become a major player in design. This study attempts to apply the latest ideas and information regarding sustainability within parks in order to develop design guidelines for a sustainable park, and then apply them to a specific site. Studies of The Grand Canyon Greenway, Grand Canyon, Arizona (2002), Maho Bay Camps, St. John, US Virgin Island (1976), and Arches National Park (Visitor experience and resource protection implementation plan), Moab, Utah (1995) will be used to determine state-of-the-art sustainable design principles, techniques, and ideas.

Brown County State Park in Brown County, Indiana was the site for this project. The park encompasses approximately 16 thousand acres in this county. The park includes 5 campgrounds, 1 lodge, and cabins for on site overnight accommodations. Many historic structures such as a covered bridge and CCC buildings dot the landscape. The park contains over 90 miles of hiking and equestrian trails, which travel the wooded rolling hills of the park. Nearly 26 miles of roadway connect the activity nodes of the park. The surrounding populations including Indianapolis are growing at a fast pace. This drastic increase in
population accompanied by the increase of out-of-town visitors is causing the park to become a major tourist destination. Overcrowding and issues regarding the park's carrying capacity will be analyzed through the course of this study. Carrying capacity involves not only the amount of something the land can handle but the social carrying capacity also, which is the effect of people upon people. These factors make Brown County State Park an ideal candidate for this study. In this study sustainable design guidelines were applied to Brown County State Park in order to transform this park into a sustainable landscape able to serve its visitors in an environmentally acceptable manner.
Figure 1.1 Project areas of study diagram
Purpose of the Study

Dwindling natural resources and increasing populations are rapidly emerging across the country. These increasing populations will continue to seek outdoor recreation as an enjoyable escape from the monotonies of everyday life. Creating places for this recreation to occur, that will withstand decades and centuries of use, is the role of landscape architects. Sustainable design is the key to this process.

Brown County State Park is the largest state park in Indiana. From the park's conception to the present day the amount of annual visitations and surrounding populations have increased dramatically. This drastic jump in population and park use puts a strain on the parks' natural and man-made resources. With the predicted increase in users and populations, action must be taken now to protect these resources before they deteriorate further. Studying the physical and social carrying capacity of a park determined exactly what the park can handle. Then sustainable design principles were applied to Brown County State Park. Sustainable principals facilitate bringing man altered environments into alignment with natural systems.

Guiding Questions

1. What are the existing conditions of the park, both natural and cultural?
   - Natural and cultural elements are interrelated and effect both the environment and visitor in a park setting.

2. What role does overuse play in regard to the negative impact upon these systems?
   - Overuse can cause stress on both natural and cultural systems.

3. How can conditions in the park be grouped/ranked in a meaningful manner to facilitate a master plan?
   - Understanding the importance of such dynamic issues in a meaningful manner allows an individual to approach them.

4. What are the interrelationships between these systems?
   - Linking systems and finding out how they work together, with other systems, and in the realm of bigger or smaller systems is the key to understanding them.
5. How can a park wide master plan be implemented using sustainable systems?
   - Finding balanced relationships between park systems will create a stable environment in balance both environmentally and culturally.

Delimitations

- The master plan did not contain specific construction details, a maintenance/management plan, or a planting plan.
- The master plan stayed within the legal boundaries of the park.
- Handicapped access to major destinations in the park were considered per ADA requirements. However, due to the natural topography and environmental impacts, a vast majority of the park’s acres do have limitations to handicapped access.
- A comprehensive environmental study was not completed prior to the master plan development, however, one should be completed before any construction is undertaken.
- Traffic outside the park boundaries were not studied, but should be examined.
- Due to the size of the park many of the parks areas were not explored, therefore unstudied areas should be studied before guidelines are imposed on those areas.
- The plan for Brown County State Park master plan included trails and roadway locations, but exact spot elevations are not given.

Definition of Key Terms

*Landscape architecture* – “is the art and science of analysis, planning, design, management, preservation and rehabilitation of the land” (http://www.asla.org)

*Regional park* – a significantly sized tract of land used for active and passive recreation

*Carrying capacity* - “Carrying capacity is the size of the population that can be supported
Introduction

indefinitely upon the available resources and services of supporting natural, social, human, and built capital” (www.sustainablemeasures.com).

Social carrying capacity – the impact of people upon people in a given setting or area

Sustainability - “Requires a change in mind-set, a change in values toward less consumptive lifestyles. These changes must embrace global interdependence, environmental stewardship, social responsibility, and economic viability” (http://www.nps.gov).

Master plan – Shows the essential elements of the park and their organization including paths, roadways, parking, key nodes, and main attraction areas.

Site analysis – evaluating the site inventory per certain criteria

Site inventory – a record of the features that comprise the site that may influence the design of elements on the site

Assumptions

Certain project elements were assumed to happen in order to complete this project. If these elements are not completed the project may cause either a design failure or a lessoning of its potential success. These include:

- All entities of Brown County State Park agree to and have prepared a maintenance plan for all elements included on the master plan prior to construction.

- Outside/unpaid help (volunteers) are deemed necessary to run the interpretative programs, enforce some rules and regulations, and help maintain some of the park.

- A thorough environmental study would be completed prior to construction.

Significance of the Study

This sustainable park model served as an example to other localities on how sustainable principles can be implemented and merged together. The atmosphere created in the park was conducive to education and through interpretation visitors learned how sustainable systems operate. Visitors were then more willing to put these sustainable principles to use in their daily lives. Since our world is faced with increasing populations and dwindling natural resources, carrying capacity studies, sustainable design and sustainable recreation appear to be a compelling consideration for the future preservation of resources.
HISTORICAL PERSPECTIVE

National Parks

The history of America’s parks is a diverse struggle to maintain public lands for the common good amongst changes in attitude, beliefs, policies, and politics. The establishment of parks can be traced back as far as the Sumerians at 4000-2000 B.C. They set aside vineyards and fishponds as parks for the king. In 1641, the great ponds act of Massachusetts Bay Colony allocated ponds over 10 acres should have some public rights. This was the first implementation of any act allowing anybody rights to land. The first lands set aside for public domain in America were those west of the 13 original colonies. Everything west of the Mississippi was originally set aside for the good of all people.

America's National Parks can be traced back to the Louisiana Purchase of 1803. Lewis and Clark were sent to survey the newly acquired land from 1804-1806. Their expedition returned with tales of gigantic waterfalls, steam shooting up from the center of the earth, and gigantic valleys that no man could imagine. Then in 1870 a large expedition lead by General Henry D. Washburn and Nathaniel P. Langsford traveled the Yellowstone River. Their journey led them to the conclusion that, “it was in itself clear that here was a portion of public domain too important for any one man or group to own, and that for all time it should continue to belong to all the people.” A year later in 1871 a scientific team was sent to document the area and testify to the significance of the natural features. Then in “March 1, 1872 President Grant brought into begin “in the territories of Montana and Wyoming” the world’s first national park,” Yellowstone (Newton 518).

In Yellowstone’s infant years the lack of funds and governance was apparent as poachers and hunters ran rampant in the park with little consequence. To deal with this problem, the U.S. Army was called in 1866 for a 30-year reign in the park. Their job was to enforce the rules and regulations of the park. While there the army found it necessary to build roads and other infrastructure to better serve their needs and police the park.

In 1864 Yosemite was given to California to be managed as a state park, but lack of funds and rules caused the deterioration of the park. This was the first act to create any kind of “state park system.” The federal government then took this national treasure back in 1890 and created Yosemite National Park. The 1890’s saw the addition
Review of Related Literature

of other parks such as Sequoia and General Grant National Parks. Once the nation started to visit some of these treasured landscapes the designers had to manage them. This included allowing the appropriate number of people to visit them, specifically Yosemite Valley. This issue was recognized as a problem because the founders of the parks didn’t want the few to ruin the parks for the many.

