Blue Hole Regional Park

A Master Planning Vision

Prepared by
Lady Bird Johnson Wildflower Center
4801 La Crosse Ave.
Austin, Texas 78739

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Lady Bird Johnson
Wildflower center
THE UNIVERSITY OF TEXAS AT AUSTIN

A Letter from the Stakeholders

The Wimberley Valley was created by and is known for two streams – Cypress Creek and the Blanco River – that meet at the heart of the Village. Running deep through the Lone Star State, these arteries have brought the Valley essential resources that have, over the years, become part of Central Texas' identity: clean drinking water for people and livestock, power for a mill that served the area for almost 80 years, and on Cypress Creek a popular swimming hole surrounded by limestone bluffs and towering cypress trees, known as Blue Hole. Blue Hole is the centerpiece of a 126-acre property containing not only the legendary swimming hole but many other examples of Hill Country plants, animals, and land forms.

Soon after the Village government was formed in May 2000, its elected officials began to address citizens' requests for parkland and water access. In 2003, the Blue Hole property came on the market, and the Village completed negotiations with Peter Way, a long time local land owner and part time resident, who generously agreed to purchase and hold the property at no profit to him while funding to purchase the property was obtained by the Village. Within 18 months, the Village raised the necessary funds and purchased Blue Hole.

Now owned by the Village, the 126 acre regional park is the largest piece of natural Hill Country public land in Hays County. The Village government has pledged to protect and preserve this Texas treasure and develop compatible recreational opportunities in the park. To achieve this, in 2005 the City Council retained the Lady Bird Johnson Wildflower Center to produce a preliminary master site plan to serve as the Village's guide for development and maintenance of the Park. A group of 25 stakeholders, drawn from a wide cross section of Wimberley Valley residents, worked for nearly a year with the Wildflower Center staff to produce this plan, and the City Council approved it on February 15, 2007. The master plan includes a variety of low impact uses compatible with protection of the environment within the park. Special thanks go to the Friends of Blue Hole for their role in raising the money to fund the plan.

This plan is dedicated to future generations who will use the park. We believe it will form a road map for the Village government as the Blue Hole Park continues to grow into the great public resource that it is destined to be.

Stakeholders Group

Bill Appleman, Planning and Zoning Chair
David Baker, Wimberley Valley Watershed Association
Brenda Bishop, Wimberley Independent School District
Mark Bursiel, Parks and Recreation Board
Curt Busk, City Council Liaison to Water/Wastewater Board
Christine Byrne, Blue Hole Lane Property Owner
Will Conley, Hays County Commissioner
Jan Fulkerson, Texas Forest Service/Parks and Recreation Board
Tevis Grinstead, City Planning and Zoning Vice Chair
Malcolm Harris, Parks and Recreation Board/Cypress Creek Property Owner
Eddie Holliman/Buddy Wilson, Hill Country Recreation Association
Dell Hood, Parks and Recreation Board/Master Naturalists
Keith Kay, Long time Wimberley resident, BH Fundraising Committee
Bob Kerrigan, Wimberley Community Tennis Association
Todd Mackenzie, Deer Creek of Wimberley
Thad Nance/Jim Neff, San Marcos Area Youth Soccer Organization
Carolyn Nichols, Friends of Blue Hole Director, Secretary-Treasurer
Bert Ray, Transportation Advisory Board
Susan Thurber, Landscape Architect/Former City Council Member
Horace Wilson, Parks and Recreation Board
Elaine Wilson, Long time Hill Country resident, ecological and hike/bike interest
Marilee Wood, Village Council and Liaison to Parks and Recreation Board
Jack Williams, long time Wimberley resident

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EXECUTIVE SUMMARY

Blue Hole Regional Park takes its name from the historic Blue Hole on Cypress Creek, which has provided residents and visitors to the Wimberley Valley with entertainment and refreshment since the 1920's. The beloved spring-fed creek has been a summer destination for generations of Central Texans. Recently transferred from private to public ownership, its 129 acres near the town square in Wimberley are now the largest contiguous park property in Hays County, Texas.

The property was purchased by the Village of Wimberley in 2005 to save it from encroaching development. The 126 acres available for the public park --three acres are reserved for other uses -- will be sensitively developed for the enjoyment of residents, visitors and future generations. Plans include new recreational facilities needed by the growing community and ecological restoration of native landscapes.

Mission

To protect, restore, and develop Blue Hole Regional Park as a **recreational, educational** and, **ecological** resource for present and future generations.

Vision

To create an **ecologically** and **economically sustainable** regional park which celebrates the character of the Wimberley Valley and thoughtfully considers the **environmental** and **recreational needs** of the community. The park invites people to experience, respect, and enjoy the uniqueness and beauty of the Texas Hill Country.

Goals

- To protect and restore the natural water resources and other ecological and environmental features of the park
- To provide and develop recreational and educational resources for park visitors
- To integrate the park with other resources in the region
- To create a regional park that is environmentally and economically sustainable

Throughout Texas, large tracts of land, especially those with natural water features, are being rapidly developed and lost as open space available for the enjoyment of all. Blue Hole Regional Park stands as a model of purposeful conservation — a Texas treasure preserved for future generations.

The Master Plan

To ensure that Blue Hole Regional Park would be developed in a thoughtful, appropriate, community-driven, and environmentally sensitive manner, the Village of Wimberley engaged the Lady Bird Johnson Wildflower Center to develop a master plan for the new regional park.

Wildflower Center staff convened a group of local stakeholders to develop a preliminary site plan. This plan illustrates the community's vision for the regional park and will guide future design and construction efforts. The process helps ensure that the regional park will match the desires of the people of Central Texas while protecting the natural resources and ecological features of this unique Hill Country property.

More details may be found in the report, "Blue Hole Regional Park: Preliminary Site Master Plan Final Report," available from the Village of Wimberley.

The Site

Wimberley is located on Ranch Road 12, 14 miles from Dripping Springs and San Marcos. Blue Hole Regional Park is just east of the downtown square on Blue Hole Lane, off Old Kyle Road near the junction of FM 3237.

The Process

The Wildflower Center and other consultants provided design, ecological, and engineering expertise and directed the master planning process. The task consisted of:

1. Clearly defining goals and objectives
2. Understanding the ecological and economic opportunities and constraints of the park
3. Developing a plan that ensures that the many proposed uses of the park are both economically and ecologically sustainable
4. Arranging park improvements in a way that works efficiently for the community and is true to the integrity of the site
5. Creating a synergy among park activities that links the park to the surrounding region--the park is greater than the sum of its parts
6. Guiding future park use and development to meet community needs while honoring the natural environment

The Village of Wimberley City Council understood the value of a community driven project and decided that a group of local stakeholders should be closely involved in the master planning.

The Council selected 25 members of the community with diverse backgrounds and interests. The stakeholders developed the master plan under the direction of the Wildflower Center and are community ambassadors for the Blue Hole Regional Park. All aspects of the site design were developed with stakeholder input and direction. The plan provides for phased construction as funding becomes available.

Park Funding: Land Acquisition

In December 2003, Wimberley entered into an option agreement with local landowner and part-time resident Peter Way, who had agreed to hold the property at no profit for 24 months to allow the Village to raise approximately $3 million for acquisition.

In partnership with The Trust for Public Land, the Village began fundraising. The land acquisition was completed in 2005 thanks to these major gifts that will also allow the initial development to proceed:

Texas Parks and Wildlife Department-- Recreation and Parks Regional Grant	$1,908,500
Hays County Parks Bond Program	$700,000
Lower Colorado River Authority	$200,000
Private funds	$300,000

Ongoing Funding Needs: Keeping the Promise

Additional funds are needed if the dream of Blue Hole Regional Park is to be realized. The master plan sets a goal of a self-supporting park that will generate income through usage, swimming, and permit fees, but the fact is that parks typically require ongoing outside funding. This park will need broad-based financial support to ensure that the promise is kept.

The Village Council of Wimberley has pledged its commitment to Blue Hole Regional Park and its operations, staffing, and maintenance for future years. The Village will fund and operate the summer swimming program. However, as public use increases and the park is further developed, annual costs will increase as well. The Village plans to include these costs in its budget, and will pursue grants for park development.

Protecting Blue Hole

In 2001, when plans were underway to develop the Blue Hole tract for private use, the Village of Wimberley seized the opportunity to save the property and ensure that this precious place would be open to the public in future generations. The Village, along with the Friends of Blue Hole, raised the funds to buy and protect the property and to develop it as a regional park. The property adjoins the Village's first park, the Cypress Creek Nature Trail.

Blue Hole Regional Park is part of a larger historic property purchased by John R. Dobie in 1897. The Dobie family lived and farmed on the 500 acres and retained ownership for more than 70 years. Beginning in the 1920's they allowed fee-based swimming and picnicking at the Blue Hole. In the mid-70's, the property was purchased by a private partnership that created the Blue Hole Recreation Club to allow limited swimming and camping along Cypress Creek.

Restoration Needs

Years of heavy use and pressure from humans, deer, overgrazing by livestock, and suppression of wildfires took their toll on the landscape.

The swimming area, with its rocky bluffs, is just one of the ecologically sensitive areas that has been damaged from frequent use over the years. The master plan recommends these steps to help restore this area, permit the regrowth of native plants, and prevent future degradation:

- interpretive signage informing visitors of the need to preserve sensitive areas
- limited entry and exit points to the creek
- control of invasive exotic species
- protection of environmentally sensitive areas and plants

The area along the creek will be carefully monitored to preserve water quality and existing native vegetation and to prevent bare soil and stream bank erosion. If the area is in danger of damage from overuse, action will be taken to protect it.

Recommendations also have been developed for restoring the Nature Trail and Preserve, the Live Oak Woodlands, Deer Creek, the Grasslands/Savannas area, and the Juniper Revegetation Area. Native plants will be nurtured with a greater diversity of species, and exotic species will be removed or discouraged. The deer population must be reduced to allow for revegetation of wildflowers, trees, and shrubs that create habitat for birds, butterflies and other wildlife.

Mission Statement

To protect, restore, and develop Blue Hole Regional Park as a recreational, educational, and ecological resource for present and future generations.

Recreational Resources

As Wimberley and Hays County grow in population, so does the need for recreation. Wimberley needs a community park with recreational fields and facilities. Much of the upland area of the regional park is no longer natural because of grading for agricultural and wastewater purposes. This previously disturbed area is an ideal location for sports facilities and other improvements.

Sports Facilities

When fully built, the park will feature soccer fields, tennis courts, and a volleyball court.

Pavilions

Handsome, open-air pavilions constructed from natural materials will blend with the setting, reflect the architectural heritage of the Wimberley Valley, and be available for multiple uses. They will use "green building" methods and technology. A community pavilion and a recreational pavilion, both with restrooms, are planned.

Community Pavilion: An approximately 1,600-square-foot covered area will be available for private and public events. Retractable basketball hoops will allow its use for "pick-up" basketball games.

Recreation Pavilion: This 400-square-foot covered area with picnic tables will provide a central gathering space next to the playscape, volleyball court and soccer fields.

Outdoor amphitheatre/classroom: This structure of about 225 square feet will be used for education and community entertainment.

Blue Hole Swimming Area

The beloved swimming hole will be kept largely in its natural state with improvements that are naturalistic in design. They include:

- Clearly designated access points to the water, with stabilized stream banks where needed
- Limestone patios and grassy areas for sunbathers

Visitors will be limited to prevent damage from overuse. An entrance fee will be charged.

Bathhouse

This multi-use facility will provide changing rooms and restrooms for swimmers and sunbathers. Located between the parking area and Cypress Creek, the bath house will include a staff office as well as the entrance and fee collection point for the swimming hole. A "green building" structure, it will be a local model of sustainable design constructed in the style of the Texas Hill Country.

Children's Playscape

A large naturalistic playscape of about 1,500 square feet will be conveniently located near the recreation pavilion and youth soccer fields. Large trees and picnic areas will surround the playscape offering shaded rest areas for visitors.

Pedestrian Trails

A walking trail system will link with other community trails and parks with educational signage, picnic areas, scenic vistas, and shaded rest stops. Designated areas will be accessible to those with disabilities. All trails will be constructed of local materials, designed with environmental sensitivity, allow natural water flow, and provide for minimal maintenance.

Hike and Bike Trail

This trail will link the eastern side of the park to a hike and bike trail that extends through the greater Wimberley Valley.

Campground

Primitive camping will be offered in designated areas for a fee. The grounds and usage guidelines will follow the Leave No Trace camping methods established by the Boy Scouts of America.

Educational Resource

When people have access to parks and spend time in a natural area such as Blue Hole Natural Park, they become more sensitive to nature and the environment of their region. Protected open spaces allow people to reconnect with the natural world and to learn first-hand about native plants and ecosystems. According to the Trust for Public Land, a growing body of research shows that spending time outdoors in nature improves physical and psychological health.

Strong ties to nature create a concern for the environment and our natural surroundings. Introducing children to the outdoors — through pleasures such as swimming at Blue Hole — leads them to appreciate nature and wildlife in their later years.

At the park, community residents and tourists can enjoy hiking, bird watching, wildlife viewing, and botanizing. Trails will lead them through varied ecosystems — savanna, woodland, and streams — and provide opportunities to view diverse plant and animal communities.

An outdoor amphitheatre/classroom of about 225 square feet will provide a comfortable gathering area for small classes, performances, and educational events. The amphitheatre will be constructed of local materials and tucked into the landscape within walking distance of the recreational center.

Ecological Resource

The vision for Blue Hole Regional Park is for a place that invites people to experience, respect, and enjoy the unique beauty of the Texas Hill Country. More than 60 percent of the park will be maintained as natural areas using adaptive management strategies to shape vegetative communities and promote native habitat.

The natural areas have three dominant habitat types: Juniper/Live Oak Woodland, Grassland Savanna and Stream Corridors. The landscape along Cypress Creek is dominated by bald cypress and other water loving vegetation. In addition to Cypress Creek, a major natural feature is a seasonal drainage known as Deer Creek that flows down the eastern half of the property. A long-term restoration plan for each area will add more plant species to increase native plant diversity and wildlife habitat.

Environmental & Economic Sustainability

The following principles and parameters were created to guide the park design.

Ecological Principles

Develop the park in a sensitive manner that promotes:

- Habitat conservation for birds and other wildlife
- Water quality and quantity protection of the Trinity Aquifer
- Ecological restoration of the landscape

Design Parameters

- Collect roof rainwater runoff for re-use
- Use architecture representative of the Texas Hill Country
- Design for energy and water efficiency using durable, aquifer friendly materials
- Avoid light pollution
- All amenities and activities must be economically and environmentally sustainable
- Minimize impervious cover when possible. Impervious cover is not to exceed 10 percent on the site or 12.9 acres. Ensure that the design, construction and operation of the park protect natural water resources and ecological/environmental features (USFWS 2005)
- During construction, minimize disturbance and damage to the site
- Route all future utility lines underground

Operation Parameters

- Provide an additional 30 percent maintenance endowment for each amenity in the fundraising goals
- Maintain the park with aquifer friendly (non-toxic, biodegradable) cleaning products that protect human health and the environment
- Monitor the landscape for degradation of the vegetation composition and erosion indicators (bare dirt, rill, gully formation). If damage occurs, take action to protect the natural resources by resting the landscape or relocating facilities

Phased Park Development

The park will be developed in two phases. Because the Village is committed to opening Blue Hole for swimming each summer, Phase 1 will include public access to the swimming hole.

Restoration of natural areas can begin before construction of other improvements. Consultants will develop detailed design and construction documents for the park in the final planning phase.

The speed of development is contingent on successful fund raising and community support.

Sequencing of Projects

One of the questions remaining is waste water treatment, which will influence the timing and sequence of development. An existing waste water treatment plant must be removed, but this cannot be done until a new plant is constructed. Three acres of the 129-acre site have been set aside for this purpose. Phase 1 assumes that the existing plant and associated drainage field remain in place. Phase 2 projects can be completed after the new plant is built, and the old facility has been removed. Graphical depictions of Phase 1 and 2 are included at the end of the Executive Summary, and in Appendix B.

Phase 1 Projects

- Pedestrian trails
- Hike and bike trail
- Picnic areas
- Restored natural areas
- Office/bathhouse (portable or composting toilets)
- Restored swimming hole
- Community pavilion
- 3 tennis courts
- 1 soccer field
- Open parkland
- Primitive camping
- Small loop road around recreation fields
- Additional parking: 125 spaces total

Phase 2 Projects

- Expanded recreation areas
  - Additional soccer fields
  - Additional tennis courts
  - Volleyball court
  - Recreation pavilion
  - Playscape
  - Road improvements
- Small amphitheater
- Running water to bathhouse

-Additional parking: 291 spaces total

Friends of Blue Hole

Friends of Blue Hole, a non-profit corporation, was created to promote, protect, preserve and develop the Blue Hole park owned by the Village of Wimberley. The organization works with the Village of Wimberley to accept and provide donations for the Blue Hole Regional Park. For more information on the Friends of Blue Hole visit www.friendsofbluehole.org.

Community support for the Blue Hole project has been strong. However, the regional park improvements described in the master plan will require significant funding from private and public sources if it is to be fully realized. In addition to their financial contributions, community members have given hundreds of volunteer hours and thousands of dollars in value in the form of in-kind contributions.

Legacy Opportunities

Legacy gifts by individuals, families, businesses, and foundations will be given permanent recognition at the park. For information on tax-deductible charitable contributions, contact

Friends of Blue Hole
info@friendsofbluehole.org
P.O. Box 1601
Wimberley TX 78676

Volunteers for Blue Hole
More than 100 volunteers, led by the Village of Wimberley Parks and Recreation Board, are striving in many ways to accomplish the mission of the Friends of Blue Hole.

Village of Wimberley
City Hall
512/847-0025

Consultant Team
The Lady Bird Johnson Wildflower Center: Steve Windhager, Heather Venhaus, Mark Simmons, Saralee Tiede, Marianne Shivers, Dick Davis, Jeannine Tinsley, and Michelle Bertelsen

Loomis Austin, Inc.: Tom Loomis and Tracy Bratton

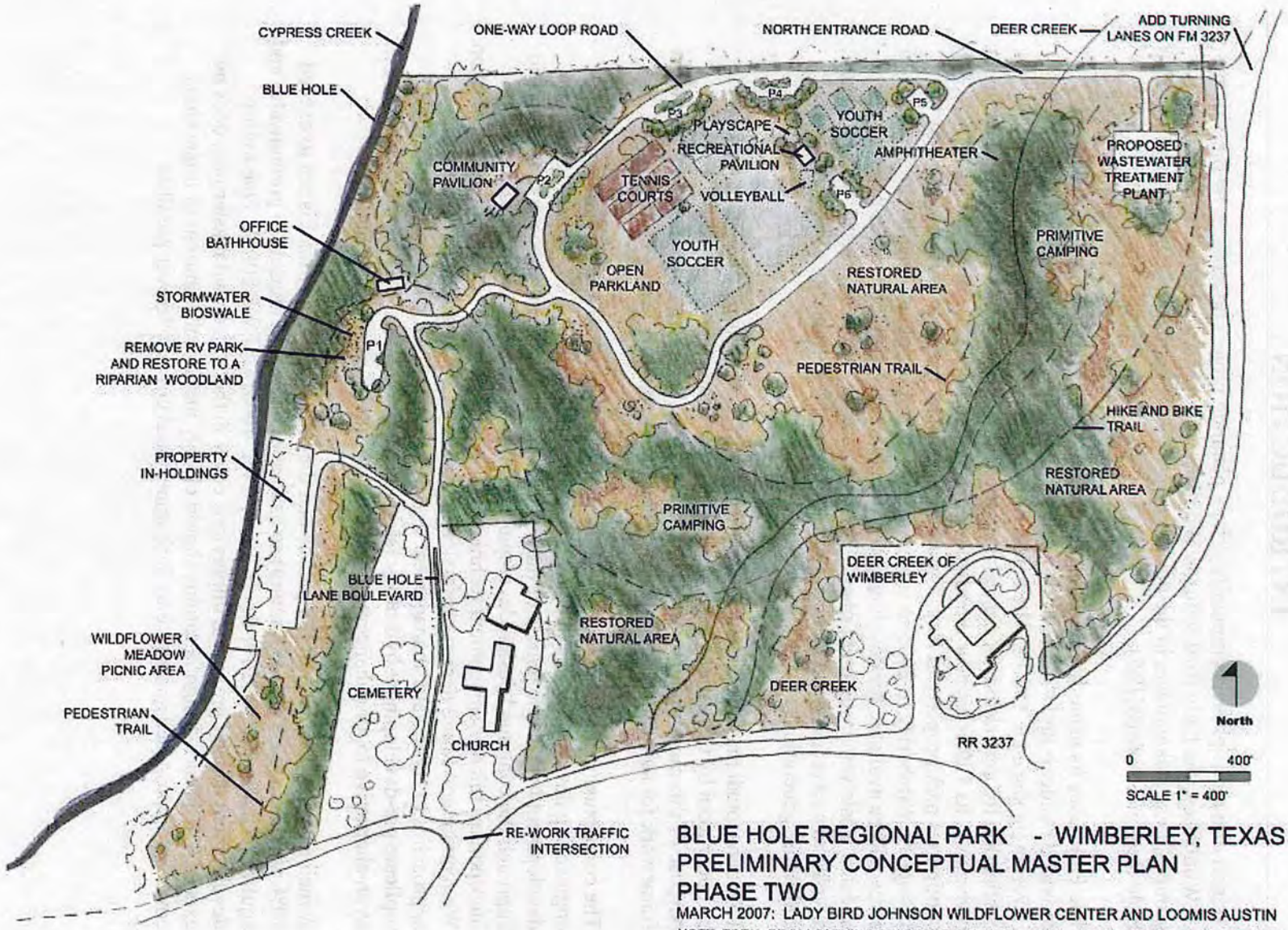
WHM Transportation Engineering Consultants, Inc.: Lance Hartland

Waste Water Technologies: Greg Gullet

BLUE HOLE REGIONAL PARK - WIMBERLEY, TEXAS
PRELIMINARY CONCEPTUAL MASTER PLAN
PHASE ONE

MARCH 2007: LADY BIRD JOHNSON WILDFLOWER CENTER AND LOOMIS AUSTIN

NOTE: TOTAL OF 181 PARKING SPACES. P1 - 40 , P2 - 16 AND 125 PARALLEL SPACES ALONG LOOP ROAD



BLUE HOLE REGIONAL PARK - WIMBERLEY, TEXAS
PRELIMINARY CONCEPTUAL MASTER PLAN
PHASE TWO

MARCH 2007: LADY BIRD JOHNSON WILDFLOWER CENTER AND LOOMIS AUSTIN

NOTE: TOTAL OF 291 PARKING SPACES. P1 - 40, P2 - 16, P3 - 22, P4 - 22, P-5 14, P6 - 22 AND 155 PARALLEL SPACES ALONG LOOP ROAD. THE LOCATION OF THE PROPOSED WASTEWATER TREATMENT PLANT IS APPROXIMATE AND SHOULD BE FIELD LOCATED TO AVOID SEASONAL DRAINAGE FEATURES AND MINIMIZE DISTURBANCE.

INTRODUCTION

As part of a multi-phase, community-driven planning project undertaken by the Village of Wimberley, the Lady Bird Johnson Wildflower Center was charged with guiding a group of local stakeholders in the development of a preliminary site master plan for Blue Hole Regional Park (BHRP).

The Park takes its name from the historic Blue Hole on Cypress Creek, which has provided residents and visitors to the Wimberley Valley with entertainment and refreshment since the 1920's. The beloved spring-fed creek has been a summer destination for generations of central Texans. Recently transferred from private to public ownership, its 129 acres near the town square in Wimberley are now the largest contiguous park property in Hays County, Texas. The property was purchased by the Village of Wimberley in 2005 to save it from encroaching development. On the site, 126 acres will be available for development as a public park with three acres reserved for an updated waste water treatment plant. The park acreage will be protected, restored, and developed as a recreational and ecological resource for Wimberley's residents, visitors, and future generations.

This conceptual master plan report is only one part of a multi-phase planning project to be undertaken by the Village of Wimberley for the Blue Hole Regional Park. The purpose of this master plan report is to clarify the design intent of the park and provide a framework for subsequent planning and fund raising phases.

The conceptual plan of the park envisions future comprehensive land planning and engineering design activities that have the goal of maintaining and enhancing the pre-development hydrologic regime of the site and watershed. Future design phases should approach the continued design development with a strategic planning process that incorporates micro-management techniques to achieve superior environmental protection. We recommend future design professionals consider Low Impact Development approaches to stormwater management that use decentralized, or source, controls to replicate pre-development hydrology (stormwater) conditions. This approach can be used as an alternative to, or enhancement for, conventional stormwater technology.

A major design parameter of the park is that the impervious cover total is not to exceed 10% of the site (12.9 acre maximum) so as to avoid potential impacts to groundwater and aquifer recharge (Klein 1979; Booth 1991; CWP 2003; USFWS 2005). Due to low development density proposed, impervious cover in the conceptual master plan does not exceed 9%. Future design iterations should closely monitor the amount of impervious cover being proposed and strive to limit impervious cover wherever possible.

PROGRAM PLAN

Pre-existing project constraints

Prior to the master planning process, pre-existing constraints were placed on the park by various funding sources, utility companies, and the Village of Wimberley. These constraints were part of the larger stakeholder group discussion and influenced the outcome of the project.

1. Public park in perpetuity that includes:
    a. public access
    b. open space
    c. green belts
    d. conservation of Blue Hole
    e. no mining or drilling
    f. habitat conservation for birds and other wildlife
    g. water quality and quantity protection of the Trinity Aquifer
    h. ecological restoration of the site (upland and streamside)
2. Wastewater treatment plant will be upgraded at a future date and a portion of the water will need to be used on site or piped elsewhere. Three acres have been set aside for the proposed treatment plant.
3. All donors will be recognized in some way
4. Blue Hole will be open for swimming during the summer months
5. Abide by existing property easements

Working with the Stakeholder Group, the master planning process was initiated by outlining the design direction and parameters of park. The project program, outlined below, was developed to guide the current and future park design.

Vision

To create an ecologically and economically sustainable regional park which considers environmental and recreational needs and the character of the Wimberley Valley while inviting people to experience, respect, and enjoy the uniqueness and beauty of the Texas Hill Country.

Mission

To protect, restore, and develop Blue Hole Regional Park as a recreational, educational, and ecological resource for present and future generations.

Goals

1. To protect and restore the natural water resources and other ecological and environmental features
2. To provide and develop recreational and educational resources for park visitors
3. To integrate the park with other resources in the region
4. To create a regional park that is environmentally and economically sustainable

Parameters common to all amenities

The following parameters were developed by the stakeholder group to give additional detail and guidance to the master planning process.

Design parameters

a. Design all rooftops and other impervious surfaces to collect rainwater runoff for re-use purposes including, but not limited to, toilet flushing and landscape irrigation.
b. Design all structures to reflect the vernacular architecture of the Texas Hill Country and to be energy and water efficient, using durable, aquifer friendly materials.
c. Design all outdoor lighting to avoid light pollution using unobtrusive lighting fixtures that cut glare, prevent light trespass, reduce sky glow and eliminate wasted energy.
d. Ensure that all amenities or activities are both economically and environmentally sustainable
e. Minimize impervious cover when possible (USFWS 2005). The impervious cover total is not to exceed 10% on the site (12.9 acre maximum)
f. Ensure that the design, construction, and operation of amenities protect the natural water resources and the ecological and environmental features of the park.
g. Design all amenities with tight construction area limits in order to minimize disturbance and damage to the site.
h. All future utility lines should be routed underground.

