ABSTRACT

PIPPI, LUIS GUILHERME AITA. Social Network Interaction and Behaviors on Recreational Greenways and Their Role in Enhancing Greenway Potential. (Under the direction of Professor Arthur Rice).

The urban sprawl, landscape transformation and fragmentation, spatial inequality, gentrification, social fragmentation and isolation have contributed to societal changes in terms of social contact, physical activity and contact with nature. The crux of the problem lies either in the lack of landscape and urban planning which takes into consideration both environmental and social issues, or in the non-implementation of such planning. Recreational greenways have the potential to mitigate these problems, because they connect the landscape systems with human society. They represent a resilient, new and effective democratic space in the urban and suburban areas that provide a myriad of functions: environmental, social, leisure, recreation and tourism. The greenway characteristics can connect people, landscapes and places thus enabling physical environment conditions that allow the occurrence of social ties, bridges and interactions among users and actors. However, many scholars have confirmed the necessity of more greenway studies that deal with social factors such as interaction, social ties and bridges and behavior. To understand the recreational greenways it is important to recognize the social life linked to them by understanding the relationship between greenway characteristics, social interactions and behaviors. These aspects are crucial to enhance the efficacy of such ecological networks.

The main purpose of this study is to describe the social interaction that arises from the greenway environments, by analyzing the different types of social tie and bridge interactions that take place on the recreational greenways. The study hypothesized that recreational greenways create an environment that fosters social networks within the community, which affect and are affected by social interaction, behavior, ties/bridges and cohesion. The type of greenway characteristics may influence the type of user, type of actor, pattern of use and behavior, promoting social integration to differing degrees and among different types of people.

Two greenway case studies with the highest volume of use in Cary, NC, were selected in an attempt to provide vital information regarding the capacity of recreational greenways to

create and promote social interaction. Multi-methods were utilized, including greenway characteristics audit, social characteristic audit, behavior mapping, standardized survey questionnaire and mapping exercise. This protocol was effective for analyzing interaction, behavior and social ties and bridges on recreational greenways and to understand the relationship between the social network aspects and the greenway characteristics. The data were analyzed with GIS and the use of descriptive statistics and data mining analysis, including decision tree, clustering and regression for complex and large data sets, to present the quantitative and qualitative data that were analyzed to test the research hypotheses and assumptions.

The results provided positive insights in terms of correlation of different greenway characteristics and different social network features. The greenway has the potential to bring people together as it provides a matrix of inner and intra interactions between users and actors. The study revealed that people tend to utilize the greenways for socialization pursuits with different types and levels, and may contribute to the development of successful greenway physical environments to promote the positive social network interaction and behaviors. The greenway structural network connection and features when well-designed contribute to social events and contacts, enhancing the quality of life and well-being of its residents. The findings provided useful knowledge for the development of new design norms and to find alternatives that encourage and support social integration and have an impact on social networks and connections, promoting the essential conditions for the establishment of social capital, gathering, lingering and social tie/bridge interactions. The results of this study provided some useful directions for the design guidelines of successful greenways with more functional and efficient characteristics.

Social Network Interaction and Behaviors on Recreational Greenways and Their Role in Enhancing Greenway Potential

by
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DEDICATION

This dissertation id dedicated to my loving and wonderful family: my wife Amy Graham, my daughter Sofia Alana, my sons Nicolas Graham and Luca Sebastian, my father Ney Luis, my mother Ana Maria, my brother Luis Fernando, my sister Ana Luisa and my sister-in-law Cris Bossoni and the rest of my big Italian-Brazilian family and my American family. Your, love, support, company, help, confidence, care and patience encouraged me to keep working and get through this 4 years of intensive study, dedication and sacrifice. Thank you for everything, especially for your tolerance during my bad days, my bad moods and for forgiving me for all the moments of my absence. I did this for you, to grow in my job career as a Designer professor and researcher and to provide us a better life in the future.

The dissertation is also dedicated to all greenway lovers: users, actors, planners, designers and researchers.

BIOGRAPHY

Luis Guilherme Aita Pippi was born on April, 10, 1972 in Santa Maria, Rio Grande do Sul, Brazil. He graduated from high school in Santa Maria, RGS. He completed 6 years of professional internship. This included architectural and landscape architectural work at two municipal government agencies: at the Secretary of the Environment (SMAM) of Porto Alegre, he worked with the supervision and design of public parks and squares, while at the Muncipal Secretary of Health and Social Service of Porto Alegre, he worked with the design of hospitals and community centers. In addition, he worked in the private sector (Takeda Architects and Associates). He received a Bachelor's degree in Architecture and Urbanism from Faculdade Integradas do Instituto Ritter dos Reis, in Porto Alegre, in Brazil in 2001. In 2004, he received a Master's Degree in Architecture and Urbanism from Universidade Federal de Santa Catarina (UFSC), in Florianópolis, Brazil. The focus area for the Master's degree was Landscape Planning and Urban Design. In 2004 he started his academic and professional career as a substitute full-time professor in the Department of Architecture and Urbanism at the Universidade Federal de Santa Maria (UFSM), SM, RGS, Brazil and at a private university: Centro Universitário Franciscano, UNIFRA. In 2004, he concluded a short-term course in Environmental Projects at UFSM, Santa Maria, Brazil, and completed several residential architectural and landscape projects. In 2005, he became an Assistant Professor at the Course of Architecture and Urbanism of the Federal University of Santa Maria (UFSM), in Brazil, a position he holds to the present moment, where he works teaching undergraduate level courses, advises students on final undergraduate projects, conduct research projects, extension projects and institutional projects in the fields of architecture, urban design and landscape architecture. Since 2006, he began to work on the national landscape architecture research project: QUAPÁ-SEL, FAUUSP (study of the Contemporary Open Space Systems in the Brazilian cities), as researcher member and coordinator of the Santa Maria nucleus at UFSM. During his participation in the PhD Program at the College of Design, NCSU, he has presented at numerous conferences and had papers published in the proceedings of the IFLA, EDRA, ENEPEA-Brazil and Revista Paisagem e Ambiente-Brazil. In 2013 he graduated in the Course in Geographic Information

Systems at the North Carolina State University, NCSU, Raleigh, NC, USA. He has experience in Architecture and Urbanism, focusing on project of architecture and urbanism, acting on the following subjects: architecture, urbanism and landscape planning and projects. He intends to continue his research in this field, especially in the study of landscape planning and public and private open spaces.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.1. Problem

In the twentieth century, new configurations of urban occupation have brought about radical transformations of extensive areas, resulting in the loss and/or transformation of important environmental resources. According to Forman (2004) and Hellmund and Smith (2006) several of the problems that have been clearly observed in many cities during the contemporary era are related to the fragmentation of landscapes commonly caused by the rupture of continuity of natural ecosystems, which occurs when landscapes are isolated between areas of urban growth, or the proliferation of suburban areas, or the concentration of poverty. The first consequence of landscape fragmentation is the reduction and loss of natural areas (forests, wildlife and water resources) and the second is the reduction of connectivity between the areas, putting the natural ecosystems at risk to varying degrees with damage to ecosystem process and functions.

Other problems include spatial inequality, gentrification, social fragmentation and isolation, in which communities are separated and segregated. Neighborhoods can also be segregated by race and socioeconomic status (Hellmund and Smith, 2006). According to Hellmund and Smith (2006), landscape and social fragmentation leads to the lack of a coherent visual and functional framework that is needed to reinforce place identity, place attachment and to create a sense of social bonding. Gentrification and densification commonly impact the natural resources and impair the access to natural urban areas, such as park facilities, producing a lack of connection between recreational places, a lack of public spaces designated for recreation and conservation (Macedo, 2008), or a lack of park system connection (Harnik, 2010).

Societal changes in recent times have dramatically reduced physical activity and contact with nature. The main cause of this problem is lack of time for leisure and recreation, as a consequence of urban and suburban sprawl and dependence on vehicle transportation. All

of this can negatively impact health and lifestyle, causing a number of diseases in our people, such as: overweight obesity (high BMI), high blood glucose, bad cholesterol and stress (Danaei, et al., 2009; Center for Disease Control and Prevention, 2002; Lusk, 2002a).

The crux of the problem lies either in the lack of landscape and urban planning which takes into consideration both environmental and social issues, or in the non-implementation of such planning. There is an acute shortcoming in the control exercised by planning organizations, as well as in the existent physical structure of recreational areas and areas designated for environmental conservation. Taken together, this sets in motion a number of social and environmental imbalances, including social segregation, reduced public and individual health and lifestyle, landscape degradation and the destruction of ecosystems.

In this sense, the implantation of an ecological planning for city landscapes and ecosystems, including those of humans, is of the utmost importance. Such planning is needed to reorganize urban land use and promote an integrated system of open spaces that interact in a balanced fashion with the environment and people. Only then, will it be possible to ensure environmental sustainability and other basic conditions, such as functionality, environmental conservation, social-economic development, sewage systems, social integration and integration with nature. Landscape ecology has rapidly emerged in world discussions in an attempt to identify solutions for such circumstances. The provision of an integrated system of open space environments that encourages recreation, such as public parks and greenways can provide settings and features for different recreational pursuits and act as a fundamental support for landscape conservation, human health and quality of life.

1.2. Overview of Greenways

Greenways, linear parks with multi-use trails that promote the connection of ecological network systems, have the potential to mitigate the previously mentioned problems, because they connect the landscape systems with human society (Flink and Searns, 1993;

Hellmund and Smith, 2006; Little, 1995; Moore and Driver, 2005). These linear parks are designed to conserve natural and cultural resources, to promote functional landscapes and to provide environmental education for citizens (Flink and Searns, 1993). Generally they are composed of ecological corridors that protect the open space and connect fragmented landscapes, communities and neighborhoods to minimize urban and suburban sprawl and anthropic actions over nature, by controlling density and urban uses in the areas surrounding greenway buffer zones, and providing these areas with facilities for conservation and/or recreational, leisure and physical activities (Ahern et.al., 2006; Flink and Searns, 1993; Flournoy, 1969; Little, 1990; Mertes and Hall, 1995). In addition, greenways are an excellent alternative for nature conservation and social integration, because they link different types of open spaces and parks with facilities, nature and people. Greenways afford numerous benefits for both the environment and society (Flournoy, 1969; Little, 1990; Flink and Searns, 1993; Mertes and Hall, 1995; Lusk, 2002a, p. 1 and Ahern et al., 2006; Sallis et al., 2012). Their characteristic linearity provides linkage between the landscape and features, enhancing access and proximity. Thus greenways represent “all-season, affordable recreation” environments for different ages, genders, income levels, actor types and cultures. By providing close-to-home destinations and features with aesthetic and functional quality, they also provide opportunities for fostering social capital.

While greenways offer myriad benefits, users may or may not be taking full advantage of them. Activities involving social integration among individuals or small and big groups, their integration with nature, as well as environmental education activities may have been insufficiently explored by users’. Thus, users may not have a full understanding of many of the greenways’ functions and objectives, which could undermine their role in the future. Certain greenway uses (recreational and physical activities) have been more prevalent than others (social integration and/or environmental education), and some users prefer certain types of recreational greenways. This may be due to differences in features, types of connection, location, destination or social factors.

1.3. Gap of Knowledge

Many greenway studies have dealt with ecological landscape planning and ecological impacts. Some theoretical studies have analyzed greenway users' perceptions, destinations and behaviors and affirmed that greenways contribute to social interaction in a positive way by connecting people and places (neighborhood, communities and landscapes). Burel and Boundry (1995) and Pungetti and Romano (2004) indicated the necessity of understanding the design of ecological networks and greenways at different scales and different levels of detail, not only as an ecological process, but also considering the cultural and social factors that drive that process as a whole. Pungetti and Romano (2004) added the point that studies that deal with ecological networks and greenways, such as landscape ecology, land use and environmental conservation, should include social aspects in which human activities, especially recreation and education, play a significant role.

The need to study the role of social factors in the efficacy of ecological networks and greenways, in fact, has been confirmed by many scholars. Different aspects related to the social issue have been emphasized by different authors, including place attachment, social bonding and interaction, types of users (age and gender) and actors (social units), their perceptions, preferences and motivations, as well as their conflicts and patterns of use. These aspects are crucial to enhance greenway system efficacy and provide useful knowledge for the development of new designs and norms for greenways, promoting more integrated neighborhoods, and more sustainable communities and landscapes (Fábos and Ahern, 1995; Gobster, 1995; Lee et al., 2002; Lusk, 2002a; Searns, 1995; Manning, 2005; Moore and Scott, 2003).

Manning (2011, p. 189) mentioned that "empirical linkages among recreation activities, settings, motivations and benefits are not fully understood. Recreation experiences are highly dynamic and emergent, and strong empirical relationships among recreation activities, settings, motivations and benefits have yet to emerge." Gobster (1995) pointed out that more studies are necessary to understand users' perceptions about the location,

design, and management of greenway trails, and how greenway features affect patterns of use. It is also necessary to identify the greenway physical environments that directly affect how users and actor types interact with each other (inter and intra relations), and also how their patterns of use and activities relate to each other. In agreement with Gobster, Lindsey et al. (2008) attests to the need for more studies that focus on understanding how the design of urban greenway trails can influence use. Specifically, they mentioned how the types of connections and forms, such as specific areas for social gathering and commuting, might influence human flow and social interaction and cohesion.

Moore et al. (1998) mentioned the necessity of more studies that deal with: user recreational experiences and conflicts; factors that might influence motivation and behaviors; social roles involved in social interactions and the sense of community among different types of users. Manning (2011) pointed out a number of problems in previous research and the need to deal with numerous social issues in outdoor recreation, which could be applied to greenway studies:

- lack of analysis of intra-group and inter-group interaction and integration;
- lack of consistency in research methods, including the way study variables are defined and measured;
- lack of studies and problems in measuring social usage and interactions among different actors (individuals, sub-groups and groups) in outdoor recreation environments;
- lack of social studies that provide a basis for understanding social experiences, meanings and perceptions;
- issues related to “inefficiencies of resource use and consequential problems of crowding, conflict, and other management issues” (ibid, p. 56);
- issues of social conflict: different activities and needs, social bonding, acculturation, social impacts and social network and social mobility;

Lusk (2002a) and White (1980) pointed to the importance of more studies about social bridges, ties and interactions and their relation with the greenway and/or other types of urban public physical environments. According to White (1980, p. 94), to better understand social interactions, ties and bridges, it is necessary to understand how and why people use public spaces as well as the "process by which some external stimulus provides a linkage between people and prompts strangers to talk to each other as though they are not" (ibid, p. 94).

> "For future research, it would be preferable to assign weighting to the features, activities, and meanings, thus providing the ability to add significance to certain destinations. (…) the phenomenon of social bridges and the features that facilitate interaction have been identified in association with the building of social capital but these social bridges have not been more carefully analyzed and a determination of the person-to-person interaction calculated. Certain social bridge features or environments could be measured for personal interactions resulting in a more complete listing of social bridge facilities and the degree of interactions with that facility. It could be determined if friends or strangers benefit from the space, thus additionally measuring the building of inter and intra-group social capital. (…) Future study could begin to determine what might motivate people who presently do not recreate to recreate" (Lusk, 2002a, pp. 442-443).

According to Fábos and Ahern (1995), understanding human interactions, values, perceptions and preferred patterns of use in relation to greenways, provides essential grounds for greenway design and management. "Locally-based survey research" and observation research "can help to understand who users are, what they use the greenways for, and when they use the greenways." It can also elucidate where they go, where they come from, what their preferred areas for use and socialization are, how they socialize and what their expectations of the greenways are.

From a social perspective, a complete observational and perception research analysis of social aspects is necessary to better understand the process and patterns of interactions that occur along the trail (interaction among a diversity of user types and uses). Studies

recording the number of users within different timeframes, i.e. different seasons, on weekdays and weekends, during peak hours and off-peak hours, would provide valuable information about frequency, amount and density of use. It is important to understand that the social element is also part of the ecological system and is important for the integrity of the landscape, especially in urban areas. The big issues are related to *how the greenway will benefit society and nature at the same time? Who is most or least likely to benefit? Is there a specific type of greenway characteristic that improves the gap between people and nature? How to improve the greenway integration between people and nature? Are greenways capable of improving social integration (people-people and people-nature)? What types of connections and relationships can be afforded by the greenway? How do greenway characteristics and their contexts influence the greenway social connection? How do greenway designs affect the social-ecological system? How often do greenways actually improve social integration (among individuals and groups) of different social classes and/or cultures? How do social characteristics (income, education, status, culture, localization) influence the performance of greenways?*

The studies mentioned previously do not expound on exactly who the different types of users and social actors are, and *how, why*, *where* and *when* the social interactions occur; neither do they address the social aspects (integration, cohesion and insertion) and social benefits of greenways. There is a gap in our knowledge about the social dimension of greenway environments. There are no studies dealing with social network interactions, such as relational ties, social bridges, social development, and the categorization of the types of actors and their relationships as a matrix of social interaction. Therefore, the purpose of this study is to understand the social network interaction and behaviors that arises from the nature of greenway environments, by verifying whether greenways promote social interaction and what catalyzes such social interactions: if it is the connection, the greenway features, the presence of different people, the uniqueness of the place, or because of all of the combination of these components. To do this, Structural Network System categories were formulated to describe the greenway characteristics and to measure and analyze these characteristics and verify how they impact social interaction. These categories were

based on Flink and Searns (1993), Gobster (1995), Flink et al. (2001), Simonds and Starke (2006), Hellmund and Smith (2006), Moore and Driver (2005) and Moore et al. (2010). Another aim of this analysis is to understand how the greenway structural network system affects social ties and bridges and cross-cultural interactions.

Because of important research and educational institution, a thriving business region, and the presence of the capital area greenway system (parks, and greenways), the Triangle Research Area of Raleigh-Durham-Chapel Hill (including the Town off Cary), functions as a powerful attractor for people to come to study, live and work as well as for tourism. Because of the large numbers of people from other countries besides the U.S., it has become a dynamic, multicultural and cosmopolitan region, with great potential for interesting multicultural interactions. People's behaviors are direct reflections of their social and cultural backgrounds and the exchange among different socio-cultural perspectives provides a rich environment for people to learn, understand and accept other cultures and at the same time a chance to understand their own cultures. This multicultural dynamic context adds interesting elements to greenway social interaction in the Triangle area.

Greenways thus have the potential to sew together not only different geographic locations, but people from different socio-cultural backgrounds while satisfying needs for recreation, leisure and tourism. In addition, the context of greenway also includes the structural network system and the type of connection (direct connection of the greenway multi-use trail with parks and neighborhoods), the type of trail surface (paved, unpaved and paved/unpaved), and other features such as landscape and physical structure. The immediate geographic location and the context of the greenway itself play an important role in bringing people to the greenway and also sending people from the greenway to destination type/point of attraction locations. In this way the location and context of greenways influence how they impact social interaction. For this reason, one of the chief objectives of this study is to describe the greenway characteristics and verify their relation with the surrounding geographic location on 3 greenways of the Town of Cary.

Different types of conventional parks, which represent one urban context, because of their varying size, function, design and recreational facilities, may afford and attract different people for different uses. The point of connection between parks and greenways establishes a symbiosis, in which greenways function as an attractor for people to go to the park and parks functions as an attractor for people to go to the greenway. With this interdependence established, people often come to use both simultaneously. The presence of neighborhoods connected to greenways represents another type of urban context that directly affects the usage of greenways, enabling greater access. The presence or absence of neighborhoods and parks near the recreational greenways may affect the intensity and frequency of use and also the social interaction and behavior as well.

Social interactions, behaviors, patterns of use/type of activity, levels and intensity of usage on greenways may change due to the urban and/or suburban type of geographic locations that the greenway connects (neighborhood, parks and both: neighborhood/parks). In this study, (using stationary observation and behavior mapping) the occurrence of social networks has been verified at the point of intersection/interface/entrance where the greenway trail meets the park(s) and the neighborhood(s) (stationary observation), and also along the whole greenway trail segments (behavior mapping). The identification of users and actors and their relational ties and social bridges was recorded by: type, age, gender, frequency and intensity; the patterns of use/type of activity will be recognized in each category of users, actors and relational ties/social bridge by type, frequency, number and level. Such information was imported to GIS and combined to other information, such as the greenway characteristics: features and structural network system.

In this study, a mapping exercise was also applied in order to gain more information about the geographic location directly from the users/actors about their relation with the greenway: where their neighborhoods are located; where they usually go (major and secondary areas); where they usually meet others (major and secondary areas); and where the places in which they usually interact with others are located. The mapping exercise approach provided information about the social networks, in terms of preferences for places: destinations,

locations in which people starts and end at the greenway trails, locations in which they meet and interact with others. Such material was imported to GIS and provided a complementary understanding about the entire greenway trail segments usage. This qualitative approach was spatialized using GIS, to provide a social network thematic map, with rich information about geographic location, greenway context and features and social interactions. The identification of the neighborhood locations combined with the municipal park boundaries and greenway boundaries (Town of Cary-GIS data files, greenway observation matrix and mapping exercise).

In this study, the total usage (users, actors, ties/bridges, centralities) for the entire greenway and also for each segment type was recorded and then correlated with the connections with neighborhoods as a destination and connections to parks as a destination) of the 2 greenways with the heaviest volume of use of Cary: Black Creek Greenway and White Oak Creek Greenway, both located in suburban areas. The results of the thematic maps, graphs and tables may help to understand how geographic location and context of the greenway impact greenway social relationships (users, actors, relational ties/social bridges, patterns of use/type of activity and levels of activity, type of interactions, levels of interactions, type of catalysts for interactions and centralities types).

1.4. Executive Summary

Recreational greenways represent a resilient, new and effective democratic space in the urban and suburban areas that provide a myriad of functions: environmental, social, leisure, recreation and tourism. Greenways enable the connection of landscapes, of people with other people and of people with different places, by transversing, penetrating and permeating different landscapes, conventional parks and neighborhoods. In this ways, they provide physical environmental conditions that may allow for the occurrence of social interactions among greenway users, also called as visitors (different age and gender), which fits into the actors categories (different social units), and within and between neighborhoods.

All the greenway users also are All the greenway users, in terms of the social dimensions, constituted the different types of social actors (individuals, sub-groups and groups). To understand recreational greenways it is important to recognize the social life linked to them based on generators including new emerging recreational activities relating to greenways' connection types, features, as well as to the presence of human interaction and behaviors.

In this sense, many scholars have confirmed the necessity of more greenway studies that deal with social factors such as interaction, social ties and bridges (different socio-relational connections between different sets of actors that occurred in the environment) and behavior. Also in how the greenway features and destinations impacts social usage and behavior. The main purpose of this study is to describe the social interaction that arises from greenway environments, by analyzing the different types of social tie and bridge interactions that take place on recreational greenways. Seven hypotheses were tested to better understand how greenways, and their specific characteristics, such as structural and landscape features, impact social life and socialization. Three main questions were created to investigate these hypotheses: Do recreational greenways impact social factors such as interaction, behavior, ties, bridges and cohesion? Do recreational greenways impact social factors in ways that are different depending upon the characteristics of the greenway? What is an effective protocol for analyzing interaction, behavior, ties and bridges on recreational greenways?

A multi-method approach was utilized to investigate the two most heavily used recreational greenways in Cary, North Carolina. The methodological design aimed to combine multiple sources of quantitative and qualitative data to compare specific characteristics of 2 greenways and investigate how those characteristics impacted social factors. The data collection methods consisted of: interview, greenway characteristics audit, social characteristics audit and standardized survey questionnaire. An effective protocol to analyze the greenway characteristics and the greenway social aspects was created. The results for each method were presented separately and then triangulated together in the conclusion. A variety of statistical approaches was conducted to test the association level between the

independent variables (greenway type, greenway segment, greenway characteristics, temporal variables, people variables and behavior variables) and the dependent variables (social interaction variables). The analyses were carried out using descriptive statistics (frequencies, distribution, proportion and correlations), and advanced data mining analysis that deals with complex and large data sets, allowing for a data reduction approach (decision tree, regression and cluster) and theory builder by coding (open coding and axial coding) for the survey and mapping exercise.

Method 1 was an interview conducted with the greenway expert of Cary to gain information related to greenway social aspects as well as design, planning and management and to identify the three most heavily used paved and three most heavily used unpaved greenways of Cary. Topics included: greenway major function; greenway structural network context; greenway master-plans; greenway structural network and features; greenway social role; greenway studies about patterns of users and use/type of activities; greenway representative greenway in terms of usage and greenways with highest volume of use.

Method 2 consisted of a Greenway Characteristics Audit based upon the greenways' structural network characteristics and features. The audit was useful to identify amount of social interaction as a function of greenway type (connecting only to a neighborhood; or connecting to a park as a destination or point of attraction) as well as to identify the places where interactions take place (where people meet and interact, stopping areas and non-stopping areas, where people go, and how the flow or movement of people takes place). General characteristics of the greenway environments (meso-scale) were described for both greenways: Black Creek Greenway and White Oak Creek Greenway. Specific characteristics of greenway environments (micro-scale) were described, categorized and spatialized in GIS. The *greenway characteristics structural analysis* protocol check list was created and some variables spatialized in GIS to be able to characterize the greenways of this study. The *greenway characteristics structural analysis* was composed of a set of different main-topics and their variables: *1) landscape features*; physical structure features configuration, type and/or quantity along the different greenways and their trail segments; *2)*

structural network system composed by type of connection and trail characteristics. The spatialization of this information in GIS served as a thematic background map and was combined with the social information.

Method 3 consisted of a Social Characteristics Audit, which utilized *behavior mapping* and *stationary observation* approaches. The data provided patterns suggesting which greenway characteristics facilitated and/or promoted social interaction. The objective of these two observational approaches was to determine the nature of the interactions that occurred on the recreational greenways by identifying the types of social network behaviors and interactions, and the type of users and actors. During the *stationary observation* approach, greenway features within 150 feet of the observation stations were described. During the *behavior mapping* approach, greenway locations and features along the entire trail were described. Temporal variables were recorded for each observation period. The behavior mapping was found to be an objective method for observing human behavior in connection to the physical environment characteristics. The observational variables utilized in the *behavior mapping* technique were: user type (age); gender, pure actor type and pure actor size (pure actors, with inter relationship); pattern of use/type of activity; complementary behavior; physical activity level; tie/bridge (occurrence); user tie/bridge; actor tie/bridge; transformative actor type; transformative actor size; tie/bridge gender types; patterns of interaction; interaction physical activity level; interaction types (level of interactions); interaction catalysts, centrality occurrence and central network between different actor types. The total frequency of ties/bridges observed for both greenways combined was 10,205 observations. For both greenways, the absence of social ties/bridges occurrence was more prevalent than the occurrence of social ties/bridges. Black Creek Greenway surpassed the White Oak Creek Greenway in terms of non-socialization (Black Creek Greenway: with no-occurrence of 79.40%; 4,377 observations versus occurrence of 20.60%; 1,135 observations; White Oak Creek Greenway: with no-occurrence of 73.28%; 3,439 observations and occurrence of 26.72%; 1,254 observations).

Method 4 consisted of a Standardized Survey Questionnaire and Mapping Exercise used to understand how users and actors used the greenway in terms of social interaction and social contact with the greenway physical environments (features and structural network system), and to obtain complementary information based on users/actors' perceptions, preferences, and attitudes related to social aspects. The study sample was comprised of 91 respondents in the survey and 124 respondents in the mapping exercise, all of whom were adult and senior users of the surrounding neighborhoods of the two greenways. The results were presented based on different topics, including: neighborhood location; socio-demographic information; geographic location; reasons of greenway use; nature and frequency of greenway use; patterns of use/type of activity in which users engage in the greenway; type of interaction in the greenway; nature and frequency of greenway interactions; greenway opportunistic place; environment for socialization; aspects of the greenway that inhibit the socialization; greenway potential opportunities; greenway types of connection; greenway benefits; greenway social benefits; user motivations for use the greenway; greenway attributes; greenway users attributes related to the greenway characteristics; greenway attachment; greenway success; greenway features; greenway user expectations, greenway places for socialization; indication of start and end locations; indication of destinations/points of attraction; meeting and interaction locations.

The GIS Mapping was conducted at two different moments. First, a greenway base map was elaborated for the application of Methods: 2, 3 and 4. Second, GIS thematic maps combining data from Method 2 with Methods 3 and 4 were elaborated. Additionally, using ArcMap 10, thematic maps and graphs (statistic programs and excel) were created with the outcomes of *behavior mapping* and *mapping exercise*.

The successful model-protocol utilized in the observational approaches, especially in the behavior mapping data collection of the recreational greenway interaction and behaviors, provided a novel approach to understanding the relationship between greenway physical environments and the social interactions that occur on them and should be replicated in other greenways (urban, suburban and rural areas) and also in other countries with different cultural, physical environment features and structural network system contexts. The study

provided useful information about the social interaction and behaviors on the greenway network. GIS database was a powerful tool to spatialize the behavior mapping and the greenway characteristics. Another strength of this study was the large, rigorous and complex data set for the Social Characteristic Audit Behavior Mapping, which provided extensive and detailed information about the recreational greenway social dimensions, mitigating the gap of knowledge in terms of understanding greenway social aspects and dimensions. The advanced and new statistical data mining analysis (decision tree, cluster and regression) provided reliable results related to the distribution and correlation of social interactions. The descriptive statistics and data mining analysis positively confirmed the seven hypotheses of this study in terms of the relationship between greenway characteristics and social aspects. The descriptive variables successfully demonstrated the association of the dependent social variables with the different independent variables in terms of frequencies, proportion, distribution and correlations.

The findings revealed that people tend to utilize the greenways for different types and levels of socialization. The greenway structural network connection and features when well-designed contribute to social events and contacts, enhancing the quality of life and well-being of its residents. The results provided positive insights in terms of correlation of different greenway characteristics and different social network features. The greenway has the potential to bring people together as it provides a matrix for inner and intra interactions between users and actors. In contrast, the greenway features need more development in terms of accommodating and affording socialization. As a result, most of the interactions occurred along the greenway trail segments in a spontaneous fashion, with few incidences occurring at or on the physical structural features such as playground, bridges, kiosk/gazebo, access areas, wood-fence near the tunnels. In terms of trail characteristics, interactions tended to occur at sinuous/organic and bifurcate locations and destination/point of attraction at the sections of the trail that directly connect or penetrate neighborhoods and/or conventional parks. The results of this study provided some useful directions for developing design guidelines of greenways that can enhance socialization.

CHAPTER 2: LITERATURE REVIEW

2.1. Leisure, Recreation and Tourism

Social science research in outdoor recreation, conducted over the last decades, has amassed a multi-disciplinary body of knowledge and provided different methods to understand outdoor recreation and has contributed to mitigating a variety of park management problems by analyzing the use of parks, greenways and related areas, and the characteristics, attitudes, and behavior of people who visit them. Many of these studies are important because of their application of multidisciplinary and interdisciplinary perspectives in order to understand the interrelationships between environmental concerns (ecological impacts of recreation and carrying capacity) and social concerns (e.g., crowding and conflict uses) (Manning, 2011). According to Manning (ibid p. 3) “the understanding of outdoor recreation is deepened when it is viewed from a behavioral approach, emphasizing why people participate in recreation activities and the experiences and benefits attained.”

Different, related and overlapping main concept definitions, such as leisure and recreation, are used to define the interactions between two different and crucial elements: people and natural environments. The human aspects are embedded in areas such as “psychology, sociology, social psychology, geography, economics, political science, public administration, history, archeology, landscape architecture”, urban design and planning, and other fields. The natural aspects are embedded in areas such as “environmental sciences, including biology, ecology, forestry, geology, botany, hydrology, range science, wildlife biology, soil science” and others (Moore and Driver, 2005, p. 4). Moore and Driver (2005) point out that outdoor recreation activities occur in natural settings, such as parks and greenways, in which the activity and user experience depends on their natural environment. To understand the human dimensions of outdoor recreation, it is necessary to understand the definitions of leisure and recreation.

Kelly and Godbey (as cited in Moore and Driver, 2005, p. 6) affirmed that the original definition of the term 'leisure' came from the Latin word *licere* meaning "to be free" and from the Greek world *schole* meaning "serious activity without the pressure of necessity." Leisure can be defined as a human state of being and mind, which consists in a state of freedom from the pressures of work and time, and engagement in certain preferred activities during free time. Unfortunately, when leisure is limited to only a list of activities, it ignores other important aspects such as people's motives and experiences.

During moments of leisure, people seek ways to be creative, to enjoy nature and people, to do things that enrich and satisfy them (Jensen and Gurthrie, 2006, p. 4). Leisure and recreation present countless patterns of usage with differing behaviors, activities and types of users and actors, which vary from one culture to another and influence personal attitudes, behaviors, socio-cultural relations and values (Cordell et.al., 2004). The term *leisure* has been defined in varying ways by different authors: Moore and Driver (2005, p. 329) define *leisure* "as a precondition of all recreational engagements". According to Farina (1991, p. 29) "leisure is characterized by freedom, a sense of freedom that is in the mind of man as differing from environmental or socially determined freedom. This freedom can be considered an opportunity to act as one pleases within limits imposed by environmental and social contexts." According to Krauss (2000):

> "Leisure embraces a host of significant and rewarding personal and social possibilities. It may include varied forms of physical, social, creative, or intellectual involvement that contributes to one's personal health and well-being and to the community's quality of life and economic growth. Outdoor recreation, travel and tourism, and sports all are linked to the nation's ecological concerns, and many recreational pursuits help build family togetherness, neighborhood unity, and a bulwark against youthful crime or other forms of deviant behavior. Artistic and cultural programs enrich the character of the society and reflect the contributions of many groups of different racial and ethnic backgrounds" (p. 1).

This eloquent claim about leisure demonstrates the close tie that leisure and recreation have to social well-being. In this sense, to truly understand greenway social networks, it is

important to consider leisure from a sociological point of view. This leads to the understanding that the specific manifestations of leisure and recreation are greatly contingent on a people's socio-cultural backgrounds. According to Bammel and Burrus-Bammel (1982), leisure is one aspect of a given culture, inseparable from the main drifts of that culture, and cannot be studied apart from the other major dimensions of that culture. In this sense, the socio-cultural background of recreational users must be taken into account in order to examine leisure in a meaningful way.

According to Moore and Driver (2005, p. 9), "the word recreation comes from the Latin root *recreare* meaning to create anew or to be refreshed. *Re-creation* of mind, body, and spirit captures the essence of recreation. The word *creation* in recreation denotes that recreation includes such things as growth and development, learning, creative expression and nurturing." The recreation concept contains two important elements: the need to refresh and restore our lives from pressures and demands and the positive energizing outcomes, such as challenge and growth (ibid, 2005).

Moore and Driver (2005) define *Recreation* as "freely chosen activities undertaken during leisure and the intrinsically rewarding experiences that result from engaging in those activities" (Moore and Driver, 2005 p. 331). As it consists of activities carried out during people's leisure time, recreation can be considered a component of leisure. "Recreation is thus a subset of leisure; what distinguishes recreation from other forms of leisure is that it is an activity. (…) Recreation and recreation programming can contribute to personal health, reduce antisocial behaviors, and provide significant economic benefits. (…) recreation programs can contribute to a sense of community or a sense of place, and hence build social capital" (Jensen and Gurthrie, 2006, pp. 9-10; Krauss, et.al., 2005).

Tourism is a geographic multi-dimensional phenomenon that stimulates, at different scales and through different types of movement, diverse relationships between people, spaces and places (Williams, 2009). "This temporary movement shapes landscapes and culture" (Weaver, 2007, p.276). Tourism also promotes the spatial pattern mobility that according to

Urry (2000) is the key element for the social life and cultural identity of a specific location. Depending on the type of tourism and the tourist movement and flow, it can impact positively or negatively the natural, social, cultural and economic environments.

The social-psychological perspective toward outdoor recreation presupposes that people participate in outdoor recreation because of their intentions to achieve specific outcomes, based on their motivations, preferences, perceptions, experiences and level of satisfaction. The basis of this assumption is rooted in the expectancy theory, which "suggests that participants engage in recreation activities with the expectation that this will fulfill selected needs, motivations, or other desired states. The congruence between expectations and outcomes is seen to ultimately define satisfaction" as a fundamental concept in outdoor recreation behavior (Floyd, 1997; Manning, 2011, pp. 12-13; Moore and Driver, 2005).

When dealing with the outdoor recreation environments, it is important to comprehend the essence of why people participate in outdoor recreation. According to Moore and Driver (2005, p. 9) "Recreation experience is a response to a recreational engagement. All recreation experiences occur at the individual level albeit strongly influenced by social and cultural influences. The experience can be psychological, physiological or psychophysiological in nature." This statement is somewhat restrictive. Other authors have considered recreation to fall within other types of experience, such as psychophysical, cognitive and kinesthetic (Manning, 1999). In addition, it is arguable that recreation experiences also occur not only at the individual level but also at group and sub-group levels.

To be able to comprehend outdoor recreation, Moore and Driver (2005, p. 15) create an experience model, which illustrates the motives for outdoor recreation behavior, based on user perspectives by listing important questions such as "who, what, where, and why". This model reflects the *user's input:* based on their motivations, preferences and desires, followed by the *user's recreation choices:* engaged activities, settings and companions in which their experience takes place, and finally by the *user's experience desired outcomes:*

their recreational experiences with nature and others. The outdoor recreation experiences can be “situational, individually specific and highly variable, and their meaning to the individual can depend on the context of their engagement” (Moore and Driver, 2005, p. 16). Related to greenways, such experiences are directly influenced by the contexts and characteristics of the physical environment (structural network connections to conventional parks and neighborhoods, greenway features) or by the social interaction and social opportunities that take place in these environment.

According to Manning (2011, pp. 13 and 18), “satisfaction is a multidimensional concept, affected by a number of potential variables (e.g., environmental conditions, use level/crowding, number and type of facilities, facility development, weather), some under the control of managers and many not.” Situational variables, such as social aspects and managerial settings can also influence the global satisfaction of the recreational experiences. In our contemporary era, “ growing urban populations with significant amounts of leisure time, combined with an overall surge in health consciousness, has led to increasing demand for outdoor pursuits such as jogging, walking, biking, cross-country” and others (Hellmund and Smith, 2006, p. 19; Manning, 2011).

> “Visitors to outdoor recreation areas often differ in ways that fundamentally affect the perceived quality of recreation opportunities, and ultimately, satisfaction. Visitors have varying socioeconomic characteristics, alternative cultural backgrounds, varying levels of experience, and a range of attitudes, motivations, and norms. While objective elements of recreation opportunities (e.g., type of facilities provided, use level) can be important in influencing satisfaction, they are filtered by subjective interpretations of individual visitors) (Graefe and Fedler, 1986)” (Manning, 2011, p. 13).

These assumptions draw attention to the need for an analysis of greenway social networks. Because of the nature of user satisfaction, experiences among different users may differ simply because some users are more sensitive to environmental and social impacts than others. Thus, the measurements of social aspects, such as behaviors, interactions and

patterns of use that take place in greenway physical environments are of great value (Manning, 2011).

2.1.1. The Importance of Public Greenways in Terms of Leisure, Recreation and Tourism

Greenway movement, popularity, efficacy and success rely on “the capacity to go beyond the ecological perspective, embracing also social and political imperatives. They are in fact not only ecological networks, but also social and political networks able to connect different people” (Jongman and Pungetti, 2004, p. 300). Connectivity plays an important role in landscape ecology planning. Greenway system design and management must be flexible to adapt to local circumstances, which are in constant transformation.

To enhance greenway networks’ function as a connector, it is necessary to consider greenways from the perspectives of leisure, recreation and tourism, all of which are related on different levels to social aspects and the well-being of individuals, community, society and tourists. In other words, it is important to understand why leisure, recreation and tourism matter to enhance the quality of public greenways.

On the one hand, substantial, consumptive and intensive tourism can disturb and negatively influence a greenway’s ecological processes. However, when well-managed with nature-based alternative types of tourism, such as ecotourism, nature tourism, adventure tourism and heritage tourism, can add value to the cultural and patrimonial landscapes, and other elements of the city (Punguetti and Romano, 2004), with low impact, environmental education and respect to the conservation and sustainability of natural environments (fauna, flora, it landscapes and people) (Moore and Driver, 2005). Indeed, Flink and Mourek (2010) affirmed that "Due to their linear nature and their ability to connect people to a variety of landscapes, greenways are ideally suited for promoting ecotourism and heritage tourism" and natural tourism (ibid, 2010, p. 526).

Sometimes the recreational greenways of urban areas, especially in metropolitan cities, may be crowded by community members and tourists and this phenomena is inevitable. It is necessary to accommodate the local community and the tourists, with respect to natural resources, through local management (parks and recreation departments) and by providing policies, guidelines, pamphlets and information panels with information for users and actors about the greenway characteristics, features and connections. In many cases, it is necessary to consider specific tourist groups when providing such information, for example in the case of ecotourism, nature tourism and heritage tourism.

On the other hand, greenways originated as an American concept and product with a main objective of connecting people and landscapes. They are created and added into an integrated green infrastructure system network of many connections of thousands miles in the United States, that are continuously in expansion. Americans promote and enjoy a rich and diverse assortment of leisure and recreation opportunities and because of this, many of the public greenways of the United States provide extensive leisure services and recreational facilities, accessible to individuals, the community and society and tourists. This provides life satisfaction and well-being, by enabling different users, actors, visitors, to connect and thus supplying many relational experiences that benefit the American communities and society as a whole (Little, 1995; Edginton et.al., 1998; Lusk, 2002a; Ahern, 2004; Jongman and Pungetti, 2004).

To better comprehend interactions that take place at public greenways, it is important to consider social interaction as both a “motivation for and benefit of leisure participation. People interact socially for the sheer socializing with friends and companions, which then becomes motivating and rewarding at the same time.” (Jackson and Burton, 1999, p. 40).

According to Manning (2011, p. 3), to understand motivations for outdoor recreation at public recreational greenways in urban areas, it is necessary to consider greenways from the multi-perspective of leisure, recreation and tourism. “Our understanding of outdoor recreation is deepened when it is viewed from a ‘behavioral approach’, emphasizing why

people participate in recreation activities and the experiences and benefits attained." In this vein, it is necessary to ask the question "what motivates people to engage or not in recreational activities?" The answer to this question is clearly complex and motivations can be divided into a number of categories, including personal, sociocultural, environmental, educational and economic:

- appreciation of nature (closeness to nature and escape from routine) and appreciation of people (family, friends and strangers; being around more people: similar and/or different);
- interactional patterns and social contact (relating and interacting with others: social and family contact, being with similar people, meeting new people, talking to new and varied people, getting away from other people, getting away from family, building friendship with new people, enjoying people's company and family togetherness);
- escape from personal and social pressures (home, work and demands of life);
- escape from physical pressure (tranquility, solitude, privacy, space crowds, escape physical stressors);
- positive behavior and social security (respecting the physical environment characteristics and other people; being near other people);
- autonomy and leadership (independence, autonomy and control);
- personal achievement stimulation (reinforcing self-image, social recognition, testing abilities and excitement);
- learning (exploration and learning of new things and the physical environment);
- teaching and leading others (skills, sharing knowledge and skills, leading, especially social, cultural patrimonial education and environmental education);
- satisfaction and enjoyment (relaxation, self-esteem, creativity, challenge, adventure/new experiences, recognition and identity);
- personal and public health (physical fitness/exercise and/or physical rest);
- social and environmental stewardship.

This dynamic list of human needs and leisure-recreation motivations encompasses extremely varied motivations particular motivations for different people may change during different life stages (Manning, 2011; Jensen and Gurthrie, 2006; Hall and Page, 2006; Moore and Driver, 2005; Kabanoff, 1982; Crandal, 1980; Maslows, 1954).

Based on the definitions and discussion above, it can be stated that these three perspectives (leisure, recreation and tourism) share many similar and overlapping attributes: people, be they from the local community or tourists, seek outdoor environments and settings for relaxation, rest and escape from their everyday routine, to escape from their personal, social, family and physical pressures and to freely chose and engage in activities that provide satisfying experiences, novelty, entertainment, adventure and recreation. Such opportunities may provide the possibility of family togetherness, meeting similar people that enjoy the same things: activities and/or environments and new people (Moore and Driver, 2005; Goeldner and Richie, 2009; Williams, 2009; Manning, 2011).