In 1891 the Forest Preserve Act was passed allowing the president “by proclamation “set apart and reserve” tracts of publicly held forested land “in any state or territory” (Newton 523). After 1907 these public land holdings became known as National Forests. The formation of the National Park Service was soon to follow. In 1908 the president could set aside by proclamation a national monument which is an area of historic or scientific importance (ex. The Grand Canyon). On August 25, 1916 the National Parks Act was passed for this purpose: “The service thus established shall promote and regulate the use of Federal areas known as national parks, monuments, and reservations hereinafter specified by such means and measures as conform to the fundamental purpose... to conserve the scenery and the natural and historic objects and the wild life therein, and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations.”

This lofty mission was first carried out by the agencies first director, Stephen Mather. His first goal was to get the parks back on their feet. This included creating public enthusiasm for the parks by enticing railroads to run lines near them, improve roadways in and around the parks, and supply sufficient concessions (food and lodging) within the parks. World War I somewhat slowed visitation to the parks, but Mather enticed people to attend with railroad connections, guided tours, and visitations by influential people. Staffing the parks with qualified individuals in the fields of superintendents, rangers, trained naturalists, etc... proved to be a challenge. The parks service soon sought the skill of landscape architects, which came on staff in 1918. These Landscape architects under Vint helped to create and maintain a master plan for every park.

The 1930’s brought the era of the great depression upon the United States. While most industries faltered the parks system was greatly benefited by the New Deal, and increasing numbers visitors to the parks.
The Civilian Conservation Corps (CCC) is responsible for a majority of the infrastructure projects at America's parks including, roadways, bridges, dams, campsites, and lodges. The CCC are the individuals that shaped many of the landscapes we see today. After this decade of prosperity for the parks the next downfall would be WWII. Emergency timber cutting and mining were allowed at certain parks, as well troops used parks to set up camp. These activities had detrimental effects on the land such as vandalism and resource degradation. After the war parks saw increased use from returning veterans with more leisure time, as a result the parks were starting to get “worn out.” When 1955 rolled around the National Park Service system was receiving 50,000,000 visitors a year, while its facilities were deigned to handle 21,000,000 visitors.

Because of these staggering numbers Mission 66 was introduced. This was a special booklet published in order to deal with some of the issues at hand. The name was derived from the expected number of visitors in 1966, 80,000,000 people. To manage this increase in visitation 8 key objectives were outlined in how to deal with the increase in visitation “(1) additional accommodations through greater participation of private enterprise, (2) better government-operated facilities, (3) services leading to better visitor cooperation, (4) operating funds and field staff for a high standard of maintenance, (5) adequate living quarters for field employees, (6) acquisition of needed lands and rights, (7) a coordinated nationwide recreation plan shared by all levels of government, (8) protection and preservation of wilderness areas” (Newton 552). Congress took action and provided appropriations to fund the construction of these facilities. This included moving, combining, and shifting facilities at most National Parks across the U.S.

In the past three decades environmental issues have been at the forefront of topics discussed at the parks. The 1980’s also saw public interest and awareness in historic and environmental issues in the parks this led to more interpretation in these areas. The increase in public education was seen throughout the 1990’s. The NPS also sought to increase its presence via the Internet.

State Parks

The movement to create state and regional parks was first introduced when Yosemite Valley and Mariposa Big Tree Grove were removed from public domain and given
Review of Related Literature

to the state of California in 1864. This land turned out to be too much of a financial burden for the state to bear and later became Yosemite national park in 1906. It was another 20 years before any state tried to create a “state park system” as we know it today. New York founded a model state parks system. During the early 1900’s New York took several small steps to develop an expansive parks system. This included educating the public, private donations, and commissions that spoke of the beauty of the nation. Funding and appropriations for the parks were highly supported by the citizens of New York when they passed bonds in 1910 and 1916 for $2,500,000 and $10,000,000 respectively. This set the precedent for state parks program, and the funding to get it launched. However WWI was looming around the corner, and the state parks movement fell to a staggering halt as the nation geared up for war.

A few years following the war state parks started to pop up all over the country. The number one catalyst for this movement was the increasing number of Americans that owned automobiles, and these individuals loved to take their newfound love for drives in parks and scenic areas. Secondly the state parks were spawned on by Mather and his National State Parks Conference in 1920. Between 1921 and 1927, due to this conference, more than 17 states created park boards. This conference marked the beginning of state parks across the US. The groundwork for state parks was laid by Olmsted in his 1929 report, California State Park Survey:

They should be sufficiently distinctive and notable to interest people from comparatively distant parts of the state to visit and use them… Also they should, in general, be situated beyond the limits of urban and suburban communities which have sufficient population and wealth to assume the obligation of providing parks that would be mainly serviceable for the daily use of their own citizens… They should be characterized by scenic and recreational resources of kinds which are unlikely to be reasonably well conserved and made available for enjoyment under private ownership. They should be as nearly as possible just sufficient in number and extent and character to meet the prospective demands of the people for the kinds of enjoyment which they can provide, and
which cannot or will not be supplied by such other means as local parks, national parks and forests, and the use of scenic highways...
They should be geographically distributed with a view to securing a wide and representative variety of types for the state as a whole, and at the same time making a reasonable assortment of them equitably accessible to the people in each part of the state.

The next noteworthy event is FDR and the New Deal programs such as the CCC. This program allowed 18-25 year old males to work in the State and Nation’s parks for employment during the great depression.
The men were responsible for most of the entryways, signs, fences, fireplaces, shelters, cabins, restrooms, bathhouses, tables, bridges and benches we use at parks today. The new Deal came screeching to a halt at the start of WWII when all of the country’s resources went to fighting the war. However at its heyday the CCC had 90,000+ men employed in 16-200 man camps in all states except Delaware. The decade of the CCC is known as the single greatest decade for the state parks movement.

The Automobile
Another relevant area of history to study is that of the automobile in the United States. In 1922, 1 in 10 Americans owned an automobile. Today that number is drastically different with the number of automobiles in the US exceeding 110 million. If you were to place the entire population of the US in an automobile the average number of people seated in a car would be 2.2 per car (Jenson 36).

Public transportation dominated the urban landscape of the pre automobile America. Americans were satisfied with the primarily electric streetcar system, which was in place at that time. Then General Motors started to take over the auto industry, and with that also came the push from GM to produce diesel busses. These busses were hard to sell at first because they were slow, polluting, and they inched through traffic. But GM pushed on and bought up streetcar systems in almost every major city, and replaced them with their busses. America was said to have had the finest public transportation system, and in 10 years it was dismantled. What was once in place was now estimated to cost 300 billion dollars to replace. Post WWII, the return GI’s purchased housing in the suburbs
at astounding rates; this in turn created the need for every family to own an automobile in order to be mobile. Not soon after this phenomenon occurred the rural roadways became clogged with more traffic than they could support. The National Highway Users Conference lobbied congress for 20 years in order to create a highway system from coast to coast. Some of their propaganda included commercials that convinced the public, “a whole new way of life for your children” was possible far superior to what was currently available. The lobbyists also pushed for a highway system for this country self defense, in order to move troops around. In 1956 President Eisenhower created the Interstate Highway System, which fundamentally changed the way people travel in this country. The highway builders were described as ravages: “that highway crowd would put a road through the Vatican if it would save a little mileage” (Klein). This kind of highway building campaign continued through the 1960’s. Then people started to encounter problems with smog and other toxic pollutants from the automobile. The environmental movement was in full swing in the 1970’s and lobbies for pollution controls and emissions were put into place.

