POST-DISASTER PARKS:

PROSPECTS, PROBLEMS, AND PRESCRIPTIONS

THESIS

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DEDICATION

To My Sisters:

To Katie for saying, “make yourself the exception;”

To Jennifer for saying, “make it work for you;”

To Mia for just wanting me to be happy.

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ABSTRACT

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Parks created on post-disaster landscapes present unique opportunities for education, research, tourism, and other activities, yet there are obstacles to their development for these purposes. Stakeholder conflicts, financial troubles, technical issues, or safety concerns may complicate park creation on these sites. This study examines parks that have been or are being developed on disaster sites, including Texas's Canyon Lake Gorge where a disaster scar is being developed into a natural interpretive area where education, research, and tourism are now taking place.

The goal of this research is to highlight the opportunities and obstacles involved in post-disaster park making and inspire further research into this type of recovery plan. It also seeks to encourage decision-makers to consider park development as a viable option in the wake of a disaster. The study asks the questions: Where have parks been created on lands that have been devastated by either natural or human-induced disasters? What are the prospects and problems for creating these post-disaster parks?

In the wake of a disaster, many important decisions have to be made, including what to do with the land affected by the event. This research is the first to examine the creation of parks in places that are known to be or are expected to be hazardous to human users. As such, the scholarly contribution of this research is to evaluate this form of adaptation or adjustment to societal risk perception as hazard mitigation. Furthermore, it is hoped that the results of this research will be useful to local government officials, park managers, community members, disaster recovery experts, non-governmental agencies, private landowners, and other decision-makers for post-disaster sites.

CHAPTER I

INTRODUCTION

Park managers and developers around the world have begun to realize the potential of post-disaster landscapes. "The valleys, ravines, and trees of Toronto are some of the city's defining natural features– and we have a hurricane to thank for them," begins a 2004 *Toronto Star* article (Hall 2004, 1). Much of Toronto's extensive park system was set aside because of the natural disaster that devastated the area more than 50 years ago. Lead interpreter at Iowa's Devonian Fossil Gorge, Terry Escher (2008, 1), said, "when we get something as unique as the Gorge from something so bad as the flood, a person can perhaps have hope that 'every cloud has a silver lining' and may even be able to apply this principle to their own personal lives." Once the largest landfill in the world, Fresh Kills on Staten Island is slated to become "a world-class park . . . combining state of the art ecological restoration techniques with extraordinary settings for recreation, public art, and facilities for many sports and programs that are unusual in the city" (NYCDCP 2008 1-2). Riverbank State Park, built on a sewage treatment plant, is currently one of New York Magazine's critics' picks. Editors said the park makes "great use of an otherwise useless area" (Matthew 2008, 1). Another disaster site, the Canyon Lake Gorge in Comal County, was formed by catastrophic flooding in Texas. The event ravaged 48,000 homes, cost $1 billion in damages, and caused the deaths of nine people, but the scarred landscape presented some unique opportunities (NOAA 2007). Erosion of the spillway channel uncovered a 100-million-year-old sea floor revealing dinosaur tracks, fossiliferous beds, aquifer channels, and ancient sea ripples. The site is now being developed as a park, technically a natural interpretive area, guided by a citizen group, a state organization, and the U. S. Army Corps of Engineers (USACE).

Decision-makers at post-disaster parks across North America will benefit from the information gathered in this study. Managers and developers at the Canyon Lake Gorge may benefit from knowledge gained by managers of Iowa's Devonian Fossil Gorge, which shares a remarkably similar history. When floodwaters overran the Coralville Dam in 1993, a gorge was cut in the limestone bedrock exposing 375-million-year-old geology (Glenister 2003). According to Glenister (2003, 1), "Recognition of the regional public interest in the educational, recreational and tourist appeal of the [Devonian Fossil] Gorge motivated a local committee, working closely with the U.S. Army Corps of Engineers, to develop a plan for development of the site." Just two months after the flood, the Devonian Fossil Gorge was opened to an enthusiastic and curious public, attracting 16,000 visitors its first weekend (Glenister 2003). Currently the Gorge Preservation Society (GPS), a community group in Canyon Lake, the Guadalupe-Blanco River Authority (GBRA), and the Corps of Engineers are attempting a similar task with the Canyon Lake Gorge: develop a site where visitors can enjoy, scientists can study, and students can learn from this marvel created at the interface of humans and nature. These and other case studies discussed in this paper serve to demonstrate that recreational, scientific, educational, and other benefits can be realized in the wake of a disaster.

Yet, because of their extraordinary circumstances, unique challenges also accompany park development on locations impacted by natural or human-induced disasters. "There is no question in my mind that the establishment of a monument or park on post-disaster sites would be significantly more challenging than on other sites," said Roland Emetaz (2008, 4), former recreation staff officer at Mount St. Helens National Volcanic Monument. "It was 'New Ground' for most of us . . . no one could say 'oh, we did it this way before!'" (Emetaz 2008, 1). Decision-makers considering park establishment on such sites should be aware of potential complications and plan accordingly. The variety of stakeholders with differing interests can complicate recovery efforts. Stakeholders may include local and federal governments, nearby landowners, community members, non-governmental organizations (NGOs), and others. The post-disaster site may also present safety, security, and site-degradation issues, as well as financial and other concerns. Because there is a need for new solutions to disaster recovery, it is timely to examine the prospects and problems associated with the creation of parks on post-disaster landscapes.

The specific research goals of this study were driven by the following questions: Where have parks been created on lands that have been devastated by either natural or human-induced disasters? What are the prospects and problems for creating these post-disaster parks?

Twelve post-disaster parks in the U.S. and Canada will be examined in this study. Cases involving parks outside this region were not included as their unique political, environmental, economic, and social contexts may make them inappropriate for comparison (de Schiller 2000). Each case involves a site that has experienced a natural or human-induced disaster and has been turned into a park (or is in the planning stages of becoming a park) as a result of the disaster. Sites where a disaster event occurred *after* a park was established will not be included.

When used in this paper, the term *disaster* refers to natural or human-induced events that have significantly altered a landscape. Post-natural disaster parks evaluated in this study are the result of earthquakes, hurricanes, tsunamis, floods, and volcanic eruptions. Human-induced disaster sites examined reflect toxic contamination, waste disposal, and waste treatment disasters.

For simplicity's sake, when referred to in this study, the word *park* represents all forms of protected areas, green spaces, natural areas, conservation zones, open spaces, ecotourism sites, etc. that fit within the guidelines of the International Union for the Conservation of Nature (IUCN) Natural Monument designation. This designation is reserved for areas that

> protect or preserve in perpetuity specific outstanding natural features because of their natural significance, unique or representational quality, and/or spiritual connotations . . . provide opportunities for research, education, interpretation and public appreciation and deliver to any resident population such benefits as are consistent with the other objectives of management. (IUCN 2007)

The International Union for the Conservation of Nature and Natural Resources, or World Conservation Union (IUCN), is a conservation network of 83 States, more than 100 government agencies, some 800 NGOs, and thousands of scientists and experts representing 181 countries. Since 1948, IUCN has been encouraging societies around the world to conserve their natural resources to ensure the protection of the resources and those that rely on them. IUCN holds the official title of Observer at the United Nations (UN) General Assembly, giving them the right to speak at the meetings. They also provide policy advice to governments, UN organizations, and international conventions (IUCN 2007). IUCN, the United Nations Environment Programme, and World Wildlife Fund created the World Conservation Monitoring Center (WCMC), which supports conservation worldwide. The WCMC manages a global database that provides information to governments, the UN, scientists, businesses, the media, and conservation and development communities about endangered plant and animal species, threatened habitats, critical sites, and protected areas. The center assists developing countries in promoting and planning for the development of their natural resources (IUCN 1996).

In 1978, IUCN developed categories for protected areas that were revised in 1992 at the IV World Congress meeting in Caracas, Venezuela. The revised categories include Strict Nature Preserves/Wilderness Areas, National Parks, Natural Monuments, Habitat/Species Management Areas, and Managed Resource Protected Areas. Worldwide over 140 names have been used to categorize and name protected areas, which has led to confusion. Therefore, the purpose of the IUCN guidelines are to "establish greater understanding among all concerned about the different categories of protected areas" (IUCN 1996, 1). These categories are helpful to managers and developers of protected areas and are designed to be consulted when preparing national protected area plans, though they can also be used at the local level (IUCN 1996). The advice in the IUCN guides is intended to increase awareness of the importance of protected areas and encourage their well-planned development, reduce confusion over protected area terms, provide international standards, create a framework for the collection, handling, and dissemination of data on protected areas, and overall improve communication about protected areas among conservation professionals (IUCN 1996).

According to IUCN, a protected area is "an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means" (IUCN 1996, 7). An area is categorized based on its primary management objectives and is assumed to follow the mandatory guidelines set forth by IUCN (IUCN 1996). Main management goals may include:

- Scientific research
- Wilderness protection
- Preservation of species and genetic diversity
- Maintenance of environmental services
- Protection of specific natural and cultural features
- Tourism and recreation
- Education
- Sustainable use of resources from natural ecosystems
- Maintenance of cultural and traditional attributes (IUCN 1996, 7)

In IUCN's *Guidelines for Protected Area Management Categories,* a Natural Monument is described as a

> protected area managed mainly for conservation of specific natural features . . . containing one, or more, specific natural or natural/cultural feature of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance. (IUCN 1996, 20)

Features of outstanding significance may include noteworthy waterfalls, marine features, fossil beds, unique or representative flora and fauna, archeological sites, or sites with import to indigenous peoples. To be included in this category, the area must be large enough to be able to protect these significant features and their immediate surroundings (IUCN 1996). The management objectives of this category are "to protect or preserve in perpetuity specific outstanding natural features because of their natural significance, unique or representational quality . . . to provide opportunities for research, education, interpretation and public appreciation . . . and to deliver to any resident population such benefits as are consistent with the other objectives of management" (IUCN 1996, 20). Primary management objectives are species and genetic diversity preservation, natural/cultural feature protection, tourism, and recreation. Secondary objectives focus on scientific research and education. A potential, but not mandatory, management objective is wilderness protection. The ownership of the site must be with the federal government or with restrictions by another level of government, a non-profit trust, corporation, or a private body as long as the long-term integrity of the area is assured. Assignment of a category serves only to describe a site's ideal situation, not determine how effectively it is managed. Some poorly managed sites are recategorized to reflect this shortcoming (IUCN 1996).

Examples of Natural Monuments around the world include Victoria Falls National Park in Zimbabwe and Devil's Tower National Monument in the United States. Victoria Falls was designated a Natural Monument because it is considered a natural wonder of the world, the area is large enough to protect the integrity of the site, and management objectives stress visitor appreciation. Likewise, Devil's Tower holds geologic significance and exemplifies a complete succession of plant and animal life from rock to mixed pine forest. It is divided into zones to fulfill a range of management goals, including conservation (IUCN 1996, 55-56).

This study focuses on post-disaster park sites that fit within the definition of the IUCN Natural Monument designation, but do not necessarily follow the IUCN definition of a protected area. Case studies may stray from the protected-area definition in that their primary objectives may not necessarily include protecting and maintaining biological diversity. A discussion with John Waugh (2008a, 1)**,** Programme Coordinator at the

IUCN North American headquarters, revealed that the protected-area definition is being updated because it was “a poorly thought out designation . . . that has caused a lot of problems with governments using these classification systems.” Waugh said that there has been a general understanding that this designation is in need of revision because more than biodiversity merits protection; scenery, ecological processes, watersheds, geological processes, and displays of earth history also need attention. Due to the controversy, revision of the protected-area definition was the first item on the agenda at the May 2007 IUCN Categories Summit in Almeria, Spain (Waugh 2008a). A proposed revision was presented and discussed: “A specifically delineated area designated and managed to achieve the conservation of nature and the maintenance of associated ecosystem services and cultural values through legal or other effective means” (Waugh 2008b, 2). According to Waugh, this definition comes from a document that is not yet public and therefore cannot be cited as such; but a version of this new definition is expected be adopted and will be published in future IUCN publications. Post-disaster sites fit into this revised definition (Waugh 2008a).

Management objectives of post-disaster parks discussed in this paper focus on preserving unique natural/cultural features and providing opportunities for research, education, interpretation, and public appreciation. For example, the mission of the Gorge Preservation Society echoes the Natural Monument objectives in its mission to promote enjoyment and conservation of the Canyon Lake Gorge site, promote academic partnerships and citizen involvement, make the site accessible to the public, offer geological, biological, historical, and natural resource education to visitors, cooperate with local eco-tourism initiatives, and maintain and steward the project (Ibes 2007).

Fresh Kills Park also fits the category with goals to create a park that restores ecological systems, creates recreational opportunities for the resident population, and provides educational opportunities (NYCDCP 2008).

CHAPTER II

LITERATURE REVIEW

Researchers have recently begun to explore the potential of post-disaster landscapes (Alberverio, Jentsch, and Kantz 2006; Beschta et al. 2004; Christoplos 2006; FEMA 2000; Levine, Esnard, and Sapat 2007; Pearce 2003; Waugh and Smith 2006). Discussion regarding innovative land-use solutions for these landscapes has been gaining noticeable attention in the last several years, especially since 2005's devastating Hurricane Katrina (Alberverio, Jentsch, and Kantz 2006; Burger and Canton 2007; Christoplos 2006; FEMA 2000; Greenberg, Lahr, and Mantell 2007; Levine, Esnard, and Sapat 2007; Waugh and Smith 2006). A handful of studies have addressed park establishment on post-disaster sites as a risk-reduction technique and mitigation strategy (Beschta et al. 2004, FEMA 2000, NRC 1968, Waugh and Smith 2006). Yet researchers have done little more than mention this as a solution for post-disaster sites, though the approach has been repeatedly praised in the popular press and practiced by post-disaster site managers for decades. The subject of park development is also lacking in the scholarly literature. "In Greenway planning in the United States: its origins and recent case studies," Fabos (2004) discusses greenway planning during the 1980s and 1990s and asserts that

> while the greenway movement has resulted in thousands of greenway plans and projects in the USA, it produced only a small amount of publications, which are placed in research libraries. Unfortunately, the greenway reports of greenway projects are published for limited distribution and only a handful of these reports become part of "scholarly literature". Secondly, the greenway reports seldom include relevant literature review or descriptions of the study methodology. Hence, their research and educational value is limited.

This absence of directly related scholarly work has necessitated the analysis of literature more loosely tied to the research questions posed here. The extant scholarship was organized into categories that discuss: the need for new solutions to disaster recovery, opportunities for using parks in the recovery process, park development, the benefits of park development, challenges associated with park planning and management, and successful steps in disaster recovery and park development.

The need for new solutions in disaster recovery

Though the U.S. has shown progress over the years, current recovery efforts are not as effective as they could be according to many hazards researchers (Applegate and Folger 2001; Birkland et al. 2003; Felgentreff 2003; Greenberg, Lahr, and Mantell 2007). Applegate and Folger (2001) warn of grave consequences if society chooses to ignore the dangers that disasters pose and the necessity for new mitigation and recovery strategies. They caution that economic, social, and political consequences will worsen as population, development, and human impact on the environment increase. These impacts will be further aggravated by people moving to disaster-prone locations (Alberverio, Jentsch, and Kantz 2006; Applegate and Folger 2001; Emanuel 2006; Harmon and Brechin 1994; IPCC 2007; Mann and Emanuel 2006; Stanley 2002).

We may not be able to stop disasters from happening, but there are ways to reduce the damage that is suffered when extreme events do occur. The current focus is on prediction, which is a necessary component of mitigation, but researchers agree that more preventative strategies should be explored. Echoed throughout the literature are recommendations that focus on improving land use planning and design to reduce disaster-related losses, involving the community in recovery decision-making, and simply learning from the past (Andrews 2006; Applegate and Folger 2001; Burger and Canton 2007; Coglianese 1999; Greenberg, Lahr, and Mantell 2007; Waugh and Smith 2006). A 2001 Natural Hazards Caucus work group report asserts that disaster reduction should be a national priority and that administration could reduce losses in several ways including the implementation of sound land use practices and by learning from history (Applegate and Folger 2001). The common reaction in the wake of a disaster is to simply "rebuild as before," but Applegate and Folger (2001, 1) warn that this practice "condemns us to recurrent losses that could be greatly reduced or avoided altogether." Levine, Esnard, and Sapat (2007) state that physical vulnerability to hazards is a result of location and warns that Hurricane Katrina victims in New Orleans who have begun to reconstruct their homes without raising them are putting themselves at unnecessary future risk. Alberverio, Jentsch, and Kantz (2006) recommend relocating communities outside of disaster-prone areas. Gaddis et al. (2007, 1) conclude that when a post-disaster "full assessment of costs" is calculated, the continued development and maintenance of settlements in disaster-prone coastal areas is exceedingly more expensive than it readily appears, and ultimately not in the national interest.

The federal government is showing signs that they are aware that disaster loss can and should be reduced, and that as development increases there will be a necessity to try new mitigating strategies. The Federal Emergency Management Agency's (FEMA) *Project Impact: Building a Disaster-Resistant Community*, implemented in 1997, is a national initiative that encourages communities to "assess their vulnerabilities and take action to limit damage before disasters occur" (FEMA 2000, 1). Pearce (2003) stresses that disaster management planning should go a step further and focus on maintaining and enhancing quality of life, fostering local resilience and responsibility, boosting local economies, and preserving the environment for future generations.

Opportunities for using parks in the recovery process

The period following a disaster is a time for new beginnings, innovative opportunities, and fresh outlooks. This optimistic belief that disasters have a silver lining is common among hazards researchers (Chang 1984, Felgentreff 2003, Skidmore and Toya 2002). In *Extreme Events in Nature and Society*, Alberverio, Jentsch, and Kantz (2006) assert that the benefit of catastrophe is that it forces us to look for solutions, which leads to progress. In the absence of impact, there is no need for change. Levine, Esnard, and Sapat (2007) consider the post-disaster period to be a window of opportunity during which communities can incorporate sustainable, long-term reconstruction principles that ultimately make them less vulnerable to future disasters. Skidmore and Toya (2002) conclude that disasters force community improvements that promote long-term growth. The site of a disaster provides a unique landscape from which visitors can learn, scientists can study, and nature can sometimes even benefit (Beschta et al. 2004). Drabczyk (2007,

1) emphasizes that “disasters offer a number of opportunities to affect positive change” and that disaster recovery can be socially and environmentally beneficial by focusing on the participatory process, quality of life, economic vitality, social and intergenerational equity, environmental quality, and disaster resilience. Christoplos (2006) addresses this window of opportunity, detailing the benefits that may follow a disaster. These benefits include revealing institutional and policy weaknesses, washing away poor infrastructure, revitalization of recovery efforts, and the procurement of funds to reconstruct more wisely. Better macro-level planning and consensus building are shown to be essential to realizing the advantages of this ‘window of opportunity.’ According to Waugh and Smith (2006), the flooding caused by Hurricane Katrina has provided an opportunity for widespread development, and they note that preliminary plans include the development of large parks and marshlands. After its thorough analysis of the 1964 Alaska Earthquake, the National Research Council (NRC 1968, 239) recognized the post-disaster period as a rare opportunity to “safeguard public safety and to improve land-use patterns.” The authors urged that “areas of high risk should be reserved for low-intensity uses of land such as parks, off-street parking, and perhaps highways” (NRC 1968, 238).