The unique role and importance of the public greenways in terms of leisure, recreation and tourism is related to connectivity and mobility. Greenway structural network systems contribute to an ongoing urban transformation in which everything and everyone are becoming connected (people-to-people, people with nature and landscape places and open spaces, such as parks, nature reserves, social-cultural structures and heritage cultural landscapes) and which allows the movement of people along the different landscapes (urban, suburban and rural areas). Within urban areas, recreational greenways have a great potential as a connector and facilitator of the social component (social connectivity), as well as a part of the ecological system. In this sense, greenways connect people, residents and visitors, to the attractions they seek for leisure and recreation.

Indeed, many of the benefits of greenway characteristics (structural network system and features) are precisely benefits of leisure and recreation. According to Moore and Driver (2005), there are extensive “benefits attributed to leisure by one or more scientific studies. (p. 29)” These include personal benefits, social/cultural benefits, environmental benefits and

economic benefits. The following list of benefits was compiled using a number of authors who mention the varied benefits attributed to leisure and recreation, many of which are overlapping:

- ***personal benefits*****:** *psychological* (holistic, prevention of stress, depression, anxiety and/or anger); *personal development and growth* (self-esteem, self-confidence, self-reliance, self-competence, development of new skills, cognitive performance); personal appreciation and satisfaction (sense of freedom, self-actualization, stimulation, sense of adventure, challenge, spiritual growth, nature and aesthetic appreciation, creativity enhancement, life satisfaction, understanding of environmental awareness, environmental stewardship, transcendent experiences, identification with special places/feeling of geographical belonging or physical grounding, transcendent experiences); *psychophysiological* (perceived quality of life, increase life expectancy, mental and physical health; enhanced patient health rehabilitation and benefits: cardiovascular, neuropsychological, respiratory, motor and fitness) and *kinesthetic* (personal learning style: body movements, physical activity and mobility) (Manning, 2011; Moore and Driver, 2005; Driver and Bruns, 1999; Driver, 1990);
- ***social-cultural benefits*** **and improvements:** community satisfaction; community and ethnic identity; patriotism; cultural/historical awareness and appreciation; public health; social sharing; social learning; social bonding/cohesion/cooperation/integration; mitigation of social problems and gaps: exclusion, segregation, alienation, crime, acculturation and loneliness; improvement of community involvement (greenway planning and design, decision-making); family bonding and quality of life; reinforces family, neighborhoods and community relations and interactions; social tie/bridge (facilitating social contact, communication and interactions); formation of close friendships and system of social support; social capital (inter and intra-groups and sub-groups); social support; social mobility; socialization; social integration (age, gender, race, ethnic); enhances world view (other cultures and customs); cultural identity and continuity; social networking;

support for democratic ideal freedom; social development (users and actors); social stability, and others (Zhou and Rana, 2012; Manning, 2011; Forman, 2008; Moore and Driver, 2005; Lusk, 2002a; Driver and Bruns, 1999; Driver, 1990);

- ***economic benefits* and improvements:** reduces health costs; increases productivity; local and regional economic growth; employment opportunities, increases property values, among others (Manning, 2011; Moore and Driver, 2005; Driver and Bruns, 1999; Driver, 1990)**;**
- ***environmental benefits*:** maintenance of physical facilities; understanding of human dependency on nature; environmental ethics; public involvement in environmental issues; provides educational opportunities; environmental protection; landscape and ecosystem sustainability; preservation of particular natural sites/cultural/heritage/historic sites; promotion of ecotourism, and others (Manning, 2011; Moore and Driver, 2005; Driver and Bruns, 1999; Driver, 1990)**;**
- ***connectivity benefits*:** ecological (landscape and it ecosystems, including humans); physical (greenway physical environments/features/settings and surrounding areas); social and cultural (families, friends, strangers, neighborhoods, communities and tourists; people with different: ages, genders, ethnic groups and socioeconomic and cultural backgrounds; greenways function as “green magnets” in which people from different ethnic groups socialize in a public environment) (Coutts and Miles, 2011; Ahern, 2004; Moore and Shafer, 2001; Gobster 2002; Gobster 1995b);
- ***interconnectedness and social benefits*:** affords important and vital environment for a diversity of people (users and actors) that use greenways close to their homes, in their everyday shared experiences and activities, exchanging the social relations between ethnic communities and neighborhoods (Zhou and Rana, 2012; Peters et. al. 2010; Lindsey et.al., 2001; Gobster, 1995a);
- social benefits through the promotion, development and maintenance of relational ties/social bridges while sharing the same greenway features and settings;
- different alternatives of socialization, including the passive forms of encountering other people (watching other people and hanging around), the cursory and interactional forms (short chats and greetings with others), and the active forms of

meeting other people (communication and interaction with relatives, parents, families, friends and strangers);

- mitigates social problems, by minimizing the social and cultural differences between users and actors and providing a democratic greenway physical environment; Mitigates social isolation and segregation, fosters social capital, strengthens neighborhood social ties and creates a sense of community and citizenship (Hellmund and Smith, 2006);
- principles for public participation, as part of the greenway role: inclusiveness and diversity, accessibility, transparency, mutual learning and a collective vision. Creates sustainable communities that value identity, bonding, ties/bridges of its community and regions (Hellmund and Smith, 2006);
- social and environmental education, helping people to rethink their relations with other people and with nature; and/or construct “learning opportunities that foster an understanding of both social and biophysical realms” (Hellmund and Smith, 2006, p. 183). Changes societal perspectives in terms of relations, usage and values within the complex networks: landscapes, people, socio-cultural organizations, professional norms, leisure and recreational behavior and interactions.

Thus, greenway networks, as both destinations for recreation and leisure and as connectors of significant components of urban areas (landscape, natural, ecological, scenic, social, economic, recreational, historical, cultural), are crucial elements to improve the urban sustainability of one location and region and well-being of the urban citizens: individuals, communities and society. Their spatial configuration and multi-use functionality has the potential to provide a range of benefits (environmental, economical and social), which can be condensed into seven important subjects: quality of life; land use planning; greener urban environments; open spaces; connections; sense of identity and/or belonging, and sustainable transport system (Vasconcelos et.al., 2007).

The social benefits of greenways are extensive recreational and physical-health activities. Activities that involve social integration may have been insufficiently explored by users and

actors. To understand recreational greenways it is important to recognize the social life linked to them based on generators including new emerging recreational activities relating to the type of connections (park as a destination, neighborhood as a destination and both: Park and neighborhoods as a destinations), type of features and/or presence of people and their interaction and behaviors.

In short, recreational public greenway characteristics play an important role in the realms of leisure, recreation and tourism because they provide multiple functions: landscape integrity, conservation and connectivity (ecosystems and biodiversity), landscape/green-infrastructure functionality (flood and storm water management and pollution filter) recreational (active recreation for different categories of users and actors and provide/accommodate different patterns of use/type of activities and levels), leisure, educational (environmental, social and patrimonial), social (interaction, relational ties/social bridges, cohesion, insertion, equity, identity and integration), cultural and historical (resource conservation and support dynamic urban cultural life and identity), aesthetic and scenic (landscape value and beauty), alternative transportation (active and/or passive), ecotourism, development (ecological, social and economic), connection (people, landscapes, open spaces and nature) and movement and mobility (people, fauna and flora). Because of these factors, greenways have the potential to enhance the quality of life and well-being of urban residents: individuals, neighborhoods, communities and society.

Greenway contexts, because they can connect people, places and spaces by penetrating and transversing a great variety of landscapes and neighborhoods, contribute to the identity and pride of local communities, providing potential and attractive environments for recreational and touristic activities. This unique character of greenways is important for tourism, leisure and recreation, by providing destinations and points of attraction to visitors, users and actors for outdoor recreation pursuits.

2.2. Landscape Ecology Planning, Ecological Network and Greenway Planning

Landscape ecology has rapidly emerged in world discussions within Landscape Architecture in an attempt to encounter solutions for natural and social conflicts. Saunders (2004) stated that greenways, ecological networks, landscape linkages and corridors are fundamental to mitigating anthropic actions and providing ecological connectivity and conservation of biodiversity, in both urban and rural areas.

Landscape ecology planning contributes in important ways to our understanding of heterogeneous landscapes within and surrounding urban areas. Urban landscape is considered a complex mosaic formed by remnants of natural areas and areas modified by humans, in which decisions about land use zoning directly distress both ecological and social structures and processes. In this manner, the application of landscape ecology principles in urban design and planning allows for less fragmentation of landscapes, less degradation of urban land and less social segregation, guaranteeing the ecological integrity of its constituent ecosystems, including humans. Ecological networks provide a basis for the implantation of continual spaces in the territorial mosaic, connecting varied natural and social sectors, ordering the existent occupation and creating parameters for the occupation of new areas. Greenways have the potential to promote the connectivity of green spaces from different city areas and people (Dramstad et al., 1996; Jongman and and Punggetti, 2004; Pellegrino et al., 2005; Zipperer et al. 2000; Zube, 1987).

Therefore, such principles are useful for architects and urban designers, landscape architects and urban planners as aids in the establishment of healthier cities that meet human and environmental needs in a harmonious fashion. Multidisciplinary approaches from landscape ecology that provide spatial analyses of the landscape are capable of analyzing, planning and managing landscapes, guaranteeing the re-organization of spatial relationships at diverse scales and making it possible to suit anthropic uses to environmental functions of landscapes.

The principles of landscape ecology, when applied to the urban environment, can reorganize rural and urban land uses on different scales: regional, state and local and at the same time transform the landscape, recuperating ecosystems and spawning ecological functions conducive to sustainability. "The difference between landscape planning and greenway planning is simple: landscape planning plans for 100% of an area, while the focus of greenway planning is primarily dealing with the fragile portions of the drainage areas such as wetlands, overly steep areas and ridgelines" (Fábos, 2010, p. 11). Ecological networks and greenways' design and management can vary on different scales (state, regional and local) and enhance the ecological planning system (Jongman and Punggetti, 2004).

> "Ecological networks and greenways have clearly brought about a new vision of landscape ecology. Previous concepts have dealt with the single elements of network, such as patches and nodes, buffer areas, corridors and linkages; or with the dynamics of the network, such as movement, flows, migration, dispersal, fragmentation and connectivity. We now deal with the entire framework, where the single elements interact with each other in a dynamic way" (Jongman and Punggetti, 2004, p. 5).

Social interactions and movement can contribute to ecological planning to balance environmental conservation with social integration and cohesion and achieve the desired sustainable development. The gap between society and nature must be closed, so that the human landscape (in a perspective that symbolizes both people and the built environment) is considered part of the landscape-ecological framework of patch-corridor-matrix. Thus, the social structure becomes an important aspect to be considered in landscape ecology planning. The linkage between nature and culture is crucial to the successful implementation of econets/ecological networks and greenways. (Ahern, 2004; Hellmund and Smith, 2006; Jongman and Punggetti, 2004, pp. 5-6).

The moment is opportune to take advantage of this strong tendency. Because of new computational possibilities, territorial data and images can be manipulated with much more precision than ever before, creating valuable bases for future territorial interventions. These methods allow landscape architects and professionals from other areas to evaluate and act

on macro, meso and micro scales (Forman, 2004). New Geographical Information Systems (GIS) technologies, such as ArcMap10, are powerful and useful tools to integrate an overlay plan for environmental conservation, recreation, and stewardship of historical, cultural and social resources (Ahern, 2004). GIS can be used to spatialize greenway characteristics with emphasis on their linear features, buffers, radius of attendance, connections, density and network structure.

2.3. Ecological Network and Greenway Concepts

According to Jongman and Pungetti (2004, p. xvii) “the development of ecological network and greenway concepts has been fast and they are widely used in scientific and planning literature.”

Several metropolitan regions around the world, particularly in Europe (EU and Eastern Europe) and America (North and South), have addressed the ecological networks and greenways concepts and implanted them in benefit of the community and the natural environment, because of their capacity in connecting the landscapes and people. The term “ecological networks” is generally used in Europe while “greenways” are known as an American product; both represent the most advanced application of landscape ecology principles, concepts and land use planning (Ahern, 2004; Jongman and Pungetti, 2004).

“Whereas in Europe the most relevant objective in ecological network development has been nature conservation and restoration, in North America common objectives are also recreation, neighborhood enhancement and, recently, environmental education. In such a complex system, it is clearly important to set up broad objectives that can be directly applied in the planning system where greenways or econets are developed” (Jongman and Pungetti, 2004, p. 294). Nevertheless, both Europe and North America have encountered some problems, such as physical and cultural barriers, during the process of planning and implementation of such systems (ibid, 2004).

According to Fábos (1995, p. 3) “the involvement of landscape planners in greenway planning is promising” especially among landscape planning professionals of US and Canada. Landscape connections are necessary for the maintenance of the ecological and social functions in the long term. In this manner, ecological networks comprise a series of connecting corridors: ecological corridors, greenways, green belts, and areas of contemplation between other types of corridors (Erickson, 2006).

Ecological networks and greenways possess multiple functions, including ecological, recreational, educational and social functions. They can differ in their degree of conformity with the landscape, their location, scale and spatial configuration, and their objectives.

Ahern (2004) defined ecological networks as systems of nature reserves and their interconnections. Greenways function as the connectors of such systems. Greenways are networks of land that are planned, designed and managed for multiple purposes and functions including ecological, wildlife habitat, movement, water resource management, recreational, cultural resource connections, aesthetic, or other purposes compatible with the concept of sustainable land use (Ahern, 2004; 1995).

The greenway concept, as a new term, presents a variety of descriptions, which causes some confusion, because of the complexity of the concept. The greenway concept has received attention from landscape architects and landscape planners, environmentalists and departments of parks and recreation as a recent phenomenon and as a potential panacea (Flink and Searns, 1993). According to Flink and Searns (1993) the greenway definition can present a realm of possibilities, because it is a very flexible term, which can be determined by many factors: local needs, values and physical environmental conditions.

According to Schwarz (1993, xv) “the word *greenway* connotes two separate images: *green* suggests amenities – forest riverbanks, wildlife; *way* implies a route or path. Put them together and they describe a vision of natural corridors crisscrossing a landscape that has been otherwise transformed by development.” Oxford defines “*greenway”* as “a strip of

undeveloped land in or near an urban area, set aside for recreational use or environmental protection" (The Oxford College Dictionary, 2007, p. 598). According to Smith (1993, p. xvi, p. 10), "the term greenway refers to open space or natural areas that have a linear form (…) greenway is a kind of corridor." And there are other types of corridors, such as "wildlife corridors" and "riparian buffers." Because greenways intend primarily to protect natural landscape resources, they can also be referred to as "environmental corridors", "ecology corridors", or "landscape linkages".

The term greenway can be defined based on characteristics such as landscape context, location, spatial configuration, spatial scale and purpose and landscape planning strategy (Smith et.al., 1993; Ahern, 2004).

> "Greenway is defined as: 1. A linear open space established along either a natural corridor, such as a riverfront, stream valley, or ridgeline, or overland along a railroad right-of-way converted to recreational use, a canal, scenic road, or other route. 2. Any natural or landscaped course for pedestrian or bicycle passage. 3. An open-space connector linking parks, nature reserves, cultural features, or historic sites with each other and with populated areas. 4. Locally, certain strip or linear parks designated as parkway or greenbelt" (Little, 1990, p. 1).

Greenways can also be considered social-networks because they can connect people (different ages, genders, races, ethnicities and cultures). Greenways, as connector of open spaces and as a meeting place, have the potential to facilitate social interactions and to tie together families, friends and strangers, by promoting the conditions for a sociable place, and then by enhancing the sense of belonging and community and reinforcing the citizenship (Little, 1990; Forman, 1995; Forman, 2008).

Hellmund and Smith (2006, p. xi) and Zube (1995), agree with the ecologic statement that *everything is connected to everything else*. Greenways are a kind of open system that can promote the connection of landscapes, open spaces and parks. Because of their linearity, they have the "ability to wind through and connect a variety of habitats and communities", in

other words, to restore and connect different landscapes and also to provide proximity between people and nature. They can also draw people together and provide social and democratic equity, through recreational and educational opportunities. Greenways connect interesting and diverse landscapes, communities and neighborhoods, increasing the public access to the outdoor recreation environments and promoting numerous linkages and experiences, including social interactions.

2.4. Greenway Movement History

Greenways originated in the context of park systems or linear parklands and parkways created to connect and tie together urban parks, conforming an urban park system (early prototypes of greenways), proposed in 1860 and denominated by Frederick Law Olmsted (Fábos, 1991; Fábos, 1995; Flink and Searns, 1993; Hellmund and Smith, 2006; Little, 1990; Smith et al., 1993). According to Smith (1993), another model was developed simultaneously in England, with the influence of Ebenezer Howard, who in 1898, proposed the design of a model called *Garden City*, which intended to protect farms and forests while insulating the cities with greenbelts that reduced the pressures of rural and urban areas, benefitting nature and society. Greenbelts were introduced in London after World War II, as a land-use control policy (Smith, 1993; White, 1968). They were also imported to the U.S. in the design of a number of new planned, low-income housing communities, called “new towns”, between 1935 and 1937, such as Greenhills, Ohio; Greendale, Wisconsin, and Greenbelt, Maryland (Little, 1990; Smith, 1993). In 1929, Beyton MacKaye, a regional planner, used the greenbelt concept with a mixture of the parkway and urban open-space concepts, when he proposed systems of wooded open space as a linear feature and belt to keep urban sprawl and pressure away from the natural areas. He proposed during this time the Appalachian Trail, with a regional open space strategy to protect its natural resource. Today, over 2,100 miles of the Appalachian National Scenic Trail is preserved and protected, because of his influence (Smith, 1993).

In the 1950's according to (Little, 1990 and Smith et. al, 1993) the term *greenway* emerged as a new concept, which gained the acceptance of landscape architects and planners and conservationists. In the 1960's, ecological planners and landscape architects, Philip Lewis and Ian McHarg, documented the necessity and importance of protecting natural landscape features and corridors. The 1970's was recognized as the "environmental decade." Philip Lewis and Ian McHarg's introduced theories dealing with the relationship between nature and human processes that influenced the way landscape architects planned landscapes. During this time, William L. Flournoy, published *A Report to The City Council on the Benefits, Potential and Methodology of Establishing a Greenway System in Raleigh.* (Fábos, 2010; Little,1990; Smith et al. 1993). Another instrumental landscape architect, William H. White, discussed greenways "in most of his books and papers on open space." In his monograph, *Securing Open Space for Urban America*, in 1959, he first mentioned the term "greenway", when discussing the work of Edmund Bacon, who planned a greenway network for an undeveloped, semi-rural area of northwest Philadelphia with the provision of "a series of cohesive neighborhood units, with a series of 'greenways' and parks in between" (Little, 1990, p. 23). In *Cluster Development* in 1964, he described the greenway plan proposed by Karl Belser in Santa Clara County, California a creek-based greenway system. In *The Last Landscape*, in 1968, he explained the greenway concept as an opportunity to link disconnected open spaces together. At this time, greenways were known as "green-line parks" (Little, 1990, p. 24).

The Greenway planning "explosion" in the U.S. occurred during the 1980's with the increase in "open-space conservation converging with the growing popularity of outdoor recreation, resulting in many new greenway projects along with vigorous support across the country." One exponent of this era was Charles Flink a greenway planner for the City of Raleigh who went on to pursue a career as an independent greenway planner (Little, 1990; Smith, 1993, p. 9). John Lyle in his book, *Design for Human Ecosystems* (1985), added to the growing body of knowledge of greenway planning (Fábos, 1995). "In 1987 the *President's Commission on Americans Outdoors in the United States of America* recommended greenways as new tools 'to provide people with access to open spaces close to where they

live, and to link together the rural and urban spaces in the American Landscape' (President's Commission 1987) (Jongman and Pungetti, 2004, p. xvii). According to Flink and Searns (1993), "in its 1897 report, the Commission responded to the basic recreation needs of modern Americans by recommending a nationwide system of greenways" (p. xvii).

During the late 1980s and early 1990s, greenways emerged as a potential panacea that aimed to protect, restore, provide recreational uses and promote a new form of public greenspace or open space. This constituted a change from considering only the environmental perspective of the landscape to include a socio-ecological perspective by including the social components of the landscapes (Hellmund and Smith, 2006). In the 1990's, a considerable body of knowledge of greenways and trails was created with the publication of articles in the *Landscape and Urban Planning Journal* and some fundamental books, such as *Greenways for America*, by Charles Little (1990), *Design with Nature*, by Ian MacHarg (1992), *Greenways: A Guide to Planning, Design, and Development*, by Charles A. Flink and Robert M. Searns (1993); in *Ecology of Greenways* (1993) by Smith and Hellmund; *Trails for the Twenty-First Century* (1993) by Karen-Lee Ryan; and *Greenways: The Beginning of an International Movement*, by Julius, Fábos and Jack Ahern (1995). In 1999, at the International Association for Landscape Ecology (IALE), one of the main topics was the discussion of ecological networks and greenways and their design and implementation which resulted in the publication of *Ecological Networks and Greenways: Concept, Design and Implementation*, by Rob Jongman and Gloria Pungetti (2004).

The most recent and complete publication about greenways is Hellmund and Smith's *Design Greenways: Sustainable Landscapes for Nature and People* (2006), which provides an insightful discussion of the social-ecological perspective of landscapes and greenways.

In 2010, the *Fábos Conference on Landscape and Greenway Planning 2010* took place in Budapest, Hungary, with 3 main topics: Landscape Planning, Greenway Planning and Landscape Design which aimed to unite greenway experts and planners from around the world to highlight contemporary greenway trends, expand the body of literature, and explore

how greenways have been planned, designed, managed and used. The proceedings were presented in 18 sections: *Landscape Planning; Greenway Development; Technical Applications in Landscape Architecture; River Corridor Greenways; Urban Green Network; Cultural-Historical Greenway Concepts; Greenways as Ecological Networks; Green Infrastructure in Planning; Climate Problems, Green Solutions; Ecological Networks; Greenway Theory; Urban Greenways; Community and Planning; Ecological Networks as Greenways; Landscape, Greenway and Tourism; Garden and Site Design; Sustainability and Cities; Ecological and Social Aspects of Greenways; Landscapes, Tendencies and Planning; and Landscapes, History and Art.* The result was a total of 73 papers, of which 3 dealt with greenways' ecological and social aspects (Fábos et al. 2010).

Another important greenway meeting in 2010 was the *V European Greenways Conference*, in Madrid, organized by The Spanish Railways Foundation (SRF) and The European Greenways Association (EGWA). This meeting focused on infrastructure to promote continuous and non-motorized transportation, safe and scenic travel trails that are accessible for all people to use in their recreation and leisure activities and sustainable tourism in rural and urban areas. The SRF is a public body that has coordinated and promoted the Spanish Greenways Program since 1993 in association with the Ministry of Environment and Rural and Marine Affairs (MARM) and the Spanish Railways Infrastructure Managers (ADIF, FEVE). The EGWA was created in 1998 in order to develop greenways in Europe, supported by 32 member organizations from 10 different countries and co-financed by the European Commission and other national partners. The purpose of this event was the exchange of experiences and good practices, entailed in the planning, maintenance, management, promotion and utilization of greenways between political and technical agents in Europe in order to develop the European greenways policy. Six main sections were presented at the proceedings: *National Greenways Programs; Heritage Preservation and New Uses for Infrastructure; Tourist Promotion and Market Strategies; The Role of Greenways in Long-distance Networks and Itineraries; Social and Economical Benefits of Greenways* (2 parts) and *Equipment and Services for All* (The Spanish Railways Foundation

and The European Greenways Association, 2010). Two of these sections were dedicated to greenways' social and economic benefits.

In this current year, as a continuity of the 2010 Fábos Conference on Landscape and Greenway Planning, that is sustained every three years, occurred the *2013 Fábos Conference on Landscape and Greenway Planning: Pathways to Sustainability, took* place in Amherst, Massachusetts, United States, April 12-13. The focus was to bring together national and international landscape architects and planners that deal with the greenway planning and design in according to their location condition: geographic, cultural and political spheres. The proceedings were presented in 6 sections about: urban waterways, green infrastructure and ecology, urban greenways and ecology, landscape planning strategies, urban greenway planning, cultural heritage panel, landscape planning, greenway and agriculture, urban greenway planning, green infrastructure, greenway planning, greenway planning and design, ecological networks, greenway strategies and open spaces to greenways. The result was a total of 67 papers, of which 2 dealt with greenways' social aspects: one article is about the landscape integrity and integration to the social framework and the other article presents a conceptual framework for the greenways, based on the environment, community and economic aspects, that contribute to community quality of life and greenway enhancement and benefits: environmental, economic and social. Such framework reinforces and corroborate with the content of my general framework that will be presented here in the item 3.2 of the chapter 3 (Fábos et al., 2013).

Until now, greenways have continued to gain increasing international attention and are receiving support by financial instruments to protect their linear features, landscape elements and to guarantee the quality of life of the environment and our society. This new phenomenon are essential to the twenty-first century triumph in terms of connecting landscapes and people and also stimulating environmental conservation and suitability (Jongman and Pungetti, 2004). While greenways are a part of the American culture, with a history dating back to the 19th century, only recently have large numbers of people with diverse backgrounds, begun to use them with greater frequency. Conversely, there is still a

vast portion of the American society that partakes in a sedentary and unhealthy lifestyle and prefers to stay inside rather than outside. The regular use of greenways is part of the new generation, and as such we are learning how to use greenway environments. For this reason, it is an exciting moment to study the social aspects of greenways. The design and management of greenways as connective networks will lead to real outcomes for society. These outcomes may be positive or not, either contributing to the increased use of greenway environments and healthy lifestyles or falling short and failing to attract more Americans to participate in greenway recreation.

2.5. Greenway Structural Network System: The Connection Trend

In order to explore the greenways trend toward creating connections within a structural network system, terms, such as *network, structural*, *system* and *connection,* must be defined. Jongman and Pungetti (2004) utilized the Concise Oxford Dictionary (1995) to define the term network, and I utilized The Oxford College Dictionary (2007, p. 919) as a more recent publication to expand their definition, by defining a "*Net-work"* as (1) "an arrangement of intersecting horizontal and vertical lines; a complex system of roads, railroads, or other transportation routes." Greenways are a type of landscape connector that, together from a linear and connected net that functions as a complex system in the city; (2) "a group or system of interconnected people or things: a trade network; a group of people who exchange information, contacts, and experience for professional or social purposes." Greenways have the capacity to connect and facilitate the integration among different people.

The Oxford College Dictionary (2007, p. 1363) defines "*Structural"* as (1) "relating to the arrangement of and relations between the parts of elements of a complex whole." In this sense, the greenway physical environment features a myriad of relationships among people and between people and the natural environments. The term "*Structure"* is defined as (1)

“the arrangement of and relations between the parts of elements of something complex; (2) the organization of a society or other group and the relations between its members.”

“Connectivity”, can be defined as (1) “the state or extent of being connected or interconnected”, and (2) “capacity for the interconnection of platforms, systems, and implications”. Connectivity is the capacity of a landscape to facilitate the flow of its biotic elements. Corridors, permeability matrices, stepping stones and proximity between patches or fragments of natural ecosystems are all elements of connectivity. *“Connect”*, can be defined as (1) “bringing together or into contact so that a real or notional link is established” (2) “join together so as to provide access and communication”, (3) provide or have a link or relationship with (someone or something)”; and the term *“Connection”* as (1) “a relationship in which a person, thing, or idea is linked or associated with something else” (The Oxford College Dictionary, 2007, p. 297).

The Oxford College Dictionary (2007, p. 1391) defines *“System”* as (1) “a set of connected things or parts forming a complex whole, in particular”; (2) “a set of things working together as a parts of a mechanism or an interconnecting network” and finally (3) “a set of principles or procedures according to which something is done; and organized scheme or method”.

In the system definition, we can verify the overlap of some other terms, such as “network”, which is why understanding the term network is so fundamental. As stated by Ahern (1991), Linehan (1995) and Helmund and Smith (2006), greenways, as a complex open space system, are composed of a host of aspects: ecological, social and economic, whose processes and relationships must be comprehended with a multi-scale perspective in mind, principally the regional scale, to provide the sustainable function of such a system.

> “The network theory may provide greenway network designers with suggestions of how greenway systems could come together and function. (…) In applying such network configurations to a case study, a team of researchers found that the theory-based configurations were best used as guides, rather than as specific desired outcomes” (Hellmund and Smith, 2006, p. 215).

Linehan et al. (1995) presented schematic examples of six common network typologies, based on their different node connections. These network types and the names given to them by the authors are shown below in Figure 01. The author mentioned that the best solution is to have a network in which all the nodes (points) are connected, such as the *circuit network types* they call *"Traveling salesman"* and *"Least cost to user."* One of the most basic forms is a branching network called the *"Paul Revere"* network, which represents a traditional and single greenway that connects two or more points; in this case all the nodes are probably visited once and there are no irrelevant segments. Another basic form is called the *"Least Cost to Builder"* network. This is a branching network in which all the nodes are terminal and function only through single linkages that converge on floating points; this network requires the least cost to builder, and the length of all the connections is reduced to achieve a better efficiency. However, which is very susceptible to disruption of wildlife movement from the dispersion and or concentration of species flow. The other type of *branching network* is called the *hierarchical network,* where more important nodes connect secondary, less important nodes; in other words, the nodes are connected to a centralized point of distribution. The main point could be an important destination, such as a school, or community resource, or an important greenway feature that attracts people *(*ibid, 1995; Hellmund and Smith, 2006).

As stated by Linehan et al. (1995, p. 184) "as networks become complex, they take on the form of closed loops"; the *"Traveling salesman" circuit network* for example, as a single route, presents a minimal loop network, in which people and/or species gets back to where they started, the advantage of this in the outdoor recreational activities is that users do not have to turn around to return to the start point; on the other hand, the other type of circuit network, the *"Least cost to user"* presents diverse loops and return networks, since all nodes are connected to each other, providing an effective greenway system. Finally, the *"Beckman" circuit network* typology, combines two types of networks: the *"Traveling salesman"* (branching) and *"Least cost builder"* (circuit) attempting to balance user and builder costs and propitiate minimum distance connection and costs to the all the nodes, while promoting the connection of all points, with an advantage to the greenway users that

can use the network to move along the greenway connection between any two nodes without passing through any other nodes (Linehan et al., 1995; Hellmund and Smith, 2006).

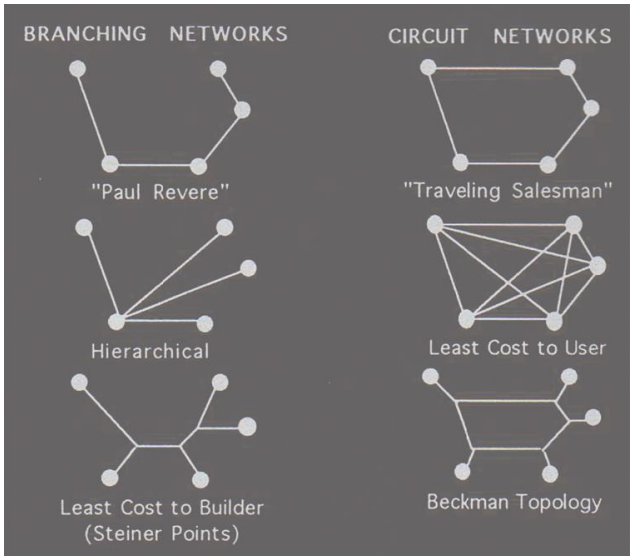

Figure 1: Examples of Common Network Typologies.
Source: Adapted from Linehan et al. (1995).

The network theory, when well applied to the development of our cities in terms of design and management, can mitigate atrophic impacts such as landscape fragmentation and social segregation through the re-connection of parts into a whole. Greenways, as a fruitful component of sustainable design, have an important role in this process, because of their complex systems, as a connector of people, connector of people with nature and connector of natural areas. The greenway network entails an incremental, multi-scale and long-term perspective and approach that must involve the participation of all citizens and multi and interdisciplinary professionals' perspective contributions in this process. However, these different perspectives and interests result in different approaches to the way greenways are

proposed, linked and implemented, as more natural or more developed types, and with different goals (Helmmund and Smith, 2006).

The planning of ecological networks and greenways has the potential to enhance ecological and cultural linkages and heritages, by the promotion of a trend of connections that can propitiate the integration of social and ecological aspects (Jongman and Pungetti, 2004). According to Ahern (1995, p. 135), “perhaps the strongest and most scientifically substantial argument for greenways is based on their potential role in ameliorating the negative effects on landscape fragmentation.” Greenways, as a connective network, seem to mitigate social and environmental problems as they can help to restore ecological functions while bringing nature and people together and enhancing their opportunities and experiences (Hellmund and Smith, 2006).

Ecological networks can be defined as systems of nature reserves and their interconnections. Greenways can function as the connectors of such systems, configuring a structural network system. “Greenways are networks of land containing linear elements that are planned, designed and managed for multiple purposes including ecological, recreational, cultural, aesthetic or other purposes compatible with the concept of sustainable land use” (Ahern 1995, p. 134). According to Smith (1993, p. xi) “greenways can be used to create connected networks of open space that also include more traditional, nonlinear parks and natural areas. They, thus, offer a powerful strategy for helping to maintain ecological integrity in human-dominated landscapes, especially with regard to preserving biological diversity and maintaining high-quality water resources.”

Greenway connectivity has the capacity to link the landscape and facilitate flow and function. But it also has the capacity to promote access, bring people into nature, provide alternative transportation and facilitate connection and interaction among people by promoting areas of socialization and by linking families, clusters of families, neighborhoods and communities together (Flink and Searns, 1993; Flink et al. 2001; Flournoy, 1969; Hellmund and Smith, 2006; Moore and Cosco, 2007; Moore et al. 2010; Simonds and Starke, 2006).

Greenway structural network systems, as mentioned by Flournoy (1969), Gobster (1995) and Hellmund and Smith (2006) can be analyzed at different scales and by network type, and also conformed by trails with different width and length:

- *different scales approach* (local development strategy and regional development strategy by primary and secondary priority trail and their relation with the destination points), according to figure 2;
- *network type approach*: traditional and single; hierarquical; minimalist; single back route; economical; single back route and economical; and/or made up of: major loop, major line, minor loop, minor line, penetrators and permeators), according to figures 1 and 3.

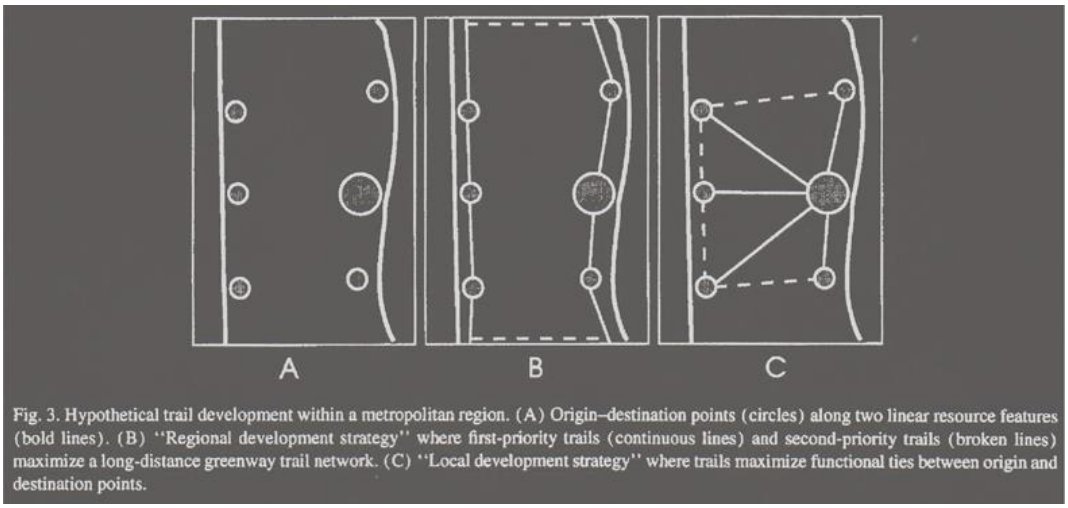

Figure 2: Examples of Regional and Local Network Typologies.
Source: Adapted from Gobster (1995).

It is important to clarify the differences between the most common linear recreation resources in the United States: trails and greenways. Even though both provide numerous

types of recreation opportunities, they are different in terms of definition and description. Commonly they are confused as the same thing, while other times these terms overlap with each other. A trail can be defined as a linear path that is used for recreation and transportation inside of parks and natural environment boundaries. A greenway is also a linear continuous open space corridor that presents natural and human-made features which provide multi-use (Moore and Driver, 2005). Flink and Searns (1993) and Moore and Driver (2005) mention that American trails are represented by many forms and layouts, based on their setting location (land and/or water), width, length and to receive a variety of purposes for passive and or active recreation, depending on human and environmental needs. The authors defined some main categories: type of *land-base routes*: urban, suburban, rural and wilderness landscapes; type of *water-base routes*: defined by the width and depth and also the navigability of the water bodies; *traditional backcountry trails*/*single-user routes* situated in more remote areas with abundance of nature, such as the narrow natural tread surface trails of National Parks and National Forests and the Appalachian Trail; *rail-trails* that are abandoned or unexploited railroad lines that have been transformed into trails for recreation and transportation purposes; *recreational greenway trails* that "are natural corridors of open space that contain a trail" (Moore and Driver, 2005, p. 265), for "walking or bicycling and sometimes areas for organized sports and other group activities" (Smith et al., 1993, p. 11); this category also can be called *multiuser routes* that are situated in any environment (land or water base) within the urban, suburban, rural greenways. According to Flink et al. (2001), the trail that provides a multi-use facility tends to attract and receive a greater variety of user types. However, in this setting, impacts, conflicts among users and types of activities and intense usage are common. These problems could be aggravated by other negative factors, such as, lack of facilities, bad management and inappropriate behavior.

Different types of trail layouts directly influence the way that people use and interact with the natural environments and with others. To balance human needs and recreation uses with natural environmental and wildlife needs, the trail layout and facilities (physical structure features) must respect the interior and sensitive areas of the landscape features. They also

limit and/or control the public access to guarantee environmental conservation and function (Flink and Searns, 1993).

Flink and Searns (1993) mentioned the existence of 6 types of trail layouts: linear, loop, stacked loop, satellite loop, spoked loop and maze, as explained below and illustrated in figure 3:

- *linear:* is the most common type of greenway connection, generally linking two destination points. The most common form of linear layout is the narrow trail within the greenway boundary. Shorter trail distances between two destinations/point of attraction present a disadvantage of this type of layout because it only offers the possibility of going from a desired destination point and coming back to the origin destination point, which may be monotonous, especially on short-distance trails. On the other hand, longer trail distances are preferred by many greenway users, such as: runners, bikers, walkers and in-line skaters, because the linear connection can enable them to go through different landscapes and places;
- *loop:* presents more flexibility to the diverse range of greenway user needs; they provide a complete circuit in which the origin and destination nodes are the same. However to implement this type of trail requires more land and has the disadvantage of lack of variation in the route.
- *stacked loop*: provides more looping alternatives with different loop size circuits, varying in length from short trails to medium and long trails; this type provides environment diversification for users and is a good alternative for different topographical features, such as varying elevation and slopes. This type is welcomed by diverse types of users because it facilitates the occurrence of different types of recreational activities, and changeable experiences with different levels of usage;
- *satellite loop:* is configured by a central collector loop from which other sub-loop circuits originate mixed with linear trails that can serve recreational and transportation needs;

- *spoked loop:* is composed of a sequence of linear trails that are connected to a central core main loop, made up of a small trail and representing a specific and strategic destination/point of attraction, into which the other trails converge. This pattern type is indicated for regional trails, that intend to link numerous communities;
- *maze:* is composed of a multi-dynamic connection of trail types: linear, looped and other alternative routes and intersections. It is ideal for multi-use trails regional community settings because of the complexity and various types of connections and intersections; it may present some routes for recreation and alternative transportation.

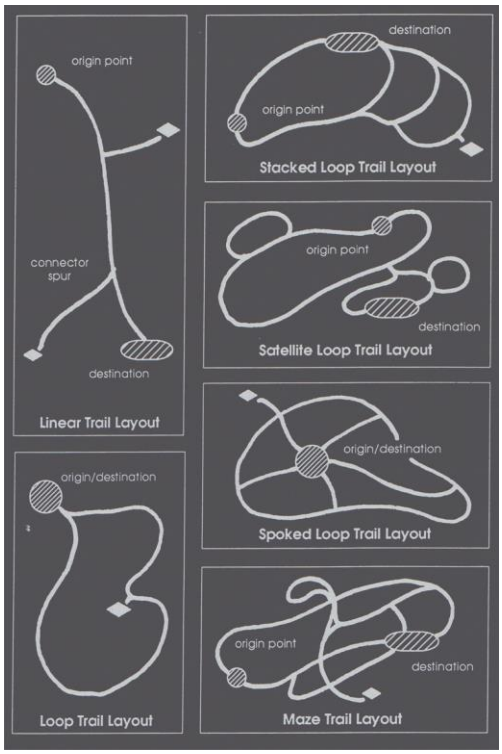

Figure 3: Examples of 6 Types of Trail Layouts.

Source: Adapted from Flink and Searns (1993).

Greenway network systems can also be evaluated by the trail morphological type, layout and function, and as a type of network of connections. The design of greenway trail networks directly influences people's outdoor activities. Some types present patterns and characteristics (connections, destinations and point of attractions) that lead to less or more intensity and density of use. When there is incompatibility of use, designers and developers may attempt to mitigate this problem, either allocating separate trails for each type of activity, or planning multi-use trails. Recreational greenways tend to receive a large number of users and activities, which has led to the interest in studies dealing with trail typology related to patterns of use (Little, 1990).

There is a clear trend toward connectivity in the current approach to developing greenway structural network systems. This strategic way of connecting people with people and people with nature may foster a social network. If we expand the greenway structural network into a larger design system, we can facilitate multiple human interactions and experiences, linking everything and everyone together (social and cultural connection and interaction). It thus seems clear that, in some way, greenways facilitate socio-cultural interactions.

2.6. Greenway Characteristics: Connections, Objectives, Benefits, Functions and Patterns of Use and Type of Users

Greenways are considered a strategy for open-space conservation and the demand for recreational open space, which can partially solve the problem of many cities: urban growth, rising land costs, and the difficulty of landscape conservation areas, while providing more inner city open spaces with recreational opportunities. Because of their linearity and narrowness, they require less land than conventional parks. They often cost less as they are commonly implanted in areas such as, bottomlands, floodplains, abandoned railbeds and other undeveloped locations and they contribute to the urban quality of life (communities and neighborhoods). They also have the "ability to wind through a variety of habitats and communities" (Flink and Searns, 1993; Hellmund and Smith, 2006, p. xi; Schwarz, 1993;

Smith, 1993). Their linear configuration also “makes them well suited for trails, while their common presence along water encourages boating and fishing and makes for beautiful scenery. Recreationists therefore have a strong affinity for greenways and have become their biggest boosters among the general public, playing a significant role in greenway advocacy” (Smith, 1993, p. 9).

The President’s Commission on Americans Outdoors (1987, p. 124) stated that greenways have the advantage of connecting different open space areas, and promoting recreational uses. Greenways “will connect parks and forests and scenic countrysides, public and private, in recreation corridors for hiking, jogging, wildlife movement, horse and bicycle riding.” Hellmund and Smith (2006, p.5) add that “Just as water and wildlife move and flow in the landscape, there are myriad social connections in the landscape that increase with greater human presence. Greenways create opportunities to steer these new connections in socially positive ways.” According to them, greenway corridors and trails have the potential to connect landscapes in an efficient network system when “designed and managed for multiple purposes, such as nature conservation, recreation, stormwater management, community enhancement, social equity, and scenery protection, with an overall aim of sustaining the integrity of the landscape, including both its natural (biophysical) and social components.”

Greenways can be defined as a transitional open space between places, a channel of different ideas and functions to serve multi and different objectives. The architect Herbert Muschamp defined that the greenway “in-betweenness” as a stage of the greenway public realm, that presents different concepts, ideas, values and opinions. Greenways have the potential to provide a public open space for recreational pursuits, a place that encompasses the dimensions of time, landscapes, nature and people. For these reasons the greenways are a dynamic, vital and enriching environment for everyone (Midtown Crossings Workshop, 2001).