The Department of Interiors data shows that 90-95% of visitors to recreation sites outside of their communities use private automobiles to travel to their destinations. To counter this influx of automobiles the National Park System Access Act of 1978 was passed to make parks more accessible while using good management, and reducing energy consumption. To accomplish this goal, more than 30 parks to date have implemented some sort of shuttle system.

RELEVANT THEORY

Sustainability

“Physical surroundings consciously or subconsciously shape human attitudes, breeding, tranquility or tension, pleasure or dis satisfaction”(Rutledge 7). How and what goes into a park shapes perception of people as they enter the environment. Therefore everything that happens in a park should serve a purpose, however not everything people desire to put in is beneficial to that environment.

“Design criteria should be developed through analysis of each situation rather than through reflection upon what has been found to be applicable to other circumstances”(Rutledge 8). Therefore each site should be treated as a unique opportunity. Within that opportunity there are many factors that come into play.
such as sustainability, carrying capacity, interpretation, social issues, cultural issues, and transportation.

"Sustainability does not require a loss in the quality of life, but does require a change in mind-set, a change in values toward less consumptive lifestyles. These changes must embrace global interdependence, environmental stewardship, social responsibility, and economic viability" (http://www.nps.gov). Taking into account this definition of sustainability, sustainable design requires a different approach to the design process. This new process of design must take into consideration how the design effects environments in every realm, scale, and resource base for the future. Sustainable communities have been present since the beginning of the universe in nature. Humans have strayed from that original model, and must return to some form of it in order to live on the earth for any considerable period of time. Obviously with development there will be some sort of environmental impact. Sustainable practices have been brought into the lime light in past 25 years as environmental awareness has become a public issue. Sustainable design takes into account natural systems and environmental conditions in all stages of the design process.

The beauty of natural resources are a major reason why individuals choose to explore America’s parks. Individuals in these resources change the natural systems and cycles, which were in place before human intervention. Therefore sustainable design seeks to bring human systems back into alignment, or as close as possible with natural systems. In order to accomplish this, key resources in an area must be identified in order to study how that ecosystem functions naturally. Then adjacent ecosystems must be considered to find links in natural systems. These links must be examined for fragmentation, which causes loss of biodiversity. Humans will obviously modify any ecosystem with some sort of development so acceptable limits of change must be determined. These acceptable changes must take into account previous demands on an ecosystem since demands are on an ecosystem cumulative. Once all these factors are considered, acceptable changes in an ecosystem can be determined.

Another resource to consider in sustainable development is cultural resources. Cultural resources are defined as tangible (dwellings, districts, landscapes)
Review of Related Literature

and intangible (myth, folklore, song) resources. "When a cultural resource achieves sufficient importance that it is deemed historically significant in human history, it becomes a nonrenewable resource worthy of consideration for sustainable conservation" (http://www.nps.gov). Since these resources are determined to be nonrenewable, considerable care must be given to development in these areas. This includes surveying for all cultural and historic resources on proposed sites. New construction should be designed, constructed, and landscaped in order to reflect the cultural heritage of a region. Cultural resources should then be interpreted so individuals may learn how the culture related to the environment in the past.

Sustainable site design should be thought of as a holistic approach to design that incorporates all surrounding ecosystems in a manner that seeks to "repair and restore exiting site systems" (http://www.nps.gov). First site context must be determined. It is not sufficient to impose a cookie-cutter model on any landscape, as each ecosystem has unique characteristics. Again, landscapes must be treated as they are interconnected to various natural systems and ecosystems. A specific site has many linkages which must be studied. Secondly the native landscape should be incorporated, mimicked, and reflected as closely as possible. Promotion of biodiversity is also key in a world where millions of acres of forest filled with species are being destroyed annually. Reusing already disturbed areas, versus using pristine lands is usually the best method of development. Another thing humans seem to forget is "there is no such thing as waste, only resources out of place" (http://www.nps.gov). Factors that should be calculated into sustainable site design according to the NPS study include:

- Carrying Capacity - see following paragraph
- Density - dispersed or concentrated
- Climate - each climate has unique design requirements
- Slopes - development on slopes should be cautious at best
- Vegetation - retain as much existing as possible, and revegetate after construction
- Views - reinforce/maximize scenic view sheds if appropriate
- Natural Hazards - design with the implications of these in mind
- Access to Natural & Cultural features
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- close proximity is desired, but can also be harmful to those resources
- Energy – use renewable forms of energy where possible
- Proximity to services – close to food, lodging, housing

Energy management at park sites can be an asset to the visitors experience or an eyesore. A visitor could learn about solar power and aerobic waste treatment, or that visitor could gaze off a vista and observe corridors carved out of forests to make way for high-tension power lines. Sustainable energy is an asset to a park in terms of its educational and environmental impact upon a visitor and the environment. A park patron could visit a lodge and have a readout displaying how much energy they saved during their visit. Or a visitor could follow the path of wastewater from the bathhouse through the water treatment process. Not only are there visitor benefits to energy management but environmental and financial benefits as well.

Areas to be considered when exploring energy include solar power in photovoltaic cells, passive solar heat, solar hot water, and lighting needs. These forms of energy use the sun's clean energy to provide for human needs. Wind is also a viable energy producer for electricity, passive cooling, and running pumps. Some parts of the country may be limited in relying on wind except for passive cooling. Renewable energy, especially passive, should be used wherever possible. These two forms of energy are specifically advantageous for remote locations since no utilities have to be run.

The water supply and wastewater treatment are also key factors in sustainable site design. Every day fresh water aquifers and other fresh water sources are being depleted. Great care must be exercised when choosing a water source, or the necessity of one existing. Where a park receives its water from can be another educational opportunity for the public. For instance, a primary source of water could be groundwater, and after that water is used once, it could be filtered and become gray water. This would then allow that water to be used again in toilets or for irrigation. There are many ways to treat water/waste. These include using dry/composting toilets. These toilets use no water and contain a large storage bin directly below the toilet where waste is composted. The compost can then be spread over the soil as a nutrient or fertilizer for plants. Another waste treatment method is anaerobic treatment
Review of Related Literature

(typical septic tanks). This process is slow and not very efficient for larger quantities of water. The third most viable solution is aerobic treatment. Here oxygen-loving microbes break down waste in water. These facilities are easy to construct and consume relatively little land (.1 acre for every 10,000 gallons treated). There are also good opportunities for visitor education at these sites via interpretation.

**Carrying Capacity**

"Carrying capacity is the size of the population that can be supported indefinitely upon the available resources and services of supporting natural, social, human, and built capital" (http://www.sustainablemeasures.com). Therefore carrying capacity plays the critical role of determining exactly how much of something a park can handle. Three things primarily affect carrying capacity: amount of resources available in an ecosystem, the size of the population, and the amount of resources each individual consumes. Calculating carrying capacity is not an exact science since this figure is not static; it changes with changes in population and technology. When environmental deterioration occurs, that land base is no longer able to support the amount of life it could once support in its prime. There is also a psychological carrying capacity which is often hard to measure, but is the impact of people on people.

Determining carrying capacity is difficult since multiple factors come into play. One of the most significant factors is transportation, specifically the mode of transportation. Transportation that uses less energy and transports more individuals is a more environmental friendly choice. Another influence that effects carrying capacity is concentration of use on a site. The effects of this can be minimized by implementing such things as durable vegetation, educational programs, increase of physical facilities, and regulations. Finally, a way to keep the use within an areas carrying capacity is thorough the use of permits and fees. These can be implemented in a number of ways including, advanced reservation, lottery, first-come, and merit. There are a number of ways carrying capacity can be increased toward the positive with sustainable choices.