Operational parameters

a. Fund all amenities with an additional 30% maintenance endowment.
b. Maintain all amenities with aquifer friendly (non-toxic, biodegradable) cleaning products that protect both human health and the environment.
c. Monitor the landscape around all amenities for degradation of the vegetation composition and erosion indicators (bare dirt, rill, gully formation). If damage occurs, take action to protect the natural resources by resting the landscape or relocating the amenity.

PROJECT HISTORY

Blue Hole Regional Park, 129 acres near the Wimberley town square, takes its name from the historic Blue Hole swimming hole on Cypress Creek, which has provided residents and visitors to the Wimberley Valley with entertainment and refreshment since the 1920's. The park property was recently purchased by the Village of Wimberley to protect this treasured local resource for the enjoyment of residents, visitors, and future generations. The conceptual master planning process, along with this report, ensures a park that meets the desires of the people of Central Texas and protects the treasured natural resources of this unique Hill Country property.

The community of Wimberley owes its beginnings to Cypress Creek and the cypress trees lining its banks. These resources provided water and an ideal location for milling, which drew settlers to the area. Flour, molasses, lumber, shingles, and cotton were all milled along the stream banks. The community's mill was located near the Blue Hole and is described in the rich lore of "old-timers" who made Wimberley what it is: a uniquely vibrant and determined community in the beautiful Texas Hill Country.

The acreage of Blue Hole Regional Park is a portion of a historically larger property that was purchased by John R. Dobie in 1897. His family lived and farmed on the land. The Dobie family retained ownership of the 500-acre property for more than seventy years and allowed fee-based swimming and picnicking at the Blue Hole beginning in the 1920's.

In the mid-70's, the property was purchased by a private partnership group for investment and possible future development. The partnership created the Blue Hole Recreation Club to allow limited swimming and camping along Cypress Creek. For years, the Gospel Music Festival was held creek side each October. The property owners also constructed a small waste water treatment plant to service Deer Creek of Wimberley, a nearby rehabilitation center.

When the Village of Wimberley incorporated in 2000, the new municipal government immediately became aware of the need for parkland with public access for swimming as well as a wastewater treatment plant to serve the business district. Although by 2001, plans were under way for residential development of the Blue Hole tract, local leaders saw an opportunity for the property to meet these needs in a rapidly growing community.

Acquiring the Blue Hole property for parkland seemed especially attractive to the Village of Wimberley because the property would adjoin the City's first park, more than seven acres purchased in 2002 and developed into the Cypress Creek Nature Trail.

In December 2003, the Village of Wimberley City Council held a news conference to announce plans to acquire the Blue Hole tract. The Village entered into an option agreement with local landowner and part-time resident Peter Way, who agreed to hold the property at no profit for 24 months to allow the Village to raise approximately $3 million for acquisition.

In partnership with The Trust for Public Land, the Village began fundraising. The Blue Hole project was awarded a Texas Parks and Wildlife Department (TPWD) Recreation and Parks Regional Grant for $1.9 million, as well as receiving significant contributions from Hays County ($700,000) and the Lower Colorado River Authority ($200,000). In addition, approximately $300,000 in private donations and pledges have been raised from individuals, private foundations, and other entities interested in preserving this Texas treasure for public use. The land acquisition was completed in 2005.

Community support for the Blue Hole project has been especially strong, with hundreds of volunteer hours and thousands of dollars donated locally, including fundraising, graphic and video design, research and planning, and a variety of in-kind contributions.

In 2005, local officials authorized the creation of a non-profit organization called Friends of Blue Hole, whose mission is to promote, protect, preserve, and develop Blue Hole Park owned by the Village of Wimberley. With funds on hand, as well as those raised by Friends of Blue Hole, the City Council in 2006 retained the Lady Bird Johnson Wildflower Center to develop the preliminary master plan presented in this report.

Fundraising continues for the Blue Hole project. A Capitol Area Metropolitan Planning Organization (CAMPO) trail system grant of $800,000 will be increased by a $200,000 match by Hays County and the Village of Wimberley. This trail system will link the Blue Hole Regional Park to regional trail systems. In addition, $100,000 of the TPWD grant is earmarked for development. And the Friends of Blue Hole Board of Directors are preparing their fundraising goals.

The waters of Blue Hole and the surrounding land have attracted people for thousands of years, and a community grew around its beauty. Villages such as Wimberley have become destinations for people seeking a small-town atmosphere with the facilities of a nearby city. As a result, large tracts of land, especially those with natural water features, are being rapidly consumed. Treasured open space must be purposefully conserved to remain intact. To preserve this Texas treasure for future generations, while developing its recreational opportunities, is truly remarkable. BHRP is now the largest contiguous park property in Hays County.

SITE DESCRIPTION

Multiple site analyses were conducted by Wildflower Center staff between March 2006 to February 2007 to provide a thorough understanding of the existing site conditions and provide direction in the planning process. This section of the report outlines the findings. Tables I and II, found in Appendix A, provide scientific names for all species mentioned in this text. Figure 1 on the following page provides a map of the property with various easements and habitat zones depicted.

General Overview

Topography and drainage

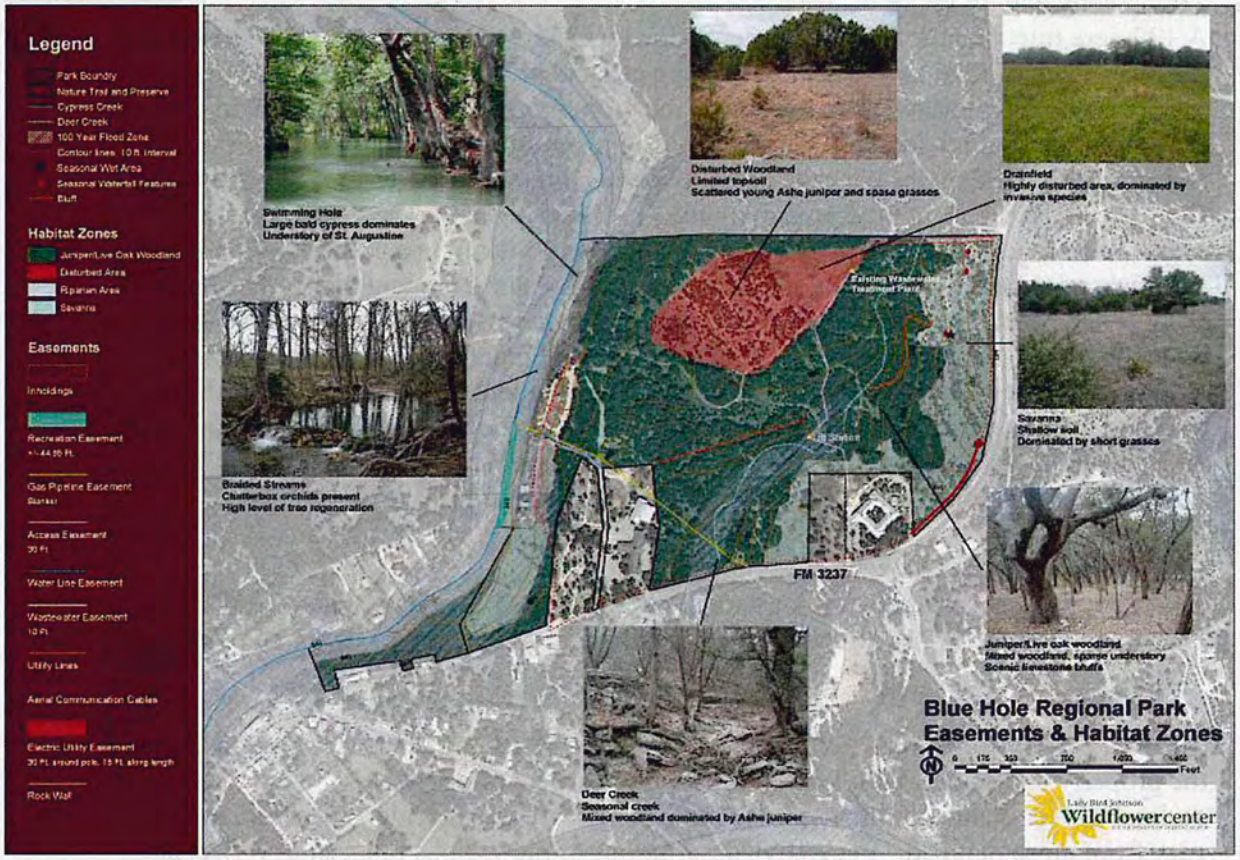
A 129-acre tract bounded on the western edge by Cypress Creek, a perennial stream that receives much of its flow from a large spring at Jacob's Well on the north side of Wimberley. The northwestern portion of the property and areas adjacent to and west of the current entry road drain to Cypress Creek, which ultimately drains southerly to the Blanco River. The majority of the property drains directly to the Blanco River through Deer Creek, an intermittent drainage running to the southwest. The Deer Creek basin's onsite boundary is approximately demarcated by portions of the current entry road and the unpaved access road leading to the current wastewater treatment plant. The highest point of the property, approximately 900 feet above mean sea level, is along the northern boundary fence, approximately NNW of the treatment plant. A former sweet-potato field to the southwest of the treatment plant contains the effluent drainfields. The drainfield area and general surrounding area to its southwest is fairly level, with evidence of sheet erosion flowing to the two drainages by ill-defined patterns. The entire property lies within the contributing zone of the Southern Edwards Aquifer.

Geology, Soils, and Rangesite Descriptions

The property is underlain by the Cretaceous limestones of the Upper Glen Rose Formation (Barnes 1981), which are visible in bluffs along Cypress Creek and Deer Creek.

The Soil Survey for Comal and Hays Counties (USDA-SCS 1984) maps the soil types of the property and categorizes them into Range Sites, according to their potential to support various climax plant communities. Soil mapping is at a gross scale, and actual soils will vary from those mapped. Vegetative descriptions of the various range sites reflect an average or hypothetical norm and are generally viewed from the perspective of livestock production, with a nod towards game management. Actual vegetation on the ground has usually been highly modified by long-term land use practices and invasion of exotic species, but these range site descriptions offer useful guidelines for expected vegetative communities or models to use as targets for restoration.

Figure 1. Property layout with habitat zones and various easements shown.



Most of the floodplain of Cypress Creek is mapped as Oakalla soils, frequently flooded. This deep, nearly level soil type is typically composed of loamy soils with varied amounts of silts and clays and is placed in the Loamy Bottomland Range Site. This range site potentially supports savanna type vegetation with approximately 30% canopy coverage by a variety of trees and is considered to be a preferred grazing area that is easily invaded by thickets of brush. Typical trees are oak, pecan, hackberry, elm, cottonwood, and sycamore. The largest vegetative components are typically Virginia wildrye and sedges, with lesser amounts of switchgrass, Indiangrass, big bluestem, eastern gamagrass, inland seaoats, and other grasses.

A linear strip to the east of much of the floodplain is mapped as Sunev clay loam, 1 to 3% slopes. These deep, gently sloping soils are placed in the Clay Loam Range Site, which has the potential to support a true prairie, with little bluestem as a major component and lesser amounts of Indiangrass, big bluestem, and a wide variety of other native grasses.

A wide band between the two drainages of the property is mapped as Gruene clay, 1 to 5% slopes, which is typically a shallow to very shallow soil found on convex slopes of stream terraces. This soil is placed in the Shallow Range Site, which has the potential to support grasslands with scattered mottes of live oak. The most common grasses to be expected would be sideoats grama and little bluestem. Expected woody species would include live oak, kidneywood, and elbowbush.

The Brackett-Rock Outcrop-Comfort Complex, undulating, covers the largest portion of the property encompassing the eastern portion of the property and the bluff area overlooking the swimming area. This range type is typified by shallow loamy and clayey soils and rock outcrops with convex slopes from 1 to 8%. Horizontal bands of rock outcrop often give the hillsides of this association a benched or stair stepped appearance. These soils are placed in the Adobe Range Site, which typically produces forage of low quality because of the limited phosphorus available to plants. Grasses make up 80% of the potential plant community with the remainder composed of woody plants and forbs. Typically little bluestem makes up about 50% of the vegetation. Other important species are Indiangrass, sideoats grama, and a wide variety of mid-grasses.

Much of the property shows effects of long-term, heavy grazing, corresponding to the predicted effects described in the range site descriptions. Under heavy grazing, the more palatable grasses, such as little bluestem, Indiangrass, big bluestem, and gamagrass decrease and are replaced by less palatable species such as threeawns, Texas wintergrass, and a variety of annual grasses and forbs. Dense growth of broomweed is a common symptom of overgrazing. Eventually woody species such as Ashe juniper, Texas persimmon, and agarita become much more common. On the Loamy Bottomlands and Clay Loams, junipers may be less important invaders than elms, oaks, agarita, and persimmon. Brush control is particularly important on Loamy Bottomlands, as they are quick to be invaded by a variety of woody species that often form dense thickets that large animals cannot penetrate. Brush control is also especially important on the Adobe Range Site, the most extensive site on this property. Here the most prominent woody

increasers are juniper and agarita, with the juniper sometimes becoming so thick as to nearly exclude all other vegetation (USDA-SCS 1984).

Roads and Rights-Of-Way

Main access to the site is currently provided by Blue Hole Road, an asphalt paved road (30' easement) that passes between the First Baptist Church and Wimberley Cemetery, before leading to a row of in-holding residences on Blue Hole Lane along the east bank of Cypress Creek. Blue Hole Regional Park owns the property between these lots and the creek bed; however, the homeowners have recreation easements to allow access to the creek. Two of these houses have concrete patios extending to the high bank of the creek. Access onto the property and to the swimming area, wastewater treatment plant, drainfields, and pump station is via caliche roads. An asphalt loop road with pullouts passes through the old trailer park area just north of Blue Hole Lane. A poorly maintained dirt road leads to an old, rather unstructured camping area with several crude fire pits on the bluff above the swimming area. A pasture road enters from FM 3237 at the northeastern corner of the property and follows the northern boundary fence to Deer Creek. Several less distinct pasture roads are present in the area east of Deer Creek.

Nature Preserve

Outside the BHRP property line, the 7.19-acre Cypress Creek Nature Trail and Preserve is adjacent to the southwest corner of the property and downstream from the swimming hole. The trails of this park are planned to be linked to the Blue Hole Park through a proposed trail system. Access to the western portion of this preserve is through a ramped entrance adjacent to a playground fronting the Old Kyle Highway.

Gas Pipeline

A 12" gas pipeline crosses the southwestern portion of the property. The right-of-way is poorly maintained and marked. Signs on either side of FM 3237 identify it as "Shell Pipeline Co LP 1 800 852-3602". Two onsite signs just to the northwest and two signs near the site entry gate identify it as "Texas New Mexico Pipeline Co 1 800 235-2053". The intervening section of right-of-way is obscured by dense woodlands for most of its length, but appears to pass under church property, immediately to the northeast of their recreation building. Erosion has exposed a section of pipeline along the northeast side of Blue Hole Lane (see photo 1).

Photo 1. Exposed gas pipeline

The pipe has been spray painted "12" TX-NM". It then appears to approach Cypress Creek, passing very close to the northernmost in-holding residence. Although the pipeline is not currently in use, the operators retain the option to restore it to use at any time. The company shows no interest in doing so at the present; however, planning for long-term use or improvements at Blue Hole Park needs to consider these possibilities.

Existing Wastewater Treatment Plant

There is currently an onsite wastewater line, lift station (see photo 2), treatment plant, and drainfields serving the Deer Creek Rehabilitation Center that are currently operated under a joint permit issued to the Village of Wimberley and Guadalupe-Blanco River Authority. The wastewater line extends in a generally northerly direction from the rehabilitation center, crossing Deer Creek encased in a concrete sleeve, which forms a low dam across the main channel. The Village of Wimberley Deer Creek Lift Station is located on the north side of Deer Creek. The Village of Wimberley, under joint agreement with GBRA, is planning to construct a new wastewater treatment facility to handle treatment of areas of Wimberley, producing up to 350,000 gal/day of effluent. The Village of Wimberley is planning to provide service to some Wimberley residents and business owners currently relying on personal septic tanks. This should reduce contamination threats to local watersheds but will require more development within the park. Additional Texas Commission on Environmental Quality requirements are associated with the upgrade. The additional treated effluent must be handled onsite or piped elsewhere. Use of treated effluent for irrigation of diversity plantings could increase success of establishment, but questions about water quality and proximity to the drainages should be considered. Thorough investigation and detailed design of the proposed wastewater treatment plant were outside the scope of this project and still need considerable investigation.

Photo 2. Existing wastewater treatment plant lift station

Electric distribution lines

Electric distribution lines currently serve buildings near the swimming area, the wastewater treatment plant, and the lift station. The line serving the treatment plant follows the northern boundary fence from FM 3237. The line serving the lift station follows a narrow cleared right-of-way running to the north-northeast from the northeast corner of the church property. The line serving the western portion of the property branches northward from the northeast corner of the row of in holding houses.

Onsite buildings, structures, and improvements

Several wood frame buildings of various sizes and states of disrepair are located in the western portion of the property. The swimming area contains several small concrete pads and a ladder for pool access. At the north end of the swimming area the foundation and pits of a small old outhouse privy remain at the base of the bluff near the northern boundary fence.

An inactive, capped water well is located northeast of Deer Creek Rehabilitation Center. Blue Hole Ltd deeded one acre to the Wimberley Water Supply Corp. to dig a well to service the area; however, it caused decreased water levels in neighboring wells to the east, so the well was capped. Wimberley Water Supply Corp. returned the 1-acre deed to the Village of Wimberley around the time of the parkland acquisition.

There are old dry-stacked rock walls and interior barbed wire fences in several areas of the property (see photo 3) .

Photo 3. Existing dry-stack rock walls

Gates and fences

Unfenced creek frontage defines the western boundary of the property. The northern boundary with the Johnson property has a barbed wire fence. A wire fence separates the in-holding houses from adjacent parklands. Boundaries with the First Baptist Church and Wimberley Cemetery are partially fenced, but the rehabilitation center property is unfenced. Portions of the property fronting FM 3237 are fenced with barbed wire. There are multiple gaps and gates in this fence. The property is currently accessed through a locked gate on Blue Hole Lane, near the northwest corner of the church property.

Neighboring buildings

Three large commercial-type buildings are situated adjacent to, and visible from the southern boundary of the property; a medical rehabilitation center operated by Deer Creek of Wimberley and two buildings of the First Baptist Church. A row of residences is situated on nine lots between Blue Hole Lane and Cypress Creek, and several residences along the west bank of the creek are visible from the property. Several buildings along Old Kyle Highway are visible from the adjacent Nature Trail and Preserve and buildings along FM 3237 are visible from nearby park lands.

Ecological Assessment

General habitat

A riparian strip, with the water's edge heavily dominated by bald cypress, follows Cypress Creek. Upland areas, comprising the great majority of the property are savannas and woodlands heavily dominated by mature specimens of Ashe juniper, with Plateau live oak as a lesser co-dominant. Diversity of woody species is generally low.

Table I, in Appendix A, lists species that were observed on the property and indicates areas in which they were observed and recorded. Herbaceous diversity may have been underestimated in this report, due to drought conditions and the early spring phenology of the main investigations. Future botanical surveys might reveal additional species and different ratios of occurrence. A species recorded in several areas could be abundant in one unit and present but rare in another. If a species is not recorded from an area, it could be present or even abundant in that unit, but not observed or recorded.

The following descriptions of various areas of the property primarily reflect observations on March 22, 2006, during a drought period.

Swimming Area

The perennial streambanks were shaded by magnificent specimens of bald cypress (see photo 4), with scattered individuals of American sycamore and cedar elm making it into the streamside canopy. Woody vegetation in the northern stretch of bank was limited primarily to a single line of cypress trees, but to the west and south of the access road there was more woody vegetation and higher diversity. The sparse understory was dominated by roughleaf dogwood and possumhaw, with scattered patches of yaupon holly and mustang grape. Woody exotic species included Japanese ligustrum, Chinese ligustrum, English ivy, and Japanese honeysuckle. Golden groundsel was widespread and abundant. Cedar sage, typically an upland species was growing abundantly in the litter of the cypress trees during the March visit, but was not much in evidence on later visits. Lyre-leafed sage, which is typically found in the eastern quarter of Texas, and is considered to be rare in neighboring Travis County, was also abundant, perhaps the result of introduction. Additional herbaceous species included little bluestem, inland sea oats, rosettegrasses, sedges, Japanese brome, frogfruit, Mexican hat, catchweed bedstraw, and scattered patches of maidenhair fern.

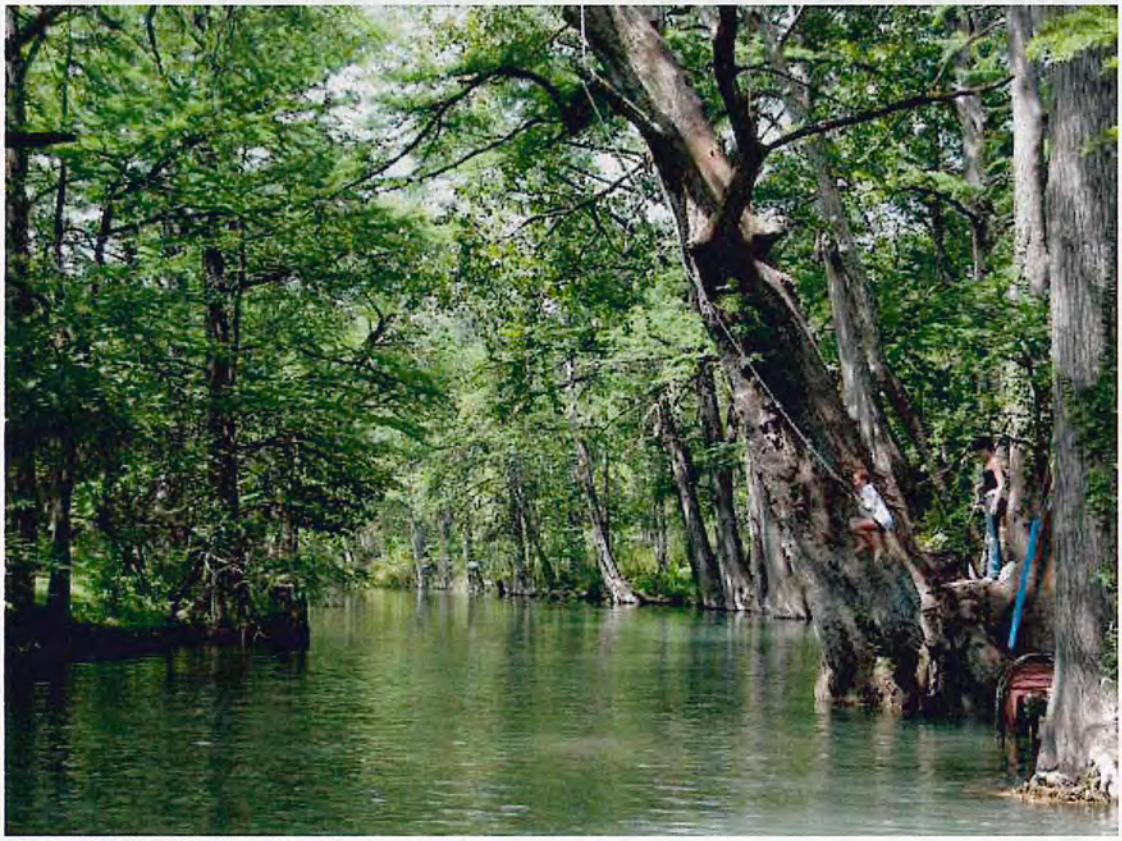


Photo 4. Blue hole swimming area

A large wide, open area between the swimming hole and the bluffs was dominated by exotic St. Augustine grass (see photo 5). Additional species here included straggler daisy, lyre-leaf sage, ponyfoot, stork's bill geranium, fleabane, wild onion, and Texas thistle.

Photo 5. Turf grass lawn near Blue Hole swimming area

The rocky bluffs (see photo 6) to the east of the swimming area marked the transition from Oakalla soils, frequently flooded, to Sunev clay loam1-3% slopes, and the vegetation graded up to the juniper-live oak woodland above. This appeared to be an area of significant seasonal seepage and supported scattered spicebush and elderberry. Saw greenbriar and rough-leaf dogwood were abundant and Japanese honeysuckle was common. Other species here included cedar elm, silktassle tree, little walnut, Virginia creeper, frostweed, Pennsylvania pellitory, and most of the previously mentioned herbaceous plants.

Photo 6. Rocky bluff near Blue Hole swimming area

In an island and braided channel area immediately downstream from the swimming hole, the creek flow divided into several smaller channels, creating one large island and numerous smaller hummocks and microhabitats (see photos 7 and 8 on the following page).

The understory became thicker and more diverse, with scattered American beautyberry, and many additional herbaceous species observed. Chatterbox orchids were one of the more interesting species here. Bexar marbleseed and Indian plantain were found here, along with most of the previously mentioned herbaceous species. Additional species included waterpenny, bushy bluestem, Jamaica sawgrass, scattered clumps of maidenhair fern, and a small amount of Southern Shield fern. Vegetation here would be subject to scouring and deposition by periodic floods.

Photo 7. Braided stream section of Cypress Creek

Photo 8. Chatterbox orchids along braided stream section of Cypress Creek

Nature Preserve

This area is outside of the official purview of this report but has been described because it is closely linked ecologically to the riparian portion of the property and is planned to be linked to the property by a common trail system. Soils, geology, and vegetation here appeared superficially similar to the riparian areas of Blue Hole Preserve, although soils of the western portion of the preserve are mapped as Gruene Clay, 1 to 5%, which would place it in the Shallow Range Site (USDA-SCS 1984). The tree canopy was more complete and extensive, and the lawn of exotic St Augustine grass had not developed in the shadier environment of this broad floodplain. Box elder and American elm were common in the canopy and understory, and there were several large Arizona walnuts. Both red and yellow flowered varieties of red buckeye were present here. There was an unusually large population of green dragon and several clumps of death camas.

Juniper/Liveoak Woodlands

The majority of upland areas supported dense woodland heavily dominated by mature specimens of Ashe juniper with Plateau live oak as a lesser co-dominant (see photo 9).

Photo 9. Upland Ashe juniper/Plateau live oak woodland

The largest and best developed specimens were on the deeper soils, mapped as Gruene clays, and the more westerly portions of the areas mapped as Brackett-Rock Outcrop. The canopy contained a few specimens of Texas oak and Durand's oak, but species

diversity of trees was generally very low. Cedar elm and sugar hackberry were present, but were most noticeable in the thin strip of woodlands west of the cemetery. Other than live oak and juniper, the most common understory components were Texas persimmon, agarita, and twisted-leaf yucca. Lindheimer silktassel was fairly common in some areas. Texas barberry, widely distributed on the property and fairly common in these woodlands, is an interesting component, being restricted in range to portions of the Edwards Plateau. Although relatively rare over most of the Hill Country, it is locally common in portions of Hays and Blanco Counties. Additional woody species included bush croton, saw greenbriar, elbowbush, red buckeye, and flame-leaf sumac.

The most common herbaceous component in closed woodlands was cedar sedge. Also present was golden groundsel and scattered grasses.

Deer Creek

Deer Creek, a seasonal drainage, (see photos 10 and 11) flowed to the southwest from the eastern portion of the northern boundary area, passing out of the property and under FM 3237 to the east of the church property. Soils along this drainage are mapped as Brackett-Rock Outcrop-Comfort Complex, undulating.

Photo 10. Deer Creek

Photo 11. West bank of Deer Creek.

Much of this drainage length, and portions of several of its minor tributaries were bounded by steep bluffs (see photo 12) and occasional limestone rimrock features with significant ecological and aesthetic values. The larger bluff areas were composed of clay loam soils with exposures of limestone bedrock. The widest of the limestone overhangs extended out to vertical shelves approximately 3 feet in width. Several of the minor tributaries contained small limestone step-down or waterfall areas (see photo 13) with near-vertical drops up to 7 feet in height, typically semicircular shaped at the canyon heads. Vegetation along this drainage system was similar to that of the surrounding woodland and savanna areas.

