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Navigation and Accessibility for Persons with Disabilities: An Anthropological Study Using GIS on the University of Arkansas Campus

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NAVIGATION AND ACCESSIBILITY FOR PERSONS WITH DISABILITIES:
AN ANTHROPOLOGICAL STUDY USING GIS
ON THE UNIVERSITY OF ARKANSAS CAMPUS

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A thesis submitted in partial fulfillment
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Abstract

The University of Arkansas was founded in 1871 on the top of a hill overlooking the Ozark Mountains, resulting in a campus that has steep slopes and numerous historical buildings that were not designed with ADA regulations in mind. This makes getting around campus especially difficult for students with limited mobility, and no campus maps exist that include handicapped accessibility features to help navigate the terrain and limited parking options. This study examines this issue using a holistic approach that explores cultural and technological factors to produce a map of the Historic Core District of campus.

Geographical Information Systems enable studying the accessibility of the campus from an integrative perspective. My research includes overlaying digitized campus features onto a Digital Elevation Model to determine how slope, distance, and placement of features (buildings, stairways, curbs) determine accessibility. Such models can help plan optimal locations for handicapped parking, bus stops and accessible entrances. They can also be used by anyone seeking to find the best route across campus. The goal is an interactive on-line map available through the University website. This would facilitate navigation for all who desire to benefit from the opportunities available on this beautiful campus by highlighting the "best" routes and options for travel and parking.

The problems surrounding navigation and accessibility on the U of A campus are not merely technical. If solutions are to be effective they will need to take into consideration the cultural factors in which these problems are embedded. These factors are multi-faceted, extending their reach through the community, student body and numerous University departments. The interplay between these players is complex with regard to the exchange of information, resource allocation and influence regarding decision making. Anthropology is

especially suited for examining these cultural factors in order to improve understanding and communication between all parties with the ultimate goal of creating a campus that is truly inclusive and accessible for everyone.

This thesis is approved for recommendation
to the Graduate Council.

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expectantly wait until time and space are transformed and I fully know him as he is. I love you Jesus. Thank you.

Dedication

This edition of *Navigation and Accessibility on the University of Arkansas Campus* is dedicated to my daughters, Tabatha Keyan and Heather Grace. The greatest blessing of my life has been to be your mother. You are both amazing young women.

I would also like to dedicate this to my “son,” Josh. Your courage and encouragement have meant so much to me these last few months.

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1.0 Defining the Problem of Navigation and Accessibility on the University of Arkansas Campus

1.1 Overview

Academia values objectivity. Whether it is analyzing literature, the behavior of subatomic particles, or ancient civilizations, one is expected to suspend one's preconceived ideas and proceed with logic and neutrality. However, the illusion of one achieving complete objectivity is beginning to be accepted, and the need to acknowledge one's personal biases is gaining respect. It is with this in mind that I admit I have a clear objective with regards to the research in this thesis. Over the past several years I have had to navigate the campus at the University of Arkansas (U of A) with a physical condition that makes walking difficult and I am intimately aware of the problems involved in doing so. I am also aware of the quality of education and the resources available at the U of A. It is my hope that the material presented in this thesis will benefit future students, employees and visitors to the U of A through an honest look at the problem and possible solutions, so that all persons, regardless of physical ability, will find the campus accessible and welcoming.

1.1.1 Terrain. The University of Arkansas was founded in 1871 on a hill overlooking the Ozark Mountains. The current campus is comprised of 345 acres of land with elevations varying 200 feet from the parking in Lot 56, to the Library on the Historic Core. While climbing hills is good exercise for most healthy people, those with mobility problems may find themselves unable to traverse the campus in certain areas.

1.1.2 Historical Buildings. The campus core contains eleven buildings that are listed on the National Register of Historic Places. Nine other buildings on campus are also considered “historic” though there is no official registration of these buildings (2012 U of A, Historic Buildings). The University of Arkansas has worked hard to find a balance between making these buildings accessible, while also preserving their historic value. Adding elevators and chair lifts, and changing classroom locations have been some of the modifications made to allow students with disabilities to participate in their academic programs. Nevertheless, it is much easier to build a new structure to comply with the Americans with Disabilities Act (ADA) regulations than it is to adapt an existing building, and the modifications are often less than ideal.

The historical nature of the campus also affects the layout of the buildings. Before the 1920s the automobile was a novelty that was available only to those who could afford it. Buildings were laid out within walking distance of each other and no land was set aside for parking lots. The 1925 Master Plan “showed a tightly structured grouping of academic quadrangles” (2009 U of A Master Plan Summary:5), quite different from the retail shopping developments of the mid-twentieth century with acres of concrete and plenty of parking.

1.1.3 Increasing population and expectations. With the advent of modern medicine, and antibiotics in particular, people are living longer than they were in 1871. Illnesses and injuries that previously carried a death sentence are now treated with medication and adaptive technology, making it possible for more people with disabilities to live full and productive lives (Murphy 1987). In this country that implies independence and gainful employment, both of which are greatly enhanced through postsecondary education (Capps and Bowman 2004; Sachs and Schreuer 2011).

In 2005 the U.S. Department of Education published a longitudinal study entitled, “After High School: A First Look at the Postschool Experiences of Youth with Disabilities” (Newman). The study showed that 77 percent of youth with disabilities had aspirations for postsecondary education, while 61 percent of the parents of youths with disabilities expected their children to pursue some type of postsecondary schooling. Overall these expectations do not become reality and only one in five were currently attending postsecondary school within two years of graduation. This is especially troublesome due to the fact that the poverty level for persons with disabilities who acquire a college education is 15 percent, compared to 50 percent for those who drop out of high school (Haller 2006). And while 18 percent of working-age people are disabled in the U.S. and Great Britain, it is estimated that only 8-14 percent of all postsecondary students have disabilities (Sachs 2011). Clearly there is a need for accessible postsecondary education in this nation that is not being met.

The problem is even more troublesome at the local level. The 2010-2011 Annual Report for the Center for Educational Access (CEA) reported a 17.5 percent increase in students with disabilities who registered for accommodations. Even with this increase only 5.4 percent of the total U of A population is registered as having a disability. When students whose disability is due to learning disabilities, Attention Deficit Disorder, psychological disabilities, and traumatic brain injury are removed from the numbers to obtain a population more in line with the general "handicapped" classification, only 1.6 percent of students at the U of A fall into this category. The US Census Bureau's *Disability Status: 2000* brief reports that 23.6 percent of the population of Arkansas over the age of five has some sort of disability, with 5.1 percent having a sensory disability and 11.8 percent having a physical disability, ranking Arkansas as the state with the third highest disability rate in the nation. From this analysis it can be concluded that the population of students with disabilities at the U of A is not a proportional representation of the disabled population in the state it serves. Either these potential students are seeking an education elsewhere or their needs are going unmet.

1.2 Importance of the Problem

With only 1.6 percent of the University's student population registered as having possible mobility problems one may think that the effort and expense involved in improving navigation and accessibility on campus would be a misappropriation of funds that could be used to meet the needs of a greater number of students. Yet the issue is more complex and far-reaching than a cursory view reveals.

1.2.1 The "YOU" of A. The University of Arkansas recently unveiled their new theme, the YOU of A, which communicates the importance of each student as an individual. The idea that each student is known by name is supported by the tradition of engraving graduates' names in the sidewalks on campus (U of A, The YOU of A 2012). The first three values listed in the 2011 Annual Report of the Division of Student Affairs are "We are student centered," "We are an inclusive community" and "We treat all individuals with dignity and respect."

With this in mind, the idea of excluding or marginalizing a specific population of people would seem to contradict all that the University stands for. The disabled population has traditionally been one of the most marginalized groups throughout history (Tremain 2005; Snyder and Mitchell 2006; Murphy 1987; Braddock and Parish 2001). While great strides have been made to improve accessibility through the passage of such legislation as the ADA, there is still a long way to go. Exclusionary practices remain, generally not because of prejudice and willful segregation, but rather due to ignorance and oversight. The result is a practically invisible population whose needs go unmet with regards to planning and resource allocation, unless mandated by law (Gray et al. 2003; Imrie and Kumar 1998). Unfortunately, without an understanding of the reasoning behind the laws, they are often implemented in such a way as to give the impression of accessibility while those with disabilities continue to have problems getting where they need to go (Rattray 2007). A similar comparison can be made with regards to laws against racial discrimination and their limited effect on eradicating racial prejudices. The laws are necessary but a change of perspective is what is truly needed.

1.2.2 ADA Revisions. The issue of campus-wide navigability for persons with disabilities is even more important now since the ADA was revised in 2010. While the previous version focused on the accessibility of buildings, the new guidelines require that routes between buildings and parking are also accessible. With regards to site arrival points the regulations state, “At least one accessible route shall be provided within the site from accessible parking spaces and accessible passenger loading zones; public streets and sidewalks; and public transportation stops to the accessible building or facility entrance they serve.” Regarding access within a site it is required that “At least one accessible route shall connect accessible buildings, accessible facilities, accessible elements, and accessible spaces that are on the same site” (Department of Justice 2010). These laws mandated compliance by March 15, 2012 for all new construction and alterations.

While there are no ADA police enforcers that will shut down the U of A for lack of compliance, the University could find itself facing lawsuits, as it did in 1975 and 1979 (Sharp 1979; *Arkansas Traveler* [*AT*] 1979). Oklahoma State University and Northern Oklahoma College were both sued in March 2011 by Mitchell Miller for accessibility issues (*Journal Record* 2011). Even if the case were to be decided in the U of A’s favor, legal costs and negative publicity are clearly not in the University’s best interests.

1.2.3 Parking Scarcity. The April 26, 2011 edition of the *Arkansas Traveler*, the U of A’s student newspaper, identified parking as the number one issue for students on campus

(Naseem). This is nothing new. Parking problems at the University of Arkansas go back to the 1920s when the automobile began to truly transform the culture of America (*AT* 1928). In the 1970s the problem became so bad that the University had to rethink the nature of parking on campus, which eventually led to the creation of the Transit and Parking department. (Towne 1978; U of A, Transit and Parking Annual Report 2009).

On October 18, 1977 the *Arkansas Traveler* noted that there were 32 registered disabled students but only 26 spaces available (Remes). The February 20, 1979 edition included an article describing a new parking plan specifically for UA handicapped students that involved a tiered permit system where the type of handicap was evaluated by the Student Health Center to determine which Class of permit would be issued. Problems still remain (Hale). Even with the passage of the ADA and 290 accessible parking spots on campus there is still not enough parking on campus for those with disabilities (Naseem 2011, March 30). The problem is not necessarily the number of handicapped parking spaces, but the placement. A study done at Auburn University revealed that while universities as a whole have a greater demand for handicapped parking than other land uses, the primary issue is one of distribution. "The number of handicapped parking stalls provided should be based not on the total number or spaces in the lot but rather on the characteristics of the facilities the lot serves" (Capps and Bowman 2004). When a person is issued a handicapped parking tag because they have difficulty walking more than 100 feet, parking that is close to one's destination is not a time-saving convenience but rather a necessity for access.

Parking and traffic flow through campus will not be increased in the future but rather decreased. The 2009 University of Arkansas Master Plan Summary states, "The plan encourages new buildings and additions on infill sites as a way of optimizing the use of land resources, while simultaneously improving the campus landscape by better defining outdoor spaces and removing parking and drives from pedestrian areas" (17). While this does not have to mean that persons with disabilities will have a more difficult time getting where they need to go, keeping this population in mind when planning for parking is essential, as evidenced by other campuses that have done so successfully.

1.2.4 Construction. There are few places on campus where construction is not taking place. While this has the long-term potential to improve things on campus for those with disabilities, the process is often disruptive for accessibility. Temporary sidewalks are made of softer materials that are more difficult to walk on, especially for those with limited vision, and almost impossible for wheelchairs to traverse. Sidewalks are partitioned off creating fewer possible paths and reducing options for finding shortest routes. Detour routes may require crossing the street, which necessitates curb cuts for wheelchair users. Closed sidewalks also limit the routes available to golf carts used by the CEA for transporting students with mobility issues.

1.3 Scope of the Problem

The problem of navigation and accessibility is not one that is limited to a specific group of people. Mobility issues affect everyone and it is often said that those who are not currently disabled are merely "temporarily able bodied." Accidents and illnesses are no respecters of persons and one never knows when one may find themselves unable to walk up stairs or down hills.

1.3.1 Students. The 2010-2011 Annual Report for the CEA reported 1,241 undergraduate and graduate students registered with them for accommodations. Medical or chronic health conditions accounted for 13 percent of these, and “16 percent included students with mobility impairments, visual and hearing impairments/deafness, and temporary conditions”. It should be noted that only about a third of students with disabilities request accommodations in postsecondary school so the number of students registered with the CEA should not be considered the number of students on campus with disabilities; the actual number would be higher (Newman 2005). Nationwide the population of persons with disabilities who are pursuing higher education is increasing (Wilson et al. 2000). This is to be expected since employment options for persons with disabilities are already limited and improving one’s education is the primary way of increasing employability (Wilson et al. 2000:1; Haller 2006; Capps and Bowman 2004).

1.3.2 Faculty/Staff. Students are not the only ones on the University campus who struggle with accessibility problems. Faculty and staff are generally in an age-bracket where mobility issues associated with aging will be greater than that of the student population, yet fewer resources are available for them. Faculty and staff may also be reluctant to actively pressure administration for improvements for fear of being seen as a “trouble maker.” No current outreach to support employees with disabilities at the U of A could be discovered. The typical solution for faculty or staff is to attempt to arrive to campus earlier than others to secure a parking spot.

1.3.3 Guests. Parking and accessibility issues are problems for guests on campus as well. In an interview with Paula Carpenter, an investigator that does background checks for the federal government, she spoke at length about the difficulties that guests have getting around the campus. The interview began due to her comment about visiting several campuses in the area and the U of A not being as “student friendly” as others. When questioned about her comment she spoke of the parking problem so I asked if I could interview her.

Ms. Carpenter’s job requires her to visit several campuses for recruitment purposes and she said the parking problem made dropping in to visit the U of A extremely difficult. She said that the U of A does a good job when it comes to job fairs, but short visits are a problem. Ms. Carpenter also has health issues that make walking difficult, mentioning that the walk up the lawn of Old Main was too long and the slope too steep for her so she avoids the campus if at all possible, attempting to hold student interviews at other locations. Ms. Carpenter is a U of A alumna so she is familiar with the campus, but said that others in her field have a hard time (personal communication 2011).

In another incident, while doing research in the University Archives at Mullins library, a guest from the community came in complaining about her walk from the parking garage because she had knee trouble and that she didn’t realize there would be so many steps to get to the library. I spoke with her as she was leaving and shared my research with her, including the map of the Historic Core with accessibility paths marked, since she wanted to avoid the stairs on her way back to the parking garage (personal communication 2012).

1.4 Summary

The University of Arkansas homepage has a link entitled “Students First”. When the link is clicked one is taken to the following text:

> Students first. What does this mean?
>
> On a somewhat superficial level, it simply means projecting a welcoming and friendly attitude to each and every student. It means being more helpful when they ask for assistance or come to faculty and staff with concerns. It means reaching out to students and creating an environment in which they feel valued.

> It only takes one careless comment or one example of red tape to turn off a student to our university—particularly prospective students. Unfortunately, we have too many examples of red tape and bureaucracy across campus.
>
> We need to break down those barriers [2012].

It is my hope that the research presented in this thesis will be a step towards removing barriers to access that are currently experienced by students, employees and guests with disabilities.

2.0 Resources and Possibilities

While the navigational and accessibility challenges on the University of Arkansas campus are many, so are the resources and possibilities. This University is known world-wide for its research capabilities and its ability to develop creative solutions to difficult problems. With a wealth of intellectual assets and a strong focus on creating an environment where diversity flourishes and every student is known by name, the potential for the U of A to be a leader in providing a universally accessible campus is great. In fact, the campus did hold that position in 1978. Jim Waugh, then advisor in the Disabled Students Resource Center, was quoted in the April 11, 1978 edition of the *Arkansas Traveler* as saying, "This campus has an excellent program going for it right now…We are being observed as a model institution in this respect not only by other institutions around Arkansas, but also by various other colleges and universities around the nation. If we can do a good job complying with the specifications for disabled students with the hilly terrain we have around here, I see no excuse for other institutions not to do the same" (Qualls:6).

Since the 1970s the "specifications for disabled students" have been expanded from those set forth in Section 504 of the 1973 Rehabilitation Act, which was the primary legislation affecting accessibility at that time. However, the technology available to meet those specifications has also expanded. In this chapter I will discuss the resources existing on the University of Arkansas campus, some of the technology available for both planning and improving navigation and accessibility, and explore how other campuses have met similar challenges.

2.1 Resources

The resources available on the University of Arkansas campus include academic, operational and research/outreach based departments. They also include the students, faculty, staff, surrounding community and the culture of the U of A.

2.1.1 GIS Experts. "What is GIS?" It's a question I am often asked. The term cannot be found in the online or 11th edition of the Merriam-Webster's Collegiate Dictionary, though GIS is pervasive in our modern culture. Businesses use GIS to determine the optimal location for the next franchise, weather forecasters analyze wind speeds, and travelers access online driving directions on a regular basis. GIS stands for Geographical Information Systems, though Science is sometimes used for the last "S". *Wikipedia* states, "In the simplest terms, GIS is the merging of cartography, statistical analysis, and database technology" (2012). It is a way of visualizing, managing, storing, analyzing and communicating geographically referenced data (Dempsey 2012, *GIS.com* 2012). GIS has the potential to be a powerful tool for improving accessibility for persons with disabilities as both a means for planning optimal routes, and for abled bodied persons to better understand the barriers that limit access (Matthews et al. 2003; Rattray 2007).

The Center for Advanced Spatial Technologies (CAST) celebrated 20 years at the University of Arkansas on September 15, 2011. According to their website, "As a multi-college organization, CAST unites personnel from the Fulbright College of Arts and Sciences, the Dale

Bumpers College of Agricultural, Food and Life Sciences, the Sam M. Walton College of Business and the School of Architecture in the common goal of introducing and making geospatial technologies available to a wide variety of researchers and professionals and to furthering the field through basic and applied research." (U of A, About CAST 2012) One of their specific focuses of research is geospatial analysis and modeling with "Research", "Outreach" and "Education" being key factors of their mission (U of A, CAST Homepage 2012). The resources available to CAST are impressive. The website states, "CAST has a full time staff of 21 and supports numerous graduate students. External support is provided from sources such as DoD, USGS, NSF, USDA, EPA, state agencies, and many other public and private sources… The Center has more than 100 high-performance workstations - many configured for 3D data extraction and manipulation in stereo - and approximately 30 larger application and data servers with more than 100 TB of disk." (U of A, CAST Facilities 2012)

In 2007 the University issued a press release describing the cooperation between CAST and Facilities Management for the purpose of developing a three-dimensional GIS of the campus that will merge information on infrastructure and buildings. Included in this information are accessibility features such as entrances and elevators (U of A, Mapping to the Edge of Information). Steps have been taken to map trees, light poles, and some utility features. Work has also been underway for the past several years to produce an online, interactive map of the campus. Last year University Relations took over the project and has received data and support from CAST. The map has recently gone live.

2.1.2 Transportation Engineering Department. The College of Engineering at the University of Arkansas supports transportation engineering research through its Civil Engineering Department. Degrees offered include a Master of Science in Transportation

Engineering (MSTE) and the undergraduate Transportation and Logistics (BSBA). The website states, "University of Arkansas faculty have developed and patented digital media systems designed to manage transportation infrastructure." (U of A, Civil Engineering, Transportation Engineering 2012) The department has an extensive research component including two research centers that focus on transportation: the Mack-Blackwell Rural Transportation Center (MBTC) and the Center for Training Transportation Professionals (CTTP). However, most of the research being done involves improving pavement materials rather than planning and routing issues.

Graduate courses offered include Traffic Engineering, Transportation Modeling, Transportation System Characteristics, and Transportation Management Systems (U of A, Transportation Engineering Homepage 2012). At this time the Civil Engineering department is seeking a tenure-track faculty member in transportation planning, and while the Industrial Engineering department does have faculty that are experts in transportation logistics, there are none that are currently focusing on traffic issues at the University of Arkansas. (Personal communication, Dr. Kevin Hall, Department of Civil Engineering, University of Arkansas 2012)

2.1.3 Razorback Transit System. Parking problems and transit solutions have a long history at the University of Arkansas. The 1947-48 "A" Book (Student Handbook) has a centerfold map of the campus depicting the "CITY BUS ROUTE NEAR CAMPUS" (pp 54-55) and the 1952-53 "A" Book states, "Fayetteville is well served by public transportation facilities. All residence halls, fraternity houses, and sorority houses are located either on the campus or nearby. Students are urged, therefore, to leave automobiles at home" (p 26). On February 14, 1978 a comprehensive parking plan was described in the *Arkansas Traveler*. The plan had two phases that were to be implemented over a five-year period, including "A transit system to provide students with an alternate to the private car with the objective being to lower automobile possession on campus by campus residents." Twelve 36-passenger air conditioned busses, two 12-passenger air-conditioned busses, a people mover system providing intra-campus transportation via a covered escalator and trams, and remote parking serviced by a Park-and-Ride system comprised the overall components of the plan (Towne 1978). In 1979 the Transit and Parking Department was established with four bus routes and a paratransit van, Barbara Horn being the first paratransit driver (*Sensory* 1985; U of A, Transit and Parking Annual Report 2009).

According to the Paratransit website, "Razorback Transit currently operates 11 accessible buses on its fixed route system with three Paratransit vans providing comparable service for disabled persons who are prevented from using the buses" (U of A, Paratransit 2012). Full service on Razorback Transit buses runs Monday through Friday from 7:00 am through 6:00 pm with reduced services in the evening and on weekends. Paratransit services run on the same schedule, though rides must be pre-scheduled.

Early Razorback Transit bus routes had no specific schedule but "ran based on headways not on an assigned time" according to Mike Seither, Razorback Transit manager (personal communication 2011). The first official timetables were distributed to the public for the fall semester of 2009 (U of A, Transit and Parking Annual Report 2009). Due to the expense of transit scheduling software and the relatively small size of Razorback Transit's fleet, the current scheduling system "is based on a series of Excel spreadsheets that duplicate the way it was done by hand 30 years ago" (Mike Seither, personal communication 2011). Attempts were made to upload the bus routes and times into Google's driving/transit directions but problems developed and the process was never completed. Current work includes installing Global Position System

(GPS) devices on all busses, known as Automatic Vehicle Location (AVL), so that locations can be tracked via the web, allowing riders to know when the next bus will arrive at a specific location (U of A, Transit, Parking and Traffic Committee Minutes 2011).

2.1.4 Center for Educational Access. The Center for Education Access provides disability related services to students at the U of A. Six full-time staff and nine part-time student employees currently work for the department to meet the needs of undergraduate and graduate students on campus. No maps or navigation tools are available through the website, though the Handbook describes personal "Mobility Orientation… for students who may have a need based on the impact of a visual or other disability." (U of A, *Center for Educational Access Student Handbook* 2009:11) Priority registration is also offered, allowing students to schedule classes at times and locations that facilitate ease of access. Providing alternate formats of texts can also benefit those with mobility issues by lightening the load of materials that need to be carried. The CEA website does not offer services to employees or visitors to campus as part of its regular mission.

One of the primary services offered to mobility impaired students through the CEA is its golf cart services. Page 17 of the CEA *Student Handbook* states:

- CEA golf cart transportation assistance is a ***supplement*** to the University Transit and Paratransit Services. Its purpose is to help students with disabilities get to/from classes or other academic-related events that are located on the interior of campus in areas otherwise closed off to motorized vehicles.
- CEA golf cart transportation is a **prescheduled, shared-ride service**. Students must contact the Center ahead of time to create a regular schedule of rides. All student rides are scheduled on a first-come, first-served basis [2009].

2.1.5 Student Population. The University of Arkansas has a wealth of student resources available with regards to labor force, creative problem solving and youthful enthusiasm. Actively pursuing student involvement not only taps into this reservoir, it is vital with regards to improving campus accessibility, since students have firsthand knowledge of the challenges involved in navigating the campus. Engaging students in relevant research may also improve retention rates (Rattray 2007). Unfortunately, when students, especially those with disabilities, are not consulted in the planning and development of the campus with regards to accessibility, their input may come in the form of lawsuits, as was the case in 1975 and again in 1979 (Sharp 1979, *Arkansas Traveler* [*AT*] 1979).

One of the recent examples of positive student involvement with regards to improving awareness of these issues on campus is the formation of the Disabilities Awareness Week (DAW) Registered Student Organization (RSO), whose stated purpose is, "To educate and connect able bodied students with students living with various disabilities by fostering an atmosphere where students with and without disabilities can interact freely and comfortably" (U of A, DAW 2012). George Turner, an undergraduate student who has been in a wheelchair all his life, developed the plan and helped organize the RSO and the first Disabilities Awareness Week that took place April 18-22, 2011. He was quoted by NWA News as saying, "It's not the daily living, it's not the getting from here to there that's hard, it's just some places, they're not as accessible as they could be and this is a good way to get that looked at" (Hogan 2011). The event was a cooperative one, involving students, the Center for Educational Access, First Year Experience, Student Activities, and Office of the Vice Provost/Dean of Students. More than 350 students, faculty and staff participated (U of A, Annual Report, CEA 2011). Opportunities for able bodied students to experience being in a wheelchair or visually impaired were offered during the event, though it was not the first time that an activity of that nature took place on campus. On March 30 and 31, 1978, the University Department of Landscape Architecture hosted "Barrier-Free Design," a project designed to "increase the awareness and sensitivity of the campus population to the areas of pedestrian, bicycling and handicapped persons." An obstacle course was set up to allow students and faculty to "see what problems are encountered by handicapped students trying to get to class" (Amason 1978). Unfortunately the DAW that was originally scheduled for this school year was postponed to an unknown future date.

U of A students are also valuable employees. The federal government's Work Study program facilitates undergraduate employment to the point where the University's Financial Aid website states, "You are practically guaranteed a job since there are a multitude of part-time Work-Study jobs available. Employers receive a large subsidy when they hire Work-Study students, so you are much more likely to be hired if you have Work-Study eligibility" (U of A, Work Study Benefits 2012). According to Kattie Wing, director of Financial Aid at the University, departments are not limited on how many work-study positions they are allow to post (personal communication 2012). Work-study is not the only form of student employment on campus. For the month of March 2012, there were 1,321 graduate assistants, 433 work-study positions, and 1,398 other student employees, for a total student workforce of 3,152 employees, according to the Human Resource department (Carol Jones, personal communication 2012).

2.1.6 Summary of Resources. Besides the previously mentioned resources, the U of A also has top-notch faculty, a strong alumni association, dedicated staff and a vibrant local community. Clearly there are extensive resources available that could be utilized to research and implement better solutions to the problems of navigation and accessibility on the campus for students, employees and visitors. In the next section I will explore how currently available technology can be used to communicate best routes for specific situations.

2.2 Technology

As long as people have been able to distinguish between "here" and "there" they have had to find ways of communicating locations remotely. The heavens above and maps on earth have guided travelers safely for centuries. According to a BBC News article by Dr. David Whitehouse, "A prehistoric map of the night sky has been discovered on the walls of the famous painted caves at Lascaux in central France. The map, which is thought to date back 16,500 years, shows three bright stars known today as the Summer Triangle" (2000). Now our GPS enabled devices access satellite signals to provide us with digital maps and driving directions to guide us on our way through GIS technology.

For persons who struggle with mobility it is especially important to understand the environment to be navigated, making maps a vital tool for independence and inclusion (Vujakovic and Matthews 1994; Rattray et al. 2008; Fry 1988). Maps are essential for route planning ahead of time, and the new mapping technology has great potential to contribute to improved independence of travel in real time as well, especially for the visually impaired when GPS enabled devices relate geographical positions and directions in a text-reader format.

GIS based maps can also contribute to improved capital planning and development as access issues can be readily addressed in architectural plans with regards to the surrounding landscape and other accessibility features. This not only provides better accessibility and eases navigation for those with disabilities; it also reduces potential costs and frustrations involved in remedying oversights. It should be noted that the perceptions and recommendations of persons with disabilities should be an integral part of both mapping and planning built environments, since it is difficult for able bodied persons to completely account for the barriers that restrict access with regards to various disabilities (Vujakovic and Matthews 1994; Rattray et al. 2008; Fry 1988).

2.2.1 Interactive Maps and GIS. Interactive maps are web-based maps that allow users to choose which features to display, and at what scale, using an intuitive graphical interface. Google maps is a commonly known interactive mapping program that allows users to not only pinpoint specific locations but also search for hotels or other attractions within a certain radius of these locations. The interactive campus map recently developed by the University of Arkansas will allow users to highlight specific buildings, bus routes, parking lots and even public art and historical markers with pop-up windows offering further details. Handicapped entrances are also displayed on the map (though some locations need correction), and plans to add additional accessibility features are underway. Many interactive web maps are also being converted to mobile applications, making them available while actually traveling. A mobile application for the new campus map is currently in the works (Chris Nixon, University Relations, personal communication 2012).