Park development

A discussion about park development has been covered by scholarly literature across disciplines (Erickson 2004, Ryder 1995). Shafer’s (1999, 1) essential components when creating a nature reserve feature: having a regional perspective, recognizing the benefit of small reserves, and “a focus on natural processes.” Millar et al. (1998) explored using geographic information systems (GIS) coupled with a suitability analysis to choose potential greenway sites. Gobster (1995, 1) found that location of greenway trails near homes "strongly influenced how a greenway trial was used, who used it, how often it was used, and other factors." Sanders (1996) compared planning and management of a National Monument and a Tribal Park. How protected areas serve to conserve biodiversity is discussed by Lovejoy (2006). Wallsten (2003, 1) looked at a Swedish conservation strategy that incorporates sustainability with socioeconomic development and found that "a shift of focus from restrictions inside the boundaries of the national park to opportunities outside" improved public opinion in Sweden.

Benefits of park development

Awareness of the benefits parks provide abounds in the popular press and scholarly literature (Cho, Bowker, and Park 2006; Cook 1990; Crompton 2001; Fleischer and Tsur 2003; Geoghegan 2002; Hillsdon et al. 2006). Parks are appreciated for their economic, educational, scientific, psychological, and conservation potential.

In a time when everything has a price tag, efforts are being made to quantify the value of parks in terms that government, developers, and planners can appreciate. John Muir, founder of the Sierra Club once said, "Nothing dollarable is safe, however guarded" (Runte 1979, 1). In his "Worthless Lands" thesis, Alfred Runte explores the theory that national parks were created only on lands that were not valuable for economic production (Runte 1979). Perhaps post-disaster park making is only viable in areas that are not "dollarable," or at least more valuable as protected areas. In fact, there is mounting evidence that park development can be an economic benefit. Kaufman and Cloutier (2006) found statistically significant correlations between property values and the proximity of parks. Nicholls and Crompton (2005, 321) found that greenways have "significant positive impacts on proximate properties' sales prices."

Some researchers have tackled the quantification of other advantages associated with park development including educational opportunities, improvement of mental health, and an increased concern for the environment. Through regression analysis, Tisdell and Wilson (2005) found that considerable environmental knowledge was gained after a visit to an ecotourism site in Australia. The authors state that on a psychological level, people have intellectual, emotional, and even spiritual connections to natural areas. They found that when people experienced nature, they tended to value it more; and that parkland expansion increases a community's appreciation of and desire for more green spaces. Other authors repeat the sentiment that parks and natural areas are necessary for human happiness (de Kievit 2001, Hillsdon et al. 2006).

There are also clues that the presence of parks can help moderate temperatures, even in arid regions. Nasrallah et al. (1990) hypothesized that rates of temperature change in arid regions is affected by the presence or absence of greenbelts. Stoll and Brazel (1992) found a correlation between surface/air temperatures and adjacent land usage.

Challenges for park development

Along with these advantages come challenges inherent in park development (Galzer and Hansley 1980). Considering the number of stakeholders involved in disaster management, researchers warn that conflicts between people can be one of the biggest difficulties (Brancati 2007, Burger and Canton 2007, Stone et al. 2007). In her list of challenges when developing parks in urban areas, Chavez (2005) includes intense recreational use, public safety, and complex informational strategies. In addition, depending on the locations of parks, there may be any number of negative impacts that may upset surrounding property owners. These negative impacts include vandalism, increased noise, traffic, and trespassing (Bakker and Paepe 1982, Chavez 2005). However, each situation is unique, making it challenging to define clear rules or guidelines for park development.

Some fear that new, more lenient definitions of protected areas will lead to a reduction of land devoted to traditional protected areas (Locke and Dearden 2005). This study does not propose that post-disaster park making replace wilderness areas; rather, this solution reflects a new niche for park creation and one more option for dealing with landscapes transformed by disasters. In fact, areas that have suffered natural or human-induced disasters are (or ought to be seen as) unusable for most development purposes, and creating parks on them should only add to the number of protected areas.

The difficulties of park development are only exacerbated by the complexities of post-disaster landscapes. There are myriad problems that accompany disasters including economic loss, conflict-production, information crises, and toxic waste disposal (Stone et al. 2007). Brancati's (2007) research reveals that earthquakes increase the likelihood of intrastate conflict, and that this increases as the magnitude and impact of the earthquake increases. Olson et al. (2007) address the complications of dealing with the concentrations of fifty-three volatile organic compounds (VOCs) from locations near the World Trade Center after the 2001 disaster. Traditional disaster-recovery funding approaches are falling short because of the unprecedented and unpredictable losses that are now accompanying disasters, according to Hoeppe and Gurenko (2006). Levine, Esnard, and Sapat (2007) thoroughly cover the topic of population displacement due to catastrophic disasters, focusing on Hurricane Katrina, as they repeatedly demonstrate the complexity of this post-disaster issue.

Successful steps in recovery and park development

Successful steps taken during the recovery and park development stages are revealed in various scholarly works. Proof of the importance of citizen involvement in decision-making is demonstrated by several studies tackling disaster recovery or park development (FEMA 2000, Li 2006, Thompson et al. 2002, Vernon et al. 2005, Waugh and Smith 2006). Dalton (2005) stresses the necessity for active participant involvement, complete information exchange, fair decision making, efficient administration, and positive participant interactions when developing marine protected areas. She concludes that incorporating these factors will ensure support by stakeholders, meet management objectives, and fulfill conservation goals. Kweit and Kweit (2004) discuss two cities affected by the same flood but experienced drastically different aftereffects. Political stability and citizen satisfaction followed the recovery efforts of the city that incorporated citizen participation. Conversely, the city whose recovery efforts were bureaucratically led experienced political instability and discontent. Pearce (2003) concludes that disaster management planning must incorporate public participation in conjunction with sustainable mitigation.

The belief that holistic, sustainable mitigation is a necessary component of successful recovery is agreed upon by other researchers as well (Fabos 2004, Lindsay

2003, Pearce 2003, Vernon et al. 2005). Fabos (2004, 1) proposes a comprehensive "national vision plan" for greenway development that "calls for nature protection, for the development of appropriate recreational uses, and for the preservation and restoration of valuable historical/cultural resources. According to Meo, Ziebro, and Patton (2004), Tulsa, Oklahoma is internationally renowned for successful natural hazards and environmental policy innovations because of the creative and sustainable ways they have addressed disaster risk. In Drabczyk's (2007) book, *Holistic Disaster Recovery: Ideas for Building Local Sustainability after a Natural Disaster,* she discusses ideas for promoting sustainability in the wake of a disaster and stresses the importance of incorporating participatory processes in recovery. She states that, "the ideal disaster recovery process is consensus-based and compatible with long-term community goals, and takes into account all the principles of sustainability" (Drabczyk 2007, 2-2).

Scholars are beginning to address the idea of park development on disaster landscapes. This mitigation strategy has been gaining attention over the years because researchers agree there is a need for new solutions to disaster recovery. Several studies address alternative land uses for disaster-prone and disaster-stricken areas. A handful of studies mention park development as one desirable post-disaster land use option. Literature that discusses development and benefits of parks is abundant. A limited number of studies address challenges to park creation. Overall, researchers have found the post-disaster period to be a window of opportunity with great potential to benefit both humans and nature if well-planned, collaborative, sustainable recovery efforts are implemented.

CHAPTER III

METHODOLOGY

Methods

This study uses a comparative case-study methodology employing observation, interviews, and archival analysis to examine parks developed on disaster landscapes in the United States and Canada. Because post-disaster park making is not backed by a history of scholarly research and theory, a flexible, empirical research design was used to allow for the natural development of theory. The research did not lead to theory, but the results provide a foundation for subsequent studies to develop theory. The data are comparable and contribute to the resolution of the research questions. This methodology is suitable for other similar research.

Extensive archival research located potential post-disaster park case studies. Archival research involved Internet and database searches for post-disaster park sites. Popular press and scholarly databases were searched with a variety of keyword combinations.

At the same time, other research methods were employed to integrate hazards research with the experience of professionals from the parks and recreation communities. In order to reach professionals in the parks and recreation industry, emails were sent to at least one national park in each U.S. state, requesting leads on parks that have been developed on post-disaster sites. Emails were also sent to the National Association of State Park directors and National Park Service regional directors.

To facilitate incorporation of the hazards research community, a request for leads on post-disaster parks was posted in the e-newsletter *Disaster Research*, which is distributed by the Natural Hazards Center at the University of Colorado–Boulder. The request read:

> I am a graduate student researching the creation of parks or natural areas on post-disaster sites (both natural and technological). I am looking for cases where parks/natural areas have been developed on disaster sites, as well as situations where disasters have struck, the areas were rebuilt, and there was a recurrence of a disaster causing further loss of life and/or property. I would be very interested in talking to managers and developers who have set up parks in post-disaster sites. Please email dorothy@txstate.edu if you have any advice or information you would be willing to share. Thank you!

The newsletter is sent out every two weeks to 3,600 subscribers, many of whom are directly involved in hazard-related work and are familiar with land use planning and events in their local communities. This request was included in two issues: April 22, 2007, and September 6, 2007.

Information about sites discovered during the previous steps was pursued. At this stage, archival research was employed to gain information about (1) the history of the site; (2) a description of the landscape-altering event; (3) the community/landowner/governmental response to the event and subsequent park development; (4) the benefits and challenges associated with park development on the post-disaster site; and (5) successful steps taken in post-disaster park planning, development, and maintenance. The 12 parks included in the final analysis are representative examples—not a complete set—of post-disaster parks in the U.S. and Canada. Time constraints prevented analyses of case studies discovered late in the research process. All cases involve landscapes significantly altered by natural or human-induced disasters and fit the IUCN Natural Monument designation.

Research served to identify stakeholders involved in disaster recovery, park development and management, as well as journalists and other writers who authored articles about these sites. To fill in information gaps, attempts were made to contact stakeholders by email, phone, or both to elicit their participation in an informal interview (Appendix I). In addition, open-ended interviewing was used to allow for the free flow of ideas and opinions capable of revealing novel perspectives on the subject. The questions were customized according to the role of the interviewee in the park-development process, the information that had already been gathered about the case study, and the gaps that still existed at the time of the interview.

Data

The data gathered included names of known post-disaster sites, information related to each sites' history, and a list of opportunities and obstacles associated with each park's development. Recommendations for future post-disaster park developments were also compiled.

Data analysis

The data were organized, consolidated, and analyzed. A database was compiled detailing the nature of the event that altered the landscape, the date(s) the event occurred, the agency that manages the site, and the name of the park. Based on observation, interviews, and archival research, brief historical geographies of each site were written and incorporated into the results. Because it had not yet been documented thoroughly, a more complete historical geography of the Canyon Lake Gorge was complied and is included as Appendix II. The triangulated approach to data gathering and resulting historical geographies provided a rich context and incorporated various perspectives from which each case study's unique prospects and problems could be understood. Prospects (Table 2) and problems (Table 3) encountered at each site were distilled from the three analytical approaches and are discussed in the results section along with recommendations for future post-disaster park developments.

This project was granted exemption from full or expedited review by the Texas State University–San Marcos Institutional Review Board (IRB) on December 12, 2007 (exemption request #12-90123).

CHAPTER IV

POST-DISASTER PARKS IN THE UNITED STATES AND CANADA

Over the course of this research, more than 30 post-disaster parks were founded in the United States and Canada. Due to time limitations, the first 12 sites discovered that fit into the IUCN Natural Monument Designation were included in the final analysis. Table 1 lists each park, its location, the event that altered the landscape, the date(s) of the event, and who manages the site.

Figure 1. Map of Post-disaster Parks Included in This Study

Table 1. Examined Post-disaster Parks

Name of Park	Location	Event	Date(s) of event	Managers of the site
Canyon Lake Gorge	Comal County, Texas	Flood	July 2002	GBRA, USACE, GPS
Devonian Fossil Gorge	Johnson County, Iowa	Flood	July 1993	USACE
Earthquake Park	Anchorage, Alaska	Earthquake	March 1964	City Government
Fresh Kills Park	New York, New York	Landfill	1948-2001	City Government
Grand Forks Greenway	Grand Forks, North Dakota and East Grand Forks, Minnesota	Flood	April 1997	City Government
Johnstown Flood National Memorial	South Fork, Pennsylvania	Flood	May 1889	NPS
Mount Saint Helens Volcanic National Monument	Skamania County, Washington	Volcanic eruption	May 1980	USFS
Rapid City Greenway	Rapid City, South Dakota	Flood	June 1972	City Government
Riverbank State Park	New York, New York	Sewage Treatment Plant	1986-present	City Government
Route 66 State Park	Times Beach, Missouri	Dioxin contamination	1970-1982	City Government
San Felipe Creek Park	Del Rio, Texas	Flood	April 1998	City Government
Toronto Floodplains parks	Toronto, CA	Hurricane	October 1954	City Government

CHAPTER V

BENEFITS OF POST-DISASTER PARKS

The impact of disasters occasionally causes decision makers to consider alternative land uses for affected areas. Turning disaster landscapes into parkland is one land use option that can potentially take people and infrastructure out of harm's way while providing a multitude of other advantages. Benefits are summarized in Table 2.

Table 2. Benefits of Post-disaster Parks

	Reduced vulner-ability	Conservation	Education	Research	Quality of life	Aesthetic	Recreation	Community pride	Commem-orative monument	Economic stimulant	Public relations
Canyon Lake Gorge		X	X	X			X		X	X	X
Devonian Fossil		X	X	X			X	X	X	X	X
Earthquake Park			X						X	X	
Fresh Kills		X	X			X	X	X	X	X	
Grand Forks	X	X				X	X	X		X	
Johnstown Memorial		X	X						X	X	
Mount St. Helens		X	X	X			X		X	X	
Rapid City Greenway	X	X				X	X	X		X	
Riverbank State Park							X				
Route 66 State Park		X	X			X	X		X		
San Felipe Creek Park	X	X				X	X			X	
Toronto Floodplains	X	X				X	X	X		X	

Reduced vulnerability

Development of a greenway in Rapid City, South Dakota, greatly reduced the city’s flood hazard. On June 9, 1972, a storm system stalled over the community of 43,000 inhabitants (NOAA 2007b). The flood dumped approximately a foot of rain on the area in under six hours causing an impoundment dam to burst. This sent a wall of water down Rapid Creek, which runs through the city. The event destroyed 767 homes and 272 businesses, caused $165 million in property damage, killed 238 people, and injured 3,000 more (AP 1997, Berg 1997). The city’s mitigation efforts included using $560 million in federal grants and loans to buy up 1,400 parcels of land in the floodplain and relocate 2,100 families and 260 businesses. The properties alongside the creek were redeveloped into a 1,000-acre greenway extending from one end of town to the other, tripling the city’s parkland acreage (Berg 1997).

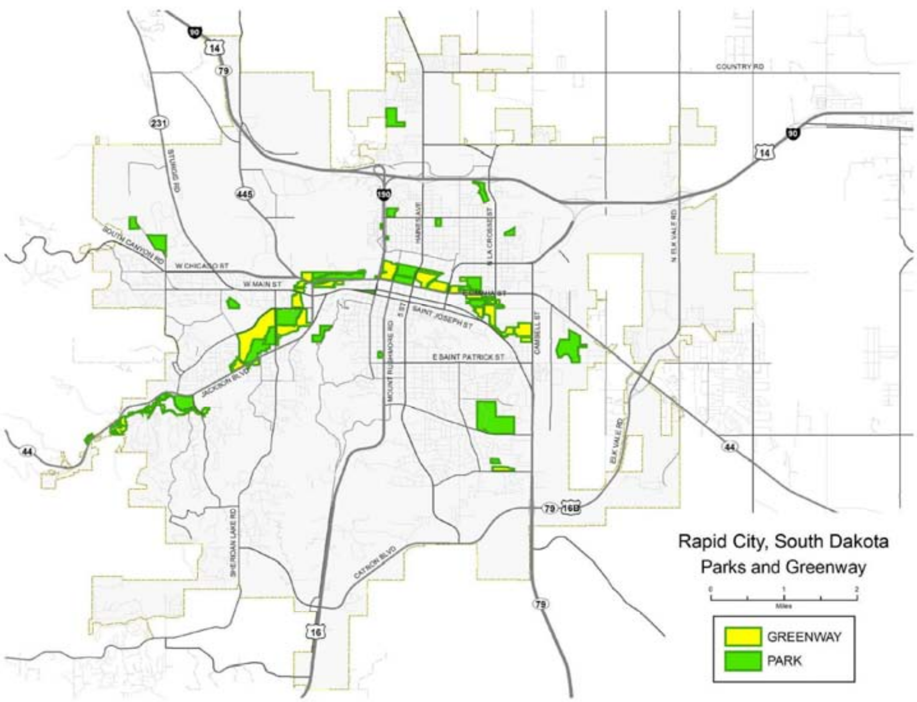

Figure 2. Map of the Rapid City Greenway. This map shows the greenway created after the 1972 flood in yellow (City of Rapid City 2008).

Just weeks before the 25th anniversary of the 1972 flood event, almost three inches of rain fell on the city in 20 minutes causing the largest flood since 1972. The greenway successfully channeled the water away from the city. In the end, there were no reported injuries and homes and roads suffered minimal damage (AP 1997).

The nearby communities of Grand Forks, North Dakota, and East Grand Forks, Minnesota, were also affected by the storms that generated the 1972 Rapid City flood, though not as severely. Despite recommendations by Rapid City's Public Works Director, Leonard Swanson, the cities took no steps to reduce vulnerability until it was too late (AP 1997). When a major flood hit the greater Grand Forks area in April of 1997, breaking the 100-year record, city officials reconsidered Swanson's advice. The event, considered one of the worst natural disasters in the nation's history, caused property damage of almost $2 billion (Draves 1999, Gregory 2007, NOAA 2006). The tragedy led leaders to move ahead with plans to construct a greenway fashioned after Rapid City's, designed to mitigate future flood damage (Haga 1997). The park, which extends for eight miles on either side of the Red River and includes a $400 million system of floodwalls and dikes, has substantially reduced subsequent flood damage (City of Grand Forks 2004).

Figure 3. Grand Forks Greenway (City of Grand Forks 2004).