**Interpretation**

Interpretation plays a vital role in how people relate to their surroundings. If an individual is aware of his/her surroundings, they are more apt to appreciate them. This includes interpreting historical site
Review of Related Literature

caracteristics, cultural site uses, natural systems, and man-made systems. By definition interpretation is “an educational activity which aims to reveal meanings and relationships through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information” (Tilden 8). Interpretation is therefore information that tells a whole story and is displayed in a meaningful manner that relates to the visitor in some manner. Ralph Waldo Emerson probably states it best when he says, “interpretation is not instruction but provocation.” The overall goal of interpretation is to evoke an interest of the subject inside the person causing that individual to do something about the topic at hand. If individuals care about a resource, historic site, or anything being interpreted they will be more apt to take initiative to take care of it. “Adequate interpretation is the certainty that it leads directly toward the very preservation of the treasure itself,” says Freeman Tilden the father of interpretation.

CASE STUDIES

Grand Canyon Greenway

The Grand Canyon Greenway, a work in progress, serves as a transportation model for my project. The Grand Canyon’s 1,217,403 acres receive more than 5 million visitors a year arriving in over 1,200,000 vehicles (http://www.nps.gov). This amount of visitors obviously creates a detrimental environmental impact on the ecosystem of the Grand Canyon. One of the most visible problems in the park is the traffic congestion. In the busiest summer months 6,500 cars search for 2,200 available parking spots while the traffic is backed up 2 miles outside of the park, see figure 2.1 (Whitman 118).

Figure 2.1 Grand Canyon traffic jam

In 1995 the NPS (National Park Service) issued the Grand Canyon Draft General Management Plan Environmental Impact Statement. Issues addressed in this statement included automobile congestion, noise (automobile, airplane), and pollution. Through a series of two charrettes by 10 leading professionals The Grand Canyon Greenway Development Plan (GDP) was
produced in 1997. The GDP outlined a 73 mile multi-use trail and transportation system for the canyon rim and adjacent cities.

The Grand Canyon Greenway is the first in the NPS system to implement a multi-use pedestrian trail system, light rail system, and drastically limit the automobile from the major destinations of the park, see figure 2.2. This alternative transportation system, when completed, will revolutionize how Americans visit a national landmark. This greenway system utilizes existing transportation corridors, as well as abandoned ones (ex. Old logging roads), and as a last resort pristine lands will be turned into transportation corridors that “lie lightly on the land” (http://www.nps.gov). Cultural and environmental resources heavily influenced the design and implementation of this project. The greenway will sway, split, and turn in order to avoid as many trees and rock outcroppings as possible, but where some of these natural features must be disturbed salvageable plants will be transplanted elsewhere in the park. The pedestrian trail itself is design to accommodate all: the elderly, and young children, as well as allow people to choose their own recreation preference. The greenway has a maximum slope of 5%, and where the greenway approaches the 5% slope there are resting spots every 30 feet (Ewan 85). Trail width and use depends on what zone an individual is traveling. For instance, in the congested areas of the park, the trail’s uses are separated (pedestrian, bicycle, equestrian) as well as wider (14 feet compared to the regular 10 foot width). Wherever possible, the greenway system will also be integrated into the existing Arizona Trail. Signage, benches, and tables will be constructed from wood harvested at the nearby Kaibab National Forest. These necessary elements will blend into the natural landscape.

Figure 2.2 Grand Canyon Greenway system

A visitor arrives to the Grand Canyon by parking in the town of Tusayan 2 miles outside of the park. Here there is lodging, food, amenities, and enough tastily placed parking spaces to accommodate the visitors. In Tusayan an individual boards the light
rail train for a leisurely ride into the park. After arriving at the information center one may continue on the train, or choose an alternative form of transportation, foot, bicycle, horse, wheelchair, stroller, roller blade, or a combination thereof, see figure 2.3 - 2.4. Equipment rental and return facilities are available along the trail so, an individual can rent a bicycle at one end of the park, ride half a day, then return it when they get tired of riding and continue to see the sights on the light rail transit. Along the way visitors may stop at nodes, which interpret cultural and geologic history. The greenway also offers a sense of intimacy, and connection with the environment while providing a challenging, enjoyable park experience to individuals of all skill levels.

Grand Canyon Village to Canyon View Information Plaza. Phase III which connects Canyon view information plaza to Tusayan is awaiting funding. Park officials believe this transportation system will decrease automobiles in the park by 80% (Whitman 118). The ultimate goal of this system is to increase visitor enjoyment while letting “the park resources be the attraction, not the transportation” (http://www.nps.gov).

Figure 2.4 Grand Canyon Greenway canon rim greenway

Maho Bay Camps

Maho Bay is a superb example of what a sustainable resort should look like, and how it should function. This resort combines sustainability into the dwellings, landscape, and everyday practices at the resort. This resort was built in order to develop sustainable “campgrounds within fragile natural properties.” The guests that come to visit this place not only enjoy their stay, but more importantly are educated, and practice a sustainable lifestyle. I will use this case study
Review of Related Literature

to gather information on how to implement a large-scale sustainable village.

Sustainable development does not start after construction, but from the first thought to the end user. When construction took place the first thing to be built were the walkways, this way workers would not trample natural vegetation. Figure 2.5 shows the walkways built on stilts in order to have the smallest footprint possible. Then utilities are strapped to the underside of these walkways in order to minimize any other need to dig in the ground. Then the dwellings are constructed following these guidelines:

- Affordable units cost under $30,000 to construct
- Units should use recycled local building materials wherever possible
- The site is to be left as undisturbed as possible
- Prefabrication should take preference to site building
- The dwellings should be easy to build by low skilled labor, and sit on hand-dug footings or anchored to boulders
- Units should be elevated to provide room for a cistern and composting toilet beneath
- Consideration should be given to sun angles and wind direction

- Units should provide a sense of privacy while maximizing views and interesting natural “assets”
- The units should be self-sufficient using renewable electric power and passive solar design

(http://www.maho.org)

Figure 2.5 Stilt walkways minimize infrastructure footprint

From the first phase of construction continuing throughout its life span, this resort is grounded on ecologically sustainable principles. Not only are the dwellings built with these ideas in mind, but every facet of the resort is grounded on these principles.

Fresh water on this island is treated as a precious resource. From the moment a rain drop touches the roof of one of the dwellings it is used. The roofs act as giant funnels and collect water to be stored in cisterns. The typical guest at a resort can use
Review of Related Literature

up to 300 gallons of water per a day, here a
quest uses 25 gallons of water per day (http://www.maho.org). This is accomplished
through the use of low volume fixtures, spring
action valves, waterless urinals, and awareness
about conservation. Grey water released from
showers and sinks is filtered and used to water
food producing crops. None of the rainwater
captured is returned to the ocean. Composting
toilets produce natural fertilizer for the
crops and flowers around the resort. While
supplying water and dealing with “waste
water” gravity is used on this hilly island, so
no energy is expended in the form of pumps.
The sun also heats water, so no gas or electric
water heater would be found at this tropical
resort.

A multitude of other resources are
also conserved, reused, and recycled here at
Maho Resort. One innovative program is
recycling glass at bins across the resort. This
glass is then used by locals as backfill and in
non-structural applications. A portion of the
“glass is selected, washed, labels removed,
crushed, and sent to a rebirthing station”(http://
www.maho.org). Then the glass is remolded
into fine works of art by local artists and sold
at the gift shop.

Solar energy is a big portion of
what makes Maho Bay happen. Not only is
electricity provided by photovoltaic cells,
but solar energy is used in the oven at the
restaurant. No gas or electricity is needed
to heat food up to 425 degrees in this oven.
Passive solar energy is used in every dwelling
to provide wind, and sun protection. Solar
heated showers are also found in every room.