2.2.2 Driving/Walking/Transit Directions. Google Transit Partner Program is a free transportation planning tool that allows public transportation information to be combined with Google Maps to provide transit and/or walking directions to users. The website states, "It integrates transit stop, route, schedule, and fare information to make trip planning quick and easy for everyone… and is compatible with screen readers for the visually impaired" (Google Maps 2012). As previously stated, Razorback Transit has attempted to upload bus information into the program but ran into several problems. The new campus map has a feature to obtain walking directions around campus which uses the Google API (application programming interface) and it is hoped that eventually the transit routes will be integrated with the network (Chris Nixon, University Relations, personal communication 2012).

The University of Arkansas also has a site license with Esri, a leading GIS software provider that has network analysis capabilities which include multimodal route planning with directions. Sidewalks, streets and bus routes could be set up to provide the same type of service offered by Google Transit Partner Program, but with local control. This would allow timely updates to be made to the network, such as when construction temporarily blocks certain pathways.

2.2.3 GPS Tracked Buses. The April 26, 2011 Transit, Parking and Traffic Committee minutes note that they are "working to get AVL (*Automatic Vehicle Location*) on all transit, charter and Safe Ride vehicles. We will eventually have bus locations available on the web." This technology works by placing GPS tracking units on all buses, which then upload their position data into mapping software that displays the positions of vehicles in "real time." Those wishing to determine the best route for travel can access such maps to see where the nearest bus is and use that information to choose which bus stop to go to, or if walking would be faster.

The November 14, 2011 edition of the *Arkansas Traveler* ran an article stating that University Relations and the Associated Student Government were working together to have the GPS tracking for buses integrated with the new interactive campus map (Huckaby 2011). Mike Seither, associate director of Transit described a three-step plan for making the positions of buses available to the public. He was quoted in the September 29, 2011 edition of the *Arkansas Traveler* as saying, "Step one will be to gather all the information we need. Step two will be to do web enabling and three will be to do specific smartphone enabling" (Suntrup 2011). It is hoped that this technology will improve the efficiency of the Transit department and allow students to easily determine if buses are running on time or not.

2.2.4 Non-map-based Technology for Accessibility. Much of the technology today that is used for accessibility purposes is for personal use, such as motorized wheelchairs and scooters. Golf carts are currently used on campus to transport students with mobility impairment between classes. The scope of this research does not further explore personal technology options available for improving accessibility on an individual basis.

2.3 Other Campus Mapping Solutions

Numerous campuses across this nation have embraced the available GIS mapping technology to better plan and communicate accessible options for students, visitors and employees. While no two campuses studied utilize these tools identically, there are common factors.

First, university homepages often have a prominent link for "Maps" displayed. The opened link may then have an "Accessibility Map" option, or an interactive map may offer the choice to display accessibility features. Accessibility guides are also common, allowing users to choose a specific building to obtain information on best routes to the building and the locations and availability of accessible features such as power doors and accessible bathrooms.

With parking and traffic issues becoming increasingly problematic across campuses nationwide, many are considering becoming auto free. A study on "Urban university campus transportation and parking planning through a dynamic traffic simulation and assignment approach," published in 2011 by *Transportation Planning and Technology* noted that the University of Arizona and Stanford University had originally been designed to be auto free and that the University of Texas at Austin had recently closed its central campus to traffic. While this research studied the various parking and access needs of students, staff and faculty as separate groups, no mention of persons with disabilities was made (Bustillos et al.). In light of the specific needs of this population, I chose to especially look at the websites of these three campuses, as well as other university websites, with regards to disability access.

2.3.1 University of Missouri. The University of Missouri has a “Maps” link on the top of their homepage and a “Disabilities Resources” link at the bottom. The Maps link opens up an interactive campus map with a menu option on the left for “More Maps and Information.” A link to the “Campus Accessibility Map” is listed under this option and takes you to an interactive map where 23 toggle options are available for display on the map (see figure 2.1).

The “Disability Resources” link takes you to a page that is “maintained by the Chancellor’s Committee for Persons with Disabilities and the Chancellor’s Diversity Initiative” and a menu of further links that include “Academic,” “Policies and Guidelines,” “Personal Health and Wellness,” “Housing and Transportation,” “Accessibility,” and more (Disability Resources 2010).

2.3.2 University of Oregon. The University of Oregon also has a “Maps” link at the top of their homepage. This link opens a page where options are given for the campus “Interactive Map,” the mobile iPhone App known as UOregon, or printable maps. The Interactive Map is a general campus map with a toggle option to display “Accessibility.” When this option is chosen the map displays handicapped parking and elevator locations, as well as accessible routes between buildings (see figure 2.2). No disability related links are displayed on the homepage.

2.3.3 Yale University. The Yale University homepage does not have a “Maps” link at the top of the page. It does have a “Quick Links” drop-down menu box near the center-right of the page with a “Maps & directions” option. An interactive map opens with a menu option on the left for “Disability Access.” This link takes you to a page where you can click on a subsection of the campus to open a map of that section with accessibility features. By clicking on a specific building a text box opens with accessibility information about that building (see figure 2.3). No disability related links are displayed on the homepage.

2.3.4 City College of San Francisco. The City College of San Francisco has nine campuses spread out across the city. Most of these campuses consist of a single building, the exception being the Ocean Campus. The main website does not have any mention of either maps or disability/accessibility services. However, when a specific campus website is chosen, both a map and a link to an “Access Guide” is available. Choosing the Access Guide opens a page that gives a photo and description of each building along with information about “Accessible Floors,” “Transportation” (both parking and public transit directions), a textual description of Interior Features such as bathroom locations, an “Interior Way-Finding” map of each accessible floor of the building and a list of “Classroom Information” rating each classroom’s accessibility. Elevator updates and construction alerts are also displayed on the Access Guides. An “ADA Accessibility Map” is available in a pdf format for the Ocean Campus, as well as Access Guides to each of the buildings on that campus. A copy of the Ocean Campus map is shown in Figure 2.4.

2.3.5 University of Arizona. This campus was one of those listed in the campus transportation study as being auto free. The University homepage has a “Campus Map” link at the top of the webpage, which opens an interactive campus map. On the left menu is an option for “Accessibility Maps” which, when clicked, allows the user to display a choice of three pdf formatted maps: “Disability Parking Map,” “Disability Cart Service” and “Access Map.” A

“Bike Route” map is also available under this menu. The Accessibility Map shows locations of elevators, handicapped parking and accessible entrances, and buildings are color coded with regards to type of restroom accessibility.

Another left menu option displays various “Cat Tran UA Shuttle” routes on the interactive map. Opening this drop-down menu also provides a link to the “Cat Tran Trip Planner” that opens a window in Google maps to obtain driving, transit, walking or bicycle directions around the campus. The trip planner software allows the user to choose how to optimize the route by the “best” route, the one with the fewest transfers, or the one with the least walking.

At the bottom of the University of Arizona’s homepage is a link to “Campus Accessibility,” which opens up a website with several sections describing the Disability Resource Center, Facilities, Parking and Transportation, Information and Communication, and Public Events and Programs. Each section had several short subsections with links to further information.

2.3.6 University of Texas at Austin. This campus was also listed in the transportation study as recently choosing to go “auto free”. The page that opens when the “Maps” link is chosen from the top of the University homepage has “Accessibility Map” listed as the second option on the left menu. The map that is displayed when this option is chosen shows the campus divided into sections. By clicking on a section, an Accessibility map opens for that location, showing parking, accessible entrances, ramps and curb cuts. Figure 2.5 shows the accessibility map for the Tower area.

At the bottom of UT’s homepage is a link to “Resources for People with Disabilities”, which opens the Disabilities Resources Home page where links to further services are offered.

2.3.7 Stanford University. Stanford University is another campus recognized as "auto free" with a gated Pedestrian Zone which allows limited vehicle access. The University homepage has no mention of disability related services. There is a "Maps" link at the top of the page, which opens a page with a link to "Other Transportation-related Maps." From this page you can go to the Stanford University Campus Access Guide, described as "An online system of maps detailing wheelchair accessibility and other disability access information (including parking options) for campus venues." The Campus Access Guide has a drop-down menu listing all the buildings on campus. Choosing a building opens a window with textual descriptions of location, the use and purpose of the building, entrances and circulation, restrooms, parking and transportation, and points of interest. There is a link to open a pdf map showing the locations of elevators, parking, accessible entrances, teletype, and bus stops, as well as both accessible paths and "imperfect" paths of travel. A sample map is shown in Figure 2.6. The link to the "View ADA map Campus-wide" on the Campus Access Guide webpage was broken as of April 6, 2012.

The "Maps" page also has a FAQ column on the right of the page, which includes the following question, "A member of our party has a mobility restriction. What resources are available to us while visiting Stanford?" The answer given is "A great way to see the campus is on a Golf Cart Tour conducted by Visitor Information Services. This tour is offered at 1:00 p.m. daily. You can also reserve a wheelchair for the day through Visitor Information Services by calling (650) 723-2560. All buildings on campus are wheelchair accessible." Contact information is then given (2012).

2.3.8 University of California at Berkeley. The homepage has a primary menu link entitled "Visiting and Getting Around" which displays a submenu when scrolled over, containing links to “Campus Map” and “Access Guide for People with Disabilities.” While the “Campus Map” link does not open any options for disability related maps, the “Access Guide for People with Disabilities” website has its own “Maps” menu. Most of the disability maps are pdfs of one or two accessibility features (see figures 2.7 and 2.8). Information on the Access Guide’s website is classified under the headings “Getting there…” and “Having Fun…,” and a phone number is given for the “Physical Access Hotline” (2012).

2.3.9 University of Arkansas. After reviewing other campus websites for navigation and accessibility tools, such as maps and access guides, a comparison with the University of Arkansas is appropriate. Until recently the U of A’s “Campus Map” was a large pdf with no accessible features displayed. The new interactive Campus Map is a big improvement and now includes accessible entrances with plans to incorporate further accessibility features, such as parking spots, in the future. The work is a new development so the information displayed is not completely accurate, but University Relations is working to improve the map and it is much easier to use than the previous pdf (see image 2.9).

The University homepage has no other disability related links, no links for parking or transit, and no “visitor” links. There is a “Schedule a Visit” link, where you can choose to get directions to the Garland Parking Garage, but there are no disability related links or information on this page either.

By following the path “Current Students” > “Transit & Parking” > “Parking Map,” one can open a pdf of the Parking Map that displays accessibility features (see Image 2.10). Unfortunately, a review of these extremely small features showed numerous errors for locations of handicapped parking and accessible entrances. At the top of the page is a link for “Visitor Parking Information.” This opens a page which describes the process for obtaining a visitor parking permit and a “Link to Visitor Parking Guide Near Campus Facilities.” The Guide displays photos of commonly visited campus buildings, descriptions of departments and services located in that building, and where the nearest parking is located along with the Parking Map section where the building can be found. No references are made to handicapped accessible parking or services for guests with impaired mobility.

2.4 Summary of Resources and Possibilities

With the wealth of resources available to the University of Arkansas and the ability of digital maps and applications to aid in navigation and accessibility, the possibilities for improvement, and even leadership in this area, by the U of A is great. Unfortunately, the issue is more complex than just the production of a map. In the next section I will explore the multi-dimensional nature of the problem of navigation and accessibility on the U of A campus.

3.0 Cultural Factors Regarding Navigation and Accessibility

The University of Arkansas boasts nearly 23,000 students, is subdivided into ten different colleges or schools, provides nearly 200 academic programs, has numerous administrative departments and employs almost 1,000 instructional faculty members (U of A, Quick Facts 2012). Those seeking to understand the issues related to navigation and accessibility on the U of A campus must take this organizational structure into account.

Applying techniques from anthropology, and especially the subfield of business anthropology, is appropriate for this study since, “Anthropologists are interested in understanding group behavior and culture,” and “The subject of a business anthropologist’s work is the behavior in and around any organization or the behavior of the consumers of products and services provided by an organization," according to Ann T. Jordan, author of *Business Anthropology* (2003:2). Concepts such as holism, ethnocentricity, liminality and theories regarding the exercise of power can shed light on underlying cultural factors that contribute to the problems of accessibility and navigation so that these factors can be addressed as solutions are considered. Not doing so results in temporary, patchwork attempts to resolve manifestations of the problems, like picking dandelions and leaving the roots untouched.

As I have undertaken this research I have also noticed similarities between development planning and the attempts of students at universities who undertake various "improvement" projects. In both situations you have temporary "experts" who are unfamiliar with departmental workings and whose help may or may not have been requested. It is for this reason that I also consider ideas from anthropologists in the development field with regards to this study.

When conducting ethnographic research, one is seeking to develop an understanding of the complex nature of human activity, attempting to find patterns and relationships behind the beliefs and actions of various individuals and groups (Jordan 2003; Schultz 2005). Participant observation, interviews and literature reviews are primary methods in this process (Miller 2005, Jordan 2003). The nature of my research was very conducive to participant observation since the mapping project allowed me to interact with various departments on campus. During this time I was able to interview people directly and implement a survey of students registered with the CEA. Besides reading relevant books and journal articles I also searched websites and archived student newspapers and documents.

Throughout this research, Ann Jordan's perception of the organization as a "web of interacting cultures" (2003:86) has been especially helpful. While the field of organizational studies sees culture as something that organizations *have*, she views the "organization *as* culture and all the components of the organization, such as organization structure, reward systems, rules of behavior, and goals, as components of the culture" (2003:86). Not only is the organization a culture of its own, it is a subculture of the surrounding community and is comprised of various subcultures and cross-cutting cultures.

Business anthropologists and anthropologists who work in development circles have several things in common. First, both can be classified as applied anthropology which, according to Gary Ferraro, author of *Cultural Anthropology, An Applied Perspective*, "is characterized by problem-oriented research among the world's contemporary populations" (2001:42). Whether the goal is a successful development project or improved revenue, the anthropologist's goal is to facilitate a specific agenda and offer insights into best possible methods. Secondly, they are both, "studying up" which is when "as a researcher one is dealing with people who have equal or superior status in every relevant respect. These people are in a position to determine what kind of research into their own work they would like or will tolerate and how that work should be subsequently depicted" (Rottenburg 2009:60). Because of this, and the desire to successfully implement an agenda, the anthropologist may find that certain information is less than forthcoming. Richard Rottenburg, author of *Far-Fetched Facts, A Parable of Development Aid,* states, "The organizations involved do precisely what all organizations have to do: They present themselves to the outside world as if they were black boxes, in which nothing occurs except the orderly and rational processing of inputs into outputs" (2009: 60). This leads to a third similarity. As a general rule, cultural anthropologists working in development circles have often been considered "troublemakers" and "nuisances" due to the way they may challenge assumptions and take a critical thinking role, as opposed to a supportive one (Miller 2005:378-379). Business anthropologists deal with the same dilemma with regards to the ethics of criticizing those one works for (Jordan 2003:60). However, when cultural anthropologists are able to play an early role in development projects or business plans, versus an “add an anthropologist and stir” approach, positive results can be achieved and potential problems avoided (Miller 2005:378).

It is my hope that, despite critical at times, this analysis will be taken as an attempt to offer fresh perspectives and deeper insights into longstanding norms and practices inherent in the University organizational structure for the purpose of better integration between the values that are espoused at the U of A and the day to day functioning that takes place.

3.1 On the University Campus

3.1.1 The “Players.” When an anthropologist goes into the field, it is important to be able to discern the various cultural groupings, understand what sets each apart, and how the different groups are in relationship to each other. Kinship and exchange systems are analyzed for this very reason. This same principal applies when seeking to understand the underlying culture at the U of A. I chose to use U of A websites to explore how the university organization is subdivided and how each department represents itself to the public.

In perusing various University webpages, the organizational hierarchy of departments and administrators on the U of A campus is not easily discerned. The Office of the Chancellor lists administration and staff contact information, as do other departments like Parking and Transit, but the overarching, hierarchical authority structure is not found in any one place. Some departments, such as Facilities Management, Student Affairs and Residence Education, provide traditional organizational charts showing the chain of command for their specific departments, but others are less clear and CAST does not even mention of the director of the program.

This lack of emphasis on openly defined, top-down authority is modeled with regards to parking on campus. In the past, reserved parking spots were for particular locations designated for specific individuals and marked by signs with each person's name (U of A 1955-1956). Currently the purchase of a "reserved" parking permit only allows the owner the right to park in several designated spots. It is said that such a permit is not a guaranteed spot but rather a "hunting permit."

While the U of A's authority structure and the holders of that authority are not prominently revealed, it does not mean such structures are not important on the U of A campus. It does reveal that understanding the informal structures of power and authority will be even more important as the balance of social control leans farther toward internalized norms as opposed to external laws (Jordan 2003; Miller 2005). The lack of clearly delineated chains of authority also reinforces the idea that the U of A is a "web of interacting cultures" where each department is its own subculture. In such an atmosphere, cross-cultural communication becomes vital for the success of any university-wide project (Jordan 2003:14).

The departments that I interacted with during this study were primarily those mentioned in chapter two as resources on the campus: CAST, Facilities Management, Transit and Parking, and the CEA. University Relations also plays a part in this since they are "responsible for articulating and presenting the university's mission and goals in a consistent manner" and currently have ownership of the online, interactive mapping project (2012). An in-depth analysis of the informal structures within and between these departments is beyond the scope of this paper. However, a brief examination of departmental webpages can reveal differences in funding, webpage presentation and authority representation, highlighting cultural variations with regards to economics, values, communication, and power structures. This is especially important since communication between departments is essentially "cross-cultural communication" and misunderstandings can be the result of approaching problems from different value systems or economic bases.

3.1.2 CAST. The CAST homepage displays a slide show presentation highlighting the various projects that CAST is involved with. The U of A logo is considerably smaller than the prominent "Center for Advanced Spatial Technologies" banner at the top of the page. The website has several drop-down menus and links that open websites, which are further subdivided into an extensive network. The "About CAST" webpage describes CAST as a multi-college organization that receives over one million dollars a year in research grants from outside sources. The "Staff Pages" link opens a list of alphabetized staff members with a short bio for each and links to webpages for each staff member. No authority structure is displayed and no one is listed as the director of CAST.

3.1.3 Facilities Management. The Facilities Management homepage has a photograph of the Associate Vice Chancellor for Facilities, Mike Johnson, prominently displayed on the right side of the page. The website is formatted with the U of A style where the logo is prominent and "FACILITIES MANAGEMENT" is in smaller font to the right of the logo. Clicking on the "About Facilities Management" link opens a page with the mission statement, a photo of their office building and a link to the "Table of Organization," which opens an organizational chart. The mission statement reads, "Facilities Management provides stewardship of the University's physical assets in support of the institution's primary mission of teaching, research and outreach excellence. We are committed to providing quality planning, maintenance services and construction at competitive prices in a timely, professional and safe manner" (2012).

The homepage also has several links to divisional and informational webpages that are also further divided. The "Departmental Rates and Fees" link gives the charges for various services offered through Facilities Management. All linked pages use the same style except for the "Campus Planning and Capital Programming" link, which has a more colorful format and the U of A logo is less prominent and lower on the page. It is interesting to note that both this division of Facilities Management and CAST solicit funds from outside sources and both have more creative liberty with regards to website presentation.

3.1.4 Transit and Parking. The Transit and Parking homepage is similar to the Facilities Management's homepage in that a picture of the Director of Transit and Parking, Gary Smith, is prominently displayed at the top right of the page. The formatting of the website is identical as well with "BUSINESS AFFAIRS, *Transit and Parking*" to the right of the U of A logo. The menu of links to internal webpages is divided into Parking Services, Transit Services and General. All nested websites retain the official U of A website format. Transit and Parking receives funds from the purchase of parking permits, parking meters, fines and government grants (U of A, Transit and Parking Annual Report 2009). The "Staff" link opens a webpage where staff members are grouped under areas of responsibility with position titles listed. While no organizational chart is readily apparent, one is included in the Annual Report that is available through the "Administration" link.

3.1.5 CEA. The homepage for the CEA has similarities with both the Facilities Management and the Transit and Parking homepages. The banner on the top is formatted the same with "DIVISION OF STUDENT AFFAIRS, *Center for Educational Access*" to the right of the U of A logo. The background of the webpage is white instead of the khaki color used for most U of A websites. This is similar to other webpages within the Division of Student Affairs. No photo is displayed on this page. The basic text begins, “Adjusting to a university setting presents many challenges for new students, especially for those with disabilities. The University of Arkansas in Fayetteville makes every effort to offer equal educational opportunities for all students and is committed to improving the total university experience for students with disabilities” (2012). The links on the left of the page open individual pages with similar formatting that generally pertain to services offered through the CEA. Opening the “CEA Staff” webpage displays the photos of all staff members with links to individual pages for each staff member. No organizational chart is available for this department.

The homepage also has a prominent “Make a Gift to this department” link on the left, under the menu options. While no other information is available with regards to funding through the homepage, reviewing the Student Affairs Annual Reports for the last two school years shows that the CEA contracts out services to convert print materials for the visually impaired with a net profit realized. However, despite attempts to curtail costs through soliciting volunteers, the department ended the 2010-2011 year with a deficit of approximately $100,000 for accommodations, primarily due to the costs of supplying American Sign Language Interpreting (Annual Report CEA 2011).

3.1.6 University Relations. The homepage for University Relations is similar to that of the CEA with a white background, no photos displayed and only plain text used. The text begins, “The office of university relations is the strategic communications and marketing unit of the university, responsible for articulating and presenting the university’s mission and goals in a consistent manner” (2012). The banner reads, “Division of Advancement, *Office of University*

Relations." Menu links on the left open outside websites, describe fee-based services, and provide style guides for all media representing the U of A. The "University Web Guidelines" link opens a page with a photo and message from the Chancellor, stressing the importance of compliance with style guidelines. No photos are displayed for any of the staff, whose names, titles and email links can be found through the "Staff" link. They are grouped according to job focus with paragraphs describing the services and responsibilities of each grouping.

3.1.7 Donors. Obviously, donors are not a university department. This, and the fact that one-fifth of the university's total revenue for the fiscal year 2011 was from gifts, grants and contracts, might imply that a section about donors should be listed under "Resources," instead of "The Players." However, when a donor contributes a substantial amount of money towards capital improvements, a specific purpose is often in mind. The potential is there for the donor's wishes to carry more influence than the needs of the disabled. An example of this is on the University of Arizona campus. Nicholas Rattray, writing in *Practicing Anthropology,* describes the difference between the Arizona State Museum, which was renovated with a universally accessible entrance, and the Administration Building, that had also been recently renovated. While the museum allowed everyone to enter the building together, the Administration Building had been made accessible through the addition of a separate ramp that was within ADA range but still too steep for many people with limited mobility. Near the ramp was a plaque recognizing the construction company that had donated it. Concerning the ramp and the plaque, Rattray writes, "[D]isabled students felt that this was an insulting statement, suggesting the entrenchment of the "charity" model of access…Despite initial indications that universal design would be implemented, the financial backing of the Alumni Association ensured that the building would prioritize the preference of the private donors" (2007:26).

Donors have affected accessibility on the U of A campus as well. The Pi Beta Phi gate that is part of the recent construction has eliminated some of the accessible parking near Old Main, as well as the nearest drop-off point to that building. Additional handicapped parking was added near Peabody, but the spots are at the bottom of a steep sidewalk (see figure 4.11). There were complaints from the public regarding the loss of accessibility for emergency vehicles, and modifications were made (Branam 2011). No such outcry was heard regarding handicapped accessibility.

The National Park Service is in a transformative period where they are rethinking how parks are designed in order to make them more sustainable and relevant to this new generation. This implies a redefining of the traditional visitor center as well. Since much of the work done at our National Parks is through generous benefactors, there are potential design conflicts. Mary Gibson Scott, superintendent of Grand Teton National Park, states, “It is true that donors gravitate toward something that is a structure, but there is a niche who want to get involved in revegetation and restoration and trail design. We have to figure out how to make those kinds of projects more appealing” (Portals of Imagination 2011:32). The same could be said with regards to donors and improving accessibility on the U of A campus.

3.2 The Issues

When considering a project such as providing an accessibility map or access guide for the U of A, several issues must be addressed and each department or stakeholder will approach these issues from a different vantage point based on their specific subculture. The anthropological perspective of holism, pulling back from the specifics of the problem to place it in a larger context, provides a means for analyzing how these various cultural components complement, contradict, and overlap, so the complexity of the problem can be more clearly understood (Jordan 2003; Schultz 2005). It can also help offset the tendency toward ethnocentrism, "judging other cultures by the standards of one's own culture rather than by the standards of those other cultures" (Miller 2005:18). In this situation, that entails gaining a perspective of persons with disabilities, as well as other departments and stakeholders.

Funding is always an issue when projects are proposed. When considering improving navigation and accessibility on campus whose responsibility is it to pay for the project? The CEA is in charge of accommodations and seeing to the needs of the disabled on campus but CAST is especially equipped for mapping. Facilities management is responsible for the physical campus so perhaps issues of physical accessibility should be their responsibility. Navigation is an issue of getting from one place to another so that would imply Transit and Parking. University relations is over all web and print communications, and aren't accessibility maps and access guides an issue of communicating to the public through the U of A website? Obviously there are no simple answers. If such a project is to be implemented and maintained someone must pay for it though.

Besides funding there are also issues of control. Knowledge is power and decisions concerning who has access to spatial data and who controls the final image are just as complex as funding issues. Even how one approaches legislation such as ADA compliance are viewed from different perspectives. And then there are the students. How do they fit into this and what should their role be?

Not only does the complexity of intercultural issues within the U of A affect navigation and accessibility, the interconnectivity with the surrounding culture must also be taken into consideration. The role of the automobile, historic preservation and disability issues all play a role in affecting how persons with disabilities can get around campus.

3.2.1 Automobile Issues. The 1920s were transitional years in the US for the role of the automobile in American culture. In the May 6, 1920 edition of the *Arkansas Traveler* student newspaper one of the items listed in an article entitled, “What’s the Matter with America?” was a “shortage of cows and surplus of big automobiles.” When a fraternity mascot was killed by a car in 1923 the paper reported,

> Wag...the little fuzzy, Shepherd puppy who was the pride and joy of the Pi K. A. house is no more….A Ford coupe, driven at a reckless rate of speed down North Block Street, crashed into his little body and crushed every vestige of life from it. The coupe went on, its driver unrecognized, but there lay Wag, a mangled corpse. A few minutes before, the little fuzzy ball had been running over the grass playing with other dogs, but one of the modern juggernauts ended his existence and he is no more...[*AT*]

Contrast this with an article in the October 10, 1930 issue when another fraternity dog was killed by a car. This time the article states that he was eating breakfast on the porch “when he spied the Pi Phi pomeranian across the street. He started in pursuit but was run down by a speeding autoist and instantly killed” (*AT*).

Prior to 1920 cars were, at best, considered uninvited guests on city streets. During the 1920s the automobile destabilized the social conventions of street life. Those who were outraged by the numerous deaths due to unruly traffic were pitted against those who saw the automobile as an important part of the advancement of society. Eventually “motordom’s” emphasis on freedom and modernity reshaped the safety issue by stressing technological, educational and regulatory solutions, and portraying those who sought to ban automobiles as old-fashioned (Norton 2008). Examples of this can be seen in the *Arkansas Traveler* ads during the 1920s which depict automobiles as means to freedom, prestige and the modern life (*AT* 1926; 1927).

In the following decades car manufacturers and advertising agents made the most of the nation's fascination with the automobile and the country was transformed (Norton 2008). The inexpensive, practical Model T was no longer fashionable and personal identity began to be infused into the car one drives as options for customization abounded (Marsh and Collet 1986). The automobile has been described as "the most psychologically expressive object that has so far been devised" (Marsh and Collet 1986). Images of speed, excitement, sexual potency and power contrast with those of a cozy, womb-like enclosure akin to a second home. Add the symbolisms of style, class, prestige, freedom and personal expression and the complexity of our relationship with the automobile can begin to be grasped (Marsh and Collet 1986; Graves-Brown 1997)

Understanding this 'psychology of the car' is necessary as one attempts to deal with navigation and accessibility issues, especially since blind spots are more common when studying problems situated in a worldview that is taken as "normal" (Rottenburg 2009) and the car is a primary component within our culture for getting from one place to another. This is especially true for persons with disabilities (Schmocker et al. 2008). In a report on how personal transportation affects the quality of life for those with mobility problems, the authors state, "For most of the United States population, community participation and basic activities of daily living depend on access to personal vehicular transportation," with transportation being a major barrier to community participation for those with disabilities (van Roosmalen et al. 2010).