Photo 12. Steep bluff along Deer Creek

Photo 13. Seasonal waterfall feature along Deer Creek

A segment in the southern portion of Deer Creek became narrowly incised to a depth of over 5 feet with evidence of a rapidly eroding stream system (see photo 14). Nearer to the southern boundary of the property Deer Creek developed a wider floodplain, and in one section the drainage became indistinct with some braiding of channels, damming by flotsam, and overland flow.

Photo 14. Incised creek bed

Grassland/Savanna

On the thinner soils of the Brackett-Rock Outcrop soil type the junipers and live oaks were generally smaller and shrubbier. East of Deer Creek, along FM 3237 from the creek's exit from the property to the northern boundary fence, they were generally more sparsely dispersed, resulting in a savanna (see photo 15).

Photo 15. Grassland/Savanna

Woody species were similar to those of the juniper/oak woodlands, but agarita, prickly pear, and Texas sotol were more frequent. Although hardly pristine, these areas contained the greatest diversity of herbaceous species, especially the large clearing to the west of the rehabilitation center. Savanna grass species included little bluestem, silver bluestem, hairy grama, sideoats grama, plains lovegrass, purpletop, Texas wintergrass, oldfield threeawn, purple threeawn, and Drummonds dropseed. Common and widespread herbaceous species included four-nerve daisy, zexmenia, and wild onion. Several minor drainages contained rimrock seasonal waterfall features, with associated minor communities of Lindheimer muhly and bushy bluestem that are associated with more available water than the surrounding savanna communities. There were also less noticeable depressional areas associated with these drainages that appear to seasonally hold water for varying periods of time, but none of these supported plant communities that would indicate a great availability of water.

An elongated, cleared strip extending southwards from the trailer park area to near the Old Kyle Highway was dominated by exotic King Ranch bluestem in the understory. Soils here were mapped as Sunev clay loam, 1-3% slope. This soil type is well suited for croplands and pastures, and this field may have been cultivated in the past. Scattered low Ashe junipers were the dominant woody species here, and gum elastic and mustang grapes were common. These deeper soils supported more honey mesquite trees than the rest of the property.

Effluent Drainfields

The area used by the rehabilitation center as effluent drainfields supported an herbaceous community of mixed grasses and forbs. Wimberley Resident and Secretary for the Friends of Blue Hole, Carolyn Nichols (2006) believed that a previous landowner had used this area for growing sweet potatoes. Grass species in this area include bermudagrass, Texas wintergrass, purple three-awn, silver bluestem, rescuegrass, little bluestem, and johnsongrass. The most noticeably abundant forbs were Mexican hat, prairie verbena, and rosettes of an unidentified thistle, probably the exotic musk thistle. Burr clover, red-seeded plantain, buffalo bur, silver-leaf nightshade, Texas bullnettle, deer pea vetch, and plains prickly pear were also present.

Juniper Regeneration Area

A larger area to the southwest of the drainfields appeared to have been cleared of all woody vegetation until fairly recent years and is now dominated by low, bushy, shrubby regrowth of Ashe juniper (see photo 16).

Photo 16. Juniper Regeneration Area

The boundaries of this old field are partly enclosed by old fencing, both barbed wire and dry-stacked rock. It appeared that the field has been leveled in the past, with differential soil elevation as much as two feet higher on the inside of the rock wall than the outside in some areas. Junipers were of fairly uniform size and were distributed in clumps and bands of varying density. The herbaceous layer of the open areas formed distinctive bands of very different composition. Vegetated areas supported a variety of predominately native grasses, dominated by little bluestem, with scattered clumps of silver bluestem.

There were wide patches and bands of mainly bare soil (see photo 17), often abruptly transitioning from well vegetated grassy areas. Scattered small clumps of grass remaining in these bare areas were often noticeably pedestaled, indicating widespread sheet erosion. Clumps of Nostoc algae and other cryptogams were scattered on the bare soil surface, but generally did not form significant mats.

Photo 17. Bare soil bands

OVERVIEW OF THE MASTER PLANNING PROCESS

Master Planning Purpose

The major challenge that confronts parks and open space planning is not determining what to do on the site, but instead, finding ways to do everything that has been proposed, without adversely affecting the site and causing deterioration of the resource being preserved. This challenge is especially true as the Village of Wimberley works to develop the Blue Hole Regional Park as a recreational and ecological resource both for its citizens and visitors to the community.

To address this challenge, the Lady Bird Johnson Wildflower Center was charged with providing design and ecological expertise while directing the master planning process. Loomis Austin, Inc. and WHM Transportation Engineering Consultants, Inc. were brought on the team for additional engineering expertise. The purpose of this master planning process for Blue Hole Regional Park was to:

1. Clearly define the goals and objectives of the project
2. Understand the ecological and economic opportunities and constraints of the park
3. Develop a plan that ensures that the many proposed uses of the park are both economically and ecologically sustainable.
4. Arrange park amenities in a way that functions efficiently for the community and enhances the overall integrity of the site.
5. Create a synergy among park activities that makes the feeling of the park greater than merely the sum of its parts and links the park to the surrounding region.
6. Guide future park use and development to meet the needs of the community while honoring the natural environment.

In order to meet the needs of the community, these diverse needs must first be understood and balanced. The Park will be a significant public asset to the residents of the Wimberley Valley as well as visitors to the area. Village of Wimberley City Council understood the value of a community driven product and decided that a group of local stakeholders should be intimately involved in the master planning so that the voice of the community could be heard through a group of local volunteers with diverse backgrounds and interests.

Role of the Stakeholder Group

The Village of Wimberley City Council selected 25 members of the community to participate in the Stakeholder Group (SG) that developed the Master Plan under the direction of the Lady Bird Johnson Wildflower Center. The stakeholder group worked to harmonize the various needs and desires of the citizenry. Together with the Wildflower Center, they explored various options and desires, some of which were mutually exclusive, and developed a single plan through a consent-based decision making process. The stakeholder group served as the community ambassadors of the Blue Hole Regional Park by developing community support in addition to their contribution to the plan itself.

Decision Making through Consent

Consent building is a popular method of making decisions that actively solicits the intelligence of the entire stakeholder group. The process is very effective in resolving competing interests because every person in the group has a voice that cannot be ignored in the decision making process. Once someone raises an objection, it ceases to be "their objection" – rather it becomes a puzzle for everyone to solve. Because stakeholders and city officials together are the decision makers in a consent-based process, participants must try to educate and persuade one another about their needs and interests. They also must listen carefully to determine how a solution can meet the needs of the other parties and community as a whole. It is the mandate of the stakeholder group to work together to find a mutually acceptable solution to any problem confronting the group. In the consent-based model, a solution is acceptable if it falls within each individual's range of tolerance. All participants have an equal voice and make decisions by consent rather than by majority vote. The stakeholder-based consent process allows creative solutions to be reached that reflect the diverse interests and expertise of the involved parties.

Highlights of Stakeholder Group Discussion Topics

From April through October, the Stakeholder Group studied and discussed the constraints and opportunities for the Blue Hole property. An addendum document accompanies this report entitled Stakeholder Process Documentation that gives detailed accounts of these meetings. The group began by discussing broad concepts and desires for the park and then focused on more detailed decisions. Once the group had developed the mission statement for the park, they began crafting a list of goals to provide direction in achieving this mission. From these goals, a framework of parameters was established to ensure that any development of the park would be compatible with the mission. The group then began discussing the specific amenities needed in the community which would be appropriate and successful on this property. Once the group had agreed upon an amenity list, the group developed individual design parameters for each proposed amenity. Site design stemmed from these discussions, and the consultants proposed general locations for park amenities that were then discussed and adjusted by the group.

The first proposed plan was presented at a public presentation for community feedback on September 7, 2006. A questionnaire submitted to the attendees on this day suggested that the Stakeholder Group's plan was on the right track (see Summary of Attendee Survey provided in the Stakeholder Process Documentation addendum to the main report). The group met one additional time in October to incorporate this feedback. More parking was added and the Wastewater Treatment Plant Site was relocated based on feedback from the attendees and Stakeholders. Roadway suggestions were tweaked and the plan was divided into two phases for implementation. The revised 2-phase version of the plan was presented at a public meeting on November 6, 2006 and again to the Parks Board and Village Council in January 2007.

Throughout this process, a number of issues were subject to extensive discussion. These issues are briefly discussed here. For a more detailed account of the discussions that led to the master plan presented in this report, please see the Stakeholder Group Meeting Notes provided in the Stakeholder Process Documentation addendum to the main report.

Many of these discussions centered on the appropriate degree of development within the park. The group felt very strongly about protecting the site's natural resources, especially water quality in Cypress Creek and the Blanco River. To this end, a 10% maximum amount of impervious cover was set for the site (Klein 1979; Booth 1991; CWP 2003; USFWS 2005) and parameters requiring that environmentally friendly construction materials be utilized within the park (7-20-06). The proximity to Jacob's Well and the Wimberley Valley Watershed Association (WVWA) influenced the scope of BHRP's mission. The Village has contracted with the WVWA to monitor the water quality in Cypress Creek and will continue to do so. The WVWA is currently undertaking a complementary planning effort to develop Jacob's Well Natural Area into a center that will provide watershed education to the public.

The stakeholder group discussed the following list of amenities at length and came to the conclusion that while there is a demonstrated need in the community, the Blue Hole Regional Park property is not the appropriate site (8-3-06; 8-17-06; 10-5-06). The group recommends that the Parks Board and City Council try to find a location for the following (10-5-06):

1. Frisbee Golf
2. Skate Park
3. Softball
4. Swimming Pool
5. Veloway

The financial viability of the park was considered in all of these discussions. The Group also discussed the possibility of RV camping at Blue Hole; however, after discussions with other parks, it became clear that RV camping was not a good fit for the park. For RV camping to be economical, it needs to be on too large a scale for Blue Hole. Attempting to allow a small level of RV camping on the site would substantially raise maintenance and site degradation issues (8-3-06), so it is not recommended for the site.

The group also spent a lot of time discussing where amenities should be located on the site and how they should be accessed. The group decided to recommend that separate entrances be provided to access the recreation fields and the swimming hole in order to protect the creek and riparian area. Phasing for the park was developed later and suggests that a single entrance will be sufficient in Phase 1; however, separate entrances should be installed at full build-out. The connecting road between the recreation field loop road and Blue Hole Lane can then be used solely for maintenance and emergency access. A decision was also made to limit the number of parking spaces near the swimming hole. This decision was modeled after Hamilton Pool's method of limiting numbers of visitors to a sustainable level as well as discussions with the previous contractor who managed the swimming hole last summer. This discussion evolved throughout the process (6-15-06; 8-17-06; 10-5-06).

The 3-acre tract for the Wastewater Treatment Plant, while not part of the park, played a prominent role in the Stakeholder Group's discussion. This pre-existing site constraint was considered at this time so that the group could recommend the most appropriate location and methods for effluent disposal. However, since the GBRA will be constructing, operating, and maintaining the plant, there are many unknowns at this time.

The group has made recommendations with the best knowledge available in the hope that they will be taken into account when the construction planning begins for the plant. The Group felt that it should remain on the perimeter of the park so that maintenance access would not interfere with visitor access, but also felt strongly that it should not interfere with the perception of Wimberley as drivers approach town along FM 3237. The Stakeholders recommend that a vegetative buffer be maintained.

In these WWTP discussions, the following information appeased some hesitations regarding the proximal location of the plant. It was noted that the town of Fredericksburg has it's Wastewater Treatment Plant located on the main road entering town and is not considered an eyesore. The current technology for WWTP is much improved from the current plant and will benefit water quality in the area by replacing this outdated plant as well as getting many residents off of failing septic systems. The technology recommended for the new plant in Black and Veatch's report has a positive track record of quiet, fragrance-free operation. (8-3-06; 8-17-06; 10-5-06)

Participants

Stakeholder Group:

1. Bill Appleman: Planning and Zoning Chair/Property owner on Cypress Creek
2. David Baker: Wimberley Valley Watershed Association
3. Brenda Bishop: Wimberley Independent School District
4. Mark Bursiel: Parks and Recreation Board
5. Curt Busk: City Council Liaison to Water/Wastewater Board
6. Christine Byrne: Blue Hole Lane Property Owner

7. Will Conley: Hays County Commissioner
8. Jan Fulkerson: Texas Forest Service/Parks and Recreation Board
9. Tevis Grinstead: City Planning and Zoning Vice Chair/Attorney
10. Malcolm Harris: Parks and Recreation Board/Cypress Creek Property Owner/Attorney
11. Eddie Holliman/Buddy Wilson: Hill Country Recreation Association
12. Dell Hood: Parks and Recreation Board/Master Naturalists
13. Keith Kay: Long time Wimberley resident, BH Fundraising Committee
14. Bob Kerrigan: Wimberley Community Tennis Association
15. Todd Mackenzie: Deer Creek of Wimberley
16. Thad Nance/Jim Neff: San Marcos Area Youth Soccer Organization
17. Carolyn Nichols: Friends of Blue Hole Director, Secretary-Treasurer
18. Bert Ray: Transportation Advisory Board
19. Susan Thurber: Landscape Architect/Former City Council Member
20. Horace Wilson: Parks and Recreation Board
21. Elaine Wilson: Long time Hill Country resident, ecological and hike/bike interest
22. Marilee Wood: City Council and Liaison to Parks and Recreation Board
23. Jack Williams (Long time Wimberley resident)

Consultants:

1. The Lady Bird Johnson Wildflower Center:
   Steve Windhager, Heather Venhaus, Mark Simmons, Marianne Shivers, Jeannine Tinsley, Dick Davis, Michelle Bertelsen, and Danielle Pieranunzi

2. Loomis Austin, Inc.:
   Tom Loomis and Tracy Bratton

3. WHM Transportation Engineering Consultants, Inc.:
   Lance Hartland

4. Waste Water Technologies:
   Greg Gullet

MASTER PLAN

Phasing Explanation

The Conceptual Site Master Plan for Blue Hole Regional Park has been divided into two phases based on feedback from the stakeholder group and community. The project phasing prioritizes the park amenities and lays out a plan for successful implementation. Ultimately, the speed at which the plan is implemented will depend largely on fund raising success and community support.

Since the existing waste water treatment plant (WWTP) and associated drainage field cannot be removed until the Guadalupe-Blanco River Authority constructs the new treatment plant, the Village of Wimberley must work around the existing plant for the time-being. The construction date for the new plant cannot be stated at this time because it is dependent on the contractual commitment of Wimberley citizens and business owners to utilize the services of a community waste water treatment plant.

In addition to the waste water treatment related site constraints, the status of fundraising efforts, the existing interest of the community, and the logical transition and construction order of park elements have been taken into account in the phasing order below. Some phasing decisions are based on the compatibility of amenities and their relationship to each other. Phase 1 assumes that the existing waste water treatment plant and associated drainage field will still be in place and suggests feasible and appropriate intermediate levels of implementation. Phase 2 depicts the full-scale implementation of the Conceptual Site Master Plan.

Phase 1
Phase 1 includes the following amenities:
Pedestrian trails
Hike and bike trail
Picnic areas
Restored natural areas
Office/bathhouse (portable or composting toilets)
Restored swimming hole
Community pavilion
3 tennis courts
1 soccer field
Open parkland
Primitive camping
2 parking lots with at total of 56 spaces
Additional parking along loop road: 125 spaces total
Small loop road around recreation fields connected to Blue Hole Lane
Site cleanup and demolition of unwanted structures

Phase 1 assumes that the existing waste water treatment plant and associated drainage field will still be in place and suggests intermediate levels of implementation. Existing

funding was also taken into account in Phase 1. The Texas Parks and Wildlife grant and the pending Capital Area Metropolitan Planning Organization grant ensure that development of the trail system can be undertaken in the near future; while the Burdine Johnson Foundation's donation for a soccer field covers the majority of the costs for one soccer field.

The stakeholder group and community showed a large interest in tennis courts and restored natural areas. Restoration of specified natural areas has also been included in Phase 1 as it can be initiated at relatively little expense and prior to the construction of other amenities.

A narrow, one-way gravel loop road will separate the Phase 1 recreation area from the existing drainage field and will provide 125 parallel parking spaces. The road traffic will be oriented so that visitors do not have to cross traffic to gain access to the recreational fields.

The Village is dedicated to opening Blue Hole for swimming each summer so additional amenities have been included in Phase 1 to facilitate public access to the swimming hole. Parking improvements will be critical to the successful maintenance and operation of swimming at Blue Hole. The existing RV Park will be removed and a smaller parking lot with 40 spaces will be put in its place. A bioswale will be installed between the lot and the creek to handle storm water runoff from the parking lot and protect the water quality within Cypress Creek.

Park amenities will be funded through sources outside of the Village government and may often include joint partnership between the Village and vested community organizations. In addition to the design and construction cost of the amenities, a 30% maintenance endowment will be included in the fundraising efforts.

Phase 2

Phase 2 includes additional amenities and improvements that will either require additional time for fundraising or will be dependent on the removal of the existing waste water treatment plant and the subsequent installation of the new facility. Some of the amenities in Phase 2 are scheduled because they are considered as support for others on the list.

Phase 2 includes:
Expanded recreation area
Additional youth soccer fields
3 additional tennis courts (6 total)
Volleyball court
Recreation pavilion with restroom and storage
Playscape
4 additional parking lots: 136 spaces total
Road improvements
Expanded one-way loop road with 155 parallel parking spaces total
Northeast entrance road off FM 3237 and improvements along FM 3237
Possible expansion of Blue Hole Lane to a boulevard
Small amphitheater
Update bathhouse with running water and functioning restroom facilities

Due to the increased traffic in Phase 2, a second entrance of off FM 3237 will be located on the north east portion of the property to service the central activities of the park. This access will require an additional turning lane of off FM 3327 and a small bridge over Deer Creek. Permitting and cooperation from Texas Highway Department will be required.

In addition to the second entrance, enhancement to the Blue Hole Lane has also been recommended. Widening the historic entrance and providing space for a boulevard would require additional property or an easement from the church property to the east.

See the park amenity descriptions section of the report for more detailed information regarding the park amenities.

Timeframe

Timing will be contingent on the progression of the waste water treatment plant plans and park fundraising efforts. [See the Blue Hole Operating Expenses and Preliminary Project Budgets for more information on fundraising needs.] The Village will need to undergo a final planning phase prior to construction to develop detailed design and construction documents for the park.

Park Amenity Descriptions

Cypress creek and the swimming hole

The historic Blue Hole swimming area will be kept in its natural state to the greatest extent possible with improvements being low-impact and naturalistic in design. Access points to the water will be delineated and stabilized where needed to protect the streambank and vegetation. Large limestone slabs will be utilized to form "patios" to provide a stabilized surface for swimmers and sunbathers to enjoy the swimming hole. The patios will be located in areas that avoid harm to the existing trees to the greatest extent possible. These patios will ideally be connected to one or more of the access points along the stream bank and provide easy access to the waters edge. It is also recommended that the remaining bank areas be revegetated and protected with shrubs and native grasses to deter additional water access point and stabilize the streambank.

Environmentally sensitive areas along the creek will have controlled or limited access. It is recommended that the braided stream area to the south have limited/controlled pubic access. Interpretive signage and simple fencing informing visitors of the need to preserve this area would probably be the most suitable technique.

Additionally, the bluff areas to the east of the swimming hole are ecologically sensitive and need to be protected from unintentional harm. These cliffs are tempting to climbers; however, access should be discouraged to avoid damage to the vegetation, geology, as well as the park visitor.

An entrance fee into the swimming area will be charged and visitors will be instructed to stay on the public park side of the creek. Following the successful model of Hamilton Pool Preserve in Travis County, the number of simultaneous visitors will be limited through the limited (40-car) parking at the site. Parking will only be allowed in the designated spaces, and a bioswale will be installed to mitigate pollution from parking lot storm water runoff. Additional visitors could be allowed to walk or bike in from the community to ensure that Wimberley residents could always access the site, even on busy days.

In addition to the swimming area, the area along the creek will be carefully monitored to prevent degradation of the water quality, damage to existing native vegetation, bare soil and stream bank erosion. If the area is being damaged because of over-use, action will be taken to protect the natural resources.

Project engineers in the next design phase should address anchoring and infill needs for both the access-points and patios to prevent disruption of slabs and scour during flood events. The entry-point slabs, as described, may be of sufficient weight to render anchoring unnecessary. Should anchoring be deemed necessary, one recommended method would involve corkscrew-shaped anchors secured with concrete through holes in the slabs. This method, or any alternate method considered, should be unobtrusive and allow proper drainage and oxygen circulation to the root zone below.

Pedestrian Trails

Over two miles of pedestrian trails will be constructed from ecologically benign, local materials that are laid out in a manner that avoids environmentally sensitive areas and significant woody vegetation. To the greatest extent possible, the layout of the six foot wide trail will allow water to flow naturally across the site avoiding re-directing or damming surface flow. The trails will be simply designed for pedestrian purposes only and constructed in a manner that can easily be maintained by volunteers and community organizations. The trail system will link with other community trail systems and provide features such as educational signage, picnic areas, scenic vistas, and shaded rest stops. Where needed, handicap accessible trails will be provided to offer a comparable experience to the existing trail system and connect to handicap parking areas.

Hike and Bike Trail

The Village of Wimberley and Hays County have been successful in raising funds for a regional hike and bike trail that will link the greater Wimberley Valley with the Blue Hole Regional Park and downtown. The regional hike and bike trail will run through the eastern side of the park and, similar to the pedestrian trails, will be laid out in a manner that avoids environmentally sensitive areas and significant woody vegetation. To the greatest extent possible, the layout of the trail will allow water to flow naturally across the site and avoid re-directing or damming surface flow. Final design and construction of the hike and bike trail will be contingent on TXDOT specifications.

Office/Bathhouse

The 1000 +/- sq. office/bathhouse will serve as the entrance point and changing area for swimming and as an office for future park staff. This multi-purpose "dog-trot" style building will be located out of the 100-year flood plain over the existing entrance road to the swimming area. The location of the building will take advantage of the previously constructed site, reducing additional disturbance. The office/bathhouse will exhibit the most current green building technology and be a model of sustainable design for the Wimberley Valley. Innovative design techniques will be used to reduce energy and water demands, re-use and conserve natural resources, and accentuate the natural surroundings. The office/bathhouse will be within short walking distance of the Blue Hole parking lot and connected to the pedestrian trail system. Vehicular access to the swimming area will be limited to maintenance and emergency vehicles. Future project architects will need to work with the Village of Wimberley to determine programmatic needs of the future staff and park facility.

Natural Areas

The vision of the Blue Hole regional park is strongly focused on protecting, experiencing and respecting the uniqueness and beauty of the Texas Hill Country. More than 60% of the park will be maintained as natural areas using adaptive management strategies such as landscape restoration to shape vegetative communities and promote native habitat. The natural areas have three dominant habitat types: juniper/live oak woodland, grassland savanna, and riparian corridors. Throughout each of the habitat types there are dominant plant species that are well represented, however the system is lacking the diversity that

would be expected on the site, and much of the area offers low habitat value in its present condition. It is recommended that a long-term restoration plan of all these areas take the form of incremental species supplementation to increase diversity and wildlife habitat. For more detail see the Site Restoration and Management Recommendations section of this report.

Recreation Center

Hays County is one of the fastest growing counties in the state, and the Village of Wimberley has become a destination for people seeking a small-town atmosphere with the facilities of a city. As the population continues to grow, so does the demand for intensive recreational areas and park facilities. Currently, the Village of Wimberley does not offer a community park with recreational fields, and through the stakeholder process, the need for recreational facilities became clear.

A large portion of the upland area of the park was altered through extensive re-grading for agricultural and waste water purposes. This previously disturbed area provides an ideal location and wonderful opportunity to develop a portion of the park for more extensive recreational purposes.

Soccer Fields

Multiple soccer fields have been included in a recreation center to accommodate youth soccer activities. Local soccer organizations will work closely with the Village of Wimberley to assure that the park is both properly cared for and economically and environmentally sustainable. In addition to soccer, the area will be open as practice fields for other sports or non-organized community activities. In keeping with the mission of the park, the fields will protect existing ecological resources by not increasing demands on the local aquifer and re-using treated effluent water to irrigate the fields. Until the wastewater treatment facility is in place, the fields will rely on natural rain events. The materials and soil imported to construct the fields will be ecologically benign and will facilitate maximum uptake of water and nutrients by plant roots. The fields will be managed by organic practices to the greatest extent possible and minimize the application and loss of fertilizer. Lysimeters will be strategically placed around fields to test water quality and assure that pollutants are not moving through subsurface flow to either Cypress Creek or Deer Creek. Bioswales will be strategically located to mitigate pollution from water runoff, and an herbaceous buffer will be incorporated into the design to prevent horizontal contamination by fertilizer. Terracing and/or retaining walls will be needed to accommodate the gentle slope required by the fields. While a preliminary site layout was developed, a full site survey will be required as part of final construction drawings.

Primitive Camping

Primitive camping will be offered in designated areas with fee-based usage. The layout of the grounds and accepted camping practices will follow the "Leave No Trace" camping methodology established by the Boy Scouts of America. In addition to the entire park, the camping areas will be carefully monitored to prevent degradation of the natural environment. If the area is being damaged because of over-use, action will be

taken to protect the natural resources by relocating or removing camping areas. Either portable toilets or permanent composting toilets should be located along hiking trails in the primitive camping areas.

Volleyball

A volleyball court will be conveniently located near the recreation pavilion and a playscape in the recreation center. The simple court will be open for public use and a free amenity for all park visitors.

Community open-air pavilion

The 1600 +/- sq. foot covered, open-air pavilion will serve as a multi-purpose facility for private and community events. The pavilion will house a small storage area, retractable basketball goals (for non-organized games), and may include a restroom facility. The building will reflect the architectural heritage of the Wimberley Valley and incorporate innovative design techniques to reduce energy and water demands, re-use and conserve natural resources, and accentuate the natural surroundings. As with all amenities, the pavilion will be constructed with tight construction area limits in order to minimize disturbance and damage to the site. The community pavilion will be connected to the trail system and will be within short walking distance of the recreational fields and parking lots. Vehicular access to the pavilion will be limited to catering, maintenance, and emergency vehicles.

Recreation open air-pavilion

The 500 +/- sq. foot covered, open-air pavilion will be a central gathering place in the recreational center located directly adjacent to the playscape, volleyball court, and soccer fields. The pavilion will be open to the public and will house picnic tables, a small storage area, and restroom facility. The public pavilion will reflect the architectural heritage of the Wimberley Valley and incorporate innovative design techniques to reduce energy and water demands, re-use and conserve natural resources, and accentuate the natural surroundings. Vehicular access to the pavilion will be limited to maintenance and emergency vehicles.

Small uncovered outdoor amphitheatre/classroom

The small, uncovered outdoor amphitheatre/classroom (225 +/- sq. ft.) will provide a comfortable gathering area for educational events. The amphitheatre will be constructed out of local, ecologically benign materials and tucked into the landscape in an area that has sloped topography, reducing the need for additional site disturbance. Located along the pedestrian trails, the amphitheatre will be within walking distance of the recreational center.

Children's playscape

A children's playscape will be conveniently located near the recreation pavilion and youth soccer fields. The naturalistic playscape (1500 +/- sq. ft.) will be a popular addition to the recreation center providing entertainment for young park visitors and their families. Trees and picnic areas will surround the playscape offering shaded rest areas for visitors to enjoy.