Arches/Yosemite Visitor Experience and
Resource Protection

The VERP, visitor experience and
resource protection, is a framework designed
to lessen impacts on park resources and
improve visitor experience by managing
visitor use. The process is ongoing and is
evaluated by measuring goals set in place by
a management plan. Desired conditions are
determined which can be natural resources
based, cultural resources based, or visitor
based conditions. These conditions are
derived from looking at user capacity, which is
defined in this case as: “the level of visitor use
that can be accommodated while sustaining
the desired resource and social conditions
that complement the purposes of the park
units and their management objectives” (http://
www.nps.gov).

Four key elements make up the VERP.
First, is determining desired conditions.
These conditions focus on values, and these values can change over time as more knowledge is gained. Secondly, a set of indicators or standards must be chosen that measure the desired conditions. “Indicators should be specific, objective, reliable, related, responsive, nondestructive, sensitive to visitor use, and should address outstanding remarkable values. Standards should be quantitative, measurable, and feasible” (http://www.nps.gov). Thirdly, these indicators and standards must be monitored. Finally, when and if these indicators are surpassed or conditions worsen management action must be taken. This includes site management, regulation, enforcement of regulations, education, and altering access.
Methodology

Project Type

This project encompasses a study, creating design guidelines, and creating a master plan for Brown County State Park, Brown County, Indiana that uses sustainable design principles as the backbone of the project.

The project is of a regional scale that responds to visitors from many parts of Indiana and other states visit the park. The project consists of studying carrying capacity and applying sustainable principles to this parcel of land. Creating sustainable portions of a project has been around for a number of years, but this project applies sustainable principles to all aspects of the park and visitor experience. Not only are sustainable principles being applied, but visitors will also be educated about these principles. The ultimate goal being a value change that leads to the applications of these principles in the daily lives of visitors.

Description of Site and Context

The site for the project is Brown County State Park in Brown County, Indiana. This is the largest state park in Indiana consisting of approximately 16,000 acres. The project area is limited to the legal boundaries of the park since that is the only land the client owns.

Figure 3.2 Yellowwood Tree, found on some north facing slopes throughout the park

The park lies 2 miles south of Nashville, IN, the county seat. Indiana Route 46 runs on the north and west sides of the park and Indiana Route 135 travels on the east side of the park. Yellowwood State Forest and Hoosier National Forest compose significant land holdings south and west of the park boundaries. To the North lies Nashville and private land holdings. To the east of the park private land holdings including multiple camps make up the surroundings. Bloomington, IN is 15 miles west of the park, Columbus, IN is 16 miles east of the park, and

Figure 3.1 The endangered Timber Rattlesnake
Indianapolis is 45 miles to the North. The north fork of Salt Creek meanders through the northern section of the park. The area lies on the southern fringe of the Wisconsin glacier. The hills and valleys of the park were formed by siltstone, sandstone, and shale bedrock eroding to form the hills, ravines, and ridges seen today. The park contains the timber rattlesnake, endangered, and yellowwood trees, rare, see figures 3.1,3.2.

The park includes 5 campgrounds, 1 lodge, and cabins for on site overnight accommodations. The park contains over 90 miles of hiking and equestrian trails, which travel the wooded rolling hills of the park. Nearly 26 miles of roadway connect the activity nodes of the park. Brown County State Park is also home to many significant CCC (Civilian Conservation Corps) remnants. Shelters, overlooks, ovens, gatehouses, and fire towers are just a few of the CCC era buildings, which remain intact on the site. There are also many significant hints in the landscape, which point toward the cultural significance of the park.
Goals

- Sustainable design, which aims to mimic natural systems, is to be the guiding principal behind all design solutions.
  - Determine the carrying capacity of the land both physical and socially and implement solutions that respond to this figure
- Modify/add transportation systems to meet user needs, follow carrying capacity, and increase safety
  - Roadways
  - Hiking trails
  - Equestrian trails
  - Bicycle trails
- Address camping/overnight stay at new sites throughout the park

Program

- **Sustainability**
  - Educate the public as to sustainable principles
    - Signage
    - Interpretive displays
    - Interactive elements
  - Design with Sustainable principles as the core concern
    - Bring man-made systems into alignment with natural systems
- **Transportation systems**
  - Trails
    - Recommend trail improvements/additions/deletions
    - Recommend possible trails as multi-use
    - Outline suitable standards for development (length/wide/surface)
  - Parking Lots
    - Reconfigure parking lots for environmental/visual/capacity
Methodology

requirements

- Meet peak use needs
- Outline suitable standards for development (size/location/organization/treatment)
  - Bicycle
    - Increase safety
      - Reduce or eliminate vehicle/bicycle conflicts
    - Provide trails/lanes sufficient to meet demand
- Outline suitable standards for development (size/location/organization/treatment)

- **Overnight Accommodations**
  - Explore the possibility of backcountry campsites – in low use areas
  - Outline suitable standards (size/location/access/treatment)
Figure 4.7 North lookout C.C.C. era structure

Figure 4.8 Picnic shelter C.C.C. era structure

Figure 4.9 Picnic shelter C.C.C. era structure

Figure 4.10 Scenic overlook from roadway (typical)

Figure 4.11 Strahl Lake, standing on dam
Transportation/Land Use

Figure 5.1 Transportation/Land Use

- 401 Class A Sites
- 28 Class B Sites
- 60 Rally Sites

Horseman’s Campground
- 118 Class A Sites
- 61 Class C Sites

Lodge/Cabins
- 84 Lodge Rooms
- 20 Family
- ? Rustic Cabins
Slopes

Figure 5.2 Slopes

<table>
<thead>
<tr>
<th>40-60+ % Slope</th>
</tr>
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<tbody>
<tr>
<td>40-20 % Slope</td>
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<tr>
<td>20-5% Slope</td>
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</table>

LEGEND
- Narrow Bridle Trail
- Wide Bridle Trail
- Hiking Trail
- Historic Trail
- Roadway
- Park Boundary
- Historic Structure
- Nature Preserve
- High-Use Areas
- Campground
- Horsemen's Campground
- Lodge/Cabin
Soils

![Map of Brown County, Indiana with soil associations]

**BERKS-WELLSTON-TREVLAC**
- Association: Moderately deep, moderately sloping to very steep, well drained soils formed in loess and in material weathered from shale, siltstone, and sandstone; on uplands

**PEKIN-CHETWYND-BARTLE**
- Association: Deep, nearly level to very steep, somewhat poorly drained areas to well drained soils formed in silty loamy deposits; on terraces.

**STENDAL-HAYMOND-STEFF**
- Association: Deep, nearly level, somewhat poorly drained to well drained soils formed by silty alluvial deposits; on flood plains

**HICKORY-CINCINNATI-ROSSMOYNE**
- Association: Deep, gently sloping to very steep, well drained and moderately well drained soils formed in loess and in the underlying loamy and silty glacial drift and till; on uplands
Topography

Figure 5.4 Topography
TRANSPORTATION / LAND USE

ANALYSIS

- The majority of park visitors limit their activities to the high use area. Here the roadways of the park connect the major activity nodes. These major activity nodes consist of the lodge, cabins, nature center, parking lots, tent campgrounds, horse campground, 2 lakes, hiking trails, picnic shelters, historic structures, and scenic vistas.

- The underused areas of the park primarily consist of the southern and eastern quadrants. The only way to access these areas currently is via horseback. Most visitors to the park never see these areas, and these areas comprise 50% of the parks area.

SLOPE ANALYSIS

- The majority of high use areas lie within the 20%-5% slope range. These areas are the most conducive in the park to roadways, trails, and structures.