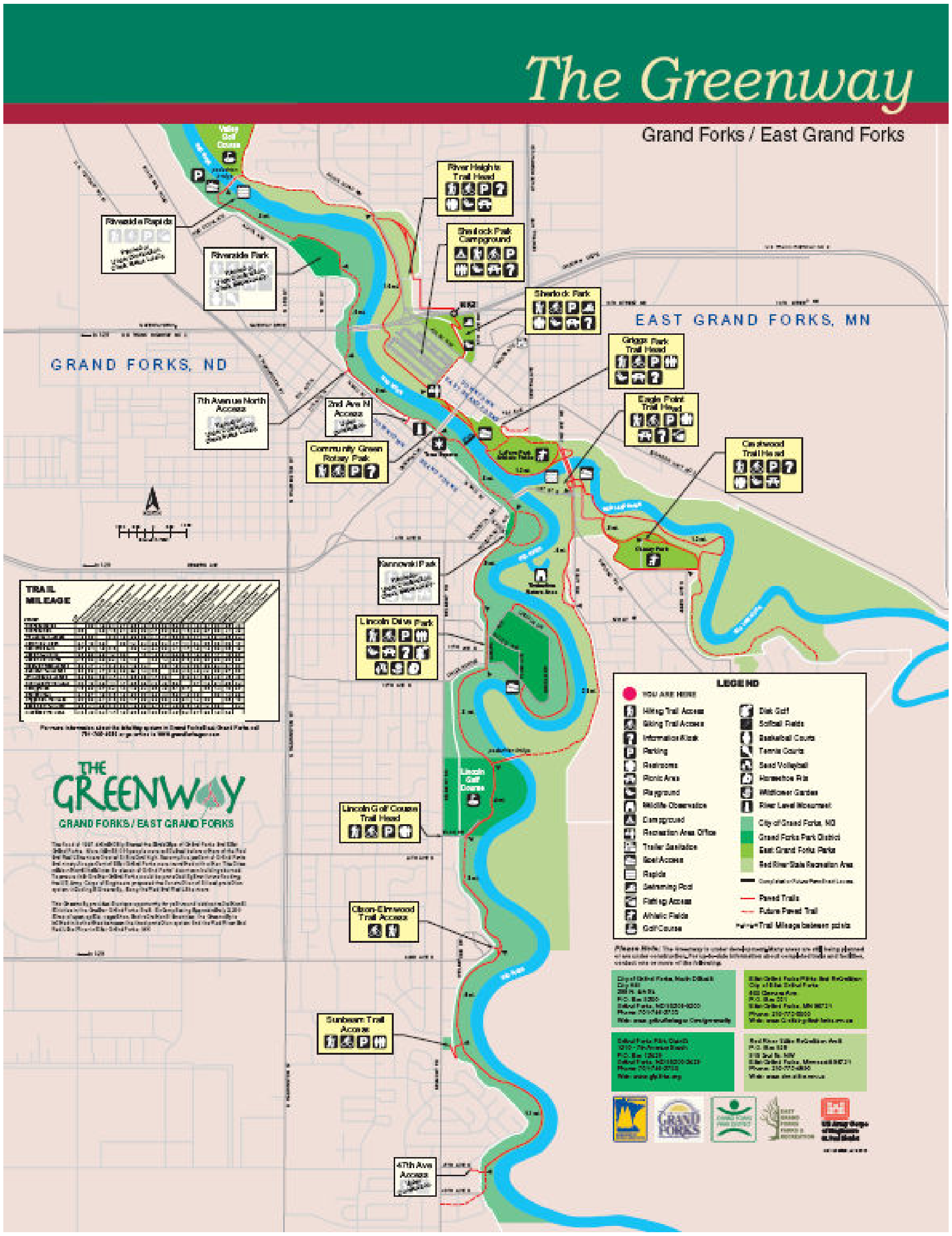

Figure 4. Map of the Grand Forks Greenway (City of Grand Forks 2004).

Flooding caused by Tropical Storm Charlie in April of 1998 also prompted construction of a greenway in Del Rio, Texas. Fifteen inches of rain in 12 hours caused flash flooding along San Felipe Creek, a tributary of the Rio Grande that flows through the city (FEMA 2003, NOAA 1998). The flood killed 14 people, injured 40 more, damaged more than one thousand buildings, and demolished 120 homes (FEMA 2003). Monetary damages totaled an estimated $30 million, causing further economic strain on one of the poorest regions in the nation. Many residents who lost homes were uninsured and could not speak English and most of the destroyed businesses were small and single-family operated. The historic downtown, situated in the flood plain, was completely destroyed (Herrick 1998). FEMA gave the city $3.75 million to buy out 170 homes in the floodplain to reduce future flood losses, and a federal transportation grant was awarded to help with trail construction (City of Del Rio 2007, FEMA 2003, Harvey 2003). These 26.1 acres were then "reborn as a stretch of urban parkland" named San Felipe Creek Park (Harvey 2003, 1).

Figure 5. Swimmers at San Felipe Creek (Eckhardt 2008).

The most extensive land use change, examined in this study, occurred in Canada after Hurricane Hazel struck Toronto in October of 1954. Raging waters caused by the storm leveled 20 bridges, dismantled communication systems, destroyed roads, and swept away entire blocks of houses filled with sleeping residents (Allemang 2004). Most of the damage occurred close to rivers and creeks. The event brought together four regional conservation authorities to establish the Toronto and Region Conservation Authority (TRCA). The unified authority was created to mitigate future storm damages. Brian Denney, the chief administrative officer for TRCA in 2004, said that Hazel made it clear that building in Toronto's floodplains needed to stop, adding that one of his organization's chief priorities was to hinder such development. In order to prevent another Hazel, TRCA began to acquire land in the floodplain (Hall 2004). All areas below high-water lines were designated as parkland, unavailable for development (Taylorsville 2005).

Figure 6. Interpretive Exhibits at Post-Hurricane Hazel Parks. A mural at Raymore Park shows where homes were wiped away during the storm, and a display at Marie Curtis Park illustrates green space created after the hurricane (TRCA 2008).

"These parks are not just frill, they're a necessity," Toronto historian Madeleine McDowell said (Allemang 2004, 2). Denney said that a storm like Hurricane Hazel could still cause damage to the Greater Toronto Area, though not as extensive; "There wouldn't be houses floating down the rivers," he said (Hall 2004, 3).

Figure 7. Greenways Before and After Hurricane Hazel (TRCA 2008).

Conservation and preservation

Post-disaster parks also have potential to conserve and preserve significant natural and cultural features. Catastrophic flooding in south-central Texas during the summer of 2002 caused USACE's Canyon Lake Dam to overflow for 39 days. Peak flow over the spillway of more than 70,000 cubic feet per second (cfs) was reported on July 5, reaching a maximum depth of seven feet the following day. Some 800,000 acre feet (af) of water overran the spillway, gouging out 17 million cubic feet of trees, soil, and early Cretaceous limestone bedrock before joining the Guadalupe River 1.2 miles downstream (Agold et al. 2002, GPS 2008). The event carved a canyon in the landscape, 40 feet deep and up to 100 feet wide in some locations (Earl, Benke, and Knaupp 2003; GPS 2008). "The geologists from academia went nuts . . . it didn't take long before it was all over Texas," Guadalupe-Blanco River Authority (GBRA) employee and Gorge Preservation Society (GPS) board member Streeter-Rhoad (2008a, 1) said about the reaction to the gorge. Ancient sea ripples, aquifer channels, fossiliferous beds, a fault line, and dinosaur tracks were discovered in the exposed strata. In July of 2002, the scoured limestone of the gorge was blindingly bright and bare. Today the site supports a variety of plant and animal life. The most common species of plants found include Sycamore, Ashe Juniper, Cudweed, Bushy Blue Stem, Cattails, Poverty Weed, and Thoroughwort. The wetland areas support tadpoles, small fish, sedges, ferns, and algae (Ibes 2007).

A similar event occurred almost ten years earlier in Coralville, Iowa, when the USACE Coralville Dam was overrun by floodwaters in July of 1993. Reaching a peak flow of 17,000 cfs on July 5, water flowed over the spillway for 28 days ripping out a road and destroying a campground as it scoured away 15-feet of vegetation, topsoil, sediment, and Middle Devonian Cedar Valley Group limestone bedrock (Leighton and Schneider 2004, Witzke and Bunker 1994). The exposed limestone surface of the half-mile-long channel revealed a jewel much like the Canyon Lake Gorge—a 375-million-year-old fossiliferous sea floor that contained diverse and, "spectacularly preserved" communities of fossils, including corals, bryozoans, brachiopods, trilobites, conularids, and placoderms (Leighton and Schneider 2004, 401). Other fascinating features included an extraordinary bone plate from an armored fish and exceptional crinoid specimens. The site was named the Devonian Fossil Gorge (Witzke and Bunker 1994). Brian Glenister (2003, 1), geology professor emeritus at the University of Iowa, wrote, "Recognition of the regional public interest in the educational, recreational and tourist appeal of the gorge motivated a local committee, working closely with the U.S. Army Corps of Engineers, to develop a plan for development of the site." Established in 1996 as a 501(c)(3) not-for-profit educational organization, a community group, Devonian Fossil Gorge Inc., formed to "preserve and interpret this unique and recently discovered Iowa geological phenomenon, and to make accessible to everyone its enormous educational and recreational potential by designing and constructing an exciting facility to promote and preserve a rarely observed 375 million-year-old resource" (Escher 2008, Glenister 2003, 1). Terry Escher (2008, 1), park interpreter and USACE employee, believes that visitors develop a sense of ownership and an emotional attachment to the gorge which invokes a desire to protect and preserve it.

Figure 8. Satellite Image and Drawing of the Devonian Fossil Gorge Facility (Google 2008).

Another post-disaster park, the Johnstown Flood National Memorial in Pennsylvania, protects important cultural and natural features. The much-delayed memorial was established by Congress in 1964 to commemorate the Great Johnstown Flood of 1889, considered "one of our country's greatest disasters" (Lewrenz 2000, 1). The extent of the devastation is attributed largely to a shoddily built and ill-maintained dam constructed by the exclusive South Fork Fishing and Hunting Club 14 miles upstream from Johnstown. The failure of the dam during heavy rains in May 1889 sent a thundering wall of water, carrying everything from barns to people, down the river and through Johnstown. More than 2,209 of the 30,000 residents lost their lives in the event. The Johnstown Flood Memorial, a unit of the National Park Service, preserves a variety of cultural features that tell the story of the disaster. Within the boundaries of the park, visitors can explore remnants of the South Fork Dam, the South Fork Fishing and Hunting Clubhouse, surrounding cottages, and the Unger House, former home of club president Elias Unger (NPS 2007). According to a survey conducted by Pennsylvania State University between 1997 and 1999, the park area also protects significant natural features. Students and faculty recorded sightings of some 70 species of birds and 13 species of butterflies within the 170-acre site (NPS 2007, Richardson 2008).

The Rapid City and Grand Forks greenways also conserve and preserve natural features. Rapid City's greenway includes open spaces that are left untouched (AP 2003). The Grand Forks Greenway website boasts that their post-disaster park "will allow for restoration and the reestablishment of native riparian prairie and stream bank vegetation" and provide "the perfect opportunity to view many different species of birds in their natural habitat" (City of Grand Forks 2004, 1-2).

San Felipe Creek Park is of special interest to Texas Parks and Wildlife Department (TPWD) biologists because it will protect "one of Texas' clearest spring-fed creeks" and home to a newly discovered species of fish, the San Felipe *Gambusia* (Garrett 2008, Harvey 2003, 1). The fish was discovered after the 1998 flood "cleaned out the system" and prompted better environmental management practices, according to Gary Garrett (2008), a biologist at TPWD. Another rare fish species, the Devil's River minnow, also calls San Felipe Creek home. The city plans to improve management practices in the creek corridor to restore the riparian zone protecting the newly discovered and threatened fishes. The local golf club has also supported conservation efforts by keeping the creek banks un-mowed and reducing their use of fertilizers, pesticides, and exotic plants. City officials said the project demonstrates that urban and natural areas can intermix, and even benefit each other (Harvey 2003).

Post-Hurricane Hazel parks in Toronto are one of the largest interconnected park and wildlife sanctuary systems in the world (Taylorsville 2005). TRCA was founded in response to the storm and has since "evolved into the most important player in the protection and revitalization of the GTA's [Greater Toronto Area's] natural environments" (Hall 2004, 1). Today the authority boasts a $45 million budget, owns more than 35,000 acres of land, and has been called the area's leader in wildlife and forest protection, biodiversity initiatives, and outdoor education programming (Hall 2004). Gregor Beck, former director of conservation science with Ontario Nature, credited recovery efforts with saving Toronto's natural habitats; "The vast majority of these wooded areas would have been paved over or built upon had it not been for what we did after that storm struck," he said (Hall 2004, 1).

An extreme natural event that has led to preservation of magnificent natural features was the eruption of Mount St. Helens in May of 1980. Triggered by a massive crater collapse, the eruption completely transformed the landscape. The north face of the volcano collapsed, and 600-mile-per-hour, 400-degree-Fahrenheit winds blasted across the landscape, "leveling forests, vaporizing foliage, and searing soils" (McNulty 1999, 1). Over 240 square miles of forest was flattened, leaving nothing but ash, fragments of volcanic rock, and what appeared to be "a scorched and lifeless landscape" (McNulty 1999, 1). According to Roland Emetaz (2008, 1), recreational staff officer at the monument from 1982-1988, "the area was so altered that new land surveys were required." On August 26, 1982, Congress established the Mount St. Helens National

Volcanic Monument under the authority of the United States Forest Service (USFS). The monument was "dedicated to protect and preserve this opportunity to observe the dynamic forces of nature and the natural recovery of the land." The park's master plan detailed "measures for the preservation of natural geologic and ecologic processes" (Emetaz 2008, 1-3). Of the monument's 110,330 acres, 99.6 percent is undeveloped. Remaining land was developed "for use by the visitors for enjoyment of the Monument" (Emetaz 2008, 1). As a dynamic and evolving area, it was understood that as succession continued and conditions evolved, plant and animal species would come and go, but increase in number overall. By 1999, more than 34 species of birds and mammals had been identified on the site, including meadowlarks, sparrows, red-wing blackbirds, mice, voles, hawks, and geese (McNulty 1999).

Figure 9. Before and After the Eruption of Mount St. Helens (USGS/Cascades Volcano Observatory 2001).

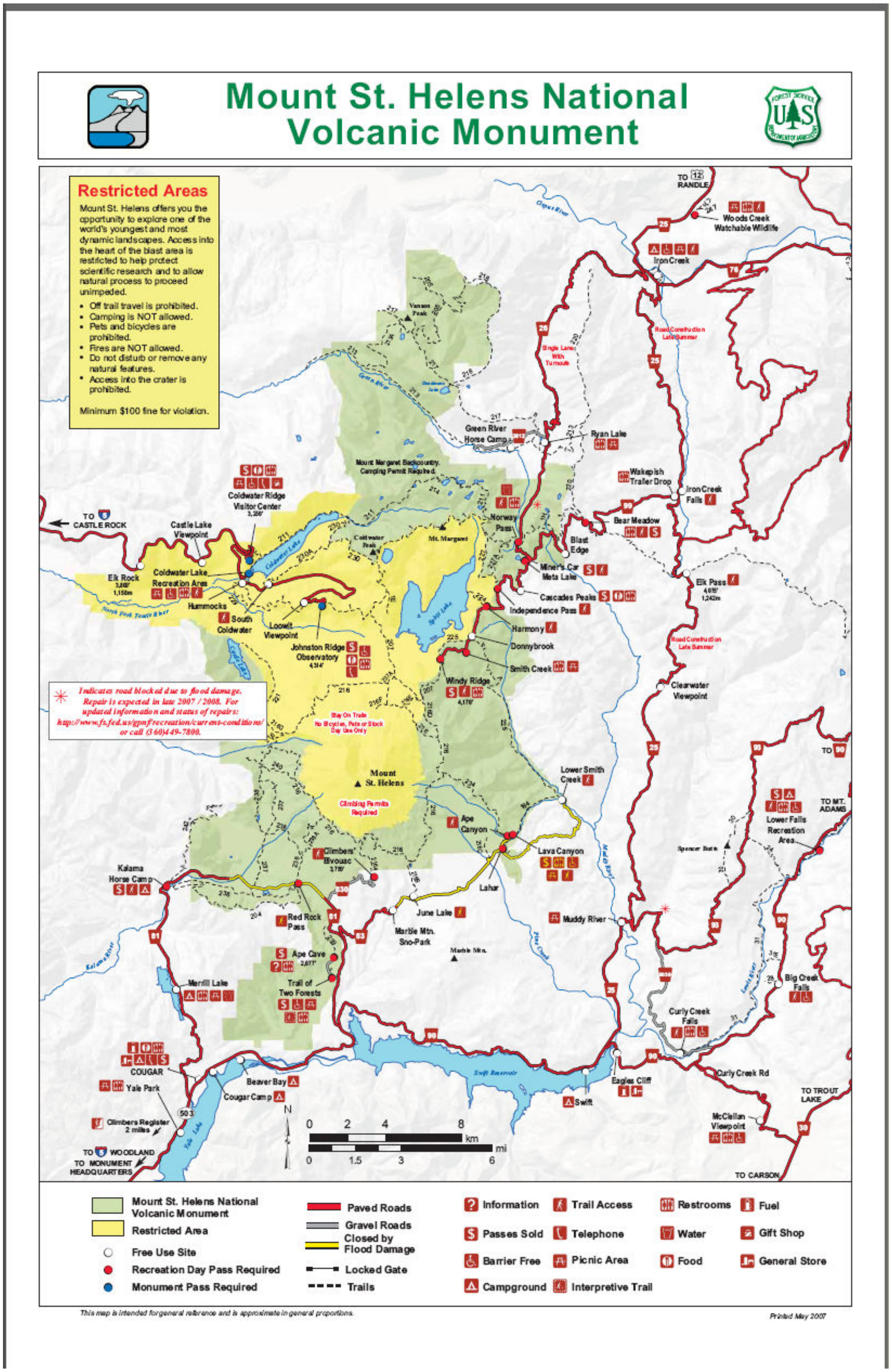

Figure 10. Map of Mount St. Helens National Volcanic Monument (USFS 2007).