Tennis courts

Six tennis courts have been included in the recreation center to accommodate the growing interest of Wimberley Valley residents in tennis. The Wimberley Community Tennis Association will work closely with the Village of Wimberley to assure that the courts are properly cared for and economically and environmentally sustainable. Terracing and/or retaining walls may be needed to accommodate the site conditions required by the courts. A detailed site survey will be required by future project designers to properly design the court layout. The materials and soil imported to construct the courts will be ecologically benign and will be maintained by non-toxic products. Bioswales will be strategically located to mitigate stormwater runoff from the courts and encourage aquifer recharge.

A small shaded arbor or pavilion (150 +/- sq. ft.) will be located within close proximity to the courts to provide a gathering and rest area for tennis players. The structure will be constructed out of local building materials and designed to flow with the other architectural components of the park.

Park Infrastructure

Hays County is one of the fastest growing counties in Texas and the population of Wimberley is expected to continually rise. The number of visitors to the park will also continue to increase each year with added amenities, access, and visibility. The population growth both in the Wimberley Valley and the increase of visitation to the park will require an increased capacity in the park infrastructure.

Parking

Multiple parking lots will be strategically located throughout the park to enable access to both the recreational center and swimming hole. After the final phase of construction, the park will have a total capacity of 291 vehicles in a combination of small parking lots and parallel spaces along the loop road. The parking lots will be constructed from ecologically benign local materials that are laid out in a manner that avoids significant woody vegetation and focuses on utilizing previously disturbed sites. Shallow bio-swales with a 10' to 15' herbaceous buffer will be strategically located downhill of roadways and parking lots to capture stormwater runoff and associated contaminants. All parking lots will be screened from the park with densely planted vegetative buffers. The buffers will quickly provide shade for most of the parking area and will be irrigated with water generated on the site through rainwater harvesting, greywater or effluent.

Roadway and Site Access Design

The roads will be constructed from ecologically benign local materials that are laid out in a manner that avoids significant woody vegetation and focuses on utilizing previously disturbed sites. Shallow bioswales with a 10' to 15' herbaceous buffer will be strategically located in various areas alongside the roads to capture stormwater runoff and associated contaminants. To the greatest extent possible, the roads will allow water to flow naturally across the site and avoid re-directing or damming surface water flow.

Access to Blue Hole calls for two entrances to the park: the historic entrance at the current Old Kyle Road (see Appendix B, Site Plan D), and a new entrance to be constructed off FM 3237 at the northeast corner of the property. This approach was selected based on the following considerations:

a. expected traffic congestion at the Old Kyle Road entrance during busy weekends if there is only one park entrance;
b. uncertainties regarding the ability to procure additional ROW for roadway widening if there is to be a single entrance to the park; and
c. the desire to have two exits/entrances available during emergency situations.

During Phase 1, the recommended project phasing plan utilizes only the Old Kyle Road entrance for patrons of both the swimming hole and the first phase athletic facilities area. There are no improvements planned during Phase 1 for the Old Kyle Road entrance roadway where it runs adjacent to the church and graveyard. Independent of this project, the Village of Wimberley is currently involved in dialogue with TXDOT to improve the safety of the intersection of Old Kyle Road and FM 3237. This improvement, if undertaken, would reduce the speed of traffic on Kyle Road and improve access to Blue Hole Lane.

Access to the first phase athletic field area will be provided with an unpaved, rough-graded gravel road. Phase 1 envisions construction of a temporary unpaved roadway section across the center of the future athletic facilities area to separate the three Phase 1 tennis courts and one Phase 1 soccer field from the existing wastewater disposal fields. In Phase 1, a 40-space parking area for the swimming hole will be constructed along with improvements to the road accessing the parking area.

During Phase 2, the northeast entrance to the park is to be constructed and will include intersection improvements on FM 3237. Improvements to FM 3237 will be based upon a detailed Traffic Impact Analysis, but are likely to include widening of FM 3237 for: (1) a southbound right turn lane into the park; (2) a northbound left turn lane into the park; and 3) a full width shoulder southbound of the park entrance for several hundred feet. These improvements will extend north and tie into existing widening of FM 3237 at Winter's Mill Parkway.

Internal roadway improvements during Phase 2 will include construction of the access roadway from FM 3237 to the athletic fields; construction of a clear span bridge over Deer Creek; and construction of a paved perimeter roadway around the completed

athletic field area. This new access from FM 3237 is recommended to be three lanes at the state highway (one inbound and one each left turn and right turn outbound) for a sufficient distance into the park to accommodate vehicle queuing. At the park facilities, the traffic lanes will split and become a one way loop in a clockwise direction around the outer perimeter of the athletic fields.

In Phase 2, vehicular access from the athletic facilities to the Blue Hole swimming area will be prohibited except for emergency and maintenance vehicles. The unpaved roadway section connecting the two facilities will be equipped with a removable barrier to prohibit routine public access.

To minimize disturbance of Deer Creek, the northeast access road bridge over the creek is envisioned to be a clear span facility with no supports located in or near the active flow area of the creek. Final selection of bridge design and configuration will occur during site design.

Based on Stakeholder Committee recommendations, Phase 2 also envisions reconstruction of the Old Kyle entrance road adjacent to the church/graveyard into a boulevard – two lanes separated by a treed / landscaped median. This will require acquisition from the owners of the church of additional property adjacent to the existing entrance.

Transportation improvement designs internal to the park will be reviewed and approved by the engineer hired by the Village of Wimberley for the final planning phase. Intersection improvements on FM 3237 will be subject to TXDOT coordination/approval and design review. Site Plans A and B (Appendix B) present the Phase 1 and Phase 2 roadway configurations, respectively. Projected costs for the Phase 1 and Phase 2 transportation improvements are presented in the Preliminary Project Budget section of this report.

Wastewater Treatment and Disposal System Improvements

An existing constraint placed on the park is the inclusion of a 3-acre wastewater treatment facility. The design of the facility was outside the scope of this master planning process, however the location and type of facility do influence the overall design of the park. Project consultants worked to understand the current parameters of the treatment plant and made recommendations based on the best information available at the time of planning. The location of the facility is approximate and final location should be field located to avoid seasonal drainage features and minimize the disturbance to the landscape.

In January, 2005, the engineering firm Black and Veatch finalized its technical memorandum entitled "Capital Improvement Plan for the Village of Wimberley Wastewater Treatment System." Based on discussions with Village of Wimberley residents, this document recommends that wastewater treatment and disposal infrastructure to serve the Village be constructed in three phases corresponding to treatment capacities of 50,000 gallons per day (gpd), 150,000 gpd, and 300,000 gpd. The

first phase (50,000 gpd) represents a Village of Wimberley "moderate participation" scenario for which both treatment and disposal infrastructure is to be constructed and operated at Blue Hole Regional Park. Subsequent treatment capacity for Phases 2 and 3 will occur also at the park; however, the additional wastewater disposal required for flows exceeding 50,000 gpd is to be provided offsite.

The Phase 1 moderate participation scenario envisions only two wastewater component sources contributing to the Blue Hole plant: (1) 40,000 gpd from downtown Wimberley commercial businesses; and (2) 10,000 gpd from the existing Deer Creek Rehabilitation facility. Presently, the Blue Hole property is the site of an existing settling tank and low pressure dose disposal system permitted by TCEQ for 15,000 gpd and serving only the Deer Creek Rehabilitation facility. Since the Black & Veatch report was written, the TCEQ permit has been obtained for the phase 1, 50,000 gpd, wastewater treatment plant.

Due to the proposed use of the public park as a site for treated effluent disposal, the Black and Veatch study recommends use of either membrane bioreactor (MBR) or the more conventional activated sludge technologies for wastewater treatment. MBR plants employ ultrafiltration through hollow fiber membranes in conjunction with biological processes while activated sludge systems focus on highly aerated microbial digestion of waste materials. Both are capable of producing excellent quality treated effluent that meets Type 1 reuse wastewater standards and is suitable for spray irrigation disposal in public use areas such as athletic fields and public landscaping. As such, both technologies offer a source of irrigation water for the proposed soccer fields in lieu of local groundwater sources, a prohibition placed on the operation and maintenance of the soccer fields by the Stakeholder's Committee. At the direction of the Village of Wimberley, the Black and Veatch study focused its preliminary study on the MBR technology as the selected approach.

The Black and Veatch study recommends spray irrigation as the preferred technology for Phase 1 effluent disposal and anticipates possible use of the proposed Type 1 effluent as an irrigation source for the proposed soccer fields. It does not, however, plan for or specify a given size or design for the athletic facilities stating only that "extensive site preparation will be required." Site preparation for wastewater disposal using spray irrigation typically includes placement of supplemental topsoil and preferred vegetation which meet the water balance requirements used in system design and permitting, along with potentially extensive site grading. The use of spray irrigation for wastewater disposal also typically requires construction of an effluent pond capable of storing treated effluent through extended wet periods when irrigation is not possible.

The Black and Veatch study estimates the following system elements will be required for Phase 1 wastewater management at Blue Hole using conventional spray irrigation disposal:

a. 21 acres of dedicated spray irrigation area
b. 13 acres of irrigation buffer zone
c. 2 acre-foot, lined, treated effluent storage pond (640,000 gal)
d. potentially extensive site preparation as described above

To minimize the required irrigation area and to eliminate the need for a wastewater effluent pond at the public park, the Wildflower Center and Loomis Austin recommends consideration of an alternative approach to effluent disposal. Surface Drip Irrigation incorporates uniform placement of tubular plastic dripper line two feet on center at natural grade in relatively dense juniper forest areas. The lower branches of the juniper trees are cut to a height of 4-5 feet, mulched, and then placed to provide 4 inches of mulch to cover the drip line areas. Over time, the juniper forest returns to a natural condition, and the drip system becomes effectively a subsurface system.

Due to this technology's extremely uniform spatial application characteristics, TCEQ allows application rates typically of 0.1 gallons per square foot per day. For the 50,000 gpd plant, the required irrigation area is about 12 acres as compared with the 21 acres for spray irrigation required by TCEQ as reported by Black and Veatch. Due to drip irrigation's ability to provide subsurface disposal 4 inches deep in a juniper mulch medium, TCEQ requires provision of only 3 days effluent storage capacity at the plant site. For a 50,000 gpd plant, the required storage would be 150,000 gallons and would typically be provided in a field-erect steel tank located at the plant site, eliminating the need for a much larger effluent pond.

Utilizing this same drip technology placed 10 inches deep across the athletic fields is also allowed by TCEQ. Experience has shown, however, that the application rates allowed for this technology (0.1 gallon/square foot/day) are insufficient in the summer months to maintain uniformly green grass. In contrast, TCEQ does not limit application rates as severely for spray irrigation of available effluent. At the Blue Hole soccer fields, use of a spray irrigation system as the primary disposal technology, in concert with the drip system as a back-up, would approximately double allowable treated effluent irrigation rates on the fields and would provide the best available irrigation water source (short of pumping from the local groundwater) for maintenance of robust turf during the summer season. This would require that all water is treated to the higher standards for spray irrigation of effluent (rather than the lower standards associated with sub-surface drip). This will also ensure that the effluent which is put out on the site is already cleaned to the highest standards and poses the least possible risk to either Cypress or Deer Creek.

To follow this approach, the spray irrigation system for the soccer fields will need to be permitted in conjunction with a 12-acre surface drip irrigation back-up system. This approach will provide the following advantages:

a. minimal area set aside for irrigation (12 acres)
b. no effluent pond requirements
c. maximum irrigation rates on the athletic fields
d. highest quality treatment of effluent before spray or drip irrigation

A preliminary cost estimate for construction of this system can be found in the Preliminary Project Budget section of this report. Final determination of the selected Phase 1 wastewater treatment and disposal technologies at Blue Hole will be performed with final design of the Village's municipal wastewater system.

Based on the recommendations of the Stakeholder's Committee, the proposed Blue Hole wastewater treatment plant is to be placed at the northeast corner of the park adjacent to the FM 3237 entrance road between Deer Creek and FM 3237. The plant site area required for Phase 1 will be approximately 0.33 acres. Modular additions to the plant required to treat additional flows under Phases 2 and 3 are not expected to exceed more than one acre. The Stakeholder's Committee has further recommended that an aesthetic façade, such as a barn structure, be used to hide the WWTP facility from public view.

Phase 1 wastewater system design improvements will be subject to review and approval by the engineer hired by the Village of Wimberley for the final planning phase of the park and at the discretion of the Wastewater Engineering firm that the GBRA hires to design and construct the plant. The VOW and GBRA have joint authority from the TCEQ to install the WWTP and provide service to customers in the Wimberley area. Under this agreement, GBRA is responsible for construction, operation, and maintenance of the plant; while the VOW will retain ownership of the real estate and improvements. The VOW is responsible for obtaining local service contracts equal to 75 units of use, or 22,500 gpd, before the GBRA will begin design and construction of the new plant.

As mentioned above, the TCEQ permit has already been obtained by VOW and GBRA for Phase 1. Phase 2 and Phase 3 improvements are expected to each require as much as one year for permit development and processing including public meetings. If vigorously contested, these time frames may be significantly extended.

Restoration Recommendations

The following section provides general guidelines for the restoration and management of the natural areas of the Blue Hole Regional Park. These activities may be undertaken by volunteer groups or future Blue Hole staff.

Swimming Area Restoration Recommendations

In order to preserve the ecological integrity of the swimming area (see photo 18), it is important to prevent further degradation of the streambed caused principally by visitor traffic.

Photo 18. Swimming Area

The rocky bluffs and the braided channel areas are some of the most ecologically interesting and sensitive areas of the park. The soft, often saturated, soils are extremely sensitive to trampling and soil compaction. Efforts should be made to control exotic species, especially Asian marshweed, which has the potential to spread from the riffle area into deeper waters of the swimming hole where it could become not only an ecological problem, but also a nuisance to swimmers. The stream and banks of the braided channel to the south of the swimming hole itself should be protected from significant public access – interpretive signage informing visitors of the need to preserve this area would probably be the most suitable technique for controlling access.

We recommend protecting the bluff areas to the east of the swimming hole (see photo 19) from trampling. The rock faces and large boulders are habitat for several interesting rock-loving plant species, as well as denning habitat for various animals. These cliffs are tempting to climbers and climbing should be discouraged to avoid damage to the vegetation, geology, as well as the park visitor.

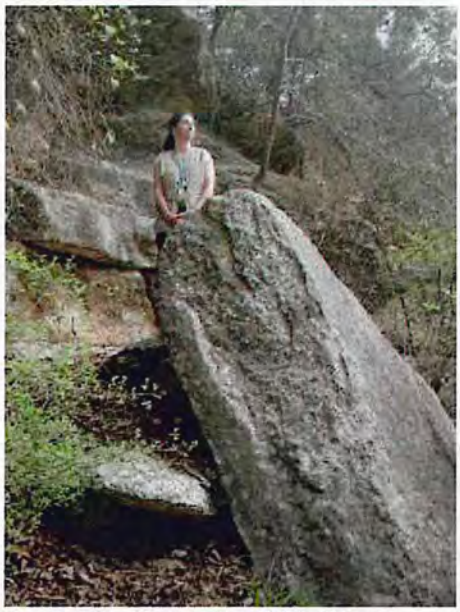


Photo 19. Example of bluff area

As visitorship increases there is further danger of degradation of the structural integrity of the river bank itself. It is recommended that specific entry/exit points to the river be created using suitable armoring (e.g. limestone paving). It is also recommended that the remaining bank areas be revegetated and protected with shrubs and larger grasses and sedges (e.g. muhly grasses, Jamaica sawgrass, sedges, eastern gamagrass). It may be difficult to minimize trampling on the banks, as swimmers tend to seek out waterside lounging spots with some degree of privacy or separation from other bathers. Traffic in and out of the water will be much easier to regulate, as most swimmers will choose the path of least resistance.

Due to past human traffic there has been little regeneration of desirable native riparian trees (e.g. bald cypress, sycamore, box elder). Existing saplings or additional liners (woody saplings grown in narrow, deeper pots) should be protected with structures unlikely to become litter during a flood, such as cedar posts. Planting of larger specimen trees is discouraged, since they are not only much more costly, but are more likely to be washed away by flood events before establishment. Established group plantings of large graminoids may provide sufficient protection for transplanted saplings. Tables VI and VIII, found in Appendix A, provide information on various plant species that could be added to provide erosion control along the creek bank and throughout the riparian zone.

Nature Trail and Preserve Restoration Recommendations

The Nature Trail and Preserve is outside of the official purview of this report, but has been included because it is closely linked ecologically to the riparian portion of the property and is planned to be linked to the property by a common trail system. It shares similar management concerns and goals with the swimming area and braided stream channel and has potential to serve as a source of plant propagules for introduction to the Blue Hole property. Similarly, foot traffic along the trail could be a mode of dispersal for various plant species, both desirable and invasive

Juniper/Live Oak Woodlands Restoration Recommendations

The juniper/live oak woodlands are the dominant plant community on the property. This system is currently lacking its historical species diversity and provides low habitat value. Because of this, a long-term restoration plan for this system will primarily focus on incremental species supplementation. Desired hardwood species (see recommended species list Appendix A, Table IV) should be grown in liners (contract-grown or otherwise) and planted in locations which favor long-term survival – chiefly:

a. sites which have deeper soils and higher soil moisture –indicated by taller or more dense herbaceous growth or along drainfield infiltration lines;
b. sites which are subject to more ambient light by planting in a natural canopy gap or by clearing existing juniper trees.

Each tree should be adequately protected from deer by utilizing vertical posts and mesh screening, or by piling large dead brush around the young tree.

Additional species may be planted directly as seeds, although the best success would be achieved by planting them within protective enclosures or in areas where juniper slash is stacked loosely on the ground. Seeds of desirable shrub species could be planted within the confines of wire enclosures erected to protect transplanted trees, if there is adequate space. These enclosures could also be used to protect desirable herbaceous plants from deer pressure. Once established, all the protected plants would serve as seed sources for the wider establishment of these species.

However, to facilitate visual and audible screening there should be no clearing within 50 feet of property boundaries, beyond what is required for fence and right-of-way maintenance. A vegetative screen would be especially worth maintaining in areas where it would give an impression of seclusion from neighboring buildings and roadways. Boundary areas near buildings that are not currently well screened would be appropriate targets for establishment of additional trees.

The relatively flat area above the bluffs east of the swimming hole, with its mature trees, lack of understory, and proximity to the swimming area is a natural candidate for a camping or picnic area (see photo 20).

Photo 20. Level area east of swimming area

Diversity enhancement and establishment of native understory vegetation could potentially create a valuable habitat and wildlife movement corridor along Cypress Creek. Its proximity to a permanent water source makes this area especially valuable to wildlife. The proximity to an area of heavy visitor usage would enhance viewer experience through viewing of more birds and butterflies.

Deer Creek Restoration Recommendations

The rocky bluffs and rimrock areas (see photo 21) can provide valuable habitat to a wide variety of animal species as well as specialized plant species, but are also attractive lures for human explorers that could be disruptive to both animal and plant populations. Restricted access to the steeper sections is recommended. One portion of the bluff crest along the east side of Deer Creek, to the north of the rehabilitation center, fits the criteria mandated by the City of Austin for a critical environmental feature to be protected from development by restricted buffer areas within that city's jurisdictional areas.

Photo 21. Rocky bluffs

The relatively small number of hardwood species in this area suggests further selective planting of these species following the previously mentioned guidelines in juniper/live oak woodlands recommendation section above. To reduce the chance of damage or removal from areas prone to scouring during storm events, container grown trees should be planted at elevations at least 4 ft higher than the drainage pilot channel.

One area along the northwest bank of Deer Creek contains numerous large specimens of junipers and live oaks growing on a wide, gentle slope leading down to the floodplain (see photo 22). A long and high bluff overlooks this area from the southwest side of Deer Creek. Some judicious thinning of trees could be worthwhile to open up modest views of the floodplain.

Photo 22. Area along northwest bank of Deer Creek

Grasslands/Savannas Restoration Recommendations

The long-term target is to create an open savanna system. This can be accomplished through the removal of selected junipers (primarily seedlings, saplings, and smaller specimens) and invasive species (especially King Ranch bluestem), and reseeding of native grasses and wildflowers. This can be achieved incrementally over time by manual and herbicide removal or facilitated through one or more growing-season prescribed fires followed by a seeding of desired species. Although this system will predominately comprise mixed-prairie species, it can also support wildflower production. This can be encouraged in high visibility areas (along trails, near recreational fields) by periodic prescribed burns or by mowing 2-3 times per year at a height of 4 to 6 inches following wildflower seed-set in July. Appendix A, Table X, provides a mix of commercially available seeds that would be appropriate for wide application in the shortgrass or savanna areas of the property, or areas where juniper woodlands have been cleared, leaving little cover; Appendix A, Table IX, provides a mix of wildflower seeds that could be planted to boost wildflower displays in grassy areas. These are sample mixes and can be modified to achieve specific goals.

The existing pasture at the southwest portion of the property between the cemetery and Cypress Creek should be restored to native grasslands or savanna. This oldfield system, on soils mapped as Sunev Clay loams, has the potential to support a true tallgrass prairie, as well as deeper rooted tree species such as pecan. The predominance of invasive

grasses will require an aggressive regimen of herbicides and/or growing-season prescribed-burns followed by seeding native grasses and wildflowers. If this area is to be further used as a shaded picnic spot, hardwood trees need to be planted throughout. Appendix A, Table XI, provides a sample mix of commercially available seeds appropriate for the establishment of a tallgrass prairie ecosystem in this area.

The existing RV park will be cleared of hardscape, ripped, and replanted to native grassland. Similar to other areas along the creek, Sunev clay loams are present which can support tall grass prairie system. As this area will be subject to run-off from the parking lot, creation of a bioswale will serve to temporarily capture and treat this run-off. The bioswale will consist of a linear depression running parallel to the river immediately downhill (west) of the parking lot. It will be sown with native species which are adapted to sporadic temporary flooding (Appendix A, Table VI). Supplemental irrigation may be needed during the establishment phase to ensure rapid establishment and hydrologic function.

Wastewater Drainfields and Juniper Revegetation Areas

The wastewater drainfields have been regraded for agricultural purpose and are now covered predominantly by unwanted vegetation such as bermudagrass and KR bluestem. The majority of this area will be re-graded for the recreational fields and associated parking. Until the construction of the fields takes place, invasive species such as johnsongrass should be mowed on a regular basis to deter seeding and spread.

General Management Considerations

Sensitive species

No endangered or threatened species are known to occur on the site. Except for the slim chance of occurrence of the golden-cheeked warbler (GCW, *Dendroica chrysoparia*), this property does not have suitable habitat for any endangered or threatened species which occur in the area. The main management concerns for rare or endangered aquatic or subterranean species -- were they to occur onsite or downstream from the property -- would be water quality issues, which are already a prime management concern.

The junipers over most of the property are of suitable age and structure to be important habitat components for the endangered golden-cheeked warbler, and the live oaks are another important habitat component. The woodlands, however, are too heavily dominated by junipers, lacking sufficient levels of deciduous tree species to qualify as habitat for the GCW. Woodlands such as those on property are only used by GCW when they adjoin higher quality habitat, but such habitat is not known to be adjacent to this property. The possibility of GCW occupancy cannot be ruled out, and woodlands on the property fall within the parameters recommended for GCW surveys (Campbell, 1995).

Habitat for the GCW on this property could be created or enhanced through a long-term project entailing selectively thinning of the junipers and an increased diversity of species such as Texas oak, Texas ash, cedar elm, hackberry, Arizona walnut, little walnut, pecan,

and Escarpment black cherry. Even if the GCW never appeared, increasing plant diversity of the site would greatly enhance wildlife habitat and ecotourism value. If GCW habitat is desired, it is recommended that the property be certified as lacking protected species, enabling it to be designated as a "safe harbor," rendering the property free from species related development restrictions in the future. For more information on safe harbor permits, see http://www.environmentaldefense.org/documents/929_handbook.htm.

The park lacks habitat for the endangered black-capped vireo (BCV, *Vireo atricapillus*), which is typically a matrix of deciduous shrubberies, dense near the ground, interspersed with open grassy areas. Such habitat can sometimes be easily created by cutting, burning, or otherwise disrupting established populations of deciduous woody species that have grown too tall or dense to constitute suitable habitat. Since the property lacks such habitats, creation of BCV habitat would be a more difficult process, but even starting from seed with these species might be a more rapid process than reestablishing GCW habitat.

Exotic species

The open area near the swimming hole is dominated by St. Augustine grass. King Ranch bluestem is the dominant herbaceous species in portions of the savanna and in the elongated cleared strip between the cemetery and Cypress creek. Bermudagrass and johnsongrass were major components in several grassy areas, especially the sewage drainfields, where musk thistle was abundant. Japanese brome and rescue grass were both widely distributed and could become major competitors with early spring native wildflowers. English ivy was also present along Cypress Creek. Exotic woody species, present but not in extensive stands, included Chinaberry, Japanese ligustrum, Chinese ligustrum, Chinese photinia, Chinese tallow, and nandina. These and additional minor exotic components are listed in Table I found in Appendix A. It is highly recommended that future management plans provide for continued, long-range efforts to control invasive species. Invasive species are one of the most important factors leading to habitat degradation. Mechanical removal and cultural practices, such as properly timed mowing or prescribed burning can be important techniques, but most serious control programs also necessitate some degree of species removal. A recommended reference for information and techniques for invasive species control is the Nature Conservancy's Weed Control Methods Handbook (Tu 2001), available on the web at http://tncweeds.ucdavis.edu/handbook.html.

Asian marshweed

Of special interest is a population of Asian marshweed that has been identified in Cypress Creek around Blue Hole. The population at Blue Hole was observed growing at the downstream end of the swimming area where the creek begins to flow through riffles and braided channels. This species has been noted at the Landa Lake and the San Marcos River in Hays County for a number of years. The population on Cypress creek could be a previously unknown disjunct population upstream from the known population in San Marcos. Asian marshweed is also known from Comal Springs and River in Comal County and near Houston at Sheldon Reservoir and Lake Houston. Other populations in the United States are in Florida and Georgia. Emergent stems were blooming on July 7, 2006.

Asian marshweed is native to India, Sri Lanka, and perhaps the Philippines. Although it is on the US Federal Noxious Weed List, it can still be purchased over the internet. It is an attractive plant and was imported for use in the aquarium trade. Intentional or careless human introductions may be its greatest agent for dispersal. Populations have been known in Florida since 1965. The Florida Department of Environmental Protection does not report it as a nuisance, but it is a major weed problem in paddy rice fields in India, China, Japan, and the Philippines. It can clog irrigation and flood control canals and pumping and power stations. It seems to have a wide range of habitat tolerance, growing in cool mountain streams in Africa, hot Florida rivers, flooded Asian rice fields, and damp soils. It is tolerant of low light conditions, growing in water to 12 feet deep, and can shade out and out-compete other aquatic species. Control seems problematic because mechanical control efforts result in fragments that can root and spread, the plant is resistant to herbicides, and is not eaten by grass carp. Each flower can produce 200 to 300 seeds, with a germination rate of 96%. Minette Marr, of the Lady Bird Johnson Wildflower Center, who identified a specimen from the Blue Hole population, says that she has repeatedly weeded the same small patch on the San Marcos River over the course of several years, to no great success. More Information is available at http://plants.ifas.ufl.edu/seagrant/limses2.html, the source of most of this information.

It is not known how long this population has been established at Blue Hole, its origin or current extent in Cypress Creek, or what its future disposition might be. Its tolerance of deep water and low light might allow it to spread into the deeper waters of the swimming area where it could become a nuisance to swimmers. Its ecological implications in this system are unknown. It probably has a tendency to spread downstream, displacing native plants, resulting in unpredictable consequences.

Usually no efforts are made to control exotic invasive species until after they have become so firmly and widely established that control is difficult and eradication is impossible. This occurrence is interesting because it has not become a nuisance problem at this site, but has the potential to do so.