Little (1990), after his experience of visiting 25 representative projects of greenways over the United States, classified greenways into five major types:

- *Urban riverside greenways:* configured by accessible paths and trails near or at the waterfront area, generally originated as a redevelopment strategy or urban renewal;
- *Recreational greenways:* that meet the human needs for outdoor recreation in urban settings, commonly made up of numerous types of paths and trails on natural corridors, canals and abandoned railbeds, with different lengths (short, medium and long distance);
- *Ecologically significant corridors:* that reconnect landscape parts, creating a whole necessary for ecological diversity conservation and ecological homeostasis; commonly occur along river and stream ridgelines, protecting their riparian areas and promoting the wilderness conservation; ideal for uses such as nature study research, nature contemplation and hiking;
- *Scenic and historic routes:* provide the value and protection of the cultural resources, with historical values along roads, highways and waterways,
- *Comprehensive greenway network systems:* consists of the combination of all the other four types, creating a complex and inter-connected system of greenways, parks and other cultural features. Commonly occurs on natural landform settings with abundance of landscape and wildlife, such as valleys and ridges; also tends to connect different types of open spaces, creating a regional green infrastructure network.

Comprehensive greenway network systems are also known as greenway networks and green infrastructure. “Green Infrastructure (GI) is defined as interconnected networks of green space that conserve natural ecosystem values and functions and provide associated benefits to human populations. The network consists of waterways, wetlands, woodlands, wildlife habitats, and other natural areas, greenways, parks, and other conservation lands; and working farms, ranches, and forests” (Hellmund and Smith, 2006; Randolph, 2004, p.98).

However, in recent literature, many names have been given to “greenways:” ecological infrastructure, ecological network, extensive open spaces, multiple use modules, habitat networks, wildlife corridors, landscape restoration framework, among others. These concepts differ from each other in terms of meaning and objectives, and sometimes can be misunderstood or confused because of the diverse meanings of their terminology (Ahern, 1995 and 2004). In fact, greenways are highly complex endeavors, each case involving unique characteristics due to local conditions, landscape elements involved and also the type of interactions with surrounding lands (Hellmund and Smith, 1993). Hellmund and Smith (2006) state that greenways can be categorized into different types, including recreational, nature conservation, or a combination of the two. In addition, some greenways are designed and planned to be multi-functional and multi-objective, to address socio-cultural and ecological concerns (Ahern, 1995; Fábos, 2004; Ndubisi et al., 1995; Sharma, 2010; Steiner, 2002), while others have more specific functions and objectives.

In order to understand the differences among greenways and how they fit into the different categories, it is important to analyze specific landscape settings and greenway characteristics, such as their objectives, benefits and functions. “While categorizing greenways help us to understand the different forms they may take, in reality, types blend and overlap. (…) the strength of the greenway movement, and the attraction of the concept itself, lies in its diversity of form and function. The greenway concept is flexible enough to adapt to many combinations of local needs, values and conditions” (Schwarz, 1993, p. xvi).

Hellmund and Smith (2006) and Smith et.al. (1993) mentioned that greenway characteristics differ by their types and forms: width, shape; different geographic locations; and diverse landscapes: vegetation type, type of topography, soil type and type of water bodies; and/or different physical environments, with a greater or lesser concentration of people, all of which inform the greenway’s function: only ecological, ecological and social, or only social, which includes recreation.

> Many greenways share common characteristics simply because, by definition, they are linear and natural. However, the ecological structure and function of any given greenway will depend on its locations, its shape, the types of habitat it contains, and the nature of any human modification that has occurred within its boundaries. These and other factors will all help determine how well a greenway functions for plants, animals, water and people" (Smith, 1993, pp. xi-xii).

In addition, Hellmund and Smith (2006) and Schwarz (1993, p. xviii) mentioned that greenway planning, construction and management must be conducted by a multi-disciplinary group: landscape architects, engineers, hydrologists, recreationists, and other professionals. According to them "every greenway type poses a different set of variables to work" with. Greenways present specific characteristics and functions based on their settings: less developed areas (more natural and rural areas), or "highly developed recreation and urban greenway" and suburban areas.

All kinds of greenways are being designed, some with a more ecological perspective, others with a more social perspective, but in both instances with the aim of maintaining the ecological processes of the natural resources of landscapes. The key-issue is how to accommodate the balance of the ecological processes between nature's need and functions, with the human uses, needs and functions (Manning, 2011; Moore and Driver, 2005; Smith, 1993).

In addition, Lusk (2002a) mentioned that the greenway characteristics (type of features, type of trails, type and number of destinations, and distance between destinations) encourage a variety of users and activities. She mentioned that may aspects must influence how people use or feel attached to the greenway environments, according to their needs, association and preferences, such as: exercise, well-being, restoration of directed attention, integration with nature and/or social interaction.

Greenways are often cited as providing both *environment and social benefits*. The *environmental benefits* are numerous, including protection of ecologically significant natural

systems, by preserving bio-diversity and wildlife migration, connection of fragmented habitats, environmental restoration, noise reduction, smog reduction, dust reduction, heat reduction and rain reduction. From a social and community perspective, *greenways provides social benefits* such as provision of places and environments for outdoor recreation, social interaction and physical-health activities, such as walking, jogging, bicycling, fishing, hiking, canoeing, swimming, playing outdoor sports: cross-country skiing, active travel-oriented sports, and at the same time the help conserving and enhancing the integrity and quality of the landscape scenery, aesthetics and function, and to preserve the community cultural heritage by the protection of historic and cultural settlements and resources (Fabos, 2004; Flink, 1993; Flournoy, 1969; Hellmund and Smith, 2006).

“Of all the benefits greenways provide, recreation has received the most popular attention. A growing urban population with significant amounts of leisure time, combined with an overall surge in health consciousness has led to increasing demand for outdoor pursuits” (Smith et al., 1993, p. 15), and that’s the reason why it is important more greenways studies that deals with the social aspects and issues. Flink (1993) mentioned that greenways must not only provide recreational benefits, they have to provide environmental and ecological benefits also, otherwise the intensively of recreational usage will definitively impact negatively on the greenways natural resources.

According to Helmund and Smith (2006), Jongman and Pungetti (2004) and Little (1990), greenways are very complex systems, even more than other types of greenspaces. They offer many functions, some of which are *environmental and ecological functions:* mitigation of landscape fragmentation; water quality protection; cleaning and recharging of aquifer waters, flood control (soaking up and storing excess water); protection of riparian vegetation and forests; habitat protection and connection for plants and wilderness; reduction of urban growth impacts. They also play an essential role in urban design, like other types of parks and natural areas, providing the *social functions* such as the enhancing aesthetic value (common located along natural physiographic corridors, streams, rivers, lakes, urban forests and ridges with historical and cultural importance); providing visual coherence and visibility;

accessibility; sense of history and culture; place identity; sense of place; sense of belonging and community integration.

Flournoy (1969) cites a variety of greenway functions, such as parks and recreation, planning, sewerage and transportation. The author also illustrates an extensive list of greenway objectives: to promote open space corridor connections; to establish linear park networks; to enhance public and private development through urban amenities; to introduce an intra-city trail system, where the community can practice outdoor activities; to buffer conflicting urban zones; to give an alternative to automobile transportation, by improving pedestrian and cycling paths; to retain and maintain natural and ecological functions in the city; to provide the city with an effective and sustainable plan for the present and the future; to elevate the livability of the urban environment; to stimulate public uses for recreational and leisure needs and to improve the urban quality of life.

Because of their linearity, narrowness and greater perimeter, greenways have more potential to reach, connect, penetrate and integrate different landscapes, different areas of the city and more neighborhoods, attending different urban and ecological needs, while providing more accessibility and visibility along its entire trajectory, much more so than conventional parks, as can be seen in Figure 04 (Flournoy, 1969).

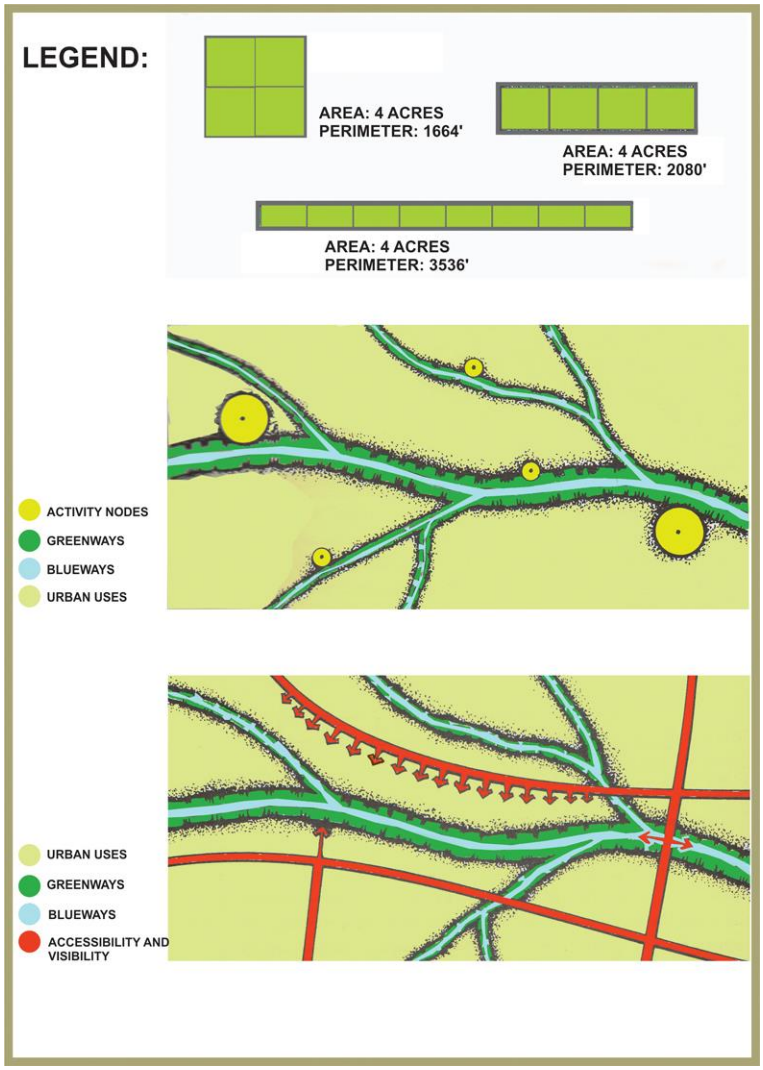

Figure 4: Greenway Format and Composition Scheme.

Source: Adapted from Flournoy, 1969. Modified by Pippi, 2010.

Greenways also can contribute to shape the city park system, by increasing the connections and concentration of urban functions through their multi-use trails and activity node areas, accommodating from 7 to 16 activities planned for the other parks, such as: walking,

running, bicycling, in-line skating, picnicking, fishing, nature walks, horseback riding and hiking (Flournoy, 1969; Lee et al. 2002; Moore et al. 1998). Helmund and Smith (2006) and Smith et al. (1993) also mentioned that greenway linearity propitiates the linkage of diverse neighborhoods, tying communities together and connecting other places such as, parks, other greenways, historic sites, residential areas, and commercial areas, facilitating the flow of people from one place to another. If they are well designed and managed, they create opportunities for new social connections, fostering positive social interaction, building a sense of community, and promoting social justice and equality, through a democratic participation in recreation activities.

According to *Americans Outdoors in the U.S*., in 1987 the greenway network functioned as a colossal circulation system, whose purpose was to link urban and rural landscapes and also to offer public access to open spaces located near people's houses and neighborhoods (Ahern, 2004). "The American concept of 'nearby nature' comes from the need to experience the natural world as a normal part of everyday life, and has been shown to improve personal and social health. It is therefore a psychological and social benefit at the same time" (Jongman and Pungetti, 2004, pp. 290-291).

The greenway structural network system can afford both environmental and social benefits, because it is easily accessible and can bring nature and people together. The *environmental benefits* include ecological restoration, protection of natural systems, rain drainage, and reduction of noise, pollution and heat. The *social benefits* include extensive recreational, physical-health activities and "recreational and nature education and appreciation opportunities for urban residents, as well as routes for non-consumptive transportation such as walking and cycling". However, greenway systems are not achieving their full potential to enhance the social integration network. Greenway users and actors may or may not be taking advantage of all of the potential social benefits. Activities that involve social integration may have been insufficiently explored by users. To understand recreational greenways it is important to recognize the social life linked to them. Nevertheless, there is an absence of research that deals with social issues related to recreational greenways. It

also unclear how greenway characteristics affect on cross-cultural interactions (Flink, and Searns,1993; Gobster, 1995; Hellmund and Smith, 2006; Little, 1990; Lusk, 2002; Luymes and Tamminga, 1995, p. 391; Moore et al. 1998; Moore and Scott, 2003; Whyte, 1980).

Table 1 (Appendix A) summarizes general greenway characteristics, including major types of greenways, associated/synonymous names related to the types of connections, objectives, benefits, functions, potential uses/types of activities, and types of users, as well as landscape features and physical structure features. Table 2 summarizes specifically the social benefits of outdoor recreation spaces (Appendix A). Tables 3a and 3b (Appendix A) presents extensive information that facilitate the description of greenways features. For the current study, they may help to identify greenway characteristics, and will serve as a basis for the greenways characteristics audit that will be carried out using a method analysis in the pilot case study.

2.7. Greenway Methodological Approaches

This section of the literature review investigates different types of methodological approaches grouped into two areas: Survey Questionnaire and Survey Mapping Exercise Methods and Observational Methods and GIS Methods that appear useful for studying greenway characteristics and its uses and interactions. I elected 19 studies that were directly related to parks, greenways and trails, to provide a range of approaches (main-concepts, protocol, variables, analysis and/or results) that served as a foundation for the construction of the methodology for this study. By combining objectives, protocols, findings and conclusions of the 19 annotations, as part of the literature review (Appendix B), I aim to summarize the different theoretical frameworks (analysis of their main concepts) in terms of main-concepts, methods, procedures, analysis and suggestions for future research.

Some of the presented studies focus on models that have been developed and/or improved in studies of outdoor recreation, landscape planning, design and management of

recreational areas and transportation, illustrating some inter-disciplinary ways to approach the greenway and trails issues and how to achieve reliable information necessary to mitigate the greenway impacts, and to provide insights to the greenways quality physical environment (natural and man-made) in harmony with recreational and social needs and objectives. Main-concepts used directly or indirectly in the studies of Gobster (1995), Moore et. al. (1998), Lee et al. (2002), Gobster (2002), Moore and Scott (2003), Manning et. al. (2005), Asakawa et al. (2004), Lindsey et al. (2008), Chon and Shafer (2009), Gobster (2005), Lusk (2002a), Cromley et al. (2005), Shahani (2013), Gobster and Westphal (2004), Bush (2010), Bush (2011), Golicnic and Thomson (2010), Reynolds et al. (2007) and Moore and Cosco (2007) include: place dependence; place attachment; place identity; sense of place; individual/community attachment; setting interaction; behavior setting, behavior segments; territoriality or territorial range development; setting affordance or segment affordance; connection types (local, regional, state), destination types and/or alternative transportation/mobility, mode of transportation, length of travel and spatial articulation/distribution; social aspects of outdoor recreation (use, uses, interactions, types of activities, activity levels, behaviors, encounters), social ecology, social inclusion, social identity, social capital, social bonding, social network, social ties/bridges, cultural diversity and inclusion, aesthetic aspects; motivation and benefits of outdoor recreation; indicators and standard quality of the outdoor environments; outdoor recreation conflicts and problems; aspects of outdoor recreation: attitudes, preferences, perception, experiences, enjoyment, values and meanings; type of features and amenities/facilities; frequency, distribution and density of users; crowding in outdoor recreation: use level, crowding perception and satisfaction; and parks, greenways and trails; guidelines for: planning, design, universal and inclusive design, management implications, policy makers and public participation in greenway/trail planning (Flournoy, 1969; Whyte, 1980; Taylor et al., 1987; Little, 1990; Flink, and Searns,1993; Gobster, 1995; Gobster, 2002; Gobster, 2005; Gobster and Westphal, 2004; Flink and Searns, 1993; Flink et al., 2001; Asakawa et al., 2004; Chon and Shafer, 2009; Cromley et al., 2008; Moore et al., 1998; Manning, 2001; Kyle et al. 2005; Lee et al., 2002; Lindsey et al., 2008; Lindsey and Lindsey, 2004; Lusk, 2002a; Moore and Scott, 2003; Moore and Driver, 2005; Low et al. 2005; Kyle et al., 2005; Hellmund and

Smith, 2006; Wong, 2007; Moore and Cosco, 2007; Reynolds et al., 2007; Thwaites and Simkins, 2007; Lee et al., 2008; Lindsey et al., 2008; Schaftoee, 2008; Knoke and Yang, 2008; Carmona et al., 2008; Dempsey, 2009; Scott, 2009; Wasserman and Faust, 2009; Moore and Cosco, 2010; Bush, 2010; Bush, 2011; Golicnic and Thomson, 2010; Shahani, 2013). To be able to integrate the theoretical perspectives of each annotation, I created the table illustrated in Appendix B: Integration of 19 Annotated Bibliographies Common and Unique Elements Investigated in Theoretical Perspective Framework that shows clearly the uniqueness and/or similarities of such studies. By comparing those bodies of work of various authors, I was able to better visualize the conceptual framework and analyze their information to finally elect the best aspects and sub-aspects that fit in my research study, or to be able to visualize what might or not be appropriate for my final research methods, or to identify the aspects and sub-aspects gaps that needs more studies or more detail information from the tables illustrated in Appendix B.

2.7.1. Survey Questionnaire and Survey Mapping Exercise Methods

Moore et. al. (1998), Lee et. al. (2002), Moore and Scott (2003) consist of fragments of the same study, with the same location area (4 mile long, eight foot wide, asphalt paved suburban multi-use greenway trail in North Chagrin Reservation near, Cleveland, Ohio). They utilized a multi-method approach (method 1: face-to-face interview with the trail adult users, administered at pre-determined trail segments on weekends and weekdays and method 2: Self-administered questionnaire (to be taken home and forwarded by mail), however, they presented different and complementary aspects (setting interaction, behavior setting, setting affordance, social aspects of outdoor recreation, motivation and benefits of outdoor recreation, type of experiences, users attitudes, preferences and perception, frequency and density of uses). The variables, analysis and results of their study, provide valuable and reliable information about those aspects.

Kyle et al. (2005) and Moore and Scott (2003) mentioned the importance of setting attachment analysis to be able to understand users' perceptions, preferences and values of the features, points of attractions and destinations of conventional parks and/or greenways and their trails, based on concepts such as place dependence, place attachment, and social bonding as an additional aspect according to Manning (2005). Such measurements are essential indicators of standard quality of the outdoor environments, because they provide valuable information such as frequency and density of use, user satisfaction and behavior.

Kyle et al. (2005) analyzed place attachment by 3 measurements: place identity, place dependence and social bonding on two types of groups of hikers of the Appalachian Trail (AT) during the summer and fall of 1999. The study used Multi-method approaches. Method 1: stratified, systematic sampling technique, with all the AT hikers, administered at pre-determined trail segments on weekend and weekdays. Method 2: Self-administered questionnaire (to be taken home and forwarded by mail). Study variables: 3 models of place attachment were tested. The study observed variation across groups in several elements of the measurement and structural components of the model; it also provided information that the scale validity and reliability of measurements of the place attachment with covariance structure analysis. However, there still remained some concern about the performance of several indicators (low factor loading, low reliability). The authors suggested that the integration of social bonds into the conceptualizations of place attachment is important, to promote greater validation and reliability of the used dimensions (low factor loadings, t-values, low internal consistency) and that more studies are needed with the addition of more items and sub-items for the measurements of place attachment and measurements of place dependence.

Moore and Scott (2003), analyzed how different scale sizes of a recreational setting (large and specific scale) influenced how people utilized them and were related to people's attachment to those environments. They developed the setting comparison of both scales to identify the common greenway trail users' perceptions, preferences and values, and the different patterns among different group type (walkers, runners, in-line skaters and bikers).

Multi-method approaches were conducted in this study. Method 1: face-to-face interview with the trail adult users, administered at pre-determined trail segments on weekend and weekdays. Method 2: Self-administered questionnaire (to be taken home and forwarded by mail). The Independent variables: the trail activity which the participants were engaged on the interview day (waking, running, in-line skating and biking); proximity of the North Chagrin Reservation to the user's home (in minutes); frequency of trail usage (times used – last 12 months), commitment to their particular trail activity (personal and behavior commitment: waking, running, in-line skating and biking); They used a 5 point-scale to rate the responses categories: (1) strongly disagree – (5) strongly agree; factor analysis were used to determine the principal dimensions of commitment. Correlation-regression analyses were used to verify if those 4 independent variables were significantly related to trail attachment. The Dependent variables: factor analysis were used to test trail attachment (8 items) and park attachment items (8 items), in which 4 to measure place dependence, and 4 to measure place identity, according to Moore and Graefe (1994) (table 1, p. 880); 5 point-scales were used to rate the response categories: (1) strongly disagree – (5) strongly agree; factor analysis were used to determine the principal dimensions of trail attachment and park attachment. Paired t-tests were used to verify whether or not trail users differed significantly in terms of their attachment to North Chagrin or their attachment to the trail.

Lee et al. (2002) posed that motivations and attitudes of suburban trail users are not well-understood and that "Even less is known about the relationship between participant's motivations and attitudes toward trail conditions" (ibid, 2002, p. 19). The study's purpose was to examine the relationship between user demographic characteristics, intensity of user involvement during outdoor activity, the recognition of the type of activity pursued, and the identification of people's motivation and attitudes toward trail condition: paved greenway suburban trail that accommodate multi-use activities (walking, hiking, bicycling and running), including a new one that recently emerged: in-line skating. Data were collected from the All Purpose Trail (APT) during summer of 1994. The independent variables of the study were: 4 trail users' demographic characteristics (gender, age, race/ethnicity and level of education); activity type: walking (including walking dogs, pushing strollers and "speed walking"),

running, in-line skating and bicycle riding. To measure the intensity of the participants' involvement in their outdoor recreation activity, it was utilized 3 scales of measure: frequency of trail use, personal commitment and behavioral commitment (users' expectations). The dependent variables were the measurements of the trail users' motivations that were categorized in 12 items (motivations of APT users scale): exercise, enjoyment, relaxation, appreciation of nature, personal control, solitude, reflection, family togetherness, excitement, friendship ties, skill development and novelty).

Lee et al. (2002) carried out a standard multiple regression analysis to "test whether or not demographic characteristics, intensity of involvement, and activity type were significantly related to motivations and attitudes" (Lee et al., 2002, p. 25). To better understand the activity type of the multivariate analysis, dummy variables were created. R-square change scores and standardized beta coefficients were also reported. The results of the study provided useful information about the respondents' demographic characteristics, including the average time to get to the greenway trail, which was 16 minutes and the average distance from the home to the trail, which was 11 miles. The motivations of APT users that were most frequently mentioned were exercise, enjoyment, relaxation, appreciation of nature, personal control, solitude. Factor analysis was utilized to provide information about the attitudes toward trail conditions, which produced a five-factor solution with the following attitude items: access/comfort amenities; depreciative behavior; trail design; conflict with other users and safety. The results corroborate with findings from other studies in that "the type of activities in which outdoor recreationist participate are likely to be strongly related to the type of benefits they seek". Results also suggest that "future studies that seek to understand motivations among users of urban trails should consider the affective attachment people have toward the activities in which they are involved" (ibid, 2002, p. 32). One implication was the need to apply those variables to other types of users, actors and activities that occur on the multi-use trail and that represent a very different mix of experiences.

“Future research should be directed at determining whether or not our findings can be generalized to other urban proximate locations. Beyond this, it is important for practitioners to understand the range of benefits people seek when using multi-use trails and the extent to which these are compatible” (ibid, 2002, p. 34). When these are not compatible, it is necessary to find “strategies for mitigating differences among trail users” (ibid, 2002, p. 34). The authors also suggested that the list of trail attitudes and motivations may be refined using other items to be able to better predict the multi-use trail users motivations, attitudes and experiences.

Moore and Scott (2003) provide useful information about the relation between setting attachments to a large metropolitan park and attachment to a particular trail located within the park boundary among adult users. Setting size may affect the users’ relationship and attachment by increasing or decreasing their personal relationship with the park or trail. One strength of the study was that it considered place attachment to be multidimensional and proposed the employment of a functional dimension (place dependence) as well as a symbolic/emotional dimension (place identity). One limitation identified by the study was that the place attachment measurement for trails and parks needs to be improved, and may be combined with symbolic/emotional meanings. One important implication was that people developed more attachment to places that are closer to their homes. The authors pointed out that more studies are needed to compare and describe the relationship between personal commitment to outdoor recreation activities and place attachment. It would be valuable to better: define the different dimensions of place attachment; understand the dynamics and catalysts for setting attachment of trails and parks (micro and macro setting physical environments); understand how different types of actors (individuals, sub-groups and groups) are related to their surrounding parks and trails settings; explore different methodological approaches that could be used to understand place attachment and context, like qualitative method approaches; use Geographic Information System (GIS) to investigate place meaning and attachment dimensions, related to parks and trails settings.

Gobster (2002) studied users from the largest park in Chicago (Lincoln Park) to identify outdoor recreation use patterns, experiences and preferences among different users (racial and ethnic groups). By investigating this public urban setting, the author aimed to understand access to recreation sites (park) and the effect of external factors (cost, transportation) and internal factors (site features and facilities) on different users, uses and actors and their diversity of needs and experiences. The study focused on users' environmental perceptions and preferences that affected their recreational activities, in order to ascertain how parks can better function for diverse racial and ethnic groups. The study consisted of an on-site sampling design and interview to survey users (racial and ethnic) with 14 items: use patterns, preferences, management concerns and user demographics. The results included the identification of different patterns of users, activities, preferences and perceptions of safety; settings preferences and incidents of racial discrimination and ethnic. The park was dived into three major zones and 30 subzones, in which interviews were conducted at different times of day (8a.m-noon, noon -4p.m. and 4-8p.m.) and on different days (week days and weekends), to achieve a representative sample of park users. Results from on-site survey of 898 park users (217 Black, 210 Latino, 182 Asian and 289 White), demonstrated different interests, preferences and concerns about the park and its management. The items utilized for the use pattern analysis were: distance to the park; mode of transportation; frequency of use and social preferences (social group size and composition: individual, groups of family and/or friends). Results from the use patterns showed that "minority park users" (Black, Latino, Asian) "came from farther away to use the park" and came by car and "were more likely to visit in large, family-oriented groups" than white park users (Gobster, 2002, p. 146).

Open-ended questions were posed about users' activities on the interview day as well as during other times and seasons, which allowed for the identification of common activities and group variations (activities types and cultural diversity). Five main items were selected and composed by sub-items: *passive activities* (social engagement in passive activities: talking, gathering together, socializing and celebrating): sightseeing/hanging out/ sitting, relaxing, resting/taking fresh air/ watching people, opp. Sex/ watching organized sports/

talking, socializing/ dating, affection; picnicking, barbeque; festival, parties; *active-individual sports:* walking; jogging, running; bicycling; rollerblade/skateboard; exercising; walking dog; *active-group sports*: soccer, baseball, basketball, volleyball, tennis, football, golf, other organized sports, games, Frisbee and children playing; *water sports:* swimming, sun on beach; fishing; boating, watch boat; *miscellaneous:* zoo, watching zoo animals; museums, conservatory; birding, feeding birds; commuting through park; working, studying.

The site preferences and perception of safety analysis were conducted with open-ended questions designed to pinpoint what park users liked and disliked about Lincoln Park. The items of things that people liked about the park included: *natural environment* (beauty, scenery and view; nature, natural environment; wide, open space; trees and other vegetation; lake, shoreline and water; beach and sand; birds and animals; sun, sunrise, weather; fresh air, lake effect; contrast of park with the city); *cultural facilities and maintenance* (city view and skyline; zoo; park buildings; play courts and fields; biking and jogging paths; cleanliness/maintenance and security); *activities and events* (seeing people/activity/ picnics and festivals; watching/doing sports); *miscellaneous* (peaceful, friendly atmosphere; good and close location; like it all, fun place). The items of things that people dislike about the park were composed by 3 items: *facilities/management problems* (lacks maintenance; not enough nature and trees; bad air and water quality; need cleaner restrooms; path conditions/length; beach condition closed areas; litter and vandalism; lack of facilities; lack of parking; cost of food, parking; lack of information, programs); *social and user problems* (lack of security; crowded; cars and traffic; trail user conflicts; loud and rude users; pet problems; drunks and drug users; gang and drug dealers; police/staff behavior; racial problems/prejudice; homeless/strange people); *miscellaneous* (parking; access problems) (Gobster, 2002).

Gobster (2002) identified at the end of his study lots of racial and ethnic minority issues and concerns: favored locations in the park (popular and unpopular areas), racial and ethnic discrimination, and ethnicity of park user types (25 different ethnic groups). Access to park facilities is a key planning and management issue; social action and interaction identified by

the social patterns occurrence, showed distinct differences among different type of users. “Although social interaction was found to be an important aspect of minority park use, results also suggest that most interaction takes place within rather than between groups. Some racial/ethnic gathering spots mentioned by park goers were very clearly delineated; this was also evident in observations made during the field sampling. A few users reported interethnic conflicts” (discrimination, park environment inequity) “from crossing racial/ethnic group boundaries” (ibid,, 2002, p. 155).

According to Gobster (2002) more research in this type or other types of settings, such as greenways is needed and qualitative and ethnographic methods must be also explored to gain a deeper understanding of the meanings and values of users’ leisure experiences, especially for different racial and cultural groups. In-depth interviews are necessary to gain information about discrimination and socialization of minority groups. Ethnic minority groups were identified as an important population for further study (parks and greenways) and also other user types, such as older adults, teenagers and children, to better understand: user patterns, preferences, perceptions and socialization patterns.

The purpose of a later study from Gobster (2005, p. 374) was to comprehend how users that sought health as their major goal of trail use differed in terms of use patterns and perceptions from individuals who used the tails for other purposes, such as pleasure. The method utilized was in-site survey approach conducted with 2,873 individuals who utilized a diverse sample of 13 trails in the Chicago Metropolitan Area consisting of questions about why they used that trails during the day of the data collection, the user type of use patterns and their perceptions. This provided information about the users’ reasons for utilizing the trail on that day and promoted the creation of a multiple category dependent variable for association. Ten type/variable category levels were counted and recognized as most important reasons for use (health, pleasure and others): use/frequency of use this trail (first time-3 times/year; 4-25 times/year; every week on trail); mode on trail (foot, bike); group size (1, 2, 3-more); close distance in miles from home to trail (1 mile or less; 2-5 miles; 6-20 miles; more than 20 miles), in this case “this pattern of results for use-estimated distance

closely mirrored a calculation of the distance between the trailhead location and home ZIP code provided by the survey respondents" (Gobster, 2005, p. 376); hours spent on the trail (1 hour or less; 1-2 hours; 2-3 hours; 3-5 hours; more than 5 hours); means to trail (foot, bike, car); number of other trails used (no other trails, 1-2 other trails, 3 other trails); perceptions about lack of patrols (no problem, partial problem, big problem); personal safety patrols (no problem, partial problem, big problem, water body preferences, safety areas preference); demographic by age (less than 18, 18-39, 40-55 and more than 55).

The results included 14 mentioned items of trail problems, being 8 items about trail development issues and trail preferences with 11 likes and 11 dislikes coded from open-ended answers. Pleasure-oriented users were more health-motivated than other users, they appreciated a well-maintained trail environment and were concerned about trail crowding and lack of trailside facilities such as bathrooms and drinking fountains. and the mentioned preferred trails presented the presence of natural-aesthetic features and water bodies. However the study didn't clearly identify other aspects such as psychological, personal, psychophysiological, social/cultural and environmental reasons and motivations of why people use the trail, neither the perceptions about the environment and social ambience (crowding areas, moderate and less used areas) nor social interaction on that occurs on the trail (Gobster, 2005).

Lusk's (2002a) study of multiple cases of greenways: Stowe, Vail I-70 (rural) in Colorado, South Plate River in Denver, Chicago Lakefront Trail in Chicago (urban), Minuteman Trail in Boston and West Orange Trail in Florida (rail-trail) used a multi-method approach, including survey questionnaire, survey mapping exercise and observational methods. The observation method it will be described later. The survey methods indicated information about users preferences including features, activities, meanings and destinations of the environments. The survey employed a technique using stickers and a map distributed to key-individuals (bicycle path/greenway expert recreators) or organizations in each case study community with the map locations of 12 attractive bicycle paths across US, 3 urban parks, 3 rural paths, 3 rail-trails and 3 Frederick Law Olmstead paths.

Lusk (2002a) found that the total of 30 to 40 surveys were distributed to a recreational club or community leader or individual habitual users of the path per case study. Except for the individual users, the other ones received a training in how distribute the surveys to a stratified population, according to gender, recreation activity, age and athletic ability (ibid, 2002a, p. 158). She provided individual maps and an additional form so they could list the destinations and features, colored pens and multiple stickers' with coded colors. Respondents provided information about their preferred greenway areas: destinations (location and name), features, activities and meanings of each destination (location, name and description), location(s) where they started on the path, indication of places of enjoyment, indication of attractive and unattractive places, appealing places, boring places, unappealing places or things, and the direction location of view enjoyment. In addition, some demographic information (gender, age, ethnic, income, occupation) along with types of activity and frequency of usage was determined.

Finally according to Lusk (2002a) the sticker map was compared to the written list. The distances of the destinations were also measured using odometers attached to each surveyor`s bicycle. After those measurements, they were recorded on a greenway map for that community and later entered into a computer data set. The number of destinations was controlled through 5 measures with a final comparison with another 2 measures: 1) an overlay map with the stickers for each case study was created; 2) a mean, median and mode were determined for each number of destination sticker per category; 3) specific mean was determined for the highly preferred destinations per case study; 4) 2 to 6 mile univariate analysis of variance showed a mean of number of destinations based on the traveled distances; 5) a mean, median and mode were determined for each of the numbers of destination for each activity type; 6) all means of the 6 case studies were compared and 7) specific numbers of destinations were elected as central tendencies to be able to prove the validity of the results. Lusk (2002a, p. 166) explained that the mean distance for each case study was first calculated based on the mean distance habitually traveled from the start to the first destination, and the second destination until their last destination. The means for the

numbers of destinations and their distances were verified with graphs and histograms to verify the levels of significance among each case study.

The study of Cromley et al. (2008) aimed to analyze how the community trail characteristics and neighborhood characteristics affected usage and physical activity. Multi-method approaches were conducted: survey and observations with GPS device and then GIS data specialization and Tabulation. The last two methods will be explained later. The trail survey provided information about the trail user profile characteristics for each trail: number of users; average age; gender; predominant racial/ethnic group; proportion of users that travelled to trail from home; predominant mode of travel to trail; travel time from home to trail within 15 minutes; proportion of users using the trail for recreation – versus transportation; predominant type of activity on trail; used 2 or more days in past 7 days for recreation; used 2 or more days in past 7 days for transportation. Those aspects were calculated for the 5 trails (Southwest Corridor: n=207, Minuteman Commuter Bikeway: n=248, Nashua River Rail Trail: n=326, Franklin Park: n=186 and Cutler Reservation: n=227). Results showed that more than 50% of the users utilized the trails for more than 2 days in the last 7 days (2 weeks). Most of the trails were utilized for recreational purposes and by single individuals. Only one of the trails, at the Franklin Park, presented a majority of African Americans 77.7%, while the rest of the trails presented greater frequency of white users (around 80 to 90 %).

Shahani's (2013) study aimed to verify whether the greenways of Tehran were an important element to generate the quality of life in urban areas, based on the greenway benefits: economic, social and environmental, to increase sustainable development. Survey was conducted on 3 major greenways: Vali-Asr st, Shariati St and Mirdamad Blv, from May to June 2012. Users were sampled everyday between 3 to 7 pm. Users were asked about their perception of the greenway and the promoter of their quality urban life. Each respondent was asked to rank the main characteristics of quality of life of their community on a five-point Likert scale: 1-very unimportant, 5-very important). The items were: natural areas present; access to public transportation; amount of pollution; new business development; opportunity for other transportation use; accessibility to shopping areas; social interaction among

residents; conditions of people`s health and fitness; accessibility to work/school; cost of transportation; residents' pride in community; time spent commuting and shopping; accessibility to recreation; economic growth and features contributing to community identity. They also asked to rank on a five-point Likert scale (1-poorly to 5-extremely well) how they perceived the greenways as a catalyst for promoting quality of life. Descriptive statistics were utilized to analyze the results (mean and rank for each item). Nearly 40% of the respondents were female and 60% males. The most important main characteristics of quality of life according to the respondents were: the presence of natural areas, amount of pollution, social interaction among residents and accessibility to work and school. The author concluded that the main factors through which greenways contributed to the quality of life were: presence of natural areas; social interactions among residents; condition of people`s health and fitness; and accessibility to recreation. However, the study lacks in terms of more detailed information about the community and greenways' socio-cultural aspects and also about greenway socialization types.

Chon and Shafer's (2009) study aimed to achieve information about how greenway users perceived (cognitive and affective dimensions) the greenways trails, and what aspects might encourage or discourage their usage. Five aesthetic dimensions were created: maintenance, distinctiveness, naturalness, pleasantness and arousal. Surveys were administered in a computer laboratory with different stimuli for the 211 undergraduate respondents. Two urban greenways of metropolitan areas were selected: Town Lake trail Austin, Texas and the Buffalo Bayou Trail, Huston, Texas. Respondents participated in virtual tours of the trails, in which the researchers created different scenarios composed of natural features, human-made features, background infrastructure and building sky-lines. Examples of scenes presented different scores. Factor analysis was utilized to identify the dimensions and items for cognitive evaluation (distinctiveness, ordinary-distinct, plain-ornate, typical-unusual, simple-complex, common-unique, naturalness, artificial-natural, bad for wildlife-good for wildlife and urban-rural) and the dimensions and items for the affective evaluation (pleasantness, stressful-calm, hostile-friendly, annoying-pleasing, unpleasant-pleasant, tense-relaxed, dangerous-safe, arousal, passive-active and boring-exciting).

Multi-regression was used to define which aesthetic variables best predicte the greenway trails' likeability. Those dimensions provided valuable information and implications for greenway designers and planners. Scenes that presented water bodies and visibility of the urban sky-line were highly preferred if compared to other dimensions. However, the study did not provide enough information for the naturalness dimension in terms of how different vegetation extract and compositions affected user perceptions and use. The study was limited to the inside of a lab in a virtual element and with a specific sample of respondents that may not represent the entire population of users of those greenways. The authors pointed out that it is necessary to carry out future research to apply the analysis of those dimensions to the outdoor greenway environments and with a sample representative of real users (different genders and ages) (Chon and Shafer, 2009).

Asakawa et al. (2004) aimed to obtain information about the surrounding residents' perception of 5 stream corridors in the urban Sapporo area that were being restored, and their vegetation (water channel, terrace, high water terrace and bank slope area). In May 2001, 675 households were randomly chosen from 5 neighborhoods within 500 m of the streams.. Six important factors were elected: recreational use; participation; nature and scenery; sanitary maintenance; water safety and lighting. Respondents rated importance of 25 sub-items on a five-point Likert scale (5- highest positive response, and 1- lowest negative response). Factor analysis using correlational coefficients was utilized for this matrix of 25 items. Analysis of variance, ANOVA was also utilized with scores (mean=0 and S.D=1) to show the mean differences of the factor scores of each of the 5 areas.

The gender percentage classification of the respondents showed that 54% were women. Even though the study mentioned the residents' age (15-29 years old with 9%, 30-49 years old with 35%, 50-59 years old with 20% and over 59 years old with 33%). However, the study did not clarify each category of type of users by age. It did not present a 'children' category and it combined 'teens' with 'young adults'. Six factors were found to account for 58% of the total variance among all results. The study concluded that recreational use (13%), participation (12%) and nature and scenery (12%) are important stream corridor

factors, based on the perception of surrounding residents. The other factors received less attention: sanitary maintenance (10%), water safety (7%) and lighting (5%).

Variance analysis result pointed important information about the greenway natural and scenery items: connectivity of greenery (0.76), good scenery (0.72), good natural environment (0.72) and good place for observation of nature (0.66). The examined vegetation (native and exotic species) provided some correspondence in the residents' perception. The study also pointed that for the stream corridor natural scenery item, 3 elements were important: water, vegetation and their sequential experience with variety. The study also proved that connectivity is an important element for greenway biodiversity conservation. However, other studies must investigate other types of vegetation classification and also the understanding of the relationship between vegetation and preferences. The study lacked in two major points: perception of man-made features and perception of social-cultural aspects (Asakawa et al., 2004).

Gobster and Westphal (2004) surveyed an urban greenway, the 150 mile Chicago River Corridor in Chicago, USA. They recognized six interdependent human dimensions of greenways: cleanliness, naturalness, aesthetics, safety, access, and appropriateness of development. Multi-method approaches were used: survey and focus-groups. Two off-river focus groups, one urban and one suburban based on neighborhoods surrounding the corridor, were selected for the sample, in which 98 participants were randomly selected by reverse telephone directories, with different genders and ages, to compose 11 focus-groups. Worksheet exercises and tape-recorded instruments were utilized to achieve in-depth information about users' perceptions, feelings and opinions about future river corridor development and enhancements. The responses were transcribed and coded in a quantitative way to be able to compare groups and issues.

Descriptive statistics were used to analyze the worksheet information. For the survey, 24 items were developed with open- and closed-ended questions about the river corridor, using

face-to-face interview with the greenway users/visitors about their perceptions, uses, values. The main topics of this questionnaire aimed to achieve information, from the on-site users, about the river corridor use characteristics (activities during that visit, visit length, frequency of visitation, and means of transport to the site); perceptions of the river (likes, dislikes, and desired changes; importance of the river; perceptions of recent improvements; ratings of facilities; potential problems), and demographics (age, gender, race/ethnicity, income, residence) (ibid, 2004, p. 150). Numerous statistical analyses were utilized, including descriptive statistics, to determine substantial differences through site characteristics and patterns of activity, including cross tabulations with $\chi 2$ and ANOVA (Gobster and Westphal, 2004).

The authors were able to demonstrate the validity of perceptional and environmental behavior of the study. Results of the focus-groups and on site interview showed that each of them care about this greenway environment, the river and the different landscapes. The 6 interdependent dimensions must be analyzed separately and also the relations among them, to better explain these results. The authors concluded that aesthetics and naturalness go hand-in-hand, cleanliness is frequently associated with safety, and managing a site to maximize aesthetics can sometimes impact people's perceptions of appropriate development. The authors suggest that greenway planners and managers must pay attention to those human dimensions, when planning and design the greenways.

2.7.2. Observational Methods and GIS Methods

Lusk (2002a, p. 164) recorded observations based on "subtle cues and behaviors at at a total of 12 different paths locations in 6 case studies. Photographs were also taken during the trail route by each participant, related to destinations, feature types, activity types, meanings and different perceived needs (physical, emotional, mental and spiritual). For each case study, the following were compiled: the weather conditions; the mileage of each path; the total number of destinations; destination types, their characteristics and their length

(mean number of destinations, mean distance between destinations and mean miles); standard deviation results; the percentage of males and females; the percentage of users by age (under 20, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79 and more than 80 years old, the study did not specify the range of age for children and adolescent categories, which were classified together in the category of under 20); the total number of features and types of features; the total number of activities and types of activities; and the total number of meanings and types of meanings.

The results provided a list of features, activities and meanings that were associated to each destination, path type and case study. Those lists were compared among the 6 case studies and also ranked. The lists were also compared to other lists of the In Situ Survey that also presented information related to features, activities and meanings. Lusk`s qualitative findings provided information about common features, common activities, common meanings, odd or unusual features and social bridges (related to the greenway features and activities) for each destination type and at most, but not all, destinations. However, the study did not recognize social bridges related to the type of user and social actor type. The study didn't provide quantitative information about the social bridges. The conclusions were combined into 3 main thematic sections: destinations, the corridor and human needs (Lusk, 2002a, p. 407).