A modest display, weathered and overgrown with vegetation is located at 4306 West Northern Lights Boulevard in Anchorage, Alaska. The monument was constructed after Alaskans endured the worst recorded earthquake in North American history and the second strongest earthquake ever measured in the world. In March of 1964, the Pacific tectonic plate slid some 30 feet under the North American Plate, causing a quake measuring 9.2 on the Richter scale that released about 10 million times the energy of the first atomic bomb (Rozell 2004). A tsunami "swept from the Gulf of Alaska across the length of the Pacific and lapped against Antarctica" (NRC 1968, ix). According to Doug Christensen, associate director of the University of Alaska's Geophysical Institute, "water sloshed in lakes and harbors as far away as Louisiana, and water levels jumped in wells as far away as South Africa" (Rozell 2004, 1). Alaskan towns were devastated. Huge landslides caused a three-block portion of downtown Anchorage to drop some 25 feet, bringing the roofs of some buildings level with the sidewalks. Trees were uprooted, homes and businesses crumbled, and crevasses formed in solid ground as the Earth shook for a full four minutes. The city of Seward was pushed some 20 feet to the south, Cordova moved about 46 feet southeast, areas of Montague Island rose more than 30 feet, a slab of Valdez's waterfront slipped into the sea, and portions of Portage dropped nine feet (Rozell 2004). All told, the event caused more than $1 billion dollars of damage (in 1964 dollars) and 131 casualties, 16 in Oregon and California (Clifford 1986). According to the National Academy of Sciences, more than 90 percent of the mussels in Prince William Sound were killed, Ship Creek stopped flowing for 18 hours, and eruptions of Old Faithful in Yellowstone National Park were shortened due to the quake (Rozell 2004, NRC 1968).

Most of Anchorage was rebuilt, but one area was spared as a "reminder of the devastation that was brought on by the earthquake" (Zawacki 1972, 1). During the event, the affluent Turnagain Heights borough in Anchorage, situated in the bluffs above Cook Inlet, "broke loose by the seismic action of the earthquake, moved outward and broke into blocks that continued to flow out into the waters of Knik Arm until equilibrium was reached" (Schmidt et al. 1965, 4). The Turnagain Slide, almost two miles wide, "resulted in the jumble of individual blocks and the total destruction of homes" (Schmidt et al. 1965, 4). In 1966, the Anchorage Centennial Commission was looking to establish a park in celebration of the centennial that had "the possibility of identifying itself as a part of the Anchorage scene, that would be easily accessible, and . . . of sufficient interest so that its economic value could be measured in the highest degree of tourist attractions," according to B. W. Creighton (1969, 1), the director of the Anchorage Parks and Recreation Department at the time. The Commission decided that the 122-acre Turnagain Slide site, held in title by the Alaska Divisions of Lands, fit the criteria. Ownership was transferred to the borough, and then leased by the city for one dollar a year until December 31, 2016 (Creighton 1969, Zawacki 1972). In 1967, development of Earthquake Park began with "construction of the access road, large parking area, small picnic area, construction of heavy duty, rustic stairway from the upper to the lower plateau, and the routing, clearing and stabilization of foot trails through the area" (Creighton 1969, 4). A permanent sign was erected that tells the story of the quake and the park (Creighton 1969).

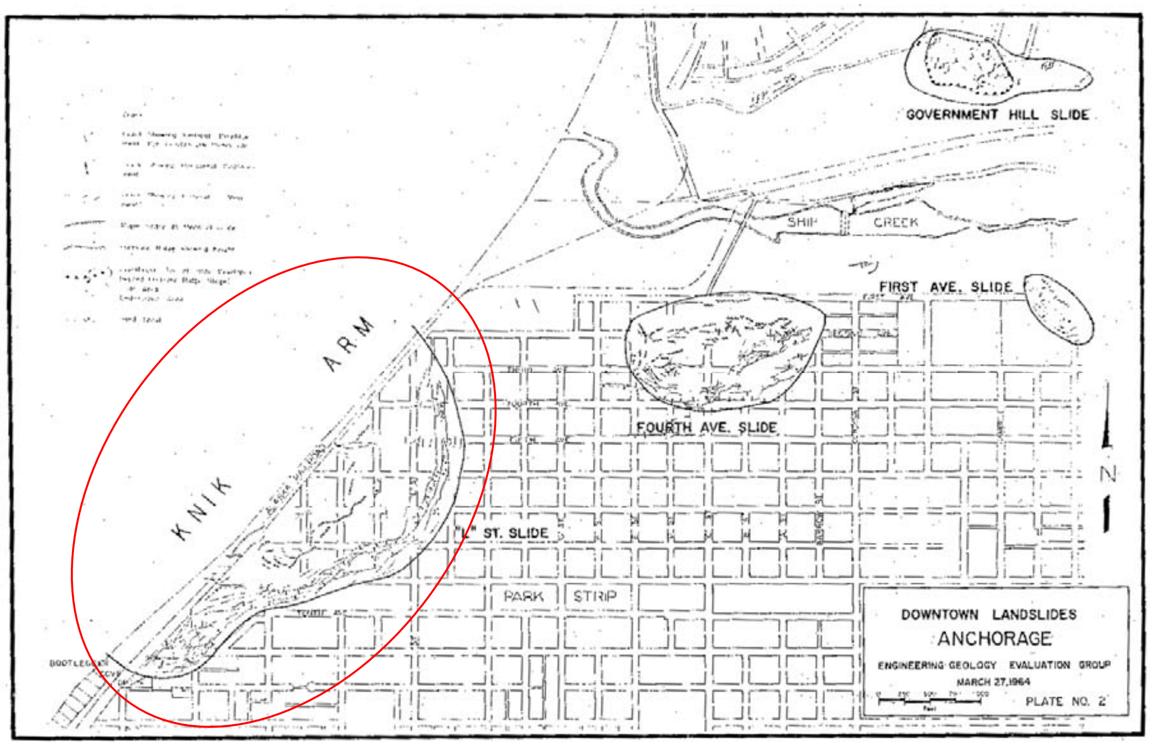

Figure 11. Map of Landslides Caused by the 1964 Quake. The highlighted area is the Turnagain Slide (Schmidt et al. 1965).

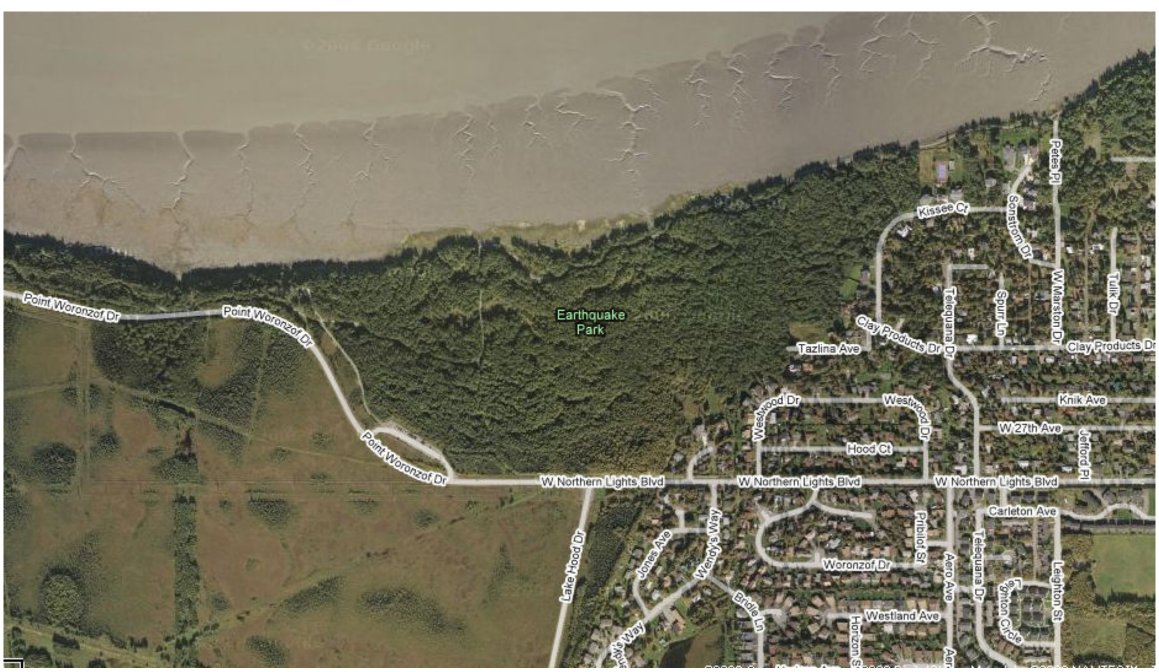

Figure 12. Satellite Image of Earthquake Park. Instead of rebuilding the area, Turnagain Slide was turned into 122-acre Earthquake Park (Google 2008).

In response to plans in the early 1970s to build a "Tidewater Highway" through the park, Charles Zawacki, an employee of the Anchorage Parks and Recreation Department, began an investigation of the site (1972, 2). Zawacki wrote a report hoping to promote "the nomination of Earthquake Park as a Historic Site, to the National Register of Historic Places." Zawacki felt the designation "would be all the park needed to prevent from being 'eaten up' by future city development" (Zawacki 1972, 2). According to Zawacki's wish, the area was established as a Historic Site in the National Register and was never developed.

In 1981, a grant from the Municipality of Anchorage Planning Department funded production of a brochure and interpretive signage for Earthquake Park. The interpretive materials discuss the natural and cultural features preserved by the park. The wildlife habitat in the area of Turnagain Heights was radically altered by the 1964 quake, causing a change in the flora and fauna of the area. The brochure shows a map of the area and points out features left by the quake including a tree that dropped 50 feet and moved sideways 500 feet, plants that drowned under clay blocks, and areas where topsoil was eroded that now only support hardy plants and weeds (Gordon Sheret & Associates 1981). The brochure also discusses which wildlife left and which species were able to adapt to the post-quake landscape. "Wildlife is not abundant," it states, but some animals still can be spotted and "vegetation thrives in many of the ponds" (Gordon Sheret & Associates 1981, 1).

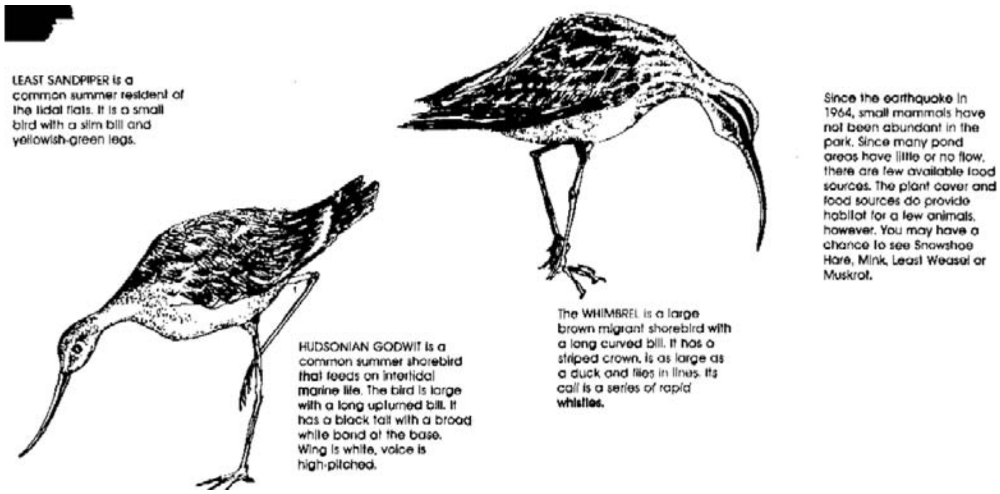

Figure 13. Excerpt from Earthquake Park Brochure. The post-quake landscape reduced habitat for a number of small mammels around Turnagain Heights, but habitat for Showshoe Hare, Mink, Least Weasel or Muskrot remain (Gordon Sheret & Associates 1981).

The closure of Fresh Kills Landfill on New York's Staten Island in 2001 presented the city with conservation, preservation, and restoration opportunities. For 53 years, the site served the solid waste disposal needs of the area, receiving up to 29,000 tons of trash daily. What remained was 2,200 acres of severely altered landscape, 45 percent of which was covered by four enormous landfill mounds ranging in height from 90 to 225 feet, containing some 150 million tons of solid waste (NYCDPR 2008).

In 2001, the city of New York launched an International Design Competition to solicit plans for adaptive use of the site that was to be named Fresh Kills Park. The competition solicited proposals for a master plan "that would meet the needs of the City's communities, and respond to the natural and constructed history of the site" (NYCDCP 2008, 2). The winning proposal, *lifescape,* was submitted by landscape architecture firm Field Operations. The 61-page plan envisioned a site that would sustainably restore native ecological systems such as native wetlands, prairies, maritime oak forests, salt marsh, and swamp forests (NYCDCP 2008).

Route 66 State Park, located on the former site of Times Beach, Missouri, is an unlikely place for conservation and preservation. In 1925, the community was founded as a summer resort and the St. Louis Times offered 2,000 square-foot lots free with a six-month subscription to the newspaper (Domjan 2003). In the early 1970s, the city hired waste oil recycler Russell Bliss to spray the streets with oil to control dust. Independent Petrochemical Corporation (IPC) had hired Bliss to dispose of dioxin waste produced in the manufacturing of a skin cleanser, hexachlorophene. Bliss disposed of the waste by mixing it with used oil, which he then sprayed on the streets of Times Beach (USDOJ 1997). Soil samples collected by the Environmental Protection Agency (EPA) in the 1980s found dangerously high levels of dioxins in Times Beach. Residents were officially informed of the crisis during the town's annual Christmas Party on December 23, 1982, during which officials from the Centers for Disease Control encouraged community members to stay out of Times Beach and relocate (Domjan 2003). In 1983, the EPA gave FEMA $30 million to buy out homeowners in the area. By 1986, all 2,041 residents were permanently relocated (Domjan 2003, EPA 2006). Times Beach, no longer on the map, is now 419-acre Route 66 State Park, named after the historic road that runs through it. Today, the site of one of the country's greatest environmental disasters is a surprising mecca for animals, boasting "a multitude of wildlife including turkey, geese, deer, and more than forty species of birds," according to Kathy Weiser (2005, 1), a writer for the online travel guide *Legends of America*. "Excellent opportunities to picnic, exercise, birdwatch or study nature await visitors," the park website states (MODNR 2008).

Educational opportunities

Educational opportunities also accompanied establishment of many post-disaster parks analyzed in this research. The Canyon Lake Gorge is being used as a dynamic outdoor classroom were students and other visitors can learn concepts across multiple disciplines including geography, biology, hydrology, paleontology, ecology, and human-nature relations. Exposed aquifer channels, artesian springs, and mysterious seeps display the interconnectedness of groundwater and surface water and teach the danger of contaminating either source. Exposed fossil beds, ancient sea ripples, and dinosaur tracks paint an image of Texas's ancient environment and illustrate how it has changed over the course of time. Primary succession taking place in the gorge offers a rare glimpse of nature repairing itself as new life sprouts in the cracks and crevasses, and aquatic plants and animals find their way into the pools and aquifer channels (Ibes 2007).

The Devonian Fossil Gorge first opened to the public on Labor Day 2003, just two months after the flood event, attracting 16,000 visitors the first weekend. Just a few miles off an interstate highway, the site was within easy reach to the hundreds of visitors that flocked to the site every day. The number of visitors increased dramatically after a nationwide news release by CNN and NBC was aired, attracting 200,000 domestic and international visitors in 1994 alone. The torrent of school groups, elderly tourists, and other visitors to the site was as one geologist stated "astounding" (Witzke and Bunker 2004, 31). The influx of people provided a rare and exciting educational opportunity. "If we were going to let people visit the site, they should be guided and informed in some way," said Escher (2008, 1). USACE printed 500 copies of an interpretive brochure, written by geologists at the Iowa Department of Natural Resources that guides visitors thorough the site while teaching them about the history of the site, the flood, and the exposed features (USACE 2007b, Witzke and Bunker 1994). Escher (2008) has been giving tours of the gorge for 15 years and feels that the most important things visitors learn from the site are the power of nature, the fact that Iowa was once covered by a tropical ocean, and that even catastrophes have a silver lining. She said when visitors see the actual fossilized remains of ancient sea life, they can more readily comprehend that Iowa was once underwater, which helps them understand the dynamic processes of our planet. The two-ton slabs of solid bedrock transported downstream demonstrate the power of nature and that "nature is a force to be reckoned with, something even the Corps of Engineers cannot stop," Escher (2008, 1) said. The park is a place of discovery, full of mysteries, according to Bettis (Iowa DNR 1994). "We are always finding something new down there. Children have an incredible time," Escher (2008) said.

Thousands of students visit Mount St. Helens National Volcanic Monument annually to learn about the volcanic eruption and how the landscape has been evolving since the event. The website has a "Teacher's Corner" which provides educators with environmental and scientific education materials and itineraries for field trips. School groups often explore the Coldwater Ridge Visitor Center and Johnston Ridge Observatory. "Located in the heart of the blast zone," the observatory allows students to enjoy interpretive displays that "magically portray the sequence of geologic events that transformed the landscape and opened up a new era in the science of monitoring an active volcano and forecasting eruptions" (USFS 2007, 3). Maps, books, and interpretive materials can be found in the visitor center. Ranger-led programs include talks on the eruption, rock identification, and how plants and animals survived the blast. Visitors can learn more about the monument and its history in an outdoor setting by following trails and interpretive signs at the Lahar Viewpoint, Ape Cave, and the Trail of Two Forests (USFS 2007).

Figure 14. Overlook at Earthquake Park. Interpretive exhibits teach visitors how the Great Alaska Earthquake of 1964 affected this area (Bain 2008).

Educational exhibits can also be found at several other post-disaster parks. Earthquake Park has served as an outdoor classroom with a trail system and interpretive signs that help visitors understand the destructive power of the 1964 quake. Two trails at the Johnstown Flood National Memorial lead to interpretive exhibits, pointing out cultural features and telling the story of the Johnstown flood. The visitor's center screens *Black Friday*, a documentary film about the event. The master plan for Fresh Kills Park also includes educational opportunities. Route 66 State Park's visitors' center houses "Route 66 memorabilia and interprets the environmental success story of the former resort community of Times Beach, which once thrived on the location of the park" (MODNR 2008, 1).

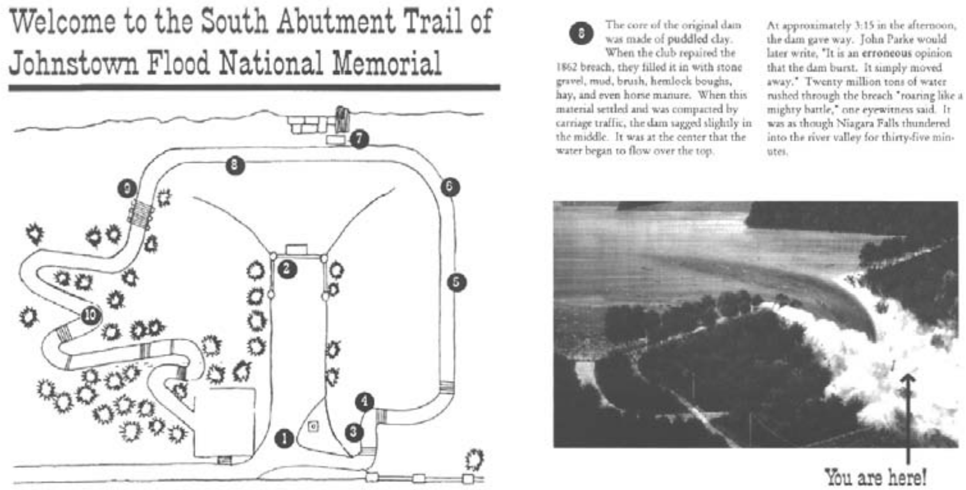

Figure 15. Excerpts from Interpretive Guide at Johnstown Flood National Memorial. The map points out features of interest along park trails (NPS 2007).