Manual removal is probably the best option for control in this situation, being very mindful that small fragments can escape to become reestablished over an even wider area. Placement of downstream nets is sometimes effective at capturing fragments before they can wash further downstream. Care should be taken to avoid fragmentation, and all material should be collected in plastic bags for burning or landfilling. If plants are left to dry in the sun, they will die, but copious amounts of seeds could remain to be washed back into the aquatic system. The flowing water at this location makes herbicide treatment difficult, reducing contact time for the target species, and spreading the chemicals downstream to non-target species. It would be very helpful to know the extent of infestation of this species on Cypress Creek. Even if it was possible to eliminate it from Blue Hole, it might be repeatedly reestablished from fragments or seeds washing downstream from any upstream populations.

Oak wilt

The fungal pathogen oak wilt (*Ceratocystis fagacearum*) is currently spreading from an infected area northwest of the Deer Creek Rehabilitation facility (see photo 23), and possibly from other sites on the property.

Photo 23. Oak wilt area

Oak wilt has the potential to eliminate live oaks over a large extent of the property, greatly diminishing habitat and aesthetic values. Since the infection spreads from tree to tree through underground root connections, it is impossible to predict how far or fast it may spread. The disease may be halted at Deer Creek or other areas of thin soil or exposed bedrock. Chemical treatment of infected trees is expensive and uncertain, but spread to new trees can often be controlled by deep trenching with a rock saw. A site visit and management advice can be obtained from the Texas Forest Service.

New infection sites could occur anywhere that oaks are damaged during clearing, construction, or road building. It is important that contractors be required to minimize damage to oaks and to immediately paint wounds inflicted to oak trees or to confine activities to climatically safe time periods. When Texas red oaks become infected, it can not only spread by the roots, but can also form fungal mats on the surface of the tree which release spores that are spread by wood boring beetles which can lead to new infection centers.

Diversity enhancement

Overall, the park has a low diversity of woodland species and habitat, largely as the result of years of pressure from humans, deer, overgrazing by livestock, and suppression of wildfires. Diversity of woody species in upland habitats is especially low, with the majority of the property greatly dominated by Ashe juniper, with Escarpment live oak a distant second, and all other species far behind. Selective thinning of junipers and enhancement of deciduous species would greatly enhance the wildlife habitat value of the property and also add aesthetic and educational value. It is fortunate that the local species of juniper can be easily killed without herbicide by cutting the trees down and insuring that no green leaves remain on the stump. Establishment of woody species will require seedling protection from browsing pressure from deer.

Appendix A, Table IV, lists woody species and vines that would be appropriate choices for introduction to the various habitats contained within this property. Appendix A, Tables III & IV, lists species that would be worthy of planting in more limited numbers than those in the general seed mixes, due to higher cost or limited availability. Care should be taken to procure not only the correct species, but also to choose genetic stock from the Central Texas region, if possible. Choosing a bald cypress or live oak from available nursery stock often yields a specimen from the southeastern United States that is not well adapted to our climates and soils. Appendix A, Table XII, lists suppliers of plant material that may be able to provide some locally appropriate genotypes. It is often advisable to plant smaller specimens. Larger specimens, while providing more immediate satisfaction, are much more costly, and harder to keep alive while becoming established. An excellent reference for propagating and establishing woody species is "How to Grow Native Plants of Texas and the Southwest" by Jill Nokes (2001).

Diversity of herbaceous species is difficult to judge at this time, since visits to the site occurred during an unusually dry year, but populations of wildflowers and other herbaceous forbs are probably also impacted by deer browsing. Open areas would

normally be dominated by several species of native perennial grasses. Management of woody species would assist in herbaceous recovery; however additional seed would accelerate this process.

Prescribed fire could be a useful management tool in the savanna/grassland areas, but much of the savanna area does not currently have enough grass cover to provide adequate fuel load to conduct a prescribed fire. Fuel loads could increase to sufficient levels after a period of greater rainfall, especially if some removal of woody species has occurred. A succession of prescribed burns over a period of years could result in lesser amounts of woody species, selective pruning of low hanging branches of larger trees, and a corresponding increase in herbaceous vegetation.

Deer

Efforts to increase plant species diversity will need to address browsing pressure from white-tailed deer. The low diversity of woody species is related to long-term browsing pressure. At the time of the March visits, there was little deciduous woody forage available within the browse range over much of the property. Even widely scattered bushes of the non-native species nandina, often considered to be a deer resistant plant, were heavily browsed. Transplants of shrubs and trees should be protected by fencing or piled brush in order to become established. If thinning of junipers occurs, cut material (branches or entire small trees) could be left scattered and piled around desired species to discourage deer browse, but this is often considered to be unsightly.

Reducing the deer population on the property will be a prime requirement for maintaining healthy habitats and the significant populations of birds, butterflies, wildlife, and wildflowers that will be expected by visitors. This is typically a very controversial issue. As hunting pressure on local deer populations diminishes as the result of development of more of the surrounding ranchlands, numbers of deer will probably increase, and browsing pressure on this property will increase accordingly. Feeding of deer within and near the property should be discouraged, as this will result in increased deer populations and browsing pressures within the park.

Visitor impacts

The main terrestrial ecological impact from visitor use is likely to be disturbance to plant communities through trampling and introductions of exotic plant species. The soft moist soils of the heavily used swimming hole and braided channel/island area will be especially susceptible to damage from trampling. Rocky bluffs that are appealing for climbing (primarily near the swimming hole) and any areas designated for camping, picnicking, or sports will also be heavily impacted. Wildlife may also be impacted by disturbance, especially during times of breeding, care of offspring, or roosting.

Increased visitorship to the park will bring an increased risk of unwanted impacts such as pollution and plant and wildlife disturbance (see photos 24 and 25).

Photos 24 and 25. Examples of negative visitor impact

The Village of Wimberley should be prepared to take action to protect the natural resources of the park by resting the landscape or relocating or re-thinking damaging amenities.

PRELIMINARY PROJECT BUDGET

Blue Hole Regional Park

Preliminary Engineer's Opinion of Probable Costs

November, 2006

Phase 1

	Estimated Unit Cost		*Estimated Quantity*	*Estimated Cost*
Erosion/Sedimentation Control				
Install, Repair and Maintain Silt Fence	$3.00	LF	3000	$9,000
Stabilized Construction Entrance	$1,500	EA	1	$1,500
	Total Erosion/Sedimentation Control			**$10,500**
Roadway and Parking Improvements (Phase 1 only)				
8" Base Material Old Kyle Road Entrance near Parking Lot (200' x 28')	$9.00	SY	622	$5,598
1-1/2" H.M.A.C. Old Kyle Road Entrance near Parking Lot (200' x 26')	$6.00	SY	578	$3,468
Clear and Rough Grade for Temporary Athletic Fields Road (2558' x 28')	$2.50	SY	7958	$19,895
Clear and Rough Grade for Future Emergency Access Road (661' x 22')	$2.50	SY	1615	$4,038
8" Base Material for 40-space Blue Hole Parking Area (200' x 64')	$9.00	SY	1422	$12,798
1-1/2" H.M.A.C. for 40-space Blue Hole Parking Area (200' x 62')	$6.00	SY	1378	$8,268
Clear and Rough Grade for Community Pavilion Parking Area (160' x 60')	$2.50	SY	1067	$2,668
8" Base Material for Community Pavilion Parking Area (160' x 60')	$9.00	SY	1067	$9,603
1-1/2" H.M.A.C. for Community Pavilion Parking Area (160' x 58')	$6.00	SY	1032	$6,192
Furnish and Install Roadway Signage	$600	EA	3	$1,800
Revegetation	$2.50	SY	500	$1,250
Parking Lot Bioswale	$120	LF	200	$24,000
	Total Roadway and Parking Improvments			**$99,577**

Water Distribution System Improvements

3" Water Line C-900	$22	LF	4,000	$88,000
Single Service Connection with Meter	$1,200	EA	4	$4,800
3" Gate Valve	$260	EA	6	$1,560
	Total Water Improvements			**$94,360**

Wastewater System Improvements

Composting Toilets Facility (Blue Hole Swimming Area and Camping Area)	$10,000	EA	2	$20,000
	Total Wastewater Improvements			**$20,000**

Electrical Utilities

Trench with 3 conduits	$24	LF	4,000	$96,000
Pulling single phase power	$2.00	LF	4,000	$8,000
Transformer Pad	$510	EA	3	$1,530
Meter Boxes	$210	EA	3	$630
	Total Electrical Utilities			**$106,160**

Athletic Facilities Construction

Clear, Grub for Soccer Fields (One Soccer Field only)	$2.50	SY	7,200	$18,000
Final Grading Cut and Fill (One Soccer Field only)	$12.00	CY	4,400	$52,800
Imported Soils Placement (One Soccer Field Only)	$20.00	CY	2,220	$44,400
Turf Placement (One Soccer Field only)	$2.00	SY	7,200	$14,400
Clear, Grub for Tennis Courts (3 Courts Only)	$2.00	SY	2,880	$5,760
Final Grading Cut and Fill for Tennis Courts (3 Courts Only)	$12.00	CY	1,850	$22,200
Tennis Courts (3 Courts only)	$160,000	3 CTS	1	$160,000
	Total Athletic Facilities Phase 1			**$317,560**

Blue Hole Swimming Area Improvements

Office/Bathouse Entrance Building	$15,000.00	EA	$1.00	$150,000
Re-Grading	$20.00	CY	500.00	$10,000
Re-Vegetation	$20.00	SY	500.00	$10,000
Limestone Slab Patio Placement	$10,000.00	EA	8.00	$80,000
	Total Blue Hole Swimming Area Phase 1			**$250,000**

Park Amenities (Phase 1 only)

Hike and Bike Trail	$25.00	LF	3,094	$77,350
6' wide Pedestrian Trail	$25.00	LF	10,423	$260,575
Primitive Camping Area Improvements	$5,000.00	EA	2	$10,000
Woodland Picnic Area Improvements	$3,000.00	EA	1	$3,000
Community Pavilion Building	$80,000.00	EA	1	$80,000
	Total Park Amenities Phase 1			**$430,925**

Soft Costs

Civil Engineering Design and Environmental Services (Phase 1 Only)	$35,000
Design Survey (assumes aerial topographic survey) with Supplemental On-the-Ground Survey	$25,000
Engineering Subcontractors including Structural, Geotechnical	$5,000
Village of Wimberley Engineering Review Fees	$5,000
Total Soft Costs	**$70,000**

Subtotal =	**$1,399,082**
Contingency (20 percent) =	**$279,816**
PHASE 1 SUBTOTAL =	**$1,678,898**

Note: Hike and Bike trail numbers are approximate. Final numbers should be based on TxDot design specs.

Blue Hole Regional Park

Preliminary Engineer's Opinion of Probable Costs

November, 2006

Phase 2

	Estimated Unit Cost		*Estimated Quantity*	*Estimated Cost*
Erosion/Sedimentation Control				
Install, Repair and Maintain Silt Fence	$3.00	LF	2500	$7,500
Stabilized Construction Entrance	$1,500.00	EA	2	$3,000
Total Erosion/Sedimentation Control				**$10,500**
Roadway and Parking Improvements (Phase 2 only)				
Intersection Improvements at FM 3237	$320,000	EA	1	$320,000
Clear, Grub and Rough Grade for FM 3237 Entrance Road (920' x 30')	$4.00	SY	3066	$12,264
8" Base Material FM 3237 Entrance Road (920' x 28')	$9.00	SY	2862	$25,758
1-1/2" H.M.A.C. FM 3237 Entrance Road (920' x 26')	$6.00	SY	2658	$15,948
Deer Creek Bridge at 3237 Entrance Road	$275,000	EA	1	$275,000
Clear and Rough Grade for WW Plant Access Road (134' x 24')	$2.50	SY	358	$895
8" Base Material FM 3237 WW Plant Access (134' x 22')	$9.00	SY	328	$2,952
1-1/2" H.M.A.C. FM 3237 Entrance Road (134' x 20')	$6.00	SY	298	$1,788
Clear/Rough Grade Athletic Fields Perimeter Road and Parking Areas	$2.50	SY	7639	$19,098
8" Base Material for Athletic Facilities Perimeter Road (3712' x 28')	$9.00	SY	11549	$103,941
1-1/2" H.M.A.C. for Athletic Facilities Perimeter Road (3712' x 26')	$6.00	SY	10724	$64,344
8" Base Material for 20-space Pocket Parking Area (110' x 64' x 3)	$9.00	SY	2347	$21,123
1-1/2" H.M.A.C. for 20-space Pocket Parking Area (110' x 62' x 3)	$6.00	SY	2274	$13,644

8" Base Material for 10-space Pocket Parking Area (60' x 64')	$9.00	SY	427	$3,843
1-1/2" H.M.A.C. for 10-space Pocket Parking Area (60' x 62')	$6.00	SY	414	$2,484
Furnish and Install Roadway Signage	$600	EA	3	$1,800
Revegetation	$2.50	SY	2500	$6,250
	Total Roadway and Parking Improvements			**$891,132**

Drainage Improvements

RCP Culvert with Headwalls and Revetment	$25,000	EA	1	$25,000
Grassed Drainage Swale	$30.00	LF	1200	$36,000
	Total Drainage Improvements			**$61,000**

Wastewater System Improvements

Composting Toilets Facility	$2	EA	10,000	$20,000
Phase 1 (50,000 GPD) WWTP with Steel Storage Tank	$750,000	EA	1	$750,000
Phase 1 (50,000 GPD) Surface Drip Irrigation System	$70,000	AC	12	$840,000
WWTP Barn Façade	$50,000	EA	1	$50,000
	Total Wastewater Improvements			**$1,660,000**

Athletic Facilities Construction

Clear, Grub for Soccer Fields (Remaining Soccer Fields)	$1.50	SY	21,280	$31,920
Final Grading Cut and Fill (Remaining Soccer Fields)	$12.00	CY	6,500	$78,000
Imported Soils Placement (Remaining Soccer Fields)	$20.00	CY	6,200	$124,000
Turf Placement (Remaining Soccer Fields)	$2.00	SY	15,200	$30,400
Clear, Grub for Tennis Courts (Remaining 3 Courts)	$2.00	SY	2,880	$5,760
Final Grading Cut and Fill for Tennis Courts (Remaining 3 Courts)	$12.00	CY	1,850	$22,200
Tennis Courts (Remaining 3 Courts)	$160,000	3 CTS	1	$160,000
Athletic Fields Treated Effluent Spray Irrigation System	$40,000.00	EA	1	$40,000
Playscape	$25,000.00	EA	1	$25,000
Recreation Pavilion	$30,000.00	EA	1	$30,000
	Total Athletic Facilities Phase 2			**$547,280**

Park Amenities (Phase 2 only)

Amphitheater	$10,000	EA	1	$10,000
		Total Park Amenities Phase 1		**$10,000**

Soft Costs

Civil Engineering Design and Environmental Services for Park Improvements (Phase 2 Only)	$40,000
Civil Engineering Design, Permitting, Construction Inspection for Phase 1 (50,000 gpd) Wastewater System	$240,000
Geotechnical Evaluation for Phase 1 Wastewater System	$20,000
Supplemental Survey	$20,000
Engineering Subcontractors including Structural, Geotechnical, Electrical	$15,000
Village of Wimberley Engineering Review Fees	$20,000
Total Soft Costs	**$355,000**

Subtotal =	**$3,534,912**
Contingency (20 percent) =	**$706,982**
PHASE 2 SUBTOTAL =	**$4,241,894**
PROJECT GRAND TOTAL =	**$5,920,792**

BLUE HOLE OPERATING EXPENSES

Implicit in the design parameters of the Blue Hole Regional Park has been that the park must cover its own day to day operational expenses. An initial assessment of budgetary costs was undertaken by examining a number of other local and regional parks. While uniform information was not available for all parks, significant data was able to be collected for 4 parks:

Park	Annual Budget	Annual Revenue	Acres	Employees
Zilker Park/Barton Springs	Not covered by annual revenue	$500,000	351	50
Westcave Preserve	$400,000	Not available	30	5 FT
Hamilton Pool	$82,000 plus Staff Salaries	$108,333	232	3.5 FT
Cibolo Nature Center	$400,000	$60,000	100	5 FT, 4 PT

While complete budget data was unavailable for most of these parks, it was clear that none of these parks operated with a positive or even neutral net revenue. Out of these 4 parks, Blue Hole was most similar in size and scope of activities to Hamilton Pool, a park operated by Travis County. This park, however, does not provide any of the active recreational activities that are proposed at Blue Hole Regional Park.

Operational expenses for 2 of the largest active recreation activities, Soccer and Tennis, were estimated by the San Marcos Area Youth Soccer Association and Wimberley Community Tennis Association respectively. Their estimated operational costs are as follows:

Annual Operating Costs for 3 Soccer Fields		
Item		**Amount**
Mowing Fields (twice a month)		2400
Portable Bathroom service		1000
Fertilizer		200
Lining of the Fields		800
Dumpster Fee		1200
	Annual cost	**$5,600**

Operating Costs for 6 Tennis Courts		
Item	**Frequency (yrs)**	**Amount**
Court Resurfacing	9	20000
Court Nets, Net Strap Replacement	3.5	900
Windscreens	5	2000
Replace Lighting Fixture Lamps	5	800
Lighting Control Replacement	5	1200
Court Surface Cleaning	0.25	200
	Annual cost	**$4,079**

Additional information used in the creation of estimated operating expenses were the actual "gate" revenue from swimming area access during the summer of 2006. The park was opened intermittently during this summer. The following table lists both the dates that the park was open, as well as the gross revenue generated from these periods.

Month	Dates	Days	Revenue
May	27-29	3	$1,005
June	10 to 11	2	$845
	17 to 18	2	$605
	27 to 30	4	$728
July	1 to 12	12	$2,183
	13 to 16	4	$2,234
	17 to 26	10	$4,318
	27 to 1st	6	$2,708
August	2 to 8	7	$3,789
	9 to 13	5	$2,585
	14 to 20	7	$2,146
	21 to 27	7	$1,617
Sept.	1 to 4	4	$1,740
	Total	**73**	**$26,502.50**
		Average Daily	**$363**

It is possible that these revenue rates are lower than what could be expected after the park becomes established. Hamilton Pool, a similar distance from large population centers and with a similar recreational attraction generates significantly greater revenue than is predicted based on Blue Hole's 2006 revenue generation. In an effort to construct as conservative a budget as is possible, however, a daily revenue rate of $363 per summer day was utilized in both of the following budgets.

Estimating Operating Costs

Based on this revenue rate, estimated staff and operating costs for similar parks, and the estimated operating costs for the active recreational activities, the following budget has been developed for the first phase of park development. This budget assumes that while the park would be open year round, the swimming hole would only be open 3 months of the year (7 days a week), and that an endowment of at least $325,000 can yield 4.5% of its total value toward operational costs. It is assumed that $40,000 from this endowment is raised from soccer facilities, and $45,000 is raised from tennis facilities. If these funds are not raised, an annual maintenance fee equal to the cost of soccer and tennis operation and maintenance should be charged. It is anticipated that the park will be operated by a Park Manager (full time for 3 months, and 25% time for 9 months) and two part time staff (24 hours a week for 3 months of the year when the swimming hole is open). Additional staff help is anticipated to come from volunteer support.

Phase 1 Development (Swimming Hole, 1 soccer Field, 3 Tennis Courts, Gravel Roads / Parking)

REVENUE			
Endowment			
4.5% return on $325,000			$14,625
Earned Revenue			
Swimming Fees			$32,674
Soccer Fees			$0
Tennis Fees			$0
		Total Revenue	**$47,299**
EXPENSES			
Staffing	Salary	Tax & benefits	Total Cost
Park Manager (full time, 3 months, 25% 9 months)	12250	3675	$15,925
Weekend staff (48 hours/week, 20 weeks)	7680	1152	$8,832
Operating Budget			
Maintenance & Materials			$12,000
Bathroom and Trash Contract			$5,000
Soccer Field O&M			$1,867
Tennis O&M			$2,040
		Total Expenses	**$43,624**
		NET REVENUE	**$3,676**

Phase 2 of the park development plan would see the completion of the remainder of planned park amenities. At this point, it is assumed that the swimming hole would be open 7 days a week for 3 months of the year, and 3 days a week for another 3 months of the year, and closed the remainder of the year. Other portions of the park would remain open year-round. Staffing is estimated to require one full time park manager, and 3 part time staff. Initial estimates on park construction costs from the Trust for Public ands suggested that full construction costs would be $2,765,000. More recent estimates of the full construction costs of the park associated with this study have shown that the full build out costs could be much closer to $6,000,000. For the purposes of estimating the endowment size associated with the park, a mid-range number of $4,000,000 for park construction costs, with an additional 25% of construction costs be put into a permanent operational endowment. It is assumed that $120,000 from this endowment is raised from soccer facilities, and $90,000 is raised from tennis facilities. If these funds are not raised, an annual maintenance fee equal to the cost of soccer and tennis operation and maintenance should be charged.

Completed Development (Swimming Hole, 3 soccer fields, 6 Tennis Courts, Community Pavilion, Paved Roads / Parking)

REVENUE			
Endowment			
4.5% return on $1,000,000			$45,000
Earned Revenue			
Swimming Fees			$42,477
Soccer Fees			$0
Tennis Fees			$0
		Total Revenue	**$87,477**
EXPENSES			
Staffing	Salary	Tax & benefits	Total Cost
Park Manager (full time)	30000	9000	$39,000
Weekend staff (72 hours/week, 20 weeks)	11520	1728	$13,248
Operating Budget			
Maintenance & Materials			$20,000
Bathroom and Trash Contract			$8,000
Soccer Field O&M			$5,600
Tennis O&M			$4,079
		Total Expenses	**$85,848**
		NET REVENUE	**$1,629**

These budgetary estimates on staff requirements represent a bare minimum, and comparable parks often have two to three times this number of staff. Additionally, it is clear that even with this very low staffing rate, the park cannot operate in an economically sustainable fashion without a sizable maintenance endowment or an annual commitment from the Village of Wimberley.

REFERENCES

Booth, D. B. 1991. Urbanization and the natural drainage system-impacts, solutions and prognoses. Northwest Environmental Journal 7:93-118.

Barnes, V.E. 1981. Geologic Atlas of Texas, Llano sheet. Bureau of Economic Geology, The University of Texas at Austin.

Campbell, Linda. 1995. Endangered and Threatened Animals of Texas- Their Life History and Management. Texas Parks and Wildlife Dept., Resource Protection Division, distributed by University of Texas Press. 130pp.

[CWP] Center for Watershed Protection. 2003. Impacts of urbanization on downstream receiving waters, section 2: Is impervious cover still important? Center for Watershed Protection Runoff Rundown Issue 9.

Klein, R. D. 1979. Urbanization and stream quality impairment. Water Resources Bulletin 15: 948-963.

Nichols, Carolyn. 2006. Wimberley Resident and Secretary for the Friends of Blue Hole Personal communication to Dick Davis, March 22, 2006.

Nokes, Jill. 2001. How to Grow Native Plants of Texas and the Southwest. University of Texas Press. Austin. 566 pp.

Tu, M., C. Hurd, and J.M. Randall. 2001. Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas. The Nature Conservancy. http://tncweeds.ucdavis.edu/handbook.html

[USDA-SCS] United States Department of Agriculture, Soil Conservation Service. 1984. Soil Survey of Comal and Hays Counties, Texas. United States Department of Agriculture, Soil Conservation Service, in Cooperation with Texas Agricultural Experiment Station.

[USFWS] U.S. Fish and Wildlife Service. 2005. Barton Springs Salamander (Eurycea sosorum) Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, NM.

APPENDIX A

PLANT LISTS

TABLE I
Plant Species Found at Blue Hole Property

Name	**Common Name**	**Growth Habit**	*	**Zone**
Abutilon fruticosum	Indian mallow	Herbaceous	n	d
Acer negundo	Box elder	Woody, Tree	n	bc
Adiantum capillus-veneris	Maidenhair fern	Herbaceous, Fern	n	b
Aesculus pavia	Red buckeye	Woody, Shrub	n	bcd
Agave sp.	Agave	Woody, Shrub	E	d
Allium canadense	Wild onion	Herbaceous	n	aci
Allium sp. *(neapolitanum?, sativum?)*	Garlic	Herbaceous	E	c
Ambrosia psilostachya	Western ragweed	Herbaceous	n	g
Ampelopsis arborea	Peppervine	Woody, Vine	n	b
Andropogon glomeratus	Bushy bluestem	Grass	n	bgi
Anemone berlandieri (A. heterophylla)	Windflower	Herbaceous	n	ij
Arisaema dracontium	Green dragon	Herbaceous	n	c
Aristida oligantha	Oldfield threeawn	Grass	n	hi
Aristida purpurea	Purple threeawn	Herbaceous	n	fi
Aristolochia erecta	Swan flower	Herbaceous	n	i
Arnoglossum (Cacalia) plantagineum	Indian plantain	Herbaceous	n	b
Asclepias asperula	Spider antelope horns	Herbaceous	n	i
Asclepias oenotheroides	Hierba de zizotes	Herbaceous	n	I
Aster drummondii var. *texanus*	Texas aster	Herbaceous	n	
Baccharis neglecta	False willow	Woody, Shrub	n	ij
Bacopa monnieri	Coastal water-hyssop	Herbaceous	n	b
Bothriochloa ischaemum	King Ranch bluestem	Grass	E	cdghij
Bothriochloa laguroides	Silver bluestem	Grass	n	efgihi
Bouteloua curtipendula	Sideoats grama	Grass	n	hi
Bouteloua hirsuta	Hairy grama	Grass	n	gi
Bouteloua rigidiseta	Texas grama	Grass	n	dj
Bromus catharticus	Rescue grass	Grass	E	f
Bromus japonicus	Japanese brome	Grass	E	aj

KEY:
* E = Exotic species. n = Native species
Zones: a=Swimming area, b=Riparian braided channel area, c= Cypress Creek Nature Preserve, d= Uplands NW of drainage, e= Regenerative area W of drainfields, f= Drainfields, g=Intermittent drainage, h=Woodlands E of drainage; i=Savanna near RM 3237.