- A fair amount of hose trails lie within the moderately sloping land from 40%-20% slopes. These lands are patched throughout the high use area, but a majority of them do occur in the south west corner of the park. Here care should be given to erosion problems where human activities take place.

- Severe slopes ranging from 40%-60% + lie within the mid-western area of the park. Here human activities are limited to ridges and valleys. Extreme caution should be exercised when human activities occur anywhere but ridges and valleys due to severe erosion concerns.

SOILS ANALYSIS

- The Berks-Wellstone-Tremlac associations comprise the majority of the soils within the park. These soils typically are found on moderately to very steep slopes. These soils are well drained formed from weathered shale, siltstone, and sandstone.

- The Stendal-Hayment-Steff associations form the river / creek basins on the northern and southern fringes of the park. These soils are typically deep, nearly level, and poorly drained soils formed by silt deposits on flood plains.
TOPOGRAPHY

- The topography of the park is primarily wooded rolling hills.
  Just to the north of the site is the southern boundary of the Wisconsin Glacier. Because of that this area was untouched by the last glaciation period leaving the hilly terrain in the southern third of the state.
CARRYING CAPACITY - HORSES

High Density - Within one square mile of a horse camp/day use area/special use area: maximum 4.5 miles of trail per square mile (640 acres)

Low Density - Area outside of high density areas: maximum 2.5 miles of trail per square mile (640 acres)

Number of Horses Per Day

The maximum number of horses allowed at any given time: total miles of trail x 10 = number of horses allowed

Horse Trail Grade/Slope

- Grade shall not exceed 20% if slope run is greater than 50 lineal feet
- Trail sections less than 50 lineal feet which exceed 20% slope must have protected surface
- Preferred grade is 10% or less

Calculation

Total area with horse trails = 9,000 acres

High density areas = 4,800 acres / 640 acres per sq mile = 7.5 sq miles * 4.5 miles trail per 1 sq mile area = 33.75 miles of high density trails

Low density areas = 4,200 acres / 640 acres per sq mile = 6.6 sq miles * 2.5 miles trail per 1 sq mile area = 16.5 miles of low density trails

Total trail miles = 50.25 * 10 = 503 horse carrying capacity

Total Horse Trail Allotment

- 33.75 miles of high density trails
- 16.5 miles of low density trails

- Maximum total horse trails = 50.25 miles
- Currently existing horse trails approximately 70 miles

CARRYING CAPACITY - OTHER TRAILS

High Density - Urban 90 users/day/mile

Low Density - Rural 40 users/day/mile

Trail Uses Per Regional Park

- Bicycle Trails: 32-40 miles
- Bridle Trails: 48-96 miles
- Hiking Trails: 48 miles
- Nature Trails: 24 miles

* figures based on Indiana 2000 SCORP suggestions for 2,000 acre regional park multiplied by 8 for 16,000 acre Brown County State Park

Trail Grade/slope

- Grade shall not exceed 15%
- Maximum average grade 5%

Calculation

- Bicycle Trails: 32-40 miles x 40 users/day/mile = 1280-1600 users per day -Currently no bicycle trails exist within the park
- Bridle Trails: 48-96 miles x 40 users/day/mile = 1920-3840 users per day
- Hiking Trails: 48 miles x 40 users/day/mile = 1920 users per day
- Nature Trails: 24 miles x 40 users/day/mile = 960 users per day -Currently no nature trails exist within the park

40
USERS

- 6080 – 8320 Target users per day under “ideal miles of trail per SCORP”
- Actual miles of trail @ 70 bridle and 12 hiking make the current users per day 3280

CARRYING CAPACITY - SOCIAL

- Backcountry
  - 4+ Parties encountered per day seen during 10% or more of the time during peak months
- Hiker
  - 3-10 People at one time on .1 mile of trail seen during 10% or more of the time during peak months
- Pedestrian high use areas
  - 20+ People at one time observed for 10% of time during peak hours
- Motorized
  - Most drivers are restricted in their freedom to select their own speed, change lanes, or pass.
### Horse Trail Classifications

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<th>Mod. Rugged</th>
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<td>24&quot;-36&quot;</td>
<td>18&quot;-24&quot;</td>
<td>18&quot;</td>
</tr>
</tbody>
</table>

**Tread & Crossing Materials**
- *Anytime aggregate is used to stabilize or protect trail surfaces, the tread area should be topcoated with aggregate not larger than 3/4" in diameter and mixed with "rock fines" (#53 grade) to reduce risks to horses.*
- Natural or synthetic
- Natural as much as possible or synthetic & blend with surroundings
- Soil, gravel or native rock, timbers or rough-appearing lumber

**Tread Irregularities**
- Smooth
- Tread free from most obstacles (easy to mow)
- Leave obstacles in trail unless causing trail widening or braiding, or prohibiting mowing

**Tread Stability**
- Goal: Sink no more than 2"

**Grade**
- Maximum 10% preferred < 8% (for 1000')
- Maximum 15% preferred < 8% (for 500')
- Maximum 20% preferred < 10% (for 300')

*When slope is greater than 10%, surface protection is required*

**Figure 5.5 Horse Trail Classifications**

source: Recreation Horse Use Standards Manual: Indiana Department of Natural Resources, June 1994
Figure 5.6 Trail activity participation in Indiana

Figure 5.7 Camping Participation in Indiana

Figure 5.8 Recreation Activities Participated in by Indiana Residents
Figure 5.9 Relationship Matrix
MATRIX RELATIONSHIP CONFLICTS

CAMPGROUND
- Poor relationship to hiking trials
- Poor relationship to existing topography/slope/soils
- Poor sustainable practices
- Poor relationship to parking lots
- Poor management of waste

HIKING TRAILS
- Poor relationship to bridle trails
- Poor signage directional/interpretive
- Little or no hiking trails in low-use areas
- Maintenance – lack of adequate
- Poor relationship to campgrounds

BRIDLE TRAILS
- Poor relationship to hiking trails
- Poor relationship to high-use areas
- Poor relationship to slope/topography/soils
- Poor signage
- Poor sustainable practices
- Poor/lack of maintenance
- Poor waste/manure management

ROADWAYS
- Poor relationship to slope/topography
- Poor safety issues
- Poor pollution practices
- Poor sustainable practices

PARKING LOTS
- Poor relationship to pollution
- Poor relationship to water (runoff)
- Unfavorable relationship to campgrounds
- Poor relationship to signage
- Poor sustainable practices
- Poor relationship to natural view sheds

BACKCOUNTRY CAMPING
- Suitable topography
- Suitable slope
- Nearby trail connections
- Safety considerations –

emergency Phone
- Permit station
- Tree canopy
- Water source
- Already disturbed area – if possible
- A substantial distance from high use areas
- Proper signage
- Suitable sq footage
Figure 6.1 Concept 1 Hiking Times
Figure 6.2 Concept 1 Trail Uses
CONCEPT 1 SUMMARY

Concept 1 looks at meeting the needs of the park users by implementing more pedestrian trails in the southern and eastern quadrants of the park. Here some former horse trails are converted into pedestrian trails for the single use of foot traffic. Horse trails also remain in these areas and are strictly to be used by horses. There are a series of hiking times allotted based on the average hiker’s pace of 2 mph. There are short one to two hour hikes close to the trail head, and longer hikes consisting of overnight stay are accommodated as hikers move further away from the trailheads. Backcountry campsites are provided as hikers approach these remote locations. These backcountry campsites provide overnight stay without the heavy traces of civilization found in other campgrounds throughout the park.