Research opportunities

Three post-disaster parks analyzed in this study were found to provide significant opportunities for scientific research. The landscape uncovered during the 2002 flood in Canyon Lake revealed a unique opportunity to study the geologic history of Texas, the movement of ground and surface water, biological succession, and the processes of weathering and erosion. The scoured landscape at the Canyon Lake Gorge provides a snap shot in time, allowing scientists to piece together a 100-million-year-old picture of Texas. The left-right, left-right progression of eight impressions on the floor of the gorge maintained a consistent length and size, giving solid evidence they were left by a dinosaur. Geologists believed these to be footprints of *Acrocanthosaurus atokensis*, a bi-pedal, three-toed carnivore that walked the shore of the sea that covered Texas during the Cretaceous Period. The leg length of the creature is an estimated ten feet and two inches with an average stride of ten feet and eight inches. Vertical successions and lateral exposures of rocks also allow geologists to study how the environment of the area has changed over time (Keairns 2003). Fossiliferous beds preserved a variety of ancient marine life, including *Orbitolina texana, Salenia texana, Porocystis globularis, Heteraster olbiquatus, Nerinia spp., Liopsitha walkeri,* and *Tousasia texana.* Carbonate ripple marks at the site were studied by scientists who determined they had been produced by wave action in a shallow marine environment. The oscillation of the waves caused the sediment to form ripples that were hardened by the sun when the sea receded. The discovery of two layers of ripples told geologists that wave patterns changed directions sometime in the area's history. The 2002 flood event also revealed the Hidden Valley Fault, a historically documented fault within the 180-mile long, 25 million-year-old Balcones fault system. This exposed portion allowed scientists to extensively study a fault at the surface for the first time in modern history (Ibes 2007).

Displays at the gorge also allowed scientists to examine and understand how water flows through a limestone fault and how groundwater and surface water are connected. Natural seeps, artesian springs, and exposed aquifer channels reveal the inner workings of an aquifer and the movement of groundwater. Features demonstrate how groundwater becomes surface water, and surface water again becomes groundwater in a potentially endless cycle. Water that appears near the access point disappears and further down reappears after traveling horizontally and vertically through the fractured and faulted limestone. It is still unknown whether the water source that supplies the waterfalls and fills the crystal clear pools is coming from the lake or an underground water supply (Ibes 2007).

Because the flood event removed all biological material, leaving only a bare limestone surface, the gorge displayed a rare example of primary succession. Over the last six years, soil has slowly deposited in the holes and crevices of the limestone. As seeds blew in, they sprouted into plants and trees. At the same time flowing water transported aquatic animals and plants that made their home in the pools and aquifer channels (Ibes 2007).

The dynamic transitioning landscape is also valuable for the study of weathering and erosion. Sediment sliding down steep cuts, rock falls, and moving water are constantly changing the face of the gorge. Pleistocene depositional sediment pours down the limestone layers like frosting on a freshly cut cake, providing nutrients for plant life that has found its way into the gorge. The changing colors of the rock from gray to gold illustrate the change in color that occurs when limestone is exposed to air. Gray underground, eventually all the exposed limestone will turn a golden color (Ibes 2007).

So far, research has been conducted at the site by Exxon-Mobil, the University of Texas–Austin, Texas A&M University, and the Southwest Research Institute (SwRI) (GPS 2007). Researchers from SwRI teamed with four major oil companies to study the geology and stratigraphy of the Hidden Valley Fault exposed at the site. SwRI's research focused on gaining a better understanding of faulting in limestone aquifers and petroleum aquifers and may lead to models for limestone structures that contain oil and gas (Fohn 2007).

Like the Canyon Lake Gorge, the Devonian Fossil Gorge is also a place of discovery where scientists can study the geologic history of the area and primary succession. According to Witzke and Bunker (1994, 31), the gorge was a "natural science laboratory" that provided a unique glimpse of Cedar Valley Group and Little Cedar Formation geology as well as significant bedding plane surfaces. A visit to the park is like walking through a living museum—an ancient seafloor preserved just as it was 375 million years ago. Exposure of the ancient seafloor uncovered fossiliferous beds deposited in an open-marine environment. E. Arthur Bettis, a professor of geosciences at the University of Iowa, raves about the layered deposits along the steep banks cut by the flood. These deposits of varying colors and textures are a perfectly preserved record of major periods of accumulation which help piece together the history of the Iowa River Valley (Iowa DNR 1994).

The eruption of Mount St. Helens in 1980 presented scientists with "a magnificent laboratory" where they could monitor and study ecosystem recovery and other geologic wonders (McNulty 1999, 1). The event offered "tremendous scientific, educational and recreational values in a very fragile environment," Emetaz (2008, 1) said. "The single greatest surprise to scientists entering the blast zone shortly after the eruption was the realization that many organisms survived in, what initially appeared to be, a lifeless landscape," according to monument scientist Peter Frenzen (2000, 14).

Enhancement of communities' quality of life

An enhanced quality of life followed the development of several post-disaster parks by boosting community pride and cohesion, aesthetically improving the areas, and/or providing recreational amenities. The greenway in Rapid City became a source of community pride for residents, as revealed by the force with which they fought for its protection. Regulations built into the original plan prohibited construction of structures, even temporary ones, on the greenway. In addition, any proposed sale of parkland had to be approved by public vote. In 1996, a developer attempted to buy parkland for a 15-acre grocery store and strip mall, but the citizens of Rapid City voted down the proposal 57.4 to 42.2 percent (AP 2003, Berg 1997). Leonard Swanson, the public works director when the greenway was built, felt the residents' attachment to the park's beauty would impede future development attempts (AP 1997). Journalist Steve Berg (1997, 3) said the unwillingness of the community to let the greenway be developed demonstrates its "symbolic and emotional significance." The greenway also provides the community with recreational amenities such as playing fields, baseball diamonds, a golf course, and hike and bike trails (AP 2003).

The citizens of Grand Forks and East Grand Forks are proud of the greenway that not only beatified their cities and provided recreational amenities, but also brought the two communities together. Facilities in the 2,200-acre park consist of a 20-mile system of hiking, biking, cross-country skiing, and snowmobiling trails, two golf courses, and a 72-site campground. The area also boasts picnic shelters, fishing, canoeing and kayaking opportunities, open space, and a sledding hill (City of Grand Forks 2004, Gregory 2007). The City of Grand Forks website states that the key function of the park is flood mitigation, but also recognizes it as "an enhancement to the local quality of life providing recreational opportunities and scenic views previously unavailable in the Greater Grand Forks area" that "will allow for restoration and the reestablishment of native riparian prairie and stream bank vegetation" (City of Grand Forks 2004). According to Tom Dennis (2007, 1), a journalist at the *Grand Forks Herald* in 2007, the greenway has become "a priceless asset, one of the very best things about living in Grand Forks and

East Grand Forks . . . an asset of which the U.S. as a whole as well as North Dakota, Minnesota and the Grand Cities can be very proud." The Grand Forks Greenway website says, "The Greenway is the result of the aftermath of the Flood of 1997. After enduring one of the greatest natural disasters of our time, the communities of Grand Forks and East Grand Forks seized an opportunity to rebuild and reshape their future along the banks of the Red and Red Lake Rivers" (City of Grand Forks 2004, 1). Melanie Parvey-Biby, the Environmental Compliance/Greenway Manager for the City of Grand Forks, feels the biggest asset to the Grand Forks Greenway is that it facilitated a relationship between the formerly distant cities. "The greenway has provided neighborhood connections that weren't there prior to development and this has been huge in bringing the two communities and their citizens closer together," she said (Parvey-Biby 2008, 1).

San Felipe Creek Park has the potential to provide much-needed assets to the citizens of Del Rio, Texas. Parkland in the city is unnecessarily lacking according to a 2007 park analysis included in the City of Del Rio Master Plan. Using figures from the 2000 census, the study recommends 210 acres of land be designated for community, neighborhood, and mini parks, but adds that "based on the park acreage available to the community today, the city is roughly 57 acres deficient in the amount of public parkland" (City of Del Rio 2007, 4-30). The city leases 73.14 acres of their parkland to a golf course that is not open for public use, exacerbating the shortage. The document mentions acquired land as unused open space just waiting to be developed for community use: "Buy-outs from the 1998 flood present a unique opportunity for the city to develop mini-parks, neighborhood gardens and gathering areas, and possible trail connections to the springs" (City of Del Rio 2007, 4-3). According to Texas Parks and Wildlife Department

(TPWD) news and information director Tom Harvey (FEMA 2003, 1), no man-made structures could do what the proposed greenway can do—protect animal habitat, beautify the city, and prevent future flood damage.

Post-hurricane parks have improved the quality of life for citizens of Toronto and neighbors of Mount St. Helens. Post-disaster parks in Toronto created a *green identity* the community is proud of while creating opportunities for recreation. "For so many people, having ribbons of green is what makes the city livable," according to Beck (Hall 2004, 1). A recreational bonus has resulted from creation of the Mount St. Helens Monument where miles of trails take visitors around the park and to the rim of the crater.

Aesthetic improvement and recreational facilities were provided by Fresh Kills Park and Route 66 State Park. The master plan for Fresh Kills Park illustrates a landscape completely transformed from a malodorous 53-year-old garbage dump to "a vibrant locus for social life—for all kinds of active recreation, for physical and cultural experience" (NYCDCP 2008, 4). Planned amenities include hiking, biking, and equestrian trails, sport fields, public art space, restaurants, boat launches, and canoeing and birding opportunities (NYCDCP 2008). Likewise, Route 66 State Park transformed the site of a toxic disaster into a 419-acre park with "pristine scenery," a picnic area, seven miles of hiking, biking, and equestrian trails, and a visitor's center featuring Route 66 memorabilia (Domjan 2003, 2; Weiser 2005).

Figure 16. Fresh Kills Park. These manipulated pictures, on the City of New York Department of City Planning website, show the vision for the now closed, 53-year-old landfill (NYCDCP 2008).

An unusual location for such amenities, 28-acre Riverbank State Park, built on top of a sewage treatment plant, provides a variety of recreational opportunities to citizens of West Harlem. Facilities in the multipurpose sports complex, built in 1993, include a soccer field, Olympic-sized indoor swimming pool, tennis and basketball courts, a football field, fitness center, picnic areas, and an ice skating rink (Cohen 2002, Matthew 2008). Amenities for young children include two playgrounds and a carousel. The area below the park houses a 900-seat amphitheater and docks along the Hudson River (Matthew 2008).

Figure 17. Satellite Image of West Harlem's Riverbank State Park (Google 2008).

Commemorative monuments

Parks created as a result of a natural or human-induced disaster can also serve as a commemorative monument where survivors of disaster victims can mourn and visitors can learn about the events that shaped the landscape. Several sites included in this study emphasized commemoration of the event that shaped the landscape. Docents at Canyon Lake Gorge begin their tours with a rundown of the events of the 2002 flood. Terry Escher, a USACE employee, was working when floodwaters overran the spillway at Iowa's Coralville Dam. Now Escher tells this story to the schoolchildren she leads through the Devonian Fossil Gorge.

Figure 18. Devonian Fossil Gorge. Terry Escher gives tours of the gorge to students, and a walkway guides visitors through the site (USACE 2005b).

Exhibits and facilities at the Johnstown Memorial tell the history of the flood. A multitude of programs and displays at Mount St. Helens teach about the eruption and how it affected the landscape, humans, and wildlife. Interpretive displays at Earthquake Park and Route 66 State Park also tell the story of the disasters that forever changed their communities (AP 2003). New York's competition soliciting plans for Fresh Kills Park, called for proposals that would "respond to the natural and constructed history of the site"

(NYCDCP 2008, 2). According to the winning proposal, elements from the past would be integrated into the site as a reminder of its history—landfill machinery would be left behind and barges once used to deliver trash would become floating gardens (Newman 2006).

Economic benefits

Post-disaster parks have the potential to provide financial benefit their communities by stimulating the local economy, increasing property values, and/or providing tourism opportunities. Objectives for the Gorge Preservation Society at the Canyon Lake Gorge included cooperation "with other local eco-tourism initiatives to contribute to the economic climate of Comal County" (Ibes 2007, 6). In this task, Streeter-Rhoad (2008c, 1) says the project has been successful; "There is already evidence of the gorge becoming an economic engine for development in the area," she said. The same has resulted in the area of the Devonian Fossil Gorge were Glenister (2003) said the stream of tourists was a driver for the site's development.

Doug Richardson (2008) who has been a ranger at NPS's Johnstown Flood National Memorial for the last 15 years said development of the Johnstown Memorial brought jobs and tourists to the city when it was struggling with a weak economy and underemployment rate of some 50 percent. "It boosted the economy at the time, and still does," he said (Richardson 2008, 1). "It draws hundreds of thousands of visitors annually. The average visitor stays at local hotels, shops in the local stores, and eats at local restaurants. The economic impact is huge," Richardson (2008, 2) added.

After a trying post-flood recovery in Rapid City, the area rebounded and grew to become a "vital regional center" with a booming economy and an optimistic mood, according to a *Minneapolis Star* reporter (Haga 1997, 2). Journalist Steve Berg (1997, 3) from Minneapolis, Minnesota's *Star Tribune* called the greenway, "the symbol of the city's resolve and recovery" and the town's signature. Mayor in 1975, Art LaCroix felt recovery efforts, including creation of the park, made the city safer and better than before (Haga 1997).

A popular press article called the Grand Forks Greenway the cornerstone of the city's post-flood turnaround (Dennis 2007). Mike Maidenberg, the publisher of the local paper in 1997, advocated the development of the Grand Forks Greenway because he felt it would initiate a "renaissance" much like Rapid City experienced after their post-flood greenway was created (Dennis 2007, 1). Maidenberg likened the greenway to a scaled-down Central Park destined to become "one of the region's most prominent attractions for families, visitors and tourists" (Dennis 2007, 1). Some felt the buzz created by the flood and greenway development set off the commercial investment boom enjoyed by the town soon after the flood during which some 60 stores were built, including Lowe's, Best Buy, Old Navy, and Kohl's (Gregory 2007). Though a formal economic impact study has not been conducted, Parvey-Biby (2008) is confident property values around the greenbelt have increased, noting that many realtors in the area highlight homes with proximity to the park.

The proposed greenbelt in Del Rio was expected to have a tourism benefit according to city manager Rafael Castillo. Castillo said there were plans to promote tourism once the greenway was completed, noting that nature tourism is the fastest growing tourism industry in Texas. The proposed greenway would make the city, a popular birding spot and home to 350 species of birds, even more attractive to tourists (Harvey 2003).

Post-disaster parks in Toronto and at Mount St. Helens are credited with bringing tourism to the areas. Toronto's green identity has made it a popular destination, well-known as a sustainable, beautiful city in harmony with the natural environment (TRCA 2008). According to Emetaz (2008), community reaction to the creation of the Mount St. Helens park was extremely favorable because of the potential for tourism and job opportunities in an area economically struggling due to the slowing timber/lumber industry.

Dedicated in June 1967, Earthquake Park in Anchorage "instantly became one of the most popular tourist attractions to the City . . . a regular stop on all tour bus routes," said Creighton (1969, 4). "Probably as many pictures have been taken of the Centennial Park sign as have been of City Hall," he added (Creighton 1969, 4). For years the park continued to be a popular tourist destination, but after several decades, memories began to fade and interest in the park waned, while erosion and new growth covered up the features and returned the once dramatic landscape back to nature (Clifford 1986, Tobin 2006). Brenda Johnston (2008), who works at the Anchorage Convention and Visitor's Bureau, said there is not much left of Earthquake Park today. Neighborhoods have rebuilt around the site, and the park itself is overgrown with trees that were just small samplings in 1964. Nonetheless, the park is still considered an important landmark. Despite its faded glory, a reporter from the *Anchorage Daily News* (2007, 3) writes, "Today, the area is a peaceful park with outstanding views of downtown Anchorage and the Alaska Range," and visiting the park is ranked #13 in *Things to Do in Anchorage* online at Yahoo's travel site (Yahoo! Inc. 2008).

Once completed, Fresh Kills Park will be the largest park in New York City—almost three times the size of Central Park. Anticipating a rise in real estate values, housing developments began popping up around the landfill's edge in 2002. By 2006, several dense housing developments had been built near the landfill (Newman 2006, Stewart 2002). Once considered a "blight," the former landfill site is expected to be "an asset for generations to come" attracting millions of visitors daily (Raynoff 2003, 1).

Public relations

Because of all the gains post-disaster parks can bring to a community, good public relations can result from involvement in such projects. Inclusion of the community in the decision-making process and support of the Canyon Lake Gorge project generated good publicity for GBRA. "GBRA's public image has turned around 180 degrees in the Canyon Lake area since we took on this challenge," according to Streeter-Rhoad (2208b, 1). "I think the public now realizes that we are, indeed, a true environmentally-concerned entity and that we take our role of protecting the resources of the river very seriously," she added (Streeter-Rhoad 2008b, 1). Thomas-Jimenez (2007, 1) said, "development of the gorge has helped improve the image of GBRA in the community," adding that tour participants were pleasantly surprised that the authority allocated resources towards offering tours and educating visitors about the gorge.

Escher said the level of public interest, the opportunity for good public relations, and the site's value as an educational tool led to plans for development of the Devonian

Fossil Gorge. Educating the public about the flood event was also good publicity for USACE because it validated the dam's effectiveness. It served to "show the public that the dam did still provide flood control even if the water did go over the spillway," said Escher (2008, 1).

CHAPTER VI

CHALLENGES WITH POST-DISASTER PARKS

Post-disaster decision-makers must also be aware of the unique challenges to development of parks on disaster landscapes. Challenges associated with examined parks are summarized in table 3.