The single most important factor in comprehending the psychology of the automobile is that "we are what we drive" (Marsh and Collet 1986; Sloman 2006). Because of this identification with our cars, feelings of personal rejection can occur when room is not made for our vehicle. Add to this the fact that all over the world young people have used the automobile in the process of self-development as a way of confirming their adulthood and separating themselves from the society of their parents (Marsh and Collet 1986). On a university campus this can result in conflicting messages being received by students with regards to parking. Ann Jordan notes, “The students at my university hear administrators say that students are their first priority but wonder, if that is the case why student parking lots are the farthest from campus” (2003:86). This connection is also made at the U of A. The December 1, 2010 issue of the *Arkansas Traveler* ran an editorial entitled, “‘Students First’ Should Apply to Parking” (Appleton). When Transit and Parking considered prohibiting freshman from parking on campus at the October 28, 2011 Transit, Parking and Traffic Committee meeting, concerns were raised that enrollment growth would be affected. This is understandable.

While the American culture supports the place of the automobile in our society, the physical campus of the U of A is limited with regards to the number of cars it can support. The pervasiveness of the car on the landscapes of our communities has currently re-opened the early debate over the role of the automobile on our city streets. This time the issue is not safety but sustainability (Sloman 2006). The May 28, 1926 issue of the *Arkansas Traveler* reported that Dean Ripley had attended a meeting of the “University Deans and Advisors of men” where banning student parking on University grounds was discussed, noting that several larger universities had done so very successfully. Universities across the country are now discussing the same question and arriving at the same result. (Bustillos et al. 2011; Fries et al. 2009) The most recent U of A Master Plan produced by Facilities Management Planning Group has a goal of removing parking and drives from pedestrian areas on campus (2009). Unfortunately, most plans for reducing traffic flow and parking fail to consider persons with disabilities (U of A, Master Plan 2009; Bustillos et al. 2011; Fries 2009).

This is an important issue for students with disabilities at the U of A. In a survey sent to students registered with the CEA, almost half of the "Comments and Suggestions" made by those with impaired mobility mentioned problems with parking. One of the students who gets around via wheelchair commented, "The entire campus being on a large hill poses constant difficulties navigating around campus in a wheelchair. More handicap parking close to buildings would be a big help."

3.2.2 Value of Historical Sites. The University of Arkansas holds fond memories for thousands of graduates whose names are engraved on sidewalks that interweave numerous historical buildings. Anything that has the potential to damage these grounds or structures also has the potential to stir up strong emotions. When a construction road was planned to cross the lawn of Old Main there was a public outcry concerning the potential destruction of a "sacred" space (Brantley 2011). It is obvious then that conflicts between historic preservation and handicapped accessibility will exist. While buildings listed on the National Register of Historic Places have resources available to support preservation, it is not illegal to modify such places. Federally funded construction projects and ADA compliance are two areas where preservationists may find themselves required to compromise (Arkansas Historic Preservation Program 2012). In both of these situations State historic preservation officers work to find solutions that retain the significance of the structures. When it comes to accessibility, historic buildings are not exempt from ADA requirements, though they may be eligible to comply under alternate requirements that seek to balance the rights of access with maintaining historical significance (National Park Service 2012).

3.2.3 Disability. Robert F. Murphy, an anthropologist who became a participant observer in studying disability due to the effects of a tumor in his spinal column, wrote in the forward of his book, *The Body Silent,* "This is, after all, not my autobiography, but the history of the impact of a quite remarkable illness upon my status as a member of society, for it has visited upon me a disease of social relations no less real than the paralysis of the body" (1987:2). The distinction between a person's medical impairment and the implications of that impairment on a person's ability to participate as a fully integrated person in the surrounding culture has become a primary premise in disability studies and activism (Tremain, 2008; Snyder and Mitchell 2006; Braddock and Parish 2001). While a full analysis of the field of disability studies is not possible in a paper such as this, a brief overview of the foundations is essential for understanding some of the cultural issues that persons with disabilities still struggle with.

The field of disability studies is relatively new. Not much is known about the early history of the role of the disabled in society, largely because of the paucity of source documents from the perspective of persons with disabilities or their families. During the Enlightenment much of the groundwork was laid for our current Western civilization with its foundations in reason and the belief that advances in science would bring improvement to the human race. Statistics began to be used by states during the mid-1800s for quantifying population characteristics and defining normality (Snyder 2006). Foucault's work (1977) describes how this use of knowledge had the effect of individualizing people, altering the basic unit of society from that of the family to that of the population. Government could then act on behalf of the good of the population through institutes of discipline such as prisons, schools, hospitals, factories and insane asylums. The use of space and time to minutely control the actions of those in the system was an effective power mechanism which resulted in "docile bodies" that functioned more as cogs in a machine than as unique individuals. This was a time when schools and institutions for persons with specific disabilities were formed and the medical model of disability with its emphasis on diagnosis and treatment became accepted (Braddock and Parish 2001). Unfortunately the majority of institutions that had originally been created with lofty goals of compassionate treatment and cure instead became overcrowded holding pens where poor conditions were the norm and administrators were primarily concerned with legitimizing and consolidating their power (Braddock and Parish 2001).

Between 1880 and 1925 social evolution became vogue as Darwin's theory of evolution merged with the goal of improving the human race. Quantification methods gained power and deviants from the norm were viewed as threats to the advancement of civilization, resulting in the widespread acceptance of the eugenics movement. This focus on categorizing, qualifying and eradicating various population groups strengthened the institutionalization movement and contributed to the dehumanizing of persons with disabilities (Snyder 2006; Braddock and Parish 2001).

Much has changed since the nineteenth century regarding the treatment of persons with disabilities, and the passage of the ADA and subsequent revisions have done much to deinstitutionalize disability and restore personhood. However, persons with disabilities still may find that they are segregated from society by power mechanisms that operate through the control of space and time. This is a primary reason that the majority of the ADA addresses issues of physical access. While this is obviously an important issue, the time factor is often overlooked.

Elizabeth Shove (2002), in her paper, *Rushing Around: Coordination, Mobility and Inequality*, explains how social interaction involves the coming together of people at specific places and times. In our culture especially, it is not only important to be able to get somewhere, one must be able to get there on time. Mobility therefore is not just a matter of moving from place to place but also implies control and flexibility of one's schedule. This is another reason why the car has such an integral part in our culture. As long as students need to get to class on time, coordinate meetings with peers and professor's, do business with departmental offices and make use of library and lab hours, mobility on campus will involve time management. It is common for undergraduates especially to struggle with this. When one has to coordinate one's movement with buses, paratransit and golf carts it can get very complicated indeed, especially since both paratransit and golf cart services must be scheduled in advance and golf carts do not run after 5:00 PM. This has the potential for limiting the social interaction of persons with disabilities. It was interesting to note that several comments and suggestions given by the surveyed students had to do with the difficulty of getting places on time and offered tips on how to accomplish this. One student advised, "Avoid scheduling classes long distances apart, you will never make it on time."

One of the most pervasive problems that persons with disabilities deal with is that of liminality. Murphy describes this as "a kind of social limbo in which he is left standing outside the formal social system…The long-term physically impaired are neither sick nor well, neither dead nor fully alive, neither out of society nor wholly in it…they exist in partial isolation from society as undefined, ambiguous people" (1987:131). It is as if persons with disabilities are invisible, and indeed they often are when it comes to planning, whether it is for capital projects, transportation or inclusion in social or business functions. In the latest Campus Plan Summary (2009) disability related issues were only mentioned twice, once being the suggestion that certain older buildings be considered for demolition verses remodeling due to loss of space in part because of ADA compliance. The other was a brief mention of wayfaring signs for accessibility entrances. While the number of single rooms and suites were mentioned in the housing plan, ADA accessible rooms were not. Transportation plans listed locations of reserved, student, staff and commuter parking, along with plans for reducing parking at the center of campus, but no mention of Handicapped parking locations was made.

It is not that we think badly of persons with disabilities. It is that we usually don't think of them at all. An example can be seen in one of the comments from the survey. "Maintance (sic) and service vehicles need to be restricted from parking in drives that block access to handicaped (sic) parking and drop off zones. I have been on campus for two semesters, two days a week, and there has never been a week when I did not face challenges finding handicapped parking or drop off. The vehicles are blocking the drive to the building and several times, I could not see the block until I was already in the drive. That meant that I had to back onto Maple, very unsafe."

Meeting the requirements of the ADA is something that the U of A definitely takes seriously. Yet removing physical barriers is relatively easy when compared to removing barriers due to ingrained ways of operating, especially when those ways are institutionalized. Historically the majority of universities meet the requirements of ADA compliance as an afterthought or strictly with regards to building compliance and number of parking spots. Courses and services, the purpose for the buildings and the need for access, are designed for traditional students and a disabilities office is assigned to deal with modifications as needed. "As long as legal obligations are met, few people ask why so many courses and programs on this campus are inaccessible to so many students, and students with disabilities stay on the margins" (Burgstahler and Cory 2008:564).

3.3 Conclusion

Chancellor Gearhart, when writing on the definition of "Students First" at the U of A (2012) states, "We can't act as though every student comes from the same background and has the same needs, the same preparation, and the same expectations and understandings. They don't." Unfortunately, some students with disabilities are not getting the message that they come first. One surveyed student advised, "If you have trouble with mobility then consider finding another campus to attend. This campus is not friendly to people with mobility issues." Improving navigation and accessibility will require a more thorough understanding of the needs of persons with disabilities and the desire to "do what it takes" to remove the barriers to social inclusion. I believe putting this "on the map" is the best place to start.

4.0 Using Geographical Information Systems (GIS) For Campus Analysis

GIS enables studying the accessibility of the campus from an integrative perspective. For this research I primarily used Esri's ArcMap software to create a digital model of the Historic Core District of the University (Esri is an acronym for Environmental Systems Research Institute, a private corporation headquartered in Redlands, California). Esri's ArcGIS software (of which ArcMap is a part) is currently the GIS industry standard, with an estimated 70 percent of GIS users using Esri products (Dempsy, 2011). Data has been obtained from the City of Fayetteville, CAST, Facilities Management, Razorback Transit and the CEA. Using two-foot contours, I first created a Digital Elevation Model (DEM), a raster file of interpolated elevation values at a half-foot resolution. Next I digitized the sidewalks in the Historic Core District using CAD data (computer aided design) obtained from Facilities Management. Using ArcMap I was able to obtain slope values (derived from the DEM) for the digitized sidewalk features, and then classify each feature according to the ADA requirements for ramp slopes. Additional digitized features such as handicapped parking, accessible entrances, curb cuts, stairways and bus stops were then added to the model. It is recommended that bathroom locations also be included.

While the ability to visualize all the features that contribute to accessibility on the University of Arkansas campus is of obvious value to campus planners and those seeking to navigate unfamiliar territory, the network analysis capabilities of ArcMap could allow an in-depth analysis of the routes available for those with limited mobility. Network analysis, based on Optimization Theory, forms the theoretical foundation for finding the most cost effective routes between points. For this analysis I compared raw distances with slope-adjusted distances that took accessibility barriers, such as stairs, into consideration. Optimal routes could then be determined for either the shortest path or the most accessible path. Such models can be used to determine how slope, distance and placement of features determine accessibility.

4.1 Coordinate Systems

Because GIS models seek to answer questions of a geographical nature, "It is most important that all spatial data in a GIS are located with respect to a common frame of reference" (Burrough and McDonald 1998:76). Geographical frames of reference, known as *datums,* consist of a clearly defined origin and a surface derived from referencing that origin. As Jan Van Sickle states, "Without a datum, coordinates are like checkers without a checkerboard, you can arrange them, analyze them, move them around, but absent the framework you never really know what you've got" (2011:1). Coordinates derived from datums can be either two-dimensional Cartesian coordinates with linear measurements, or geographic coordinates, using longitude and latitude with angular measurements. Often converting between the two is necessary. "Geodetic coordinates are useful but somewhat cumbersome at least for conventional trigonometry.

Cartesian coordinates on a flat plane are simple to manipulate but inevitably include distortion. Moving from one to the other it is possible to gain the best of both." (Van Sickle 2011:7) For this project, conversions between coordinate systems was necessary to produce the best results.

When I began my research, CAST was currently overseeing the production of the online interactive campus map. In an effort to coordinate this research with the work that was in progress, CAST provided me with the ArcMap layer file that was to serve as the University's basemap layer. The coordinate system for this layer file was WGS 84 Web Mercator, which is a spheroid geographical coordinate system with angular measurement units.

CAST also provided me with two-foot elevation contours for Washington County. These contours were most probably developed from a massive point cloud data set by the Sanborn Mapping Company for the City of Fayetteville. The contour data used the North American Datum (NAD) 1983 State Plane AR North 0301 coordinate system, which is a projected coordinate system with linear measurement units (feet). No metadata was available for the contours, and the geoid (model of the earth's shape) that was used to reference elevations could not be determined.

GPS measurements were used for testing purposes to determine the usability of the contour data for this study. These measurements were taken using the WGS 1984 geographic coordinate system, which also uses angular measurement units.

In order to analyze sidewalk slopes and classify them according to ADA guidelines for ramp slopes, it was necessary that linear units be used during the analysis and classification process. The desire to have the results be compatible with CAST's work of mapping the campus meant that transformations across coordinate systems were necessary. ArcMap has tools designed for transforming across coordinate systems and these were used during this study.

Since the WGS 84 Web Mercator coordinate system cannot be directly transformed into the NAD 1983 State Plane AR North 0301 coordinate system using ArcMap's process, it was necessary to do an intermediary transformation to the WGS 1984 coordinate system when moving between the two.

4.2 Contours Analysis

Contours are not the most reliable way to measure small scale elevation changes due to the distance between data points when interpolating intermediary values and the fact that it is often difficult to ascertain the accuracy of the contours themselves (Maune 2007:15). However, contours are convenient to work with since they are easy to obtain. It was therefore necessary to first determine if using the available contours to analyze slopes would be accurate enough for ADA classification purposes. To do this I chose to compare slopes calculated using the contours with slopes obtained from high-accuracy GPS data.

Considering the problems of using contours as described above, it might seem that using GPS would be the best way to collect campus location data. However, because of the close proximity of buildings on campus, interference with the satellite signals, known as multiple pathways, or "multipath," is an ever-present problem as the signals reflect off the windows creating duplicate signals, hence the name "multipath." The buildings also act as barriers, limiting the number of satellites a GPS receiver can access signals from, also degrading the quality of data. Since vertical accuracy is more difficult to obtain than horizontal, a loss of satellite access and an increase in multipath makes using GPS collection impractical for digitizing elevation data for most features such as sidewalks and handicapped entrances on campus. Multipath may also be a problem in parking lots due to the reflective nature of cars, as is finding a time when the parking spots are unoccupied while the satellite configuration is also favorable.

For my project I chose three areas of campus that had good access to the sky, were relatively free from multipath and had varying degrees of slope. Two points and one line were collected at each location. I use a Trimble H-star GPS receiver in order to obtain the most accurate data possible in a short amount of time while working alone. While the H-star is able to provide sub-meter accuracy in two-minute collection periods, it is also able to make use of carrier waves when 30-minutes of continuous satellite lock is maintained, something I hoped to achieve. Besides determining the locations for data collection I also had to determine the optimal times for satellite configurations. Obtaining the most accurate data relies on both the number and relative positions of the satellites that the GPS receiver can access. Since earth positions are determined by the intersection of satellite signals, accuracy is improved when satellites are spread out across the sky. Dilution of Precision (DOP) values are measurements of how the diffusion of satellites within range of the receiver affect the accuracy of the GPS readings, with low values implying less dilution and greater precision (Langley 1999). I began by using the Pathfinder Planning data to find times when DOPs were low and the number of available satellites were high. Since I also needed to maintain lock on the available satellites, I analyzed the predicted visibility and elevation charts as well as the elevation and azimuth list.

Data was collected on November 24, 2010 in the late afternoon and evening hours. For each feature collected an observation log was filled out and three pictures were taken. At the first site, the hill behind Gregson Hall, data collection was less than ideal due to the hill blocking one of the available satellites and possible interference from a tree and a couple walking up the hill, which caused a temporary loss of satellite lock. While this reduced the overall accuracy of the data, it was still sufficient for this purpose since the loss of lock was in the middle of the data collection, allowing the slope to be determined from the beginning and ending points. Graphs showing the line data points collected for each site may be seen in Figures 4.1, 4.2 and 4.3. Maps showing the data collection sites may be seen in Figures 4.4, 4.5 and 4.6.

The GPS file (.ssf) was then uploaded from the H-star into the GPS Pathfinder Office software to differentially correct the data in order to improve accuracy by comparing the readings to known stationary locations. I chose to use H-Star Processing with multiple base providers, chosen for both proximity and integrity indexes, for the differential correction. The estimated accuracies for the files that were corrected were 78.9 percent being between 0 – 15 cm, 13.4 percent in the 15 – 30 cm range and only 1.3 percent falling above 0.5 m. The relatively large number of files that were not corrected was probably due to one of the stations (EFAY) only having 35 percent coverage, though both other stations used had 100 percent coverage. Table 4.1 gives the 67 percent vertical error range for each feature.

Just as one must choose a coordinate system to reference horizontal positions, when defining elevations values one must determine how one references height by choosing a specific geoid, or mathematical representation of the shape of the earth. Since the geoid information was not available for the contours I was not able to reference the GPS data to the same geoid. This was not a problem since this project is only concerned with ascertaining slopes; therefore I compared the changes in elevation for both contours and GPS data, rather than the actual elevation values. The ADA Accessibility Guidelines for wheelchair ramps require that slopes not be greater than .0833 and preferred slopes are between .0625 and .05.

The difference between slopes calculated from contour elevations and those obtained through GPS data ranged from zero to .011. In order to determine if these differences were acceptable I varied the GPS elevation by the 67 percent error range to determine the 67 percent error range for slope. All values were within the error range so it was concluded that the contour data would be sufficient to categorize slopes on campus as being below, within or above ADA specifications (see table 4.2). Sidewalks could then be color coded accordingly.

4.3 Contours And DEM Creation

After determining that the contour data was accurate enough to use for determining ADA slope classifications the next step was to produce the best possible DEM from the contours. ArcMap has two primary ways for developing rasters from contours, both of which involve interpolation – predicting values at unsampled points based on surrounding known values (Borrough and McDonnell 1998).

ArcMap's *Topo to Raster* tool uses an algorithm that has been specifically developed to produce a model that is hydrologically correct and offset common problems that result from creating a DEM from contours. When comparing the DEM created by this method with a test area, it was shown that the algorithm's focus on creating structures that model drainage by "imposing a drainage enforcement condition" created artificial sinks where the actual topography was flat due to anthropogenic features, such as concrete loading zones. (Maune 2007:14; Hutchinson 2006; ArcGIS, Topo to Raster 2011) For this reason the *Topo to Raster* method was rejected.

A second method for creating DEMs in ArcMap is the *TIN to Raster* tool. Obviously using this method first requires the creation of a TIN (Triangular Irregular Network) from the contours, something that is easily done in ArcMap using the *Create TIN* tool. Two methods of interpolation are possible when using the *TIN to Raster* too: linear interpolation and natural neighbor interpolation. According to the ArcMap help file, "Linear interpolation views TIN triangles as planes. Each output cell is assigned a height by finding which triangle, in 2D space, it falls in and evaluates the position of the cell center relative to the triangle plane. Natural neighbor interpolation produces a smoother result than linear. It uses an area-based weighting scheme on the closest TIN nodes found in all directions around each output cell center" (ArcGIS TIN to Raster 2011). It is also possible to choose the cell size of the final raster.

In order to determine the method that would interpret the topography as realistically as possible I compared each interpolation method using varying cell sizes on a small test area for which I also had one-foot contour elevations from survey data. I then ran correlation matrices for similar methods on each data set. DEMs were also examined by using the *Hillshade* tool, a method used to find errors such as striping or other patterns in the data (Maune 2007:16). Using linear interpolation produced DEMs with more triangular facets than the natural neighbor method (see figures 4.7 and 4.8). Using natural neighbor interpolation with a cell size of 0.5 feet produced the best overall results.

4.4 Slope Analysis and Sidewalk Classification

Sidewalk features were digitized by using CAD data from Facilities Management as a template. ArcMap has tools to import CAD files but they must be formatted correctly and assigned a coordinate system. The CAD data from Facilities Management had to be transformed to Engineering Scale with (0, 0) as the basepoint and scaled by 1/12. For this project I assigned the NAD 1983 State Plane AR North 0301 coordinate system. The University of Arkansas currently has its own datum based on local benchmark points for referencing elevations (U of A, Master Plan 2009). Since the sidewalk classification categories are relatively broad and the CAD features visually matched the underlying basemap and campus image, the level of error introduced by using the State Plane coordinate system is insignificant for this purpose.

To digitize sidewalk sections the "snapping" utility was used to overlay the newly digitized features directly onto the CAD sidewalk centerlines, when possible. Individual sidewalk objects were digitized for each sidewalk section, with sidewalk intersections marking the beginning and endpoints of objects. Care was taken to place nodes strategically to best model both curvature of the features and slope variations, for reasons described below.

Raster formats are typically used for analyzing slope data since they better represent gradual changes across distances. Digital representations of features that have curves, such as sidewalks, are better suited for vector modeling though (Borrough and McDonnell 1998). In order to determine the best way to analyze sidewalk slopes, I compared calculated sidewalk lengths and slopes in three different GIS software packages: ArcMap, IDRISI and Geomedia. Both IDRISI and Geomedia distorted the lengths due to rasterizing effects, though Geomedia's distortion was lessened by its use of Tomlin codes, which better represent movement across raster cells. Only ArcMap had the capability of analyzing the slopes of vector features with its *Add Surface Information* tool. However, the software does not determine the slope across the entire vector feature. Instead, it extracts the elevation values for each of the feature's nodes from either a TIN or a DEM and then calculates the slope for each inter-nodal section. It then uses a length-weighted average to determine the slope of the arc (ArcGIS, Add Surface Information 2011). It is therefore important when initially digitizing the sidewalk features to make sure that nodes are placed at points where the slopes will be calculated as accurately as possible. It is also important to keep the individual objects of each feature at lengths that model the changes in topography. Errors of this type could be discovered by comparing the object's maximum slope with its average slope.

The ADA has specified that the maximum slope for accessibility ramps for new buildings not exceed 4.76 degrees. Any surface with a slope above 2.86 degrees is to be considered a ramp. When ramps are being placed for existing buildings or in confined spaces, the limit of 4.76 degrees is loosened depending on the space available, but in no circumstances may they exceed 7.3 degrees (Smyth 2012). These parameters were used when classifying sidewalks for this project. The four classifications were labeled: Level, ADA ramp slope, ADA steep ramp, and CAUTION: out of ADA range (see Appendix A for further information on coding for sidewalks in ArcMap).

Map images can then be set to display the feature differently for each slope classification. To make the map accessible to as many persons as possible, I chose to use patterns as well as colors to distinguish the different categories on the final map so that those who are color blind could also differentiate between classifications.

Besides analyzing the slopes of individual sidewalk objects, I also analyzed the slope of the entire area by first using ArcMap's *Slope* tool to "identify the slope (gradient, or rate of maximum change in z-value) from each cell of a raster surface" (ArcGIS, Slope 2011). I then reclassified the raster according to ADA ramp guidelines and finally used the *Raster to Polygon* tool to make a vector model of slopes across campus. I had initially considered using these polygons to code the sidewalk features but could not find an appropriate method to deal with sidewalk objects that crossed multiple polygons. However, overlaying the slope-coded sidewalks onto the slope-coded polygons could be used to determine possible sidewalks where cross-slopes might be an issue, since the linear slope of the sidewalk wouldn't match the slope of the surrounding landscape in areas where sidewalk slope colors don't match the underlying polygons (see figure 4.9).

To facilitate testing, streamline the processes involved and make communication and data sharing easier, I built a model using ArcMap's Model Builder (see figure 4.10). This allows changing the input sidewalk features or DEMs while insuring the same transformations and processes are being performed consistently. For one of the tests I used the line feature created from my GPS collection as a template and then digitized a new sidewalk feature using the "snapping" utility so the coordinates would be identical. I then processed the "sidewalks" using the model builder and compared the average slopes with the previous GPS and contour derived slope calculations. As expected, the Gregson Hall error was the greatest at .015, but still well within the 67 percent error range (see table 4.2).

4.5 Map Creation

To create an accessibility map for the campus required verification and digitizing of features important to persons with disabilities. At the time the parking map was the only campus map with any accessibility features. However, it was found to have numerous errors with regards to location of handicapped parking spots, accessible entrances and even a building placement. With the help of the Center for Educational Access the Historic Core district was physically examined to accurately record these features. Curb cuts and barriers were also identified. I had hoped to record the condition of the sidewalks as well, noting areas where cobblestones were loose or sidewalks damaged, but it proved to be too big of a task to gather the data at that time. Digitized bus routes and stops that service the Historic Core district were obtained from Razorback Transit, and Facilities Management provided access to RUSS (Room Use Survey System) data showing elevator locations for buildings in the mapped area. Finally, the areas that were planned be fenced off due to construction were digitized, along with the expected construction road and alternate sidewalks (see Figure 4.11).

4.6 Network Analysis

Network analysis, based on Optimization Theory, forms the theoretical foundation for finding the most cost effective routes between points (Rardin 1998). It is, therefore, the basis for online programs such as Google Maps' driving, walking and transit directions. Having such directions available would allow anyone with a smart phone or computer to feel comfortable navigating the campus, especially those desiring to find accessible routes. Detailed route directions would be invaluable for persons with limited vision, since the directions could be heard through a text reader.

ArcMap has additional extensions available to further the analytical capabilities of the program. Network Analyst is such an extension. Esri's website describes this extension: "ArcGIS Network Analyst provides network-based spatial analysis, such as routing, fleet routing, travel directions, closest facility, service area, and location-allocation. Using ArcGIS Network Analyst, you can dynamically model realistic network conditions, including one-way streets, turn and height restrictions, speed limits, and variable travel speeds based on traffic. You can easily build networks from your GIS data by using a sophisticated network data model" (2011).

The primary algorithm used by Network Analyst to determine routes, closest facilities and Origin/Destination matrices is Dijkstra's algorithm. Dijkstra's algorithm is one that determines shortest paths from one node to all others with all costs nonnegative. It does so by maintaining a set of junctions ***S,*** whose final shortest path from the starting location has already been computed. "The algorithm repeatedly finds a junction in the set of junctions that has the minimum shortest-path estimate, adds it to the set of junctions ***S***, and updates the shortest-path estimates of all neighbors of this junction that are not in ***S***. The algorithm continues until the destination junction is added to ***S***" (Arc GIS, 2010).

When using Network Analyst within ArcMap, it is not necessary to understand the mathematics and programming language behind the program. A "New Network Dataset" wizard directs the user through all the necessary steps to set up the essential parameters and attributes. Once the network dataset is up and running, dialog boxes can be used to set up properties for creating new Routes, OD Cost Matrices, Service Areas, etc. It is necessary, however, to understand how to prepare data for a network dataset, and how to use the tools correctly for different analysis problems. Tutorials and help files are available to instruct users in the basics.

4.6.1 Creating the Network Dataset. Network analysis is based on graph theory where paths along a connecting collection of edges and vertices are analyzed for optimal routes. It is necessary then that source features for the development of a network dataset have a structure that would support this type of analysis (de Smith et al. 2011). I chose to run the network analysis on a section of the Historic Core District that had several parking options, staircases that served as barriers and sidewalks with a variety of slope classifications. Since the section I chose for the network dataset was clipped from the larger section, several of the sidewalk features ended up as dead ends. I deleted the majority of these as irrelevant. It was also necessary to convert the files from the spherical coordinates of the online campus map into a projected coordinate system so that cost distances would be linear units. I chose to use the NAD 1983 State Plane system where distance units are measured in feet (see Figure 4.12).

Network Analyst has 3D capabilities, allowing for elevation to be a factor in connectivity. This is useful when running an analysis with multi-storied buildings so sidewalks do not connect to second story hallways. For this analysis I chose to ignore elevation with regards to connectivity since all features were at ground level. My initial source file did not have names associated with any of the features either. I added names to each of the source features to help clarify routes when using the analysis functions, as well as to enable the creation of directions.

I chose to define two possible cost impedances: distance and slope cost. Distance values were simply set to reference the SHAPE_Length field of the sidewalk feature. The slope costs were a calculated value that multiplied the SHAPE_Length field by a factor determined according to the ADA classified slope rating for that particular sidewalk section. Level slopes would be weighted with a value of "1" so that the distance alone would be the slope cost. I chose values of 1.25, 1.5 and 5000 for the remaining weights so that lengths would be adjusted depending on the steepness of the slope. The value of 5000 for a slope rating of 4 (CAUTION: out of ADA range) has the effect of multiplying the length by a factor that effectively excludes those sidewalk sections from the resulting optimal route. These values were chosen arbitrarily according to my own personal experience. It is recommended that a more thorough analysis of appropriate weighting values be undertaken if a complete campus network is set up. See figure 4.13 for a map of a section of the network with distance costs as determined by the SHAPE-Length field.