The articles of Bush (2010 and 2011) provide important information from the Town of Cary volunteer Greenway Committee, that attended the staff counseling of Cary`s Department of Parks, Recreation and Cultural Resources. This committee measured greenway usage over three years (Spring 2007 until Spring 2010) based on weekend daily and year frequency of use. The program ran from Spring 2007 until Spring 2010, and the main objective was to mitigate the lack of information of their greenway system usage facilities and to provide reliable information that could guide the greenway design, planning and funding in the present and future. The committee conducted a walking check along the entire length of each greenway, trails and paths segment, during three year-round on weekends (Saturday or Sunday) off-peak and peak hours. The reason for not doing observations on weekdays

was because the volunteers had regular weekday jobs. Weekend observation times were between 50 to 70 minutes of daylight hours, composing a total of 633 weekend daylight hours (10.5 hours per day in fall and winter and 14 hours per day in spring and summer). The longer segments-facilities were divided into smaller units, to be able to meet this time-frame. According to Bush (2010, p. 26) checkers were instructed to count users each time a "meet or overtake" occurred. Any type of user who repeatedly passed a checker would be counted at each encounter. No attempt was made to keep track of individual users. The intent was to replicate the type of count that would result from a stationary automated traffic counter, where each individual is counted every time it passes the counter.

According to Bush (2010 and 2011) the protocol categories for the study analysis such as, the activity category, the study elected 11 types: walk, with pet, run, bike, wheel chair, skate, skate board, stroller, baby in arms and other; the category of user by gender: male and female; the category of user by age: senior, teen and child (number of infants) and finally additional categories like the number of pets and the number of groups; the race ethnic category: Black, Asian/Indian and Hispanic; Until July 2010, a total of 947 checks were directed and 20,016 users had been recorded (Bush, 2011). Median use by class (overall, facility type: greenway, trail and multi-use path and segment type: metro and neighborhood) with 95% confidence interval were used. Each segment was grouped based on qualitative characteristics. However the greenway committee program did not interview the greenway users to determine the distance traveled to access each facility-segment or other type of information, such as frequency of use, preference for activity and preference for greenway features and/or destinations.

Results showed that the volume of uses was higher on the greenway metro segments ("median of 46.42 users per hour with a 95% confidence interval of 40.75 to 51.30 users per hour", in a "total of 251 observations on 14 segments") than on neighborhood segments only ("median of 8.40 users per hour with a 95% confidence interval of 7.64 to 9.15 users per hour", in a total of "688 observations on 38 segments") and that "overall median usage for any segment is 11.35 users per hour on weekends" (Bush, 2011, p. 8). The total observation

counts of greenway users, on the weekend periods (Saturday or Sunday) until July 2010 was 947 checks with 20,016 users, coming to aound 1,358,579 weekend users per year (Bush, 2011). Temperature also affected the greenway usage, in that the highest usage occurred with temperatures in the 60`s Fahrenheit. It was found that little variation of usage occurred among the time-periods of day (morning, afternoon and evening). However, Sunday evening presented the highest usage, with a median use level of 15.28 users per hour. The study also provided information about the types of activities, and walking was the most prevalent activity observed with 39% of users, followed by biking with 24%, running with 16% and traveling with pet or dog walkers with 15%. The type of segments presented different higher usage activity type: the metro segments showed the presence of more runners and bikers, while the neighborhood segments presented more walkers and traveling with pet activities. “Bike trailers, tag-alongs, bike seats, and tricycles” were classified within the “other” category. Within this “other” category, strollers presented 3% of usage (ibid, 2010, p. 29). Skaters and skateboarders were not significant in terms of usage, with very few cases, and horse riding activity was only found on the American Tobacco Trail, where it is permitted. Wheelchair usage was very low, 5 users out of 16,768. The study was able to identify which facilities were more or less used (Bush, 2010 and Bush, 2011). The map of the Greenway Weekend Users/Hour Cary, NC Spring 2007-Spring 2010, is illustrated in Appendix O.

The limitations of the study were the small sample size and the absence of weekday observations data information of the Cary`s greenway system usage. It is necessary the application of more observations during all times of the day and for different periods (morning, afternoon and evening). To better understand the greenways usage, behaviors and interactions at the Cary`s greenways, it is necessary to expand the presented protocol categories: type of social actors, type of social bridges, more types of activities and also their pattern of use and types and levels of interactions. The characteristics protocol for each greenway, trail and path segments could also be improved by the classification of their features type, connection type and destination type. The application of other types of methods, such as survey is necessary to determine information about the greenway

characteristics, features, connections, destinations, perception of the greenway positive and negative attributes, impacts, values, meanings and social aspects: interaction and behaviors (Bush, 2010 and Bush, 2011).

Cromley et al. (2008) aimed to identify the differences in the characteristics of the trails and their neighborhood characteristics and how they affected and attracted different trail users and different types of physical activity. Six trails in northeastern Massachusetts were selected for this observational study by using GPS device (data was exported later as shapefile to GIS), based on their layout configuration and community settings: linear trails (1 urban, 1 suburban and 1 exurban) and loop trails (1 urban, 1 suburban and 1 exurban), the information was spatialized in GIS and also provided the possibility to combine with Census 2000 data and land use data information. A total of 13 variables were collected, 7 about the community trails (length, circulation level, intersecting surface, width, surface material, trail amenities, trail land use mix) and 6 variables about the neighborhood characteristics (street density, neighborhood land use mix, housing density, race, ethnic, family income).

The protocol for this observational study defined the trail characteristics and features: “width, surface, amenities and land use mix in the immediate trail corridor” and the neighborhood characteristics were: street network density, land use mix, housing density and socio demographic composition. The study also compiled the count of the most common trail amenities/features by each of the trail: amenities (safety, bollards/boulders, curb cuts, emergency call boxes, gates, lights, public telephones, signs, traffic signs, wheelchair cutouts), convenience amenities (bicycle stands, dog litter bags, drinking water, parking areas, seating, shelters, tables, toilets, transit stops, trash receptacles), recreation amenities (play areas and exercise areas) and aesthetic amenities (public art and view/overlooks). The information about the total amenities per total length of the trail segments was combined with the information of the length of all access (primary and secondary). Correlations between trail segment characteristics and amenities, neighborhood characteristics and socio-demographic characteristics measured the complex degree of the relations between trail segment attributes with neighborhood attributes (Cromley et al., 2008).

The study found a strong association between trail characteristics and surrounding neighborhood characteristics. The study provided vital information about trail characteristics: structural network types and features types, and how they may affect usage and type of activity. One of the major findings of this study is about the relation of trail segment type and length with the neighborhood street density form that directly affects usage and the physical activity, because of the access and trail continuity influence. Cromley et al. (2008, p. 17) explained that `the presence of numerous intersections and short block length` directly affect the linear trail dynamic, because `the high street neighborhoods with high street network densities and high traffic volumes` impacts negatively in the recreational usage as it requires users to make frequent stops to cross safely and because of this. On the other hand, it can provide more access points to those linear facilities and make the trail closer to a greater number of residences and neighborhoods. In this case, because of the fragmented and shorted segments of the trail, it may be useful to reactivate the recreational attractiveness of this area, by putting amenities/features that make people to stop, like play areas, restrooms, educational areas, information areas and resting sitting areas. In conclusion, this study provided important information on how to improve trail environments in terms of encouragement or discouragement of usage.

Golicnic and Thompson (2010) described the different patterns of use at public parks of two European Cities, Edinburgh and Ljubljana, which presented the same size and density of population. Multi-methods were used: behavior mapping and GIS. The study aimed to investigate the relationship between large public parks (Princes St. Gardens, The Meadows and Tivoli) design-configuration and use. It also intended to verify the physical environmental and behavior relationships. Systematic observations were utilized for both case studies between the \May 2012 and May 2013 and for different periods of day: 10 am-12 noon; 12-2 pm; 2-4 pm and 4-7pm. Each park's boundaries were divided into sub-areas, in which 10-min visual scans were recorded. The total observation period of the sub-areas was between 30 min to 1 hour. The information was drawn on a detailed base-map (1:1000 scale) with code-symbols. Also other categories where created, each of them with different

values: age (0-5, 6-12, 13-19, 20-34, 35-50, 51-65 and more than 65 years old), activity duration (<1 min, 1-2 min, 2-5 min and >5 min), Direction (N, NE, E, SE, S, SW, W, NW), temperature (<5C, 5-9C, 10-14C, 15-19C, 20-25C and <25C), wind (yes, yes/no and no), dryness (yes and no) and sunshine (sunny, part cloudy, cloudy, rainy). A range of passive and active activities was collected. Each activity/day was compiled by the sum of people (male, female and all genders together). Descriptive statistics were used for the production of histograms, drawings of the observed activities and behaviors. The study of the parks revealed similar patterns of occupancy in terms of usage on different days, time and weather condition.

Golicnic and Thompson (2010) also were able to spatialize in GIS the size (big groups, medium groups, small groups and individuals), age, gender of the users and type of activity (overall park area and on each sub-area). GIS techniques allowed the creation of buffer zones of the mapped activities that provided evidence about user distances from physical and spatial boundaries as an alternative to verify the co-habitation of occupancies and comfort distance in each of the park areas and sub-areas. Buffer zones were also created to spatialize the active activities (buffer between an edge, buffer between two active groups within different territories and buffer between a numbers of adjacent active groups using different territories) in relation to size and shape of the areas and sub-areas. The research concluded that the buffer between zones and between each activities revealed elucidative information about how physical attributes impact usage, behaviors and activities.

Reynolds et al. (2007) measured the trail and its environments with trail selection, trail user counts and audits, with the comparison of the user category percentages by age, gender and types of activities. The trail selection standards of the study consisted in: trail from different regions; urban and suburban continuous and multi-use trails with length superior of 15 miles, which transversed mixed neighborhoods: Hispanic, African American and European American. The trails elected for this research study were: Chicago Lakefront Trail, Dallas White Rock Lake Trail and Los Angeles River Trail. The traffic count procedure variables of the study defined for the user type category, different age sets: under 18, 18-39,

40-64 and more than 65 years old. User gender categories were male and female. For the activity type, there were 5 categories: cycling, running, walking, skating and others. Observations occurred in 2 weekdays and 2 weekends with a 15 minutes break between the observations. Segment boundaries were verified by the use of GPS. The parameters for trail view characteristics were:

The study results of Reynolds et al. (2007) showed that for the 3 trails, the total users counted were 17,738 users, in which 67% were male and 33% females. Users also varied according to age: under 18 with 6%, 18-39 with 56%, 40-64 with 36% and more than 65 with 2%. The occurrence of usage during the weekends was 57% and weekdays was 43%. In terms of type of activity the findings were 67% of cyclists, 14% of runners, 13% of walkers, 5% of skaters and 1% of other types of activities.

The findings of this study suggest that lower usage is directly associated with the environment enclosure provided by dense vegetation and natural areas near the trail, and on the other hand, the heavy usage is associated with open areas with less dense vegetation and natural areas. The study found that mixed views, street lighting, good maintenance of the trail and the trail pocket of activities features/amenities impacted positively the trail usage. On the other hand, the presence of litter, noise pollution, bad drainage, tunnels and dense vegetation areas negatively impacted the trail usage. The study showed that the user category by age and gender affected trail preferences, behaviors and physical activities. One of the major findings was that user perception of trail safety may increase usage. The trail pockets of activity service, like food service can increase usage. The problem of the study in terms of the user category by age, was the definition of the set under 18 years old, that combined together children and adolescents under 18 years old category. It may be useful to redefine this category, for example, children (0-12 years old) and adolescent (13-17 years old). The adult category also could be combined in one, e.g., (18-64 years old). The study lacked in terms of more detailed information of the types of activities that took place on the trails. The study did not analyze the social aspects in terms of interactions. The study also did not spatialize the crowding areas, with density analysis of

the total observations. The authors suggest for future research the utilization of GIS to analyze those variables and more detailed exploration with correlational information about the trail type and characteristics with usage, gender and age (Reynolds et al., 2007).

Moore and Cosco (2007) analyzed the Kids Together Park, in Cary, which offers a variety of multi-use and dynamic settings for different types of users. They utilized 3 main-concepts in their study: territorial range development, behavior setting and affordance. By direct field observations, behavior settings evaluation and behavior mapping, the researchers efficiently examined the physical environment to understand how it was used. The methodology involved behavior mapping, behavior tracking, setting observation, videotaped park visits and on-site interviews. The analyses were administered at 3 levels: observational analysis of *the patterns of use* of children and adults in each setting, to be able to understand the dynamics of usage; the variations of use and types of behavior in each setting, and the distribution of usage in each setting, to be able to verify park utilization; and, finally, the comprehension of the special uses of the park, such as a universal design layout, settings and features.

A GIS data base was used to provide a spatial model simulation of the distribution of use in each setting, the setting size and the children and adult ratio in the different setting types. They also were able to measure the zone of attractiveness of each area of the park. The Kids Together Park was divided into multiple observation zones, in which activities were scanned in constant rounds, to have a sense of the usage of the Park spaces. They observed the park interaction by group, size, age and gender. The study results were well-illustrated and well-explained by charts and maps, showing the use space ratio (% of usage and ratio %), the levels of distribution in each zone as well as clustered together. They also provided illustrations of the settings and the diversity of user interactions. The study provides powerful information of behavior and insights about the relationship between the social need and inclusion related to physical environments, because of the constant observation, showing how, when and why this place is used and what the favorite spots are. It also presents a good and fluid discussion about the key-concepts and a good

methodological approach that can be replicated for other parks and or squares. In conclusion, the presented study provides an efficient tool and technique to understand social inclusion, environmental inclusion and accessible and universal design to improve the layout, design and renewal of the urban neighborhoods parks and to promote an interesting, stimulating and enriching experience for families: adults and children (Moore and Cosco, 2007).

Gobster (1995) utilized a multi-method approach (observational and survey) that analyzed the perception and uses (patterns and preferences) of 13 Chicago metropolitan greenways. The results exemplified valuable information about: trail location and use patterns; duration and frequency of use; travel to and on the trail; trail use diversification and substitutability; social and demographic aspects of the trail use; trail preferences and perceptions, and trail development issues. He concluded that the greenway location, design and management influence how people use the greenway, who uses and what their preference areas are. However, the results of this study give general information about the greenway use patterns, and mask the information about the aspects of distance of trails and who uses them. He concluded that the quality of the trail, the natural environment and the paved surface type influence the user preferences and needs. The study did not provide information about the greenways social bridges/ties and interactions. The author pointed out that more studies are necessary to understand the user perceptions about the location, design, and management of the greenway trails, and how their features affect the pattern of use, users' perceptions and preferences.

Gobster (2005) affirmed that the active living perspective could help to reduce the American sedentary lifestyles and diseases (diabetes, heart disease, and depression) with the promotion of the development of urban trails within parks and greenways, as the key contributors to improve American's health, fitness and well-being by the integration of physical activity in their everyday lives. Diverse active recreation experiences can occur in such environments when people freely engage in their outdoor recreation activities to achieve the benefits of multiple dimensions: physical, psychological, social, economic,

mental, spiritual health and restoration. To better understand the active living complexity, it is necessary the comprehension of the “ecological model” of the physical activity character that influences the relationship among different environmental, personal and social variables. Recreation and leisure research appears to have a positive impact in reducing the active living issues. Greenways, because of their characteristics, can provide a safe and attractive environment that encourage recreational use, especially with the promotion of more trail lengths and modes of movements. They also can mitigate the active living problems, because they facilitate the linking of everyday leisure and recreation close to nature by linking individuals, groups, neighborhoods and community and this facilitates their health, socialization and fitness goals.

The purpose of the study was to “examine individual, social and environmental factors associated with urban trail users exhibiting low, medium and high levels of physical activity” (Gobster 2005, p. 369). The utilized method was the observational approach to understand the patterns of use (racially and ethnically) of a Chicago Park local trail (1.2 mile loop trail of the Warren Park). Nevertheless, the study only focused on the physical activity aspects and it is necessary other complementary studies to better understand the study of individual, social and environmental factors associated with urban trail users, and their relation with other inter and intra activities types (passive and active). “Observed activities were reclassified to examine use patterns as a function of three physical activity levels: High = fast walking, running, calisthenics, roller-skating, skateboarding, roller skiing, skiing; Medium = walking, slow walking, bicycling; low = standing, sitting, riding in a stroller, picnicking, laying down” (ibid, 2002, p. 370). During 9 months (three seasons) of 1989, a total of 5,496 trail users were observed in a 151 observation periods and 53 different locations along the trail, in which the frequency of use along the trail was identified. The observational study also provided information of social factors based on the social groupings that were classified according to group size, age, gender (male, female, mixed sex) and racial/ethnic diversity (Anglo, Afro-American, Hispanic, SE Asian, S Asian, Mixed Race). However, other methods also should also be used to gain a better understanding of the trail use. To better

understand the trail user patterns in terms of social factors, more studies needed to identify the type and level of social interaction that takes place between inter and intra-activities.

The results of Gobster (2005) for trail pattern use level were: 9% high, 65% medium and 26% low. The major amount of active users was 18-38 years old. For race and ethnicity, a larger proportion of individuals was composed of Anglo Americans, African Americans and Southeastern Asians, while Asians, African Americans presented lower activity level of users. According to Gobster (2005, p. 370) “solo trail users were more often highly active users, and groups of two or larger were more often low activity users” (…) also “all groups were quite homogeneous with respect to race/ethnicity regardless of their activity level”. About the frequency of use “low activity users tend to be clustered within a small number of locations along the trail at benches and other amenities, while medium and high activity users were more evenly distributed along the trail.” Younger users with high activity were constituted by absence of dogs (13 times more than the ones with dogs), cool temperatures (range between 40-59 degrees Fahrenheight), morning hours (6:30 a.m. – 10:00 a.m.), or precipitation, weekdays and single-sex groups were more significant predictors of high activity and small groups (solo trail users were 8 times more active than people in groups of three or more and 3 times more likely than pairs. “Social groups that were not purely homogeneous with respect to sex and race were assigned into an ‘other’ category while mixed-age groups were grouped into one of the four categories based on their mean scores” (ibid, 2005, p. 372).

In summary, both studies of Gobster (2005, 1995) provided important information about the active-living dimension and its representation by the ecological model with the identification of sets of individual, social and environmental factors that support affect patterns of usage among highly active and health-motivated trail users. Both provide information useful to the recreation and leisure research with a better understanding of people’s use of outdoors environments with an active living perspective. To better understand the active living perspective and the reasons people use the trails, it is necessary to carry out more studies

that deal with other aspects of leisure and recreation and focus on the social and psychological aspects.

Lindsey and Lindsey (2004) investigated the pedestrian crosswalk volume of use of the Indianapolis/Marion County, Indiana for greenway trails with short sampling intervals: 5, 10 and 15 minutes to count trail traffic. The greenway system presented at that time 40 miles of existing trails and another 146 miles planned. The study occurred on two trails: the Monon Trail and the White River Trail. Their traffic counts were taken with infrared counters since the year of 2001 and 2002, respectively. The counting protocol “data were collected at four locations on the Monon Trail on weekdays between June 12 and 27, 2003 from 7:00 AM to 7:00 PM and at the White River sites, counts were taken on both weekdays and weekends and the counting periods were only four hours long” (Lindsey and Lindsey, 2004, p. 57), a total of 142 hours of data for the Monon Trail were documented, and 24 hours of data for the White River Trail. The categories created for this analysis was: number of users, mode of use, people in groups, and gender of users. However, two categories were eliminated, because they were least important to the study. The counts were conducted by two observers that prohibited from comparing their results to preserve the integrity of the data information. “To estimate expansion equations for each of the time intervals” it was created the natural logarithm function to all of the individual counts (Lindsey and Lindsey, 2004, p. 58). Finally the final purpose of the study was to compare the manual Projected Traffic with Traffic Estimates from Infrared Counters (total uses of the manual counts per each interval type and percentage error).

The Monon Trail sites, presented in their totality 11,612 users. The most prevalent type of use was bicycling (44.7%), followed by walking (25%), running (18.1%), skating (8.3%), babies (3.0%) and others (0.9%). On average, there were 82 users per hour. Men were more likely to use the Monon trails, 56.7%, or 6,579, and 43.3%, or 5,033, were women. The White River Trail presented 716 users. The most prevalent type of use was bicycling (82.7%), followed by walking (7.5%), running (7.3%), skating (1.5%), babies (0.4%)

and others (0.6%). Men were more likely to use the White River Trail than women, with more than 70% males (Lindsey and Lindsey, 2004).

According to Lindsey and Lindsey (2004) in terms of findings for group use of the greenway trail, different elements were selected: the total groups for the Monon Trail were 2135 and for the White River Trail 170; the total people in groups at the Monon Trail was 4901 and the White River Trail was 419. The total people percentage of use was 42.2% for the Monon Trail and 58.5% for the White River Trail. Findings showed that between 42 percent and 58 percent of users may be in groups of two or more, indicating valuable information about the presence of the social dimensions of trail use. “A useful finding not previously reported concerns group activity on trails” (Lindsey and Lindsey, 2004, p. 65). According to Lindsey and Lindsey (2004), the group social aspect information presented implications for the promotion and management of trail systems. For example, managers, seeing the already existing tendency for users to travel in groups, could use this data to actively promote group events on the trail. Events could be targeted at families, and changes could be made to the trail to make it more accessible to large groups of users (Lindsey and Lindsey, 2004, p. 65). It also important to add nodes of activities along the trails to accommodate those larger groups, their activities, interaction and behaviors.

Heavy usage during peak hours and weather conditions affected in part the traffic count record and its accuracy. One of the limitations was the small sample sizes, principally for the White River Trail. The research study wasn’t able to describe why trail traffic varies in different trail locations and segments. The correlation between the manual trail counts and the infrared counters proved the efficiency of the estimations. However, it is important to install the infrared counts in specific trail locations. Researchers suggest the aggregation of an extra 30 minutes in the observations to be able to predict more efficiently the hourly usage counts. They also mentioned the necessity of more optimal methodological observational approaches to achieve data information about greenway trail traffic counts. The study concluded that the different sample intervals provided valuable and precise information about the greenway hourly usage predictions, which is valuable to planners,

designers and managers especially in providing information about where to allocate funds most efficiently to improve the trail features and usage. For example, trails with heavy volume of usage need attention to accommodate the different needs, different activities and different group sizes. Conversely, trails with less volume of use also need attention in terms of promotion of infrequent use and security (Lindsey and Lindsey, 2004).

Lindsey et al. (2008) tried to understand the relationship between design and trail use, by analyzing by field observation the urban greenway users and uses by utilizing new models of measurements of viewshade structure and contents, using LIDAR data. They utilized a network of 30 infrared counters installed over the 33 miles of the multi-use trails of Indianapolis to count the daily traffic and observation of the 12 different characteristics of the trails to collect information about the trail characteristics. The daily traffic was correlated with the openness and interconnectedness of the trail viewsheds, the greenness of the trail viewsheds, the diversity of the land use within the trail viewsheds and the set of trail characteristics. However the study did not recognize and quantify the type of users and type of activities and the social interactions and behaviors. The dependent variable was the natural log of daily counts; the independent variables were divided into the following categories: weather, temporal, neighborhood demographic, neighborhood urban form and trail features.

The study results provide interesting information about greenway trail environment usage in that lower trail usage is associated with enclosure, and this means that enclosure areas directly affect people's perception of safety. Their study provides reliable evidence of the reality, based on the relationships between trail use and trail features, and the number of users, which can be manipulated through design. Unfortunately they didn't distinguish between types of users. They mentioned that additional and multi-disciplinary research is needed to better comprehend how design of urban trails can influence use; it also may be necessary to test the study findings using different types of methods, different settings and also use GIS analysis to enhance the knowledge of greenways socio-cultural systems (Lindsey et al., 2008).

The research study of the suburban greenway trail user groups carried out by Moore et. al. (1998) provided valuable information about the nature of the impacts which various user groups have on each other, by the analysis of their behaviors and how they influence other users' experiences, as well as how they interact. The asphalt paved trail according to the type of activity (walking, running, in line skating and bicycling) can increase or decrease the user enjoyment because of the trail problems and impacts: bad behaviors and obstruction. Twenty-one sample days were collected systematically on summer 1994, each divided into 6 periods of 2 hours, during the morning, afternoon and evening (8a.m.-8p.m.). They utilized mail-survey questionnaire for adult users only. The independent variable of the study: trail activity in which the participants were engaged on the interview day. The dependent variables were the effect of other activities on the respondent's trail influence, the positive, neutral and negative effects that each type of group of users had on the trail experiences of others groups type. They utilized a 7-problem scale measurement for each group type activity (ibid,1998).

Moore et. al. (1998) concluded that different activity groups had considerably different effects on the experience of other groups, with different levels; some groups present some similarities, while others present unique characteristics. About the social aspects, the authors claimed that walkers tend to socialize and communicate more than other group types. Overall, the study provides insights about the importance of understanding the intra and inter-activity among different group types.

Based on these annotated bibliographies studies (methods, results and conclusion), and the visualization of their theoretical frameworks with main aspects and secondary aspects that directly and/or indirectly deal with the recreational settings, uses and interactions, it was possible to compare their different methodological approaches and results and add knowledge about the outdoor recreation arena to my research topic, in order to structure the present study based on the relationship between the greenway characteristics and the social network.

In terms of the parks and greenway trails studies, many of the 19 annotated studies dealt partially with the social aspects and dimensions, however there remains a lack of deep information about the social role of the greenways: social network, interaction and behaviors. The study of Lee et. al. (2002) provided some very preliminary information about the social ties and bridges of the greenway trails with two of the 12 aspects (dependent variables): family togetherness, and friendship ties. Gobster (2002) provided significant information about the social factors, including type and quantity of actors (individual, sub-groups and groups) and group size (1, 2 and more than 3) and type classification (gender, age and race). However, more clarification is needed about the type of social bridges and ties that take place among the actors types, as well as more detailed quantification of the social actors.

2.8. Public Spaces: Social Dimension and Social Function

2.8.1. Public Realm

The public realm, also known as public life, entails a universal social context and is established in different urban settings and open spaces, also called public spaces. Public space is an integral part of the public realm, and it has received increased attention across a range of social science and humanities disciplines. (Carmona et al., 2003; Carmona et.al., 2010, p. 137; Macedo, 2008; Macedo et al., 2009; Tângari et al., 2009). “The public realm has ‘physical’ (space) and ‘social’ (activity) dimensions. The physical public realm is understood here to the mean the spaces and settings – publicly or privately owned – that support or facilitate public life and social interaction. The activities and events occurring in those spaces and settings can be termed the socio-cultural public realm” (Carmona et al., 2003, p. 109). The ‘publicness’ of spaces and settings can be defined by three qualities: ownership—publicly or privately owned; access or accessibility—public capability to enter and use the space, as a democratic and accessible arena for everyone; and use—activities

and shared actions among different individuals, sub-groups and groups (Carmona et al., 2010).

The public realm ideally functions as a forum for political action and representation; as a 'neutral' or common ground for social interaction, intermingling, and communication; and as a stage for social learning, personal development, and information exchange (Loukaitou-Sideris and Banerjee, 1998, p. 175). Unfortunately, the decline of the public realm, in terms of social interaction is attributed to both reduced availability and time for public space utilization and public life. Social interaction has been affected by several conflicts: lack of demand of social spaces, lack of new open spaces that meet human needs, mechanized movement, and individual usage without socialization (Carmona et al., 2003).

2.8.2. Successful Public Spaces

According to the Audit Carmona et.al. (2008), Comission (2002), Ghel (2008), Manning (2011), MORI (2002), Project for Public Space (2000) and White (1980), some key qualities that make the public spaces successful:

- *image and attractiveness* (physically and visually accessible, aesthetic quality, visually stimulating, perceptions about safety and cleanliness, pleasant, peaceful, charming, spiritual, historical, greenness, cleanliness, use of public art);
- *comfort* (sittability, walkability, possibility for standing/staying, appropriate seeing/hearing/talking distances, free of heavy traffic, free from noise, infrastructure, such as public restrooms, parking areas and so on);
- *access and linkage* (ease of movement, easy to get and move around, and visible, walkability, reliability, continuity of space, proximity, connectedness, functionality, convenience, good location, accessibility and lack of congestion);
- *functional* (compatible functions without conflict of use; infra-structure and green-infrastructure);

- *universal* (equitable, flexible, simple/intuitive, perceptible, tolerance for error, low physical efforts, and size and space for approach use);
- *uses and activities* (recreation, socialization, uniqueness, affordability, enjoyment, passive and active use and engagement, and multi-use, features that accommodate different users, and their needs and activities);
- *sociability* (place where people go to see and meet friends, where they feel comfortable in interacting with people they know and strangers; cooperation, commute, pride, welcoming, friendliness, interactivity, inclusion, diversity);
- *inclusion* (provides open access and equity to all type of users regardless of gender, age, race, disability, ethnicity, unrestricted);
- *presence of natural environmental settings and its features* (landscape features and physical structure features);
- *uniqueness* (stimulates human senses: vision, sound, touch, smell, kinetic; dynamic physical environment features and multi-usage; reinforcing);
- *connectivity and visual permeability* (ease of moving from one place to another, visual clarity);
- *protection* (safe from accidents, traffic, crime, violence, vandalism, anti-social behavior; pedestrian and cyclist safety; free from pollution and noise)
- *clean* (well cared for and free of litter, bad smells, trash, graffiti);
- *greenness* (healthy and natural environment; green buildings and spaces; green infrastructure; biodiversity; unpolluted: water, soil and air; access to nature),
- *fulfilling* (sense of ownership and belonging; provides social interest of different actors: individual, sub-groups and groups; fostering pride, citizenship and neighborliness; allowing personal freedom; opportunities for self-sufficiency).

2.8.3. Social Factors and Public Settings

According to Carmona et al. (2010), Gehl (2010), Carmona et al. (2003), and Dear and Wolch, (1989) understanding human needs and their relations with the environment as a space is crucial in urban design, architecture and landscape architecture. Human behavior and actions are influenced by “social, cultural and perceptual contexts and settings” (Carmona et al., 2010, p. 133) as well as by the physical environment. Urban public settings, such as conventional parks, greenways and squares provide opportunities for human relations and for understanding those relations. In order to understand human actions in public settings a number of questions are useful: *what are the catalyst for certain behaviors, actions and interactions; what do people actually do in certain settings, how do people frequently use these settings; how do people colonize these settings; how do they interact with each other; how do these settings function; how do these settings really work and how do people perceive and think about these settings; how do people appreciate the public urban environment settings*. The answer to these questions helps designers to understand what aspects make a successful and effective public urban space for people (White, 1980; Carmona et al., 2010).

Carmona et al. (2010), Carmona et al. (2003), Dear and Wolch, (1989) and Manning (2011) mentioned that social interaction influences the relation between society and space. Social interaction can be both c*onstituted through space*, in that the physical environment characteristics influence the setting and how it is used by people or c*onstrained by space*, in that the physical environment acts either as a barrier or restraint for human activities. Social interaction is fundamentally influenced by basic human needs, and their effect on values, perceptions, goals, aspirations, motivations and attitudes. Human needs therefore can indirectly influence the relation between society and space. The basic human needs can be categorized into a number of hierarchical stages, starting with the most basic and progressing to the most developed (Carmona et al. 2003; Carmona et al. 2010; Dempsey et al. 2011; Manning, 2011; Wood and Landry, 2008):

- *Biological needs:* need for survival, food, shelter and to mate;
- *Safety and security needs:* need for safety and protection from natural environmental and human threats;
- *Affiliation needs:* need to belong to formal and communal organizations such as place, community, society and/or nation;
- *Psychological needs:* need for friendliness and comfort, health and development;
- *Interactional needs*: need for social interaction;
- *Esteem needs*: need to feel valued by others: family, friends, group, community;
- *Cognitive needs:* need for learning and experiencing;
- *Self-actualization needs:* need for personal expression and achievement,
- *Aesthetic needs:* need for beauty and sensorial gratification.

2.8.4. Social Sustainability

According to Dempsey et al. (2011, p. 291), urban social sustainability inter-relate with concepts, such as “sustainable communities, quality of life, social cohesion and, more recently livability and well-being”. Dempsey claims that urban social sustainability can be understood by defining the social dimension of sustainable development based on *non-physical factors* and *predominantly physical factors,* conforming illustrated on the table 1 below.

Table 1: The Social Dimension of Sustainable Development: Defining Urban Social Sustainability.

Source: Dempsey et al. (2011).

Non-Physical factors	***Predominantly Physical Factors***
Education and training	Urbanity
Social justice: inter and intra-generational	Attractive public realm
Participation in local democracy	Decent housing
Health, quality of life and well-being	Local environment quality and amenity
Social capital	Accessibility (e.g. to local services and facilities/employment/greenspace)
Community	Sustainable urban design
Safety	Neighborhood
Mixed tenure	Walkable neighborhood: Pedestrian friendly
Fair distribution of income	
Social order	
Social cohesion	
Community cohesion (i.e. cohesion among different groups)	
Social networks	
Social interaction	
Sense of community and belonging	
Employment	
Residential stability (vs turnover)	
Active community organizations	
Cultural traditions	

In accordance with Table 08, a scenario representing a negative urban social environment would involve both physical characteristics, such as dirty, unsafe or lacking greenness, as well as social qualities, such as social exclusion or crime (Dempsey et. al, 2011). A positive environment would also include both physical factors, i.e., safety, mobility, and social factors, social integration.

> "Like the concept of sustainability, social sustainability is neither an absolute nor a constant. Social sustainability has to be considered as a dynamic concept, which will change over time (from year to year/decade to decade) in a place. This may come about through external influences, for example, social cohesion and interaction may increase, prompted by changes in a local authority service delivery. (…) Economic, environmental and political crisis at a local

> or broader scale may also influence social activity at the local scale" (Dempsey et al. 2011, p. 292).

To achieve such social sustainability it is necessary to balance environmental needs with social needs. "Behavior in public spaces is often discussed in terms of civility and incivility. Civility involves awareness of and respect for others' use of public space." Some designers believe that respectful and positive behavior especially in urban public environments can be achieved by a good design. Jan Gehl (1996), Jan Gehl and Lars Gemzoe (1996), Jane Jacobs (1961) and William White (1980) "believe that good streets, sidewalks, parks, and other public spaces", such as greenways "bring out the best in human nature and provide settings for a civil and courteous society. Everything will be fine if we can just get the design right" (Carmona et al., 2010, p. 135). These authors highlighted the social functional role of public spaces as "containers of human activity and places of social interaction" (Carmona et al., 2003, p. 7). In the same vein, a bad design can contribute to the creation of a low-quality environment and foster anti-social behavior (Carmona et al. 2010).

Gehl (1996) added that high-quality public spaces can be achieved with good design, positive social activities and behavior, and public utilization. To be able to understand the complex social dimension and its role in sustainability, some key-aspects and overlapping concepts are necessary*: Social Interaction; Social Behavior; Social Communication; Social Groups; Social Cohesion; Neighborhoods and Communities; Sense of Community and Community Stability; and Communities of Interest* (Dempsey et al. 2011; Carmona et al. 2010; Hellmund and Smith, 2006; Carmona et al. 2003; Lusk, 2002b).

2.8.4.1. Social Interaction

Social interaction is described by Wirth (1964, p. 17) as "the basic process in the formation both of human nature and the social order." Without this interactional dimension, humans would live separate lives without establishing communities (Dempsey et al., 2011). Wood

and Landry (2008) describe an interaction cycle that informs social interaction, in which social actors move from one type of interaction to another. Four possible permutations describe the circumstances in which a person might interact:

- *Grounding:* interactions that take place among close friends and family and are based on common values and beliefs in shared experiences. However, there is a risk of differences among different ethnic actors being overemphasized.
- *Strokes:* interactions take place among people who are acquainted but not close, as occurs in neighborhoods or other places where people share the same community or physical environment. Consolidates a common external environment, which is known, recognized and identified as important and symbolic. However there is risk of producing complacency;
- *Opportunity:* interactions among people that know each other as well as unfamiliar people. Interaction can increase depending on external environmental characteristics. Generally promotes new possibilities and self-promotion or network configuration. The positive aspect is social mixing, however the risk is that social inequality may be reinforced in new networks;
- *Growth:* interaction among strangers coming from different backgrounds. Generally they share common motivations and exchange experiences, positively impacting inter-ethnic interactions through understanding and integration. However, may there is a risk of social alienation, identity dilution or superficial interactions.

Cantle (2008) proposed a similar framework, when arguing that it is necessary to establish a new typology of cross-cultural relationships and inter-communal exchanges that occur through different forms of social engagement:

- *Intra-associational:* associations arising from the multiple and different people backgrounds. Interchange, cooperation and organization are the types of association;

- *Inter-associational:* associations formed by networks with different interests and identities;
- *Social incidental:* emerge from everyday activity, in which different actors (individual, sub-groups and groups) meet during their recreational and leisure activities, normally without organization;
- *Structural cross-cultural contact:* depends of the connection of fragmented and segregated communities and neighborhoods; provides opportunities for cross-cultural linkage and engagement.

2.8.4.2. Social Behavior

Social Behavior is a broad concept dealing with social actors' physical reflexes, habits, custom, actions, and so on**.** Commonly it is defined as the result of someone's personality and situation on the one hand and expectations and behavioral dispositions on the other (Rummel, 1976). The Oxford College Dictionary (2007, p. 118) defined behavior as "the way in which one acts or conducts oneself, esp. toward others.(…) the way in which one person acts in response to a particular situation or stimulus."

According to Rummel (1976), behavior is any individual's activity or lack thereof which can be expressively understood in three ways: reflex (causal meaning) as a reaction to some event; act (intentional meaning) in with humans direct their actions and activities to be able to achieve specific goals, and practice (rational meaning) represented by human rules, norms and habits. Social interactions, defined as a social behavior space, are the performances, actions, or practices between two or more people. "Social interactions can also be characterized by their direction (solidary, antagonistic, mixed), intensity, extension, duration, and organization" (Rummel, 1976).

2.8.4.3. Social Communication

Cathcart, et al. (1996) explains that “The link between group activity and communication is so strong that studying one without another is virtually impossible” (Cathcart et al., 1996, p.231). These authors consider social communication a complex and dynamic process in which internal (psychological or physiological) or external (physical) barriers can cause [it] to break down” (ibid, p. 232).

> “Human interaction is pervasive in our culture. We choose to be with other people some of the time, and other times we are forced into the company of others. Whenever these interactions take place, communication is occurring. It is through communication that we initiate, maintain, and perpetuate relationships; and many of these relationships take place in a group setting. Without communication we would have a difficult time fulfilling our needs and accomplishing our goals” (Cathcart et al., 1996, p.231)

2.8.4.4. Social Groups

Participation in social groups and networks in the community generally occurs in local and community activities and is an important part of as part social capital and social sustainability. The participation in organized outdoor activities contributes to the construction of collective groups and contributes to community sustainability (Dempsey, 2006; Dempsey, et al., 2011; Litting and Griessler, 2005; Manning, 2011; Putnam, 1993; Skidmore et al. 2006).

2.8.4.5. Social Cohesion:

Moreno & Jennings (1937, p. 371) defined social cohesion as “the forces holding the individuals within the grouping in which they are”. Festinger et. al. (1950, p. 164) defined

cohesion as “the total field of forces which act on the members to remain in the group”. Friedking (2004) mentioned that to understand social cohesion, it is necessary to integrate the individual and group level. Social cohesion can be studied through of specific groups, such as families, schools, military units, recreational groups and sport teams.

> Cathcart et al. (1996, p. 179) said that “People frequently join groups that mirror their values and preferences, and the members enjoy the link that exists between them and the group. Cohesion is the ‘glue’ that causes the members to remain in the group even when there are pressures or influences to leave it. (…) Cohesive groups usually enjoy low turnover and high participation because members desire continuation of the group and its commitment to goal accomplishment.

2.8.4.6. Neighborhoods and Communities

Neighborhood and community are important concepts to understand the public realm. The terms neighborhood and community are closely related. “Neighborhood, as a space of nearby residential buildings and people, and *community*, as a group of people with vibrant linkages, are useful places to begin considering social patterns and urban regions. (…) people interacting and remaining in a neighborhood create a community” (Forman, 2004; Forman, 2008, p. 67). Neighborhoods must be comprehended by their physical and spatial layout and as well as their social aspects, such as neighborhood interaction, creation of neighborhood identity, and establishment of a sense of community and social balance. “Neighborhoods are fundamentally physical and place-based and have functional relevance for all the people living in a given area” (Hellmund and Smith, 2006, p. 161). Sometimes the sense of community carries a strong social and cultural connotation (local, regional and/or national) that suggests the way that members experience the environment (neighborhood, place, greenway features: landscape and physical structure), based on their interests, motivations, education or activities (ibid, 2006).

Different neighborhood residents can share physical environments, such as greenways or parks, in different ways: they can be shared by spatial proximity; through mutual identity; and they can be used by similar or different socio-economic or ethnic groups (Carmona et al., 2003; Carmona et al., 2010). Recreational greenways, neighborhood parks and squares have an important role in creating the identity and character of the neighborhood and then creating a sense of place and meaning for the community. Greenways structural network and function come organized in relation to concepts of neighborhood and community (Hellmund and Smith, 2006). Greenways, because of their linear configuration, act as a continuous “bridge”, with the potential to link different neighborhoods, different conventional parks, different greenways and different people, enhancing the opportunities for greater social interaction and creation of a sense of social community (Carmona et al. 2003; Carmona et al. 2010; Jacobs, 2011; Magnoly, 2006).

2.8.4.7. Sense of Community and Community Stability

Public spaces afford users a sense of belonging and/or emotional attachment and sometimes a rootedness, leading to their identification with that place (Tallen, 1999, p. 1370)” (Lynch, 1960; Relph, 1976; Montgomery, 1998; Tallen, 1999; Gehl, 2001; Nash and Christie, 2003; Carmona et al., 2010; Dempsey et al., 2011; Manning, 2011). A sense of community can be defined as an amalgam of shared emotional contact through interaction with others, place attachment and sense of membership in terms of feelings of having a ‘right to belong’ (Carmona et al., 2010; Dempsey et al., 2011; Gehl, 2001; Tallen, 1999, p. 1370)” (Lynch, 1960; Manning, 2011; Montgomery, 1998; Nash and Christie, 2003; Relph, 1976; Tallen, 1999). Communities of place that share a specific locale, such as greenways or urban parks, may promote the creation of sense of community. This choice of remaining in a community or leaving may be related to the physical environmental quality and maintenance and the level of accessibility to key provision of services and facilities, such as the presence of nearby greenways and/or neighborhood parks to accommodate the need for outdoor recreation as well as to numerous other factors

(Bramley and Morgan, 2003; Dempsey, et al., 2011; Jacobs, 2011; Manning, 2011; Moore and Driver, 2005; Newman, 1980; Wilson and Taub, 2006).

2.8.4.8. Communities of interest

A community of interest "has as its premise the assumption that for most people, at different stages in their lives, there is a need for areas immediately outside their homes which can be used for activities that involve others like themselves – places to play, to gather and gossip, to meet members of the opposite sex" (Newman, 1980, p. 17). In the past people living within the same community generally were "united by a common background, similarity of pursuits and physical proximity." With the increase in physical mobility, this gave way "to communities of people sharing similar interests but separated by physical distance." In such cases, communication is carried out via journals, letters and telephone, and more recently via SmartPhones, internet networks, and infrequent meetings (Newman, 1980, p. 11). Newman (1980, p. 12) said that interest communities could "consist of bowling clubs in a particular town, a concert society, or even a group of skilled workers making up a union local in a assembly plant" and also pointed that "most communities today are formed for the purpose of pursuing narrow interests and limited associations. Greenways are befitting for several types of communities of interest, who use the greenway physical environment to pursue the same recreational activities.

2.9. Greenways as an Interactional, Convivial and Experiential Urban and Suburban Space

Greenways represent an effective ecological system that connects natural systems with human society. "By bringing nature into people's everyday lives, greenways and other forms of nearby nature can help us to rethink old ideas and forge new relationships that are healthier for both people and nature" (Hellmund and Smith, 2006, p.167). They provide easy access to nature and places for recreation and leisure. This enhances people's engagement

with nearby nature environments contributes to psychological and spiritual renewal and refuge from the rush and stress of urban environments (Hellmund and Smith, 2006; Kaplan and Kaplan, 1989). But more than that, “Greenways can play an especially important role in a revived commons because they are strategic repositories of concentrations of public values; because they literally tie communities and regions and other sorts of common space together; and because they are a new form open to experimentation and innovation” (Hellmund and Smith, 2006, p.179). Greenways can promote learning, environmental and social education encouraging people to engage with and act in favor of natural environmental resources while providing the opportunity for people to interact and embrace social diversity (ibid, 2006).