Table 3. Challenges with Post-disaster Parks

	Stakeholder conflict	Community support	Technical	Financial	Safety	Site degradation	Staffing needs	Time-consuming process	Stigma attached to site
Canyon Lake Gorge	X				X	X	X	X	
Devonian Fossil Gorge						X	X		
Earthquake Park						X			
Fresh Kills			X	X	X			X	X
Grand Forks Greenway		X							
Johnstown Memorial									
Mount St. Helens				X	X				
Rapid City Greenway									
Riverbank State Park	X	X	X		X			X	
Route 66 State Park	X	X	X	X	X			X	X
San Felipe Creek Park								X	
Toronto Floodplains									

Conflicts

Conflict among stakeholders and/or lack of community support can complicate park establishment on disaster landscapes. From the start, planning for the Canyon Lake Gorge was complicated by the varied, sometimes conflicting interests of the various stakeholders. Streeter-Rhoad felt the political landscape posed the biggest obstacle to park development. Planning this type of project while integrating the input of so many stakeholders is “challenging,” she said (Streeter-Rhoad 2008c, 1).

Some residents of the Greater Grand Forks area did not support greenway development because they felt the replacement of homes with parkland eliminated affordable housing while increasing property taxes (Gregory 2007). They feared displaced families would move away, further harming the area’s already struggling economy (MacDonald 1997). Community members were also concerned about the financial contribution needed to develop and maintain the greenway and its amenities (Dennis 2007, Parvey-Biby 2008). Furthermore, homeowners feared the construction of trails, access points, and parking facilities in their neighborhoods would reduce property values (Parvey-Biby 2008).

The histories of Riverbank State Park and Route 66 State Park are also riddled with conflict. At one point, the sewage treatment plant underneath Riverbank State Park processed an average of 170 million gallons of raw sewage daily, with peak flows reaching 340 million gallons. Harlem residents complained of noxious odors that smelled like rotten eggs and reported side effects including itchy eyes, shortness of breath, and other asthma and respiratory ailments. Malodors, reported as far as two miles from the site, reportedly intensified during hot summer months (Kolben 2004). In response to concern by Harlem residents an investigation was conducted in 1991 at Riverbank State Park. In January of 1994, West Harlem Environmental Action (WE ACT) made a $1.1 million settlement with the City of New York to relieve "adverse impacts created by the poor operation of the treatment plant" (WE ACT 2003). A 2000 *New York Times* article reads, "Living with foul odors is a way of life for Harlem residents who leave near the North River Water Pollution Control Plant," which the author refers to as "Sewage Chernobyl" (Day, 1). The article reported that in late 2000 the city decreased environmental monitoring of the site, no longer testing for carbon monoxide or semivolatile organic compounds, though testing of hydrogen-sulfide, which produces the rotten-egg smell, continued (Day 2000, Kolben 2004). The spokesperson for the Department of Environmental Protection said that six years of collected data showed there were no harmful amounts of contamination present around the site. Yet to some, these tests were deemed unreliable because data were collected by Intertek Testing Services, indicted that same year on charges of falsifying data at Superfund and hazardous waste sites in Texas and in other western states (Day 2000).

To some former residents of Times Beach, establishment of Route 66 State Park was more like a stab in the heart than a blessing. Relocation and integration was difficult for residents forced out of their homes and stigmatized in their new communities. One former resident said she felt ostracized and worried people in her new community thought she got rich from Times Beach buyouts. Another man used to ride his bike behind the dioxin truck and slip and slide in the sludge. He has since developed "deep pock marks on his cheeks, earlobes and neck, and cysts and fatty tumors on his chest and back" (Bertelson 1991, 2). In his family alone, there have been two stillbirths, two miscarriages, and a child born with birth defects and a learning disability, all linked to dioxin contamination (Bertelson 1991).

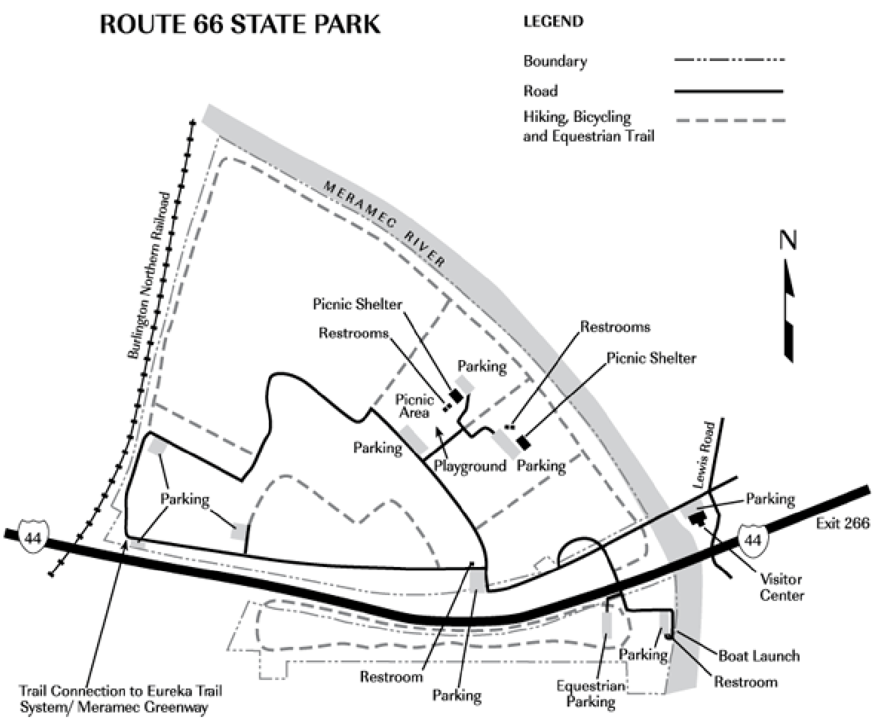

Figure 19. Map of Route 66 State Park. No longer on the map, the former community of Times Beach is now Route 66 State Park (MODNR 2008).

Technical, financial, and safety issues

Rugged terrain, eroding edges, precarious cliffs, wet slippery slopes, and loose rocks posed a safety nightmare for managers of the Canyon Lake Gorge. "Because it was an unstable area, and still likely to change, finding a way to allow public access in a SAFE way was a major concern," one involved party said (Anonymous 2008). In order to mitigate the site's safety issues, strict rules for visitors were implemented. The website warns, "Hiking through the Canyon Lake Gorge can be physically demanding, and is not recommended for people with bad knees, ankles or heart conditions. Persons who are overweight may want to rethink hiking through the gorge" (GPS 2007, 6). Children under the age of seven are not allowed in the gorge, children aged 7-10 must be accompanied by one adult each, children 10-15 must be chaperoned by one adult for every three children, and visitors aged 16-20 must have one adult for every five young adults. Adults are defined as anyone 21 years of age or older (GPS 2007). Before entering the gorge all visitors must sign a lengthy and disconcerting *Liability Release Form*. The form refers to the terrain as "potentially hazardous" and makes sure guests understand they accept all risks "including but not limited to, falls, bumps, strains and sprains, being struck by loose rocks or timber, being stuck or trapped, being bitten or scratched by wild animals, being bitten or stung by insects or other invertebrates, and exposure to rabies and other diseases." The guest is warned they could potentially suffer, "broken bones, ruptured or otherwise injured internal organs, disfiguring physical injuries, incapacitating injuries such as neurological damage, brain damage, psychological damage, muscular damage, paralysis, blindness or death" (GPS 2007, 6). Despite these foreboding warnings, Streeter-Rhoad (2008c) said the only injury of a gorge visitor was a turned ankle, sustained on the road before the woman even entered the site.

After the eruption of Mount St. Helens, numerous decisions had to be made concerning facility placement, headquarters locations, workloads, travel time, finances, and park boundaries. The situation forced stakeholders to think outside the box as they strove to protect the delicate resources while providing interpretive, research, and recreational opportunities to visitors. Financial matters have become even more concerning over the years as interest in the project has waned. Emetaz (2008, 3) said, "Operation and maintenance funds are a third of what they were five years ago," leaving many facilities, trails, roads, and interpretive signs in need of support. He worried that without proper funds, "visitor safety may be compromised" (Emetaz 2008, 2). Current interpretative programs are largely funded by donations and interpretive sales.

New York Times reporter Barbara Stewart foresaw two major obstacles to plans for Fresh Kills: "money and the lengthy and technically complicated conversion of a landfill that is three times the size of Central Park into safe, open land" (Stewart 2002, 1). Stewart's conversations with Phillip Gleason, director of landfill engineering at the Department of Sanitation, revealed that it would take at least 30 years for the garbage to decompose completely and for the trash mounds to settle. Though parts of the site could be finished before this, dissipation of methane and polluted water must take place before major construction of the site can begin. Pipes and pumps had to be installed to channel methane to energy companies and polluted water to treatment plants. A plastic liner was installed to prevent pollution and foul odors, but Gleason warned it would be difficult to avoid damaging it during construction (Stewart 2002). For safety reasons, the site will need continuous maintenance, monitoring, and evaluation for at least 30 years while decomposition, settlement, and gas production processes continue (NYCDCP 2008). A 2006 *New York Times* article said the project would take hundreds of millions of dollars to complete. The author of the article attended the first public tour of the site where one participant complained it smelled of rotting cabbage (Newman 2006). A New York City Parks and Recreation website claims the gas collection system is controlling odors and that all the mounds will eventually be capped, reducing odors and eventually removing them altogether (NYCDPR 2008).

Likewise, cleaning up the extensive dioxin contamination at Times Beach and preparing it to become parkland was a technically complicated, expensive, and delicate process. Building rubble and contaminated soil were excavated and thermally treated at a temporary on-site incineration facility. During thermal treatment the area was protected from potential flooding by a temporary unit that surrounded the site. Treatment residue (ash) was disposed of at an on-site facility. In total, 265,000 tons of contaminated soil from Times Beach and other eastern Missouri dioxin sites were incinerated. In 1992, all structures and debris from the site were removed and landfilled. By June 1997, cleanup of the site was completed and the incinerator was discharged at a cost of approximately $200 million (EPA 2006, USDOJ 1997).

Dealing with sewage smell and side effects experienced by Harlem residents has been the most difficult management issue at Riverbank State Park. Kolben reported in 2004 that the problems with smell had "mostly been resolved," and that a hotline was started to handle complaints related to the smells, but that problems with asthma were yet to be addressed (Kolben 2004, 4).

Staffing needs

The overwhelming interest in the Canyon Lake Gorge has become a time-consuming task for managers. Research proposals from the scientific community forced the creation of strict rules and guidelines for research. The Canyon Lake Gorge website states that all institutions, educational and scientific, must complete a Research Proposal and Application following the Canyon Lake Gorge Research Guidelines and that all notes and findings from research activities are public property to be posted on the website (GPS

2007). Yet, perhaps the biggest challenge for park managers has been dealing with the immense public interest. Without GBRA or GPS's knowledge, on October 3, 2007, notice that the park was opening for tours was communicated to the press and an article was published in the *San Antonio Express-News* (GPS 2007). That article led to an inquiry and subsequent article by the *Associated Press* on October 6, 2007. "We were only prepared for a soft opening," Streeter-Rhoad (2008c, 1) said. Gorge managers wanted time to tweak the tours and train docents before releasing the news to the public at large, and they were completely unprepared for the inundation that followed. The unbridled response gave managers a hint of people's fascination with the site. Within hours, the news spread around the world with stories popping up as far away as Singapore, according to Streeter-Rhoad. The story was even featured on the front pages of AOL, Yahoo, and other popular search engine news sites. In one day, the Canyon Lake Gorge website received 167,000 hits. Meanwhile, calls were coming from all over the U.S. and GBRA's website and phone lines were flooded with inquires from academic groups and people who wanted tours. As a result of the onslaught, monthly tours were booked almost a year in advance. Managers feared participants would not even remember to show up for a tour they scheduled so many months in advance so they decided to schedule new tours on a quarterly basis from then on, and a waiting list was started. Eleven tours were opened up for January through March of 2008 and were completely booked within 2 days of the announcement. The waiting list continues to grow by approximately ten requests a day. "There were 500 people on the waiting list at one point," Thomas-Jimenez (2008, 1) said. The inability for managers to deal with the barrage of interest had some prospective visitors frustrated. Managing the response became so time-consuming that GBRA was forced to create a new job for a Natural Resource Specialist who would be responsible for the daily operation and continuing development of the Canyon Lake Gorge park (GPS 2007). Streeter-Rhoad (2008c) felt the fiasco put the project back at least a year.

Despite the droves of visitors to the Devonian Fossil Gorge, Escher is the only trained interpretive tour guide. She chuckles when she recounts the many times she has had to turn away school groups because she has no time, and how occasionally groups of 100 or more students just drive up in a bus (Escher 2008).

Site degradation

From the beginning, volunteers fought to keep the Canyon Lake Gorge as it was in 2002—a blindingly clean slate of limestone, covered in perfectly displayed geologic wonders. However, managers eventually realized it would be impossible to avoid damage to the geologic features by the wave of visitors, weathering, erosion, and biological progression. Already innumerable fossils have been stolen and the traffic of so many feet cannot help but damage the features. Pieper (2008, 1) said if they would have built the fence at the end of the gorge sooner they could have avoided much of the trespassing and the theft of "hundreds of fossils." Plant growth kept volunteers busy removing vegetation from the cracks and crevasses, and efforts to stop sediment from washing down the hillside and covering up the sea ripples was a constant struggle. Eventually the GPS board decided to remove exotic plants such as Chinese tallow and some native invasive plants such as cattails. They became resigned to the fact that the site would restore itself and in the process, some features would be covered and perhaps destroyed (Thomas-Jimenez 2008).

Visitors at the Devonian Fossil Gorge also wish to preserve the site as it was right after the flood event (Glenister 2003). Bettis warns that this view of the region's historical geology will not last forever. Softer materials will slump over limestone that is more resistant and spreading vegetation will eventually cover up many features (Iowa DNR 1994). Natural weathering of the site has been exacerbated by the harsh Iowan climate and the countless feet that have traversed this ancient sea floor. The *Sierra Club Guide to Areas in and around Iowa City* calls this "Legacy of the flood of '93," a transient feature of the landscape (Jones 2008, 4). "Freezing and cooling will flake the rock surface, acid rain will blunt the sharper features, and vegetation will find footholds in cracks in the rock" (Jones 2008, 4). A promotional video assures visitors that as unfortunate as we believe them to be, these processes are natural and unavoidable: "the Earth is tending to its scar by gradually filling in the void . . . the age old processes of soil formation, erosion, and weathering are taking place" (USACE 2005b). The limestone is cracking and breaking, but Escher said this is actually revealing even more fossils. "We cannot stop the forces of nature," she said (Escher 2008, 1).

In fact, the degradation of the site by visitors has been even more damaging than natural forces (Jones 2008). Just 14 months after opening the site, Witzke and Bunker (1994, 32) wrote, "The traffic of hundreds of thousands of visitors has taken its toll," having weathered and abraded many of the fossil specimens. During a 1993 newscast, journalist Matt Hamel reported, "Though hard as rock, this fossil find has already suffered some unintentional damage from souvenir seekers" (USACE 2005b).

Innumerable fossils have been damaged and have disappeared, though signs warning about this illegal act are displayed in the entryway (Escher 2008, Witzke and Bunker 1994). Fortunately, degradation of the site has been mitigated by removal of the best fossils soon after the event. These features were then put on display at the USACE visitor's center to protect them from damage or vandalism (Witzke and Bunker 1994, 32). Escher said there has been some vandalism of the site, but surprisingly little. Robberies of the numbered hexagonal discovery point markers have been the most expensive loss. "There are probably a lot of those brass plates in dorm rooms," said Escher (2008, 1), "They make great souvenirs." At $200 apiece, this is no cheap problem, but Escher does not seem too worried. "We will just have to find a cheaper material to make them from," she said (Escher 2008, 1). Even after the traffic of millions of people across this seemingly fragile post-disaster landscape turned park, visitors are still overwhelmed and exhilarated—"It is still a fantastic experience" Escher (2008, 1) said.

Degradation of parks was also a concern at Mount St. Helens and Earthquake Park. Emetaz (2008, 2) at Mount St. Helens worried that lack of funding, which has decreased over the years, could lead to irreparable damage of the site's "geological and ecological features." Today, Earthquake Park is just a shadow of what it once was in the 1960s. The current, unpretentious display at the park consists of a small parking lot, some weathered interpretive signage, a few benches, and a guardrail over which visitors may be able to spot some rubble from the earthquake still hidden in the thick vegetation (Johnston 2008).

Time-consuming process

The Canyon Lake Gorge, Fresh Kills Park, Riverbank State Park, and Route 66 State Park have all been very slow-moving projects requiring a significant amount of time and effort to complete. More than five years after the flood event, the Canyon Lake Gorge is only now being opened for public tours. After 53 years of enduring a landfill in their community, residents of Staten Island will have to wait still longer to enjoy the site. Some construction has already begun, but other projects at Fresh Kills cannot be started for another 30 years after trash mounds have settled, methane has been piped out, and polluted water has been treated (Stewart 2002). Residents of Harlem had to wait seven years after the opening of the treatment plant before the park was opened (Kolben 2004). And cleanup alone at Route 66 State Park took over 13 years (EPA 2006).

The only problem with the proposed post-disaster park in Del Rio has been following through with all the high hopes and promises. As of February 2008, almost 10 years after the flood, the much-praised Del Rio greenway project has made little progress. Garrett (2008) at TPWD said the agency has been working with city officials in Del Rio to try and move ahead with the project, but that the process has been very slow. The state agency is trying to work with the city to develop multi-use and natural areas along the greenway, as well as hike and bike trails. TPWD is especially interested in moving ahead with the project because it will protect the habitat of the San Felipe *Gambusia.* Garrett (2008) urged the city to avoid mowing the area to serve as a riparian buffer, which he said, “they have done for the most part.” The only other progress thus far has been creation of a baseball field (Garrett 2008).

Stigmas

A last problem, that seems to be linked to human-disaster sites, is the stigma attached to the park site and sometimes even the people who once called it home. Some former residents of Times Beach felt stigmatized in their new communities; "When you say Times Beach, their eyes bug out and some of them get bent out of shape," a former resident said (Bertelson 1991, 3).

Staten Island resident Michael Heinz worried about "people lying on grass on top of toxic chemicals" at Fresh Kills and added that he did not feel safe bringing his kids to the park (Stewart 2002, 3). According to Phillip Gleason, director of landfill engineering at the New York Department of Sanitation, the stigma attached to the landfill creates public relations issues that can only be remedied by education, and lots of it (Stewart 2002).

On the other hand, not all post-disaster parks have been stigmatized. John Lowy, owner of the River Room restaurant in Riverbank State Park, worried that customers would be scared away by the location of the restaurant atop one of the city's largest sewage treatment plants, but reported that people never even talk about it; "it's a nonissue," he said (Richardson 2006, 1). In fact, the upscale restaurant is reportedly quite successful, a fact made more impressive considering its location in a traditionally low-income neighborhood (Richardson 2006).