4.6.2 Running the Analysis. Once a network dataset is correctly configured and enabled, running various types of network analyses is relatively simple. For the purpose of this project I made use of the New Route, New Closest Facility and New OD Cost Matrix analysis tools. All of these are basic transportation problems, which according to Ronald L. Rardin (1998) are, "special minimum cost network flow models for which every node is either a pure supply node (every arc points out) or a pure demand node (every arc points in)."

For the OD Cost Matrix layer, the supply nodes are known as Origins and the demand nodes are Destinations. When running a Route analysis, supply and demand nodes are all referred to as 'Stops.' Each Stop is numbered and a choice is given about whether or not to allow the reordering of stops to improve optimization. While it doesn't say so explicitly in any of the help files, it is my assumption that each section of the route is considered separately, with the first stop serving as the supply node and the second as the demand. Once the optimal route for that section is determined, I assume the second node then becomes the supply while the third takes on the role of the demand, with this pattern continuing until the final node in the series is visited. The final step would then be to tally the impedance totals for all sections. A Closest Facility analysis requires points for both 'incidents' and 'facilities' to be entered. Which of these is supply and which is demand is determined in the properties configuration by choosing which direction to run the analysis.

The result of running each of these tools is a network analysis layer with ties to the network. A network analysis layer is made up of input and output features known as objects. Input objects consist of such things as Origins, Destinations and Stops, as described above, which are added to the layer by importing them from existing features or by manually choosing locations on the map. For this project I used both methods.

Optional barriers can also be added as input objects to either restrict flow or add costs to various analysis options. I made use of this option when performing analyses that would reflect accessibility so that optimal solutions would not include stairways. Barriers were not considered when only the shortest distances were required. Output objects, such as optimal routes, cannot be added to the layer since they are created by the solver.

After adding input objects to the layer, the layer's properties should then be configured to define which impedance (cost) is to be used, if there are any restrictions that will need to be obeyed (such as one-way streets), or other analysis-specific properties. The final step is simply to click on the 'Solve' icon on the Network Analyst toolbar. The software generates the solution and adds it to both the analysis layer and the map display. The layer can then be saved to be added to future maps.

4.6.3 Campus Analysis. For this project I made use of the three analysis layer options described above: Route Analysis, OD Cost Matrix Analysis and Closest Facility Analysis. Though not intentional, the initial analyses proved to be tests of the validity of the network structure, as opposed to determining optimal paths.

The first time I attempted to set up a network dataset I received an error message stating that some features had not been incorporated into the network. An examination of the text file revealed that some of the objects were rejected from the network as a "standalone user defined junction". Three of these were Accessible entrances that were not connected to the nearest sidewalk endpoints. The others were point barriers that were to represent locations of staircases. Upon further investigation it seemed that the "snapping" function I had used to place the point features onto the sidewalk features had a buffer that was not accurate enough for this purpose. Rather than attempt to narrow the buffer range, I chose to create a new line feature, "stairs," that could serve as line barriers. Since the individual data elements of this new line feature each intersected the sidewalk feature, less accuracy was required and the barrier acted appropriately.

Repairing the barrier problem led to the discovery of another problem with the connectivity of the sidewalk source feature. The Help files describe a "Verify Network Connectivity" command that is supposed to check for invalid geometry and inconsistent connectivity for features in geometric networks, where flow is allowable in only one direction such as a network of streams and rivers. Unfortunately I was not able to find a similar toolset for use with the Network Analyst networks. It is essential then that the creation and verification of the source data to be used for the network analysis be done with care to insure that all features are appropriately connected before running the final analysis.

In this project I created route layers to compare the shortest path for someone going from Mullins Library's west entrance to the Arkansas Union east entrance, and then to the northeast entrance of the Music Building, using both pure distance and accessibility parameters. The shortest path using distance as the impedance and ignoring all barriers is approximately 815 feet for the entire path. The accessible path used modified slope costs, as described previously, and defined stairs as barriers. The "distance" for this path is about 1369 feet. A map showing a comparison of paths may be seen in Figure 4.14.

To model the problem of choosing which parking option would enable the shortest path to a specific building, I created closest facility layers, again using both accessibility parameters and pure distance measures. Even though in reality a person would travel from a parking place to a building, I ran the analysis so that the building entrances would be the supply nodes and the parking places would be demands. This is because the analysis outputs optimal routes from each supply to a single nearest demand. If the model were to be run with the parking spots as supply nodes, only one nearest entrance to that parking place would be returned, which is not a very helpful output. The results of the analysis showed that the majority of optimal paths had the same geometry, and seven of the sixteen routes had identical distances. Only one entrance, the east entrance of the Arkansas Union, had different optimal parking spots depending on which parameters defined the analysis. Maps showing the comparison of all optimal paths may be viewed in Figure 4.15.

Finally, I created OD Cost Matrix layers for both distance and accessibility parameters. This type of analysis outputs a matrix with optimal values for paths between each 'Origin' and each 'Destination' that the user inputs. Because of the processing needed to derive a potentially large amount of data, this analysis does not keep track of decision labels and therefore the geometry of specific optimal routes is not available. When running this analysis, I chose to let the accessible entrances serve as 'origin' points and the parking spots as 'destination' points, for the same reasoning as described above. The output matrices group the results for each origin and order them by optimality, with the closest destination point at the top of the list. When setting up the parameters for this type of analysis, it is possible to have a graphical output placed on the map with straight lines representing each optimal path. Since this type of output is not significant for my project, I have only included the matrices in the Appendix (see Appendix B), without any corresponding maps.

4.6.4 Implementation of a Network Dataset and Analysis on the University of Arkansas Campus.   The new ADA guidelines state that "At least one accessible route shall be provided within the site from accessible parking spaces and accessible passenger loading zones; public streets and sidewalks; and public transportation stops to the accessible building or facility entrance they serve" and "At least one accessible route shall connect accessible buildings, accessible facilities, accessible elements, and accessible spaces that are on the same site" (Department of Justice 2010). The University of Arkansas campus is comprised of 345 hilly acres with 23,000 students enrolled. Analyzing the entirety of routes within and between buildings, parking, bus stops, etc., is clearly a daunting task. A five year study is currently underway to address the issue of the University's compliance with the ADA regulations. I believe that incorporating GIS methods, including network analysis as described in this paper, would facilitate such a study. Optimal routes between accessible elements could be evaluated by examining slope-adjusted distance values. Where values exceed a specific cut-off value, routes can be examined to determine if moving elements, such as parking spots or bus stops, could improve optimality.

Developing a complete network dataset for the University of Arkansas would be a large undertaking on the development side, but once set up could be used to provide invaluable information to a variety of constituents. Foundations have already been laid though, and the technology exists to finish this project. Allocating the necessary resources to do so would produce multiple benefits beyond improving ADA accessibility compliance.

The ease of adjusting parameters and running analyses makes "what-if" testing possible for a wide range of situations. Besides studying the campus with regards to navigation and accessibility as this sample analysis has done, emergency evacuation, parking and transit issues, and construction planning are other areas that would benefit from network analyses. By incorporating the three-dimensional capabilities of the network structure, routes through buildings can be modeled. The multi-modal options would allow bus routes to also be included in the network dataset. Time sensitive parameters can be set up to model when buildings are open and busses are operational. Having a complete network dataset of the campus would offer an integrated view of the campus' 'circulatory system,' and give insight into ways to ease congestion and optimize flow. It would also improve the quality of the online map currently being developed by highlighting the "best" routes and options for travel and parking and allow for the immediate update of relevant information. This would facilitate navigation for all who desire to benefit from the opportunities available on this beautiful campus.

5.0 Recommendations and Conclusion

The United Nations' *Final report of the Ad Hoc Committee on a Comprehensive and Integral International Convention on Protection and Promotion of the Rights and Dignity of Persons with Disabilities on Its Eighth Session* recognized the right of persons with disabilities to an education without discrimination and with equal opportunity for the following purposes:

> (a) The full development of human potential and sense of dignity and self-worth, and the strengthening of respect for human rights, fundamental freedoms and human diversity;
> (b) The development by persons with disabilities of their personality, talents and creativity, as well as their mental and physical abilities, to their fullest potential;
> (c) Enabling persons with disabilities to participate effectively in a free society [2006].

I believe the University of Arkansas desires to fully support this right and numerous dedicated people work hard to make this a reality on the campus. Despite this fact, discrimination does occur due to accessibility and navigation problems which create barriers for those with disabilities. Ann Jordan states, "One of the tasks of the anthropologist is to sort out all the conflicting cultural messages." (Jordan 2003:86) This requires people to be open to examining areas where they have blind spots or prejudices, be willing to critically evaluate methods and procedures that may be deeply entrenched in the bureaucratic structure, and communicate honestly and respectfully with those whose cultural perspective is different from theirs. The process may get messy and emotional but the thought of excluding intelligent and talented people from a fully-integrated university experience should motivate all parties to persevere and cooperate for the inclusion of all. One never knows when one may be in that very population.

5.1 Recommendations

Access is more than merely adding power doors and designating a percentage of parking places as handicapped. A study done by *New Mobility* magazine to identify the top "Disability Friendly Colleges" in the nation notes that the campuses that ranked highest focused on program access verses physical access (Ross 1998). Access is also more than simply adding accommodations to existing programs. If inclusion is to mean that all persons have equal rights with regards to program access, then the needs of all should be included when programs are designed so that the structure of the program takes everyone into consideration. Instead, programs are designed for the "average" student and then modified as needed for persons with disabilities (Burgstahler and Cory 2008). Tanya Titchkosky writes, "Disability remains dependent on and vulnerable to the essential needs of bureaucratic order" (2010). When modifications and accommodations need to be made they disrupt the original structure of the program, creating extra work for those involved. University employees, whether staff or faculty, may resent the interference with their routines while students may feel as if they are a burden. This is the reasoning behind Universal Design, "a proactive approach to assure access for a large group of potential participants" (Burgstahler and Cory, 2008).

5.1.1 Task Force. If the U of A is to be a truly integrated, accessible campus the needs of those with disabilities should be considered from the beginning of the recruitment process, through graduation and alumni status. This is not something that will happen without deliberate measures, financial backing and bureaucratic authority. I believe the creation of a task force that not only includes comprehensive departmental representation, but also embraces students and employees with disabilities, as well as appropriate community stakeholders such as the City of Fayetteville and Ozark Regional Transit, is the first step in this process. This task force should be separate from the CEA, serving more as an advocacy, education and development group, as opposed to a student services department. The task force should have upper-level administrative support and funding if it is to be truly effective.

One of the purposes of the task force should be campus education. Just as the values of diversity and sustainability are promoted throughout the university system, so should the ideas of universal design. Whether that is incorporated into the current diversity training or implemented separately is debatable. Often it is assumed that persons with disabilities are getting “special privileges.” Concerns about handicapped parking abuses also exist. The task force would be able to initiate dialog on these issues, with the goal of deeper understanding and creative solutions to accessibility problems.

Research should also be a component of the task force. An examination of how other campuses have successfully created an atmosphere that welcomes and supports those with disabilities would provide valuable ideas. However, rich communication and a careful inquiry into how such an atmosphere would look at the U of A will facilitate the acceptance of proposed changes and reduce the impression of having another political agenda imposed upon the community.

5.1.2 Survey Results. On April 22, 2011 a “Campus Accessibility Survey” was sent via email to all students registered with the CEA. The email read in part, “The purpose of this study is to assess how the navigability of the U of A campus affects students with disabilities and to get input from these students concerning possible improvements." Forty-nine students responded, with twenty-six indicating that their disability interfered with navigation. While a full analysis has not been done, preliminary results showed that students with impaired mobility considered structural changes to buildings and/or sidewalks; improving maps with handicapped parking, entrances, bus stops and optimal routes marked; and improving handicapped parking options as the most beneficial with regards to campus navigation (see table 5.1). It was interesting to note that students rated improving maps by including accessibility features higher than improving parking options (see Appendix C for a complete listing of survey results with student comments and suggestions).

5.1.3 Structural Changes. Physical barriers to access are often seen by persons with disabilities as both an expression of social inequality and a means for perpetuating that inequality (Imrie and Kumar 1998). The emotions and reactions to such barriers can range from hopelessness to anger and from humiliation to confrontation (Imrie and Kumar 1998). A major problem in the perpetuation of physical barriers is their invisibility to those who can get around easily. In a study on disability and access in the built environment the researchers state, "disabled people are consistently confronted by an environment designed by planners, architects and builders who, they perceive, have limited disability awareness, consult all too infrequently and, even after consultation, may not fully appreciate the problem" (Imrie and Kumar 1998:368). These perceptions were validated in a study published in the *Journal of Architectural and Planning Research* titled "Environmental Barriers and Disability." The study found that built-environment professionals felt that the concept of universal design was not realistic, focused too much on one segment of the population and restricted their creativity. It was also revealed that none of these professionals ever consulted with a person with a disability to get their perspective, since they felt that the problem was rather insignificant. The study recommends discussion and interchanges between builders and persons with disabilities, and concluded, “Establishing acceptable accessibility equivalents to guidelines will require that the ideas of environmental designers, disability advocates, and health care providers converge” (Gray et al. 2003:35). The fact that the U of A Master Plan makes no mention of improving accessibility confirms the importance of cross-cultural dialog on the U of A campus with regards to how the built environment either supports or restricts access to services and programs.

Students surveyed at the U of A rated structural changes the highest with regards to improving navigation and accessibility on campus. Elevators, ramps and sidewalks were mentioned in the comments as physical barriers in need of improvement. One way to gain a deeper understanding of how the campus is perceived by students with disabilities is to conduct map-based research, similar to studies done by the University of Arizona, Coventry University, UK, and in Northamptonshire, UK, which gave opportunities for persons with disabilities to express their own “personal geographies” and communicate their perceptions of the build landscape. (Rattray et al. 2008; Vujakovic and Matthes 1994; Matthews et al. 2002).

Another means for getting a perspective for how persons with disabilities view the U of A campus is to design an app that could be used to report barriers. The app could allow the user to differentiate between temporary barriers, such as a delivery truck blocking an accessible parking place, or structural, such as a need for a curb cut or sidewalk repair. The Spring 2012 issue of *ArcUser* magazine ran an article on civic engagement apps that allow communication between citizens and various organizations. For example, the City of Boston has an app that allows residents to report needed repairs, such as damaged road signs, and follow up on the work order status. The article concludes, “Civic engagements apps have the potential to enlist new segments of the population – people who had not previously participated in government – and bring their concerns, insight, energy, and commitment to reinvigorate government" (Pratt:35). The same could be said concerning persons with disabilities and the U of A.

5.1.4 Accessibility Maps. The importance of maps to the empowerment of persons with disabilities cannot be overstated. Not only do maps allow persons with disabilities to better plan their routes, increasing their freedom and independence; not only do they provide a way for the able-bodied to gain a better understanding of the importance of access and the subtle barriers that impede it; maps can help address the social and cultural discrimination that often goes unrecognized by giving voice to a previously "invisible" population and validating their needs and worth.

Several years ago my mother-in-law attempted to get a visa to visit us in the United States. At the time we lived in a small, rural community in north-central Arkansas. When she went to the Embassy to request the visa she was told that "Mt. Pleasant" didn't exist because it wasn't on the map. She had to show them a letter from us with the postmark as proof that the town was a real location. In a similar fashion, when the needs of those who depend on maps the most are not reflected in those maps, it is as if they are being told they do not exist.

Maps are powerful political texts that speak with a whisper. Their authoritative nature is often taken for granted but the lines they draw speak volumes. J. B. Harley writes, "Cartographers manufacture power: they create a spatial panopticon…It is a power that intersects and is embedded in knowledge. It is universal…To catalogue the world is to appropriate it" (1989:13). He notes that besides this embedded, *internal* power that works through the maps, there is also an *external* power associated with maps and the centers of political control. Cartographers generally have patrons with specific agendas for the creation of the map. Harley references Foucault in describing the map as an instrument of 'juridical power' where knowledge is used as an instrument of control (1989:12). This may help to explain why the creation of the campus online interactive map has taken so long to produce. It is also why the map needs to display accessibility features. It needs to empower persons with disabilities to be able to navigate the campus with confidence. It is also why they need to be involved in the mapping process.

One of the surveyed students had the following advice for those seeking to get around at the U of A, "Do as much by phone as possible and map out in advance the routes you need to take to get to the various buildings. Find a good map of the sidewalks, which I have not been able to find." Hopefully that will not be the case for much longer.

5.1.5 Transit and Parking. Surveyed students had much to say about parking but one student summed it up with "Parking SUCKS on campus." Many requested more parking places be allocated to handicapped parking. Unfortunately the issue is more complicated than this since there is only so much land on "the Hill." I believe the problem is one of understanding needs and coordinating resources.

An analysis of handicapped parking was done on the Auburn University campus and it was concluded that the location and distribution of accessible parking was more important than the number of spots (Capps and Bowman, 2004). This was determined by collecting occupancy data for each of the handicapped parking locations to determine which lots students were using and at what times. I believe a similar analysis should be done at the U of A but it should not be just limited to parking. I believe that the campus should be regarded as a multimodal transportation network that serves to support the regularly scheduled campus activities. Integration between bus stops, bus times, parking locations and class schedules should be considered. As previously stated, until recently the buses did not even have a specific time table that they ran on, and there is no logistics planning software used to determine optimal routes and times. A full network analysis of both pedestrian and vehicular traffic on campus, that also considers persons with disabilities, would enable Razorback Transit to better meet the transportation needs of those on campus.

I grew up in New York City and learned to use the network of public transportation at an early age. Despite my familiarity with buses and bus schedules I have found it difficult to use the current U of A transit system for intercampus travel. The majority of people who need to navigate the campus at the U of A grew up in rural America and do not have the experience that I do. My impression is that the transit system is primarily used to get people to the center of campus and then everyone walks from there. For some, that is not possible.

Having more optimized transit routing and parking distribution would also reveal “gaps” in the transportation network. For example, there is currently no easy way to get close to Old Main. The nearest handicapped parking and bus stops are all located at the bottom of hills at the end of long sidewalks (see figure 4.11). One surveyed student suggested, “For getting from one part of campus to another, maybe there could be a regular golf cart circuit where you can just hop on / hop off; can get a cart even if you didn't know in advance you'd be needing it, and that you don't have to specifically arrange in advance. Like a little tram system, but with carts. And put a little CEA logo on our IDs so that the drivers can do a quick check to prevent abuse of the service.” Other students, staff, faculty or guests who have difficulty navigating the internal campus may have other suggestions.

5.1.6 Way Finding Signs. The U of A already has plans to improve way finding signs around the campus. Numerous survey comments regarded improved signage as well, including signs for elevator locations in buildings. Due to the lack of experience with using public transportation for the majority of persons visiting the U of A campus, I would suggest that these way finding signs also be used as an educational tool to familiarize people with the Razorback Transit system and how to utilize it best.

The way finding signs are also excellent means of communicating accessibility, especially to those who do not have smart phones. There is currently at least one such sign near the library. However, the sun has bleached out the icons for accessible entrances so they are no longer visible. Care should be taken to use inks that won't fade in the sun and the signs should be monitored to ensure that the information is current.

5.2 Conclusion

As a public institution that serves to educate students and research ways to improve life for everyone on this planet, the University of Arkansas should take the lead in making its campus accessible to everyone. The reasons are numerous. Obviously it is the law and compliance with the new ADA requirements is important.

Recruitment is another important reason for improving accessibility and navigation. There are many people in Arkansas and the surrounding area who have disabilities and would like the opportunity of a quality education. To misquote a line in *Field of Dreams*, "If you build it, they will come." A fully integrated campus that communicates a welcoming message to potential students and employees, regardless of mobility impairment, will garner the attention of those for whom that is important.

Successful recruitment will result in a more diverse campus as well. The U of A doesn't need "token" disabled people. A large percentage of the population in this country have some form of disability, and everyone has the potential for their mobility to be impaired at some point. If the U of A is to be a truly representative campus it needs to make room for everyone, and that will require some adjusting. But it will result in a richer, more vibrant atmosphere that is truly diverse.

Finally, it is just the right thing to do. The need is there. We live in an age when technology has the potential to meet this need in many powerful ways. We have a campus with a rich array of resources and creative thinkers. It is a matter of deciding what is important. And this is important because it speaks to the very heart of what it means to be human. We all live with an illusion that we are in control and have the freedom to do as we please, within the confines of the law and good manners. Yet a car accident or an illness is all it takes to tear away the veneer and expose our vulnerability. The truth is we are all "disabled" in some way and we all need each other. Our worth is not based on how well we perform, which is sometimes forgotten on a university campus where grades and grants are awarded based on our achievements. When we make room for persons with disabilities, we make room for ourselves.

6.0 References Cited

Amason, Patricia
1978 Barrier-free Design to Suit Environment. *Arkansas Traveler* 28 March:4. Fayetteville, Arkansas.

Appleton, Millie
2012 'Students First' Should Apply to Parking. *Arkansas Traveler* 1 December. Electronic document, http://www.uatrav.com/2010/students-first-should-apply-to-parking/, accessed April 18, 2012.

ArcGIS Resource Center
2010 Algorithms Used by Network Analyst. *Esri.* Electronic document, http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#//004700000053000000.htm, accessed December 5, 2011.
2011 Slope (Spatial Analyst). *Esri.* Electronic document, http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#//009z000000v2000000.htm, accessed April 18, 2012.
2011 Add Surface Information (3D Analyst). *Esri.* Electronic document, http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#//00q900000016000000, accessed April 18, 2012.
2011 How TIN to Raster (3D Analyst) Works. *Esri.* Electronic document, http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#//00q900000078000000, accessed April 18, 2012.
2011 How Topo to Raster Works. *Esri.* Electronic document, http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#//009z0000007m000000.htm, accessed April 18, 2012.

Arkansas Historic Preservation Program
2012 National Register of Historic Places, Frequently Asked Questions. Electronic document, http://www.arkansaspreservation.com/historic-properties/national-register/faq, accessed April 12, 2012.

Arkansas Traveler (AT) University of Arkansas, Fayetteville, Arkansas.
1920 What's the Matter with America? 6 May, Fayetteville, Arkansas.
1923 Ford Coupe Ends Life of Wag, Pi K A Mascot. 11 October, Fayetteville, Arkansas.
1926 "Advertisement placed by Camel cigarettes." 25 February, Fayetteville, Arkansas.
1926 Dean of Men Discuss Ban on Auto Parking. 28 May, Fayetteville, Arkansas.
1927 "Advertisement place by Old Gold cigarettes." 28 October, Fayetteville, Arkansas.
1928 How Do You Park? 13 December, Fayetteville, Arkansas.
1930 Hit-Run Driver Kills Frat Dog; Brethren Weep. 10 October, Fayetteville, Arkansas.
1979 Aid for Disabled Set. 22 March, Fayetteville, Arkansas.

Braddock, David L., and Susan L. Parish
2001 An Institutional History of Disability. In *Handbook of Disability Studies*, edited by

Gary L. Albrecht, Katherine D. Seelman and Michael Bury, pp. 11-68. Sage Publications, Thousand Oaks, California.

Branam, Chris
2011 UA Revises Plan for $1 Million Gate: Original Plan Didn't Meet Fire Code. *Arkansas Democrat Gazette* 7 July. Little Rock, Arkansas.

Brantley, Max
2011 Advocate: Save the Old Main Lawn. *Arkansas Blog* 21 May. Electronic document, http://www.arktimes.com/ArkansasBlog/archives/2011/05/21/advocate-save-the-old-main-lawn, accessed April 18, 2012.

Burgstahler, Sheryl, and Rebecca Cory
2008 Moving in from the Margins: From Accommodation to Universal Design. In *Disability and the Politics of Education: An International Reader,* edited by Susan L. Gabel and Scot Danforth, pp. 561-581. Peter Lang, New York.

Burrough, Peter A., and Rachael A. McDonnell
1998 *Principles of Geographical Information Systems.* Oxford University Press, New York.

Bustillos, Brenda I., Jeffrey Shelton, and Yi-Chang Chiu
2011 Urban university campus transportation and parking planning through a dynamic traffic simulation and assignment approach. *Transportation Planning and Technology* 34(2):177-197.

Capps, Christopher Shaun, and Brian L. Bowman
2004 Analysis of Handicapped Parking at Auburn University. *Transportation Research Record: Journal of the Transportation Research Board* 1885:21-27.

City College of San Francisco
2012 Ocean Accessibility Map. Electronic document, http://www.ccsf.edu/Offices/Office_of_Instruction/Access_Guide/index/ada-ocean.pdf, accessed April 6, 2012.

de Smith, Mike, Mike Goodchild, and Paul Longley
2011 Introduction to Network and Location Analysis. *Geospatial Analysis – A Comprehensive Guide.* 3rd ed. Electronic document, http://www.spatialanalysisonline.com/output/, accessed April 18, 2012.

Dempsey, Caitlin
2011 Commercial GIS Software Applications. *GIS Lounge.* Electronic document, http://gislounge.com/gis-software-applications/, accessed December 20, 2011.
2012 What is GIS? *GIS Lounge.* Electronic document, http://gislounge.com/what-is-gis/, accessed April 17, 2012.

Department of Justice
2010 *2010 ADA Standards for Accessible Design.* Electronic document, http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm#pgfId-1010125, accessed April 17, 2012.

Esri
2012 ArcGIS Network Analyst, Overview. Electronic document, http://www.esri.com/software/arcgis/extensions/networkanalyst/index.html, Accessed April 18, 2012.

Ferraro, Gary
2001 *Cultural Anthropology, An Applied Perspective.* 4th ed. Wadsworth, Belmont, California.

Foucault, Michel
1977 *Discipline and Punishment.* Vintage Books, New York.

Fries, Ryan, Anne Dunning, Mashrur Chowdhury
2009 Impact of On-Street Parking in the Core of a University Campus. *Proceedings of the Transportation Research Board Annual Meeting.* January 10-14, Washington, D.C.

Fry, Caroline M.
1988 Maps for the Physically Disabled. *The Cartographic Journal* 25(June):20-28.

GIS.com
2012 What is GIS? Electronic document, http://www.gis.com/content/what-gis, accessed April 17, 2012.

Google Maps
2012 Google Transit Partner Program. Electronic document, http://maps.google.com/help/maps/transit/partners/index.html, accessed April 17, 2012.

Graves-Brown, Paul
1997 From Highway to Superhighway: the Sustainability, Symbolism and Situated Practices of Car Culture. *Social Analysis* 41(1):64-75.

Gray, David B., Mary Gould, and Jerome E. Bickenbach
2003 Environmental Barriers and Disability. *Journal of Architectural and Planning Research* 20(1):29-37.

Hale, Linda
1979 UA handicapped Students Encounter Parking Problems. *Arkansas Traveler* 20 February. Fayetteville, Arkansas.

Haller, Beth A.
2006 Promoting Disability-Friendly Campuses to Prospective Students: An Analysis of University Recruitment Materials. *Disabilities Studies Quarterly* 26(2). Electronic document, http://dsq-sds.org/article/view/673/850, accessed April 17, 2012.

Harley, J. B.
1989 Deconstructing the Map. *Cartographica* 26(2):1-20.

Hogan, Liz
2011 UA Disabilities Awareness Week. Electronic document, http://nwahomepage.com/fulltext-news?nxd_id=232937, accessed April 17, 2012.

Huckaby, Megan
2011 UA Officials Plot Campus GPS for Next Semester. *Arkansas Traveler* 14 November. Electronic document, http://www.uatrav.com/2011/ua-officials-plot-campus-gps-for-next-semester/, accessed April 17, 2012.

Hutchinson, M.F.
2006 ANUDEM Version 5.2. Electronic document, http://fennerschool.anu.edu.au/publications/software/anudem.php, accessed July, 11 2011.

Imrie, Rob, and Marion Kumar
1998 Focusing on Disability and Access in the Built Environment. *Disability and Society* 13(3):357-374.

Jordan, Ann T.
2003 *Business Anthropology.* Waveland Press, Inc., Prospect Heights, Illinois.

Journal Record, The [Oklahoma City, Oklahoma]
2011 Oklahoma Shopping Centers Sued Over Disability Issues. 3 October, Oklahoma, City, Oklahoma.

Langley, Richard B.
1999 Dilution of Precision. Electronic document, http://gauss.gge.unb.ca/papers.pdf/gpsworld.may99.pdf, accessed April 8, 2012.

Matthews, Hugh, Linda Beale, Phil Picton, and David Briggs
2003 Modelling Access with GIS in Urban Systems (MAGUS): capturing the experiences of wheelchair users. *Area* 35(1):34-45.

Marsh, Peter and Peter Collett
1986 *Driving Passion: The Psychology of the Car.* Faber and Faber, Boston.

Maune, David F. (editor)
2007 *Digital Elevation Model Technologies and Applications: The DEM Users Manual.* 2nd ed. American Society for Photogrammetry and Remote Sensing, Bethesda, Maryland.

Miller, Barbara D.
2005 *Cultural Anthropology.* 3rd ed. Pearson Education, Boston.

Murphy, Robert F.
1987 *The Body Silent.* H. Holt, New York.