Name	**Common Name**	**Growth Habit**	*	**Zone**
Callicarpa americana	American beautyberry	Woody, Shrub	E	bg
Calyptocarpus vialis	Straggler daisy, Horseherb	Herbaceous	n	a
Carduus nutans?	Thistle	Herbaceous	n	f
Carex planostachys	Cedar sedge	Herbaceous, Gramminoid	n	
Carex sp.	Wood-sedge	Herbaceous, Gramminoid	n	
Carya illinoinensis	Pecan	Woody, Tree	n	d
Celtis laevigata	Sugar hackberry	Woody, Tree	n	d
Centaurium beyrichii	Mountain pink	Herbaceous	n	i
Cephalanthus occidentalis	Buttonbush	Woody, Shrub	n	b
Cercis canadensis var. *texensis*	Texas redbud	Woody, Tree	n	g
Chamaesyce sp.	Spurge	Herbaceous	n	
Chasmanthium latifolium	Inland sea oats	Grass	n	ab
Cheilanthes alabamensis	Alabama lipfern	Herbaceous, Fern	n	g
Cirsium texanum	Texas thistle	Herbaceous	n	ai
Cladium mariscus ssp. *jamaicense*	Jamaica sawgrass	Herbaceous, Gramminoid	n	b
Clematis drummondii ?	Old man's beard ?	Herbaceous, Vine	n	b
Cnidoscolus texanus	Texas bull-nettle	Herbaceous	n	f
Cocculus carolinus	Carolina snailseed	Woody, Vine	n	j
Colocasia esculenta	Elephant-ears	Herbaceous	E	b
Commelina erecta	Dayflower	Herbaceous	n	dg
Convolvulus equitans	Bindweed	Herbaceous	n	I
Cooperia pedunculata	Rain lily	Herbaceous	n	ci
Cornus drummondii	Roughleaf dogwood	Woody, Shrub	n	ab
Croton fruticulosus	Bush croton	Woody, Shrub	n	dg
Croton monanthogynus	Prairie-tea	Herbaceous	n	hi
Cynodon dactylon	Bermudagrass	Grass	E	f
Dasylirion texanum	Texas sotol	Woody	n	gi
Desmanthus virgatus	Wand bundleflower	Herbaceous	n	i

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Name	**Common Name**	**Growth Habit**	*	**Zone**
Dichanthelium sp.	Rosettegrass	Grass	n	b
Dichondra sp.	Ponyfoot	Herbaceous	?	a
Diospyros texana	Texas persimmon	Woody, Tree	n	dgij
Elymus virginicus var. *virginicus*	Virginia wild-rye	Grass	n	c
Epipactis gigantea	Chatterbox orchid	Herbaceous	n	bc
Eragrostis curtipedicillata?	Gummy lovegrass ?	Grass	n	j
Eragrostis intermedia	Plains lovegrass	Grass	n	di
Erigeron sp.	Fleabane	Herbaceous	n	ah
Erigeron strigosus	Prairie fleabane	Herbaceous	n	hi
Erioneuron pilosum	Hairy tridens	Grass	n	i
Erodium texanum	Stork's bill geranium	Herbaceous	n	i
Eupatorium (Ageratum) havanense	Shrubby boneset	Woody, Shrub	n	ab
Eupatorium serotinum	White boneset	Herbaceous	n	bc
Euphorbia marginata	Snow-on-the-mountain	Herbaceous	n	dghi
Evax prolifera	Rabbit tobacco	Herbaceous	n	gi
Forestiera pubescens	Elbowbush	Woody, Shrub	n	cd
Frangula caroliniana	Carolina buckthorn	Woody, Shrub	n	g
Fraxinus texensis	Texas ash	Woody, Tree	n	b
Gaillardia pulchella	Indian blanket	Herbaceous	n	
Galium aparine	Catchweed bedstraw, Cleavers	Herbaceous	E	ac
Galphimia angustifolia	Narrow-leaf goldshower, Thryallis	Herbaceous	n	h
Garrya ovata ssp. *lindheimeri*	Lindheimer silktassel	Woody	n	adg
Geranium carolinianum	Wild geranium	Herbaceous	n	a
Gilia incisa	Cut-leaf gilia	Herbaceous	n	dh
Glandularia (*Verbena*) *bipinnatifida*	Prairie verbena	Herbaceous	n	fh
Gnaphalium?		Herbaceous	n	bd
Hedeoma drummondii	Limmoncillo, Drummond's false pennywort	Herbaceous	n	ghi

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Name	**Common Name**	**Growth Habit**	*	**Zone**
Hedera helix	English ivy	Woody, Vine	E	b
Helenium elegans	Creek bitterweed	Herbaceous	n	
Heliotropium tenellum	White heliotrope	Herbaceous	n	hi
Hexalectris sp.	Crested-coral root orchid	Herbaceous	n	d
Hydrocotyle sp.	Pennywort	Herbaceous	?	b
Ilex decidua	Possumhaw	Woody, Shrub	n	b
Ilex vomitoria	Yaupon holly	Woody, Shrub	n	ab
Indigofera miniata	Scarlet pea	Herbaceous	n	
Juglans major (?)	Arizona walnut (?)	Woody, Tree	n	abc
Juglans microcarpa	Little walnut, Nogalito	Woody, Tree	n	g
Juniperus ashei	Ashe juniper	Woody, Tree	n	abdeghij
Justicia americana	American water-willow	Herbaceous	n	b
Liatris mucronata	Gayfeather	Herbaceous	n	d
Ligustrum japonica	Japanese ligustrum	Woody, Tree	E	b
Ligustrum sinense	Chinese ligustrum	Woody, Tree	E	b
Limnophila sessiliflora	Asian marshweed	Herbaceous, aquatic	E	ab
Lindera benzoin	Spice bush	Woody, Shrub	n	abc
Linum sp.	Flax	Herbaceous	n	
Lippia (Phyla) sp.	Frogfruit	Herbaceous	n	a
Lolium perenne	Rye grass	Grass	E	ab
Lonicera japonica	Japanese honeysuckle	Woody, Vine	E	abc
Ludwigia sp.		Herbaceous, aquatic	?	b
Lupinus texensis	Bluebonnet	Herbaceous	n	i
Mahonia (Berberis) swaseyi	Texas barberry	Woody, Shrub	n	dg
Mahonia (Berberis) trifoliolata	Agarita	Woody, Shrub	n	cg
Malvaviscus arboreus	Turk's cap	Herbaceous	n	cj
Marshallia caespitosa	Barbara's buttons	Herbaceous	n	I
Matelea reticulata	Milkvine	Herbaceous	n	d
Medicago sp.	Medic, Burrclover	Herbaceous	E	fj
Melampodium leucanthum	Blackfoot daisy	Herbaceous	n	i
Melia azedarach	Chinaberry	Woody, Tree	E	i

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Name	**Common Name**	**Growth Habit**	*	**Zone**
Mimosa borealis ?	Pink mimosa ?	Woody, Shrub	n	
Mirabilis jalapa	Four-o'clock	Herbaceous	E	c
Monarda citriodora	Horsemint	Herbaceous	n	j
Morus rubra	Red mulberry	Woody, Tree	n	bcdg
Muhlenbergia lindheimeri	Lindheimer muhly	Grass	n	gi
Muhlenbergia reverchonii	Seep muhly	Grass	n	i
Nandina domestica	Nandina, Heavenly bamboo	Woody, Shrub	E	cdghij
Nassella leucotricha	Texas speargrass, Wintergrass	Grass	n	fi
Nemophila phacelioides	Baby blue-eyes	Herbaceous	n	c
Nolina sp.		Woody, Shrub	n	g
Onosmodium bejariense	Bexar marbleseed	Herbaceous	n	bg
Oplismenus hirtellus	Basketgrass	Grass	E	b
Opuntia engelmannii var. *lindheimeri*	Texas prickly-pear, Lindheimer's prickly-pear	Woody, Shrub	n	dgj
Opuntia macrorhiza	Plains prickly pear	Woody, Shrub	n	dfi
Oxalis dillenii	Yellow wood sorrel	Herbaceous	n	i
Oxalis drummondii	Drummond's wood-sorrel	Herbaceous	n	i
Packera obovata (Senecio obovatus)	Golden groundsel	Herbaceous	n	abd
Panicum sp.	Panicgrass	Grass	n	i
Panicum virgatum	Switchgrass	Herbaceous	n	g
Parietaria pensylvanica	Pennsylvania pellitory	Herbaceous	n	a
Parthenocissus heptaphylla	Seven-leaf creeper	Woody, Vine	n	d
Parthenocissus quinquefolia	Virginia creeper	Woody, Vine	n	ac
Paspalum setaceum	Thin paspalum	Grass	n	
Passiflora sp.	Passionflower	Herbaceous, Vine	n	g
Phoradendron tomentosum	Hairy mistletoe	Woody	n	dgi
Photinia serratifolia	Chinese photinia	Woody, Tree	E	g
Phyllanthus polygonoides	Knot-weed leaf-flower	Herbaceous	n	I
Physalis cinerascens	Ground-cherry	Herbaceous	n	i

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Name	**Common Name**	**Growth Habit**	*	**Zone**
Plantago helleri	Cedar plantain	Herbaceous	n	I
Plantago rhodosperma	Red-seeded plantain	Herbaceous	n	
Platanus occidentalis	American sycamore	Woody, Tree	n	bd
Polygala lindheimeri	Purple milkwort	Herbaceous	n	i
Prosopis glandulosa	Honey mesquite	Woody, Tree	n	ij
Quercus buckleyi	Texas oak	Woody, Tree	n	dg
Quercus fusiformis	Plateau live oak	Woody, Tree	n	bdghi
Quercus sinuata var. *breviloba*	White shin oak	Woody, Tree	n	g
Quercus sinuata var. *sinuata*	Durand's white oak, Bluff oak	Woody, Tree	n	d
Ratibida columnifera	Mexican hat	Herbaceous	n	afj
Rhus lanceolata	Flame-leaf sumac	Woody, Shrub	n	dg
Rhynchosia minima	Least snout-bean	Herbaceous	n	
Rhynchosia senna var. *texana*	Texas snout bean	Herbaceous	n	d
Rhynchospora (Dichromena) colorata	White topped sedge, Star sedge	Herbaceous, Graminoid	n	b
Rubus trivialis	Southern dewberry	Woody, Shrub	n	b
Ruellia nudiflora	Wild petunia	Herbaceous	n	g
Sabal mexicana ?	Texas palmetto ?	Woody, Shrub	n	I
Salvia farinacea	Mealy blue sage	Herbaceous	n	i
Salvia lyrata	Lyre-leaf sage	Herbaceous	n	ab
Salvia roemeriana	Cedar sage	Herbaceous	n	abg
Sambucus nigra ssp. *canadensis*	Elderberry	Woody, Shrub	n	a
Sapindus saponaria var. *drummondii*	Soapberry	Tree	n	d
Sapium sebiferum	Chinese tallow	Woody, Tree	E	d
Schizachyrium scoparium	Little bluestem	Grass	n	bdefghij
Senna roemeriana	Two-leaved senna	Herbaceous	n	h
Sida abutifolia	Sida	Herbaceous	n	i
Sideroxylon (Bumelia) lanuginosum ssp. *oblongifolium*	Coma	Woody, Tree	n	j
Smilax bona-nox	Saw greenbriar	Woody, Vine	n	abd

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Name	**Common Name**	**Growth Habit**	*	**Zone**
Smilax tamnoides (S. hispida)	Black-bristle greenbriar	Woody, Vine	n	c
Solanum dimidiatum	Western horse-nettle	Herbaceous	n	i
Solanum eleagnifolioum	Silver leaf nightshade	Herbaceous	n	f
Solanum rostratum	Buffalo bur	Herbaceous	n	cf
Solidago sp.	Goldenrod	Herbaceous	n	j
Sonchus sp.	Sow-thistle	Herbaceous	E	ab
Sophora affinis	Eve's necklace	Woody, Shrub	n	dg
Sorghum halepense	Johnsongrass	Grass	E	bdfij
Sporobolus compositus var. *drummondii (S. asper* var. *asper)*	Drummonds dropseed	Grass	n	
Sporobolus vaginiflorus	Poverty dropseed	Grass	n	I
Stenotaphrum secundatum	St. Augustine grass	Grass	E	a
Stillingia texana	Queen's delight	Herbaceous	n	I
Symphyotrichum drummondii var. *texanum*	Drummond's aster	Herbaceous	n	
Taxodium distichum	Bald cypress	Woody, Tree	n	abc
Tetragonotheca texana	Nerve ray	Herbaceous	n	
Tetraneuris linearifolia var. *linearifolia*	Slender-leaf bitterweed	Herbaceous	n	i
Tetraneuris scaposa	Four-nerve daisy	Herbaceous	n	i
Thamnosma texana	Dutchman's breeches	Herbaceous	n	i
Thelypteris kunthii	Southern shield fern	Herbaceous	n	b
Tinantia anomala	False day-flower	Herbaceous, Forb	n	
Toxicodendron radicans	Poison ivy	Woody, Shrub	n	ab
Tragia sp.	Noseburn	Herbaceous	n	I
Tridens flavus	Purple top	Herbaceous, Grass	n	i
Ulmus americana	American elm	Woody, Tree	n	b
Ulmus crassifolia	Cedar elm	Woody, Tree	n	abdgi
Ungnadia speciosa	Mexican buckeye	Woody, Shrub	n	a
Verbena canescens	Gray vervain	Herbaceous	n	
Verbena halei	Texas vervain	Herbaceous	n	j

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Name	**Common Name**	**Growth Habit**	*	**Zone**
Verbesina virginica	Frostweed	Herbaceous	n	abd
Vernonia lindheimeri	Woolly ironweed	Herbaceous	n	i
Vicia ludovicianus	Deerpea vetch	Herbaceous	n	f
Vitis mustangensis	Mustang grape	Woody, Vine	n	b
Vitis sp.	Grape	Woody, Vine	n	j
Wedelia texana	Zexmenia	Herbaceous, Forb	n	hi
Wisteria sinense	Chinese wisteria	Woody, Vine	E	b
Yucca rupicola	Twisted-leaf yucca	Woody, shrub	n	dgi
Zigadenus nuttallii	Death camas	Herbaceous	n	c

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TABLE II
Nomenclature of Species Referred to in Report

Common name	Botanical name	*
Plants and Fungi		
Agarita	*Mahonia (Berberis) trifoliolata*	n
American beautyberry	*Callicarpa americana*	n
American elm	*Ulmus americana*	n
American sycamore	*Platanus occidentalis*	n
Andropogon glomeratus	*Bushy bluestem*	n
Arizona walnut	*Juglans major*	n
Ashe juniper	*Juniperus ashei*	n
Asian marshweed	*Limnophila sessiliflora*	E
Bald cypress	*Taxodium distichum*	n
Bermudagrass	*Cynodon dactylon*	E
Bexar marbleseed	*Onosmodium bejariense*	n
Big bluestem	*Andropogon gerardii*	n
Black cherry	*Prunus serotina* var. *eximia*	n
Box elder	*Acer negundo*	n
Broomweed	*Amphiachyris dracunculoides (Xanthocephalum dranunculoides)*	n
Buffalo bur	*Solanum rostratum*	n
Bush croton	*Croton fruticulosus*	n
Catchweed bedstraw, Cleavers	*Galium aparine*	E
Cedar elm	*Ulmus crassifolia*	n
Cedar sedge	*Carex planostachys*	n
Chatterbox orchid	*Epipactis gigantea*	n
Chinaberry	*Melia azedarach*	E
Chinese ligustrum	*Ligustrum sinense*	E
Chinese photinia	*Photinia serratifolia*	E
Chinese tallow	*Sapium sebiferum*	E
Cladium mariscus ssp. jamaicense	*Jamaica sawgrass*	n
Coma	*Sideroxylon (Bumelia) lanuginosum* ssp. *oblongifolium*	n
Cottonwood	*Populus* sp., presumably *Populus deltoides*	n
Death camas	*Zigadenus nuttallii*	n
Deerpea vetch	*Vicia ludovicianus*	n
Drummonds dropseed	*Sporobolus compositus* var. *drummondii (S. asper* var. *asper)*	n
Durand's white oak, Bluff oak	*Quercus sinuata* var. *sinuata*	n
Eastern gamagrass	*Tripsacum dactyloides*	n
Elbowbush	*Forestiera pubescens*	n

KEY:
* E = Exotic species. n = Native species

Common name	Botanical name	*
Elderberry	*Sambucus nigra* ssp. *canadensis*	n
Elm	*Ulmus* sp.	n
English ivy	*Hedera helix*	E
Flame-leaf sumac	*Rhus lanceolata*	n
Fleabane	*Erigeron* sp.	n
Four-nerve daisy	*Tetraneuris scaposa*	n
Frogfruit	*Lippia (Phyla)* sp.	n
Frostweed	*Verbesina virginica*	n
Gamagrass (Eastern gamagrass)	*Tripsacum dactyloides*	n
Golden groundsel	*Packera obovata (Senecio obovatus)*	n
Green dragon	*Arisaema dracontium*	n
Hairy grama	*Bouteloua hirsuta*	n
Honey mesquite	*Prosopis glandulosa*	n
Indian grass	*Sorghastrum nutans*	n
Indian plantain	*Arnoglossum (Cacalia) plantagineum*	n
Inland sea oats	*Chasmanthium latifolium*	n
Japanese brome	*Bromus japonicus*	E
Japanese honeysuckle	*Lonicera japonica*	E
Japanese ligustrum	*Ligustrum japonica*	E
Johnsongrass	*Sorghum halepense*	E
Juniper	*Juniperus ashei*	n
Kidneywood	*Eysenhardtia texana*	n
King Ranch bluestem	*Bothriochloa ischaemum*	E
Lindheimer muhly	*Muhlenbergia lindheimeri*	n
Lindheimer silktassel	*Garrya ovata* ssp. *lindheimeri*	n
Little bluestem	*Schizachyrium scoparium*	n
Little walnut, Nogalito	*Juglans microcarpa*	n
Live oak (Plateau live oak)	*Quercus fusiformis*	n
Lyre-leaf sage	*Salvia lyrata*	n
Maidenhair fern	*Adiantum capillus-veneris*	n
Medic, Burrclover	*Medicago* sp.	E
Mexican hat	*Ratibida columnifera*	n
Muhly	*Muhlenbergia* sp.	n
Musk-thistle	*Carduus nutans*	E
Mustang grape	*Vitis mustangensis*	n
Nandina, Heavenly bamboo	*Nandina domestica*	E
Nostoc algae	*Nostoc* sp.	n
Oak	*Quercus* sp.	n

KEY:
* E = Exotic species. n = Native species

Common name	Botanical name	*
Oak wilt (a fungus)	*Ceratocystis fagacearum.*	n
Oldfield threeawn	*Aristida oligantha*	n
Prickly pear	*Opuntia* sp.	n
Pecan	*Carya illinoinensis*	n
Pennsylvania pellitory	*Parietaria pensylvanica*	n
Pennywort	*Hydrocotyle* sp.	?
Persimmon	*Diospyros texana*	n
Plains lovegrass	*Eragrostis intermedia*	n
Plains prickly pear	*Opuntia macrorhiza*	n
Plateau live oak	*Quercus fusiformis*	n
Ponyfoot	*Dichondra* sp.	n
Possumhaw	*Ilex decidua*	n
Prairie verbena	*Glandularia (Verbena) bipinnatifida*	n
Purple threeawn	*Aristida purpurea*	n
Purple top	*Tridens flavus*	n
Red buckeye	*Aesculus pavia*	n
Red-seeded plantain	*Plantago rhodosperma*	n
Rescuegrass	*Bromus catharticus*	E
Rosettegrass	*Dichanthelium* sp.	n
Roughleaf dogwood	*Cornus drummondii*	n
Salvia roemeriana	*Cedar sage*	n
Saw greenbriar	*Smilax bona-nox*	n
Sedge (Caric sedge)	*Carex* sp.	n
Sedge (Flat sedge)	*Cyperus* sp.	n
Sideoats grama	*Bouteloua curtipendula*	n
Silver bluestem	*Bothriochloa laguroides*	n
Silver bluestem	*Bothriochloa laguroides*	n
Silver leaf nightshade	*Solanum eleagnifolioum*	n
Southern shield fern	*Thelypteris kunthii*	n
Spice bush	*Lindera benzoin*	n
St. Augustine grass	*Stenotaphrum secundatum*	E
Stork's bill geranium	*Erodium texanum*	n
Straggler daisy, Horseherb	*Calyptocarpus vialis*	n
Sugar hackberry	*Celtis laevigata*	n
Sweet-potato	*Ipomoea batata*	E
Switchgrass	*Panicum virgatum*	n
Sycamore	*Platanus* sp., presumably *Platanus occidentalis*	n
Texas ash	*Fraxinus texensis*	n

KEY:
* E = Exotic species. n = Native species

Common name	Botanical name	*
Texas barberry	*Mahonia (Berberis) swaseyi*	n
Texas bull-nettle	*Cnidoscolus texanus*	n
Texas oak	*Quercus buckleyi*	n
Texas persimmon	*Diospyros texana*	n
Texas sotol	*Dasylirion texanum*	n
Texas thistle	*Cirsium texanum*	n
Texas wintergrass	*Nassella leucotricha*	n
Threeawn	*Aristida* sp.	n
Twisted-leaf yucca	*Yucca rupicola*	n
Virginia creeper	*Parthenocissus quinquefolia*	n
Virginia wild-rye	*Elymus virginicus* var. *virginicus*	n
Wild onion	*Allium canadense*	n
Yaupon holly	*Ilex vomitoria*	n
Zexmenia	*Wedelia texana*	n

Animals		
Grass carp	*Ctenopharyngodon idella*	E
Golden-cheeked warbler (GCW)	*Dendroica chrysoparia*	n
Deer, White-tailed deer	*Odocoileus virginianus*	n
Black-capped vireo (BCV)	*Vireo atricapillus*	n

KEY:
* E = Exotic species. n = Native species

TABLE III
Grass species to add at Blue Hole

Name*	Species*	Recommended Habitats**	Availability
Big Bluestem	*Andropogon gerardii*	tg	dlwy
Silver bluestem	*Bothriochloa laguroides*	g s	don
Sideoats grama	*Bouteloua curtipendula*	g s tg	dowy
Inland sea oats	*Chasmanthium latifolium*	w	dnow
Texas cupgrass	*Eriochloa sericea*	g s tg	dn
Green sprangletop	*Leptochloa dubia*	g s tg	dy
Lindheimer muhly	*Muhlenbergia lindheimeri*	g s	ow
Switchgrass	*Panicum virgatum*	g s tg	dlowy
Texas bluegrass	*Poa arachnifera*	wm	lw
Yellow Indian grass	*Sorghastrum nutans*	g s tg	dlwy
Eastern gamagrass	*Tripsacum dactyloides*	tg	dlwy

Some species included here may be commercially available by seed in limited numbers, but price and availability may prevent them from being commonly used in mass seedings. These species may be appropriate for limited plantings by hand collected seed from wild populations, or purchased in limited quantities. Potted specimens may be available from specialty nurseries.

**HABITAT KEY:
**g = grassland, s = savana, tg = tallgrass, w = woodland, wm - woodland margins

*** AVAILABILITY KEY:
o-indicates a species that has been observed growing onsite, and could be used as a source of seeds for propagation.
d- Available from Native American Seed as a D-pak @$29.
l- Available from Native American Seed as live roots @$15.
n- Available from Native American Seed in varied amounts. Higher priced than many of their species.
w-Often available as potted specimen at plant sales at the Wildflower Center.
y- Widely available as seed, at reasonable prices

KEY:
b= Bluffs and slopes, d= Deep upland clay loam (Oldfield mapped as Sunev clay loam), r= Riparian, flood plain, s= savanna on thin Brackett soils, w= Juniper/oak woodlands.

TABLE IV
Woody Species and Vines to add at Blue Hole

Name	Common Name	Growth Habit	Habitats for introduction
Acacia farnesiana (A. smallii, A. minuata)	Huisache	Tree	d
Acer negundo	Box elder	Tree	r
Aesculus pavia	Red buckeye	Shrub	bdw
Amorpha fruticosa	False indigo	Shrub	r
Callicarpa americana	American beautyberry	Shrub	dr
Capsicum annuum var. *glabriusculum*	Chile piquin	Shrub	dw
Carya illinoinensis	Pecan	Tree	dr
Celtis laevigata	Sugar hackberry	Tree	bdrsw
Cephalanthus occidentalis	Buttonbush	Shrub	r
Cercis canadensis var. *texensis*	Texas redbud	Tree	bdsw
Condalia hookeri	Brazilwood	Tree	bsw
Cornus drummondii	Roughleaf dogwood	Shrub	r
Crataegus spp.	Hawthorn	Tree	dr
Diospyros texana	Texas persimmon	Tree	bsw
Ehretia anacua	Sugarberry anacua	Tree	bd
Eupatorium (Ageratum) havanense	Shrubby boneset	Shrub	b
Eysenhardtia texana	Texas kidneywood	Tree	bsw
Forestiera pubescens	Elbowbush	Shrub	sw
Frangula caroliniana	Carolina buckthorn	Shrub	dr
Fraxinus pennsylvanica	Green ash	Tree	r
Fraxinus texensis	Texas ash	Tree	bsw
Ilex decidua	Possumhaw	Shrub	dr
Ilex vomitoria	Yaupon holly	Shrub	dr
Juglans major	Arizona walnut	Tree	dr
Juglans microcarpa	Little walnut, Nogalito	Tree	b
Lantana urticoides (L. horrida)	Texas lantana	Shrub	ds
Lindera benzoin	Spice bush	Shrub	r
Maclura pomifera	Osage orange, Bois d'arc	Tree	dr
Mahonia (Berberis) swaseyi	Texas barberry	Shrub	bdsw
Mahonia (Berberis) trifoliolata	Agarita	Shrub	bdsw
Malus ioensis var. *texana*	Blanco crabapple	Tree	dr
Malvaviscus arboreus var. *drummondii*	Turk's cap	Shrub	bdrw
Mimosa borealis	Pink mimosa	Shrub	s
Morus microphylla	Texas mulberry	Tree	br
Morus rubra	Red mulberry	Tree	dr
Nolina lindheimeriana	Devil's-shoestring, Lindheimer's nolina	Shrub	bs

KEY:
b= Bluffs and slopes, d= Deep upland clay loam (Oldfield mapped as Sunev clay loam), r= Riparian, flood plain, s= savanna on thin Brackett soils, w= Juniper/oak woodlands.

Name	Common Name	Growth Habit	Habitats for introduction
Nolina texana	Sacahuista, Bunch-grass	Shrub	bs
Pavonia lasiopetala	Rose mallow, Rock rose	Shrub	bw
Platanus occidentalis	American sycamore	Tree	r
Populus deltoides	Eastern cottonwood	Tree	r
Prosopis glandulosa	Honey mesquite	Tree	d
Prunus mexicana	Mexican plum	Tree	bdsw
Prunus serotina var. *eximia*	Escarpment black cherry	Tree	bdrw
Ptelea trifoliata	Hop tree	Shrub	brw
Quercus buckleyi	Texas oak	Tree	bw
Quercus fusiformis	Plateau live oak	Tree	bsw
Quercus macrocarpa	Bur oak	Tree	d
Quercus marilandica	Blackjack oak	Tree	dw
Quercus muehlenbergii	Chinqapin oak	Tree	r
Quercus sinuata var. *breviloba*	White shin oak	Tree	bs
Quercus sinuata var. *sinuata*	Durand's white oak, Bluff oak	Tree	bw
Quercus stellata	Post oak	Tree	dw
Rhus aromatica (Rhus trilobata var. *trilobata)*	Fragrant sumac	Shrub	bsw
Rhus lanceolata	Flame-leaf sumac	Shrub	dsw
Rhus virens	Evergreen sumac	Shrub	bsw
Rubus trivialis	Southern dewberry	Shrub	ds
Sabal mexicana	Texas palmetto	Tree	r
Sabal minor	Dwarf palmetto	Shrub	r
Salix nigra	Black willow	Tree	r
Sambucus nigra ssp. *canadensis*	Elderberry	Shrub	r
Sapindus saponaria var. drummondii (S. drummondii)	Soapberry	Tree	dw
Sideroxylon (Bumelia) lanuginosum ssp. *oblongifolium*	Gum bumelia, Coma,	Tree	bdsw
Sophora affinis	Eve's necklace	Shrub	bdw
Sophora secundiflora	Texas mountain laurel	Tree	bw
Styrax platanifolius	Sycamore-leaf snowbell	Shrub	b
Taxodium distichum	Bald cypress	Tree	r
Tilia americana var. *caroliniana*	Carolina basswood	Tree	r
Ulmus americana	American elm	Tree	dr
Ulmus crassifolia	Cedar elm	Tree	bdrsw
Ungnadia speciosa	Mexican buckeye	Shrub	b
Viburnum rufidulum	Southern black-haw, Rusty black-haw	Tree	bdrw
Vitis mustangensis	Mustang grape	Vine	
Vitis sp	Grape	Vine	
Yucca rupicola	Twisted-leaf yucca	Shrub	bsw
Zanthoxylum hirsutum	Toothache tree	Tree	sw
Zizyphus (Condalia) obtusifolia	Lotebush	Shrub	s

KEY:
b= Bluffs and slopes, d= Deep upland clay loam (Oldfield mapped as Sunev clay loam), r= Riparian, flood plain, s= savanna on thin Brackett soils, w= Juniper/oak woodlands.