CHAPTER VII

DISCUSSION

Patterns

The analysis of the case studies revealed some patterns to benefits and challenges experienced at post-disaster park sites. As would be expected, the post-disaster parks built in floodplains—the Rapid City and Grand Forks greenways, San Felipe Creek Park, and Toronto floodplains—reportedly reduced the flood hazard in their areas. Conservation was a benefit offered by all parks except for Riverbank State Park, which focuses more on recreational amenities than conservation/preservation of natural or cultural features. Educational opportunities were realized at all parks except the greenways and Riverbank State Park. It was found that most parks increased the quality of life in their communities by providing aesthetic improvements, recreational amenities, or community pride, with the exception of the Johnstown Memorial and Earthquake Park. Nonetheless, it must be noted that such benefits may accompany these sites even though it was not revealed during the course of the research. Ten of the 12 case studies reveal post-disaster parks may provide an economic stimulus to an area. Good public relations were only realized by two sites, the Canyon Lake Gorge and Devonian Fossil Gorge, but it is expected that further investigation would reveal good public relations followed the development of other parks as well.

Challenges associated with development of post-disaster parks varied widely among the case studies. Some parks, such as the Johnstown Memorial, Rapid City Greenway, and Toronto floodplain parks had no associated challenges, while Route 66 State Park was plagued by seven of the nine analyzed problems.

Recommendations

In order to mitigate problems associated with the creation of post-disaster parks, the case studies reveal successful steps in park development. Most plans begin with collaboration. Planning and decision-making processes should include, as applicable, as many stakeholders as possible including governments at all levels, NGO's, local business, citizens, and other interested parties. Formation of a citizen's group was also cited as a positive step, which helped gain community support for projects while providing volunteers for fundraising, site maintenance, and other assistance.

At the Canyon Lake Gorge, creation of a master plan was driven primarily by three key players: GBRA, USACE, and the Gorge Preservation Society (GPS). After completion, the groups invited local business owners and landowners to a barbecue, allowing guests the opportunity to review the master plan. Planners wanted to assure locals that the park would not change the area much, according to Streeter Rhoad. "We wanted them to know the park would have a soft footprint," she said (Streeter-Rhoad 2008c, 1).

Site managers at other sites also emphasized collaboration between all stakeholders and inclusion of the community in decision-making processes to ensure the success of their projects. The most successful steps taken in the recovery and park-creation efforts at the Devonian Fossil Gorge, according to Escher (2008), were the planning, fund raising, and establishment of the 501(c)(3) that allowed the group to accept donations for planning and construction. Toronto floodplain parks were planned and developed by the four unified conservation agencies that joined forces after Hurricane Hazel. In Rapid City, any changes to the greenway had to be voted on by the community. Even before residents began moving back to Grand Forks after the 1997 flood, the mayor of Grand Rapids, Pat Owens had begun forming a citizen's group to help with plans for their greenway while keeping close ties to neighboring East Grand Forks (Haga 1997). City officials in Del Rio partnered with Texas Parks and Wildlife to help with their greenway development (Harvey 2003). Regarding the development of the Mount St. Helens Monument, Emetaz (2008, 3) praised the support and cooperation among government agencies at all levels, referring to their efforts as "top notch."

A key component of the Fresh Kills plan was collaboration among stakeholders and integration of public decision-making through every step of the process. "The transformation of Fresh Kills should be a model of continued public engagement," the plan stated (NYCDCP 2008, 4). Interviews with government officials and community leaders to identify concerns and hopes for the future park began immediately in September of 2003. The first public meetings began in January 2004 during which the conceptual plan was discussed. Feedback was to be incorporated into the master plan. The consultant contract required the involvement of a variety of stakeholders including the Municipal Art Society, the Staten Island Borough President, and the Departments of Sanitation, Parks and Recreation, State and Environmental Conservation, and Cultural Affairs (Raynoff 2003). Completed on April 6, 2006, the $3.38 million draft master plan was sent to a number of parties including local elected officials, community boards, public libraries, and Staten Island colleges. The plan was also displayed at the Staten Island Greenbelt Conservancy headquarters and posted electronically online at the Fresh Kills Park website (Raynoff 2006). In June 2006, the Parks Department began conducting tours of the site, now offered from April to November. The 90-minute tours are by bus, guided by NYC park rangers and are free of charge (NYCDPR 2008).

Stakeholders at all levels also agree that sustainable mitigation strategies are essential for successful post-disaster parks. This process begins with professional, long-term, collaborative, community supported, interdisciplinary planning. Long-term plans must also strive to create a symbiotic relationship between humans and the natural environment that complements the dynamic natural processes occurring on many post-disaster landscapes. Managers at Canyon Lake Gorge hired Halff & Associates, a landscape architecture and engineering firm, to create a master plan for their site. The winning proposal for Fresh Kills Park, *lifescape,* was submitted by a multidisciplinary landscape architecture firm, Field Operations. The 61-page plan envisioned a site that would sustainably restore native ecological systems such as native wetlands, prairies, maritime oak forests, salt marsh, and swamp forests (NYCDCP 2008). City officials in Del Rio said their greenway project demonstrated that urban and natural areas could intermix, and even benefit each other (Harvey 2003). TRCA's vision for Toronto is "the Living City, a new kind of community where human settlement can flourish forever as part of nature's beauty and diversity" (TRCA 2008, 1). Denney said creation of Toronto's floodplain parks were "part of the respect for nature that Hurricane Hazel demanded of us" (Hall 2004, 3).

According to Emetaz (2008, 3), the post-disaster park at Mount St. Helens, was "probably the finest of any such development in the United States . . . developments were superlative, interpretive facilities were state of the art and visitors received and continue to receive outstanding, quality customer service." But all along Emetaz had "an internal voice saying LESS MIGHT BE MORE," which prompted him to visit similar facilities that were 15-25 years old, as research for long-term planning for the monument (Emetaz 2008, 3). What he noticed is of significant interest to post-disaster park decision-makers. Money and support was always ample on the onset and during development phases. "Architects, planners, and contractors went wild with all sorts of innovative, high-tech facilities, and elaborate structures," said Emetaz (2008, 3). Nevertheless, as excitement waned and annual visitation decreased over the years, so did funding and support. Emetaz advises post-disaster park planners to look 15-25 years ahead and plan for low-maintenance facilities and displays made of durable materials that will last. Planners should ask how they can reduce costs and avoid depending on a stable source of funding. "Rather than wowing visitors with infrastructure and visitor centers, maybe we should figure out ways to let the natural features do the wowing with necessary protection and interpretation," he said (Emetaz 2008, 4).

Lessons learned

The purpose of this research was to get a broad overview of post-disaster park creation in the United States and Canada to discover where it is happening, if it is prevalent, and what prospects and problems are associated with this type of hazards mitigation. When research began, it was assumed the practice of creating parks on disaster landscapes was a rare occurrence, but this was not the case. More case studies were found than could be analyzed during the course of this research. Therefore, it is recommended that future studies focus on a smaller, perhaps statewide study area, thus allowing for a more manageable and complete study.

It is also recommended that future studies integrate as many sources as possible, as each stakeholder may offer a different perspective on the park development process depending on their role. Triangulation of data gathering helps even out the responses to offer a fuller view. Government officials, private citizens, and agency representatives all experienced the effects of post-disaster parks in different ways and members from each group should be interviewed. Because locating and contacting residents who were affected by a disaster event necessitates time-consuming and expensive fieldwork, a more efficient and financially feasible solution is distilling such perspectives from popular press publications. Often these publications include in-depth, personal interviews with affected residents, soon after the event. Yet in the end, it must be noted that no matter how many sources are consulted, it is possible that not all problems and prospects will be uncovered.

CHAPTER VIII

CONCLUSION

On the 50th anniversary of Hurricane Hazel, reporter John Allemang (2004) wrote an article commemorating the terrifying event he credits with shaping the city Toronto is today. "It is rare that you can point to a single event on a particular night and say: This is where a city found its identity," he wrote, "but that is exactly what happened to Toronto" (Allemang 2004, 1). He realized that had it not been for the devastating events of October 15, 1954, the city would look very different today. "It was Hurricane Hazel that built Toronto—a terrible event forced us to create this beautiful city," said Allemang (2004, 1).

The impact caused by disasters occasionally causes decision-makers to consider alternative land uses for affected areas. The benefit of catastrophe, according to Alberverio, Jentsch, and Kantz (2006), is that it forces change and progress. One possible option for post-disaster landscapes is their development as parkland. Though there are complexities related to this recovery plan, parks have great potential to benefit communities affected by natural or human-induced disasters. As discovered by several hazards researchers, parkland creation can reduce vulnerability, conserve and preserve significant natural and cultural features, and present opportunities for research and education (Applegate and Folger 2001, Beschta et al. 2004, FEMA 2000, NRC 1968, Waugh and Smith 2006). Post-disaster parks can also enhance a community's quality of life by beautifying an area, providing recreational amenities, boosting community pride, and facilitating public appreciation and enjoyment of natural and cultural resources. This echoes results of numerous studies that explore the myriad benefits of parks (de Kievit 2001, Hillsdon et al. 2006, Kaufman and Cloutier 2006, Nicholls and Crompton 2005, Pearce 2003, Tisdell and Wilson 2005). These areas can also serve as commemorative monuments where survivors of disaster victims can mourn and visitors can learn about the events that shaped the landscape. Agencies, organizations, and governments involved in these projects may also benefit from improved public relations. Pearce (2003) asserts that post-disaster planning can and should strive to enhance community quality of life and boost local economies. This research found that parks created on disaster landscapes *can* improve local economies by attracting businesses, increasing property values, and providing tourism opportunities.

Post-disaster decision-makers must also be aware of the unique challenges encountered when developing parks on severely altered landscapes. Conflict among stakeholders with varying interests and unsupportive community members can complicate efforts. Planning, site degradation, maintenance, and management of these sites can also be challenging as stakeholders struggle with staffing, safety, financial, technical, and site preparation issues. The challenges with post-disaster park development revealed by this study are found to be similar to those uncovered by previous research on parks that were not created on disaster landscapes (Bakker and Paepe 1982, Chavez 2005, Stone et al. 2007).

Obstacles to this post-disaster land use solution can be reduced if proper steps are taken. Stakeholders at examined parks agree that collaboration with all stakeholders, integration of the community in decision-making, and the formation of a citizen's group are essential elements to any post-disaster park plan. The involvement of the community in post-disaster decision-making is also recommended by a variety of hazards and parks researchers (Andrews 2006; Applegate and Folger 2001; Burger and Canton 2007; Coglianese 1999; Greenberg, Lahr, and Mantell 2007; Waugh and Smith 2006). Plans must also take into account dynamic natural processes and strive to form a mutually beneficial relationship between humans and nature. Projects should also be sustainable and long-lasting so as to reduce maintenance and increase the longevity of developments. Sustainable mitigation and recovery efforts have been shown to be successful by several researchers in both the parks and hazards fields (Fabos 2004; Lindsay 2003; Meo, Ziebro, and Patton 2004; Pearce 2003; Vernon et al. 2005).

By sharing successes and failures, developers of post-disaster parks can serve as a model helping disaster site decision-makers determine whether park development is a viable solution for recovery in their community. Consultation of these and other case studies can help stakeholders maximize advantages and minimize the obstacles to post-disaster park development.

APPENDIX I

POST-DISASTER PARK INTERVIEW QUESTIONS

1. Are you answering the following questions from the perspective of a private citizen or representative of an agency? (Please list agency)

2. Please explain the event that impacted this area, including any relevant history.

3. What events/actions led to the decision to make this area a park*?

4. What were the political, economic, and social responses of the community, affected landowners, government, and other involved parties to the event?

5. What were the political, economic, and social responses by these parties to the development of the park?

6. Were there obstacles to the development of the park on this site (environmental, social, economic, political, personal)?

7. Were there any benefits to the development of this park on this site (environmental, social, economic, political, personal)?

8. What were the basic steps taken in the park development?

9. In hindsight, is there anything you would have done differently regarding the creation of the park?

10. What were some successful steps taken in the recovery and park-development process?

11. Is there any other information you could share that might be of value to this research?

* When the word *park* is used, it is referring to any green space, open space, conservation area, natural area, or park. The word *park* was chosen for the sake of simplicity.

APPENDIX II

THE CANYON LAKE GORGE

Study area

Canyon Lake Dam and Reservoir is located in Comal County, Texas, some 40 miles north of San Antonio and 17 miles northwest of New Braunfels. The reservoir sits on the northern edge of the Balcones Escarpment that cuts south-central Texas into two distinct zones creating the boundary between the Edwards Plateau to the west and the Blackland Prairie and coastal plains to the east. Rocky hills and limestone canyons characterize the Edwards Plateau, contrasting the flat fertile landscape of the coastal plains. The Guadalupe River, which begins in the Edwards Plateau region, is a perennial stream with a drainage area of approximately 6,000 square miles (Smyrl 2008). The river runs through a number of large and small Texas communities. The upper canyons of the Guadalupe River have a channel capacity of 40,000 to 50,000 cfs, while the lower channels can only support approximately 12,000 to 13,000 cfs. The contrasting capacities of the river channels paired with the region's inter-annual precipitation variability of around 30 percent make the area particularly susceptible to droughts and flooding (Earl, Dixon, and Day 2006; USACE 2005a). Shallow clay soils intensify runoff amounts, increasing the hazard (Earl, Benke, and Knaupp 2003).

In the late 1950s, plans began to build a dam on river mile 303 of the Guadalupe River to provide water supply to the Guadalupe Basin and flood protection for the 157,250 acres of land downstream (USACE 2007a). Construction of the Canyon Lake Reservoir and Dam was a joint project between the United States Army Corps of Engineers (USACE) and the Guadalupe Blanco River Authority (GBRA). GBRA, a state agency established by the Texas legislature in 1933, manages water supply and conservation in the Guadalupe River Basin of central Texas. Their authority extends from the headwaters of the Guadalupe and Blanco Rivers to San Antonio bay, representing the ten counties of Kendall, Comal, Hays, Caldwell, Guadalupe, Gonzales, DeWitt, Victoria, Calhoun, and Refugio (GBRA 2007). USACE is a federal agency composed of civilian and military members that provides engineering and environmental services to the United States. They are responsible for the planning, design, construction, and operation of certain civil water works projects pertaining to flood control, disaster response, and environmental protection.

Though not listed as a major purpose for the dam's construction, the reservoir vitalized the local economy, attracting large numbers of boaters, anglers, scuba divers, tubers, and swimmers who shopped in the towns, ate at the restaurants, and stayed at the local hotels (Kiel 1992). In 1959, well before the dam was completed, the Texas Highway Department published *A Plan for Highway Development in Vicinity of Canyon Dam and Reservoir*. The document foresaw the lake's potential contribution to the area's economy. The report states that "The close proximity of Canyon Dam to San Antonio . . . will generate a heavy traffic volume during holidays, weekends and the summer vacation period" and that construction of feeder roads to the lake would develop the area as “one of the major recreation facilities in the state” (THD 1959, 4). In Kiel’s (1992, 55) *A History of Canyon Dam,* the author states that although recreation was a secondary purpose for the dam’s construction “recreational amenities and enhancement of wildlife became part of Canyon’s legacy.” The reservoir project designated 130 acres for parkland, and recreational facilities were built to accommodate up to 3 million visitors. Prior to the dam, the region was dominated by rangeland valued at approximately $200/acre. By 2003, land values near the scenic lake had skyrocketed to over $10,000/acre (Earl, Herbert, and Williams 2003).

Construction of the earthen dam, made of rolled, compacted earth, started in 1958. The 7,000-foot long and 223-foot high dam cost $21 million. Impoundment began in 1964 and the lake reached conservation-pool level four years later. At conservation-pool level, 909 feet above mean sea level (msl), the surface area of the reservoir is 8,230 acres and it holds 378,852 af of water. At this level, 80 miles of shoreline encircle the lake. At full capacity, 943 feet above msl, Canyon Lake Reservoir has a surface area of 12,875 acres and can store up to 733,517 af of water (Ibes 2007).

GBRA’s contribution to construction and land acquisition costs bought them rights to water in the lake’s conservation pool (USACE 2005a). GBRA uses lake water for municipal water supply, irrigation, industrial uses, and operation of several small hydroelectric plants. Each year they pay a portion of the operational and maintenance costs for the conservation pool to the U.S. Government (USACE 2005a). At 911 feet above msl, USACE maintains the authority to release water and bring the lake down to between 909-911 feet (Earl, Herbert, and Williams 2003).

Flood event

Since the completion of Canyon Dam, 12 major floods have affected the Guadalupe River Basin (Ibes 2007). The eleventh flood occurred in the summer of 2002 and was marked by heavy rains over the course of nine days. Total rainfall at Canyon Lake from June 28 to July 6 was 19.83 inches. Nearby Comfort and Sisterdale, Texas received 33.45 and 30.75 inches respectively (Earl, Benke, and Knaupp 2003). When the first drop fell on Friday June 28, the elevation of the lake was 908.34 feet above msl. By Monday, the lake levels were rising and predictions for further rain prompted the closure and evacuation of low-lying park areas. As heavy rains continued over the next two days, all parks were closed and holiday campers downstream of the dam were evacuated. On July 3, USACE met with Comal County officials to discuss preparation for spillway flow and further evacuation of downstream areas. The lake had risen 30 feet in six days by the morning of July 4, and it was showing no signs of slowing down. Overflow of the lake at 943 feet above msl began to look like a possibility and evacuation of riverside roads began (USACE 2002). At 3:50 pm on July 4, floodwaters overran the spillway for the first time in the reservoir's 38-year history (Earl, Benke, and Knaupp 2003).

Downstream areas experienced extreme flooding as the river began to flow outside its channel. Peak inflow to Canyon Lake occurred on July 5 at an estimated 94,400 cfs according to the United States Geological Survey (USGS) (Earl, Benke, and Knaupp 2003). On July 6, flow over the spillway reached a maximum depth of seven feet and peak elevation of 950.32 feet above msl (USACE 2002; Earl, Benke, and Knaupp 2003; Earl, Herbert, and Williams 2003).

For 39 days water ran over the spillway causing an overflow of approximately 800,000 af of water. The total runoff was over 1,100,000 af—enough to fill the reservoir three times. Rushing waters from the flood severely damaged a hydroelectric power plant and ripped out a road, a subdivision, and 17 million cubic feet of early Cretaceous limestone bedrock before joining the Guadalupe river 1.2 miles downstream (Agold et al. 2002, GPS 2008).

Figure 20. Floodwaters Cutting the Gorge at Canyon Lake (CCEO 2002).

In mid-July, an emergency contract was issued to Phillips and Jordan for removal of the eroded material at the spillway/river confluence. On August 10, Colonel Wells and District staff began monitoring flood releases from Canyon Dam, finally dropping the lake to its capacity at 943 feet above msl. On September 23, the lake reached its conservation pool level of 909 feet above msl (USACE 2002). Removal of the 500,000 cubic yards of eroded material, including vegetation, soil, and limestone bedrock, continued until October 13, 2002 when funds were exhausted (Earl, Benke, and Knaupp 2003; USACE 2002). The final cleanup cost at Canyon Lake was $236,306 (USACE 2002).