CONCEPT 1

- 50% Hiking & 50% Horse trails split evenly throughout the southern and eastern low-use areas of the park
- Some existing horse trails switch uses and are turned into hiking trails
- Conflict is minimized between horse riders and hikers by providing separate loops for each rider with minimal overlapping.
- Approximately 30 miles of horse trails are converted into hiking trails to meet the carrying capacity of horse trails allowed in this region. The trails in this area didn’t warrant the converting 64% hiking and 13% horse as seen in figure 5.6. The reason for this decision is the rate at which horses (faster) and hikers (slower) travel.

BACKCOUNTRY CAMPING – CONCEPT 1

- Suitable topography/slope occurs on gently sloping terrain primarily located in ridges and valleys
- Connections to trials should be within ¼ mile of campsites, preferable campsites should be located directly adjacent to trails
- Safety considerations include a solar powered emergency phone within 1 mile of a campsite
- Tree canopy cover is a benefit to campsites
- Close proximity to a water source is needed
- Using an already disturbed area, if possible, is recommended
- Campsites should be located a substantial distance from high use areas
- Proper signage alerting hikers exactly where to camp is necessary
- Proper size for a campground should be determined by taking into consideration amount of land available and number of campsites in the area
Figure 6.3 Concept 2 Hiking Times
Concept 2

Figure 6.4 Concept 2 Trail Uses
CONCEPT 1

- 50% Hiking & 50% Horse trails split evenly throughout the southern and eastern low-use areas of the park
- Some existing horse trails switch uses and are turned into hiking trails
- Conflict is minimized between horse riders and hikers by providing separate loops for each rider with minimal overlapping.
- Approximately 30 miles of horse trails are converted into hiking trails to meet the carrying capacity of horse trails allowed in this region. The trails in this area didn’t warrant the converting 64% hiking and 13% horse as seen in figure 5.6. The reason for this decision is the rate at which horses (faster) and hikers (slower) travel.

BACKCOUNTRY CAMPING – CONCEPT 1

- Suitable topography/slope occurs on gently sloping terrain primarily located in ridges and valleys
- Connections to trials should be within ¼ mile of campsites, preferable campsites should be located directly adjacent to trails
- Safety considerations include a solar

CONCEPT 2 SUMMARY

Concept 2 looks at meeting the needs of the park users by implementing more pedestrian trails in the southern quadrant of the park. Here some former horse trails are converted into pedestrian trails. Horse trails also remain in this area and in the eastern quadrant of the park. In the southern quadrant there are some portions of trails shared between horses and hikers to maximize the number of miles of trail available to each of the user groups. In the northern quadrant there are also three hiking trails added. There are a series of hiking times allotted based on the average hikers pace of 2 mph. There are short one to two hour hikes close to the trail head, and longer hikes as hikers move further away from the trailheads.

CONCEPT 2

- 40% Hiking & 60% Horse trail split allows for more horse trails in the eastern section and an even split in the southern section of the park
- Some existing horse trails switch uses and are turned into hiking trails
- Conflict is minimized between horse riders and hikers by providing separate loops for each rider with even less overlapping than concept 1
Concept Bicycle

Figure 6.5 Concept - Bicycle Trails

Figure 6.6 Bicycle Trail Section
SUMMARY – BICYCLE TRAILS

Since this park is deficient in bicycle trails these additions were made using the least impact on the environment as possible. This solution used the existing roadways within the park and converted them into mixed use, cars and bicycles. Two one-way loops exist within the park, see figure 6.5. These loops provide one lane of car traffic and one lane of bicycle traffic. On other roads within the park bicycle and car lanes are marked within the existing roadway.

CONCEPT – BICYCLE TRAILS

- One-Way loops (seen in yellow in figure 6.5) provide for a four mile and six mile loop in the northern and southern loop, respectively.

- Traffic is limited to one-way in the loops, and a planted median is installed to allow a greenway/bicycle path on the other side of the existing roadway, see figure 6.6.

- The existing traffic lanes are restriped on the purple roads seen in figure . This configuration allows for a safer road for all users by delineating a certain portion of the roadway for bicycles. This however does not mean that two cars cannot pass simultaneously, but consideration is given to bicycles as well as cars sharing the road safely in this concept.
RATIONAL FOR CONCEPT SELECTION & MASTER PLAN SUMMARY

While designing the final master plan, ideas from all of the concepts were applied to derive the final solution. The conversion of horse trails to hiking trails in the southern and eastern quadrants of the park was deemed necessary in order to support the number of hikers using the park (see figure 5.6). Horse trails were also removed because their number exceeded the physical carrying capacity of the land (see page 40). These added hiking trails were designed to minimize conflict between horses and hikers. In only two locations do these two user groups share a section of trail. When this occurs, a separation is provided via a planted median, so the two groups never set foot on the same soil (see figure 7.7). Since hikers travel at a slower pace than horses and limited access points are provided to access the southern hiking trails backcountry campsites were deemed necessary to provide for longer hiking trips. These backcountry campsites allow for hikers to stay for a night or two and explore the remote trails without having to venture back into the main campground. This allows users a unique park experience removed from the modern conveniences of the other park campgrounds (see figure 7.15-7.20).

As seen in figures 5.6, 5.8, and page 40, bicycle trails are deemed necessary in a regional sized park such as Brown County. There were many limited factors that allowed for placement of this entity in one location. Converting existing trails into bicycle trails was not a sustainable solution due to the steep topography, erodable soils, and conflicts between user groups (see figures 5.2 and 5.4). The only other location suitable to bicycle trails were the parks existing roadways. Wider roadways were not an option due to the steep topography. Many park roadways are placed in narrow ravines or on hill crests. Widening a roadway in this type of situation alters the topography severely and costs a substantial amount of money, therefore this type of solution would not be deemed sustainable. Using the existing width of the roadway and converting a portion of it into a bicycle trail was the solution used in this master plan. As seen in figure 7.8-7.10 and concept figure 6.5 two solutions were derived. In two locations one-way loops are employed. In these location cars are allocated one lane and bicycles the other, separated by a median. Conflict points were minimized by making both loops run in a counter clockwise
direction. Thus vehicular traffic can run on the outside allowing easy turnoffs to the main entrance, campground, and horse campground without crossing bicycle lanes. Where conflicts do occur intersections were designed to increase safety, these can be seen in figure 7.11. The second solution is implemented on the other roadways within the park minus campground roadways. Here the asphalt roadway is marked with car and bicycle lanes. This delineates the space as both a vehicular and bicycle friendly space. How the lanes are used for safe travel and passing can be seen in figure 7.12.

Parking lot design also effects the bicycle movement as well as users and safety. The typical parking lot which exists within the park currently poses many problems remedied in this master plan. Innovative concepts on how to manage vehicles within the park are also seen within the parking lot design. Parking lots will be placed at key nodes and trail heads throughout the park. The exact number of spots in each lot is to be determined by the carrying capacity both physical and social of the amenity serviced by the lot. To accommodate only this number of vehicles the lots are designed to prohibit parking on the entry/exit drives as well as along the roadway.

One may wonder what happens when all of the parking spots are filled and an individual wants to use the amenity? This is exactly what this plan is trying to achieve, dependence upon the bicycle/trail system for commuting throughout the park. When the park is at peak capacity, or the park deems it necessary to implement a full time shuttle service, shuttles would also be running and would drop visitors off at the amenities. Therefore, only a prescribed number of visitors would be allowed to drive their vehicles into the park. After this number is reached the remaining would park either in a lot at the entrance of the park, or a more sustainable choice would be to use an existing lot in Nashville and shuttle visitors to the park. The full parking lot design as well as layout can be seen in figure 7.13.