TABLE V
Forb Species Suitable for Increase

Name*	Species*	Recommended Habitats**	***
Prairie paintbrush	*Castilleja purpurea*	g s	c
Scarlet leatherflower	*Clematis texana*	wm	
Black dalea	*Dalea frutescens*	g s	rw
Round-headed clover	*Dalea multiflora*	g s	orw
Narrow leaf coneflower	*Echinacea angustifolia*	g s	nw
Cutleaf (Engelmann) Daisy	*Engelmannia peristenia*	g s	wy
Eryngo	*Eryngium leavenworthii*	g s	cw
Bluebell	*Eustoma grandiflorum(E.exaltatum* ssp. *russellianum)*	g s	dnw
Prairie verbena	*Glandularia (Verbena) bipinnatifida*	g s	now
Annual sunflower	*Helianthus annuus*	g s	y
Maximilian sunflower	*Helianthus maximiliani*	g s	lorwy
Standing cypress	*Ipomopsis rubra*	g s	wy
Gayfeather	*Liatris mucronata*	g s	owy
Texas yellow star	*Lindheimera texana*	g s	wy
Skeleton-plant	*Lygodesmia texana*	g s	cw
Turk's cap	*Malvaviscus arboreus*	w	cdorw
Blackfoot daisy	*Melampodium leucanthum*	g s	orw
Foxglove	*Penstemon cobaea*	g s	nw
Pigeonberry	*Rivina humilis*	w	dnw
Pitcher sage	*Salvia azurea*	*tg*	wy
Engelmann's sage	*Salvia engelmannii*	g s	cw
Two-leaved senna	*Senna (Cassia) roemeriana*	g s	cw
Lindheimer's (Velvetleaf) senna	*Senna (Casssia) lindheimeriana*	g s	cow
Bush sunflower	*Simsia calva*	g s	lwy
Plateau goldeneye	*Viguiera dentata*	wm	cw

*Some species included here may be commercially available by seed in limited numbers, but price and availability may prevent them from being commonly used in mass seedings. They may be appropriate for limited plantings by hand-collected seed from wild populations, or purchased in limited quantities. Potted specimens may be available from specialty nurseries.

KEY TO HABITATS **
g = grassland, s = savana, tg = tallgrass, w = woodland, wm - woodland margins

KEY TO SOURCE FOR SEED ***
o indicates a species that has been observed growing onsite, and could be used as a source of seeds for propagation.
c- Available from Native American Seed as a conservation pack @$4.95.
d- Available from Native American Seed as a D-pak @$29.
l- Available from Native American Seed as live roots @$15.
n- Available from Native American Seed in varied amounts. Higher priced than many of their species.
r- Often available as a potted specimen at some retail nurseries.
w-Often available as potted specimen at plant sales at the Wildflower Center.
y- Widely available as seed, at reasonable prices

TABLE VI
Bioswale Restoration Species

Scientific Name	Common Name	Availability
Grasses		
Andropogon gerardii	Big bluestem	dflswy
Andropogon glomeratus	Bushy bluestem	Gnw
Elymus canadensis	Canada wild rye, Prairie wildrye.	Flsy
Leptochloa dubia	Green sprangletop	Dfsy
Muhlenbergia schreberi	Nimblewill	X
Panicum virgatum	Switchgrass	flswy
Sorghastrum nutans	Yellow Indian grass	dlwy
Tripsacum dactyloides	Eastern gamagrass	dfglswy
Muhlenbergia lindheimeri	Lindheimer muhly	W
Forbs		
Coreopsis tinctoria	Golden-wave	Fwy
Desmanthus illinoensis	Bundleflower	Fwy
Dracopis amplexicaulis	Clasping coneflower	Fy
Engelmannia peristenia	Englemann's daisy	Fwy
Eustoma exaltatum ssp. *russellianum, (Eustoma grandiflorum)*	Texas bluebell	cdnw
Helianthus maximiliani	Maximilian sunflower	Flwy
Oenothera speciosa	Pink evening primrose	Fwy
Physostegia intermedia	Marsh obedient-plant	Flwy
Rudbeckia hirta	Black-eyed Susan	Fwy
Salvia azurea	Pitcher sage, Giant blue sage	Fwy
Salvia coccinea	Tropical sage	Fwy

KEY TO AVAILABILITY

c- Available from Native American Seed as a conservation pack @$4.95.

d- Available from Native American Seed as a D-pak @$29.

f- Available from Native American Seed as a component of the Wetland Fringe seed mix..

g- Available from Native American Seed as a Grass D-pak @$8. Grass D-paks are estimated to yield approximately 200 square feet coverage.

l- Available from Native American Seed as live roots @$15.

n- Available from Native American Seed in varied amounts. Higher priced than many of their species.

r- Often available as a potted specimen at some retail nurseries.

s- Available from Native American Seed as a component of the Drainfield seed mix.

w-Often available as potted specimen at plant sales at the Wildflower Center.

x- Usually not commercially available.

y- Widely available as seed, at reasonable prices from suppliers such as Native American , Douglas King, Pogue, or Bamert seed companies.

TABLE VII
Riparian Restoration: Herbaceous Species

Name	Common Name	Habitats for introduction*	Means of Introduction**	Erosion Control Value***	Wildlife Value***
Andropogon glomeratus	Bushy bluestem	brw	dns		
Carex spp.	Sedges	bw		g	g
Chasmanthium latifolium	Inland sea oats	br	dns	e	g
Cladium mariscus ssp. *jamaicense*	Jamaica sawgrass	bw	dns	l	l
Eleocharis spp.	Spikerush	bw	dn	f	
Elymus virginicus	Virginia wild-rye	br	dns	g	g
Equisetum hyemale	Horsetail, Scouring rush	b	n		
Juncus spp.	Rush	bw	dn		
Justicia americana	American water-willow	bw	dn		
Lobelia cardinalis	Cardinal flower	bw	dn		
Muhlenbergia lindheimeri	Lindheimer muhly	r	n		
Panicum obtusum	Vine mesquite	br	ds	e	g
Panicum virgatum	Switchgrass	bw	dns	e	e
Polygonum spp.	Knotweed, Smartweed	bw	ds	e	g-e
Rhynchospora (Dichromena) colorata	White topped sedge, Star sedge	bw	dn		
Schizachyrium scoparium	Little bluestem	r	dns	e	g
Sesbania drummondii	Rattlebush	rw	s		
Sesbania herbacea (S. macrocarpa)	Coffee-bean, Colorado river hemp	br	s	e	e
Sorghastrum nutans	Yellow Indian grass	r	dns	e	e
Thelypteris ovata	Lindheimer shieldfern	b	n		
Tripsacum dactyloides	Eastern gamagrass	br	dns	g	g
Typha domingensis	Narrowleaf cat-tail	w	ns		

KEY TO HABITATS *
- b = Bank, watersedge, soil often saturated.
- r = Riparian, floodplain, bottomland habitat.
- w = Hydric, in shallow water or permanently saturated soil.

KEY TO MEANS OF INTRODUCTION **
- c = cuttings
- d = field dug, transplanted
- n = potted nursery stock
- s = seeds

KEY TO VALUES ***
Values from Texas Parks and Wildlife website: Texas Plant Information Database http://tpid.tpwd.state.tx.us/index.asp
f = fair g = good e = excellent

TABLE VIII
Riparian Restoration: Woody Species

Name	Common Name	Habitats for introduction*	Means of Introduction**	Growth Form***	Erosion Control Value****	Wildlife Value****
Acer negundo	Box elder	br	dn	t	e	g
Amorpha fruticosa	False indigo	br	dn	s	g	g
Cephalanthus occidentalis	Buttonbush	b	dn	s	g	g
Cornus drummondii	Roughleaf dogwood	br	dn	s	g	g
Fraxinus pennsylvanica	Green ash	br	dns	t	e	g
Ilex decidua	Possumhaw	br	dn	s	g	g
Ilex vomitoria	Yaupon holly	br	dn	s	e	e
Lindera benzoin	Spice bush	br	ns	s	g	g
Platanus occidentalis	American sycamore	m	ns	t	g	f
Populus deltoides	Eastern cottonwood	br	cdn	t	e	g
Salix nigra	Black willow	b	dcn	t	e	f
Sambucus nigra ssp. *canadensis*	Edlerberry	br	dcn	s	e	g
Taxodium distichum	Bald cypress	brw	ns	t	g	g

KEYS:
* HABITATS
b = Bank, watersedge, soil often saturated.
r = Riparian, floodplain, bottomland habitat.
w = Hydric, in shallow water or permanently saturated soil.

**MEANS OF INTRODUCTION
c=cuttings
d=field dug, transplanted
n=potted nursery stock
s = seeds

***GROWTH
s = Shrub
t = tree

**** VALUE RATINGS
Values from Texas Parks and Wildlife website: Texas Plant Information Database http://tpid.tpwd.state.tx.us/index.asp
f = fair g = good e = excellent

TABLE IX
Seed Mix for Wildflower Displays

Acres seeded: 1

Name	Species	Recommended seed rate for this area (lbs/acre)	Ideal % in Mix	Ideal lbs needed	Recommended purchase	Cost*	$ Cost/ lbs**
Forbs							
Huisache daisy	*Amblyolepis setigera*	8	6.28%	1.00	1.00	$24.00	$24.00
Annual winecup	*Callirhoe leiocarpa*	4	3.10%	0.25	0.25	$8.00	$19.00
Indian Paintbrush	*Castelleja indivisa*	0.25	12.50%	0.06	1 oz	$46.00	
American basketflower	*Centaurea americana*	10	5.00%	1.00	1.00	$29.00	29.00
Plains coreopsis	*Coreopsis tinctoria*	2	6.25%	0.25	0.25	$7.50	19.00
Cutleaf (Engelmann) daisy	*Engelmannia pinnatifida*	18	8.34%	3.00	3.00	$87.00	29.00
Indian blanket	*Gaillardia pulchella*	10	15.00%	3.00	3.00	$57.00	19.00
Standing cypress	*Ipomopsis rubra*	6	2.10%	0.25	0.25	$18.00	49.00
Gayfeather	*Liatris mucronata*	10	1.24%	0.25	0.25	$19.00	58.00
Texas bluebonnet	*Lupinus texensis*	20	15.00%	6.00	6.00	$77.70	12.95
Horsemint	*Monarda citriodora*	3	16.59%	1.00	1.00	$19.00	19.00
Black-eyed Susan	*Rudbeckia hirta*	2	6.20%	0.25	0.25	$9.00	24.00
Mealy blue sage	*Salvia farinacea*	6	2.10%	0.25	0.25	$30.00	89.00
Forb total			**99.70%**			**431.20**	

*Cost is calculated on purchasing partial pounds to reach this ratio for 1 acre. Increasing the acreage or the rate of application could result in a lower unit price for the higher volume.
**Cost is calculated from Native American Seed catalog.

TABLE X
Seed Mix for Savannas

Acres seeded: 1

Name	Species	Recommended seed rate for this area (lbs/acre)	Ideal % in Mix	Ideal lbs needed	Cost*	$ Cost/ lbs**
Forbs						
Huisache daisy	*Amblyolepis setigera*	8	6.28%	0.50	$24.00	$24.00
Annual winecup	*Callirhoe leiocarpa*	4	3.10%	0.12	$8.00	$19.00
Indian paintbrush	*Castelleja indivisa*	0.25	12.50%	0.03	$46.00	
American basketflower	*Centaurea americana*	10	5.00%	0.50	$29.00	29.00
Plains coreopsis	*Coreopsis tinctoria*	2	6.25%	0.13	$7.50	19.00
Cutleaf (Engelmann) daisy	*Engelmannia pinnatifida*	18	8.34%	1.50	$43.53	29.00
Indian blanket	*Gaillardia pulchella*	10	15.00%	1.50	$28.50	19.00
Standing cypress	*Ipomopsis rubra*	6	2.10%	0.13	$6.17	49.00
Gayfeather	*Liatris mucronata*	10	1.24%	0.12	$7.19	58.00
Texas bluebonnet	*Lupinus texensis*	20	15.00%	3.00	$38.85	12.95
Horsemint	*Monarda citriodora*	3	16.59%	0.50	$9.46	19.00
Black-eyed Susan	*Rudbeckia hirta*	2	6.20%	0.12	$2.98	24.00
Mealy blue sage	*Salvia farinacea*	6	2.10%	0.13	$11.21	89.00
Forb total			**100%**		**$262.40**	

Name	Species	Recommended seed rate for this area (lbs/acre)	Ideal % in Mix	Ideal lbs needed	Cost*	$ Cost/ lbs**
Grasses						
Big bluestem	*Andropogon gerardii*	8	12.50%	1.00	$13.25	13.25
Sideoats grama	*Bouteloua curtipendula*	7	3.50%	0.25	$2.76	11.25
Buffalograss	*Buchloe dactyloides*	24	4.15%	1.00	$12.90	12.95
Prairie (Canadian) wildrye	*Elymus canadensis*	10	15.00%	1.50	$23.93	15.95
Green sprangletop	*Leptochloa dubia*	2	12.50%	0.25	$3.31	13.25
Upland switchgrass	*Panicum virgatum*	4	6.30%	0.25	$3.52	13.95
Little bluestem	*Schizachyrium scoparium*	8	31.31%	2.50	$38.20	15.25
Waco Indiangrass	*Sorghastrum nutans*	6	16.59%	1.00	$14.18	14.25
Grass Total			**101.85%**		**$112.04**	
Total					**$374.44**	

*Cost is calculated on a per pound basis, however, grasses are typically sold in whole pounds.
**Cost is calculated from Native American Seed catalog.

TABLE XI

Seed Mix for Tallgrass Prairies

Acres seeded: 1

Name	Species	Recommended seed rate for this area	Ideal % in Mix	Ideal lbs needed	Cost*	$ Cost/ lbs**
Forbs		(lbs/acre)				
American basketflower	*Centaurea americana*	10	10.00%	0.00	29.00	29.00
Annual winecup	*Callirhoe leiocarpa*	4	25.00%	0.00	19.00	19.00
Black-eyed Susan	*Rudbeckia hirta*	2	12.50%	0.00	0.09	24.00
Cutleaf (Engelmann) daisy	*Engelmannia pinnatifida*	18	16.65%	0.00	87.00	29.00
Indian blanket	*Gaillardia pulchella*	10	10.00%	0.00	19.00	19.00
Maximillian sunflower	*Helianthus maximiliani*	4	6.20%	0.00	11.50	29.00
Pitcher sage	*Salvia azurea*	3	8.40%	0.00	18.00	49.00
plains coreopsis	*Coreopsis tinctoria*	2	12.50%	0.00	7.50	19.00
Standing cypress	*Ipomopsis rubra*	6	4.20%	0.00	18.00	49.00
Forb total			105.45%		$209.09	
Grasses						
Big bluestem	*Andropogon gerardii*	8	12.50%	0.00	0.00	13.25
Sideoats grama	*Bouteloua curtipendula*	7	3.60%	0.00	0.00	11.25
Prairie (Canadian) wildrye	*Elymus canadensis*	10	2.50%	0.00	0.00	15.95
Green sprangletop	*Leptochloa dubia*	2	25.00%	0.00	0.00	13.25
Upland switchgrass	*Panicum virgatum*	4	6.30%	0.00	0.00	10.35
Little bluestem	*Schizacyrium scoparium*	8	37.50%	0.00	0.00	15.25
Indiangrass	*Sorghastrum nutans*	6	16.73%	0.00	0.00	13.25
Eastern gamagrass	*Tripsacum dactyloides*	12	2.50%	0.00	0.00	13.95
Grass Total			106.63%		$0.00	
TOTAL					**$209.09**	

*Cost is calculated on a per pound basis, however, grasses are typically sold in whole pounds.
**Cost is calculated from Native American Seed catalog.

TABLE XII
Plant and Seed Suppliers

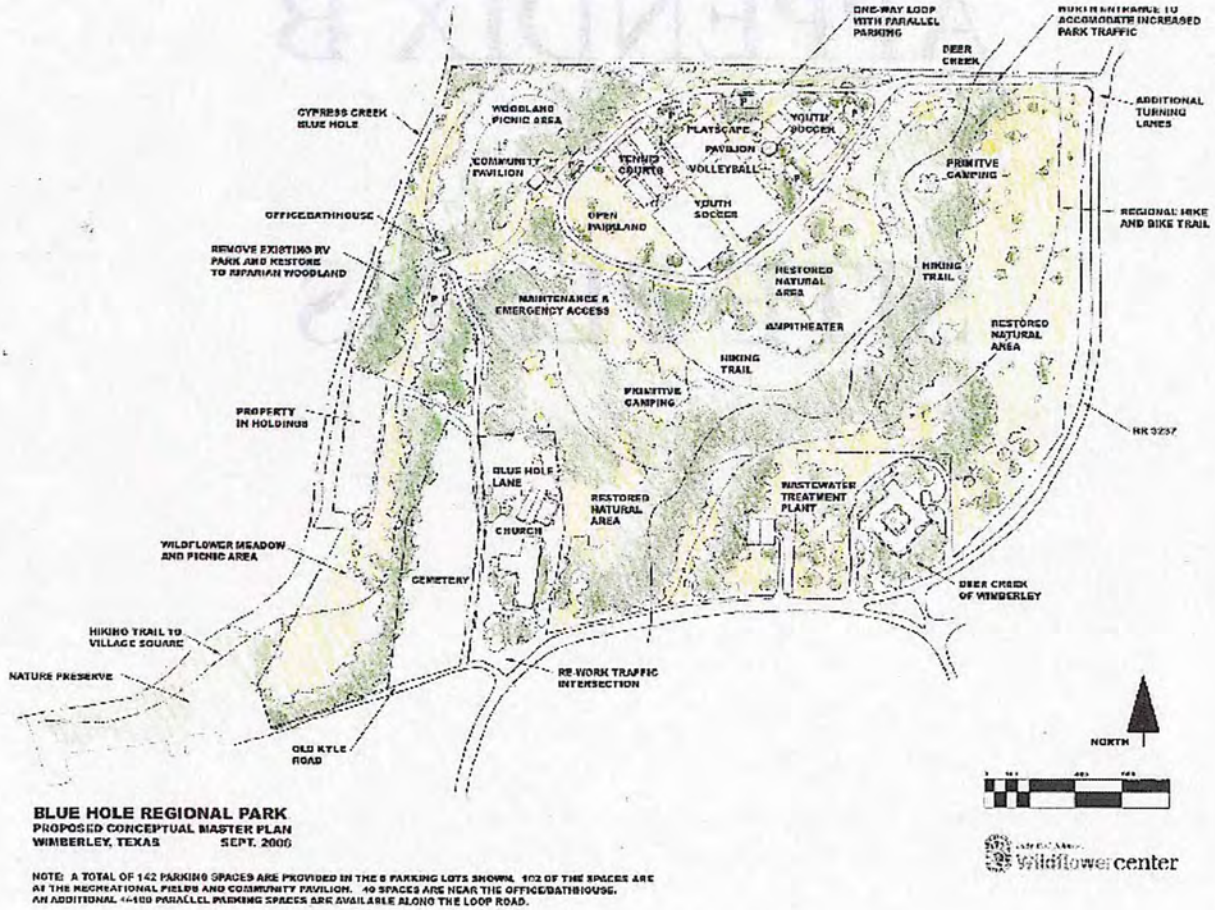
Supplier	Location	Phone	Web	Product	Comments
Bamert Seed Company	Muleshoe	800/262.9892	http://www.bamertseed.com	Seeds	Agricultural focus, centered on Texas Panhandle.
Barton Springs Nursery	Austin	512/328-6655		Potted plants	Retail nursery-sells some natives.
Bluestem Nursery	Arlington	817/478-6202	http://bluestemnursery.com	Potted native grasses	
Douglass W. King Seed Company	San Antonio	888/357-3337	http://www.dkseeds	Seeds	Agricultural focus.
Dry Creek Tree Farm	Austin	512/292-8733		Larger trees	Mainly large specimen trees (20-30 gallon pots).
Far South	Austin	512/291-4648		Potted plants	Wholesale, some retail, increasing focus on natives.
Gabriel Valley	Austin	512/930-0923		Potted plants	Some native wildflowers and trees.
Hill Country Natives	Austin	512/914-7519		Potted plants	Focus on native Hill Country trees. By appointment.
Joss Growers	Austin	800-478-7773		Potted plants	Some natives.
Lady Bird Johnson Wildflower Center	Austin	512/292-4200	http://www.wildflower.org	Potted plants	Native plant sales events twice a year, with extensive selection, including many hard to find species. Limited sales at other times.
Madrone Nursery	San Marcos	512/353-3944	http://home.earthlink.net/~madronenursery/	Trees, shrubs, and perennials	Wholesale/retail grower, features many hard to find Hill Country natives Sales by appointment. Contract grower.
McNeal Growers	Austin	512/280-2233	http://www.mcnealgrowers.com	Potted plants	Wholesale grower. Contract grower.

Supplier	Location	Phone	Web	Product	Comments
Moyer Tree Farm	San Antonio	830/980-7287	http://mtfsa.com	Trees and shrubs	Wholesale/retail grower, features many hard to find Hill Country natives. Sales by appointment, or during periodic sales.
Native American Seed	Junction	800/728-4043	http://www.seedsource.com	Seeds	Focus on Hill Country natives for ecological restoration and landscaping. Contract grower.
Native Texas Nursery	Austin	512/276-9801	http://www.nativetx.com	Potted plants	Wholesale.
Pogue Agri Partners	Kenedy	830/583-3456	http://pogueagri.com	Seeds	Agricultural focus, centered on northwestern Texas.
Schumacher's Hill Country Gardens	New Braunfels	830/620-5149		Potted plants	Lots of native species.
Turner Seed	Breckenridge	800/722.8616	http://www.turnerseed.com	Seeds	Agricultural focus.
Wildseed Farms	Fredericksburg	800/848-0078	https://www.wildseedfarms.com	Seeds	Focus is on home landscaping. Many selections are non-native or from Texas Coastal Plains.

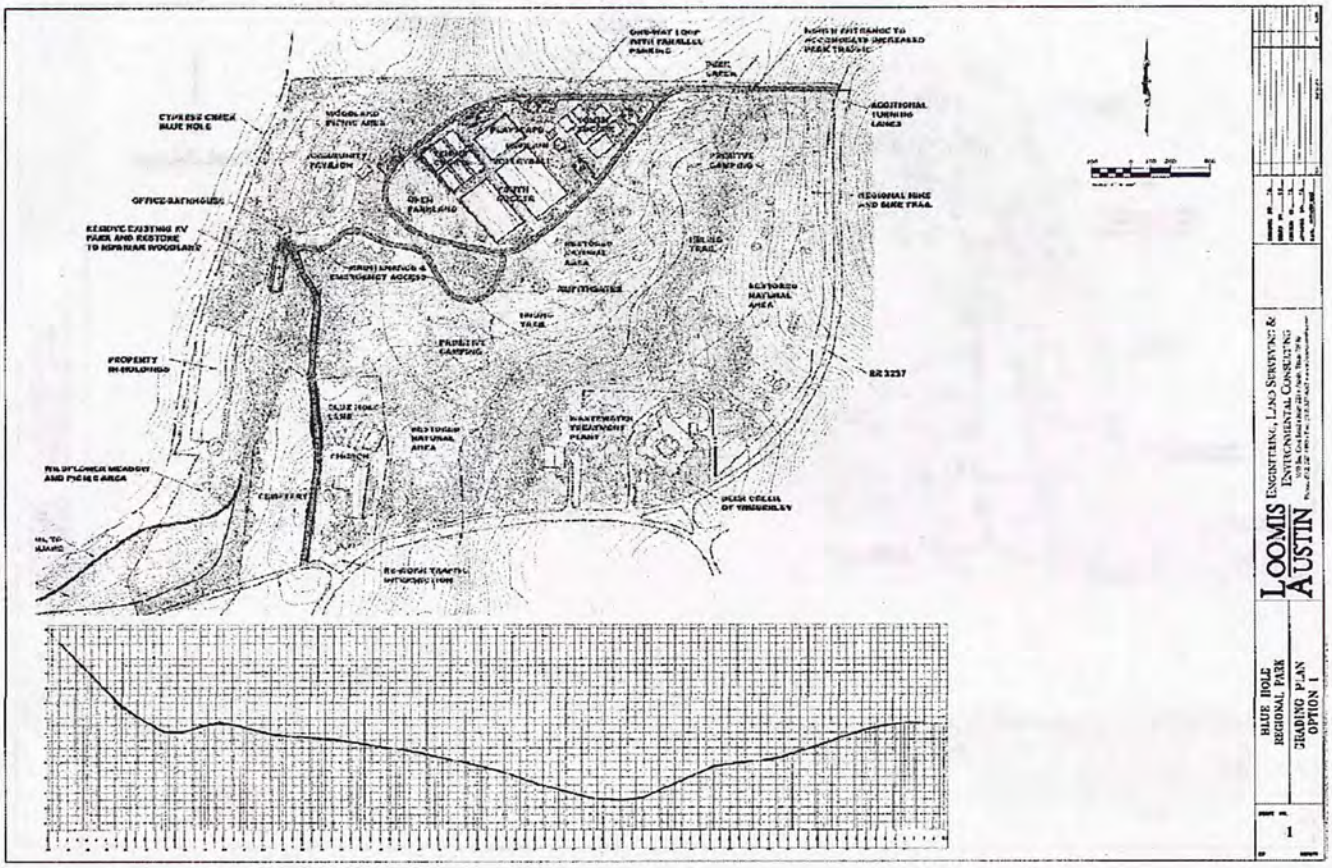
APPENDIX B

SITE PLANS

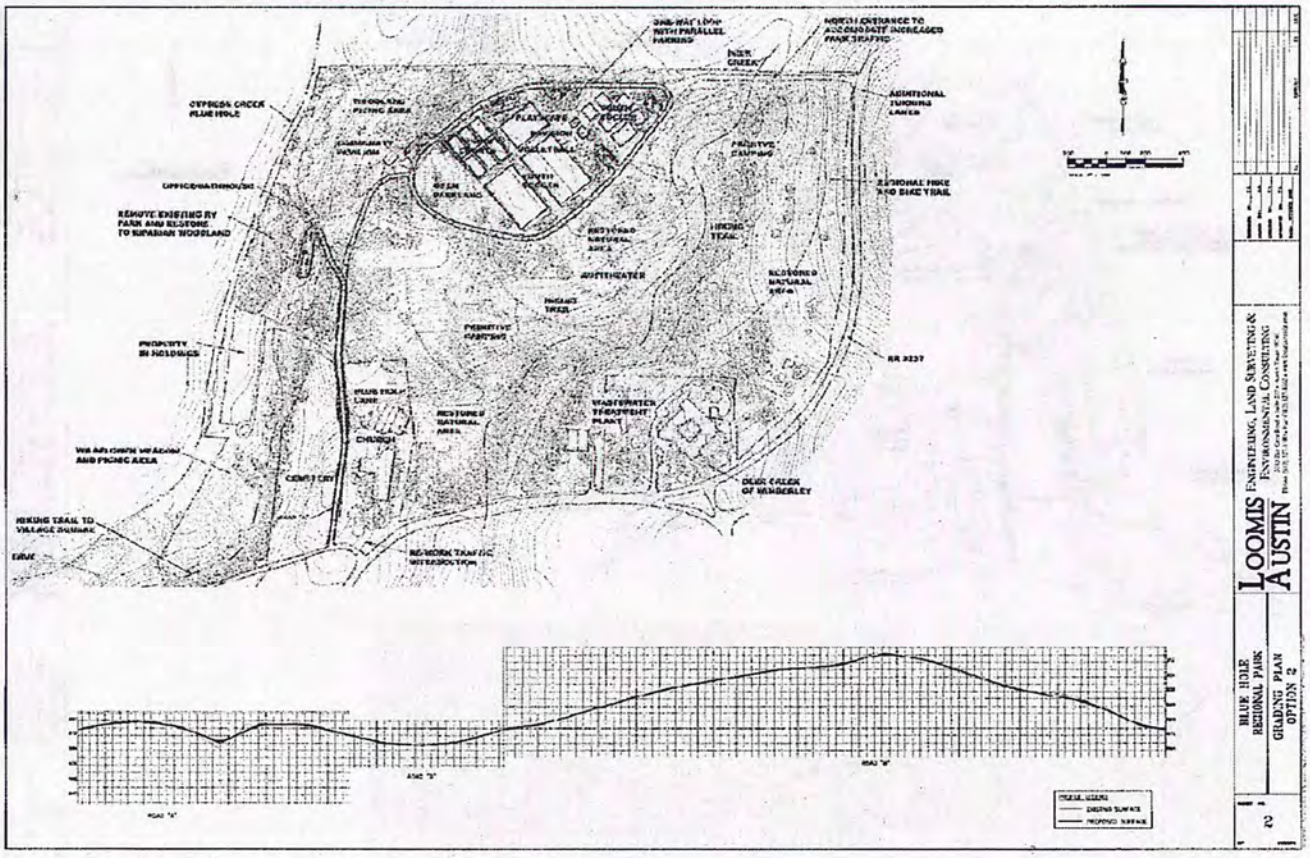
SITE PLAN A – Draft Conceptual Master Plan, September 2006