Professor of Landscape Architecture and author of *the Florida Statewide Greenways System Planning Project*, Margaret Carr (2002 phone-interview, as cited in Ahern et.al., 2006, p. 71) said that “human interaction should also be considered when planning a successful greenway because human well-being is dependent on healthy, functioning ecosystems”. She argued that “the ideal approach is one that blends immediate human needs (e.g. for recreational opportunities) with long-term human reliance on healthy ecosystems.” According to Hellmund and Smith (2006), the social function of the greenways can be grouped into different categories:

- *Guides social connectivity:* greenway attractions and recreational uses directly influence the movement of people and offer alternative means of mobility: walking, jogging, biking and sometimes horse riding;
- *Promotes social interaction:* the greenway can improve the sense of community and neighborhood unity promoting social networks that foster effective social, economic and political activities;
- *Promotes the connection between people and nature:* the specific greenway characteristics, such as linearity, high ratio of edge to interior area, greater accessibility, and other aspects can also influence the way that people interact with nature,

- *Improves local and regional economics:* by increasing business activities and the value of surrounding properties.

People use greenways for diverse reasons. Dines and Cattell (2006) and Manning (2011) acknowledged the many diverse motivations people have for utilizing a public spaces: achievement/stimulation, autonomy/leadership, family togetherness, similar people, new people, learning, enjoy nature, introspection, creativity, nostalgia, physical fitness, physical rest, escape personal/social pressures, escape physical pressure, social security, teaching/leading others. Considering this variety of motivating factors, studies that deal with social aspects of recreation use and users are important because they provide valuable information about the characteristics of users and patterns of use, which can be utilized by planners, designers and managers. These professionals have a number of social issues that deserve thoughtful consideration at all stages of planning and maintenance: designing landscape and recreation facilities that accommodate different social uses; providing public information for educational programs; evaluating equity, inclusiveness, universal accessibility, transportation and mobility; and promoting social interaction and development (Manning, 2011; Moore and Driver, 2005).

According to Manning (2011, p. 23) many studies have utilized “measures of recreation activity and characteristics of recreationists, including their social characteristics and cultural influences on recreation activity and behavior.” Basic demographic and socio-economic characteristics, such as “age, education, income and occupation” help to explain “why people participate or don’t participate in outdoor recreation.” Knowing who the users and actors are and how they recreate and interact with each other is essential for “predicting future recreation patterns and evaluating issues of social equity” (ibid, p. 33) as well as “monitoring the popularity of recreation activities; designing recreation facilities and services; planning budgetary personnel; and other resource needs; conducting public information and education programs, and evaluating the efficiency and equity of public outdoor recreation” (ibid, p. 56).

Many studies have shown statistically significant relationships between recreation participation (uses and users) and demographic and socio-economic characteristics (Manning, 2011). Nevertheless, “demographic and socioeconomic variables (…) are generally not powerful predictors of overall participation in outdoor recreation, but are often more strongly related to specific activities; (…) cultural context also influences outdoor recreation participation and behavior. Potentially important cultural influences include one’s social group and other social relationships, childhood experiences, and other elements of socialization, the type of community in which one lives, a general social class tendency toward status emulation, race and ethnic, and gender” (ibid, p. 57).

Greenways can propitiate numerous opportunities for social interaction, because they facilitate social access, visibility and attendance. “When greenways run through a variety of neighborhoods for a greater diversity of people” (Hellmund and Smith, 2006, p. 189), their physical environments facilitate the social-mix and bound within and between neighborhoods, that shares a communal place identity and sense of place. The promotion of diverse social contexts, have the potential to open up opportunities for socialization (Hellmund and Smith, 2006; Gobster, 1995). The diversity of the greenway enhances social identity, sense of place, community and citizenship. “Greenways can weave together communities not just physically, but in the sense of creating the distinctive common spaces and experiences that help to hold communities together” (ibid, 2006, p.192). However, greenways can also be problematic because of problems with safety, anti-social behaviors such as vandalism and crime, which would lead to a reduction in the levels of utilization, social interaction and community participation.

Greenways can also enhance inter and intra-cultural relations, promoting the proximity of different neighborhoods and interaction among different types of users and actors, thus facilitating communication and cohesion across socio-economic and ethnic groups, despite differing values and perspectives. Nevertheless, such relationships are not easy to start and sometimes take some years or decades to establish (Hellmund and Smith, 2006; Manning, 2011; Wood and Landry, 2008). Hellmund and Smith (2006), Jacobs (2011), Putnam

(2000), Whyte (1980), Wood and Landry (2008, p. 106) argued that having a social mix, i.e. different social networks, in public urban spaces, such as squares, parks and greenways, promotes social interaction, cohesion, insertion and harmony “by reducing social and racial tensions, by reopening channels of communication and interaction, decreasing mistrust and hostility, and promoting a better understanding between groups.”

However, many humans do not seek outdoor recreation environments for social benefits, but for the psychological benefit of immersion alone in natural areas and internal renewal or integration with nature. These users generally prefer places with fewer users and uses. In addition, some greenways with ecological features that are more sensitive to human impacts, need to be protected from high levels of usage and crowding and provide the accommodation of more passive activities (Gehl, 2010; Manning, 2011). Greenways can afford both experiences of solitude and social gathering. Greenways often provide a variety of environments and features, some more integrated with nature and less frequented by people, others such as destinations, points of attraction and activity node areas where more people gather. Designers must be aware of these aspects in order to plan pleasant, functional and peaceful places that accommodate the needs of different users, actors and activities (Gehl, 2010; Manning, 2011). The consideration of distance is necessary to achieve this balance. “Different forms of communication take place at different distances, and distances vary constantly depending on the subject and nature of the contact” (Gehl, 2010, p. 47). Gehl (2010) described four different communication distances which influence the way people interact among people they know and among strangers:

- Intimate distance: distance at which strong emotions can be exchanged, i.e. love, tenderness and consolation, as well as anger and rage, includes physical touching such as patting, and hugging;
- Personal distance*:* is the close contact that occurs during interactions between family members and friends, utilized when gathering together;
- Social distance: intermediate distance for interactions and conversations that occur during informal contact among people,

- Public distance: distance used in formal contact and communication; people tend to maintain significant distance.

Distance is related to human perception of public space environments. Long distances can provide contemplation and observation of the landscape and people. Shorter distances cause stronger impressions, and the senses of smell and touch come into play (Gehl, 2010). Humans interact with the environment through all of the human senses. Human interpretation of the environment on a complex group of variables, including location, size, form, function, texture, aeration, temperature, color, geometry, proportion, rhythm, scale, balance, lightness and sound. These values are identified through the perceptive senses of vision, olfaction, audition, taste and touch, as well as other internal senses, such as the senses of space, proxemic behavior, thought, language and pleasure (Kaplan & Kaplan, 1982; Okamoto, 2002). The sense of space includes the kinesthetic sense, which is related to movement and body awareness, and the vestibular sense which is related to balance and gravity. The kinesthetic aspect represents an important aspect of urban design, as it is through movement that people have access to places and interact with the environment (Carmona et.al., 2003; Scardua, 2009). Humans utilize their senses to interact and communicate with both the environment and people, as illustrated at the Appendix C. Visualization and visibility is clearly another important sensorial factor to be considered. Greenways can provide not only beautiful natural landscapes, but also the opportunity to view other people with diverse backgrounds, promoting a pleasant, interesting environment (Flournoy, 1969; Gehl, 2010).

Socialization in physical environments, such as greenways, may differ from the socialization that takes place in other public spaces (conventional parks and squares). This is one reason that studies dealing with the social aspects and dimensions of greenways are important: they can provide a deeper understanding of *the catalysts of social interaction*, by the understanding in what is the catalyst that makes the people to interact and congregate? What are the features and activities that encourage the social interaction? What make the greenway physical environment a desirable, experiential and symbolic place? (Shaftoe,

2008; Thwaites and Simkins, 2007). Carmona et al. (2008, pp. 14-15) mentioned that it may take some time for social interaction to emerge (days, months or years) and sometimes for just a few moments or times (few days, few hours or few minutes) “to create or refurbish local environments, to make them conducive to social interactions that extend across successive visits.” It is important not only to observe *how people behave and interact*, but also *how different users and actors experience public spaces*, *such as greenways*, during their recreational and leisure pursuits.

Lusk (2002a and 2002b) examined how greenway characteristics encourage a variety of uses by analyzing their destinations and characteristics or features. One interesting connection that Lusk found was between greenway characteristics features and public spaces that originated from the Greek *Agora*, Roman *Stoas* and Cypriot *Khirokitia.* These ancient public spaces were democratic arenas and spaces for commerce, debate and political action. Lusk (2002a) mentioned that Khirokitia in Cyprus (5500 B.C) was organized by roads that connected houses, natural resources and neighborhoods, in a configuration that is very similar to the early greenway function and characteristics.

According to Lusk (2002a, p. 39) “*Khirokitia*, Greek *Agorae* and Roman *Stoas* were sometimes pass-by or pass-through spaces, meaning they were not destination endings but fluid in activity. The relationship to the space in activity, meaning and even human needs would have been met differently by the ‘pass by’, ‘pass through’ and ‘terminate in’ destination for the expectation raised by the spaces would have altered from one to the next.” This concept is illustrated below in Figure 05. Greenways often will have a start and termination in space because people anticipate where they will start and where they will terminate their activity.

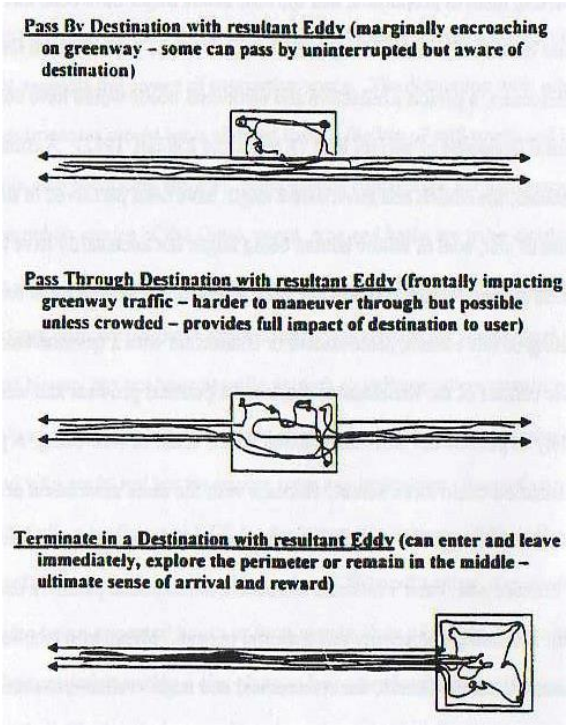

Figure 5: Greenway Destination/Point of Attraction Types.
Source: Lusk, 2002a, p. 39.

This type of destination, point of attraction or activity node placed along a greenway would foster social congregation and the creation of democratic spaces for social development, learning and exchange of information. A place for the social and democratic life can enhance social diversity (Magnoli, 2006) and “involves and symbolizes activities important to ‘citizenship’ and the existence of a civil society (i.e. social relations and public participation)” (Carmona et al. 2003, p. 109). One of the fundamental values of public spaces is that, as democratic arenas for free and spontaneous use, they must accommodate the desired as well as undesired users (Carmona et.al. 2010; Lynch, 1965; Whyte, 1980).

Lusk (2002a, p. 418) defined greenway destination areas as democratic places and “plaza destinations”, similar to the Italian piazzas and Greek agora that “can bring” everyone, i.e. different types of users, together to recreate and socialize. Design solutions were suggested

to enhance the socialization among users, such as activity node areas or expansion of trail areas. In both cases, Lusk proposed multi-use activity accommodation and small spaces for social interaction without interfering in the trail usage flow. As can be seen in the drawing below, Figure 06, both solutions aim to mitigate and/or avoid conflict among different users, actors and uses.

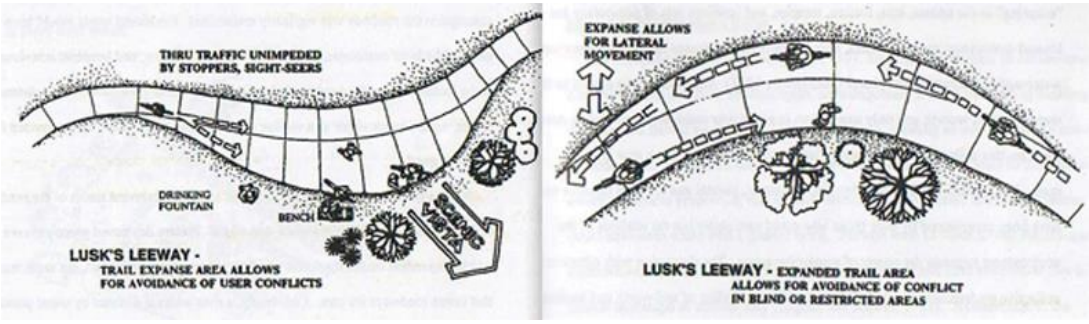

Figure 6: Greenway Design Solution to Mitigate Trail Use Impact.
Source: Lusk, 2002a, p. 39.

According to Garvin (2011, p. 198) a park or greenway is socially sustainable “if, throughout its existence, people of every age, ethnicity and income want to be there” and functionally sustainable if people are able to get to it and enjoy it without interfering with others’ enjoyment” (ibid, p. 200).

> “Greenways are fundamentally a form of common space with important social functions. They are not only open for public use in a strict legal sense, but represent a relatively new vigorous form of an old idea – that commonly held and commonly managed resources have a vital and far-reaching role to play in society. Greenways are ideally both egalitarian and democratic. They are egalitarian in that they, at least in theory, offer important benefits to all citizens, regardless of wealth, power, or social standing. They are democratic in that they both depend

> on and further strengthen traditions of civic participation and collective decision making" (Hellmund and Smith, 2006, p.178).

Greenways provide a shared environment that accommodates a variety of engaging activities, such as recreation, exercise, and social meetings, providing direct contact between people and nearby nature. Social interaction that takes place may be in the form of "planned and spontaneous meetings, unexpected meetings, greetings, verbal exchanges and conversations with acquaintances met on walks" (Gehl, 2010, p. 148). Specific circumstances, such as events, activities and programs may catalyze social interaction. Other arbitrary conditions such as the presence of children, domestic pets and wildlife may also be catalysts of social interaction. Greenways, thus, have the potential to reinforce human relationships Greenway gathering places, such as destinations and points of attraction and/or activity node areas, if well planned and designed, can contribute to mitigating social conflicts. In this context, recognizing and describing which greenway environments and features encourage or facilitate people to socialize is a highly worth, while pursuit.

2.9.1. The Context of Recreational Greenways and their Immediate Geographic Location in Impacting the Social Role

Some metropolitan areas and medium size cities face landscape, land-use and social problems. Social interactions are losing space due to urban sprawl, social isolation, distances to be traveled in order to reach the public environment, dependence on vehicles and lack of outdoor recreation facilities (principally among the low-income people). On the other hand, a number of metropolitan areas and medium size cities present very dynamic urban public spaces, with lots of interactions because of the provision of landscape and physical structure features and greater accessibility and visibility.

The meaning of such public spaces differs for each culture, ethnic group and age in terms of settings, social interaction and context of recreation and leisure. Understanding the

everyday usage and involvement with physical settings enables us to understand the social interaction and integration. This is important because people construct their identity by expressing themselves and interacting with others, and thus their patterns of use can be negotiated and constructed, providing different patterns of human relations.

Greenways, as a fruitful component of sustainable design, have an important role in this process, because of their complex system, as a connector of people, connector of people with nature and connector of nature with nature, depending of the network typology. Because of this connecting character, greenways can link people and landscapes, mitigating social and environmental problems, such as fragmentation, segregation and exclusion. At the same time, with the addition of features (landscape and physical structure) they can also satisfy human needs for leisure, recreation and tourism.

Thus recreational greenways have a strong potential to promote the connection of different geographic locations and contexts (landscapes, places: different types of conventional parks, neighborhoods, commercial areas, schools and so on) and also people (different users, actors, neighborhoods and communities), serving as a resilient, new and effective democratic space, often more so than conventional parks. Lusk (2002a, p. 407 and 2002b) examined how greenway characteristics encourage a variety of uses by analyzing the number of destinations and their characteristics or features. She also analyzed the corridor and distance between destinations, and human needs (what are human needs and how are they related to the greenway features). However, her study did not give more detailed information about the relationship between the greenway characteristics (type of connection and type of features) and the users, nor did it demonstrate that the sequence of features might motivate or direct users' attention to recreate and/or socialize. In her conclusions, she mentioned that uses might be attached to recreational or physical activity desires, or to "issues related to well-being such as the restoration of directed attention or social interaction."

Greenway characteristics, such as formal linearity, narrowness and vast perimeter, provide more accessibility and visibility for everyone, allowing greenways to penetrate, permeate and transverse different areas of the city and propitiate opportunities for social interaction. Their connections and features facilitate accessibility, flow and different levels of usage (high, moderate and low). According to Hellmund and Smith, “When greenways run through a variety of neighborhoods (…) these diverse social contexts, in turn, have the potential to open up opportunities for the sort of social interaction both within and between neighborhoods” (Hellmund and Smith, 2006, pp. 189-190).

In this way, greenways can enhance inter and intra-cultural relations, strengthening the communication and cohesion across cultures, ethnic groups and genders by enabling the contact of different people and situations to interact and to get in contact with each other, even though they have different beliefs, values and perspectives. However, such relationships are not easy to start and sometimes take some years or decades to establish, or depend on temporal connections. In addition, public spaces enable social diversity and present many opportunities for the construction of social relations, social mixing and the mitigation of conflict and differences (Hellmund and Simth, 2006; Wood and Landry, 2008; Manning, 2011).

Recreational greenways within urban areas function as a great democratic place, in which people (diversity of users and actors) can greet, meet (families, friends and strangers), exchange ideas, share places and experiences, exchange conversation and share the activities and interactions (people-to-people and people-to-nature). The greenway structural network system can be seen as a trend of connections. This strategic way of connecting people with people (linking the greenway users and actors) and people with nature (linking the trail network, linking the landscapes, linking the greenway features, linking the activity node areas) facilitates access and enhances multiple human recreations, interactions and experiences. Such a network creates different and functional landscapes that have the potential to link everything and everyone together (social and cultural connection and interaction).

To be able to undertake the social network analysis, incorporating its main concepts into this greenway social network study, it is necessary to understand some basic concepts such as graph, nodes and lines and their function in a Geographic Information System (GIS) analysis of the greenway itself (physical environment context) and the surrounding areas of the greenways (neighborhoods and parks).

According to Scott (2009, p. 64) “graph theory concerns sets of elements and the relations among these, the elements being termed points and the relations lines”. Graph theory can be used to analyze social network concepts and spatialize them within the greenway context and surrounding geographic locations, in which *nodes* represent the type of connection destination (parks, neighborhood and parks/neighborhoods, primary and secondary greenway activity node areas) and *lines* represent the greenway multi-use trail (by it totality and by segment). The social network concepts, such as density mapping and point of centrality, center and dispersion locations can be applied to the greenway GIS analysis.

Mapping density is an important tool for comparing and analyzing population density, locations, features and usage. By mapping the quantity of people within particular geographic locations surrounding a greenway, such as different neighborhoods, as well as the quantity of people within specific segments of a greenway or surrounding specific features and connections, it is possible to understand the influence that locations, connections and features have on social interactions. Commonly the density hierarchy or intensity is shown by dots, where dots represent the quantity of people. Density analysis commonly utilizes census block within a neighborhood location by zip code area. Density can also reflect behavior mapping and behavior tracking information about the intensity/quantity of users, actors, their activities and their social relations (ties/bridges) that happen along the greenway multi-use trail.

Density can be used to identify the number and intensity of patterns of use, or users or actors and their social interaction intensity levels (degree) and to estimate the density of the greenway usage for socialization areas (high, moderate and low). Density surface analysis

can be utilized to indicate the occurrence of social density islands within greenway trail segments. Also density analysis can be applied to the surrounding neighborhood locations, in which the densely neighborhood areas may justify the more intensity volume of users', actor's and uses. Such analyses can provide important information about which of the greenway physical environments (places and features) are more utilized for socialization. They also can be combined with the network analysis.

The centers and dispersion tools can be used to measure areas of concentration or of sprawl. When applied to the geographic locations surrounding the greenways (neighborhoods and park areas), these tools can provide valuable information about the distance from each neighborhood location to the greenway, in order to spatialize the distribution of greenway usage. The central points or points of centrality can be used to identify the greenway location that receives more central attention in terms of interactions. Such tool in future works as a sequence of this dissertation study.

ArcMap 10 can be used to represent linear data sets, such as the greenway network system and its features and attributes, such as trail type (surface, length), route direction, crossing areas (over-pass and lower-pass). Thus, this tool provides the possibility to record multiple conditions that may overlap in a single segment. By identifying clustering and/or scattering areas, it can be used to provide the locations of greater or fewer interactions of users and actors. It can also be used to calculate the distance from those cluster areas to the greenway features and also neighborhood locations; statistic graphs can be generated with the identification of the peak zone areas and to present the results (HTML) of p-values, z-scores, confidence level values, and so on.

Another possible GIS tool to use in the study of the greenway social network is the ArcGIS Network Analyst, which provides network-based spatial analysis including trail routing performance and networks and travel directions (ArcGIS Online Help, 2011). With the GIS Network Analyst tool it is possible to carry out a site-level inventory analysis with the identification of the service area attendance within a half-mile area and a one-mile area from

the greenways and also from the conventional parks. This information analyzes the walkability (1/2 mile), bikability (1 mile) and, thus the accessibility to the greenways. This tool also can be used to generate a greenway social network map. The intention is to use the ArcGIS Network Analyst tool in future works as a sequence of this dissertation study.

GIS tools offer many possibilities for spatialization of social network data. This spatialization can enhance our understanding of how the greenway network, the immediate geographic location and the greenway context impact the social role and potential of the greenway. This can contribute valuable information for greenway planning, design, management and policy.

2.10. The Spheres of Local, State and Federal Policies in Providing Development of High Quality Greenways

The creation of a high-quality interconnected network system of parks and greenways (master plan; design; implementation and management of the greenways and parks recreation: services, facilities, connections and features) adds paramount value to our public spaces. The greenway structural network system will benefit from actions at the federal, state and local levels, in regards to land acquisition and areas of landscape biodiversity protection and conservation (Hoctor et. al. 2004), definition of recreational areas (different types of greenways and parks) and definition of the suitable areas for expansion and connection of urban land and its landscapes.

Local, state and federal policies are needed to create effective laws and policies that aim to mitigate environmental, social and cultural impacts, and safeguard the patrimony of the natural, social and cultural environments, providing successful greenways with high quality and generating sustainable environments and communities. Local, state and/or federal policies could better support the development and provision of high quality and successful greenways by considering the aspects listed below:

- Encourage those involved with leisure, recreation and tourism (community and municipal Departments: Parks, Recreation, Cultural Resources, Transportation and Tourism) to comply with local, regional and federal planning policies and to participate in planning process (Goeldner and Richie, 2009);
- Encourage municipal, regional, national and citizen groups to support more greenway trail developments and research studies (Moore and Shaffer, 2001);
- Encourage positive integration and communication between greenway and park managers, and researchers at municipal and regional levels to improve the quality of greenway research (Manning, 2011);
- Provide and encourage at municipal, regional and national levels more studies related to outdoor recreation social phenomena, including the greenway social role in order to provide suggestions that can more effectively guide management (Manning, 2011, p. 340), and provide better greenway design: effective connections as a network system (outdoor recreation areas: different types of greenways and conventional parks); provide zoning and feature improvements (landscape and physical structure) to better accommodate human needs, other than strictly for recreation activities (ibid, p. 312);
- Provide effective and integrated polices at national, regional and local levels that concentrate on expanding the greenway network system: connecting local, regional and possibly national trails in a systemic network of long-distance corridors, as an interconnected system, (Gobster, 1995);
- Promote communication and integration of greenway management at the municipal, regional and federal levels (Manning, 2011);
- Provide an effective and integrated greenway, park comprehensive master plan (recreation, transportation and tourism) integrating the national, regional and local levels, that defines and provides information about the trail: hierarchy, connection, routes, facilities/features and destinations;
- Encourage at the local, regional and national authorities levels to identify the landscape and greenways natural/cultural heritage suitable for conservation,

development and/or conservation/development, including the identification of the landscape, tourism activities, recreational activities, historic sites and interpretative/educational opportunities and information (Manning, 2011; Lardner and Klein ; 2010; Dirk et.al., 2010; Goeldner and Richie, 2009);

- Local, state and/or federal policies should carry out ongoing studies of recreation norms with the analysis of the greenway users and actors experiences, (social indicators of the greenway users and actors frequency, intensity, numbers and interactions may provide important information about the quality of their recreation experience). Such indicators and standards of quality are important elements to provide more effective design and deliver of the high quality greenways physical environments (Manning, 2011);
- Local, regional and national authorities should identify impacted areas of the greenway physical environments and provide mitigation actions to recuperate the natural and man-made resources/facilities (greenway features);
- Promote at the local and regional levels educational programs (knowledge) to encourage visitors, users and actors to adopt behaviors (positive behavior, attitudes and actions) that attend to greenway norms, reducing the experiential and interactional impacts on the greenway features and structural network systems (Manning, 2011);
- Encourage at the local and regional levels the implementation of greenway features (landscape and physical structure) that better accommodate social needs, providing opportunities for social interaction and relational ties/social bridges matrices;
- Establish at the municipal level suitable development policies encouraging land developers to incorporate greenways into their development plan in accordance with greenway and park comprehensive master plan;
- Provide more greenway destinations and connections; radius of attendance; good physical access; welcoming spaces, and choreography of spaces, aggregating spaces with multi-use to accommodate different users and actors (type and size) and their interactions without blocking the greenway trail flow and recreational activities, providing different types of activity node areas and/or expanded trail areas;

encouraging diverse users and actors to interact and share common spaces and recreational activities (Peters and Buijs, 2010; Lusk, 2002a);

- Promote social equity, social and cultural inclusion (neighborhood and communities) as an important element to the greenway planning process; (Melcher, 2010);
- Promote public and private partnerships at the local level, involving citizens in the greenway decision-making, design and implementation process, improving the local economy, and local community quality of life and providing a sustainable formation of civil neighborhoods, communities and society (Klitsounova, 2010; MacLean, 1985);

2.11. The Relationships between the Social Processes and the Recreational Greenways

Greenways, and their many different types of structures and characteristics, can afford both environmental and social benefits, as they are easily accessible and can bring nature and people together, enhancing their opportunities and experiences. However, the promise of greenway systems to enhance and accommodate social interaction and behaviors that occur among users and actors may not be fully realized. Users and actors of the recreational greenways are not taking advantage of some of the greenways' social benefits, because they are not well understood by users and actors. Also, many policy makers and designers may not have thought about improving the greenway environments to accommodate and improve social network relations and needs. Activities that involve social integration, integration with nature, environmental education and environmental conservation have not been sufficiently explored by users and actors.

The main aim of this study is to examine the role of the social network, and its relation with the greenway characteristics—structural network system and features—in order to enable recreational greenways to reach their full social potential. In other words, this study aims to comprehend how social-ecological systems work, and verify the connections, linkages and relations between those systems and human society, answering the questions "how do

protected greenspaces benefit society and who, specifically, is most likely to benefit" (Hellmund and Smith, 2006, p. 158).

Greenways have the potential to link different city areas and to promote an enjoyable and quality physical environment for leisure, recreation and tourism, offering a myriad of benefits to the city, society and nature (Flournoy, 1969). Greenways must be thought of as a powerful system, rather than a punctual solution, and provide a more sustainable platform for protecting nature and accommodating human need and usage. Greenways can show society how to live in harmony with the land, by providing alternatives for transportation, recreation and interaction with the nature, nature interpretation and socialization. The fulfillment of such lofty goals starts with policy, followed by design, and finally implementation of socialization programs and activities, like environment education programs and interpretation programs in which people can reflect about themselves and their actions, re-thinking and re-educating themselves about how we live, how we use the land, how we interact with the land and others, how we respect the land and others. Greenways have the potential to enable our society to achieve the desirable goal of sustainability.

> "Greenways to me, because they are long, they are typically long and skinny, and traverse, you know…quite a bit of distance and by that virtue they may cover many jurisdictions and also they go through different types of lands, they can go through urban lands and rural lands, and wilderness lands. I think that we should use that systematic approach, to put those corridors in place, no matter what landscapes they traverse and inform and begin educating people, the value of the ecological system and the impacts of human beings of having on that system (…) so we've been trying in our own little way in the projects we work on to talk about a more sustainable way of living and we use greenways as a vehicle to get to that sustainable living" (Flink, 2010).

I believe that the greenway characteristics, which include the types of features and the types of network systems, are important for social utilization and well-being, because they directly influence the way that people perceive, experience, use, interact and behave when utilizing the recreational greenway physical environments. By bringing nature into people's everyday

lives, “greenways and other forms of nearby nature can help us to rethink old ideas and forge new relationships that are healthier for both people and nature” (Hellmund and Smith, 2006, p. 167), building sustainable neighborhoods and communities that work together to change behaviors and care about environmental and social challenges. Each greenway type and context has its own unique and complex issues.

According to Hilty et. al. (2006, p. 96) “in general, the smaller, more heavily used and less biologically intact greenways will likely have less biodiversity value compared to larger, more intact greenways with less human activity. There is a need to better comprehend how the different types of greenways are used by different actors, especially different types of groups and sub-groups use—how people interact, behave and benefit from different greenway physical environments. Studies that deal with these issues may enhance comprehension about the quality of recreational greenways in urban areas, encouraging aspects such as: social interaction, social integration, social insertion, social-nature integration, environmental conservation and environmental education, thus making greenways more successful and more interesting places for the community.

> “We have folks that study the social aspects which is because this is a health path, we are very interested in the social impact to the people, being beneficial (…) we’ve have people that come in and evaluate the project from that perspective you know, what will be the benefit to human health? What will be the benefit to human social interaction?” (Flink, 2010).

In addition, Manning (2011) pointed out that some studies on social aspects of outdoor recreation indicated that social groups influence recreational participation and usage (motivations, personal characteristics, type of actor, experience level, type of activity), however they did not provide enough evidence of why such influences exist.

> “More recent research has explored expansion of social groups to locate such ‘personal communities’ within the large framework of society (Stokowski, 1990; Stokowski and Lee, 1991). This theoretical approach suggests that individuals are socialized into recreation styles not only by means of social groups, within which they participate, but their broader social

> contacts and relationships as well. Using social network analysis, an initial exploratory study suggests that broad social relationships can both facilitate and constrain recreation and leisure behavior. For example, individuals with social ties to multiple types of groups, such as immediate family, extended family, and friends, were involved in a broader range of recreation activities than individuals with social ties to only one group type" (Manning, 2011, p. 41).

The success of the greenways in recent times (design, implementation and usage) has also induced an interesting phenomenon—everyone (designers, recreationists, politics and community) wants this network to be expanded and connected as a system (provision of more greenways and more features), and this means more linkages between people-to-people and people-to-nature. These connections may affect (positively or negatively) the way people use the greenway physical environments, how they move along the greenway trail segments and immediate geographic locations destinations (where they go, where they interact with others).

According to Manning (2011), when dealing with social characteristics of outdoor recreation participants, it is crucial to understand complex issues such as why people participate or don't participate in outdoor recreation, how people interact and behave when using outdoor recreation environments and what type of activities or new patterns emerge in the recreational environments. This information helps to predict future recreation patterns and to evaluate issues of social equity, social health, social capital and social sustainability.

Understanding the social network processes and patterns that happen along the greenway trail, contributes to inform the society about the social needs and the social potential of such physical environments, reinforcing positive relations and usage between society and greenway public spaces, emphasizing the social and natural environment harmony. Such information about greenways' social role may positively affect trail utilization, behaviors, actions and interactions, enhancing social development and sustainability through the formation of sustainable communities, with good quality of life, and strong social ties/bridges

and community cohesion. This information can be used to create new design approaches that can better accommodate these social processes and patterns, creating more successful greenways.

The methods of this study, explained in more detail on the chapter 4, were structured to provide reliable results in terms of greenway social network interaction and behaviors and then provide valuable guidelines and recommendations to the policy makers and designers in terms of greenway development parameters. Such information and actions also will reflect and affect positively in how our society will use the greenways and benefit from them in the future.

Below it is a tentative list of directives for the greenway policy makers, planners and designers, according to the literature review:

- Provide new and different connections within the greenway network system: major and minor destinations/point of attractions (parks, neighborhoods, schools, museums, commercial areas, hospitals and community centers); trail network expansion (different typologies and sizes); trail connections (uninterrupted network with physical barrier with more secure crossings: overpasses and underpasses); green-infrastructure and spaces for social interaction and commuting;
- Promote the design of an efficient greenway network system with different social destinations and the increase of social capital (offering opportunities for people to congregate and interact with known and unknown actors and users) (Lusk, 2002a);
- Provide more effective social-ecological design that accommodates the needs of both people and nature (Hellmund and Smith, 2010);
- Design more physical connections and a hierarchy of greenway types (arterial and secondary), increasing the connections and concentration of urban functions through the enhancement of multi-use trails, different types of trails and different types of activity node areas to accommodate concentration and isolation;

- Design greenways that provide and allow more social interaction, with the provision of connections and features that accommodate human needs for both concentration/spreading out and socialization with others/seclusion;
- Design and implement a hierarchy of greenway trails and provide the major greenway points of intersection nodes of activity with more physical structural features (public restrooms, information panel, water fountain and stretching areas) and also specific points along the trail to be able to accommodate the concentration and distribution of greater numbers of people (users and actors);
- Avoid and mitigate trail usage and flow conflicts, mitigate physical barriers;
- Manage the trail multi-use conflicts (among different types of users, actors and different patterns of use/types of activity) (Flink et.al., 1993);
- Design more multi-use social facilities (flexible and multi-functional) to accommodate the social need for commuting, congregating and integrating;
- Design, improve and provide successful and effective greenway features: benches, picnic areas, scenic view areas for landscape and wilderness contemplation, picnic tables, amphitheater, public restrooms, walking board areas, bridges, trail surface, stretching areas, bike facilities, trail signs, water fountain, activity node areas or pocket of activity (different types), urban furniture and public art;

Policy-Makers should be accountable to:

- Provide guidelines for the multiple functions of the greenways (opportunities and challenges): understand trail impacts (quantity and intensity), plan greenway routes and connections carefully (cause and consequences), understand trail users and actors' needs, understand trail social dynamic usage (interaction and behaviors), manage trail use, monitor trail impacts over time, involve users and actors with the trail management (Ahern, 2004);
- Establish a design standard that defines how the recreational greenways in urban areas are to be planned and built;

- Establish a design standard that defines successful greenways in terms of some key-attributes qualities of effective public spaces: image and attractiveness, comfort, access and linkage, functionality, universality, sociability, inclusion, presence of natural environments and features;
- Provide useful information about the social aspects to planners, designers and recreation managers;
- Predict future recreation patterns and evaluate issues of social interaction and behavior;
- Plan, design and create norms that allow the creation of a comprehensive greenway system, with a clear definition (selection, priorities, planning, design, management and use) of connection type, destinations/points of attractions, features and routing;
- Create effective partnerships among agencies, municipalities, public and private, affiliations, institutions and researchers (Hellmund and Smith, 2006; Flink et. al. 1993);
- Promote the community empowerment through citizen group or greenway community member representation (forming local government and community partnerships) in the greenway design project decision, stewardship, management (Flink et.al., 1993; Melcher, 2010);
- Manage and organize temporary and permanent programs, such as environmental education and social activities (marathon and race or movement) without interfering in the regular trail uses, users actors and wildlife (Flink et.al., 1993);
- Determine an efficient greenway management that defines how the recreational greenways in urban areas are to be used by users and actors;
- Greenway planning must be incorporated and integrated to the tourism planning policies to receive more financial resources to be able to preserve cultural heritage (Ahmed and Ismail, 2010).

2.12. Social Network Theory

Social network analysis stems from social and behavioral sciences. Overall, the network analysis focuses on the relationships between people. According to Knowe and Yang (2008, p. 9), “social network analysis works at describing underlying patterns of social structure, explaining the impact of such patterns on behavior and attitudes” (Knowe and Yang, 2008, p. 9). The concept and theory of social network emerged during the past three decades to analyze both structures and entities (Barbási, 2002; Knowe and Yang, 2008, p. 2; Newman, 2003 and Watts, 2003).

According to Wasserman and Faust (2009), “Social network analysis is concerned with understanding the linkages among social entities and the implications of these linkages. The social entities are referred to as *actors.* Actors are discrete individual, corporate or collective social units” (ibid, 2009, p. 17). The linkages among actors occur through relational ties, which is defined as anything that establishes a linkage between a pair of actors” (ibid, p. 18) Some examples of a relational tie that Wasserman and Faust mention and that are applicable to the greenway environment include a type of physical connection, such as a road, river or physical bridge, a movement between places or statuses, such as migration, and social or physical mobility, and behavioral interaction, such as talking together. According to Knowe and Yang (2008) “Relations may be either directed, where one actor initiates and the second actor receives (…), or nondirected, where mutuality occurs” (ibid, pp. 6-7).

Lusk adds the concept of social bridges, which she defines as “components in the environment that can facilitate courtesy, fraternization, and goodwill between two or more strangers. A social bridge provides the opportunity for a positive eye glance, nod of hello, smile or perhaps even an exchange of conversation, returning the elements of socializing that enhance quality of life and building social capital within the community” (Lusk, 2002a, pp. 327-328). Some examples of a social bridge mentioned by Lusk are a door being opened, an elevator, where people may push buttons for others. According to Lusk (2002a),

the need for self-sufficiency and the Americans with Disabilities Act (ADA) has reduced the number of social bridges. She claims that without eliminating ADA facilities, urban designers can incorporate social bridges into their designs, thus providing positive social interaction.

According to Wasserman and Faust (2009) networks can be studied with social network analysis by categorizing them based on the sets of actors and the properties of their ties. This type of analysis is applicable to a study of the social aspects of greenways, through the identification of the types of actors, the types of relational ties/social bridges and the social interactions that occur through these ties. Interactions may involve the physical interaction of actors. “One of the major concerns of social network analysis is the identification of cohesive subgroups of actors within a network. Cohesive subgroups are subsets of actors among whom there are relatively strong, direct, intense, frequent, or positive ties” commonly represented by dyads and triads.

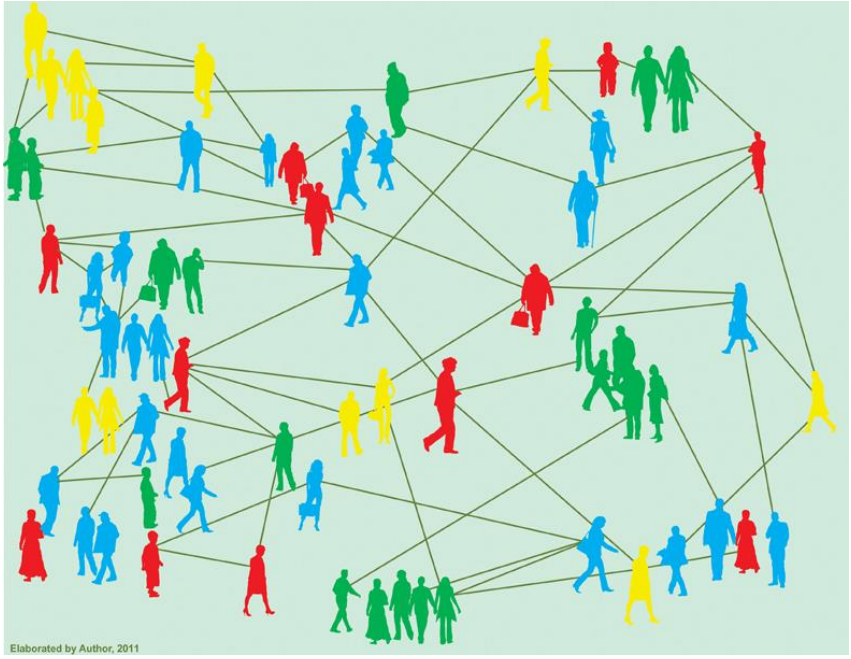

Figure 7: Human Social Network.

Source: Author (2011).

The potential of this research study area is to contribute to the technical-scientific knowledge in the field of Landscape Architecture. The purpose of the current study is to understand the relationships between the recreational greenway and patterns of use and interaction, behavior, ties/bridges and cohesion that take place among the greenway users, providing valuable information about the recreational greenways and their social networks: relational ties, and matrices; social bridges; and types of actors as illustrated above in Figure 7. The types of actors, categorized by size, and social relational ties and matrices, are illustrated in Figure 8 below:

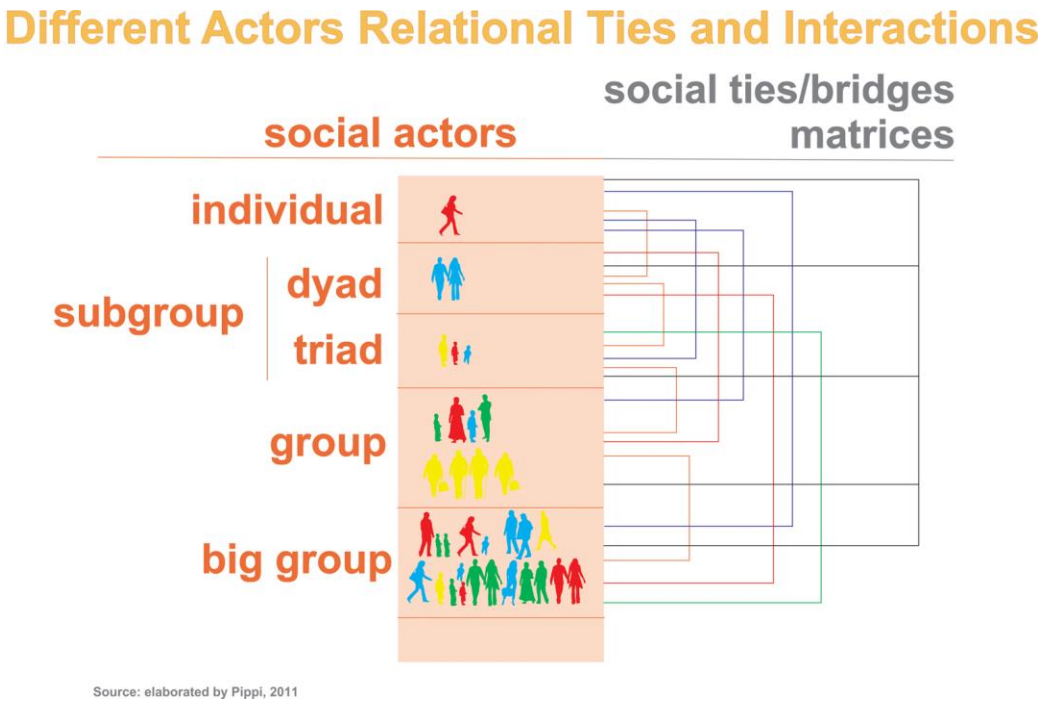

Figure 8: Social Relational Ties and Bridge Scheme.

Source: Author (2011).

This study further aims to describe and spatialize greenway social networks and their relation to specific greenway characteristics and demonstrate how recreational greenways' physical environments make up a network of connections that may influence the social network, as shown in Figure 9 below:

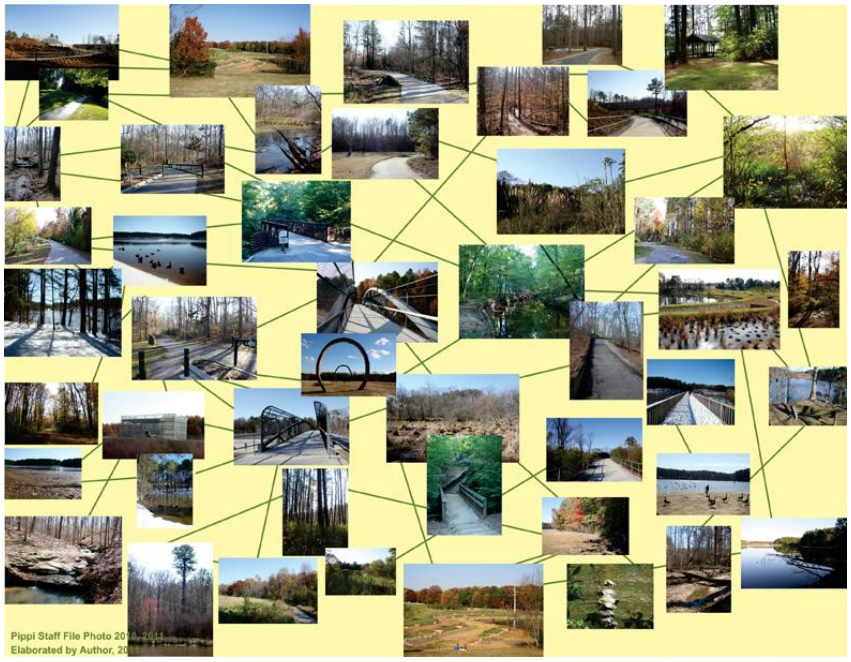

Figure 9: Greenways Features Connections Scheme.
Source: Author (2011).