Naseem, Saba
2011 Walkways Trouble Disabled at UA. *Arkansas Traveler* 30 March. Electronic document, http://www.uatrav.com/2011/walkways-trouble-disabled-at-ua/, accessed April 17, 2012.
2011 Major Issues Change with Student Body. *Arkansas Traveler* 26 April. Electronic document, http://www.uatrav.com/2011/major-issues-change-with-student-body/, accessed April 17, 2012.

National Park Service, U.S. Department of the Interior
2012 Preservation Brief 32: Making Historic Properties Accessible. Electronic document, http://www.nps.gov/hps/tps/briefs/brief32.htm, accessed April 17, 2012.

Newman, Lynn
2005 Postsecondary Education Participation of Youth with Disabilities. In *After High School: A First Look at the Postschool Experiences of Youth with Disabilities,* prepared by Mary Wagner, Lynn Newman, Renee Cameto, Nicolle Garza, and Phyllis Levine, pp.4-1 – 4-17. SRI International, Menlo Park, California.

Norton, Peter
2008 *Fighting Traffic.* MIT Press, Cambridge, Massachusetts.

Portals of Imagination: Designing the Parks of Today…and Tomorrow
2011 *Common Ground.* Winter:27-39.

Pratt, Monica
2012 Improving Citizen Engagement: GIS fosters participation. *ArcUser: The Magazine for Esri Software Users* 15(2):32-35.

Qualls, Chris
1978 Buildings Adhere to Standards. *Arkansas Traveler* 11 April:1, 6. Fayetteville, Arkansas.

Rardin, Ronald L.
1998 *Optimization in Operations Research.* Prentice Hall, Upper Saddle River, New Jersey.

Rattray, Nicholas
2007 Evaluating Universal Design: Low- and High- Tech Methods for Mapping Accessible Space. *Practicing Anthropology* 29(4):24-28.

Rattray, Nicholas A., Sarah Raskin, and Jacklyn Climino
2008 Participatory Research On Universal Design and Accessible Space at the University of Arizona. *Disability Studies Quarterly* 28(4). Electronic document, http://dsq-sds.org/article/view/159/159, accessed April 17, 2012.

Remes, Mark
1977 Disabled Students Seek Equality in Educational Opportunities. *Arkansas Traveler* 18 October. Fayetteville, Arkansas.

Ross, Rachel
1998 Disability Friendly Colleges. Electronic document, http://www.newmobility.com/articleViewIE.cfm?id=122, accessed April 14, 2012.

Rottenburg, Richard
2009 *Far-Fetched Facts, A Parable of Development Aid.* The MIT Press, Cambridge, Massachusetts.

Sachs, Dalia, and Naomi Schreuer
2011 Inclusion of Students with Disabilities in Higher Education: Performance and participation in Student's Experiences. *Disabilities Studies Quarterly* 31(2). Electronic document, http://dsq-sds.org/article/view/1593/1561, accessed April 17, 2012.

Schmocker, Jan-Dirk, Mohammed A. Quddus, Robert B. Noland, Michael G.H. Bell
2008 Mode Choice of Older and Disabled People: A Case Study of Shopping Trips in London. *Journal of Transport Geography* 16(2008):257-267.

Schultz, Emily A., and Robert H. Lavenda
2005 *Cultural Anthropology: A Perspective on the Human Condition.* 6th ed. Oxford University Press, New York.

The Sensory: U of A Access News
1985 Getting to Know: Barbara Horn. February:2-3. Fayetteville, Arkansas.

Sharp, Jeannie
1979 Barriers Bring Charges at HEW: Disabled Co-ed Says UA Campus Difficult. *Arkansas Traveler* 20 March:1, 4, 11. Fayetteville, Arkansas.

Shove, Elizabeth
2002 Rushing Around: Coordination, Mobility and Inequality. Electronic document, http://www.lancs.ac.uk/staff/shove/choreography/rushingaround.pdf, accessed April 17, 2012.

Sloman, Lynn
2006 *Car Sick, Solutions for our Car-addicted Culture.* Green Books, Bodmin, Cornwall, UK.

Smyth, Joshua
2012 ADA Ramp Slope in Degrees. Electronic document, http://www.ehow.com/print/info_7846744_ada-ramp-slope-degrees.html, accessed April 17, 2012.

Snyder, Sharon L., and David T. Mitchell
2006 *Cultural locations of disability*. University of Chicago Press, Chicago.

Stanford University
2012 Campus Access Guide map for Meyer Library. Electronic document, http://maps.stanford.edu/ada/, accessed April 6, 2012.
2012 FAQ: Stanford University. Electronic document, http://www.stanford.edu/dept/visitorinfo/site/faq/index.html#faq_9, accessed April 18, 1012.

Suntrup, Jack
2011 Buses Will Be Tracked With New GPS System. *Arkansas Traveler* 29 September. Electronic document, http://www.uatrav.com/2011/buses-will-be-tracked-with-new-gps-system/, accessed April 17, 2012.

Titchkosky, Tanya
2010 The Not-Yet-Time Of Disability In The Bureaucratization Of University Life. *Disability Studies Quarterly* 30(3/4). Electronic document, http://dsq-sds.org/article/view/1295/1331, accessed April 17, 2012.

Towne, Sheri
1978 Preliminary Plan Being Considered. *Arkansas Traveler* 14 February:7, 10. Fayetteville, Arkansas.

Tremain, Shelley
2005 *Foucault and the Government of Disability*. University of Michigan Press, Ann Arbor.

United Nations General Assembly
2006 UN Enable - Final Report of the Ad Hoc Committee - Advance Unedited Copy. Electronic document, http://www.un.org/esa/socdev/enable/rights/ahcfinalrepe.htm, accessed April 14, 2012.

University of Arkansas
1947-1948 *"A" Book*. Fayetteville, Arkansas.
1952-1953 *"A" Book*. Fayetteville, Arkansas.
1955-1956 Parking and Traffic Regulations. *"A" Book*. Fayetteville, Arkansas
2007 Mapping to the Edge of Information. Electronic document, http://planning.uark.edu/space_management/content/press_famacast20070625.pdf, accessed April 17, 2012.

2009 University of Arkansas Master Plan Summary. Electronic document, http://planning.uark.edu/campus_planning/content/masterplan_summary.pdf, accessed April 10, 2012.
2009 *Center for Educational Access Student Handbook.* Fayetteville, Arkansas.
2009 Transit and Parking Department Annual Report. Electronic document, http://parking.uark.edu/FY07-09_Annual_Report.pdf, accessed April 17, 2012.
2011 Annual Report: 2010-2011, Center for Educational Access. Electronic document, http://studentaffairs.uark.edu/annualreport/3441.php, accessed April 10, 2012.
2011 Annual Report: 2010-2011, Division of Student Affairs. Electronic document, http://studentaffairs.uark.edu/annualreport/, accessed April 17, 2012.
2011 Transit, Parking and Traffic Committee Minutes, 26 April. Electronic document, http://parking.uark.edu/11_April_26.pdf, accessed April 17, 2012.
2012 About CAST. Electronic document, http://www.cast.uark.edu/home/about.html, accessed April 17, 2012.
2012 About Facilities Management. Electronic document, http://fama.uark.edu/76.php, accessed April 18, 2012.
2012 Campus Map with accessible entrances displayed. Electronic document, http://campusmap.uark.edu/, accessed April 15, 2012.
2012 Center for Advanced Spatial Technologies (CAST) Facilities. Electronic document, http://www.cast.uark.edu/home/about/facilities.html, accessed April 17, 2012.
2012 Center for Advanced Spatial Technologies (CAST) Homepage. Electronic document, http://www.cast.uark.edu/, accessed April 17, 2012.
2012 CEA Homepage. Electronic document, http://cea.uark.edu/, accessed April 10, 2012.
2011 Chancellor's Report 2011, By the Numbers. Electronic document, http://annualreport.uark.edu/#5, accessed April 23, 2012.
2012 Civil Engineering, Transportation Engineering. Electronic document, http://www.cveg.uark.edu/5496.php, accessed April 17, 2012.
2012 Facilities Management Homepage. Electronic document, http://fama.uark.edu/, accessed April 10, 2012.
2012 Historic Buildings. Electronic document, http://planning.uark.edu/campus_planning/campus_history.htm, accessed April 17, 2012.
2012 Office of University Relations Homepage. Electronic document, http://universityrelations.uark.edu/index.php, accessed April 9, 2012.
2012 Paratransit. Electronic document, http://parking.uark.edu/24.php, accessed April 17, 2012.
2012 Parking Map. Electronic document, http://parking.uark.edu/parkmap.pdf, accessed April 6, 2012.
2012 Quick Facts. Electronic document, http://admissions.uark.edu/1454.php, accessed April 18, 2012.
2012 Students First: A Definition. Electronic document, http://chancellor.uark.edu/13226.php, accessed April 17, 2012.
2012 Transit and Parking Homepage. Electronic document, http://parking.uark.edu/, accessed April 19, 2012.
2012 Student Organizations, Disabilities Awareness Week. Electronic document, http://leadership.uark.edu/organizations/sidebar/rso_list.php, accessed April 17, 2012.

2012 Transit, Parking and Traffic Committee Minutes, 28 October. Electronic document, http://parking.uark.edu/12_Oct_28.pdf, accessed April 12, 2012.

2012 Transportation Engineering Homepage. Electronic document, http://trans.cveg.uark.edu/trans/Courses.html, accessed April 17, 2012.

2012 Work Study Benefits. Electronic document, http://finaid.uark.edu/88.php, accessed April 17, 2012.

University of California at Berkeley

2012 Access Guide. Electronic document, http://access-guide.berkeley.edu/, accessed April 6, 2012.

2012 Pathway Slopes Map. Electronic document, http://access-guide.berkeley.edu/2005-GIS-Route-Slopes-Map-color.pdf, accessed April 6, 2012.

2012 Parking and Building Entrances Map. Electronic document, http://access-guide.berkeley.edu/2005-GIS-Parking-and-Entrances-Map.pdf, accessed April 6, 2012.

University of Missouri

2010 Disability Resources. Electronic document, http://disability.missouri.edu/, accessed April 17, 2012.

2012 Campus Accessibility Map. Electronic document, http://accessibilitymap.missouri.edu/, accessed April 6, 2012.

University of Oregon

2012 Interactive Map: University of Oregon. Electronic document, http://map.uoregon.edu/, accessed April 15, 2012.

University of Texas at Austin

2012 Accessibility map for Tower Area. Electronic document, http://www.utexas.edu/maps/main/access/tower.html, accessed April 6, 2012.

U. S. Census Bureau

2003 *Disability Status: 2000.* U.S. Department of Commerce, Washington, D.C.

van Roosmalen, Linda, Gregory J. Paquin, Aaron M. Steinfeld

2010 Quality of Life Technology: The State of Personal Transportation. *Physical Medicine and Rehabilitation Clinics of North America* 21(1):111-125.

Van Sickle, Jan

2011 *Coordinates.* PDH Center, Fairfax, Virginia.

Vujakovic, P., and M. H. Matthews

1994 Contorted, Folded, Torn: Environmental Values, Cartographic Representation and the Politics of Disability. *Disability and Society* 9(3):359-375.

Whitehouse, David

2000 Ice Age Star Map Discovered. *BBC News* 9 August. Electronic document, http://news.bbc.co.uk/2/hi/science/nature/871930.stm, accessed March 14, 2012.

Wilson, Kristi, Elizabeth Getzel, and Tracey Brown
2000 Enhancing the Post-secondary Campus Climate for Students with Disabilities. *Journal of Vocational Rehabilitation* 14(2000):37-50

Wikipedia
2012 Geographic Information System. Electronic document, http://en.wikipedia.org/wiki/Geographic_information_system, accessed April 17, 2012.

Yale University
2012 Central Campus Area Access Map. Electronic document, http://www.yale.edu/rod/accessmap/central.htm, accessed April 15, 2012.

7.0 Figures

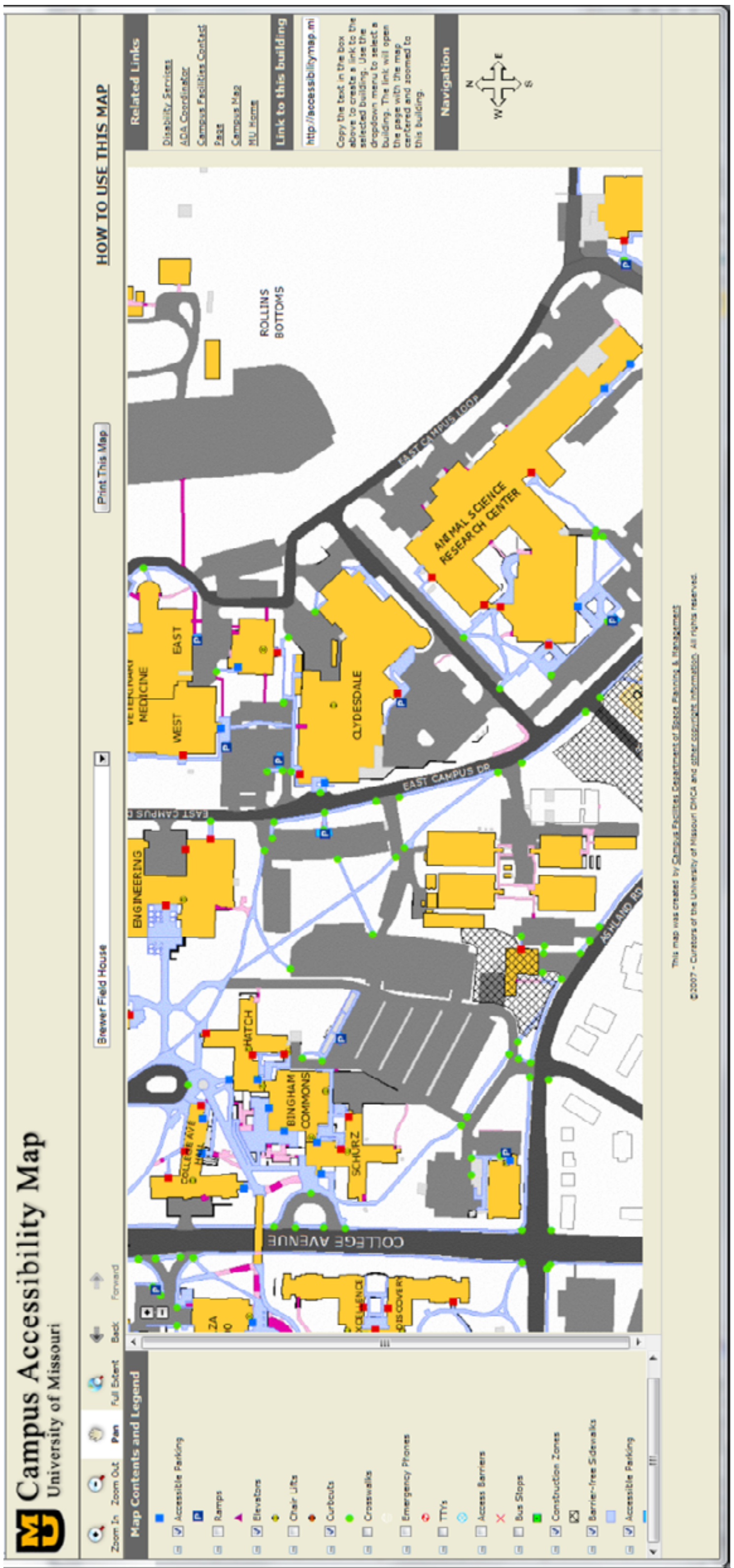


Figure 2.1: University of Missouri, Campus Accessibility Map

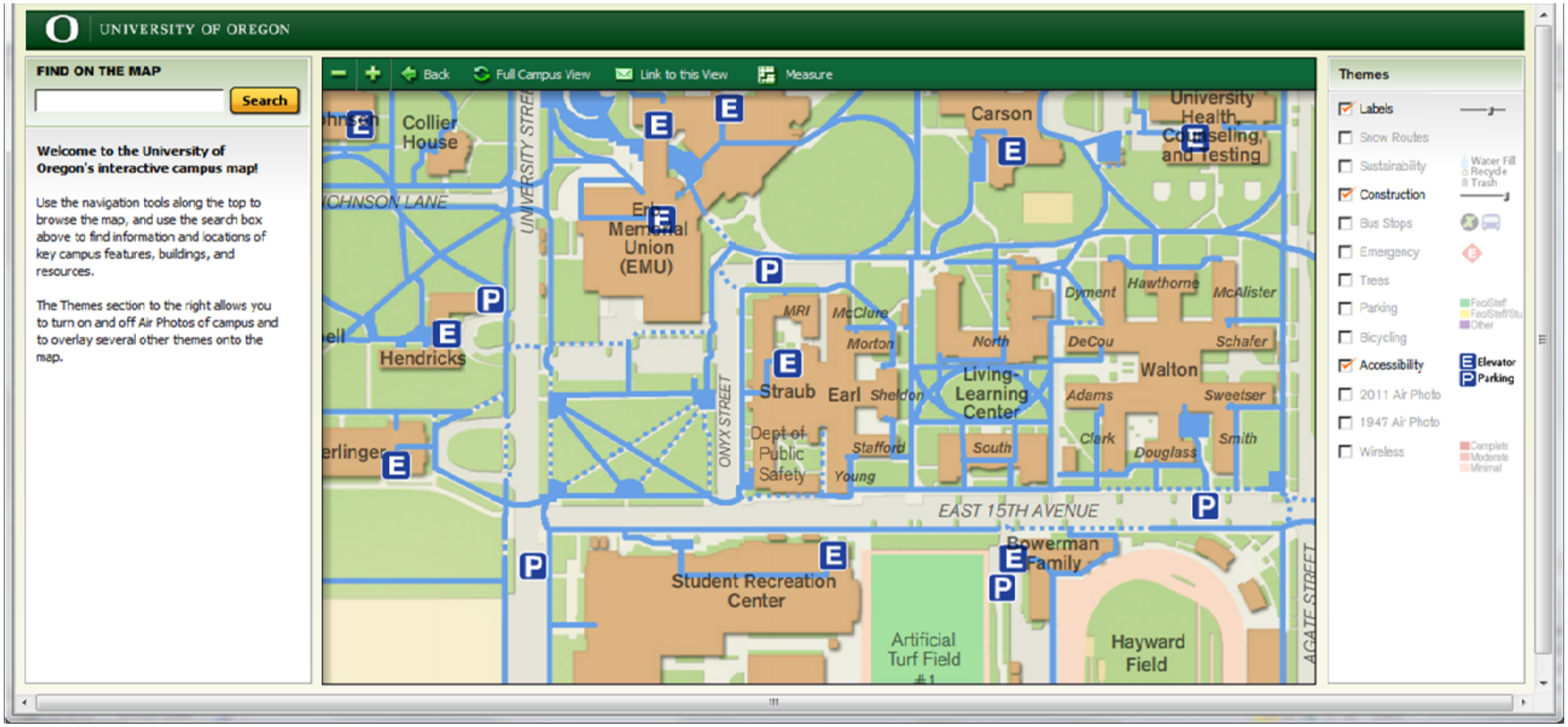


Figure 2.2: University of Oregon, Campus Map with Optional Accessibility Features

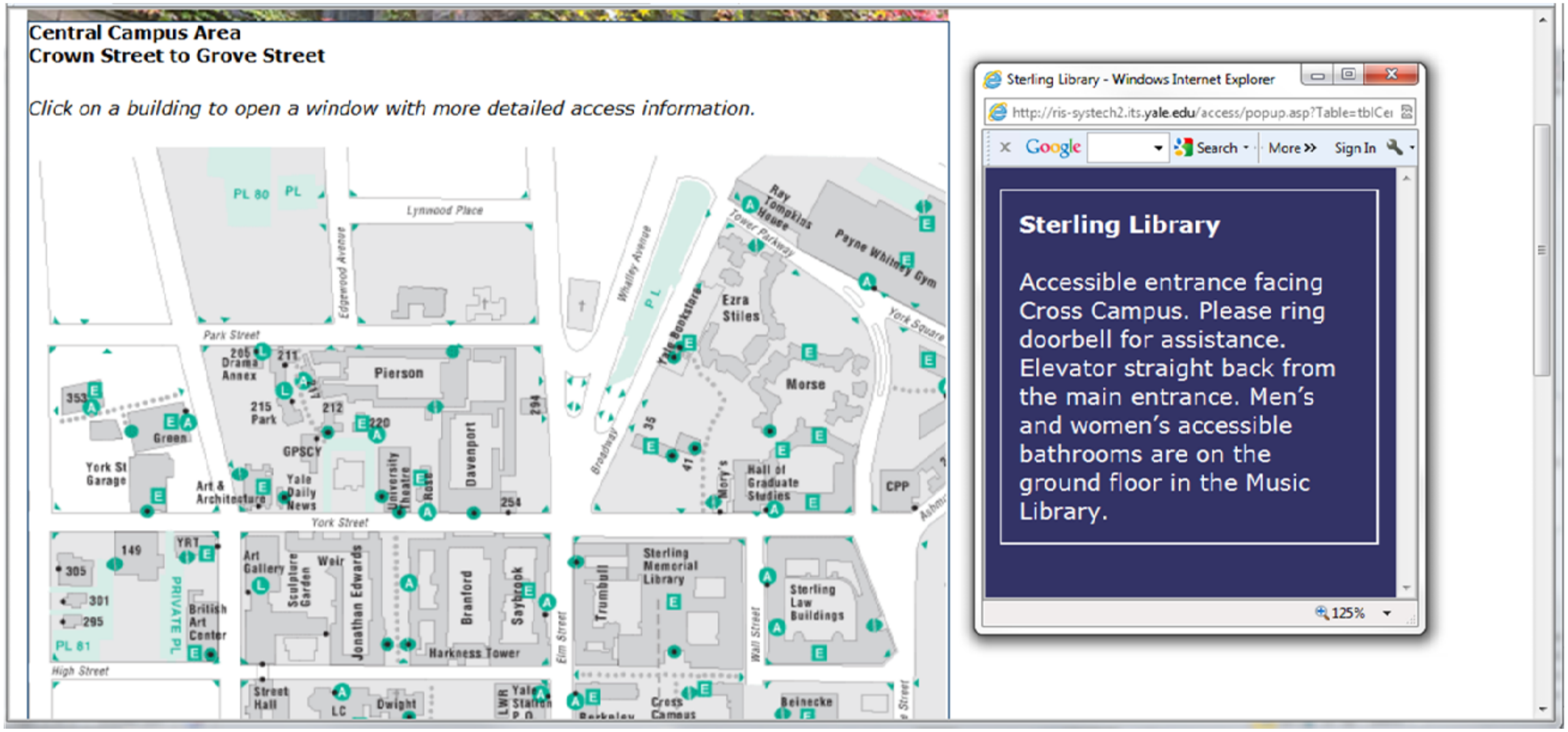


Figure 2.3: Yale University, Access Map for Central Campus Area, with Sterling Library Detailed Access Information box