Combining all of these design solutions using sustainable design principals as the backbone of the project create an integrated master plan for Brown County State Park. This plan addresses user needs, carrying capacity both social and physical, and maintenance issues. Taking a look at how all of the systems within the park can be integrated and work together more efficiently will only serve to benefit the park and users of generations to come.
Figure 7.1 Master Plan
NARROW TRAIL

- Used in low-use areas
- Single file line of hikers
- Smaller footprint equals less impact upon the land

Figure 7.2 Narrow Pedestrian Trail

WIDE TRAIL

- Used in high-use areas
- Wide enough for two people to hike side-by-side
- Bigger footprint equals more impact upon the land
- Maintained more frequently than low-use trail

Figure 7.3 Wide Pedestrian Trail
TRAIL/ROAD INTERSECTION

- Used where a hiking trail crosses a roadway
- Visual sight lines are a clear at least 25’ down the roadway and 20’ down the trail to increase safety
- A 10’ rest area is provided on each side of the crossing, that may contain, benches, water, shade, and signage
- The roadway widens at the intersection allowing room from a planted median; this allows people to cross one lane of traffic at a time
- The pavement changes from asphalt to concrete as the roadway approaches the intersection to delineate the space
- There are concrete bands or rumble strips in the roadway that alert the vehicles to an upcoming crossing
TYPICAL HORSE TRAIL

- See figure 5.5 for classifications and exact dimensions
- Wide enough for a single line of horses
- Maintained per DNR standards

Figure 7.6 Typical Horse Trail

SHARED HORSE/PEDESTRIAN TRAIL

- See figure 5.5 for horse classifications and exact dimensions
- Wide enough for a single line of horses
- Wide enough for two people to pass side-by-side
- Clear separation between horse and pedestrian trails
- Clear signage delineating both trails
- Maintained per DNR standards

Figure 7.7 Shared Horse/Pedestrian Trail
ONE-WAY LOOP

The one-way loops offer a unique opportunity to integrate bicycle lanes into the park without compromising natural scenery and topography for added roadway width. The two one way loops within the park effectively separate vehicular and bicycle traffic with a planted median. This new form of transportation, the bicycle, within the park decreases the dependence upon the automobile because the bicycle can now safely travel to all of the parks major activity nodes and trail heads.

Figure 7.8 One-Way Loop Perspective
ONE-WAY LOOP-CAR

- Existing park roadways are used
- 2 loops exist (see master plan)
- Planted median separates vehicular lane from bicycle lane
- Traffic flows in one direction

![Figure 7.9 One-Way Loop Section - Car](image)

ONE-WAY LOOP-SHUTTLE

- Same as above except for shuttle occupies vehicle lane

![Figure 7.10 One-Way Loop Section - Shuttle](image)
INTERSECTION
VEHICLE/BICYCLE

- Used where the vehicular lane crosses the bicycle lane or vise versa
- Visual sight lines are a clear at least 25' down the roadway and 20' down the access lane
- The pavement changes from asphalt to concrete as the roadway approaches the intersection to delineate the space
- There are concrete bands/ rumble strips in the bicycle/vehicular lanes that alert traffic to an upcoming crossing
- Appropriate signage alerting vehicles and bicycles to the upcoming intersection should be placed accordingly
- Vegetation in the median should remain below 3' within 50' of the intersection to allow clear visibility throughout the intersection

Figure 7.11 Intersection Vehicle/Bicycle
RESTRIPED LANES-USES

Bicycle

Car passing bicycle

Car waiting to pass bicycle

Car

Figure 7.12 Restriped Lanes
RESTRIPED LANES-
SUMMARY

The restriped lanes offer the bicycle space on park roadways that are not conducive to the one-way loops. Formerly unmarked roadways were unsafe and not “bicycle friendly.” Now the bicycle and vehicle can more safely share the existing roadway. Both forms of traffic are allotted space on the roadway. As seen in the previous diagram the many uses of the roadway are depicted. This second form of bicycle integration also serves to make Brown County State Park’s major attractions fully accessible by bicycle.
TYPICAL PARKING LOT LAYOUT

Figure 7.13 Parking Lot Plan

- Parking is only allowed in designated spots, not on the roadway or along entry/exit drives
- The exact number of spots in each lot is determined by the carrying capacity both physical and social of the amenity serviced by the lot
- Visual sight lines are maintained to allow clear views to the roadway from the entry/exit drives
- Vegetation screening is employed to make the parking lots as unobtrusive as possible
- Restrooms are available at each parking lot, and they are appropriately screened with vegetation
- A bicycle storage device is provided at each parking lot to allow secure storage of bicycles while visitors use the amenity
- The parking lot and entry/exit drives are appropriately sized to allow shuttles access to drop off/pick up people
PARKING LOT VIEW
LOOKING TOWARDS TRAIL HEAD

Figure 7.14 Parking Lot Perspective A

PARKING LOT VIEW
LOOKING TOWARDS PARKING LOT

Figure 7.15 Parking Lot Perspective B
The backcountry campsite experience is designed for hikers who wish to explore the remote areas of the park (see page 56 for specific locations). A typical hiker that uses this campsite may hike up to 12 miles into the southern quadrant of the park. They could then spend a night or two at the campsite and travel the trails around the area. These campsites are to follow the no trace rules and regulations found on www.Int.org. The campsites are primitive and hikers must bring everything they need for survival. Blow up diagrams of the specific areas will follow.
An ideally shaded spot is provided for the campsite.

- The 2’ wide spur trail travels 100’-300’ from the main trail to reach the campsite.
- There should be enough room for 3-4 8’x8’ tent footprints.
- Access to water or a view shed should be provided at each campsite.

Figure 7.17 Campsite Blowup
Backcountry Campsites

TRAIL SPUR TO
CAMPsite BLOWUP

- Clearly visible identifying sign should be placed at the spur trail to each campsite giving an address to each campsite
- Trail spurs should be no closer than 50' to each other

Figure 7.18 Trail Spur to Campsite Blowup
EMERGENCY PHONE BLOWUP

- An self sufficient solar emergency phone should be located within 1 mile of all campsites
- The phone should blend in with its surroundings
- The solar array/antenna should travel up a tree and be extended beyond the tree canopy
- The call box may be attached to a tree
- The phone should be clearly visible and appropriately marked

Figure 7.19 Emergency Phone Blowup
TOILET BLOWUP

- A pit toilet should be provided in close proximity to backcountry campsites.
- Wind direction should be taken into consideration while placing toilets as to avoid blowing into campsites.
- Pit toilet should be well screened and not be visible from the trail.

TO MAIN TRAIL.
MEETING PROJECT GOALS & OBJECTIVES

This master plan has met the project goals and program as prescribed on pages 30 and 31. First and foremost, sustainable design principals were used in the creation of the master plan addressing the physical and social carrying capacities of the park, amount of users, and resource consumption. Secondly, improvements to transportation systems were suggested in the master plan based also upon users and carrying capacity. The conversion of trials from horse to hiker was based upon user needs, physical limits of the land, and standards from DNR sources. The addition of safe bicycle travel within the park modified existing vehicular corridors to meet the needs of users now and in the future. This addition will pave the way for alternative forms of transportation, to the vehicle, within the park such as shuttles or trams. Limiting the number of vehicles, especially at peak times, will be a benefit to all users, wildlife, and natural resources within the park. This is accomplished in part through the redesign of aesthetically pleasing and functional parking lots. These parking lots take into consideration the physical and social carrying capacities of the amenities serviced by them. Finally, backcountry camping was introduced into the southern area of the park serving to diversify the park goers experience and provide longer hiking experiences within the park. These campsites will also facilitate bringing the hiker into the southern area of the park where formerly only horses traveled. This master plan addressed key issues within the park involving sustainability, transportation systems, and camping to meet the needs of current and future users of Brown County State Park.
Books


Periodicals


Internet Resources


Film

*Taken For a Ride*. James M. Klein. New Day Films.