Figure 10, represents the combination of the human network with the greenway physical environment network, in which the greenway characteristics may impact and influence social aspects, by configuring a social greenway network.

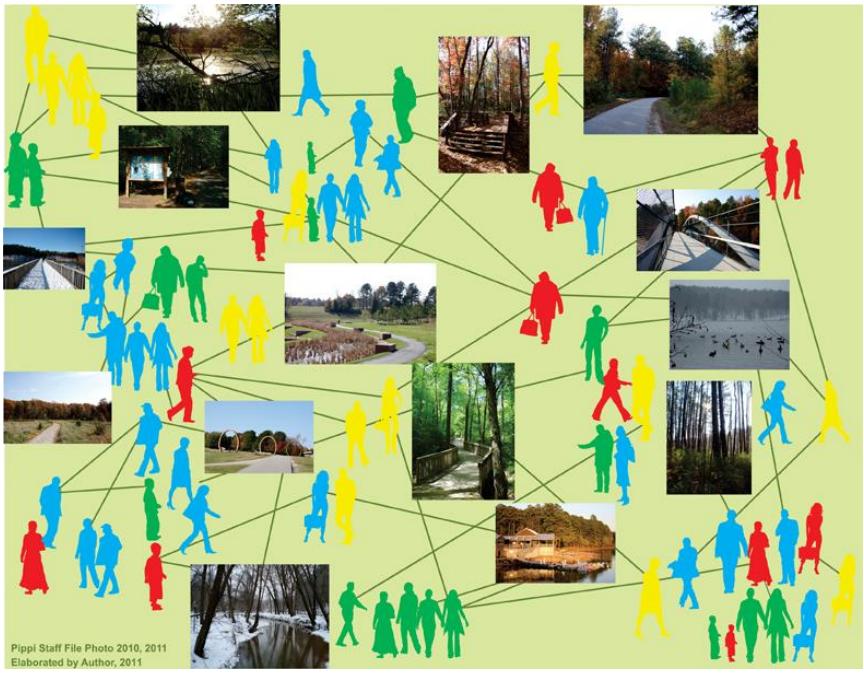

Figure 10: Greenway Physical Environments Connectors and Social Connections.
Source: Author (2011).

2.12.1. Social Network Analysis Incorporated into a Study of Recreational Greenways as Social Networks

The concepts of social network and social bridges are derived from the social and behavioral sciences and are useful concepts for recognizing and describing social patterns, relationships among sets of actors (individuals, sub-groups and groups), and their linkages and organization as communities. These relationships affect the beliefs, behaviors, perceptions and attitudes of each unit (individuals). Overall, network analysis focuses on the relationships (set of one or more relations) between people. Thus, it seeks to understand feelings people have for each other, exchanges of information and exchanges of goods and shared activities, such as outdoor recreation activities, instead of examining characteristics

of individuals (Knoke and Kuklinski, 1982; Knoke and Yang, 2008; Wasserman and Faust, 2009; Scott, 2009).

According to Knowe and Yang (2008, p. 9), “social network analysis works at describing underlying patterns of social structure, explaining the impact of such patterns on behavior and attitudes” (Knowe and Yang, 2008, p. 9). Social entities are referred to as *actors*, which are “discrete individual, corporate or collective social units” (Wasserman and Faust, 2009, p. 17). To Knoke and Yang (2008, p. 8), “a social network is a structure composed of a set of actors, some of whose members are connected by a set of one or more relations.” The interconnections of a network are expressed through social ties. The most common types of social ties are: interaction between two individuals and associations (sub-groups and groups). Social ties are determined by shared activities, as well as by actor and user movements between places and physical connections (Wasserman and Faust, 2009).

According to Wasserman and Faust (2009, p. 249) a chief concern of social network analysis is to identify cohesive subgroups of actors within a network. Cohesive subgroups are subsets of actors with relatively strong ties, often represented by dyads and triads.

> “Although the literature on cohesive subgroups in networks contains numerous ways to conceptualize the idea of subgroups, there are four general properties of cohesive subgroups that have influenced social network formalizations of this concept. Briefly, these are: the mutuality ties; the closeness or reachability of subgroup members; the frequency of ties among members; the relative frequency of ties among subgroup members compared to non-members” (ibid, 2009, p. 249).

Commonly, social network data is collected through observation and interviews with individual actors to understand the ties that actors have with other actors in a set (Wasserman and Faust, 2009, p. 43). Within the social network analysis the attitudes, opinions and behaviors of agents and actors, can be analyzed by their *attribute data*, in other words using variables that measure actor attributes (ibid, p. 29). Variables, which may include socio-demographic information, such as income, education, occupation, gender,

ethnic group or geographic location), are commonly gathered using interviews and surveys. *Relational data* (structural of social action), on the other hand consists of “the contacts, ties and connections, structural relations (socialization, communication relations, family social relations) that are crucial to sustain social cohesion and solidarity within a category of actors. According to Wasserman and Faust (2009, p. 29) “structural variables measure ties of a specific kind between pairs of actors”. Actor relations are evaluated by their intensity, frequency or strength of interaction between pairs of actors”, commonly with the use of observations and texts about the interactions and behavior among actors (Scott, 2009; Knoke and Yang, 2008, p. 11; Wasserman and Faust, 2009).

The potential of this research study area is to contribute to the technical-scientific knowledge in the field of Landscape Architecture, aggregating more information for dealing with *social network aspects*, specifically the identification of social users and actors, social bridges and ties, patterns of use/types of activity, complementary activities types, types and levels of interactions, types of centrality and catalyst of interactions. However, to be able to recognize the social network aspects it is also necessary to describe the greenway characteristics: *features* (landscape and physical structure) and *structural network system* (type of trail surface: paved and unpaved; type of connection: parks as a destination, neighborhoods as a destination and neighborhoods and parks as a destination), which also may impact the social aspects (positively or negatively). It is very important to give attention to the relationship between the greenway physical environment and its social features in order to understand existing conflicts and also potentialities of the greenways.

Details of how the social network analysis can be incorporated into a study of recreational greenways will be presented in chapter 3 by the intended conceptual framework, the objectives, assumptions, hypothesis and research questions of my study that aims to examine the relationship among this conceptual triad: greenway features, greenway structural network system, and social network, also in chapter 4 by the description of each multi-method approach protocol of this study.

2.12.1.1. Type of Actors: Individual, Sub-Groups: Dyads and Triads, and Groups

Relations between different actors are the fundamental elements of any social network. “Social categorizations are discontinuous divisions of the social world into distinct classes or categories. Social identification can refer to the process of locating oneself, or another person, within a system of social categorization used by a person to define him-or herself and others…Social categorization defines a person by systematically including them with some, and excluding them from other related category” of actors (Tajfel, 1982, p. 17). The actors category can be described as a cell of individual natural persons or collectivities conformed by subgroups and/or groups of informal and/or formal organizations. The actors’ cells relations are configured by a kind of contact, connection, interaction, tie/bridge and cohesion in which one actor(s) “initiates” and the second actor(s) “receives” or accepts the “direct” or “indirect” social relational action in a mutual way during their patterns of interaction, behavior and attitudes (Knoke and Yang, 2008, p. 7)

The individual actor represents one unit or one person alone, based on their “ascribed” characteristics (gender, age and/or race/ethnic and so on) or “acquired characteristics” (marital status, education, occupation, religion and so on) presence within a complete network. Individuals can have connection, friendship, association and common attitudes and values or share similar habits, activities or environments of other individuals and collectivity. These attributes can help to bring people together or keep them apart, and are an important factor in whether social ties or brigdges occur. The individual actors make important contribution to the social network studies and analysis. Because our society, community and neighborhoods are composed of relations and the roles of a group of “mutually interacting individuals” in which one’s mutual contact depend upon all other parts (Warner and Lunt, 1941; Ksadushin, 2012, p. 19 and Prell, 2012).

According to Prell (2012, p. 151), Wasserman and Faust (2009) and Kadushin (2012) the subgroups are the smallest network configurations and can include dyads (two nodes, a relationship between two people or a pair) and/or triads (three nodes, a small group or subgroup composed by 3 people), that “share strong, direct, mutual, frequent or positive

ties." Sub-groups composed of dyads and triads can represent and give elucidative information for researchers to understand larger network relations.

Dyads are a simple network consisting in the connection of pairs. "A dyad consists of two actors", composed by two individuals, "and the ties linking these actors together" (Prell, 2012, p. 134). Commonly the dyads or pairs of people are constituted by people who are close to one another that shares and exchange by reciprocity and mutuality similar characteristics, values, motivations and social statuses, such as social kinship and friendship (Ksadushin, 2012 and Prell, 2012). In a dyad relation "each individual still maintains his or her own identity, yet this situation shifts with the introduction of a third member", the fourth member and so on (Prell, 2012, p. 37). In this common sense, "dyads also influence how larger structures form," for example a close friendship or kinship with a particular family member (ibid, 2012, p. 134). Erickson (1988) presented four dimensions of dyadic relationships that can influence attitudes: frequency of interactions (quantity and correlation of similar attitudes), tie multiplexity (sharing and agreement in various issues), strength of tie (strong connection and intimacy between the pair of actors, like friendship or family kinship) and asymmetry (asymmetrical relation with dominance and subordinate esteem and status). The figure 11 bellow illustrates different matrix types of relational ties and bridges occurrence between a pair of actors in which "A relates to B, B relates to A and A and B both relate to one another" (Prell, 2012 and Kadushin, 2012, p. 21).

Figure 11: Matrix Types of Relational Ties/Bridges Between Dyads
Source: Prell, (2012, p. 136)

The addition of a third person to a pair relation creates a triad, which represents the boundary between small groups, or sub-groups and more complex relational sets, when compared with the pair relation of the dyad sub-group (Kadushin, 2012). Prell (2012, p. 37) mentioned that “the simple addition of a third person transforms the social dynamics in crucial ways, and that understanding this transformation could shed light on society at large, e.g. how larger structures constrain individuals.” The figures 12 and 13 below illustrate two types of explanation of a triad relation, the first representing the 6 different possibilities of connections. The second represents the different possibilities of relational ties/bridges configurations in term of number of mutual connections, asymmetric and null dyads occurrence within a triad, based on the illustration of 16 different matrix types of relational tie and bridge occurrences between a triad of actors. Such arrangements affect the interpretation of cohesiveness in a small subgroup (Kadushin, 2012).

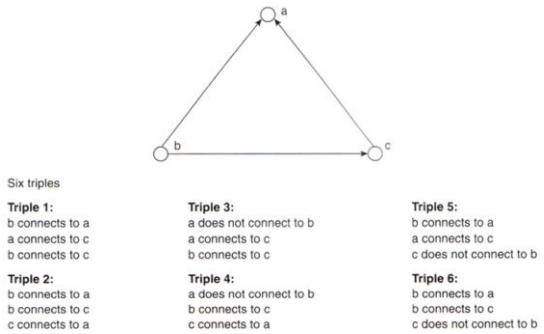

Figure 12: Six Different Triples Connections

Source: Prell, (2012, p. 141)

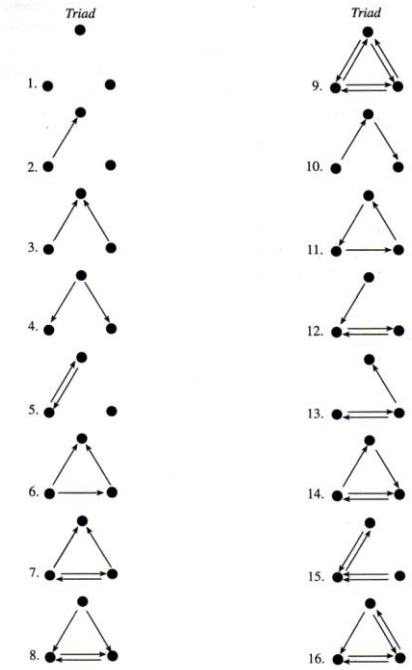

Figure 13: Different Matrix Types of Ties/Bridges Between Triple Relations

Source: Wasserman and Faust (2009, p. 244)

“With dyads, each individual still maintains his or her own identity” and commonly interacts by mutual reciprocity and affinity. However, “this situation shifts with the introduction of a third member”, so a triad relation can represent a situation that may “constrain and/or undermine the individuality of each person” (Kadushin, 2012 p. 37).

Tajfel (1982, p. 20) explained that there can be two extreme situations in terms of the sub-groups and groups inter and intra relations, which define the “poles of a continuum describing a transition from interpersonal and intergroup behavior: at one extreme… is the interaction between two or more individuals which is fully determined by their interpersonal relationships and individual characteristics and not at all affected by various social groups or categories to which they respectively belong. The other extreme, consists of interactions between two or more individuals (or groups of individuals) which are fully determined by their respective memberships of various social groups or categories, and not at all affected by the interindividual personal relationships between the people involved (Tajfel and Turner, 1979, p. 34).”

Groups can be defined as a collection of communally interacting individuals of 4 people or more. Usually group members share a common social identification of themselves. The group behavior and interactions also were defined as a manifestation of cohesive and social exchanges of the relationships between each individual, in which “each person influences and is influenced by each other person” in a cooperative and mutual social interaction that “reflects the members’ attraction to each other, to the group as a whole and to group activities” (Tajfel, 1982, p. 15-16). Groups can also be defined by outsider elements, between two sets of actors: one actor set type with another actor set type, in this case the relational interaction is more complex the social structure, composing a complex network of social relations (Scott, 2009; Prell, 2012).

In the case of interaction between different actor categories, individuals can be attracted or assigned to a sub-group and/or group (intra-group relation) because they assume that they must have some characteristics and affinity in common, such as age, sex, nationality,

religion, political affiliation, social position, type of culture, type of community, type of neighborhood, stage of life, “status, emotional experiences, needs, goals, attitudes, behavioral norms. Social groups tend to influence and motivate each individual to participate in a recreational and leisure experience, or activity, or interact with others. The “intragroup relations tend to be characterized by: (I) the perceived similarity of members; (2) mutual attraction between members or social cohesion; (3) mutual esteem; (4) emotional empathy or contagion; (5) altruism and cooperation, and (6) attitudinal and behavioral uniformity” (Tajfel, 1982, p. 29 and Manning, 2011; Prell 2012).

The information of the social actor structure is important for the studies that try to understand the social characteristics and their impacts on peoples’ behavior and interactions, and perfectly fits in the landscape architecture field when dealing with the outdoor physical environment and landscape usage, their interfaces and social interfaces. “The structure of relations among actors and the location of individual actors in the network have important behavioral, perceptual, and attitudinal consequences for the individual units and for the system as a whole”, since the individual actors can join other actors categories, such as dyads, triads and different groups size (Knoke and Kuklinski, 1982, p 13).

The comparison of different social categories and their inter and intra sub-group relations, and/or insider and outsiders relationships, provides relevant information for the social network research. Social network data can be approached and measured by different units of observation and with different methodological techniques: observations, interview and/or questionnaire dealing with the understanding of relational ties from these actors in the set (single set of actors, two sets of actors and/or more than two sets of actors). Observations of actors interacting can also provide reliable information in terms of who interacts with whom in public spaces such as streets, squares, parks and greenways. However, the researcher must clearly define in advance the type of interactional analysis, its variables and its scale, because gathering observational data in public places may involve the occurrence of several interactions simultaneously, especially at the high peak hours (Tajfel, 1982; Wasserman and Faust, 2009; Prell, 2012;).

2.12.2. Social Tie Matrices and Social Bridges

Network data can be studied and organized by the network matrices: type of relation and interactions, connections, levels and density. Relational ties matrices and social bridges are the contacts, interactions, ties and connections, the actors attachment and meetings that one set of actor has with another set of actors (Scott, 2009; Prell, 2012). It can provide valuable information's of the social relations occurrence within a single set of actors and/or among different sets of actors and their intra and inter relations. Different types of relations can reflect that type of analysis: individual evaluations, interactions, movement from place-to-place, formal and informal roles.

According to Wasserman and Faust (2009, p. 39) the network studies can provide different social tie matrices and social bridges measurements: one can measures the relationship between the outsiders sets of actors, that means "two sets of actors, or on a set of actors and a set of events", and/or set of places or physical environments, bringing information about by the relational ties/bridge manifestation between two different actors types. The other one can measures the ties/bridges occurrence inside of one set of actor type, like an inner actor interaction, when they are utilizing together the physical environments.

Social tie matrices also can be called social bridges. Lusk defines social bridges as "components in the environment that can facilitate courtesy, fraternization, and goodwill between two or more strangers. A social bridge provides the opportunity for a positive eye glance, nod of hello, smile or perhaps even an exchange of conversation, returning the elements of socializing that enhance quality of life and building social capital within the community" (Lusk, 2002, pp. 327-328). Magnoli (2006) claimed that the bridges of social gatherings unify and transform sets of relations, bringing new meanings and lessening limits and thresholds among users and actors. According to Magnoli (2006), Lusk (2002) and Whyte (1980) urban designers can incorporate social bridges into their designs of public open spaces, thus providing positive social interaction.

Lusk (2002) pointed out the importance of understanding the connection between the phenomenon of social bridges and greenway characteristics, as a valuable way to build social capital. She also emphasized that there have not been careful analyses of social bridges and person-to-person interactions. The study of relational ties and social bridges may emerge as a powerful tool for greenway studies, aiding to better understand the social benefits of greenway physical environments as well as how they may offer opportunities for socialization and social development, due to the high intensity of usage.

Few studies have focused on the way that greenway users interact with one another (Lusk, 2002) and no studies have identified social actors and their social network relations, adding a unique and rich quality to my study. And because of the lack of studies that deal with greenway social aspects, this type of network analysis is important to better comprehend the dynamics of public physical environments such as recreational greenways, especially when dealing with different types of users and actors.

Public urban networks, according to Wasserman and Faust (2009), can be studied with social network analysis by categorizing them based on the sets of actors and the properties of their ties and bridges. Using this assumption, it is possible to incorporate the concept of social bridges into a study of greenways as social networks. This type of social network analysis is applicable to a study of the social aspects of greenways, principally to understand social ties and bridges, by identifying: 1. the types of users (children, adolescents, adults and seniors) and the types of actors (individuals, dyads, triads, sub-groups and groups); 2. the types of relational ties/social bridges that occur among the categories of actors and users; 3. the users' and actors' patterns of use/ types of activity and their total diversity and activity level; 4. the social interactions and behaviors that occur through these relational tie and social bridge matrices (occurrence, quantity, type and diversity of pattern of use/type of activity and activity level). The spatialization using graphs, matrix diagrams, statistical diagrams and GIS maps can be used to illustrate greenway social aspects. Interactions may involve the physical interactions among actors and users and with the greenway physical environment (density, intensity, direction, frequency,

quantity, type), that's why the description of greenway characteristics (features and structural network) is also important.

Social relational ties and bridges are pertinent to the greenway environment and are influenced by the type of physical connection, such as a trail, road, river, creek, walking board or physical bridge, by the presence of features to accommodate recreational, leisure and tourism pursuits, by the movement between places or positions, such as migration, flow or direction, social or physical mobility, and finally by socio-behavioral interactions. In summary, a myriad of relations (directed and undirected), may be caused by different catalysts: the presence of different types of users and actors; the different types of features (landscape and physical structure); the types of connections (trail surface type, type of destination); and the type of behavior and/or pattern of use/activity.

Chapter 4 will provide a better explanation in how I see the concept of social bridges being incorporated into a study of greenways as social networks, with the detail description of each multi-method approach of this study, that will provide more reliable information about social network interactions and behaviors, by including information related to how and why people (user: age and gender, and social actors) interact and behave, and which of the greenways places (structural network connections, features and/or segments) they like to use to meet and interact with others.

2.12.2.1. Patterns of Sociability/Interactions

Humans are social human beings that need to interact for existence. They naturally search for companionship and camaraderie, based in their needs, feelings and desire. A number of studies stated about the structure of the social relations that are based on different types of relational patterns: the *socialization patterns*, the *family kinship patterns of socialization and* the *cultural patterns*. Society, communities and neighborhoods are formed based on those grounding interactions that are cohesive and self-confident. During those social relations

different people exchange and engage in social, material resources and physical environments that are fundamental to all human interaction power and dynamics. Interactions develop from processes within two or more people. Such interactions generally are based on nurturing feelings that one person has with another(s) person(s) and also by the combination of activities and interactions, fostering peoples' social relations (Landry, 2008; Cantle, 2005, p. 177; Kadushin, 2012; Prell, 2012).

2.12.2.1.1. Pure Actors Ties/Bridges Interactions

Actors who are similar according to their motivations, perceptions, attitudes, values and behaviors are likely to have a pure actor tie/bridge type of interaction with to one another, as an inside relationship with a strong tie/bridge association and experiences. Commonly the formation of this interaction occurs in familiar interactions with close and familiar people, like family and friends (Landry, 2008; Prell, 2012). Wasserman and Faust (2009) explained that cohesive sub-groups (dyads or triads) and groups (more than four persons) presented strong social forces acting through their direct and inner contact and interaction with closeness ties within the one actor category (sub-group and group).

Wasserman and Faust (2009, pp. 251-252) mentioned that cohesive sub-groups and groups influence social network formalizations based on four different properties: "the mutuality of ties; the closeness or reachability" among members; "the frequency of ties among members, and the relative frequency of ties" among members. Persons or individuals within the boundary of one actor category can be more close to each other, by their closeness ties than if compared with their ties/bridges with the outsiders that increase the distance among merged members (inside and outside members).

2.12.2.1.2. Transformative Actors Ties/Bridges Interactions

Actors when they extrapolate their inner-actor category interactions (inter-relations) and become open to interact with other types of actors (intra-relations), they lose their original stage of pure actor pattern, thus transforming into the transformative actor ties/bridges pattern of interaction, with an outside relationship with other category of actors that means a more dynamic relationship in term of interactions and behaviors. The formation of this type of interaction generally happens in familiar and/or unfamiliar interactions, with close and familiar people, and/or not too close and familiar people, and/or strangers. In this type of social tie/bridge the actors' categories can mutually influence one another, and also can become related to one another over time. Wasserman and Faust (2009) mentioned that when the that pure actor cohesive sub-groups (dyads or triads) and groups (more than four persons) extrapolate their inner social interaction limits and interact with other categories of actors such as individuals, subgroups and groups, causing new ties/bridges relations between two different categories of actors in a relative cohesion to outside actors, as an opening ties with others (individuals, sub-groups: dyads and triads, and groups) with the transformation of the actor pattern change and then they start to present a more dynamic and complex dimension of social interaction.

2.12.2.1.3. Centrality and Central Person

Another important aspect of the network analysis is the centrality, or popularity of the central person. Generally central persons rooted in a structural network system of strong ties, and they "have a high potential for transmitting ideas, but also send messages to those who share those ideas or practices", they also can impact, influence others with their opinions, decisions and actions. They present a strong potential to link people from different categories of users and actors together by the "betweenness" phenomena (Kadushin, 2012, p. 32)

They are more open to interaction with different users and actors at the same time, and/or keep interacting in a sequential way with isolated users and actors, without connecting them, in this case the connection can occur between two isolated sets or cell of users and actors can occurs latter, creating new social circles, as a social diffuser or connector. Social circles create the main bases for the interactions (direct and/or indirect) based of common and sharing interests, activities and/or places to hang out and gathering together (Kadushin, 2012; Prell, 2012).

Centrality or central persons demonstrate that some users and actors or social nodes have more or less connections and/or interactions than others, and they present a high degree of bridge and ties to others, because they fall between all other users, actors and nodes. Their importance is not related in their place within that social network, but in how many people they know and/or interact. The central actors commonly present a central position in a network and tend to know and interact with more people and also many people know them. Central relations and connections serve to link them the other users, actors or nodes more often. They can be interpreted by different ways, they can radiate many connections from them, as leader central person or they can provide the connection and interactions among other persons by the “betweenness” phenomena, or they can be defined as the most popular person or individual or entity among the popular. In other words, they are more open to socialize with others and maybe, act as a promoter and connector that link other people together by the social interactions (Kadushin, 2012; Prell, 2012), as illustrated below in figure 14, the actor “A” is the central person that interacts with different set of actors: “D, G, C, E, B, F, H and I”.

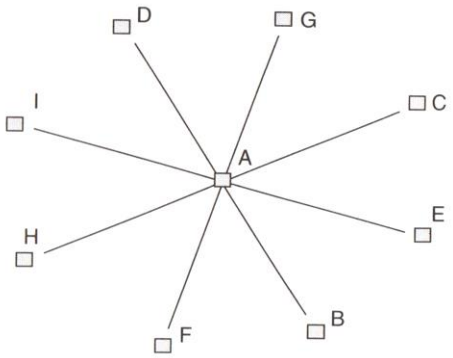

Figure 14: Centrality and Central Actor
Source: Prell (2012, p. 96)

Prell (2012, p. 99) defined two types of centrality, the "*indegree* centrality is the number of ties received by an actor from others" with a degree of popularity, and "*outdegree* centrality is the number of ties given by that actor to others", with a degree of expansiveness. In this study of recreational greenways we will describe the centrality person(s) by type of user (by age and gender) and type of actor based in their open characteristics in socialize more often with others within the greenway physical environments.

The GIS behavior mapping of centrality will show the location of the central persons by their user and actor information. It will show their location and also the this/bridges, as a new patters, of the central person(s) with the other categories of actors, like per example: a central dyad (2 individuals) that interact first with a triad (3 individuals) and then in sequence with another dyad (2 individuals), in this case the dyad central persons will be counted twice (one count per individual person of the dyad). I intend to indicate the centrality person(s) actor type(s) of social network interaction with other types of actors: First, when they interact with the triad composing the first tie/bridge and then secondly, when they interact with other dyad composing another tie/bridge relation during their interactions, so it will be a central network of a dyad with a triad and a dyad. The central actor(s) is/are counted twice because

of their popularity in interacting with others, and because they are able to create more ties/bridge patterns than others.

2.12.2.2. Social Interaction Ritual Elements and Behavior in Public Space

According to Goffman (1967) “every person lives in a world of social encounters” and interactions involved either in “face-to-face or mediated contacts” in which acts of interactions, patterns of interactions and levels of interactions can be expressed by “verbal and nonverbal” communications, in short, medium and expanded conversations and/or signs and/or symbols behaviors (ibid, 1967, p.5).

For Goffman (1981) each person or individuals “in the presence of others respond to events, their glances, looks, postural shifts” and words “carry all kinds of implications and meanings” in terms of social interaction ritual elements and behavior in a positive, negative and/or null fashion of interactional replies and responses of two or more different parties, or actors. The process of social interaction ritualization presents numerous ways of expressing, acting and behaving that can vary in type, degree and sequence (ibid, 1981, p. 1). Face-to face or immediate interaction presents different features: “richness of information flow and facilitation of feedback” that consists of social norms regulating person’s interactions and behaviors during their closely existing ritual to one another (Goffman, 1963, p. 17).

Body talk gestures, represents the type of interaction involvement between two or more persons without verbal communication that can be expressed by physical gestures such as waving or saluting; facial expression gesture and broad emotional expression such as smiling together or eye and eye, such interactions “dies in the moment in which directness of the function is lost (…) this mutual glance between persons, in distinction from the simple sight or observation of the other, signifies a wholly new and unique union between them” (Goffman, 1963, p. 93). The greetings represent another type of interactional manifestation with short conversation between two or more persons. Body talk gestures and greetings

represent the lowest levels of interaction. In those cases the communications (body gesture and verbal) start and end quickly without interfere in both persons acts and behaviors, like for example without stopping their recreational activities. However, there are some circumstances in which those lowest levels of interactions, opens a new ritual role of actions, interactions and communication between two or more persons, and transform the ritual into medium and/or high degree of interaction. The expanded conversations can exemplify the medium and high degrees of interaction, depending on their frequency, time, act and behaviors, in which both persons will change their acts and behaviors and start a new one together, like for example stopping their recreational activity and start a conversation for a period of time, and/or start to talk and do activities together (Goffman, 1967; Goffman, 1963).

Finally Goffman (1963, p. 18) incorporate into the interaction ritual elements the explanation of public places physical environments, such as parks and greenways and their role in enhancing the gatherings, situations and interactions for social occasions and social encounters, as a democratic behavior settings. A social occasion provides the structuring social context in which many situations and their gatherings are like to form, dissolve, and re-form, while a pattern of conduct tends to be recognized as the appropriate and (often) official or intended one – a standing behavior pattern" and interactional pattern. "The term situated may be used to refer to any event occurring within the physical boundaries of a situation", like for example the public order or safety rules and/or environments of the public spaces that allow people to interact more often. However if those places are not secure, and/or not have public order, it will lacks in terms of usage and interactions (ibid, 1963, p. 21).

Goffman (1963, p. 83) stated that social interaction ritual elements, during their face engagements presents two situational properties: unfocused interaction, concerned with what can be communicated between persons merely by virtue of their presence together in the same social situation" and/or physical environment; and focused interaction, concerned with clusters of individuals who extend one another a special communication license and

sustain a special type of mutual activity that can exclude others who are present in the situation" and/or physical environment.

According to Gehl (2011, p. 67) another factors that affects into the social interaction ritual are (1) the social distances and communication aspects that are "used both to regulate intimacy and intensity in various social situations and to control the beginning and end of individual conversations, implies that a certain space is needed for conversations"; (2) the time to experience, for example, when the moderate recreational activities, like walking, because of it lower speed movement, it provides "reasonable amount of time for people to experience, see and interact with others. "When two people walk toward each other, approximately thirty seconds pass from the time they see or recognize each other until they meet. During this entire period, the mass of information and degree of detail perceived increase gradually, giving each person time to react to the situation. If this reaction time is critically reduced, the ability to perceive and respond to the situation disappears" because of the lack off more time-frame to experience and interact with each other. "It is important that all meaningful social activities, intense experiences, conversations, and caresses take place" in sedentary and moderate activities "when people are standing, sitting, lying down, or walking" (ibid, 2011, pp. 71-72). However, in vigorous activities such as biking and running are harder for people to experience others, they can only experience and interact if they stop or reduce their high movement activity.

In terms of how social distances affects the different forms of interaction and communication rituals, Hall (1969) study about different societal cultural and social dimensions, defined for the Western European and American cultures some measurements:

> "*Intimate distance* (0 to 45 centimeters - 0 to 1 ½ ft.) is the distance at which intense feelings are expressed: tenderness, comfort, love and also strong anger. *Personal distance* (0.45 to 1.30 meters – 1 ½ to 4 ½ ft.) is the conversation distance between close friends and family. Social distance (1.30 to 3.75 meters – 4 ½ to 12 ft.) is the distance for ordinary conversation among friends, acquaintances, neighborhoods, co-workers and so on. Finally, *Public distance*

> (greater than 3.75 meters – 12 ft.) is defined as the distance used in more formal situation – around public figures or inteaching situations with one-way communication or when someone wants to hear or see and event but does not wish to become involved ” (Gehl, 2011, p. 69; Ghall, 1969).

In addition, the relationship between distance and intensity, close and warm, in several contact and interactional situations direct affect people perception and experiences, especially when dealing with small, large and/or narrow public spaces, like sidewalks, squares, parks and greenways, which are seeing as intimate, warm and personal environments and because of those conditions it is important the development and improve of more of those physical environments in our cities, to enhance and influence recreational, communal and interactional outdoor activities on nature, increasing the democratic life and it social network possibilities (Gehl, 2011).

2.13. Social Network Structure and Greenway GIS Analysis

In the social network analysis, the Graph Theoretic Notation provides an opportunity for network representation and visualization with the use of computational programs. Graphs consist of nodes joined by lines, in which the nodes in the networks represents the people and types of actors while the linear linkages represents the relationships and flows between the nodes in a data set (Scott, 2009; Wasserman and Faust, 2009). According to Scott (2009, p. 63) “a common framework for social network analysis programs is the mathematical approach of graph theory, which provides a formal language for describing networks and their features. Graph theory offers a translation of matrix data into formal concepts and theorems that can directly relate to the substantive features of social networks.”

For Wasserman and Faust (2009, pp. 94-95) “A graph is a model for a social network with an undirected dichotomous relation; that is, a tie is either present or absent between each

pair of actors. (…) In a graph, *nodes* represent actors and *lines* represent ties between actors." In this sense, a matrix of relations is created, in which the patterns of connections among these points can be identified. Other social network concepts are commonly used in this model, such as ties, walks, trails and paths. *Ties* can be understood as a connection between a pair of nodes whether they are adjacent or not; walks and paths provide the calculation of the distance between two nodes:

> "A *walk* is a sequence of nodes and lines, starting and ending with nodes, in which each node is incident with the lines following and preceding in the sequence. (…) Trails and Paths are walks with special characteristics. A *Trail* is a walk in which all of the lines are distinct, though some node(s) may be included more than once. (…) A *Path* is a walk in which all nodes and all lines are distinct" (Wasserman and Faust, 2009, pp. 105-107).

"Graph theory concerns sets of elements and the relations among these, the elements being termed points and the relations lines" (Scott, 2009, 64). The patterns of connection among points are descried through a number of graph theory concepts, including neighborhood, density, inclusiveness and centrality. These social network concepts can be applied to greenway GIS analysis. The density can be used to identify the intensity of patterns of use, or type of users, or type of actors, or ties/bridges, or centralities. The central point or point of centrality can be used to identify the greenway location that receives more central attention. GIS tools offer many possibilities for the linear and social relational spatialization, which will enhance our comprehension of the greenway networks that connect different types of greenways, conventional parks, neighborhoods and people.

CHAPTER 3: DESCRIPTION, STUDY SCOPE AND CONCEPTUAL FRAMEWORK

3.1. Research Theoretical Perspective

In the arena of design research, there are a variety of topics that encompass both dimensions of art and of science. With this in mind, we can argument certain fundamental issue based on the range of theoretical perspectives, or paradigms, or systems of inquiry that are suitable as epistemological support of any given research study. In the field of design, it is commonplace for researchers who work with a particular type of theoretical perspective to criticize and rebuke the other types, according to their quality standards. The definition of the terms, theoretical perspective, paradigm and theory, and the explanation of the *ontology, epistemology and methodology* are important to comprehend the foundations of this study.

The *Ontology* deals with questions like “What’s real? What is the nature of reality and what can be known about it? “How do things really work? What is the nature of knowledge?” (Groat and Wang, 2002) and “How a thing really is. How do things really work?” (Guba and Lincoln, 1998, p. 108). *Epistemological* main questions are: “What is the nature of the relationship between the knower and the would-be-known? What is knowledge and how do we come to know it? How do we know what we know? How do we think? What can we know? How to know the world? How to find things?” (Guba and Lincoln 1998, pp. 108-201). On the other hand, *Methodological* main questions are: “How can the knower go about discovering the would-be-known? How to organize, analyze and interpret the knowing?” (ibid, p. 201). Crotty put forth the questions: “What theoretical perspective lies behind the methodology in question? What methodology governs our choice and use of methods?” (1998, p. 2), similar to Guba and Lincoln’s question: “How can the inquirer (would-be-knower) go about finding out whatever he or she believes can be known?” (1998, p. 108). Methodological questions also elucidate the methodological issues and whether or not its results are applicable or not to other contexts and/or circumstances.

The theoretical perspective or paradigm is especially true and can be better understood when considering two different schools of thoughts about knowledge generation, such as naturalistic (positivism/post-positivism) x anti-naturalistic (emancipatory and naturalism), especially when dealing with the epistemological and methodological assumptions. The reality is that all the types of theoretical perspectives can provide appropriate alternatives and solutions (Groat and Wang, 2002). The issues essential in this study is presented by the naturalistic (positivism/post-positivism theoretic perspectives) world-view.

Positivism is “a philosophical system that holds that every rationally justifiable assertion can be scientifically verified or is capable of logical or mathematical proof.” This term can be expanded to include “the theory that laws are to be understood as social rules, valid because they are enacted by authority or derive logically from existing decisions, and that ideal or moral considerations (e.g., that a rule is unjust) should not limit the scope or operation of the law” (Oxford College Dictionary, 2007, p. 1068). The positivist philosophy claims that objectivity within the scientific approach was the way to ascertain the truth in terms of the way we view the world. Science was seen as a way to understand the world well enough so that we might predict and control it. The world and the universe were deterministic, operating by laws of cause and effect that we could discern if we applied the unique approach of the scientific method. The positivists believes in empiricism, the idea that observation and measurement are the core of the scientific endeavor. The key approach of the scientific method is the experiment, the attempt to discern natural laws through direct manipulation and observation.

Questions made from a positivist perspective might be “How can positivist researchers predict future behaviors of the objects”? “What are things really like?” or how do things really work? “or “How to conduct truth-tests of theories given that some of their components are unobservable, immeasurable and seemingly illusory?” (Guba and Lincoln,1998, p. 111).
The ontological assumption of positivism, as described by Crotty (1998, p. 7), is that “positive theories are descriptive and explanatory systems that, because they can identify causal links, can predict future behaviors of the objects in question”. In other words, this

theoretical perspective tends to be rigorous in testing the theory. Guba and Lincoln (1998, p.109) state that “the ontological assumption of positivism is based on naive realism, which accepts the existence of reality in terms of “immutable natural laws and mechanisms”. Knowledge of “how things are” is predictably summarized in terms of time-and content-free generalizations, in which some will take the cause-effect law. According to Guba and Lincoln (1998), the epistemological assumption of positivism sustains that the observer/investigator are independent entities, the studied object is autonomous from the influence of the observer. Thus, values and biases are prevented from influencing outcomes. This epistemology can be considered dualist and objectivist. True findings can be replicated. The methodological assumption of positivism is that hypotheses and questions are verified by the utilization of quantitative methods (they need to be tested and verified, by experimental and manipulative verification) (Guba and Lincoln,1998).

According to Crotty (1998, p. 2) “postpositivism emerged to attenuate its claims without rejecting its basic perspective”. Postpositivism, also known as post-empiricism is a philosophy called critical realism, which believes that there is a reality independent of our thinking about it and which science can study. The postpositivist critical realist recognizes that all observation is fallible and has error and that all theory is revisable. In other words, the critical realist is critical of our ability to know reality with certainty. Crotty (1998) mentioned that this new theoretical perspective accepted *fallibilism,* the idea that it is impossible to achieve absolute knowledge, in terms of human knowledge, different than the logic of positivism.

Postpositivist research principles highlight the meaning and the creation of new knowledge and are able to support committed social movements, that is, movements that aspire to change the world and contribute towards social justice. Theory and practice cannot be kept separately. Questions approached in a Postpositivist perspective might be, “What is really going on in the world? What can we establish with some degree of certainty? How can we study a phenomenon so that our findings correspond insofar as is possible in the real world?” (Patton, 1990, p. 91).

The postpositivist ontological assumption is based on a critical-realist perspective that reality can be known only with some level of probability (Denzin and Lincon, 2003; Guba and Lincoln,1998). The epistemological assumption of postpositivism is based on empiricism. Assumptions may also be modified by dualist/objectivist components, to estimate reality, but never fully achieve it (Denzin and Lincoln, 2003; Guba and Lincoln,1998). The postpositivist methodological assumption is that hypotheses and questions can be confirmed by the utilization of quantitative and qualitative methods. There is a tendency toward falsifying the hypothesis rather than verifying it (Guba and Lincoln,1998).

Postpositivism challenged the positivist attempts to seek “absolute truth” arguing that this was not appropriate when studying the behavior and actions of people. This led to an acceptance that absolute truth can never be found and that research evidence is not infallible or perfect. Researchers attempt to look for and describe associations, as well as cause and effect relationships. This is an ongoing process, whereby positive findings form the basis for additional research. Data which do not support their theory may result in necessary revisions followed by additional testing. On the other hand, positivist researchers criticize postpositivism because of its utilization of qualitative inquiry.

Both positivists and postpositivists share some characteristics, such as: their ontological assumptions are characterized by the strength of the internal validity (isomorphism of the findings; determines whether our research instruments truthfully represent our object of study) and applicability as the basis for the external validity (generalizability of the findings, facts and cause-effect linkages about the possibility of applying the results of the study to the larger world, when defining whether contextual constraints within the results are valid), objectivity (whether the process can be replicated in other cultural settings and environments, or other circumstances, or other people) and reliability (consistency of the measurements and findings) when building knowledge accumulation of facts (Guba and Lincoln,1998). Both positivist and postpositivist epistemological assumptions claim to be “value free”, in order to avoid bias (ibid, p. 114; Lang, 1987). Both require the use of conventional benchmarks of “rigor” such as internal and external validity, reliability, and

objectivity. Both present the rigor of the methodological domain, where the researcher controls and manipulates the items of interest when dealing with the truth value, and the applicability and consistency of their standards. In both paradigms, the posture of the inquirer is independent of the research subject. They both test hypotheses, but diverge on the way that positivism establishes the facts as law and postpositivism accepts the possibility of their alteration. The method of validation of their findings is directed, and sometimes can be repeated (Guba, E. and Lincoln, Y., 1998; Guba, E. and Lincoln, Y., 2005; Groat and Wang, 2002).

The main differences between postpositivism and positivism is that the Positivists believes that the goal of science is to uncover the truth and that the world must be sufficiently known to predict and be controlled, while postpositivist critical realists believe that the goal of science is to hold steadfastly to the goal of ascertaining reality, even though we can never achieve that goal. Because all measurement is fallible, the post-positivist emphasizes the importance of multiple measures and observations, each of which may possess different types of error, and the need to use triangulation across these multiple errorful sources to try to get a better notion of what is happening in reality. According to Groat and Wang (2002), postpositivism is considered the belief in a reality ‘out there’ that can only be known within some degree of ‘probability’. Positivism assumes that objectivity can be achieved in the research process; postpositivism presumes that objectivity is a legitimate goal that may be imperfectly realized. Positivism uses math, science and technical knowledge to consolidate objectivity and validate the truthfulness of the findings. Postpositivism accepts the dualism of the findings as true or probably true, a characteristic that is considered inadequate by positivists.

The principal difference between the qualitative and quantitative theoretical perspectives and tactics is that “quantitative research assumes an objective reality and a view of the researcher independent of the subject of inquiry. Qualitative research, on the other hand, assumes a subjective reality and a view of the researcher as interactive with the subject of inquiry” (Patton, 1990; Patton, 2002; Groat and Wang, 2002, p. 25; Creswell, 2009).

Positivism only allows the use of quantitative data. Postpositivism allows the use of quantitative and qualitative data. However, there is a possibility of a transitional arena stage between postpositivism and postpositivism, because they share some similarities, in terms of the usage of quantitative tactics.

There are arguments in favor of a compatibility theory which acknowledge the different theoretical perspectives and their philosophical assumptions, while recognizing that each approach has its strengths and weaknesses and that neither is “right” or “wrong” but rather that the methods typically used by each could be mixed in the same study.

I postulate that, by understanding the role of the naturalistic paradigm by the positivist and postpositivist theoretical perspectives, it is possible to use both in order to enhance the potentialities and possibilities of this study’s research design. Although the theoretical perspectives presented are bit different and at the same time complementary, both are excellent tools, each having its place and contribution in this design research study. The establishment of a given theoretical perspective will depend on the research question and the definition of the ontological, epistemological and methodological assumptions.

Finally, I attempted to assess the use of both theoretical perspectives within my own design research interest area that deals with the potential of recreational greenways as a social network. The issues of interest are the different characteristics of the recreational greenways: structural network system, greenway landscape features and physical structure features, and also the different patterns of usage: type of user, type of actor, frequency of use, type of use/pattern of activity, type of ties/bridges, type and level of interaction, catalyst of interaction, centrality and cohesion. Toward this end, I endeavored to determine how the overall methodological assumptions of each perspective fit into my area of interest and how each study could change, based on different paradigm perspectives, in the way it addressed the phenomena and issues at hand.