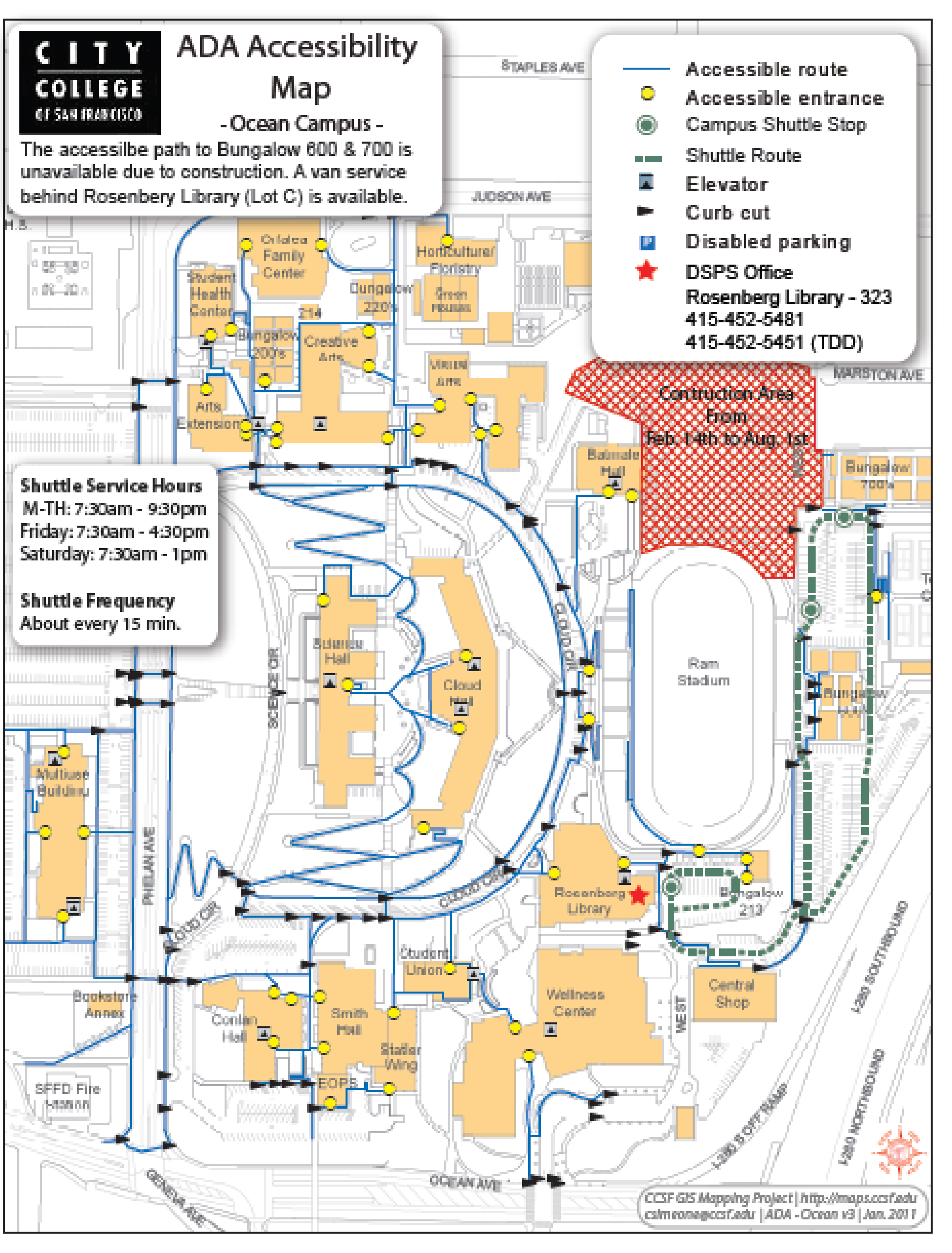


Figure 2.4: City College of San Francisco, Ocean Campus Accessibility Map

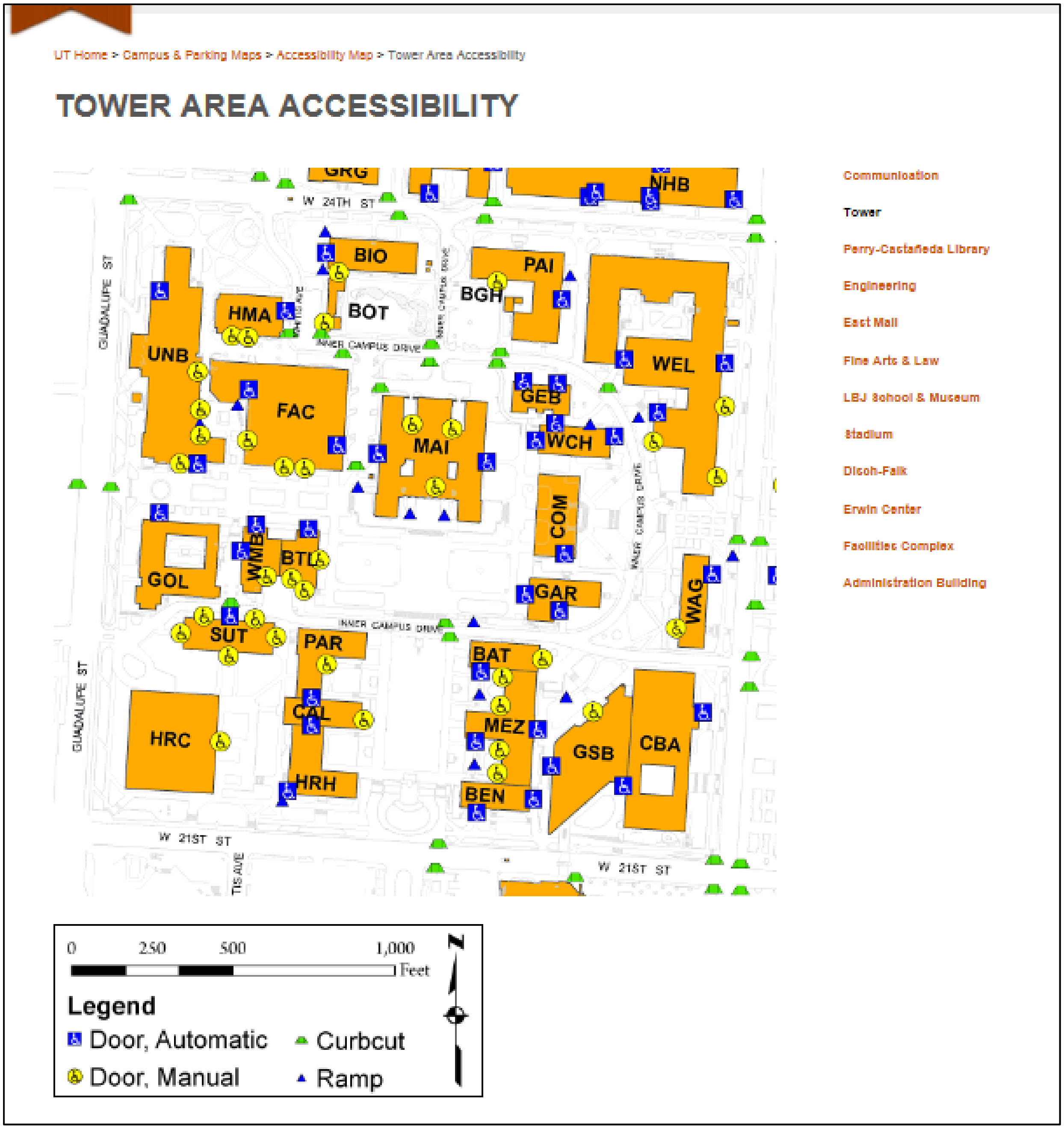


Figure 2.5: University of Texas at Austin, Accessibility map for Tower Area

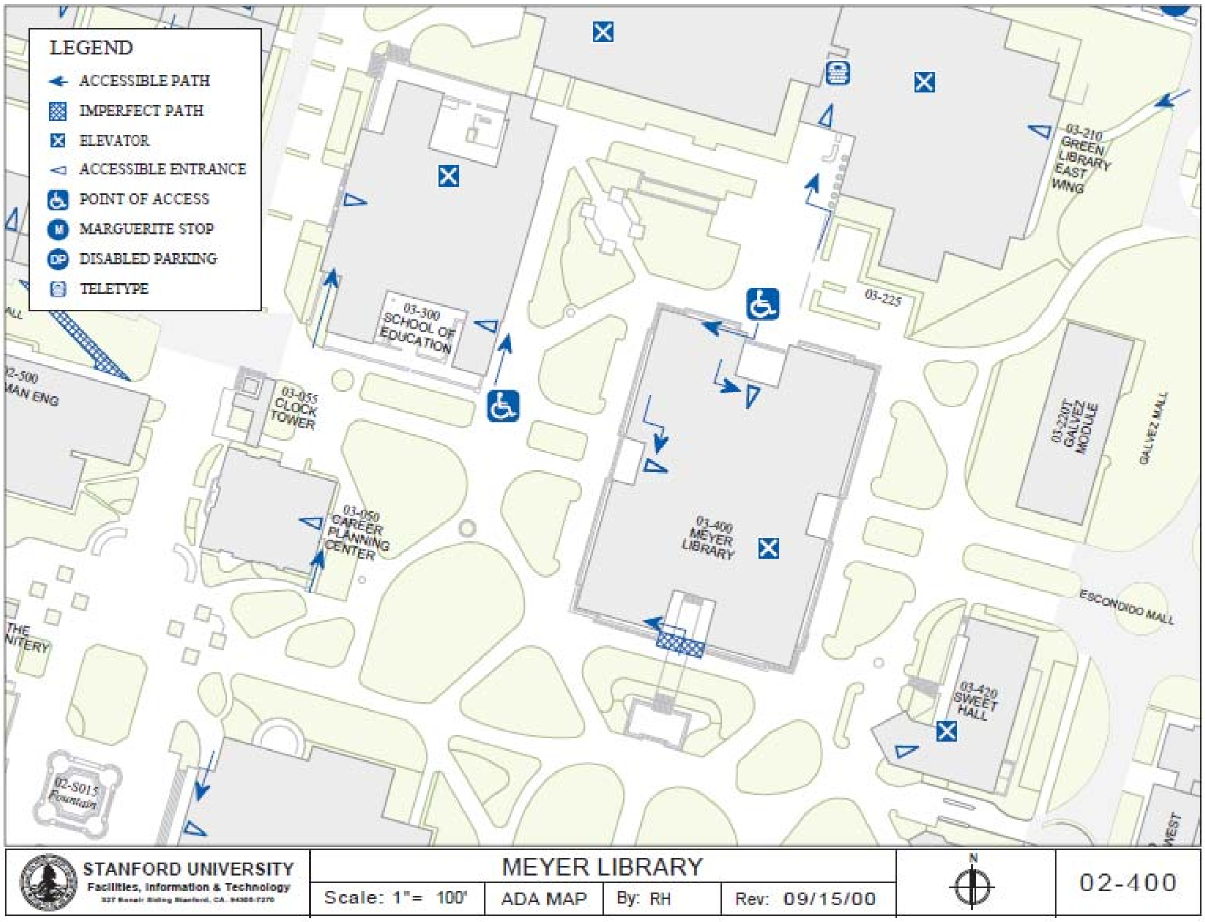


Figure 2.6: Stanford University, Campus Access Guide map for Meyer Library

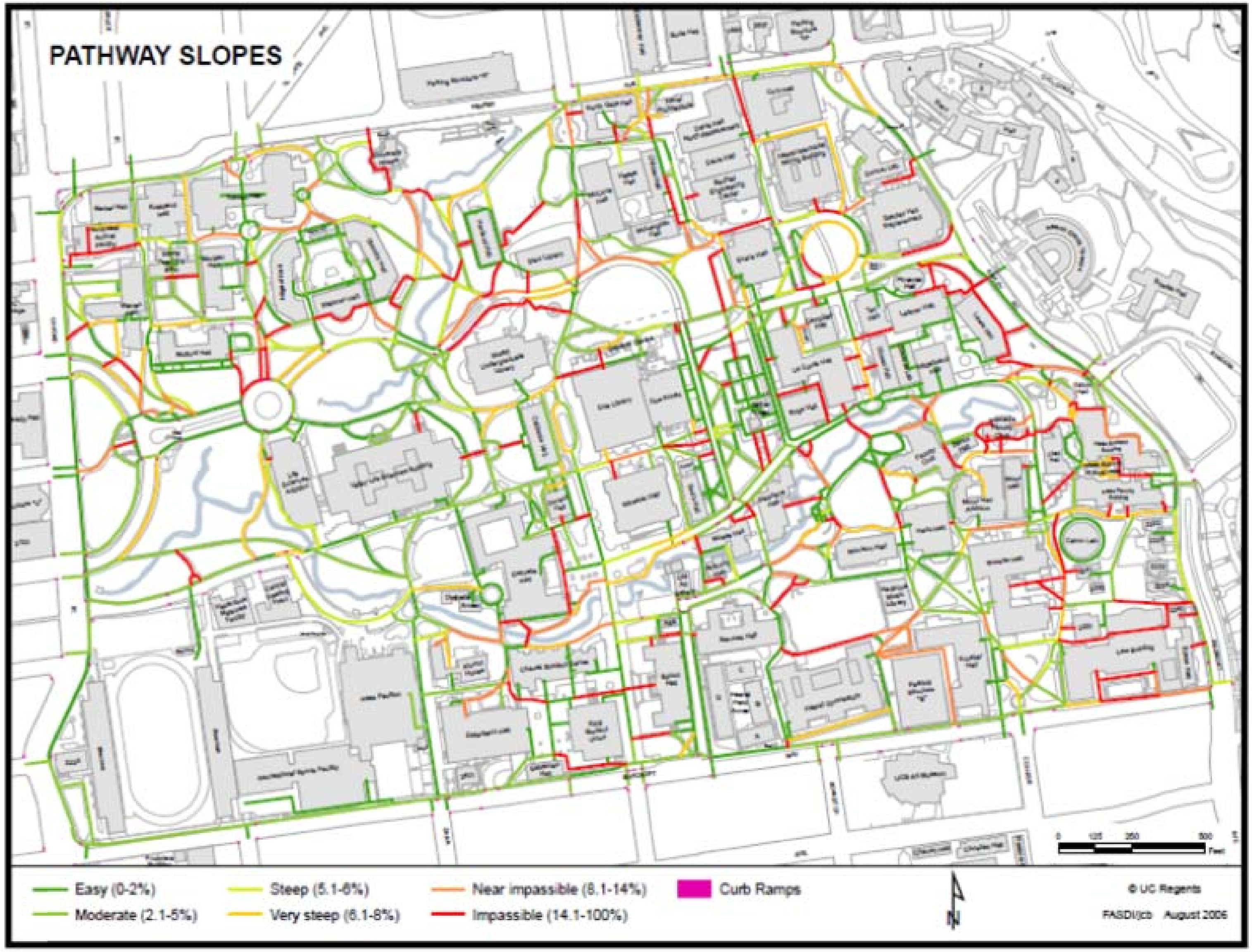


Figure 2.7: University of California at Berkeley, Pathway Slopes Map

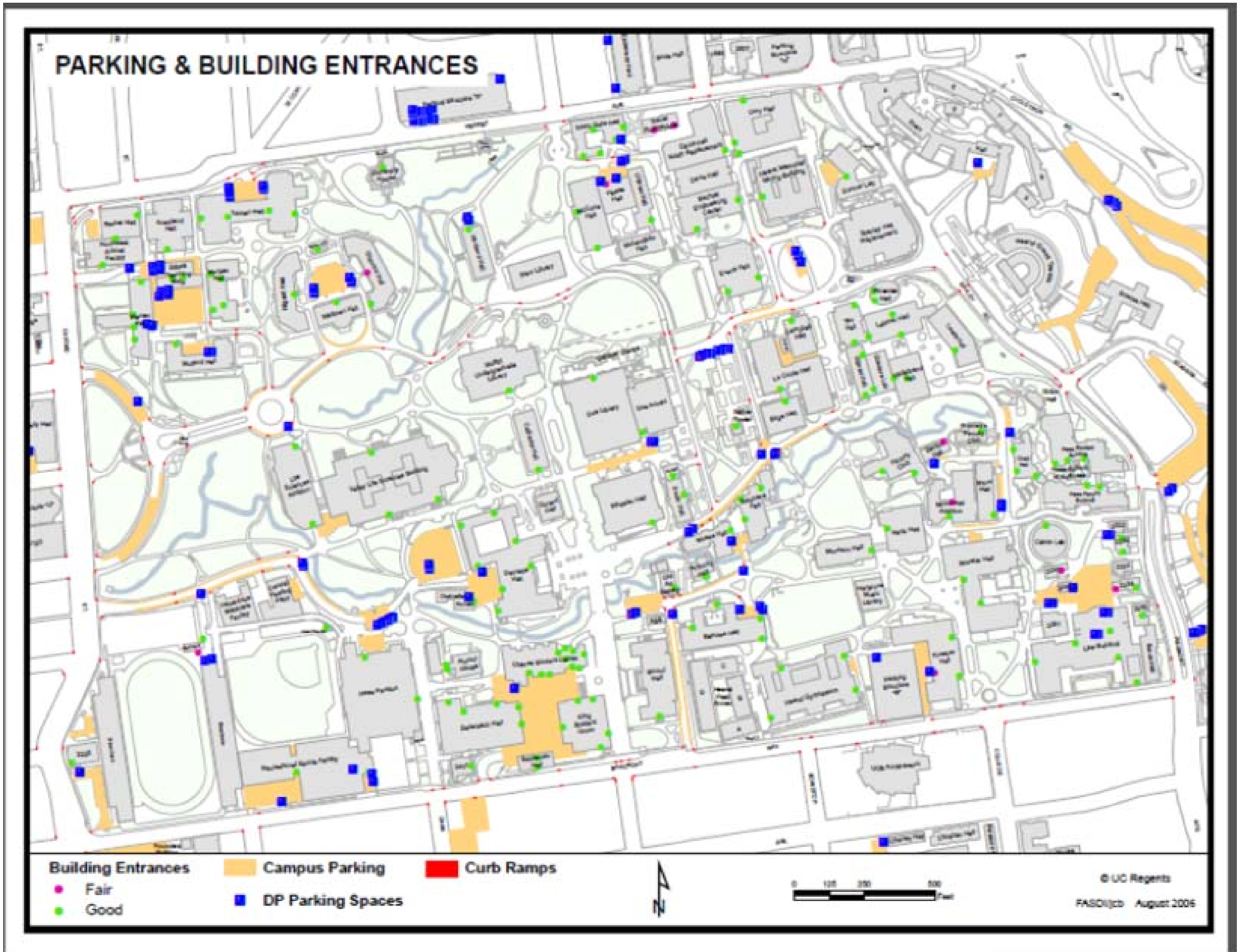


Figure 2.8: University of California at Berkeley, Parking and Building Entrances Map

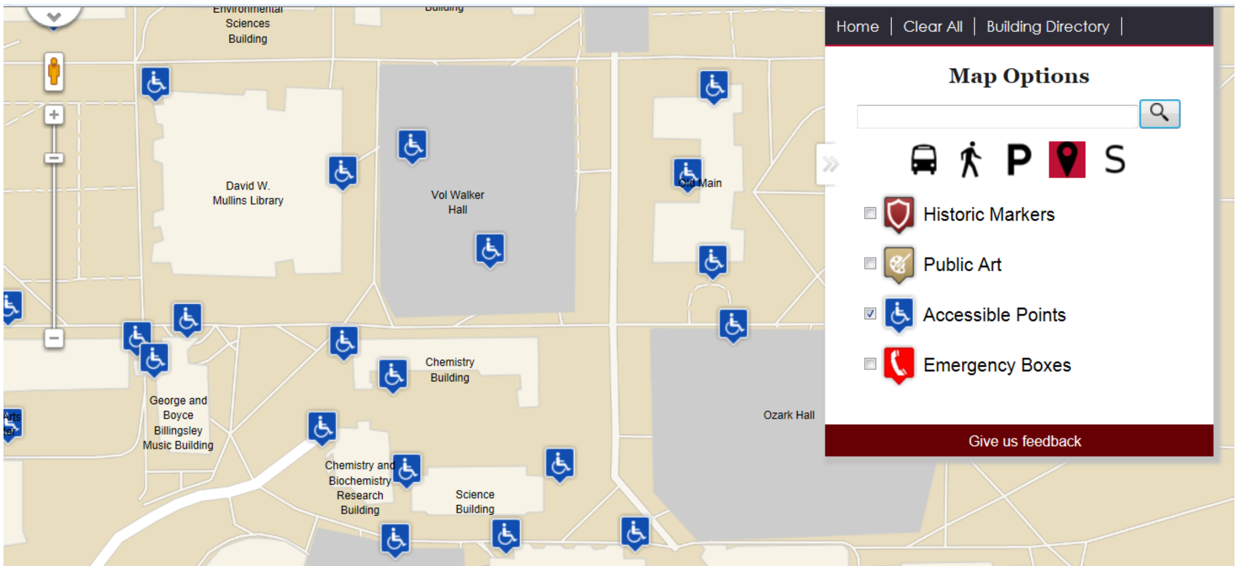


Figure 2.9: University of Arkansas, Campus Map with accessible entrances displayed