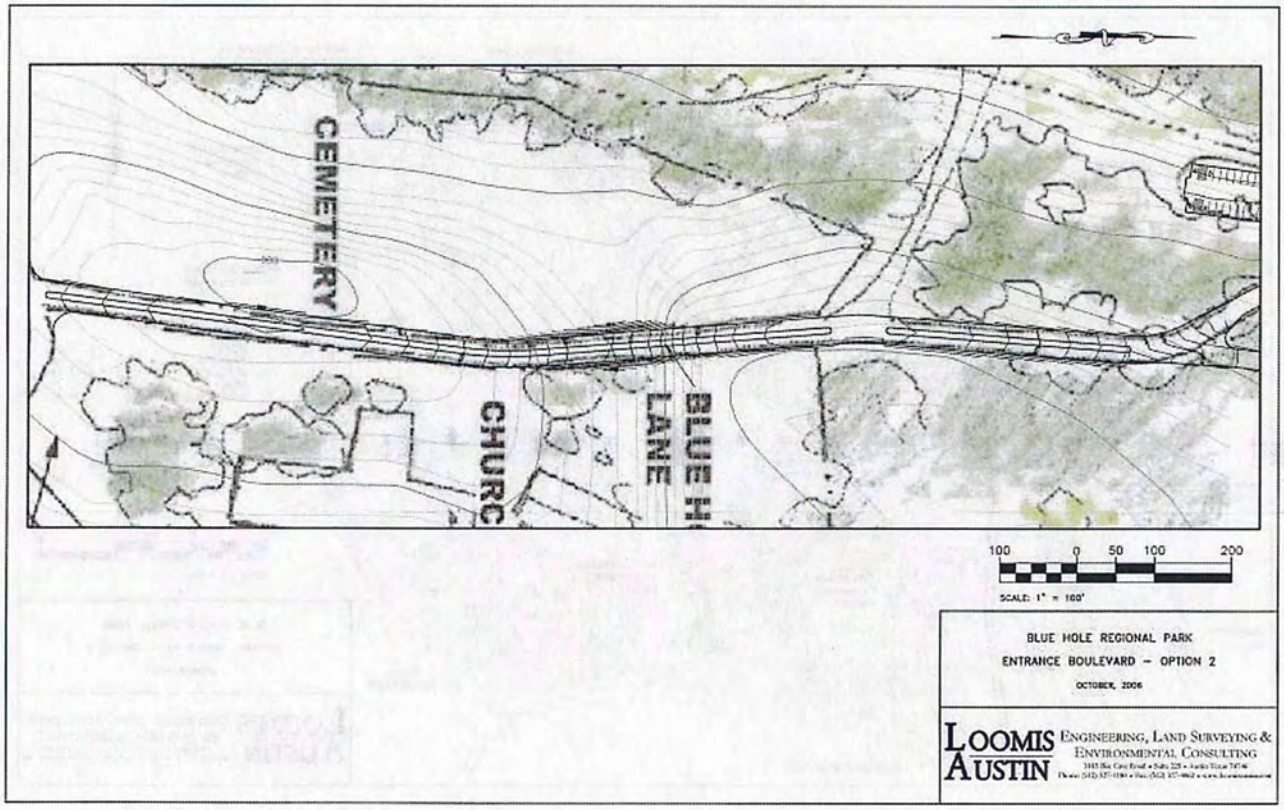
SITE PLAN B: Roadway Configurations Phase I



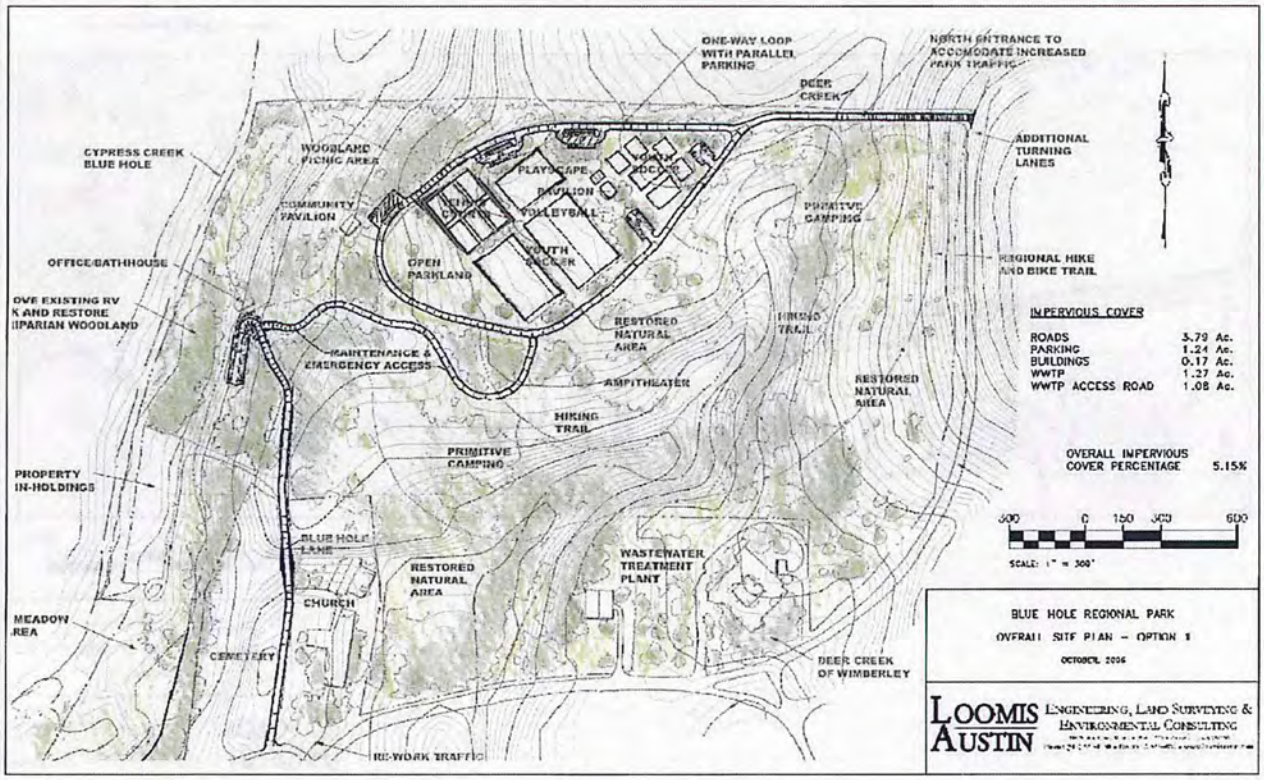
SITE PLAN C – Roadway Configurations Phase 2



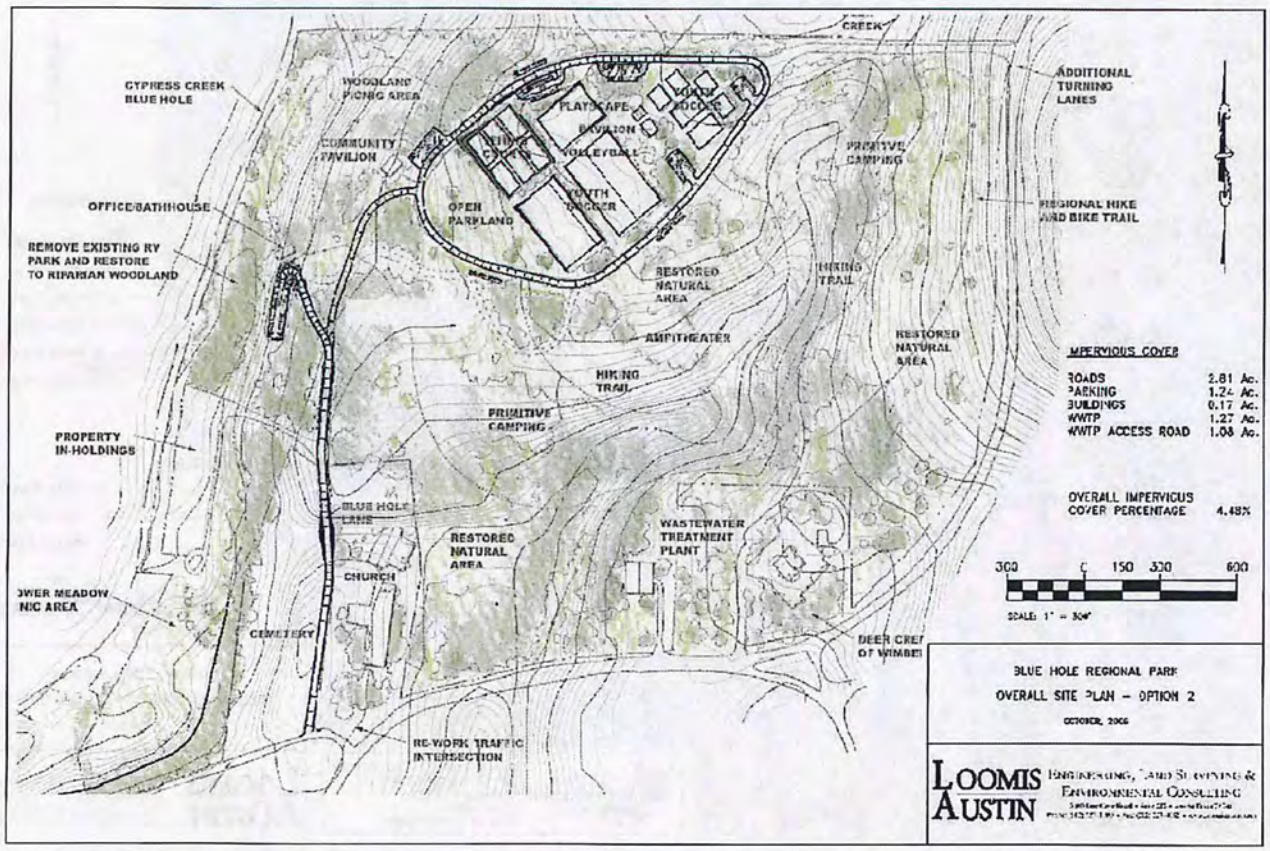
SITE PLAN D: Access Plan



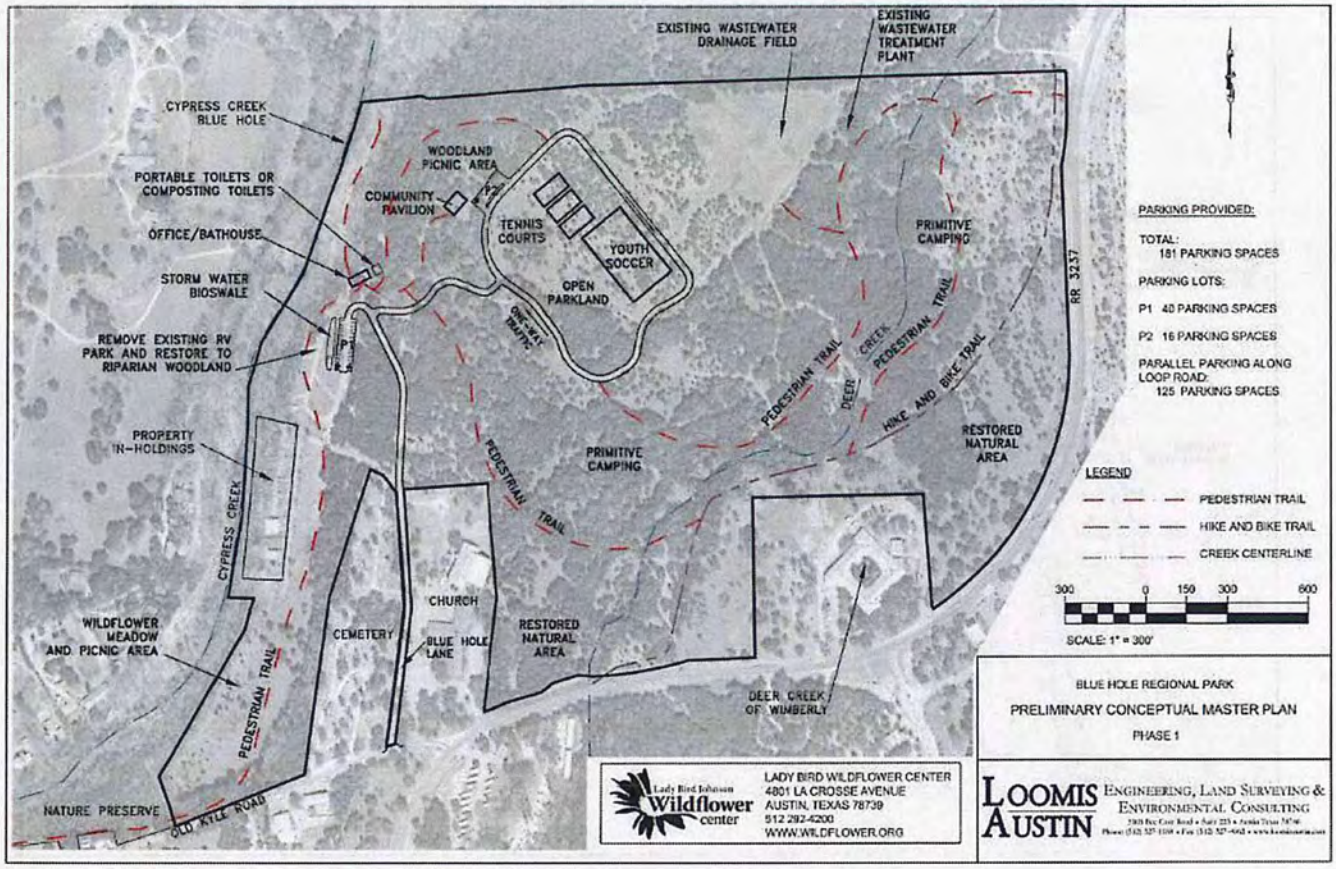
SITE PLAN E: Draft Phase 1 Site Plan, Impervious Cover Values, October 2006



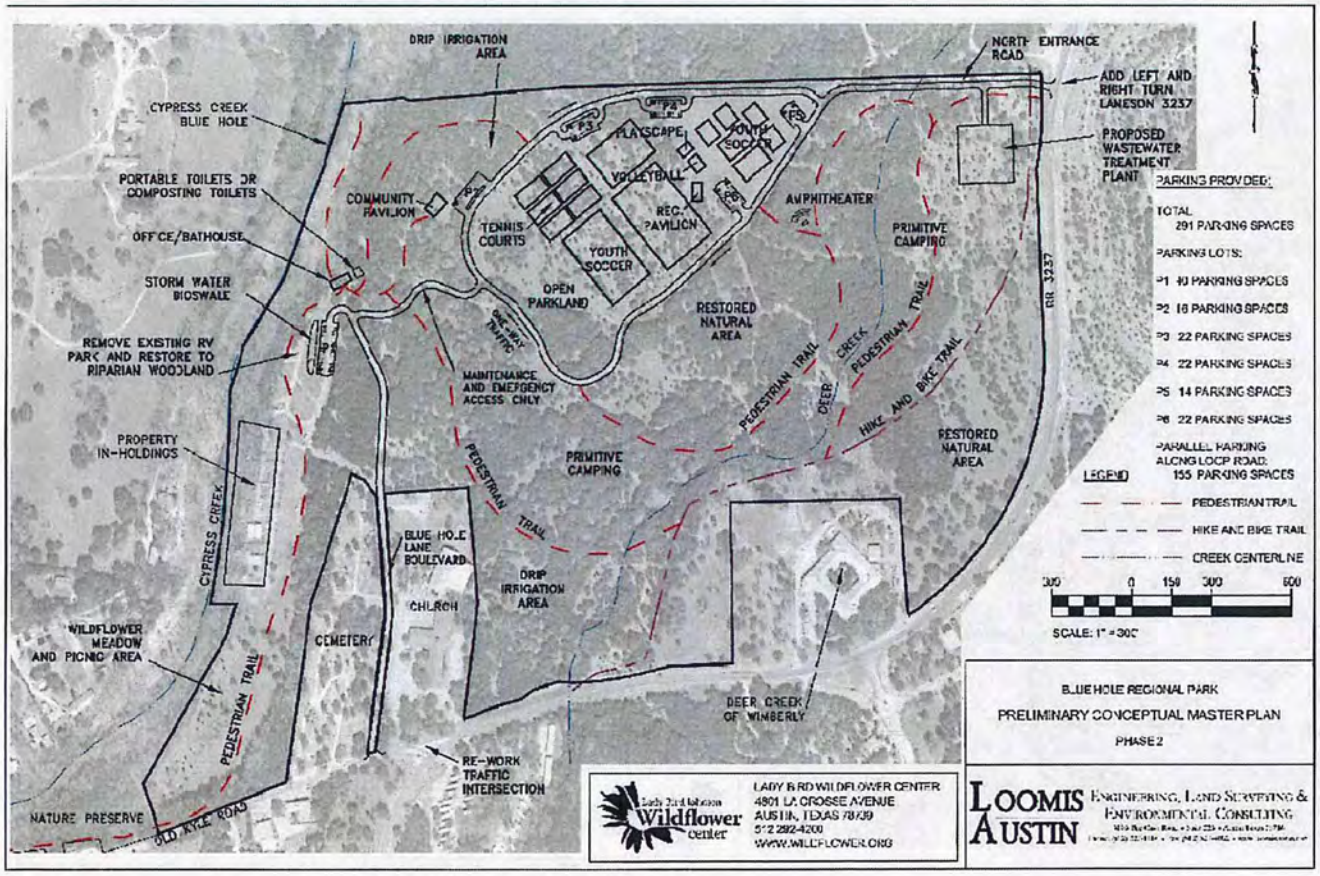
Site Plan F: Draft Phase 2 Site Plan, Impervious Cover Values, October 2006



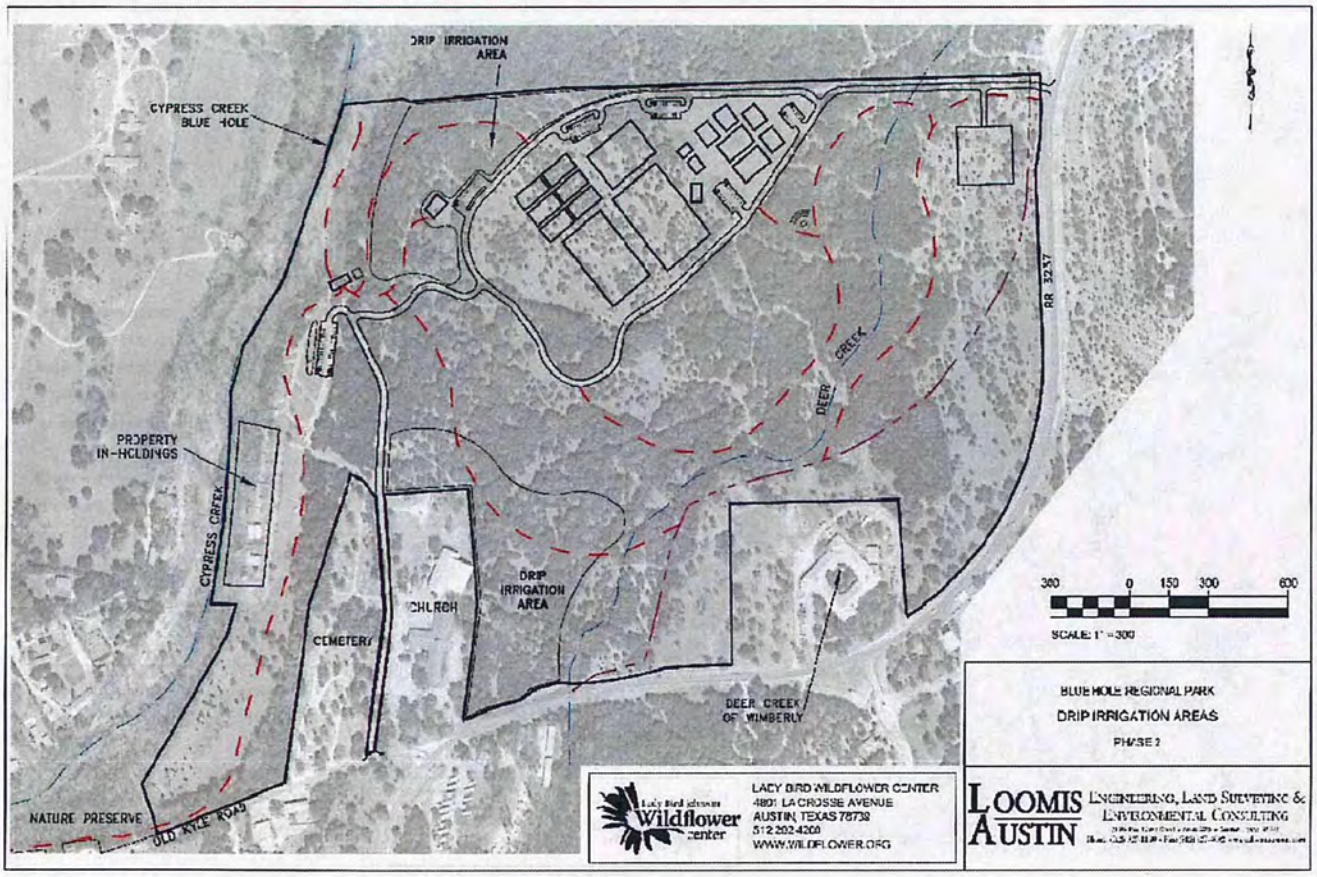
SITE PLAN G: Draft Conceptual Plan – Phase 1, December 2006



SITE PLAN H: Draft Conceptual Plan – Phase 2, December 2006



SITE PLAN I: Proposed Drip Irrigation Areas, December 2006

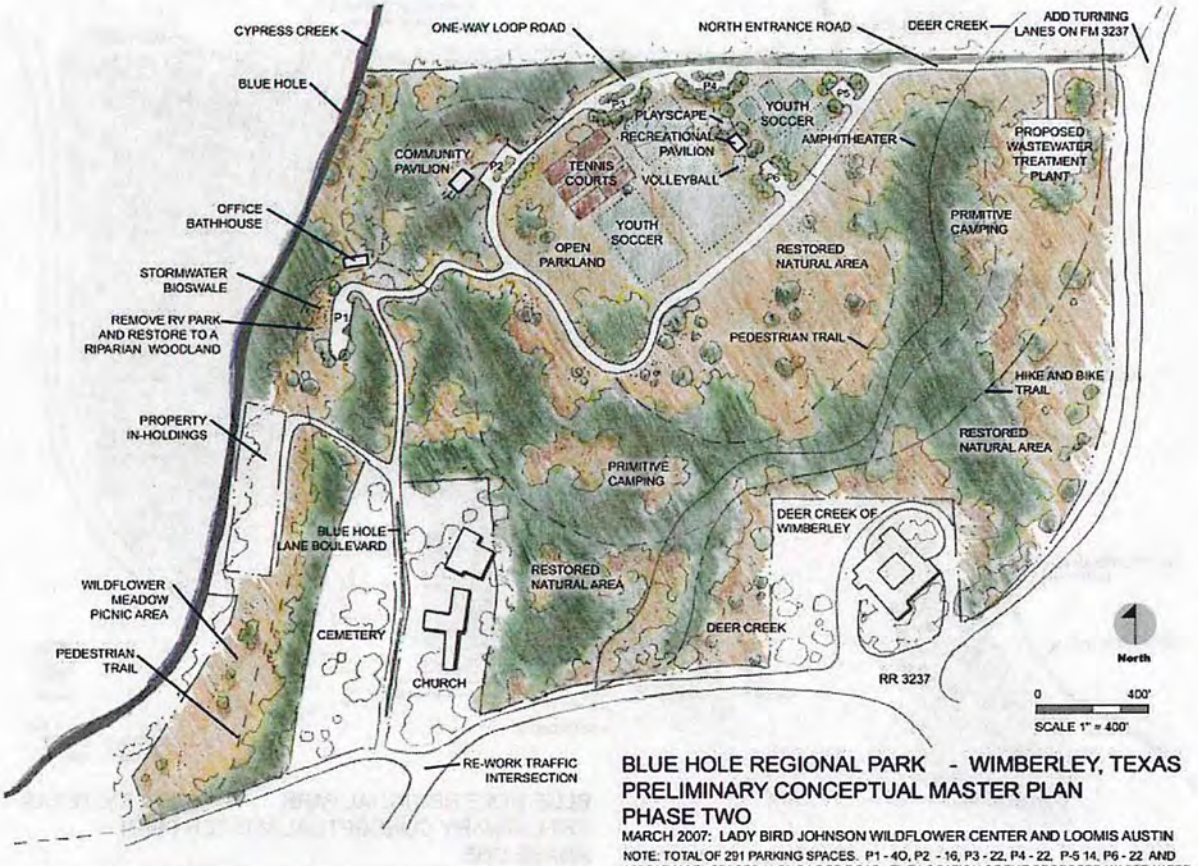


SITE PLAN J: Final Phase 1 Master Plan, March 2007

BLUE HOLE REGIONAL PARK - WIMBERLEY, TEXAS
PRELIMINARY CONCEPTUAL MASTER PLAN
PHASE ONE
MARCH 2007: LADY BIRD JOHNSON WILDFLOWER CENTER AND LOOMIS AUSTIN

NOTE: TOTAL OF 181 PARKING SPACES. P1 - 40 , P2 - 16 AND 125 PARALLEL SPACES ALONG LOOP ROAD

SITE PLAN K: Final Phase 2 Master Plan, March 2007



BLUE HOLE REGIONAL PARK - WIMBERLEY, TEXAS
PRELIMINARY CONCEPTUAL MASTER PLAN
PHASE TWO

MARCH 2007: LADY BIRD JOHNSON WILDFLOWER CENTER AND LOOMIS AUSTIN

NOTE: TOTAL OF 291 PARKING SPACES. P1 - 40, P2 - 16, P3 - 22, P4 - 22, P-5 14, P6 - 22 AND 155 PARALLEL SPACES ALONG LOOP ROAD. THE LOCATION OF THE PROPOSED WASTEWATER TREATMENT PLANT IS APPROXIMATE AND SHOULD BE FIELD LOCATED TO AVOID SEASONAL DRAINAGE FEATURES AND MINIMIZE DISTURBANCE.