The positivist theoretical perspective could potentially be applied to the study as a scientific method whose inquiry allows me to observe and measure the empiric facts using quantitative data: observational methods and survey, with traditional statistical analyses of the recreational greenway characteristics with the greenway usage and a statistical analysis specific to social network aspects. I intend to analyze the reality without interfering in the facts. I retained the objective distance from the subject and did not rely on interpretations; I intend to observe all the ties/bridges, social patterns, types of interactions, levels of interactions and behaviors that occur on the recreational greenways and also to verify by my observation, only the facts of social interaction, behavior, ties/bridges and cohesion, without participation in the process. However, I might lose some information about the social relation and interaction, because of the rigidity of this paradigm, and also because of the utilization of merely quantitative data. I also will not be able to achieve the absolute truth about the phenomena, because the positivism paradigm may not be appropriate for a study that deals with behaviors and actions related to recreational greenways. Because of this condition, I intend to also incorporate the postpositivism theoretical perspective that has the potential to provide a clear comprehension and analysis of the reality of recreational greenway usage by utilizing scientific verification through statistical analyses. I can carry out an analysis at an objective distance from the subject of the study and avoid relying on interpretations. The physical data analyzed, Geographic Information System (GIS), and other statistical computer programs allowed for the measure of patterns of usage and the social aspects of the greenways users and actors, and formerly able to combine them with the information of the greenway characteristics. I used these programs to confirm our hypothesis and to prove the findings as probably true, based on the results of the expected measurements and representations of the recreational greenways physical environment and their social behavior and interactions role: people with people and people with nature. Qualitative investigation was also added to the methodology with the utilization of multi-method analysis: survey, sorting task and mapping exercise to confirm and validate the quantitative data information and to provide additional new knowledge about the social aspects of the recreational greenways.

3.2. Conceptual Framework

To better understand the complex role that greenways play, I propose a framework with concepts and possible relationships. Two frameworks were created to help visualize the main concepts of this study and to comprehend the relationships between them, contributing to the formulation of research questions. The first is a general framework that presents a global representation of each of the main concepts and the relationships between them. The second is a simple framework that provides a more in-depth representation of the purpose of the research study, demonstrating the relationship between the main concepts in this study and their relations with the research questions.

The first diagram, the general conceptual framework of the study (Appendix G), is in the form of a network model. According to Lombardi (2007), an integrated network cannot be represented through a hierarchical structure, as all of its elements involve an interdependence and interaction. In this network diagram, the greenway characteristics are shown in the center, because they have an effect on all of the other elements. Around this center, there are four basic elements involved in the greenway system, namely, environment, community, individual and economics. Interactions between each of these four elements generate sub-elements, which are social insertion and conviviality, produced from interactions between individuals and the community; values and behaviors, which result from the interactions between individuals and the environment; nature conservation, which is a result of interactions between the environment and economics; and finally, patrimony and education are a result of interactions between the community and economics. Further interactions between these sub-elements generate even more aspects to be considered: environmental education, environmental conservation, quality of life, sustainability and social integration.

The demonstrated relationships between all of the variables of the network will directly affect social interaction values. However, those communications are also directly affected by individual, sub-group and group units, which are constructed through the human senses

aspects (touch, olfaction, visual, taste and kinesthetic): interacting dimensions, references, meanings, attitudes, preferences, perceptions, affective dimensions, cognitive dimensions, behaviors, experiences, memories and values (Appendix G.1 and Appendix G.2).

This study has been limited to address only the aspects related to social networks. Few other studies have focused on the way that users interact with one another (Lusk, 2002). Relative to the many studies that deal with the environmental and ecological aspects of greenways, there is clearly a lack of knowledge related to their social features. We therefore consider it very important to give attention to the relationship between the greenway environment and its social features in order to understand existing conflicts and also potentialities of the greenways.

The simple conceptual framework of the study (Appendix H) illustrates a scheme for analyzing a triad of concepts that will be the focus of our study: greenway characteristics: the structural network system and greenway features, and their relation with the social network resulting in a myriad of relations and concepts, including including social, interactions, behaviors, ties/bridges and cohesion. I believe that a better understanding of these relationships could contribute to potentialize the efficacy of greenways. This triad of concepts and their relationships are affected by internal sub-aspects, such as landscape aspects and physical structure aspects (greenway features); these relationships are also affected by external sub-aspects, such as cultural aspects, educational aspects, physical aspects, open space aspects, economical aspects, ecological aspects and temporal aspects.

The first relationship to be considered is that between greenway characteristics and social networks; the second relationship to be examined is that between the greenway structural network system and the social network. In order to examine the first relationship, between greenway characteristics and user interactions, it is necessary to define the type of greenway that will be studied. The type of greenway that will be analyzed in this study is the recreational greenway. My aim is to make a multi-case study comparison, to verify the

possible similarities and differences in the recreational greenways and verify how their characteristics influence and/or intensify social usage and behaviors, by the identifying elements of the social network such as integration, cohesion and ties/bridges. For the second relationship, between the greenway structural network system and the social network, the aim is to recognize perceptions and usage of this system by the social users and actors.

I utilize the actors as one of the attributes of the people variables in my analysis that will be combined the other two peoples` variables: users (different categories by age) and gender. In this case, I`m evaluating the recreational greenways *users* that can also be defined and called as *visitors* in the outdoor recreation field related concepts. In this study I will utilize the term *user* instead of *visitor*, because I`m defining users here, as the social elements or as the people that utilize the public recreational greenways in their recreational, leisure and tourism pursuits, such definition are commonly defined and utilized in the design field as someone that uses and engage in an activity and/or interaction in the outdoors physical environments and/or inside at the built spaces.

Such terminologies clarifications are necessary and appropriate especially for the parks and recreation literature and field to become used to the term *users*, instead of *visitors.* Even though Manning (2011, p. 22-23) utilizes the terms *users* and *visitors* to explain the social aspects of outdoor recreation in how their use and user characteristics impacts the outdoors physical environments. He undertakes that it is crucial studies that deals with the social aspects and it issues (“recreation activities, characteristics of recreationists”, their “social characteristics and cultural influences”, their “attitudes, preferences, perceptions of visitors to outdoor recreation areas”, their values and motivations) that bring information about users and their recreational patterns of use to determine “new trends in outdoor recreation”, to predict future recreation patterns and also to guide planners, designers and managers to design, build and improve new recreational features/amenities, like for example to accomplish the physical features of parks and greenways, to provide public information end the implementation of educational programs or recreational users (ibid, 2011). In this

common sense, I`m indicating that I will utilize the term *user*, rather than *visitor*. It also appropriate to explain here the difference between *users* and *actors*. I utilize the term *user* from the design literature that means people that uses the physical environments, they can be classified by age, for example children, adolescents, adults, seniors and/or elderly, and gender , for example male and female. The term *actors*, came from the social and behavior literature and field that means the recognition of people by their social units, interactions, ties/bridges and cohesion. In the social network studies, they call people as *actors*, that can be represented by different categories of social unites or *actors'* types: individuals, subsets or sub-groups: dyads, triads and groups. The definition of the people variables by their type of users by gender, type of users by age and type of actors by their social units are crucial in terms of understanding in how these independent variables can affect the dependent variable that is the social factors and the social interactional variables.

For the study's triad of concepts, different parameters were created:

- *Parameters for use with social networks:* measures of user characteristics and behavior, such as type and number of users (children, adolescents, adults, and seniors), type and number of actor (individual, dyad, triad, sub-group and group), pattern of use/type of activity and activity level; type of relationship and interactional measures (social ties/bridges) such as, catalyst, type, level, pattern of use/type of activity, pattern type of centralities, and finally duration measures (frequencies, intensities; densities) (Hartup, 1979; Knoke and Yang, 2008; Scott, 2009, Wasserman and Faust, 2009).
- *Parameters for use with recreational greenways:* location, form and function: identification of preferred areas for socialization based on the greenway characteristics; identification of the features: landscape features and physical structure features, street furniture and their presence and/or absence, location, proximity, destination, connection, preference and potential areas for socialization, and also the presence and/or absence of activity node areas along the greenway trail (Fabos and Ahern, 1995; Fabos et.al, 2010; Flink, 1993; Flournoy, 1969; Hellmund

and Smith, 2006; Jongman and Pungetti, 2004; Little, 1990; Lusk, 2002a; Lusk, 2002b; White, 1980; Zube, Brush and Fabos, 1975).

- *Parameters for use with the greenway structural network system:* spatial scale, type of configuration, type of organizational connection: physical barriers with fragmentation, physical barriers with connections, connected), quantity, spatial distribution, destination points or points of attractions and trail characteristics (Erickson, 2006; Fabos et.al, 2010; Forman, Olson, and Dramstad, 1996; Forman, 2004, 2008; Hellmund and Smith, 2006; Jongman and Pungetti, 2004; Lusk, 2002a; Lusk, 2002b; Lynch and Rodwin, 1958).

3.3. Assumptions

Six assumptions, based on the literature review, are important to keep in mind:

- Greenways have an impact on social networks *(A1)*;
- Because of their intrinsic and unique characteristics, greenways are a thread that ties different areas (structural network system and features) and people, providing a unique place for recreation, social interaction and social gathering. The greenway has the potential to bring people together as it provides a matrix of user interactions (age and gender) and a matrix of actor interactions (inter and intra: groups, sub-groups and individuals) *(A2);*
- However, different types of greenway structural (type of connections and trail characteristics) might present different levels and types of social interaction *(A3);*
- However, different types of greenway features (landscape features and physical structure features) and/or street furniture components might present different levels and types of social interaction *(A4);*
- When a greenway is connected to a point of attraction or destination such as a park, it presents higher and different levels of social interaction and usage than a single and simple greenway that connects only neighborhoods, without

a park destination point. In summary, we can identify different interactions, different users, different actors, different ties and different patterns of use, depending on the type of connection, where we can outline three main types of connections: a connection where a greenway penetrates the park as a destination point; a connection where a greenway only permeates the park; and, finally, where a greenway presents only a neighborhood connection, with no destination. Different types of greenway connections impact social interaction differently *(A5),*

- Greenways with the same type of connection may impact social interaction differently because of their different features and/or street furniture components *(A6).*

3.4. Research Questions

Main questions and dominant sub-questions have been elaborated to investigate the relationship among this conceptual triad: greenway structural network system, greenway features and social network.

Main questions (3):

1. **Do recreational greenways impact social factors such as interaction, behavior, ties, bridges and cohesion?**

2. **Do recreational greenways impact social factors in ways that are different depending upon the characteristics of the greenway?**

3. **What is an effective protocol for analyzing interaction, behavior, ties and bridges on recreational greenways?**

Dominant sub-questions (10), related to the intended multi-method approaches:

1. **Which are the most used greenways of the entire structural network of Cary?** (interview greenway expert)
2. **What are the characteristics of recreational greenways? (Q2)** (observations)
3. **How do the types of greenway characteristic impact social factors? (Q1 and Q2)** (observations, survey and mapping exercise)
4. **Do recreational greenway characteristics provide a catalyst for social interaction? (Q2)** (observations, survey and mapping exercise)
5. **What is the nature of social interactions on greenways? (Q1 and Q2)** (all methods)
6. **Do the greenway characteristics impact social aspects and play a role in creating social ties and bridges? (Q2)** (all methods)
7. **Do greenways promote social interaction in a various type and degrees? (Q2)** (observations, survey)
8. **What are the type of users, actors, ties/bridges and centralities of recreational greenways?** (observations)
9. **What kind of social interaction and behaviors can be found on recreational greenways?** (observations, survey and mapping exercise)
10. **What are the catalysts for greenway social network behavior and interactions?** (observations, survey)

The research questions also are illustrated in the summary of the methodology diagram, together with the intended method phases and outcomes (Appendix 9.3.1).

3.5. Research Objectives

The *main objective* of this study was to describe the social interaction that arises from the nature of greenway environments, by analyzing the different types of social interaction and social ties that take place on the recreational greenways.

Secondary objectives:

- To develop effective protocols to analyze recreational greenways social factors (interaction, behavior, ties/bridges) and greenway characteristics (structural network system and features), and test the relationship between these social factors and the greenway characteristics;
- To identify the type of social network features in different characteristics of recreational greenways;
- To recognize the different patterns and intensity of social interaction on the greenways;
- To verify which type of greenway structural network system based in their characteristics (connection, destination and specific trail segments), presents more social interaction;
- To verify which type of greenway features (landscape features and physical structural features), based in their characteristics, presents more social interaction;
- To understand the relationships between the greenway characteristics and the social network aspects: users and actors types; frequency of use; patterns of use/types of activity; type and level of interactions; preferred greenway features, places and connections, and perception of the social role that takes place on the recreational greenways.
- To spatialize, analyze and evaluate the types of social network: interactions and behaviors features (social network ties/bridges types, patterns of interactions, type and level of interactions, type of social activity level and social catalyst types) with database (GIS);
- To spatialize, analyze and evaluate the greenway features (landscape and physical structural features) with database (GIS) and different statistic approaches;
- To spatialize, analyze and evaluate how different greenway features (landscape and physical structure) encourage or discourage the social development and impacts more or less the social interaction with multi-methods and different statistic approaches,
- To analyze the phenomenon of social ties/bridges by measuring and calculating the social interactions among the different users, activities and the social network types:

person-to-person; person-to-sub-group; sub-group-to-sub-group; person-to-group; group-to-group; and group-to-sub-group.

3.6. Hypotheses

Greenways create an environment that fosters social networks, which affect and are affected by social interaction, behavior, ties/bridges and cohesion. More specifically, I believe that recreational greenways can contribute to social interaction. The type of greenway characteristic may influence the type of user, type of actor, pattern of use and behavior, promoting social integration to differing degrees and types between people to people (positive and/or negative). I believe that the reason that people like recreational greenways is because they can promote contact between people and nature. The many variables involved may affect the frequency of social use on the recreational greenways.

- All recreational greenways provide a positive impact on social factors, such as interaction, behavior, tie/bridge and cohesion, because they catalyze interactions within the community *(H1);*
- The greenways characteristics have the potential to catalyze interactions within the community. However, patterns of use and interaction might be affected by the greenway characteristics: type of structural network connection (destination/point of attraction), type of features (landscape and physical structural features) and street furniture components *(H2);*
- Different types of recreational greenways can impact social factors, such as interaction, behavior, tie/bridge and cohesion differently; depending on their intrinsic structural network characteristics: neighborhood connection and connection to a park, and connection to both: neighborhoods and parks as a destination/point of attraction *(H3)*;
- Different styles of recreational greenways can influence social factors, such as interaction, behavior, tie/bridge and cohesion differently; depending on

their type of features. The physical structural features and street furniture components encourages more the social development than the landscape features *(H4);*

- The greenway that presents a connection with a park and with a park and neighborhoods, as a destination/point of attraction, presents more and specific interactions than does a greenway that only connects neighborhoods *(H5);*
- Recreational greenways can impact the social factors, to a greater and different extent than other types of greenways *(H6).*
- Different interactional styles such as pure and transformative actor categories and also the age categories and the gender of the recreational greenways users' can influence the social factors, such as interaction, behavior, tie/bridge and cohesion *(H7);*

3.7. Variables

According to Agresti and Finlay (2009, pp. 11-12) "any characteristic we can measure for each subject is called a variable. Because each subject presents different characteristics, they also diverge in terms of values" or levels "of a variable". Variables can be defined as quantitative "when the measurement scale has numerical values" and categorical, "when the measurement scale is a set of categories" (ibid, 2009).

The variables can be dependent or independent, depending in how it will be used by the researcher in an inquiry. Dependent Variable is "the variable that is affected, the consequence or outcome of the manipulation" or the response, in other words the "term 'dependent' is used because the changes in it depend upon the manipulation of the independent variable". Independent Variables also called as experimental variables, or predictor variables consists in variables that are "manipulated or systematically altered by the experimenter" (Sommer and Sommer, 2002, p. 85).

The scope of the study is to investigate the social interactions that arise from the nature of greenway environments, with the understanding of the greenway characteristics (the structural network system, the greenway features and the street furniture composition), which suggest that the greenway characteristics have an effect on social factors. I aim to verify which characteristics of the greenway are more and/or less related with social aspects, such as interaction, behavior, tie/bridge and cohesion. The greenway physical environment characteristics when relates to the social network producing in a myriad of relationships and concepts, including social, interactions, behaviors, ties/bridges and cohesion.

Therefore, the study will investigate how people perceive the greenway characteristics, other people characteristics and their behaviors, and how those conditions may affect the socialization and may generate certain preferences, meanings and origin various types of interactions, behaviors and experiences. The Appendix I illustrates the variable structural diagram with more detail information about the intention of the variables measurements of this study and also their types.

The *central dependent variable or outcome variable* of this study is the social factors or the social interaction variables (ties/bridges, interactions, centralities, patterns of interactions, level of interactions and catalyst of interactions) that occurs based on the exploratory factors. The *independent variables or predictor variables* of this study consist in five exploratory factors that affect the social factors (dependent variable):

- **greenway type** that means about the two levels of the analysis: the entire greenway and the greenway parts (greenway 1: Black Creek Greenway and greenway 2: White Oak Creek Greenway; and each greenway segment type: 1, 2, 3 and 4);
- **greenway physical environment characteristics** (structural network system type and greenway features: landscape features, physical structure features and street furniture components);
- **greenway temporal variables** (week: weekdays and weekends; period of day: morning, afternoon and evening, and weather conditions);

- **people variables** (type of user by age and gender, and type of actor: pure and transformative),
- **behavior variables** (pattern of use/type of activities; complementary behavior and physical activity level).

All the five independent variables listed above will be analyzed with descriptive statistics. Three of the independent variables or predictor variables: *greenway characteristic variables, people variables and behavior variables*, will be analyzed together with the dependent variables: *social factors or interaction variables* through the data mining analytical process that commonly is used to derive accurate and useful insights to big and complex data variables and to answer multifaceted questions, such analysis will be carried out with decision tree explorations: association, clustering and/or classification and regression analyzes and more rigorous statistical analyzes.

Decision tree is an alternative for analyzing complex and large data in terms of distinguishing data based on a particular variable. The behavior mapping observation data presented the total of 10,205 people of both greenways combined (5,512 people for the Black Creek Greenway and 4,693 people for the White Oak Creek Greenway). Decision tree is a technique in which the researcher can break down the data variables, based on their characteristics, into small groups and then generate a decision among the variables and sets. Decision tree works with dependent variables or outcome variables and independent variables or predictor variables, in terms of what the researcher chooses to differentiate from those multi-variables. The main idea is to use and manipulate the independent variables to predict the outcome of a dependent variable. The researcher must select the variables by choosing the variable targets of interest. In the present study, the independent variables or predictor variables will include: people variables (user type: age and gender, and actor type), greenway characteristics variables (structural network system type and greenway features (landscape features, physical structure features and street furniture components) and behavior variables in order to understand how each group affects the social factors or interactions and what patterns of interaction, what levels of interaction, what catalysts for

interaction (pattern of use/type of activities; complementary behavior and physical activity level).

Below are the descriptions of each decision tree category of this study in relation to the elected variables:

Interaction Variables and Greenway Variables (structural network system):

- **decision tree:** tie and bridge interaction occurrence – related with total greenway length and network type configuration;
- **decision tree:** tie and bridge interaction occurrence – related with trail segment length, trail segment layout type, segment trail surface type and segment trail pavements;
- **decision tree:** tie and bridge interaction occurrence– related with structural connection with other areas and segment physical barriers with connections (total and segments);
- **decision tree:** tie and bridge interaction occurrence – related with network segment, segment destination configuration and connectivity conventional park types (park boundary areas),
- **decision tree:** tie and bridge interaction occurrence – related with activity node configuration, activity node surface, activity node usage type, use related and associated with activity node configuration.

Interaction Variables and Greenway Variables (features: landscape features, physical structure features and street furniture components):

- **decision tree:** tie and bridge interaction occurrence – related with vegetation type (boundary area) and (total and segments);
- **decision tree:** tie and bridge interaction occurrence – related with physical structure configuration (boundary area and/or quantity) and (total and segments),

- **decision tree:** tie and bridge interaction occurrence – related with street furniture components (quantity) and (total and segments).

Interaction Variables and People Variables (user type, gender and actor type):

- **decision tree:** tie and bridge interaction occurrence – related with user type by age and gender;
- **decision tree:** tie and bridge interaction occurrence – related with pure actor type (D, T, SB, G, not I) and size – as an inter-interaction, in other words inside of each of the pure actor type category and gender.

Interaction Variables and Behavior Variables (patterns of use/type of activities, complementary behavior and physical activity levels)

- **decision tree:** tie and bridge interaction occurrence – related with type of activity;
- **decision tree:** tie and bridge interaction occurrence – related with complementary activity,
- **decision tree:** tie and bridge interaction occurrence – related with physical activity level.

3.8. Greenway Area Characteristics

The definition of the greenway areas of my study within the Triangle Area were defined by the clarification of two main questions: *Which greenways do I intend to analyze?* Recreational greenways with highest volume of use and with different type's structural network system: one with a park as a destination, other one with a park and neighborhood as a destination and the other one without a destination, with only a neighborhood

connection and features (landscape features and physical structure features). *Which greenway aspects do I intend to test?* The social aspects that take place in greenway environments. I intended to distinguish two types of greenways, based upon their structural network (the conventional parks as a destination/point of attraction connection, the conventional parks and neighborhoods as a destination/point of attraction connection, and the neighborhood connection) and their features. These sub-groups were studied in detail, by scanning the different segments of each of their paved trails to be able to verify the levels and patterns of social interaction, if they are the same or different.

I utilized a multi-method approach to identify which greenway type (a greenway type that presents an incomplete pattern, because it connects only neighborhood; or a greenway type that presents a multiple pattern, with a park as a destination or point of attraction) presents more or less social interaction, and also which greenways are more successful than others (successful and unsuccessful) in terms of socializations; and also to identify the places where the interactions take place (where people meet and who they are, where are the places where people interact, the stop areas and non-stop areas, where people go, and how the flow or movement of people takes place).

The original idea was to study Raleigh and Cary greenways, carrying out the analysis with Raleigh and Cary greenways, because both of them are areas with extensive greenway systems. Raleigh presents the oldest existing greenways, since it is where the first greenway system was developed in the United States. Raleigh and Cary present areas with extensive greenway systems and substantial representative samples of established greenways, they also are not big cities that probably can present specific situation in terms of social network aspects. Raleigh Department of Parks and Recreation do not have research studies in progress or results about the greenway users quantity, just the expert opinion by their experience in dealing with greenways over the last 25 years. On other hand, the Department of Parks, Recreation and Cultural Resources of Cary has research study and results about greenways users (number, frequency, intensity) only on weekends for the last 4 years, plus their experts opinion over the last 10 years. Cary followed Raleigh in terms

of greenway master-plan during the 80`s and today has surpassed Raleigh in terms of reliable and effective greenway analysis and thus was chosen as the object of this study.

Using a multi-method approach, I intend to identify the different types of greenway structural networks (the type of patterns that are presented in the Town of Cary, and how they affect the social interactions that take place and how users perceive these connections and features. I`m looked, with different qualitative and quantitative methods, at the types and levels of human social interaction and behavior that take place on the recreational greenway. I also verified whether the users are interacting or not. If they do interact: W*hat are the catalysts; what types of social bridges and ties exist; who are the users and actors; where are the places for social interaction located? Which aspects of the greenway facilitate social interaction, by bringing people together? Which places do people use and why? How often? What is the duration of the interaction and where does it takes place?* It could be among the different attributes or features; among different people, and also among different activities. By the multi-method approach I was be able to say the quantity, quality and type of social interaction that happens on the greenways.

3.8.1. Capital Area Greenway Historical Background

The city of Raleigh, capital of the North Carolina State in the United States, in 1792 had its first Master Plan by William Christmas, which limited its urban area around the New Bern Avenue and Hillsboro Street. By this time, were protected for public use an area of four square acres (Caswell, Nash, Burke and Moore), a legacy that this was the first public park in the city. In 1887, Stanhope Pullen donated an area of 69 hectares for the government that formed another public park. In 1925, representatives of the citizens clubs and organizations formed the first committee of City Parks, responsible for formulating the first plans for the development of the Park System. In 1935, was established the first committee of recreation in the city, now program several recreation programs. Only in 1950, significant natural areas were included in the city's zoning. At that time, the first flood control projects were made, as

well as the plan development of urban land where it was originally promoted to public corridors surrounding water resources within the city, as a partial solution to contain the problems of flooding and while promoting recreational uses and conservation of resources. In year 50, 60 and 70, other parks were developed, whose programs and physical structures and infrastructure were installed in an area of approximately 40% in a total of 182.115 hectares (ha). Over the years the city expanded outside these limits and began to put pressure on natural areas (Crabtree and Walnut Creeks). At this early stage of development of the city, water shaped by rivers, streams and tributaries that were not even respected and protected. The zoning of urban areas located on these different urban uses: residential, industrial and commercial (Flournoy, 1969; Zachary et al., 1977).

On the period between 1970 and 1980 the city of Raleigh was planned again in order to guarantee the quality of their open spaces from the impacts of the urban growth. Due the presence of the landscape natural attributes it began a discussion about the future of the city and the importance of ensuring the perpetuity and integrity of the ecological and scenic resources. The system was created by the parks, recreation areas and open greenspaces, in order to safeguard the future of the city and consolidate an example to be followed in the United States, through the theory "*the park with a city in it* ". According to Evans (1969) and Flournoy (1969) at this time the city had abundantly remaining open spaces conformed by vegetation and water resourced, whose landscape attributes could only receive recreational uses of intra-neighborhood, thus satisfying the need for everyone: children, adolescents, youth, adults and seniors.

The planning and understanding of the relationship between open space and built space, was fundamental to promote a new form of planning, in which the open space, composed by the natural resources, had a role in the new city coordination and configuration. On the other hand, due to the high price of urban land, the ecological and landscape were only granted initially by the most successful society: individuals, social groups represented. To reverse the deficit of settings for public use it was created the structure of the Park System, Recreation Areas and Greenway System of the City of Raleigh.

According to Little (1990) the Capital City Greenway Plan for the Raleigh Area was the first plan in the United States within the local sphere, produced by the work of William Flournoy (1969) master's thesis, student of the College of Design, North Carolina State University, which introduced the greenway concept in: *A Report to The City Council on the Benefits, Potential and Methodology of Establishing a Greenway System in Raleigh* and intended to provide guidelines for the conservation of natural resources and their roles in the urban environment through the formation of a system called "green fingers" which conform a network of linear corridors that make up an integrated system, linking parks, communities, schools, shopping areas/malls and other locations (Searns and Flink, 1993; Flink, 2006).

Little (1990) mentioned that after William Flournoy submitted his master plan: Capital Area Greenway in Raleigh, he got a job with the state government, and started the implementation of the greenway guidelines. His action plan occurred in the period between 1965-1975, in which few miles of greenway were created. In 1974, the plan, known as *"Raleigh: the park with a city in it"* first developed by Frank Evans, director and coordinator of the Department of Parks and Recreation of the city, which structured Raleigh's Greenways System. The same was based on assumptions, and ideas released by William Flournoy on how greenways should be planned, structured, zoned and implemented, as floodplain areas of the city and built the paths to be connected in order to ensure the preservation and conservation of the natural areas and at the same time to promote human outdoor recreation uses. Thus was formed the plan of action to protect the beauty and potential of natural and scenic attributes of the impacts of urban green corridors (Evans, 1969; Little, 1990).

During this time, for the creation of the greenways were necessary the following measures: the creation, the first Commission of Raleigh Greenways, consisting of 18 representatives, which would support the administrative assistance of the Department and City Building, and support operating promoted by the Department of Parks, the search for resources for the implementation of two pilot projects, the acquisition of more than 40.47 hectares to be allocated to green corridors and the actual construction of the pilot projects. The action plan

consisted of two major steps: first, the selection of the most significant landscape units of the city that should be preserved (trails and park connectors, water resources, scenic views, historic sites, wetlands and topography). Subsequently, those landscape units were listed and valued by their sensitive environmental areas conditions to anthropogenic uses, and then preserved and protected to perpetuate their landscape, aesthetic, ecological, morphological and functional. Thus, through the Capital City Greenway plan made possible the construction of trails and paths, as well as activity nodes aiming to promote the mobility of pedestrians and cyclists and connecting parks, schools and other environments in the city and to provide the promotion of social, economic, environmental and aesthetics, in order to ensure the use, maintenance, and the promotion of public safety of its users (Evans, 1969; Zachary et al., 1977; Little, 1990; Searns and Flink, 1993).

The Wake County Area located in the U.S. State of North Carolina, geographic land area of 831.92 square miles, is part of the Research Triangle Metropolitan Region. The term Triangular Regional System Area was used in the 1950s to describe the region configured by Raleigh (State Capital), Durham, Chapel Hill Area and posterior the Town of Cary. Since then, those cities until the actual days exchange educational, cultural, economic, scientific and recreational benefits (Hart, 1997).

The Capital Area Greenway Plan was configured as a Triangular Regional System shaped by the areas of Raleigh, Durham and Chapel Hill. They were thus proposed Areas Reservation (*New Rope R., Falls of Neuse River, Wilson R. Mills, William B. Umstead State Park, Falls of the Neuse State Park*), Recreation Areas (*Eno River, Neuse River)* and Greenways (*Cabtree, Walnut and Swift Creeks*). I add the Town of Cary in this area, because it also part of this Triangle Area, since it will be the focus of our study, and also because it was influenced by the Capital Area Greenway network system plan. The Capital Area Greenway is presented below in Figure 15 (Flournoy, 1969).

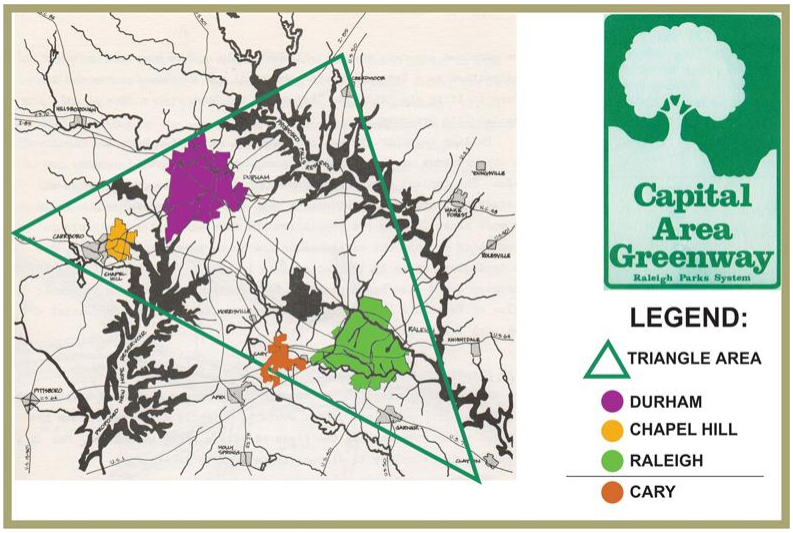

Figure 15: Capital Area Greenway Network Triangle Area.
Source: Flournoy (1969). Modified by Pippi (2010).

> "In central North Carolina, for example, the Capital Area Greenway served as an effective model for a much more comprehensive regional effort to create a greenway network in the Research Triangle cities of Raleigh, Durham, and Chapel Hill along all major (and many minor) waterways, which are dominant landform of the Carolina Piedmont. The Network protects this large regional waterway system by superimposing a greenway framework upon it" (Little, 1990, p.130).

According to Evans (1969) for the Capital City Greenway plan and design, different stages of financing and implementation were created and divided into three parts: *system of greenways; network of trails and paths, and active recreation areas*, which were organized according to their environmental and recreational needs. In parallel, environmental protection policies were created, to provide legal support to the Raleigh's Greenways Plan, thus controlling the density and maintaining the livability of the city. The plan followed some implementation goals: acquisition of parcels of public areas; zoning of floodplains; zoning of recreational areas; cooperation in the areas of development and urban planning, and

preservation of private open spaces (clubs with private tax rebates and legislative mechanisms). The system was mapped both, the public and private greenspaces configured by: Parks (proposed and existed) School Units (existed and proposed), physical structures and Community Greenway Network. The zoning of different hierarchical Parks had the intention to ensure the operation of active recreation areas of the city in harmony by promoting environmental preservation and conservation allies to urban uses in the present and the future. Thus the Park System, connectivity through the greenway, would link the pre-existing areas and privileged as well as the suburbs (ibid, 1969). The Green Corridor Plan was constituted by an integrated system of trails, connecting and penetrated different areas and city parks.

“The greenway would be capable of serving five recognized public functions (parks, recreation, planning, sewers, and transportation) as well as one emerging function (environmental control). These functions should prove sufficient to allow the City Council to legally proclaim a public need for the greenway corridor” (Flournoy, 1969, p. 8).

Flournoy (1969) posted that one of the objectives of the plan was to provide to the Capital City Greenway the conformation of an effective and secure park, greenway and recreational system, with the introduction of a park network to Raleigh, “which would be more accessible to the population and make activities available to them” and then able to mitigate in some city areas, the lack of accessibility of such public facilities and the community contact with nature and with others, and also was to afford compatible uses over the greenway surrounded areas, reducing the urban impacts over the environment.

According to Flounoy (1969, p. 8) “the greenway concept proposed for Raleigh is a variation of a style of city-regional design which dates back at least as far as the Thirteenth Century, B.C., with the Biblical description for the Levitical Cities of Palestine (numbers 35:1-4)” which was used in different moments and places around the world with diverse names, such as Green-Belt Cities and Garden Cities (a desirable concept for the American New Towns) and

various conformation form, which main purpose was to “give the urban population space in which to live, rather than just exist.”

Flournoy (1969) and Planning Department of the City of Raleigh (1979) mentioned that the idea used on the Capital Area Greenways, had its origins in the alternative strategy to contain the problems of flooding in the city, through the introduction of an interconnected system of corridors with available greenspaces, adjacent to different areas and urban uses, with minimum sizes ranging from 80 feet to 1500 feet according to their hierarchical stream classification and characteristics. Through this integrated network and connected by trails, penetrating and permeating different areas of the city.

Flournoy (1969), the design elements used in the Capital Area greenways were and represented by the following aspects and figure 16:

- *Loops:* conformed by different sizes of settings: major and minor loops. The major loops form a circuit represented by the connectivity of areas (Crabtree and Walnut Creek). The distances of these major loops range from 25 miles, 40 miles and 75 miles. The larger portion of trails that connect different areas of the city community, being confined to this, can receive an intensive use of pedestrians and cyclists and therefore should be planned for these purposes. The minor loops consist on the conformation of smaller greenways, characterized by it recreational standards, whose main objective is to promote a continuous greenway through the circular system, where recreational activities occur;
- *Penetrators:* this type of greenway conformation formed one interconnected web, represented by the main tributaries of the city (Cabtree and Walnut Creeks). The main objective is to cover and reach all urban areas of the city, attending all its parts as a way to equalize the benefits of greenways throughout the whole population. The greenway trails are characterized by neighborhood units, which constitute specific characteristics of each site. The penetrators serve as connectors for the local system of major loops.

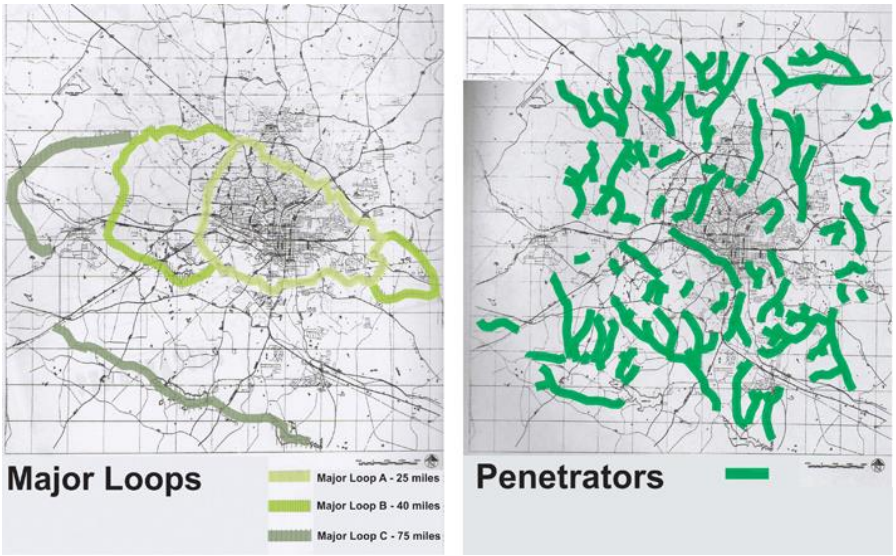

Figure 16: Raleigh's Greenway Design Element.
Source: Flournoy (1969). Modified by Pippi (2011).

The greenways implementation wasn't so easy, especially in the already consolidated urban areas, and due to the fact that there are small tracts of available open space and also because of the intense interest of the speculation over these areas. On the other hand, in areas not yet occupied, that were configured by empty urban spaces corridors, have emerged as an alternative to mitigate the urban conflicts, thus reducing competition and problems during urbanization, connections and promoting alternatives to urban land and while providing structure and functions for future expansion areas of the city (Flournoy, 1969).

After the establishment of the first greenways, the community, developers and planners perceived their benefits and potential, they started to value and protect those areas for future planning and to structure more greenways within the city. This phenomenon has changed the city urban development, and began to influence the direction of the pattern of urban growth and to promote the design and plan of more public greenspace areas with

recreational facilities, opportunities and physical infrastructure and landscaping. According to Flournoy (1969, p. 16) “the Capital City Greenway could be used to separate competing land uses, thus reducing the undesirable impact one has upon the other. At the same time, the greenway would serve to connect the various compatible land uses along its perimeter. The greenway, through these two city planning principles, would give structure and function to the city’s future expansion.”

> "The Capital City Greenway would complement the present park and recreation system by introducing a park network to Raleigh which would be more accessible to the population and make activities available to them which are not available or are inconvenient to undertake, due inadequate space in less accessible locations (...) the effect of the Capital City Greenway will be to conserve some of the last remaining open space within the Raleigh urban area, thus stabilizing the density and maintaining the liveablility of the city” (Flournoy,1969, p. 15).

Little (1990) mentioned that in the 1980, the landscape architect Charles Flink was hired as a greenway planner; a specific position adopted by Raleigh, and conducted with excellence the city greenway plan during 6 years and then started a solo business as a greenway-planner. Since then he became knowing as the “Father of Greenways” in America and also other places around the world with the recognition of his knowledgeable and notorious experience with greenways plan and designs. His foundation is based on the intention to look the natural areas in a different way, and to promote a sustainable environment for the future, in which the natural systems can be valued, protected and function in symphony with the provision of human access and use for recreation and citizen formation.

In 2009, the population of the Triangle Area was 897,214; the second most populated County of North Carolina (U.S. Census Bureau, 2009). In 2010, the population of the Wake County area was 900,993 (U.S. Census Bureau, 2010). Since then, the State of North Carolina - US presents an extensive of local government, state and national greenway plan, projects and programs, and “well known for promoting and disseminating important information about greenways through the United States and around the globe” (Flink, 2006, p. 11).

According to the Raleigh-NC, USA Public Comment Portal (2011), Raleigh has one of the most thriving developed park systems, including greenways linear parks, in the Southeastern United States. The actual system is composed by 42 neighborhood parks, 22 community parks, and eight metro parks (approximately 4,100 acres of land). The park system is complemented by an additional 101 special parks that range in size, type and scale. Currently, the parks and recreation areas of Raleigh is composed by a system configured for 165 sites, with extensive area of 8,800 acres and 3,300 acres, consisting of 34 trails of greenways, in a totality of 56 miles, and other areas for community centers, sports areas and squares (Raleigh-NC, USA Public Comment Portal, 2011).

Despite the success of Raleigh greenways, still is necessary to consider the continuity and perpetuity of such planning system, in order to further enhance their natural, physical environmental attributes, and landscape to accommodate more programs and recreational activities in symphony with the natural resources. It is also necessary to encourage the public participation, involvement and education for better effectiveness of the plan. The actual Department of Parks and Recreation of Raleigh is taking into account the projection of future needs for the year 2030, with the projection of duplicate the number of parks and greenways areas. The urban quality of life of Raleigh citizens and the functionality of it system, especially of natural areas, will be guaranteed if planned and demanded the acquisition of new areas, as well as increasing opportunities for the greenway network interconnection, without interruptions and / or fragmentation (Raleigh-NC, USA Public Comment Portal, 2011).

According to Raleigh-NC, USA Public Comment Portal (2011) in order to build a solid foundation to the Plan of the Capital Area Greenway project, some strategies are necessary:

- to seek funding for the planning of confinement, acquisition, design and deployment of new areas of parks and green corridors;

- to improve the greenways efficiency through their renewal and the increase of their facilities, infrastructure, physical structures attributes, and conservation of the environment and landscape resources;
- to increase and maintain the facilities and attend the recreational needs, and to review the parks and greenways policies;
- to add and build new greenway trails with the enhancements of the existed ones;
- to enhance the effectiveness of the implementation of different types of green infrastructure to benefit the goals of the park and greenway system and it recreation areas, satisfying the population and natural resources needs;
- to improve the greenways connectivity, principally among greenway segments and better accommodate the greenway users' mobility and flow;
- to facilitate public access to natural areas; to increase even more the recreational and educational programs;
- to review and / or to provide targets for future planning in the short, medium and long term for the parks and recreation areas.

The planning and implementation of the Capital Area Greenway, has shown over the years the success and benefits of this program that promoted not only a more sustainable urban environment city, but the perpetuation of the plan and it implementation as a greenway system, with varied functions at the local, regional scale. The Plan *"Raleigh: the park with a city in it" served* therefore as a model to be followed by various American cities, as well as abroad, due to its effectiveness and success. Currently, the Capital Area Greenways are responsible for the maintenance and conservation of intrinsic aspects of the landscape of Raleigh and Cary, essential for the potential and feasibility of this integrated system at both, local and regional level. Greenways have been widely used by the population (citizens and tourists), throughout the year, and this reflects in the efficiency of the greenway network system, if compared to other recreational open spaces (parks, recreational areas and squares), greenways have been consolidated even more, as a network of linear parks that

have been widely sought and used by the community due their characteristics, connectivity types, accessibility and visibility.

For the efficiency and benefit of this system as a whole, it requires the incorporation of new areas and the re-arrangement of the existed connectivity, as an uninterrupted system and without fragmentation by subdivisions and urban occupations, in order to improve the connectivity and accessibility to its users (different age, different gender and different activities), as well as promoting the perpetuity of ecological functions over a continuous greenways system among Raleigh and Cary urban areas. It is also necessary to plan such system by the regional level, in other words, with other neighboring states in order to further strengthen the effectiveness of this system.

To enhance even more this greenway and parks system, more studies are needed, that seek a greater understanding of social and ecological aspects (patterns of use, frequency of use, forms of social integration and cohesion, user`s preference in relation to the greenway characteristics: landscape features and physical structure features; and the connection, integration and operation of the green infrastructure), to lead the planning, design and renewal of greenways in the present and future.

3.8.2. Cary Greenway Program and Master Plans Background

The Town of Cary is an example of the implementation of the plan “Raleigh: the park with a city in it”, as it is part of the Triangle Area, directly receiving influence from the Capital Area Greenways, and also is a growing suburb of Raleigh.

In this section, the historical sequence of events of important periods of Cary`s development will be describe, as well as the implementation of Cary greenway system, with a brief chronology of it Master Plans background in the past, present and future. The Town of Cary land area is 55.34 square miles and presently the population estimate is of 145,693 habitants (Town of Cary Planning Department, 2010; United States Census Bureau, 2010).

The map in figure 17 illustrates the land expansion of different periods, especially between the period of 1960 to 2000, showing how Cary`s territorial growth and population doubled (Town of Cary Planning Department, 2010).