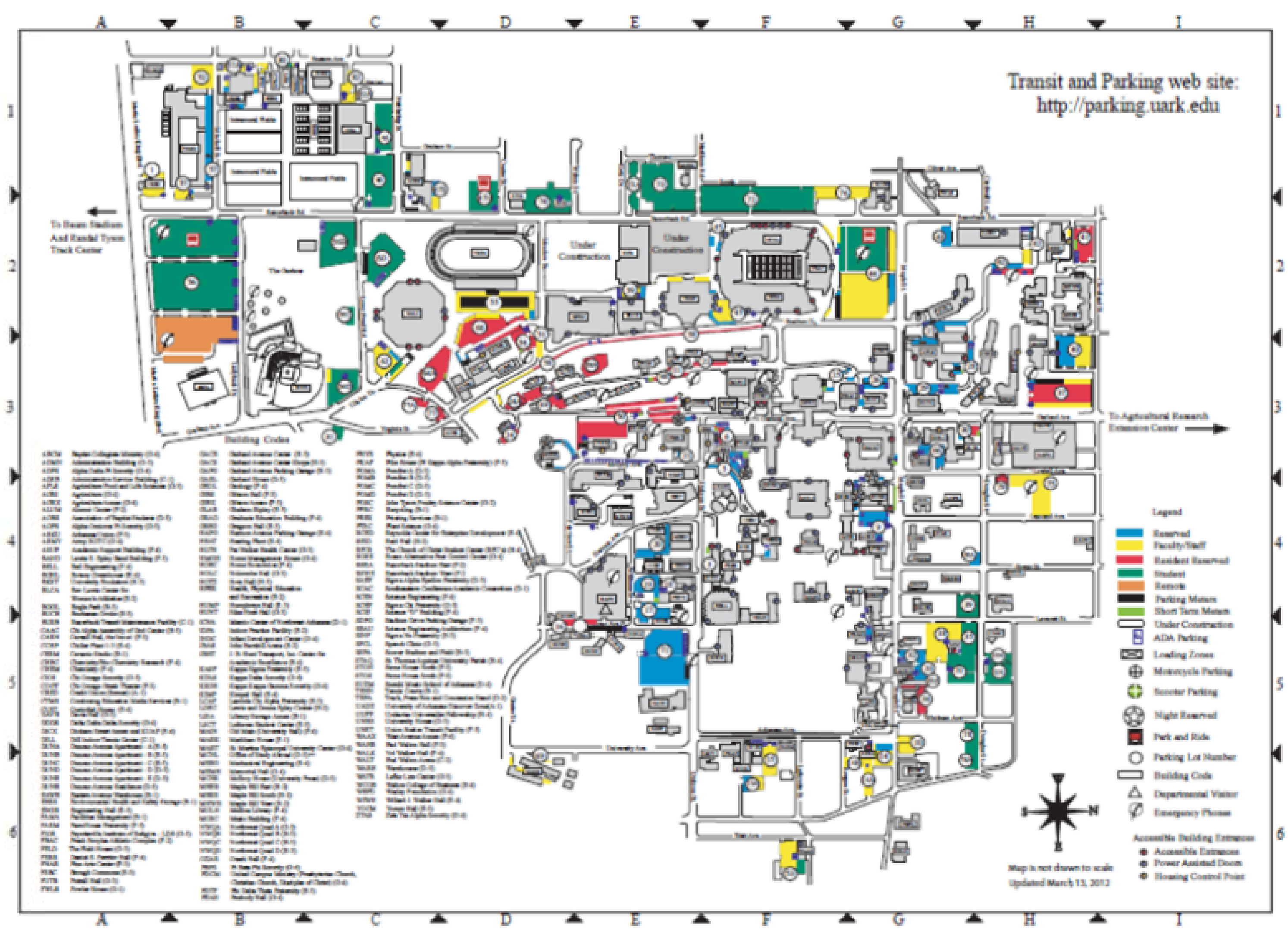


Figure 2.10: University of Arkansas, Parking Map

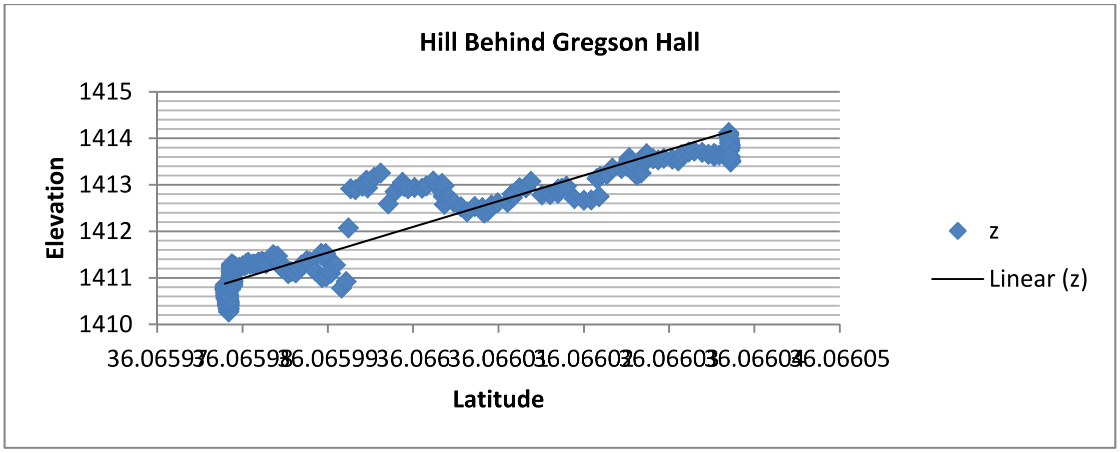


Figure 4.1: GPS data points from the hill behind Gregson Hall

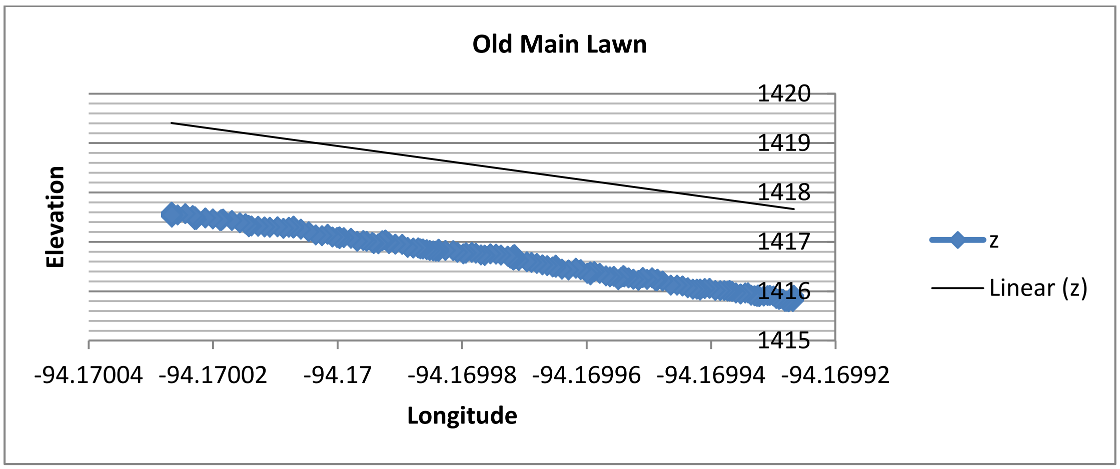


Figure 4.2: GPS data points from Old Main lawn

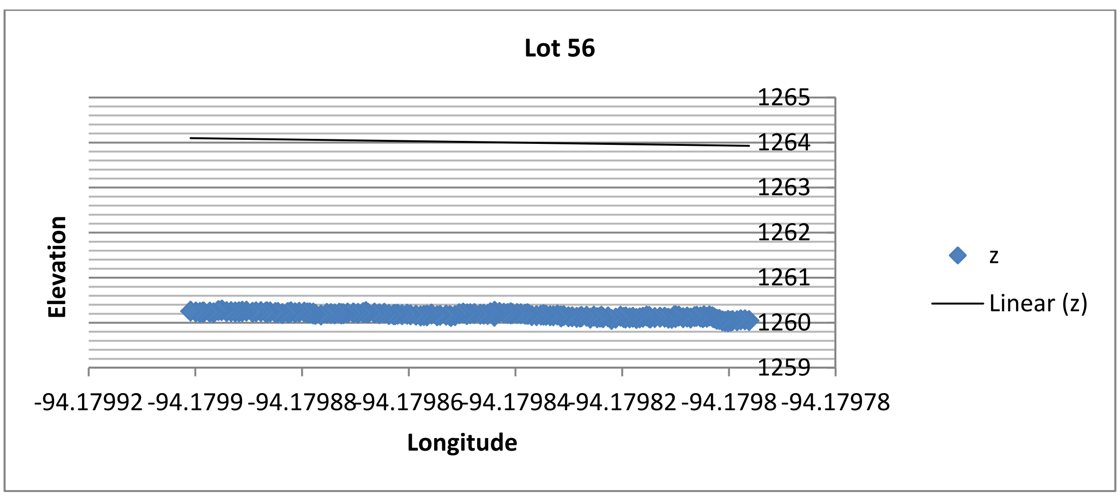


Figure 4.3: GPS data points from Lot 56 parking lot

Figure 4.4: Contours and GPS data for the hill behind Gregson Hall

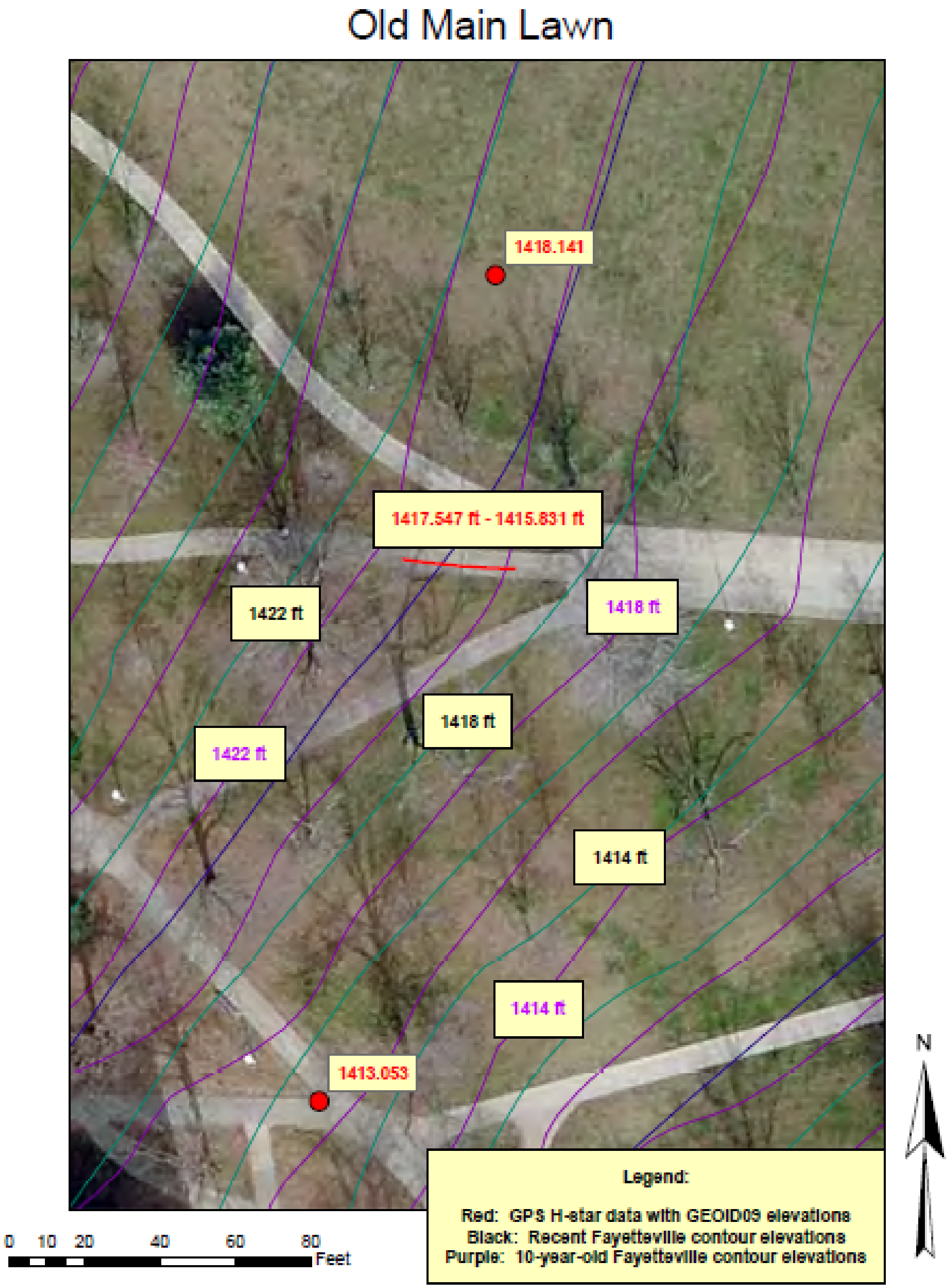


Figure 4.5: Contours and GPS data for Old Main lawn

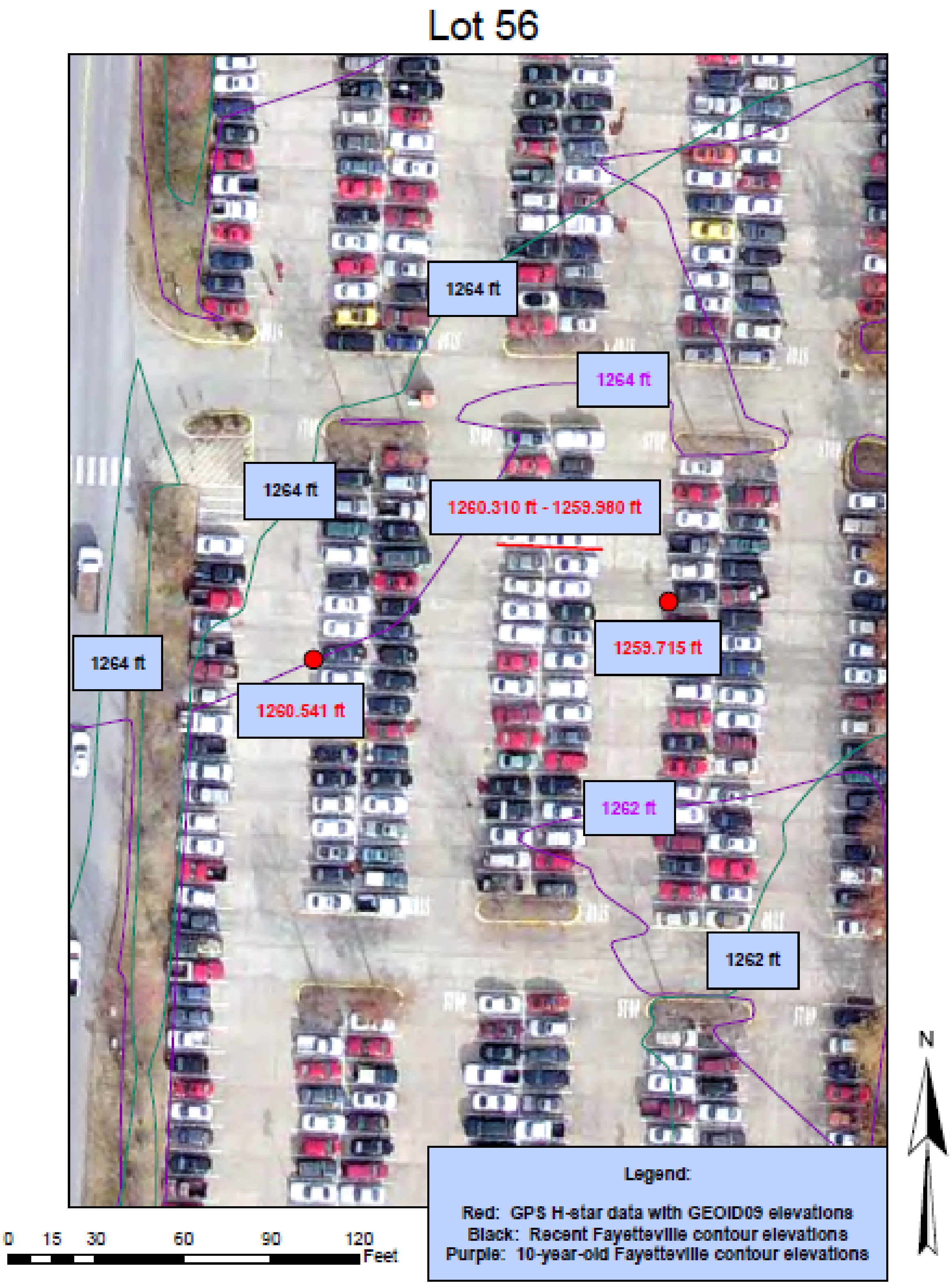


Figure 4.6: Contours and GPS data for Lot 56 parking lot

Figure 4.7: DEM derived from CAD contours using linear interpolation

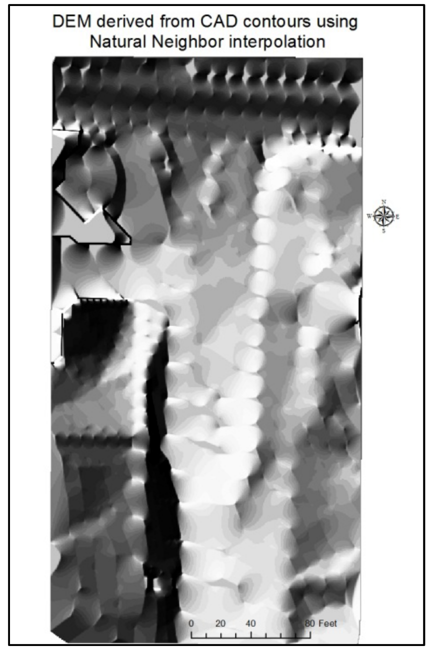


Figure 4.8: DEM derived from CAD contours using Natural Neighbor interpolation

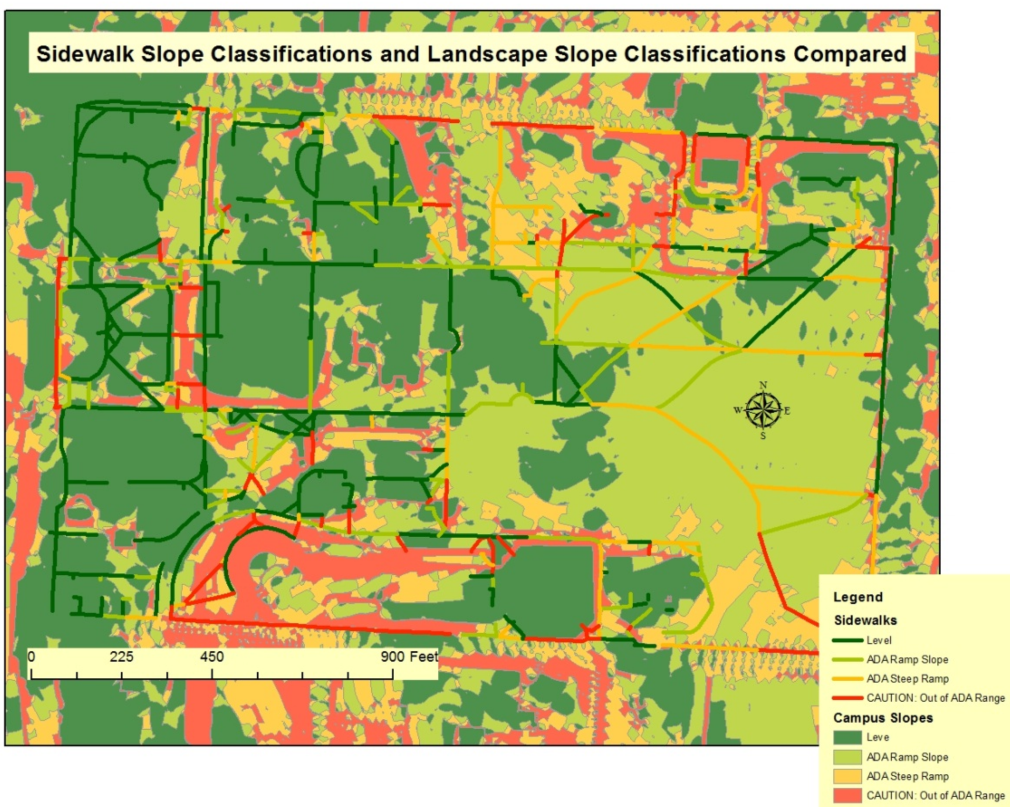


Figure 4.9: Sidewalk Slope Classifications and Landscaper Slope Classifications Compared

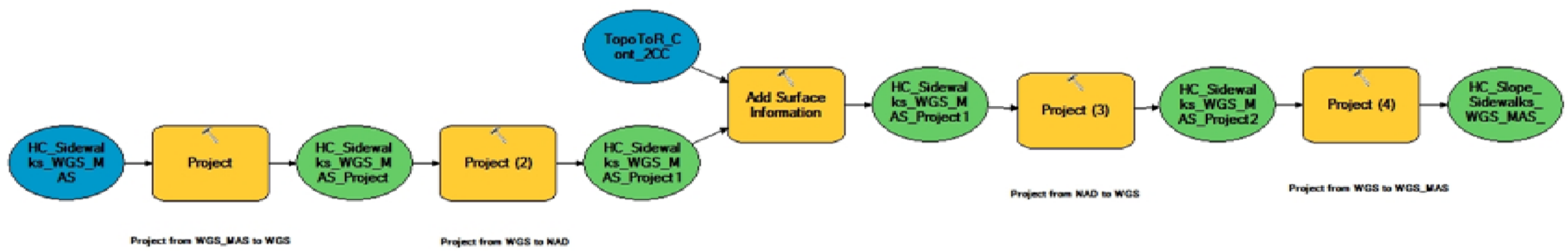


Figure 4.10: Model of Sidewalk Slope Creation Process

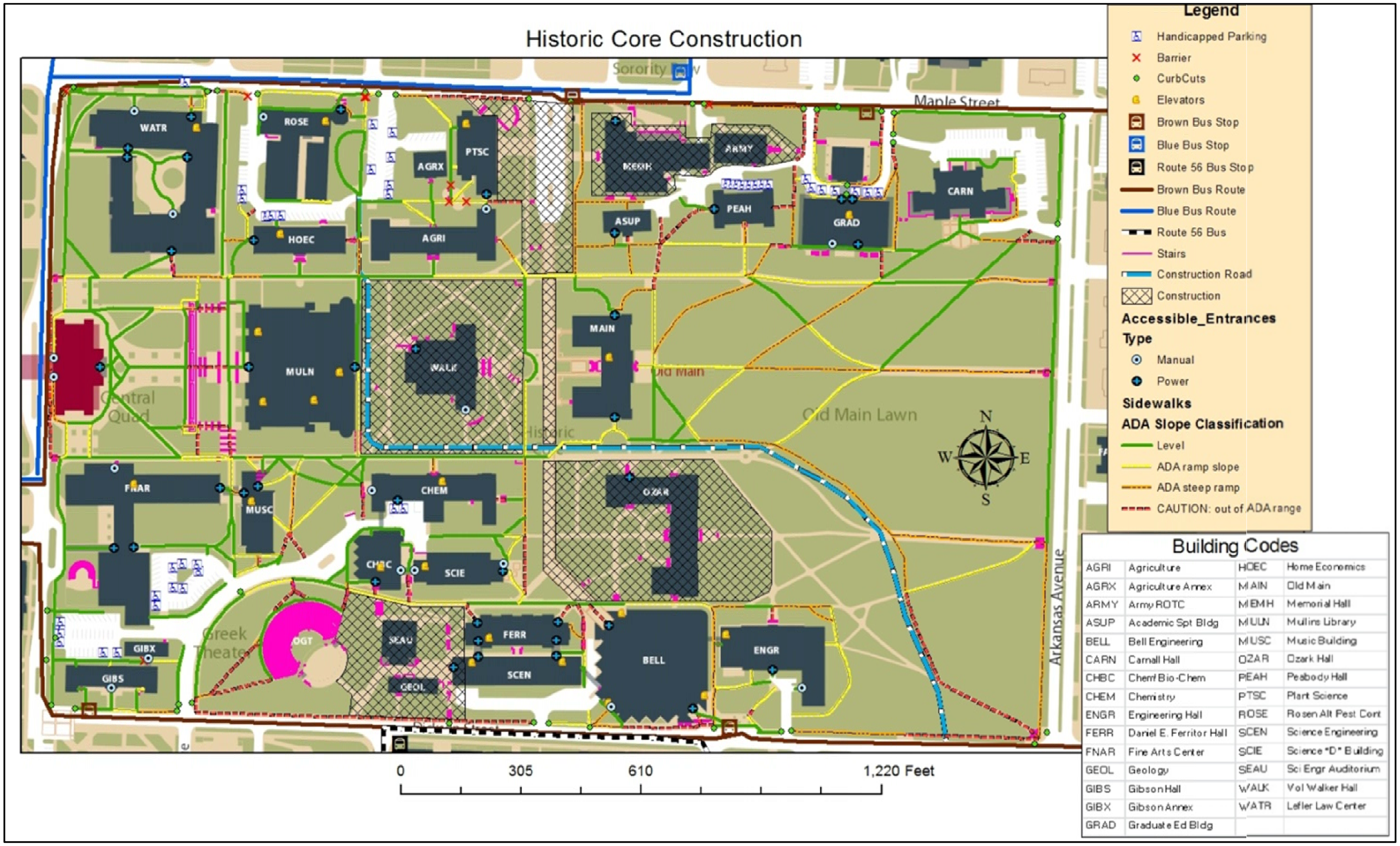


Figure 4.11: Historic Core Construction Map

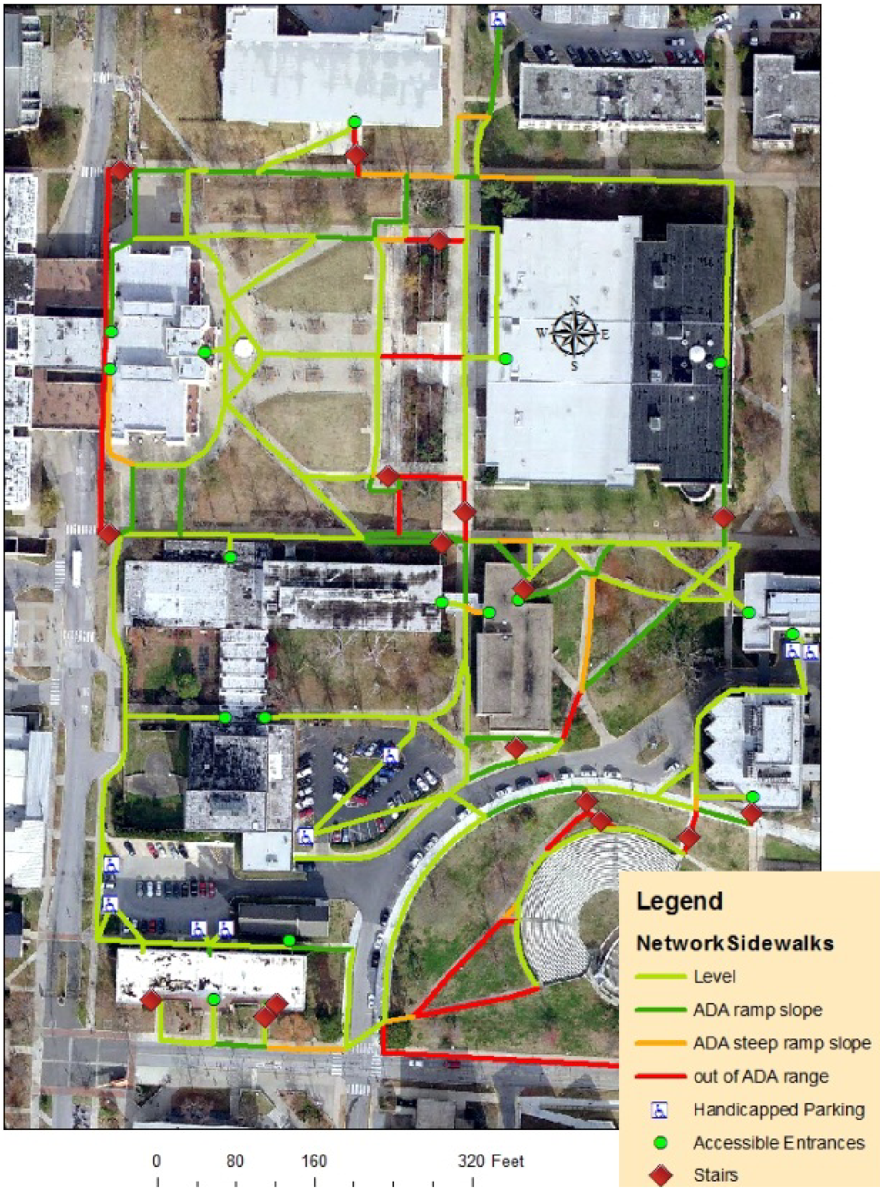


Figure 4.12: Network dataset map

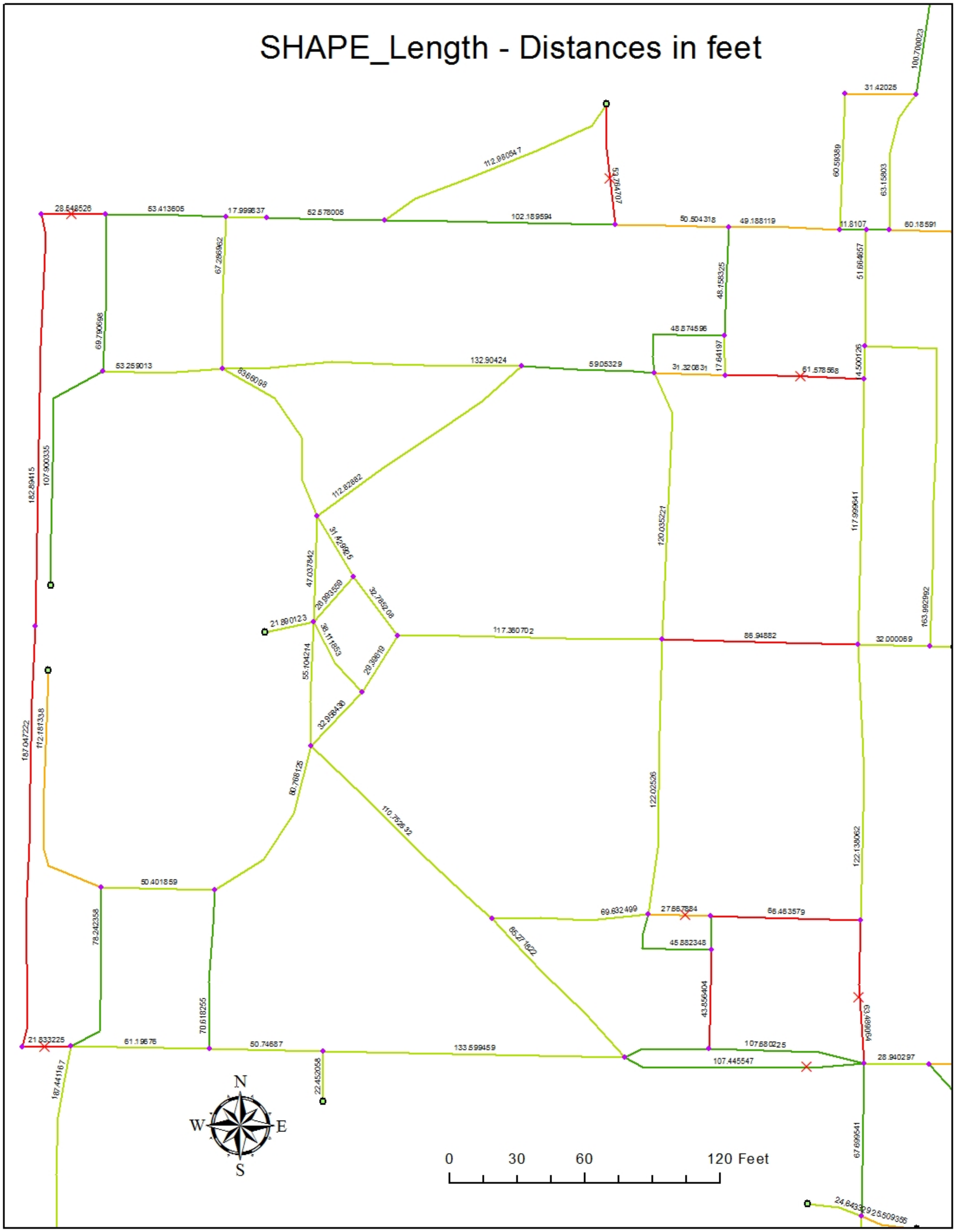


Figure 4.13: Network SHAPE_Length field values

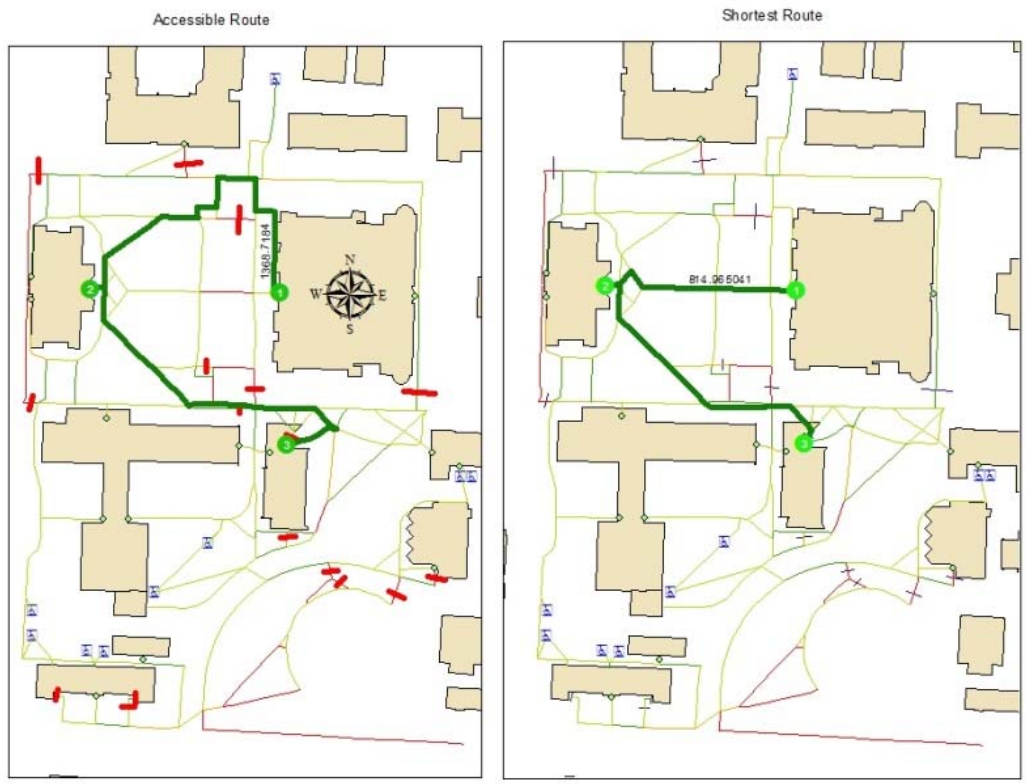


Figure 4.14: Comparison of shortest route with accessible route from Mullins Library to the Music Building

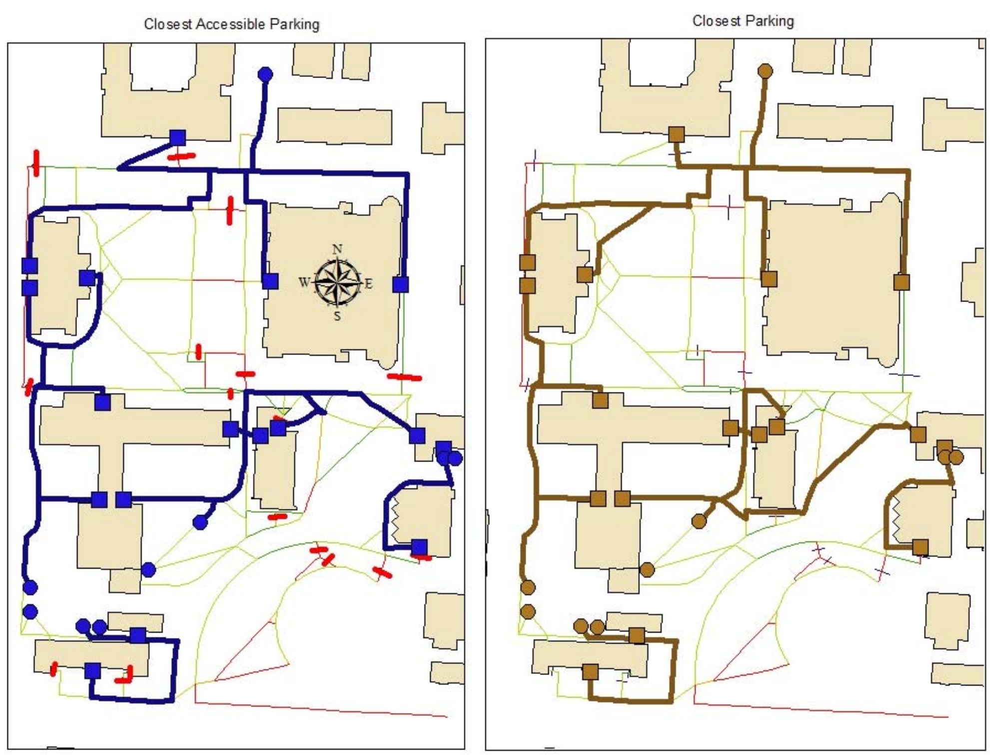


Figure 4.15: Comparison of closest parking and closest accessible parking

8.0 Tables

FEATURE	PDOP	Vert. Precision	67% Error Range
1 – Point 1	4.581	0.712	3.262
2 – Point 2	3.736	0.439	1.640
3 – Line 1 average	3.962	0.754	2.987
3 – Line 1 worst	3.962	1.219	4.830
4 – point 3	1.871	0.057	0.107
5 – Line 2 average	3.867	0.064	0.247
5 – Line 2 worst	3.867	0.091	0.352
6 – Point 4	3.425	0.540	1.850
7 – Point 5	2.447	0.084	0.206
8 – Line 3 average	4.240	0.092	0.390
8 – Line 3 worst	4.240	0.148	0.628
9 – Point 6	1.972	0.117	0.231

Table 4.1: Sixty-seven percent vertical error range for GPS features. Measurements in feet.

Site and Data Type	GPS Slope	Contour Slope	GPS/Contour Difference	ArcMap Slope	GPS/ArcMap Difference	67% Error Range
Gregson Hall Point Data	.259	.248	.011	N/A	N/A	.012
Gregson Hill Line Data	.127	.117	.010	.112	.015	.135
Old Main Point Data	.023	.020	.003	N/A	N/A	.005
Old Main Line Data	.058	.056	.002	.055	.003	.008
Lot 56 Point Data	.007	.007	0	N/A	N/A	.002
Lot 56 Line Data	.009	.008	.001	.008	.001	.007

Table 4.2: DEM, Contour and ArcMap derived slope comparison values

How beneficial would each of the following be with regards to campus navigation?