Communities across south-central Texas suffered the effects of the heavy rains. Twenty-seven rivers flooded more than 80 counties. Hundreds of roads were closed, numerous telephone and power lines went down, several water treatment plants were inundated and shut down, there was extensive damage to agricultural equipment and livestock, and 5,000 people were evacuated. The governor of Texas called on the help of the National Guard to assist with rescues and evacuations. The event caused nine fatalities and damaged over 48,000 homes. Damages and losses totaled an estimated $1 billion (NOAA 2007).

Figure 21. Post-Flood Landscape below Canyon Dam (Ibes 2008).

Response

This devastating event left some unexpected treasures in its wake. The impressive force of the rushing water over the Canyon Dam Spillway sliced a canyon in the landscape measuring 1.2 miles long, 40 feet deep, and over 100 feet wide in some locations (Earl, Benke, and Knaupp 2003; GPS 2008). Erosion of Glen Rose Formation limestone uncovered a 100-million-year-old sea floor. Ancient sea ripples, aquifer channels, fossiliferous beds, a fault line, and dinosaur tracks were discovered in the exposed strata (Ibes 2007).

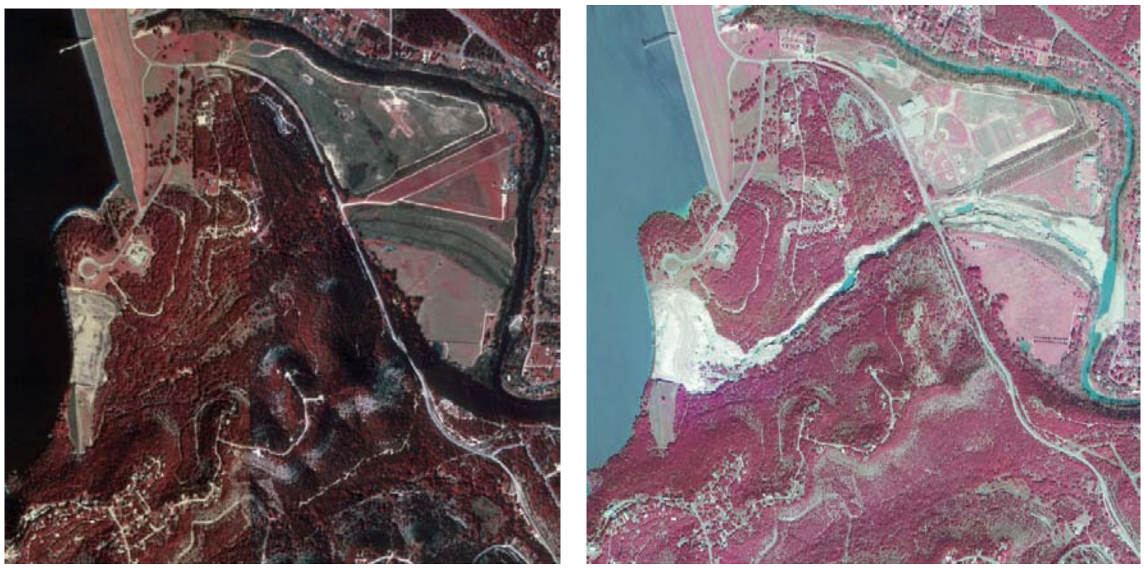

Figure 22. Canyon Dam Spillway Before and After the 2002 Flood. The images show the bright limestone gorge, cut by floodwaters (TNRIS 2004).

Realization of the scientific, educational, and tourism potential of the site led to plans for the development of the *Canyon Lake Gorge*. "The geologists from academia went nuts . . . it didn't take long before it was all over Texas" GBRA employee and GPS board member Streeter-Rhoad (2008a) said about the reaction to the gorge. The surge of public interest and desire to protect the special features and formations motivated plans for the park's creation (GPS 2007, GPS 2008). Initial interest in developing the site came from the Water Orientated District of Comal County (WORD). But after two years of inactivity, GBRA approached USACE about moving ahead with the project. Since USACE lacked the time, money, and resources necessary to develop the site, GBRA was asked to submit a proposal. The proposal was soon accepted and USACE leased the 61.5

acre gorge site to GBRA. Public meetings held in November and December of 2004, resulted in formation of a 12-member advisory group, the Gorge Preservation Society (GPS). GPS board member J. W. Pieper (2008, 1) was at this first meeting and said his desire to develop the park stemmed from his "interests as a Master Naturalist to introduce others to the wonders of the outdoors and the power of water." The group was soon established as a 501(c)(3), with GBRA as their major benefactor (Streeter-Rhoad 2008c). The mission of GPS was to "promote the enjoyment and conservation of the Canyon Lake Gorge by encouraging responsible, quality access opportunities through academic partnerships, economic initiatives and citizen involvement" (Ibes 2007, 6). Their objectives were to "create a safe, integrated system of trails alongside and through the Gorge, obtain sufficient project funding, encourage diverse and broad-based community participation in the project, offer opportunities to citizens and visitors through the trail system to learn about geological, biological, historical and natural resources, cooperate with other local eco-tourism initiatives to contribute to the economic climate of Comal County, and create a sustainable, effective organization to support the long range funding, maintenance and stewardship of the project" (Ibes 2007, 6).

With the support of the community, the group moved on to develop a vision for the site. Creation of a master plan was driven primarily by three key players: GBRA, USACE, and the Gorge Preservation Society (GPS). Halff & Associates, a landscape architecture and engineering firm, was hired to create a master plan. The plan was reviewed and revised for months. Upon completion, GPS hosted a neighborhood meeting. "We wanted them to know right up front what was going to happen . . . to avoid misinformation," Streeter-Rhoad (2008c, 1) stated. The society invited local business owners and landowners to the barbecue, allowing guests the opportunity to review the master plan. Planners wanted to assure locals the park would not change the area much. "We wanted them to know the park would have a soft footprint," said Streeter-Rhoad (2008c, 1).

Benefits

The scoured landscape at Canyon Lake provided a snap shot in time allowing scientists to piece together a 100-million-year-old picture of Texas. The left-right, left-right progression of eight impressions on the floor of the gorge maintained a consistent length and size, giving solid evidence they were left by a dinosaur. Geologists believed these to be footprints of *Acrocanthosaurus atokensis*, a bi-pedal, three-toed carnivore that walked the shore of the sea that covered Texas during the Cretaceous Period. The leg length of the creature is an estimated ten feet and two inches with an average stride of ten feet and eight inches. Tracks left by this same species of dinosaur can be found at Dinosaur Valley State Park in nearby Glen Rose, Texas. Other features of interest were the vertical successions and lateral exposures of rocks that allowed geologists to accurately study how the environment of the area has changed over time (Keairns 2003). Fossiliferous beds preserved a variety of ancient marine life, including *Orbitolina texana, Salenia texana, Porocystis globularis, Heteraster olbiquatus, Nerinia spp., Liopsitha walkeri,* and *Tousasia texana* (Ibes 2007). Carbonate ripple marks at the site were studied by scientists who determined they had been produced by wave action in a shallow marine environment. The oscillation of the waves caused the sediment to form ripples that were hardened by the sun when the sea receded. The discovery of two layers of ripples told geologists that wave patterns changed directions sometime in the area's history. The 2002 flood event also revealed the Hidden Valley Fault, a historically documented fault within the 180-mile long, 25 million-year-old Balcones fault system. This exposed portion allowed scientists to extensively study a fault at the surface for the first time in modern history (Ibes 2007).

Figure 23. Dinosaur Tracks and Ancient Sea Ripples at the Canyon Lake Gorge (Whitley 2007).

Displays at the gorge also allowed scientists to examine and understand how water flows through a limestone fault and how groundwater and surface water are connected. Natural seeps, artesian springs, and exposed aquifer channels reveal the inner workings of an aquifer and the movement of groundwater. Features demonstrate how groundwater becomes surface water, and surface water again becomes groundwater in a potentially endless cycle. Water that appears near the access point disappears and reappears after traveling horizontally and vertically through the fractured and faulted limestone. It is still unknown whether the water source that supplies the waterfalls and fills the crystal clear pools is coming from the lake or an underground water supply (Ibes 2007).

Because the flood event removed all biological material, leaving only a bare limestone surface, the gorge displayed a rare example of primary succession. Over the last six years soil has slowly deposited in the holes and crevices of the limestone and as seeds blew in, they sprouted. At the same time flowing water transported aquatic animals and plants that made their home in the pools and aquifer channels. Today the site supports a variety of plant and animal life. The most common species of plants found include Sycamore, Ashe Juniper, Cudweed, Bushy Blue Stem, Cattails, Poverty Weed, and Thoroughwort. The wetland areas support tadpoles, small fish, sedges, ferns, and algae (Ibes 2007).

Figure 24. Biological Succession at the Canyon Lake Gorge. Algae, cattails, Sycamore trees, and tadpoles are some of the flora and fauna that found their way into the gorge since 2002 flood (Ibes 2008).

The dynamic, transitioning landscape is also valuable for the study of weathering and erosion. Sediments sliding down steep cuts, rock falls, and moving water are constantly changing the face of the gorge. Pleistocene depositional sediment pours down the limestone layers like frosting on a freshly cut cake, providing nutrients for plant life that has found its way into the gorge. The changing colors of the rock from gray to gold illustrate the change in color that occurs when limestone is exposed to air. Gray underground, eventually all the exposed limestone will turn a golden color (Ibes 2007).

So far, research has been conducted at the site by Exxon-Mobil, the University of Texas–Austin, Texas A&M University, and the Southwest Research Institute (SwRI) (GPS 2007). Researchers from SwRI teamed with four major oil companies to study the geology and stratigraphy of the Hidden Valley Fault exposed at the site. SwRI's research focused on gaining a better understanding of faulting in limestone aquifers and petroleum aquifers, and may lead to models for limestone structures that contain oil and gas (Fohn 2007).

Managers have realized the potential of the gorge as an engaging, dynamic outdoor classroom where students and other visitors can learn concepts across multiple disciplines (Thomas-Jimenez 2008). The site provides the perfect fodder for inquiry-based learning in geography, biology, hydrology, paleontology, ecology, human-nature relations, and other subjects. Exposed aquifer channels, artesian springs, and mysterious seeps display the interconnectedness of groundwater and surface water and teach the danger of contaminating either source. Exposed fossil beds, ancient sea ripples, and dinosaur tracks paint an image of Texas's ancient environment and illustrate how it has changed over the course of time.

Development of the park has proven beneficial to stakeholders—facilitating collaboration among government agencies, local businesses, and the community, reinforcing the local economy, and even boosting public relations for GBRA. Park publicity drew a lot of attention to the Canyon Lake area. "There is already evidence of the Gorge becoming an economic engine for development in the area," Streeter-Rhoad (2008c, 1) said in February 2008. GBRA's inclusion of the community in the decision-making process and support of the project has also served to improve public relations for the Authority. "GBRA's public image has turned around 180 degrees in the Canyon Lake area since we took on this challenge," said Streeter-Rhoad (2008b, 1), "I think the public now realizes that we are, indeed, a true environmentally-concerned entity and that we take our role of protecting the resources of the river very seriously." Even the political landscape had evened out; "Everyone wants to get on board with a successful project," Streeter-Rhoad (2008a, 1) said. Thomas-Jimenez (2008, 1) added that "development of the Gorge has helped improve the image of GBRA in the community," and tour participants have been pleasantly surprised that the Authority allocated resources towards offering tours and educating visitors about the gorge.

Challenges

The phenomenal potential of the Canyon Lake Gorge is weighted by obstacles to its development on a post-disaster landscape. In the second GPS newsletter, dated January 2008, chair Valerie Schroller begins, "We have many challenges ahead, but the Gorge Preservation Society's (GPS) energetic board of directors, along with many dedicated volunteers, should have no trouble turning those challenges into opportunities"

(GPS 2008). Answers to frequently asked questions posted on the GPS website clearly illustrate some of the major challenges faced by gorge managers including trespassing, safety, and site preservation:

1. Can I go into the Gorge unescorted?
   No. The Canyon Lake Gorge is on Federal property that is currently leased by the Guadalupe-Blanco River Authority. You must call GBRA (800-413-5822 or 830-379-5822) to schedule a tour to enter the Gorge, to request a temporary permit, or sign up for one of the Saturday tours.
2. What if I sneak into the Gorge?
   No Trespassing signs are posted on all entry points, and if you are caught in the Gorge without a permit you will be subject to arrest and/or a trespassing fine of up to $2000.
3. Can I swim in the Gorge?
   Absolutely Not. The GPS strives to maintain the natural integrity of the site, and it is not safe.
4. Can I take fossils out of the Gorge?
   No. Fossils are considered by federal law to be antiquities, and are covered by the Federal Penal code. Theft of fossils is a felony offense.
5. Can I bring a group of school-age children into the Gorge?
   For safety reasons, at present the policy is that students under grade 9 are not allowed in the Gorge (GPS 2007, 9).

From the start, planning for the gorge was complicated by the varied, sometimes conflicting interests of the various stakeholders. Streeter-Rhoad (2008c) felt the political landscape posed the most difficult obstacle to park development. Planning this type of project while integrating the input of so many stakeholders is challenging, she said.

Other major concerns mentioned by gorge managers were safety and site preservation (Pieper 2008, Streeter-Rhoad 2008c, Thomas-Jimenez 2008). Rugged terrain, eroding edges, precarious cliffs, wet slippery slopes, and loose rocks posed a safety nightmare for managers. “Because it was an unstable area, and still likely to change, finding a way to allow public access in a SAFE way was a major concern,” one involved party said (Anonymous 2008). In order to mitigate the site’s safety issues, strict rules for visitors were implemented. The website warns, “Hiking through the Canyon

Lake Gorge can be physically demanding, and is not recommended for people with bad knees, ankles or heart conditions. Persons who are overweight may want to rethink hiking through the Gorge" (GPS 2007, 6). Children under the age of seven are not allowed in the gorge, children aged 7-10 must be accompanied by one adult each, children 10-15 must be chaperoned by one adult for every three children, and visitors aged 16-20 must have one adult for every five young adults. Adults are defined as anyone 21 years of age or older (GPS 2007). Before entering the gorge all visitors must sign a lengthy and disconcerting *Liability Release Form*. The form refers to the terrain as "potentially hazardous" and makes sure guests understand they accept all risks "including but not limited to falls, bumps, strains and sprains, being struck by loose rocks or timber, being stuck or trapped, being bitten or scratched by wild animals, being bitten or stung by insects or other invertebrates, and exposure to rabies and other diseases." The guest is warned they could potentially suffer, "broken bones, ruptured or otherwise injured internal organs, disfiguring physical injuries, incapacitating injuries such as neurological damage, brain damage, psychological damage, muscular damage, paralysis, blindness or death" (GPS 2007, 6). Despite these foreboding warnings, Streeter-Rhoad (2008c) said the only injury of a visitor was a turned ankle, sustained on the road before the woman even entered the site.

From the beginning, volunteers fought to keep the gorge as it was in 2002—a blindingly clean slate of limestone, covered in perfectly displayed geologic wonders. But managers eventually realized it would be impossible to avoid damage to the geologic features by the wave of visitors, weathering, erosion, and biological progression. Already innumerable fossils have been stolen and the traffic of so many feet cannot help but damage the features. Pieper (2008, 1) said if they would have built the fence at the end of the gorge sooner they could have avoided much of the trespassing and the theft of "hundreds of fossils." Plant growth kept volunteers busy removing vegetation from the cracks and crevasses, and efforts to stop sediment from washing down the hillside and covering up the sea ripples was a constant struggle. Eventually the GPS board decided to remove exotic plants such as Chinese tallow and some native invasive plants such as cattails. They became resigned to the fact that the site would restore itself and in the process, some features would be covered and perhaps destroyed (Thomas-Jimenez 2008).

The overwhelming interest by the scientific community who wanted to conduct research in the park posed a time-consuming management challenge. Managers were forced to organize strict rules and guidelines for research. The Canyon Lake Gorge website states that all institutions, educational and scientific, must complete a Research Proposal and Application following the Canyon Lake Gorge Research Guidelines and that all notes and findings from research activities are public property to be posted on the website (GPS 2007).

Yet, perhaps the biggest challenge for park managers has been managing the immense public interest in the site. Without GBRA or GPS's knowledge, on October 3, 2007, notice that the park was opening for tours was communicated to the press and an article was published in the *San Antonio Express-News* (GPS 2007). That article led to an inquiry and subsequent article by the *Associated Press* on October 6, 2007. "We were only prepared for a soft opening," Streeter-Rhoad (2008c, 1) said. Gorge managers wanted time to tweak the tours and train docents before releasing the news to the public at large, and they were completely unprepared for the inundation that followed. The unbridled response gave managers a hint of people's fascination with the site. Within hours, the news spread around the world with stories popping up as far away as Singapore, according to Streeter-Rhoad. The story was even featured on the front pages of AOL, Yahoo, and other popular search engine news sites. In one day, the gorge website received 167,000 hits. Meanwhile, calls were coming from all over the U.S. and GBRA's website and phone lines were flooded with inquires from academic groups and people who wanted tours (Streeter-Rhoad 2008a). As a result of the onslaught, monthly tours were booked almost a year in advance. Managers feared participants would not even remember to show up for a tour they scheduled so many months in advance so they decided to schedule new tours on a quarterly basis from then on, and a waiting list was started. Eleven tours were opened up for January through March of 2008 and were completely booked within 2 days of the announcement. The waiting list continues to grow by approximately ten requests a day (Thomas-Jimenez 2008). "There were 500 people on the waiting list at one point," Thomas-Jimenez (2008, 1) said. The inability for managers to deal with the barrage of interest had some prospective visitors frustrated. Managing the response became so time-consuming that GBRA was forced to create a new job for a Natural Resource Specialist who would be responsible for the daily operation and continuing development of the Canyon Lake Gorge natural interpretive area (GPS 2007). Streeter-Rhoad (2008c) felt the fiasco put the project back at least a year.

Conclusion

The effects of the 2002 flood event on the landscape downstream of the Canyon Lake Dam spillway resulted in a fascinating but delicate and complex resource. Though development and management of this transformed landscape has posed various obstacles, everyone involved senses the importance of this legacy. Volunteers understand the importance of the gorge as a place of discovery, learning, research, and recreation. The community is beginning to view the gorge as an economic booster and a source of community pride. Government agencies realize the gorge provides the opportunity to reach out to the public, have a relationship with the community, and share this silver lining to the devastating events of July 2002 with Texas, and beyond.

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