Scale: 1-7 where 1 = not needed at all; 7 = Major Impact

Improving maps with handicapped parking, entrances, bus stops and optimal routes marked	Improving handicapped parking options	Improving bus stop options and routes	Improving golf cart services	Improving paratransit services	Walking/Transit directions, similar to driving directions, available in text format	Structural changes to buildings and/or sidewalks
5.4136	**5.3302**	**3.876833**	**2.5784**	**2.126**	**3.2478**	**5.5264**

Table 5.1: Survey results with concerning campus improvements for navigation

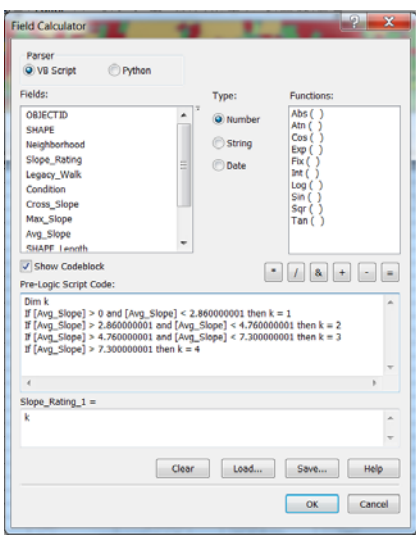
9.0 Appendix A: Coding sidewalks in ArcMap

Four slope classification categories were determined with a code of “1” assigned to slopes below ramp grade, a “2” for slopes that fall within regular ADA ramp guidelines, a “3” for slopes that are allowable for ramps under limited circumstance, and a code of “4” for slopes deemed outside of ADA accessibility. To code individual objects within the sidewalk feature the Field Calculator can be used to populate a new field based on the average slopes derived from the *Add Surface Information* tool. In the Field Calculator dialog box the “Show Codeblock” box must be checked in order to add the following Pre-Logic Script code:

```
Dim k

If [Avg_Slope] > = 0 and [Avg_Slope] < 2.860000001 then k = 1
If [Avg_Slope] > 2.860000001 and [Avg_Slope] < 4.760000001 then k = 2
If [Avg_Slope] > 4.760000001 and [Avg_Slope] < 7.300000001 then k = 3
If [Avg_Slope] > 7.300000001 then k = 4
```

The new field should then equal “k” as shown in the image below:



10.0 Appendix B: Origin-Destination Cost Matrices

Distance Cost Origin-Destination Matrix

OD Distance Cost Matrix					
ObjectID	Name	OriginID	DestinationID	Destination Rank	Total_DistanceFeet
1	GIBS_S - Lot6_Mid	1	2	1	447.556459
2	GIBS_S - Lot6_E	1	1	2	450.146005
3	GIBS_S - Lot6_SW	1	3	3	545.190104
4	GIBS_S - Lot4_SW	1	5	4	665.570395
5	GIBS_S - Lot6_NW	1	4	5	668.676037
6	GIBS_S - Lot4_NE	1	6	6	678.548946
7	GIBS_S - CHEM_Lot_W	1	7	7	896.001461
8	GIBS_S - CHEM_Lot_E	1	9	8	936.379109
9	GIBS_S - Lot7	1	8	9	1324.19413
10	GIBX_S - Lot6_Mid	2	2	1	107.025147
11	GIBX_S - Lot6_E	2	1	2	109.614693
12	GIBX_S - Lot6_SW	2	3	3	204.658792
13	GIBX_S - Lot6_NW	2	4	4	328.144725
14	GIBX_S - Lot4_SW	2	5	5	661.067609
15	GIBX_S - Lot4_NE	2	6	6	674.04616
16	GIBX_S -	2	7	7	891.498675

	CHEM_Lot_W				
17	GIBX_S - CHEM_Lot_E	2	9	8	931.876322
18	GIBX_S - Lot7	2	8	9	1319.691343
19	CHBC_SW - CHEM_Lot_W	3	7	1	302.582026
20	CHBC_SW - CHEM_Lot_E	3	9	2	342.959674
21	CHBC_SW - Lot4_SW	3	5	3	485.020634
22	CHBC_SW - Lot4_NE	3	6	4	497.999185
23	CHBC_SW - Lot6_Mid	3	2	5	830.020647
24	CHBC_SW - Lot6_E	3	1	6	832.610193
25	CHBC_SW - Lot6_SW	3	3	7	927.654292
26	CHBC_SW - Lot6_NW	3	4	8	1051.140225
27	CHBC_SW - Lot7	3	8	9	1143.644368
28	FNAR_W - Lot6_NW	4	4	1	262.445147
29	FNAR_W - Lot6_SW	4	3	2	377.088023
30	FNAR_W - Lot6_Mid	4	2	3	473.347892
31	FNAR_W - Lot6_E	4	1	4	475.937438
32	FNAR_W - Lot4_NE	4	6	5	898.765927
33	FNAR_W - Lot4_SW	4	5	6	1017.014915
34	FNAR_W - Lot7	4	8	7	1104.216615
35	FNAR_W - CHEM_Lot_W	4	7	8	1393.45711
36	FNAR_W - CHEM_Lot_E	4	9	9	1433.834758
37	FNAR_E -	5	6	1	198.699022

	Lot4_NE				
38	FNAR_E - Lot4_SW	5	5	2	316.94801
39	FNAR_E - CHEM_Lot_W	5	7	3	754.972919
40	FNAR_E - CHEM_Lot_E	5	9	4	795.350566
41	FNAR_E - Lot6_Mid	5	2	5	873.747728
42	FNAR_E - Lot6_E	5	1	6	876.337274
43	FNAR_E - Lot7	5	8	7	905.926919
44	FNAR_E - Lot6_SW	5	3	8	971.381374
45	FNAR_E - Lot6_NW	5	4	9	1063.703121
46	CHEM_S - CHEM_Lot_W	6	7	1	15.412788
47	CHEM_S - CHEM_Lot_E	6	9	2	24.964859
48	CHEM_S - Lot4_SW	6	5	3	652.413806
49	CHEM_S - Lot4_NE	6	6	4	665.392357
50	CHEM_S - Lot6_Mid	6	2	5	1001.619682
ObjectID	Name	OriginID	DestinationID	DestinationRank	Total_DistanceFeet
51	CHEM_S - Lot6_E	6	1	6	1004.209228
52	CHEM_S - Lot6_SW	6	3	7	1099.253328
53	CHEM_S - Lot6_NW	6	4	8	1222.73926
54	CHEM_S - Lot7	6	8	9	1311.037541
55	MUSC_W - Lot4_NE	7	6	1	214.895286
56	MUSC_W - Lot4_SW	7	5	2	333.144274
57	MUSC_W -	7	8	3	637.056992

	Lot7				
58	MUSC_W - CHEM_Lot_W	7	7	4	709.586469
59	MUSC_W - CHEM_Lot_E	7	9	5	749.964117
60	MUSC_W - Lot6_NW	7	4	6	794.833195
61	MUSC_W - Lot6_Mid	7	2	7	828.361279
62	MUSC_W - Lot6_E	7	1	8	830.950825
63	MUSC_W - Lot6_SW	7	3	9	909.476071
64	CHEM_W - Lot4_NE	8	6	1	490.266541
65	CHEM_W - Lot4_SW	8	5	2	549.447274
66	CHEM_W - Lot7	8	8	3	854.583133
67	CHEM_W - CHEM_Lot_W	8	7	4	883.86981
68	CHEM_W - CHEM_Lot_E	8	9	5	924.247457
69	CHEM_W - Lot6_Mid	8	2	6	1002.64462
70	CHEM_W - Lot6_E	8	1	7	1005.234166
71	CHEM_W - Lot6_NW	8	4	8	1012.359335
72	CHEM_W - Lot6_SW	8	3	9	1100.278265
73	FNAR_NE - Lot4_NE	9	6	1	214.029261
74	FNAR_NE - Lot4_SW	9	5	2	332.278249
75	FNAR_NE - Lot7	9	8	3	636.190967
76	FNAR_NE - CHEM_Lot_W	9	7	4	708.720444
77	FNAR_NE -	9	9	5	749.098091

	CHEM_Lot_E				
78	FNAR_NE - Lot6_NW	9	4	6	793.967169
79	FNAR_NE - Lot6_Mid	9	2	7	827.495254
80	FNAR_NE - Lot6_E	9	1	8	830.0848
81	FNAR_NE - Lot6_SW	9	3	9	908.610045
82	MUSC_NE - Lot4_NE	10	6	1	362.652689
83	MUSC_NE - Lot4_SW	10	5	2	480.901677
84	MUSC_NE - Lot7	10	8	3	649.415314
85	MUSC_NE - Lot6_NW	10	4	4	807.191516
86	MUSC_NE - CHEM_Lot_W	10	7	5	857.343873
87	MUSC_NE - CHEM_Lot_E	10	9	6	897.72152
88	MUSC_NE - Lot6_SW	10	3	7	921.834392
89	MUSC_NE - Lot6_Mid	10	2	8	976.118682
90	MUSC_NE - Lot6_E	10	1	9	978.708228
91	FNAR_N - Lot6_NW	11	4	1	483.031351
92	FNAR_N - Lot4_NE	11	6	2	520.582537
93	FNAR_N - Lot6_SW	11	3	3	597.674227
94	FNAR_N - Lot4_SW	11	5	4	638.831525
95	FNAR_N - Lot6_Mid	11	2	5	693.934097
96	FNAR_N - Lot6_E	11	1	6	696.523643
97	FNAR_N - Lot7	11	8	7	807.345161

ObjectID	Name	OriginID	DestinationID	DestinationRank	Total_DistanceFeet
98	FNAR_N - CHEM_Lot_W	11	7	8	1015.27372
99	FNAR_N - CHEM_Lot_E	11	9	9	1055.651367
100	ARKU_SW - Lot6_NW	12	4	1	539.059359
101	ARKU_SW - Lot6_SW	12	3	2	653.702235
102	ARKU_SW - Lot6_Mid	12	2	3	749.962105
103	ARKU_SW - Lot6_E	12	1	4	752.551651
104	ARKU_SW - Lot4_NE	12	6	5	782.0788
ObjectID	Name	OriginID	DestinationID	DestinationRank	Total_DistanceFeet
105	ARKU_SW - Lot7	12	8	6	849.463776
106	ARKU_SW - Lot4_SW	12	5	7	900.327788
107	ARKU_SW - CHEM_Lot_W	12	7	8	1276.769983
108	ARKU_SW - CHEM_Lot_E	12	9	9	1317.14763
109	MULN_E - Lot7	13	8	1	611.802106
110	MULN_E - Lot4_NE	13	6	2	706.133081
111	MULN_E - Lot4_SW	13	5	3	791.06303
112	MULN_E - CHEM_Lot_W	13	7	4	1125.485567
113	MULN_E - Lot6_NW	13	4	5	1150.671908
114	MULN_E - CHEM_Lot_E	13	9	6	1165.863214
115	MULN_E - Lot6_Mid	13	2	7	1244.260377
116	MULN_E - Lot6_E	13	1	8	1246.849922
117	MULN_E -	13	3	9	1265.314784

	Lot6_SW				
118	MULN_W - Lot7	14	8	1	400.506029
119	MULN_W - Lot4_NE	14	6	2	485.5045
120	MULN_W - Lot4_SW	14	5	3	603.753488
121	MULN_W - Lot6_NW	14	4	4	867.504056
122	MULN_W - CHEM_Lot_W	14	7	5	980.195684
123	MULN_W - Lot6_SW	14	3	6	982.146932
124	MULN_W - CHEM_Lot_E	14	9	7	1020.573331
125	MULN_W - Lot6_Mid	14	2	8	1078.406801
126	MULN_W - Lot6_E	14	1	9	1080.996347
127	ARKU_E - Lot7	15	8	1	572.898363
128	ARKU_E - Lot6_NW	15	4	2	635.042342
129	ARKU_E - Lot4_NE	15	6	3	637.549811
130	ARKU_E - Lot6_SW	15	3	4	749.685219
131	ARKU_E - Lot4_SW	15	5	5	755.798798
132	ARKU_E - Lot6_Mid	15	2	6	845.945088
133	ARKU_E - Lot6_E	15	1	7	848.534634
134	ARKU_E - CHEM_Lot_W	15	7	8	1132.240994
135	ARKU_E - CHEM_Lot_E	15	9	9	1172.618641
136	ARKU_NW - Lot7	16	8	1	685.205166
137	ARKU_NW - Lot6_NW	16	4	2	905.010391

138	ARKU_NW - Lot4_NE	16	6	3	907.517859
139	ARKU_NW - Lot6_SW	16	3	4	1019.653267
140	ARKU_NW - Lot4_SW	16	5	5	1025.766847
141	ARKU_NW - Lot6_Mid	16	2	6	1115.913136
142	ARKU_NW - Lot6_E	16	1	7	1118.502682
143	ARKU_NW - CHEM_Lot_W	16	7	8	1402.209042
144	ARKU_NW - CHEM_Lot_E	16	9	9	1442.58669
145	WATR_S - Lot7	17	8	1	339.324391
146	WATR_S - Lot4_NE	17	6	2	792.144866
147	WATR_S - Lot4_SW	17	5	3	910.393854
148	WATR_S - Lot6_NW	17	4	4	994.696393
149	WATR_S - Lot6_SW	17	3	5	1109.339269
150	WATR_S - Lot6_Mid	17	2	6	1205.599138
151	WATR_S - Lot6_E	17	1	7	1208.188684
152	WATR_S - CHEM_Lot_W	17	7	8	1286.83605
153	WATR_S - CHEM_Lot_E	17	9	9	1327.213697

Slope Cost Origin-Destination Matrix

Slope Cost OD Matrix					
ObjectID	Name	OriginID	Destination ID	Destination Rank	Total_SlopeDistance
1	GIBS_S - Lot6_Mid	1	2	1	518.165906
2	GIBS_S - Lot6_E	1	1	2	520.755452
3	GIBS_S - Lot6_SW	1	3	3	615.799551
4	GIBS_S - Lot4_SW	1	5	4	719.843611
5	GIBS_S - Lot4_NE	1	6	5	732.822162
6	GIBS_S - Lot6_NW	1	4	6	739.285484
7	GIBS_S - CHEM_Lot_W	1	7	7	994.12284
8	GIBS_S - CHEM_Lot_E	1	9	8	1034.500487
9	GIBS_S - Lot7	1	8	9	1797.961264
10	GIBX_S - Lot6_Mid	2	2	1	107.025147
11	GIBX_S - Lot6_E	2	1	2	109.614693
12	GIBX_S - Lot6_SW	2	3	3	204.658792
13	GIBX_S - Lot6_NW	2	4	4	328.144725
14	GIBX_S - Lot4_SW	2	5	5	677.40384
15	GIBX_S - Lot4_NE	2	6	6	690.382391
16	GIBX_S - CHEM_Lot_W	2	7	7	951.683069
17	GIBX_S - CHEM_Lot_E	2	9	8	992.060716
18	GIBX_S - Lot7	2	8	9	1554.853937
19	CHBC_SW - CHEM_Lot_W	3	7	1	302.582026
20	CHBC_SW - CHEM_Lot_E	3	9	2	342.959674
21	CHBC_SW -	3	5	3	516.995768

	Lot4_SW				
22	CHBC_SW - Lot4_NE	3	6	4	529.974319
23	CHBC_SW - Lot6_Mid	3	2	5	900.161234
24	CHBC_SW - Lot6_E	3	1	6	902.750779
25	CHBC_SW - Lot6_SW	3	3	7	997.794879
26	CHBC_SW - Lot6_NW	3	4	8	1121.280811
27	CHBC_SW - Lot7	3	8	9	1595.113421
28	FNAR_W - Lot6_NW	4	4	1	262.445147
29	FNAR_W - Lot6_SW	4	3	2	377.088023
30	FNAR_W - Lot6_Mid	4	2	3	473.347892
31	FNAR_W - Lot6_E	4	1	4	475.937438
32	FNAR_W - Lot4_NE	4	6	5	942.845547
33	FNAR_W - Lot4_SW	4	5	6	1061.094535
34	FNAR_W - Lot7	4	8	7	1218.070121
35	FNAR_W - CHEM_Lot_W	4	7	8	1466.9957
36	FNAR_W - CHEM_Lot_E	4	9	9	1507.373347
37	FNAR_E - Lot4_NE	5	6	1	198.699022
38	FNAR_E - Lot4_SW	5	5	2	316.94801
39	FNAR_E - CHEM_Lot_W	5	7	3	781.197723
40	FNAR_E - CHEM_Lot_E	5	9	4	821.57537
41	FNAR_E - Lot6_Mid	5	2	5	890.08396
42	FNAR_E - Lot6_E	5	1	6	892.673506
43	FNAR_E -	5	3	7	987.717605

	Lot6_SW				
44	FNAR_E - Lot6_NW	5	4	8	1107.782741
45	FNAR_E - Lot7	5	8	9	1322.186673
46	CHEM_S - CHEM_Lot_W	6	7	1	15.412788
47	CHEM_S - CHEM_Lot_E	6	9	2	24.964859
48	CHEM_S - Lot4_SW	6	5	3	678.63861
49	CHEM_S - Lot4_NE	6	6	4	691.617161
50	CHEM_S - Lot6_Mid	6	2	5	1061.804076
51	CHEM_S - Lot6_E	6	1	6	1064.393622

ObjectID	Name	OriginID	DestinationID	DestinationRank	Total_SlopeDistance
53	CHEM_S - Lot6_NW	6	4	8	1282.923654
54	CHEM_S - Lot7	6	8	9	1756.756264
55	MUSC_W - Lot4_NE	7	6	1	227.649963
56	MUSC_W - Lot4_SW	7	5	2	345.898951
57	MUSC_W - CHEM_Lot_W	7	7	3	751.800116
58	MUSC_W - CHEM_Lot_E	7	9	4	792.177763
59	MUSC_W - Lot6_NW	7	4	5	851.667492
60	MUSC_W - Lot6_Mid	7	2	6	860.686353
61	MUSC_W - Lot6_E	7	1	7	863.275899
62	MUSC_W - Lot6_SW	7	3	8	958.319998
63	MUSC_W - Lot7	7	8	9	1066.071424
64	CHEM_W - Lot4_NE	8	6	1	602.451403
65	CHEM_W - Lot4_SW	8	5	2	720.70039

66	CHEM_W - Lot6_NW	8	4	3	1057.220079
67	CHEM_W - CHEM_Lot_W	8	7	4	1126.601555
68	CHEM_W - CHEM_Lot_E	8	9	5	1166.979203
69	CHEM_W - Lot6_SW	8	3	6	1171.862955
70	CHEM_W - Lot6_Mid	8	2	7	1235.487792
71	CHEM_W - Lot6_E	8	1	8	1238.077338
72	CHEM_W - Lot7	8	8	9	1271.624011
73	FNAR_NE - Lot4_NE	9	6	1	214.029261
74	FNAR_NE - Lot4_SW	9	5	2	332.278249
75	FNAR_NE - CHEM_Lot_W	9	7	3	738.179414
76	FNAR_NE - CHEM_Lot_E	9	9	4	778.557061
77	FNAR_NE - Lot6_NW	9	4	5	838.046789
78	FNAR_NE - Lot6_Mid	9	2	6	847.065651
79	FNAR_NE - Lot6_E	9	1	7	849.655196
80	FNAR_NE - Lot6_SW	9	3	8	944.699296
81	FNAR_NE - Lot7	9	8	9	1052.450721
82	MUSC_NE - Lot4_NE	10	6	1	543.31104
83	MUSC_NE - Lot4_SW	10	5	2	661.560028
84	MUSC_NE - Lot6_NW	10	4	3	998.079716
85	MUSC_NE - CHEM_Lot_W	10	7	4	1067.461193
86	MUSC_NE - CHEM_Lot_E	10	9	5	1107.83884

87	MUSC_NE - Lot6_SW	10	3	6	1112.722592
88	MUSC_NE - Lot6_Mid	10	2	7	1176.34743
89	MUSC_NE - Lot6_E	10	1	8	1178.936975
90	MUSC_NE - Lot7	10	8	9	1212.483648
91	FNAR_N - Lot6_NW	11	4	1	483.031351
92	FNAR_N - Lot4_NE	11	6	2	564.662157
93	FNAR_N - Lot6_SW	11	3	3	597.674227
94	FNAR_N - Lot4_SW	11	5	4	682.911144
95	FNAR_N - Lot6_Mid	11	2	5	693.934097
96	FNAR_N - Lot6_E	11	1	6	696.523643
97	FNAR_N - Lot7	11	8	7	942.645241
98	FNAR_N - CHEM_Lot_W	11	7	8	1088.812309
99	FNAR_N - CHEM_Lot_E	11	9	9	1129.189957
100	ARKU_SW - Lot6_NW	12	4	1	614.710618
101	ARKU_SW - Lot6_SW	12	3	2	729.353494
102	ARKU_SW - Lot6_Mid	12	2	3	825.613364
103	ARKU_SW - Lot6_E	12	1	4	828.202909
104	ARKU_SW - Lot4_NE	12	6	5	899.903652
105	ARKU_SW - Lot7	12	8	6	999.847361
106	ARKU_SW - Lot4_SW	12	5	7	1018.15264
ObjectID	Name	OriginID	DestinationID	DestinationRank	Total_SlopeDistance
107	ARKU_SW - CHEM_Lot_W	12	7	8	1424.053805

108	ARKU_SW - CHEM_Lot_E	12	9	9	1464.431452
109	MULN_E - Lot7	13	8	1	667.070066
110	MULN_E - Lot4_NE	13	6	2	1506.197273
111	MULN_E - Lot6_NW	13	4	3	1567.017915
112	MULN_E - Lot4_SW	13	5	4	1624.44626
113	MULN_E - Lot6_SW	13	3	5	1681.660791
114	MULN_E - Lot6_Mid	13	2	6	1777.92066
115	MULN_E - Lot6_E	13	1	7	1780.510206
116	MULN_E - CHEM_Lot_W	13	7	8	2030.347425
117	MULN_E - CHEM_Lot_E	13	9	9	2070.725073
118	MULN_W - Lot7	14	8	1	428.230658
119	MULN_W - Lot4_NE	14	6	2	1241.861629
120	MULN_W - Lot6_NW	14	4	3	1302.682271
121	MULN_W - Lot4_SW	14	5	4	1360.110617
122	MULN_W - Lot6_SW	14	3	5	1417.325147
123	MULN_W - Lot6_Mid	14	2	6	1513.585017
124	MULN_W - Lot6_E	14	1	7	1516.174563
125	MULN_W - CHEM_Lot_W	14	7	8	1766.011782
126	MULN_W - CHEM_Lot_E	14	9	9	1806.389429
127	ARKU_E - Lot6_NW	15	4	1	654.602932
128	ARKU_E - Lot7	15	8	2	667.191279
129	ARKU_E - Lot4_NE	15	6	3	681.629431

130	ARKU_E - Lot6_SW	15	3	4	769.245808
131	ARKU_E - Lot4_SW	15	5	5	799.878418
132	ARKU_E - Lot6_Mid	15	2	6	865.505678
133	ARKU_E - Lot6_E	15	1	7	868.095224
134	ARKU_E - CHEM_Lot_W	15	7	8	1205.779583
135	ARKU_E - CHEM_Lot_E	15	9	9	1246.15723
136	ARKU_NW - Lot7	16	8	1	806.473167
137	ARKU_NW - Lot6_NW	16	4	2	951.546064
138	ARKU_NW - Lot4_NE	16	6	3	978.572563
139	ARKU_NW - Lot6_SW	16	3	4	1066.18894
140	ARKU_NW - Lot4_SW	16	5	5	1096.82155
141	ARKU_NW - Lot6_Mid	16	2	6	1162.44881
142	ARKU_NW - Lot6_E	16	1	7	1165.038356
143	ARKU_NW - CHEM_Lot_W	16	7	8	1502.722715
144	ARKU_NW - CHEM_Lot_E	16	9	9	1543.100363
145	WATR_S - Lot7	17	8	1	606.800747
146	WATR_S - Lot6_NW	17	4	2	1027.401483
147	WATR_S - Lot4_NE	17	6	3	1054.427982
148	WATR_S - Lot6_SW	17	3	4	1142.044359
149	WATR_S - Lot4_SW	17	5	5	1172.67697
150	WATR_S - Lot6_Mid	17	2	6	1238.304229
151	WATR_S - Lot6_E	17	1	7	1240.893775

152	WATR_S - CHEM_Lot_W	17	7	8	1578.578135
153	WATR_S - CHEM_Lot_E	17	9	9	1618.955782

11.0 Appendix C: Survey Results

Survey Comments and Suggestions

- More signs to direct people are needed. Elevators in older buildings are not retrofitted optimally (e.g. Memorial Hall; elevator is not readily accessible from the second floor)
- Parking SUCKS on campus
- I have little or no issues as a result of my disability. I registered with the CEA because at times I do need ankle braces and it is a little tougher to get around in them. It's nothing unmanageable though. However, for others sakes I think some more ramps would be beneficial.
- AGRI and PTSC share a single elevator, on the far end of PTSC. If you have a class upstairs in AGRI, you have to walk to the far end of PTSC, ride up, then walk back the length of two buildings. It can be both exhausting and very time-consuming -- there's no way I can do that in the ten minutes between class slots, and a golf cart can't help in this case. / For getting from one part of campus to another, maybe there could be a regular golf cart circuit where you can just hop on / hop off; can get a cart even if you didn't know in advance you'd be needing it, and that you don't have to specifically arrange in advance. Like a little tram system, but with carts. And put a little CEA logo on our IDs so that the drivers can do a quick check to prevent abuse of the service. / Finally, there's just way too little handicapped parking. Right away, I adopted the habit of getting to campus at least an hour early, so that I had time to circle around and find somewhere to park. Yes, I could also park in any other lot if a handicapped space wasn't available, and that was an okay backup, but when I had a lot of weight to carry with me -- like a filled wooden plant press, plus all my books -- I was

wrecked after carrying all of that from near the child care center, to the 4th floor of biological sciences. I am sure the university gets some nice income from having reserved parking spaces right up next to the buildings, but given how hard it often is to find a handicapped spot, I believe that twice as many of those super-close spots need to be designated for the handicapped.

- The entire campus needs to be ADA compliant and there needs to be more service provided to those with disablities, such as wheelchair bound folks, and people like me with severe asthma.
- Maintance and service vehicles need to be restricted from parking in drives that block access to handicaped parking and drop off zones. I have been on campus for two semesters, two days a week, and there has never been a week when I did not face challenges finding handicapped parking or drop off. The vehicles are blocking the drive to the building and several times, I could not see the block until I was already in the drive. That meant that I had to back onto Maple, very unsafe. There are no signs on the sidewalk to direct students to buildings and the student center is a nightmare for somebody with mobility issues. The elevators are not marked as to which ones will lead to what offices. I have to allow an extra 10 to 15 minutes to get to the ACCESS office.
- My impairment is multiple... I have severePAD and spinal stenosis and can not walk veery foar or up hills and steps very well,especially if carrying a bag of nbooks. I am almost deaf. The hearing transmitters and around the neck receivers that workinto hearing aids perform poorly. A head-mike that stays in front of the mouth is needed. The batteries drain RAPIDLY. / Ask maintenance to put hooks in the restroom stalls so wa can hang up jaclets and sweaters insread of dropping them on the floor. The hooks keep being taken or broken.

This needs to be a weekly check .

- Much more handicapped parking at locations close to buildings.
- for non trational students who have to travel to campus, they should get a discount on the parking grages since all the on campus students fill up the off campus spots, yet off campus students can not park in on campus spots. therefor if off campus students had a discount on the parking grages they would be less stressed about finding a spot to park there car. also if you send as much as the u of a charges for a deck pass, you should be able to park in any of the parking grages, not just one of them.
- How is it that some buildings still do not have elevators??!!! Outrageous!!! And why do people with bona fide, documented disabilities struggle to walk across campus while the carts sit unused? Ridiculous.
- while I am not physically handycapped I have several friends that are and the side walks are horrable for them / many places have to be navagated around the entire building or you have to go into the road / for example the sidewalk between jb hunt and kimbel there is an ally road between the two building and the side walk is too steep with not wheelchair access, this is also the case at the physics building loading area threre is a ramp but no way to get on it or off it, there are several other places but these are the bigest ive seen / moreover there are a couple of quadropeledics on campus who have to use a mouth stick to open doors this is wrong there should be a pressure sensor at at least one door on each side of the building.
- The entire campus being on a large hill poses constant difficulties navigating around campus in a wheelchair. More handicap parking close to buildings would be a big help.
- My disability is High Functioning Autism and I have a problem with social issues with

reciprocal interaction, so I struggle with making friends because I come on to heavy on campus.

- Make sidewalks level. no bumbs or dips in going up and down. And improve handicap parking. Too many non-handicap persons park in handicap spots, including some able professors.
- Improvement it much needed. Allow scooters to drive under the union. Allow scooters to go "the wrong way" down the one way by pat walker, going all the way around cam us is really annoying and inconvenient. Also more scooter parking would be helpful!
- I half of the time never get a note taker and when I do, they never send me the note. I have such a hard time with math, I am going to have to look into other options like taking it somewhere else?
- COME TOGETHER AS ONE VOICE.
- My bus route helps out so much so I do not have to pay for park, etc.
- fix the sidewals!!!!!!!!!!
- It would be VERY VERY helpful if U of A would help sponsor ozark regional transit to have an early bus coming from bentonville rogers to arrive around 730 am and a late bus going the other way after evening classes.

Survey Advise for Navigating Campus

- Many people did not know that the disabilities office could transport you if you had a broken leg or foot. I would tell them to contact this office to make arrangements if they are ever in that situation.

- Be sure to get a Parkin pass or you will for sure get a TICkET
- I'd tell others that it's okay to ask for assistance.
- Always get there an hour early if you need to park. Register with CEA to get your books in electronic format so that you don't have to haul as much weight with you. Take advantage of CEA early registration priority, to schedule your courses in physically-friendly arrangements (and if you can, plan your semesters so that you're taking courses physically close together; and if you do have to jet across campus, arrange a golf cart from CEA).
- Avoid scheduling classes long distances apart, you will never make it on time. And avoid the hills if at all possible, they are treacherous to navigate.
- Do as much by phone as possible and map out in advance the routes you need to take to get to the various buildings. Find a good map of the sidewalks, which I have not been able to find.
- Walk carefully, don't try to go over curbs, lookfor the ramp. Some ramps are not too good, especially at curbs. / / Handicap poeple needto be able to park in any space besides having the Handicap only space. I see TOO. TOO many physically able young healthy students using handicapped spaces. The campus policeneed to be able to challenge anyone parking in handicappedspaces to show they are THE HOLDERS OF THE HANDICAPPED PERMIT by showing the DRs. orders. I think many students are using their parents handicapped permit to get a parking spot.
- If you have trouble with mobility then consider finding another campus to attend. This campus is not friendly to people with mobility issues.
- get ready for lots of walking

- Improve paratransit services...they could do a much better job scheduling rides. Utilize the carts, and not just for people with temporary mobility issues. And for goodness sakes, make all floors of all buildings accessible to persons with disabilities.
- Look at the map
- if your physically handycapped avoid certain building and sidewalks
- Use bus routes as much as possible whenever handicap parking isn't available or during times when handicap parking is usually full. Use golf cart services and other such services if getting around campus proves too much for your stamina or abilities.
- Having them protest for better ramps and more ramps easily accessible for those with physical disabilities and those that also have motorized wheelchairs.
- Always give yourself time between classes when registering if they are in different buildings.
- Get a scooter if you have difficulty getting around but are not confined to a wheelchair
- Use Old Main or the Union as a reference point. Old Main has a north and south tower to help. And also just become familiar with the names of buildings and/or what they are used for.
- Have a UofA planner or something with a map of the campus in a backpack
- The buses are very helpful to off campus students.
- plan an hour or so between stuff if you plan to take the bus
- Allow plenty of time to walk long distances if one is lucky enough to find a parking spot. Long walks are lovely , but are anxiety producing when trying to be punctual. /

/ Students walking between classes should stay on the sidewalks or in crossroads. jaywalking and walking in the streets provides added aggravation to drivers with disabilities.