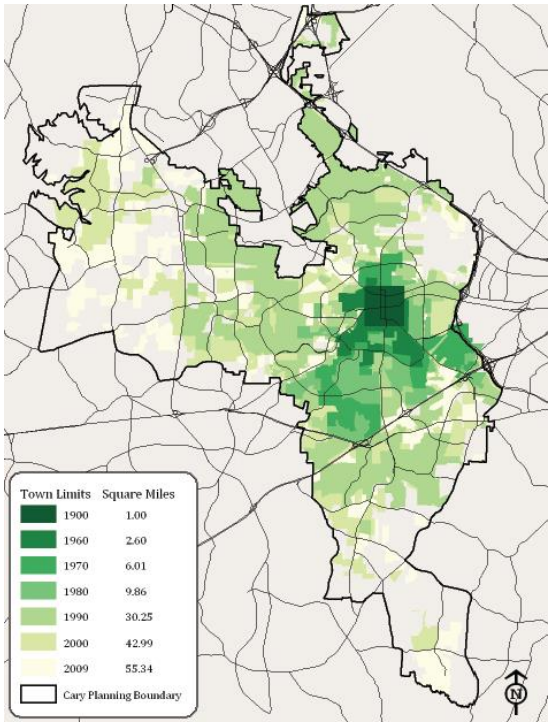

Figure 17: Cary's Municipal Land Growth Limits
Source: Town of Cary Planning Department, 2010

In the *period of 1700-1879,* major transformations occurred in the Cary territorial system: from rural area, it changed to a suburban area and then inner city. Cary`s originally was a Settlement called Bradford`s Ordinary. In 1854 the Town of Cary was created by its founder Allison Francis, by that time the town boundary area was 300 acres.

During the *period of 1940-1998,* Cary presented an impressive population growth during the last half-century. According to Town of Cary Planning Department (2010) the Census of population of Cary was in 1940, 1,141 habitants; in 1950 it was 1,496 habitants; in the 1960 it grew to 3,356 habitants; and in 1970 the population increased to 7,640 habitants. For the first time a Planned Unit Development (PUD) of NC was implemented to accommodate urban growth of the Research Triangle Area. This plan provided multi-use zones: residential, commercial, institutional and industrial. Cary`s first greenway program began at the end of the 70`s, and had its first trail opened in 1979. Cary experienced many transformations because of its rapid growth and development. During the 80`s, additional trails and greenways were incorporated and constructed into this original system, in which facilities (paved and unpaved trails) were completed by two private developers: Kildaire Farms and Lochmere. For the first time the "Town Council passed a land dedication ordinance that required a greenway easement for those properties under development where an approved public greenway had been proposed" Stating in 1978, the Town prohibited any development within the 100-year floodplain area, such legal condition-term persists until the present time (Bevington, 2006; Bush, 2010, p. 24).

According to Cary Census, the population in 1980 was 21,958 habitants, with 4.8% of the annual Growth Rate (Town of Cary Planning Department, 2010).

From the time-frame of "1980s to 1995, leaders and residents of Cary became more serious about constructing a network of greenways and similar facilities". In 1995, the first formal greenway plan was completed and consisted of a "public system of greenways and trails" of 10 existing miles and an extra of 25 proposed miles. This system presented many gaps and fragments, lacking in terms of resilient connections. However it was sufficient for the citizens of Cary to perceive the potential and functions of this system (Bush, 2010; Bush, 2011, p. 2).

In July of 1998, the Parks, Greenways and Bikeways Master Plan was completed that was based in the classification of 4 categories of parks: mini-parks, neighborhood parks, community parks and metro parks; classification of an integrated system of greenways, trails

and bikeways; classification of the special use and cultural arts facility as a form to improve the quality of life of Cary`s citizens. A survey was distributed to 5000 households and also focus groups meetings occurred among the Town of Cary staff, organizations and communities as a way to promote the democratic participation of Cary`s citizens and consolidate partnerships on the process of planning and achieve public input to this master plan. The greenway system consisted in “approximately 70 miles of greenways and trails, and 50 miles of bikeways” (Bush, 2010, p.24). “The Town adopted in 1998 a ten-year Master Plan that addressed parks, greenways and bikeways”. During that time no evidence was compiled and available about the existent greenway system usage (Cary Parks, Greenways and Bikeways Master Plan, 1998; Cary Parks, Recreation and Cultural Resources Facilities Master Plan, 2003, p. 17; ibid, 2010; Bush, 2011, p. 3). The 1998 Parks, Greenways and Bikeways Master Plan is presented in Appendix M.

The main goals of the Parks, Greenways and Bikeways Master Plan – 1998 were:

- to improve the connectivity of the greenway system with the Town destinations:, neighborhoods, schools, parks (principally Bond Park, Lake Crabtree and Research Triangle Park), downtown Cary and commercial areas (shopping and office development);
- to enhance the alternative transportation of the greenway system by the implementation of more greenways, on-road bikeways and sidewalks);
- to provide the greenway multi-function: alternative transportation corridors, recreation facilities, conservation of habitats for wildlife, improve the water quality and promote the floodplain management;
- to afford multi-use trail for a variety of users, mitigate recreational conflicts and improve the greenway trails design (standard quality facilities and universal design) and education of it citizens;
- to provide safe greenways and trails (Cary Parks, Greenways and Bikeways Master Plan, 1998).

Eleven pubic greenway trails were developed in 1998: Annie Jones Trails (1.26 miles), Black Creek (3.50 miles), Higgins Greenway (0.40 miles), Hinshaw (0.80 miles), Oxford Hunt greenway (1.50 miles), Parkway Greenway (0.80 miles), Pirate`s Cove Greenway (0.70 miles), Swift Creek (0.9 miles), Symphony Lake (1.22 miles), White Oak Creek (1.00 miles) and Panther Creek (2.00 miles), compiling a total of 14.08 miles (Parks, Recreation and Cultural Resources Facilities Master Plan, 2003).
The *period of 2000-2012* was crucial in terms of the concretization of an integrated greenway structural network system, with still some gaps to be connected to achieve full completion. Cary Census, the population in 2000 was 95,949 habitants, with 8.6% of the annual Growth Rate (Town of Cary Planning Department, 2010).

In 2002, Cary was able to expressively increase the proposed coverage of the greenway system. In December 11, 2003 it was approved the Parks, Recreation and Cultural Resources (PRCR) Facilities Master Plan. The greenway system was reorganized with the development of 160 miles network, whose main objective consisted in protecting the stream corridors, improving the water quality and conservation of its ecosystems:--natural areas and greenway corridors—and at the same time provide to it residents recreational facilities (cultural arts, passive and/or active recreation), alternative transportation and connection to their conventional parks. The plan also proposed alternatives to the enhancement of their natural and cultural resources with the development of environmental education programs and activities. Also the acquisition of joint sewer and greenway easements through new, and in some cases existing, developments" made possible the implementation and construction of new greenways, according to the Master Plan. The master plan vision of providing cultural and recreational activities and programs was for the year of 2020. Cary Census, the population in 2003 was 106,715 habitants, with 3.3% of the annual Growth Rate (Parks, Recreation and Cultural Resources Facilities Master Plan, 2003; Bush, 2010, p. 24; Bush, 2011; Town of Cary Planning Department, 2010).

The 2003 greenway network system master plan established the hierarchical corridors classification: "primary and secondary greenways, multi-use trails and sidewalk connectors"

by some standards: promotion of a safe and conventional integrated system (accessibility and safety, within one mile walking distance of residents in surrounding neighborhoods); development of different road crossing areas; provide safe connection of the greenways to parks and destinations; promotion of alternative transportation mobility; designation of trail types; identification of destinations and bicycle routes; investment into a pedestrian-friendly alternatives; provision of public/private partnerships and promotion of public art opportunities, and providing cultural and recreational activities and programs for everyone and for different purposes with the universal design principles guidance; provide the conservation and preservation of the natural resources by buffers and connectivity of the overall open space system and it landscapes, mitigating their fragmentation and impacts; promote the enhancement of the cultural and heritage resources (Parks, Recreation and Cultural Resources Facilities Master Plan, 2003, p. 8).

Additional specific goals of the Parks, Recreation and Cultural resources Facilities Master Plan – 2003 were incorporated:

- Designate Bond park as the main central connector of greenways;
- Facilitate Cary`s connection to surrounding regional destinations;
- Provide safe crossings, such as: overpasses and underpasses (Parks, Recreation and Cultural Resources Facilities Master Plan, 2003).

An extra 30.80 miles of greenways were incorporated to the Cary`s greenway system (Central, West and South Areas): 13.36 miles of Cary`s greenways (per example, Black Creek with 3.50 miles and the goal to expand and connect to Bond Park and White Oak Creek with 3.51 miles with the goal to extend from the Bond Park and connect to the American Tobacco Trail), 8.71 miles of Cary`s multi-use trails, 4.49 developer`s greenways and 4.24 developer`s multi-use trails. The map of the Parks, Recreation and Cultural Resources Facilities Master Plan – 2003 is showed in Appendix N.

In 2004, the town negotiated intensively with the developers, the provision of credits to construct more public greenways instead of paying recreational fees. This mitigated the developers' disagreement in terms of the greenway founding and construction (Parks, Recreation and Cultural Resources Facilities Master Plan, 2003; Bush, 2010).

In 2007, evidence of the Cary`s greenways system began to be compiled by the Town`s citizens volunteer Greenway Committee, serving the Parks, Recreation and Cultural Resources Advisory Board Staff, for four years, during the weekends. The analysis and results provided fundamental and important information that served as structural main basis for new and actual 2011 Master Plan. According to Cary Census, the population in 2009 was 135,955 habitants, with 4.0% of the annual Growth Rate. In 2010, there were 135,260 habitants with the population percent change, April 1, 2010 to July 1, 2012. In 2012, the population estimate of Cary is 145,693 (Bush, 2010; Town of Cary Planning Department, 2010; United States Census Bureau, 2019; United States Census Bureau, 2010).

At the current moment, the Parks, Recreation and Cultural Resources -Town of Cary is filling in its greenway system's gaps and improving facilities to create an effective and functional structural network system. The Town of Cary with the guidance of it Watershed Management Project, at the present moment requires every new developer to provide 100-foot wide riparian buffers on all perennial and intermittent streams, depending on the stream classification, and "greenway construction is permitted in the outer edge of the 100-foot buffers" (ibid, 2010, p. 24; Bevington, 2006).

The Cary Parks, Recreation & Cultural Resources (PRCR) Master Plan was accepted on November 13, 2012 and consists of a continuation of the 2003 Master Plan with the provision of additional information about their greenways actual usage and future plans and also directions for the inclusion of approximately 205 miles of greenway trails and directions for future connections and improvements of it greenway system network with Raleigh, Morrisville, Apex and Wake County. The plan described the new classification for Cary`s trail

system terms, as a substitute of the term multi-use trail, with 3 different types and design standards and procedures of trails:

> "*Greenway Trail:* refers to a 10' wide, paved multi-use trail, typically located in a natural or green setting. "Greenway trail" replaces "Secondary Greenway" and "Primary Greenway";
> *Street Side Trail:* where greenway trails are not feasible, sidewalks and bicycle-friendly roadways are recommended as "Street-Side" trails, in order to preserve overall connectivity. These types of trails provide local residents with safe routes to connect to and from separate trail heads and other destinations not served by the greenway trails. Street Side trails include the previous categories of "Multi-use Trail" and "Sidewalk Connectors" from the 2003 Plan;
> *Natural Surface Trail:* refers to an unpaved trails, takes the place of "unpaved Footpath", "Equestrian or Mountain Bike Trail" and "Soft Surface Greenway" (Parks, Recreation & Cultural Resources Master Plan, 2012, p. 6.9)."

The PRCR Master Plan received input guidance form descriptive statistics surveys; greenway user counts on weekends 4 years study findings; focus groups meetings and discussions; greenway committee feedback and support, and coordination and meetings with the adjacent jurisdictions. The main aspects of the plan consisted in: "summary of accomplishments of the 2003 greenways plan; key findings; greenway trail network; greenway trail network types and standards; signage and way finding; greenway maintenance; special facilities/areas; public art and recommendations" (Parks, Recreation & Cultural Resources Master Plan, 2012, p.6.1). The 2012 PRCR Master Plan also provided comprehensive recommendations for the future 10 years, period from 2012–2022 (ibid, 2012).

The Committee Members recommended main goals for the 2012 PRCR Master Plan that consists:

- To prioritize with connections and funding's, the vital spine of the greenway system: Black Creek Greenway and White Oak Creek Greenway;
- To provide the entire system connectivity, principally with other greenways, parks and schools and promote more attendance to bigger number of citizens;

- Give more attention to the budged of designed greenways to acquire more funds;
- To afford as higher priority the connection with the American Tobacco Trail;
- To create, as a higher priority, more safe crossings for the greenway users: underpasses and overpasses;
- To replace the definition of multi-use trail by the new classification of types and design standards;
- To provide more effective signage to the greenway system, especially the trail markings and information. Mitigate the lack of signage information and replace the old signs with new ones in some greenways;
- To provide more trailheads, as a priority, especially in the greenway main access areas;
- To provide more connections of the greenways to the Downtown Area,
- Mitigate the problems with maintenance and safety issues (Parks, Recreation & Cultural Resources Master Plan, 2012).

Recommendations were created to provide a myriad of benefits to the Cary`s citizens and the wildlife in providing multi-functional, safe and well maintained greenway network. For the *trail system and it connections*, it was suggested the improvement of the greenway connections with the parks, schools, other public facilities, residential neighborhood areas, commercial areas and employment areas; the increase of connections with surrounding communities jurisdictions, American Tobacco Trail, Metro Bond Park, Apex lake greenway and Downtown Cary Area. The *greenway plan, design, funds, construction/implementation* proposed trail head significances, trail significances (arterial greenways implementation, more connection to neighborhoods and schools, fill the trail gaps and provide more loop trails); the trail design must be designed in a sustainable and environmental stewardship way. For the *greenway and trail network expansion* it was advocated the condition of attend at least the budget for 2 miles of trails per year; highlight the continuity of greenway system development/ require the developers to build new trails and endurance the trails project feasibility and funding's. It was proposed for the affordance of trail the provision of *well-*

maintained and safe trails with better maintenance and the development of program like Adopt-a-Trail and safe crossing areas. For the *trail connection network (national, regional and surrounding jurisdictions)* it was suggested the provision of the grouping of the Black creek Greenway with the White Oak Creek Greenway, connecting to the American Tobacco Trail, creating the first major arterial greenway; promote a conjugate future planning efforts among the different jurisdiction to coordinate connections, exchange greenway knowledge and search for Federal grants for the “Triangle” national and regional greenway system and create a new trailhead parking area in the location of the Lake Crabtree area with the Umstead State Park (Parks, Recreation & Cultural Resources Master Plan, 2012).

The 2012 PRCR Master Plan provided also information about their new hierarchical greenway corridors classification, composed by 5 main arterial greenways, that consisted with the combination of previous existed greenways/destinations: 1) Umstead Park to American Tobacco Trail (with 14.06 miles and 78% completed); 2) Research Triangle park to Middle Creek (with 25.47 miles and 25.47% completed) ; 3) Umstead Park to Hemlock Bluffs nature Preserve (with 12.22 miles and 20.5 % completed); 4) Downtown Cary to City of Raleigh (with 4.29 miles and 7.7% completed) and 5) Lake Crabtree Park to American Tobacco Trail (with 12.96 miles and 7.7% completed) with a total of 69 miles and 29.6% completed (Parks, Recreation & Cultural Resources Master Plan, 2012).

The arterials numbers 1, 2 and 5 described above will conform a major loop in the Cary`s structural network system. All the arterials, numbers 1, 2, 3, 4 and 5 functioned now as major penetrators within this network system and will provide future regional connections with the surrounding areas, with the intuition to expand with larger connectivity the trail system with other communities. The arterial greenway number 1, will combined the 2 greenways of this study: Black Creek Greenway and White Oak Creek Greenway with the American Tobacco Trail; also the greenway number 5 will promote the connection with the American Tobacco Trail. The map of this new categorical system is illustrated in Appendix P.

3.8.3. Greenway Study Cases Selection

The recreational greenways with the highest volume of use in *Cary - NC: Black Creek Greenway and White oak Creek Greenway*—were selected in an attempt to provide vital information regarding the capacity of recreational greenways to create and promote social interaction, within three core areas of information: (1) *structural network systems* (type of connection, segment and trail surface); (2) *recreational greenway physical environment characteristics* (landscape features and physical structure features); (3) *social network* (type of user, type of actor, patterns of use, type of activity, type of social interaction, relational ties or social bridges, patterns of interaction, levels of interaction, catalyst of interactions and centralyty). The multi-methods of this study will be described in detail in the following chapter 4: Methodology.

Results attempted to understand our research questions and assumptions and prove right or wrong the hypothesis of this study. The research questions framed the basis of the study and sought to bring about a better understanding of social aspects of recreational greenways.

CHAPTER 4: METHODOLOGY

4.1. Research Design Overview: Multi-Method Strategy

In order to measure the quality of the physical environment as an indicator of whether a greenway will be successful in terms of social interaction I utilized both quantitative and qualitative research methods (Dempsey, 2009). Descriptive quantitative research commonly involves either the identification of characteristics of an observed phenomenon or place, or exploring possible correlations among two or more phenomena, in both cases without changing or modifying the situation, relationship and/or behaviors under the investigation (Leedy and Ormrod, 2005). According to Creswell (2009), the most used multi-method is the concurrent triangulation strategy, which compares quantitative and qualitative data to verify their convergences, differences or some combination. This model is very advantageous, since the results can be well validated in a short period of time, because the qualitative and quantitative approaches are gathered at the same time at the research sites (mixed case studies).

4.2. Case Study Strategy

Case Study research is a way to investigate an empirical and contemporary topic or phenomenon, in a real life context, generally to comprehend the relation between phenomenon and context. “A case study is an empirical inquiry that (i) investigates a phenomena or setting in depth and with a real-life context, especially when (ii) the boundaries between phenomenon and context are not clearly evident” (Leedy and Ormrod, 2005; Yin, 2003; Yin, 2009; Groat and Wang, 2002, p. 346).

According to Leedy and Ormrod (2005, p. 135) “a case study may be especially suitable for learning more about a little known or poorly understood situation. It may also be useful for investigating how an individual or program changes over time, perhaps as the result of certain circumstances or interventions.” It is an important research strategy to understand

complex social phenomena, due to the in-depth level of study and because it permits the preservation of the holistic characteristics of real life (Yin, 2003).

Sommer and Sommer (2002, p. 205) explained that “case studies provide illustrative examples within larger investigations using multiple methods. A case study can humanize a quantitative study and increase reader interest by connecting statistical findings to real-life examples.” According to Leedy and Ormrod (2005), the researcher collects extensive data such as observations, interviews, documents, past records and audio visual records (photographs, videotapes and audiotapes). In all these circumstances, the researcher may spend a prolonged period of time on site and interact regularly with the people who are being studied. “The researcher also records details about the context surrounding the case, including information about the physical environment (…) and social factors that have bearing on the situation. By identifying the context of the case, the researcher helps others who read the case study to draw conclusions about the extent to which its findings might be generalizable to other situations” (ibid, pp. 135-136).

Zeizel (2006) and Sommer and Sommer (2002) brings up some excellent points for design researchers that intended to conduct a systematic application of observational procedures, like for example behavior observation of physical environments as a way to understand the case studies dynamics occurrence and also collect observational data with the use of this case study strategy. Important issues are introduced about how different quantities of people, individuals, pairs, sub-groups and groups, use their environments and what their needs are. To assess this, he came up questions such as “what do they do? how do activities relate to one another spatially? how do spatial relations affect participants?” These are key questions for understanding the relationships between people and between people and the physical environment, in terms of understanding users` existing and expected uses, their re-invented and re-elaborated uses, their misuses and formal and/or informal activities that take place in public environments, like squares, plazas, parks and greenways (ibid, 2006, p. 191).

Zeizel (2006) is very effective in describing the practical steps and techniques for observing environmental behavior, including simple flow texts, explanation, exemplification and efficient illustration (pictures, tables and schemes). He elected 4 main steps for observation. The first deals with qualities of the method, which is related to how the researcher can be directly or indirectly involved in observing the phenomenon or chose to be an “outsider” or participant in any situation. This also involves how the research setting observation must be planned and how to recognize the dynamics of the environment and the social interactions by observing the different set of activity episodes and the existing patterns of behavior. The second entails the observer’s vantage points, which is related to whether researchers decide to be involved in the activities as a participant or as an observer. The researcher observation spot can be central to the study phenomenon or peripheral, where he observes the behavior and pattern of usage from a distance or “hiding” from the scene. He can also be a recognized outsider, in which the actors know that they are being observed as a part of the experiment. The disadvantage of this is that users can change their behavior and this might not reflect the real world. The third point is related to recording devices: which consists of an explanation of the strengths and limitations of the different approaches to recording behavior observations: notation, pre-coded checklists, hanDBase computers, diagrams, maps, photographs, videotapes and movies. The fourth aspect entails what to observe: different actors (type of users, size), actions or activities, type of relationships (including human senses) and ties, context characteristics, composition and setting dynamics. Such steps for observations are very easy to comprehend and helps designers to visualize “how the contexts of observed activities affect those activities, because in socio-cultural and physical settings the same behavior can have different design implications” and also different approaches and values (ibid, 2006, p. 203).

Zeizel (2006) points out an interesting technique, which is to capture a whole scene of the observation action using “track sheets” to record, count and analyze, as a single tool. If the researcher adds other types of equipment to collect the data, it might improve the detail and precision of the information, however, when observing the behavior in a multi-use and dynamic place with lots of people, the best way to capture all the scene and action is to

record by photograph and videotape, and later to code the information. In synthesis, the author provides some interesting information about different approaches for collecting and observing the human and environmental behavior within the case study strategy. Finally, Sommer and Sommer (2002, p. 208) explained that “the validity of a case study is enhanced by using multiple approaches and then integrating the information through a process of triangulation or converging operations.”

4.3. Quantitative and Qualitative Data Collection

Quantitative data provides evidence about the world in numerical forms and can be structured as a replication of the researcher-imposed constructs. Quantitative data provides evidence about the world in no numerical data, in form of words and can be structured or not structured and also may or may not encompass researcher imposed-constructs. Quantitative data if compared to qualitative data “offer the advantages that number have over words as measures of some quality. On the other hand, they also carry the disadvantages that numbers have, including a potential loss in richness of meaning” Babbie, 2007, p. 23). Both types of data collection differ in the process of measurements. “Quantitative data enable standardized, objective comparisons to be made, and the measurements of quantitative research permit overall descriptions of situations or phenomena in a systematic and comparable way” bringing different perspectives about the phenomena and providing systematic answers to the research questions. Qualitative data are more flexible, they can be used “in a wider range of situations” and for different purposes. It provides more deep understanding and better picture about the phenomena, because allows the researcher “of getting the insider`s perspective, the ‘actor’s definition of the situation’, the meanings people attach to things and events”, and physical environments, providing rich and holistic information about the complexity of social phenomena (Punch, 2000, p. 243).

Case studies are not limited to a single source of information, they can use and combine multiple sources of evidence, as for example, formal observations to produce data information that is quantitative (measures of observation and survey of behavior and attitudes) with qualitative methods, such as open-ended interviews and documentary analyses. The combination of qualitative and quantitative data adds relevance to the findings and allows a comparison among techniques (Leedy and Ormrod, 2005; Yin, 2003). Multiple case studies commonly contain two or more cases that are different in certain key ways, to enable comparisons, build theoretical frameworks or propose generalizations. This approach can be called a multiple or collective case study. In this approach, replication is needed and for each case there should be a prediction of similar results (literal replication) or contrasting results for predictable reasons (theoretical replication). It is essential to provide a rich theoretical framework that affirms where a particular phenomenon can be found and where it will not likely be found (Leedy and Ormrod, 2005; Yin, 2003; Punch, 2000).

The strength case study is that data from case studies tend to come from multiple sources providing exhaustive information: documents; archival records; open-ended interviews; focus interview; structured interviews and surveys, and observations. Each of these sources presents strengths and weakness, and these are complementary (Yin, 2003). However, the weakness is the amount of information that must be controlled by the researcher, especially if multiple sources are used. The researcher that doesn't have a global vision and control over the different sources of information and the variety of techniques can fail and provide wrong or inconsistent conclusions.

The mixed-method strategy of my research is based on a multiple case study in which I analyze 2 heavily used recreational greenways in Cary, North Carolina to provide information related to three categories: (1) *structural network systems* (types of connections, segments and trail surfaces); (2) *recreational greenway physical environment characteristics* (landscape features and physical structure features); (3) *social network* (type of user, type of actor, patterns of use, type of activity, type of social interaction, relational ties or social

bridges). I intended to describe the nature of social interaction of the greenways, combine multiple sources of evidence of quantitative and qualitative data by comparing specific characteristic of 2 greenways and investigating how those characteristics impacts the social factors. The objectives are to define the trail that has the greatest number of users, actors, uses and the greatest diversity of use, by identifying frequency, density, intensity and type of usage, and to recognize the types of ties/bridges, types and levels of social interaction, patterns of use/activities, interactions catalysts and user preferences, as illustrated in the methodology diagram summary (Appendix I).

4.3.1. Data Mining Analysis for Advanced Analysis

Data mining consists in the process of analyzing complex and large data sets from different perspectives, finding correlations, patterns, associations or relationships among them and summarizing it into useful information. The data mining analysis and decision tree technique were used in this study, because it presents a complex and large set of variables in which I intended to find the correlations, patterns and relations among the variables in a reliable, fast and useful manner. Commonly the “target data is generally divided into two sets, the training set and the test set. The training set is used to train the data mining algorithm(s), while the test set is used to verify the accuracy of any pattern found” (Patel and Thomson, 2013, p. 4). This technique allows researchers to analyze the data with different dimensions, categorize them and then summarize the categorized relationships. The principal purpose of this technique is to use and manipulate the independent variables to predict the outcome of a dependent variable with the inclusion of quantitative methods and/or different mathematical methods.

The data mining model is used to make predictions based on mathematical relationships of the dependents and independents variables. It also searches for hidden patterns in the data that can be utilized to predict future behavior. It “searches for a combination of the data that reliably predicts a desired outcome” (ibid, 2013, p. 5). The predictive analytics data mining

platform “provides capabilities for each step of the process to identify the most significant variables, develop models using the latest algorithms, validate the accuracy and fitness of the model(s) and generate a scored data set with predictive values” that can be utilized in other statistical operational applications. It “provides powerful data preparation tools that address data problems, such as missing values and outliers” and help the researcher to develop prediction and directions. “Data modeling takes advantage of a suite of predictive and descriptive modeling algorithms models, such as decision trees, neural network, clustering, linear regression and logistic regression” and the data mining can be multifaceted passing through them, and/or combining them, and/or average them to achieve a stronger solution (ibid, 2013, p. 6).

Representative task types of relationships of data mining application are: association, clustering, classification, sequential patterns, regression and summarization are described below (ibid, 2013; UCLA Data Mining Laboratory, 2013; SAS Institute Inc, 2012):

- In the *classification* application, the variable of interest is categorical in nature. Commonly assign income patterns into already formed groups and stores the data sets in predetermined groups by generalizing known structure to apply to new data. The advantage is to treasure variables strongly associated to the variable of interest, and also predict a model in which the set of variables are used to classify the variable of interest;
- In the *cluster* application there is not a variable of interest. The data set is commonly sorted into groups or clusters (similar and different clusters) suggested by the data, like individuals and relationships. Allows the researcher to find the variables that presents the greatest influence in the grouping, it also provides the comparison of clusters through the variables of interest and verify new cases of clusters. Generaly the variables with large variances tend to present more effect than the ones with small variance. The cluster node accepts different types of data, such as binary, nominal, ordinal and/or interval;

- In the *association* application, the data sets can be extracted to identify associations for relationships among variables;
- In the *sequential patterns* application the data is mined to predict behavior patterns and trends. It finds sets of data items that happen together normally in some sequences;
- In the *regression* application, the variable of interest is continuous in nature, it design the functions that can be utilized to model the final data use with the least error. It presents the same advantages as the classification category. There are two types od regressions: linear (that aims to predict the score of an interval target by the linear function by utilizing one or more inputs that can be continuous: interval or discrete:nominal or binary) and logistic regression (that aims to predict the probability of a binary(s) or ordinal target(s) of the dependent variable(s) as an accomplish from the function and input(s) of one or more variables),
- In the *summarization* application, it is provided a more compact demonstration of the data set, including visualization and report generation.

This study used three different data mining approaches: *classification, clustering and regression.*

The advantages of data mining are: the possibility to select, explore and create model of large amount of data. Discover new and important insights form the data, to achieve deep understanding and ideas about data key variables relationships, trends and anomalies. It makes better decisions and act faster and provide accurate analysis and results (Patel and Thomson, 2013).

4.3.1.1. Decision Tree Analysis

Decision trees were originated in the fields of data mining, pattern recognitions and computer science during the 80`s and since then this multivariate technique can be utilized by different fields, principally to classify observations. Commonly the decision trees are

utilized when “the problem of making decisions where the outcomes are uncertain, consciously or unconsciously will take into account, in assessing the alternatives and selecting a course of actions” based on its decisions. It represents set of decisions. In other words, it can be possible with those predictions to establish “subjective probabilities to the possible outcomes, which can then be incorporated into a formal decision model framework” and then make possible subjective conclusions about actual and future outcomes, especially when dealing with outdoors recreational greenway physical environment and social trends (King, 1973, pp.79-80).

Decision tree is called a “binary tree, or 2-tree”, that consists in “a structure of nodes where each node can have up to two daughter nodes”, or two pair nodes. “A decision tree is an *n*-tree which can be used to classify observations into *n*-classes”, the initial node is called “root node” (identifier number t=1), then followed by pair of daughter or pair nodes (left and right with the identifier nodes 2t and 2t+1) outcomes and so on. Every outcome of the decision tree has its own node pair. “The nodes are either internal (have daughter nodes) or terminal (no daughters). Terminal nodes are called leaves” (…) “each leaf has an assigned decision tree output value” (…) an observation defined by variables x will, starting from the root node, follow a unique path through the decision tree depending on the outcomes of the tests from the internal nodes passed. Eventually the observation will end up at a leaf and the classification of the observation is the decision tree output value of this leaf” (Gillberg, 2011, p. 62).

“In the decision tree, decision nodes are shown as “the root node” and correspond to a point of decision for the mining data” in which the researcher “is required to make a choice between alternatives. The other nodes (i.e. points of intersection of the branches) in the tree correspond to points where the outcome is governed by chance. (…) The assessed or subjective probability of outcome is indicated on each branch.” The decision tree is not a simple approach; sometimes it encompasses a whole sequence of branches connecting sequential cases decision and chance nodes (King, 1973, p. 84). Analysis, such as the Classification and Regression Trees (CART) and Chi-Square Automatic Interaction

Detection (CHAID) that commonly are used for the data set organization into multi-trees, providing a set of rules to the new dataset and then able to predict which records will have a given outcome. Decision trees utilizes different methods in the procedures of the decision tree consist in different steps: “learning (…), training, building or growing” (ibid, 2011, p. 54; UCLA Data Mining Laboratory, 2013).

Gillberg (2011) mentioned that decision trees present many advantages and limitations. The advantages are: analyze complex data by the tree that allows a human-readable structure; is less complex to learn and work than neural networks analysis; can use discrete variables directly in the analysis; and can afford the inclusion of extra variables, without compromising the analysis of the performance of the decision tree. The limitations are that it may “include the instability of the tree structure with respect to the learning sample composition (…) creating decision trees using random subsets of the same samples may produce very different trees, but usually with similar separation power”, and that the decision tree output is discrete, because the output values are unique of each leaf content and the number of leaves is finite. To mitigate these limitations, it is crucial the construction of “many different trees and taking the average of their output” (ibid, 2001, p. 64).

4.3.2. Descriptive Statistics Analysis

Descriptive statistical analyses were utilized in this study to make it easier to assimilate the data of the multi-method approaches information. The type of descriptive statistics utilized depended on whether the outcome measured was categorical or continuous. It summarizes quantitative data in a comprehensible and significant manner. It can describe single variables and also the associations one variable have with another (Sommer and Sommer, 2002; Babbie, 2007; Agresti and Finley, 2009). According to Sommer and Sommer (2002, p. 246) “categorical refers to variables that have levels that are mutually exclusive”, commonly use relative frequency (the number of observations) in each category and then presents their number or mentions, proportion or percentage that fall in each category; the frequency distribution consists of the list of possible values for a variable, together with the number of

observations at each value. The bar graph shows each category characteristic in a bar and the height of the relative frequency in that category. The histogram graphs consist of the relative distribution for quantitative variables and can be very convenient in making comparisons. Frequency distributions and graphs are very convenient for quantitative variables. The “continuous variables are those whose levels can take on any value within the lowest and uppermost limit of the variable”, the “data set is described in terms of both its central tendency and its variability (spread or dispersion values)” (Agresti and Finley, 2009; Sommer and Sommer, 2002, p. 258).

The measures of an average or central Tendency consist of the description of the center of a frequency distribution for a quantitative variable and refer to a statistical number that best characterizes the group as a whole. Mean, median and mode are the types of average. The mean consists of the sum of the observations (all the scores) divided by the number of observations (cases). The median consists in the simple measurement of the center or midpoint of a distribution of the observations. It divides the sample in two parts of equal numbers of observations, and then orders them from lowest to highest scores. The mode is the single score or value that occurs more often in a frequency distribution. The measure of variability refers to the spread or dispersion among a set of scores or observations. The range is the difference between the highest and lowest score or observation (Agresti and Finley, 2009; Sommer and Sommer, 2002).

The standard deviation indicates the variability or dispersion of the scores or observation and describes the distance from the mean and specifies the degree to which the scores cluster around the mean (Agresti and Finley, 2009; Sommer and Sommer, 2002). According to Agresti and Finley (2009, p. 47) “each observation has a deviation. The deviation is positive when the observation falls above the mean. The deviation is negative when the observation falls below the mean. The standard deviation is equal zero when the observations present the same value.

The descriptive statistics will be used in two of our method analyses: the social characteristics audit in method 2 and the standardized survey questionnaire and mapping exercise, in method 3.

4.3.3. Correlational Research Strategy: Categories Variables – Comparing Proportions and Contingency Tables

According to Leedy and Ormrod (2005, p. 180) “a correlational study examines the extent to which differences in one characteristic or variable are related to differences in one or more other characteristics or variables. A correlation exists if, when one variable increases, another variable either increases or decreases in a somewhat predictable fashion.” According to Groat and Wang (2002) this strategy focuses on naturally occurring patterns of relationships and allows for an understanding among complex sets of real-word variables. In this type of study, researchers gather data about two or more characteristics for a particular group of people using precise measurements of the characteristics in questions, such as test scores, ratings assigned by an expert and frequencies of certain behaviors. The researcher might plot the data on a scatterplot to understand the relationship between the two variables. The scatterplot allows the researcher “to describe the homogeneity or heterogeneity of the two variables. (…) describe the degree to which the two variables are intercorrelated” (Leedy and Ormrod, 2005, p. 181). There are two types of correlational research: relationship and causal-comparative. The relationship study describes relationships among the key variables, and focus on the nature and prognostic power of such relationships (Groat and Wang, 2002). In the causal-comparative type, the researcher selects comparable groups of people, or groups of actors, or different physical environments, and then collects the data of the different relevant variables (Groat and Wang, 2002). According to Groat and Wang (2002, p. 215) “the purpose of selecting comparable examples is to isolate the factor(s) that could reveal a ‘cause’ for significant differences in the levels of measured variables. (…) to make the causal-comparative design persuasive, the researcher must establish the essential comparability of the examples studied.”

The strengths of correlational research study is that it “permits the measurement of several variables and their relationships simultaneously and in a realistic setting” Isaac and William (1995, p. 53). It is an adequate strategy to identify relational patters (similarities, differences and ambiguities) and can also establish predictive relationships (Groat and Wang, 2002). “A wide range of data collection and analysis techniques are used in correlational research”: survey, observation, mapping, sorting and archives (ibid, p. 218). If compared with others methodological strategies, the sampling in a correlational study is extremely important, because it needs to predict the findings as accurately as possible (ibid, 2002).

The weakness is that “The research cannot control the levels or degrees of variables” (…) the phenomenon may be explored superficially, and not be able to “establish causality” (Groat and Wang, 2002, p. 244). To mitigate this problem, the variable categories and protocol need to be well planned and pre-tested before it is applied by the researcher. The researcher needs to understand the implication of using different levels of measurement precision. Correlation were used in this study in the descriptive statistic approach to compare the social network variables (dependent variables) with other (independent variables) that are illustrated in the Appendix I.

4.3.4. Coding Analysis

Coding is a process in which extensive answers are reduced and organized into specific categories. The categorical data characteristics are the easiest items to be coded. Each category receives a code of identification (tags, names, labels, letters or numbers) which reflects a nominal level of measurement and not quantity information. The coding can occurred by three instances: one is based on the research purpose of the study with the provision of unique and specific coding; the other one is based in existing code scheme, because it permits the researcher to compare the findings with previous studies and the other one emerges directly from the data. The coding procedure allows the researcher to summarize or condense the qualitative data by grouping the themes and by identifying

patterns. The final outcome of the coding process is the conversion of the data into numerical codes, as composing variables that assign specific location within the data file and the interpretation of the coding (Babbie, 2007; Sommer and Sommer, 2002; Punch, 2000).

Punch (2000, p. 205) mentioned about the “two types of codes: descriptive codes, and inferential (or pattern codes)”, the first type of coding uses “descriptive, low-inference codes, which are very useful in summarizing segments of the data, and which provide the basis for latter higher-order coding.” (…) The second coding type focuses on pattern codes (similar and different patterns). “Pattern codes pull together material into smaller and more meaningful units. A good way to understand pattern code is by analogy with factor analysis in quantitative research.”

According to Babbie (2007, p. 409) data entry is the process of “transforming data into quantitative form, researchers interested in quantitative analysis also need to convert data” into a computer program to be able to read the data, such as excel and statistics programs (JMP 10 or SAS 9.3). For example, after the data collection by questionnaire, the researcher will do the coding and then enter the data into those programs.

Punch (2000) explained that the grounded theory analysis commonly utilizes in their analysis of qualitative data the conceptualization of the data categories primarily with some level of abstraction, then secondly by finding the relationships between the categories and then thirdly by generating codes from them, and then creating new theories from that information (theory building). There are three types of coding process: *substantive codes or open coding* that consists on the first level of the data conceptual category analysis that discovery the substantive or conceptual codes. The indicator of the concept is compared to other indicators to provide the categorization of codes based in their similarities and differences; the *theoretical codes or axial coding*, that consist in the process of using those codes and to inter-connect these the main-substantive categories codes. It uses two levels of abstraction process, “first from data to first-order concepts, and then from first-order concepts to high-order concepts” (ibid, 2000, p. 214). On the first level of the axial coding, it

uses the main categories that emerged in the open coding to group them according to their characteristics. On the second level, it arrange the categories based in their interconnected categories concepts, then at the last level, group them according their similarities into a final and *selective coding topic*, producing the *core codes* in which theory is written (delimitation and development).

Coding analysis (open coding, axial coding and core code procedures) was utilized in the standardized survey questionnaire and mapping exercise qualitative approaches, in method 3 for the categorical data answers.

4.3.5. Behavior Mapping

Mapping technique, also called activity mapping, is generally utilized in behavior sciences to study people's relationship with the environment and with other people. Social scientists, urban planners and landscape architects commonly uses a combination of observation checklists, time lapse photography, GIS mapping (spatial form conversion and data features compilation) and photography to measure urban and suburban public space usage. According to Cosco et al. (2010, p. 514) the foundation for behavior mapping came from two main concepts: behavior settings and behavior affordances. "Behavior settings are ecological units where the physical environment and the behavior are indissolubly connected" and "Affordances are the perceived properties of the physical environment that support the individual's actions."

Behavior mapping is an unobtrusive direct observational approach for observing human behavior in connection with the physical environmental characteristics and to understand people's relationship to their environment in terms of how they perceive and use the environment (Cosco et al., 2010). "Observing behavior means thoroughly watching how people, individuals, pairs of people, small groups, and large groups, use their environment" (Zeizel, 2006, p. 191). Behavior mapping is generally concerned with the locations, actions,

movement and behavior of people and how people use spaces. The researcher can only record variables that are readily observable, such as gender, age, size, type and level of activity and so on (Project for Public Spaces, 2000; Sommer and Sommer, 2002; Zeizel, 2006; Cosco et al., 2010).

According to Sommer and Sommer (2002) the researcher can choose which of the mapping procedures best fits the study goals. In place-centered behavior mapping, observers station themselves to observe the action, activities and movement at specific site locations. In individual-centered behavior mapping, the researcher follows particular actors (individuals, sub-groups or groups) across time and location, which is also known as behavior tracking. Both types of behavior mapping can be combined in the same study as well. The recording can be done with different types of approaches: base map, videotape, time-lapse video photography, photography and observation checklist diagrams and/or protocol. It also provides valuable insights that can be achieved by regular observation of a physical environment, during different times of day, different week and weekend days, different months and seasons of the year, providing a comprehensive picture of the human usage of a place (Project for Public Spaces, 2000; ibid, 2002). Project for Public Spaces (2000) pointed out that the patterns of use/types of activity can be recorded in different ways: follow a protocol list of activities to observe; check off more than one activity per person observed; observe different types of socialization activities and finally observe the sequence of activities per type of users and type of actors.

4.3.6. Stationary Observation

Stationary means “not moving or not intended to be moved” (The Oxford College Dictionary, 2007, p. 1342). *Observation* consists in the “action or process of observing something or someone carefully or in order to gain information. The ability to notice things, esp. significant details” and the definition of the *observer* as “a person who watches or notices something”

and register this evidence as being significant. “A real or hypothetical person whose observation is regarded as having a particular viewpoint or effect” (ibid, 2007, p. 947).

Putting those terms together, I can define that the observer, as a researcher, when observing someone, or the physical environment, or a phenomena or something else in a stationary way, in other words, without moving himself or herself, in which he or she emerges into a stationary observation, to achieve a better “picture” of the observed with more direct and detail attention, and description in how people use the public spaces and it features.

4.4. Multi-Methods Summary

This main aim of this study is to analyze the different types of social interaction, behavior, ties/bridges and cohesion that take place on the recreational greenways, by understanding the relationships between greenway characteristics, their users, actors, pattern of uses, behaviors and interactions. Two of the most used greenways of Cary (Black Creek Greenway and White Oak Creek Greenway) will be observed to identify the level and types of interactions and behaviors (social integration, ties/bridges and behaviors) that occur on the recreational greenways and investigate how they are related to the greenway physical environment: features and structural network system. I was also able to identify the nature of such interactions with the information about the greenway catalysts for social interactions.

The multi-methods approaches were used in the different phases of the study and with different populations: greenway expert and greenway users. The summary of the different methods by phase was created to provide information about the sequence and organization of the methods of this study, before presenting each method separately (item 4.6. Data Gathering Methods). The scheme diagrams of the methodology of this study are illustrated in Appendix F: Diagram of the Research Methodology.

First stage: Interview the Greenway Expert (Method 1): Senior of Parks, Recreation and Cultural Resources of Cary, who provided information from their experiences in planning, developing and managing greenways in the Triangle Area, NC, EUA (Cary). The interview was conducted in the summer of 2011 and provided information related to which greenways receive the heaviest amount of use, which was used to select the greenways to be observed in the following methods. In the interview, the greenway expert indicated the three most heavily paved and the three most heavily unpaved greenways in Cary. Of the 6 greenways indicated by Cary`s greenway expert (3 paved and 3 unpaved greenways), the two most heavily used paved greenways in Cary were selected for analysis in the subsequent methods. A general scan of these areas was carried out, to get a feeling for the trails and to verify the areas with more intense usage within their greenway network structures and to elect the trail segments and observation stations for the general data collection. Four segments of each of the two greenways were chosen: based on their characteristics (structural network system, features and street furniture). Sites of those segments possessing a greater number of features and street furniture were then selected as observation segments and stations for *Methods: 2, 3 and 4.*

Second and fourth stages: the survey with the greenway adult and senior users provided information from their experiences, perceptions (about the greenway characteristics, greenway users, behaviors, activities, socialization, positive and negative aspects). The mapping exercise provided information about the greenway characteristics: structural network, features and street furniture. Participants showed with the use of stickers their physical environment preferences when utilizing the greenway (where they start, end, destinations and places for meet and interact with others). The information provided was used to identify the relationships between greenway characteristics (structural network, features and street furniture) and the social network.

Third stage: A multi-method approach combining *Methods 2 and 3* were utilized. *Method 2: Greenway Characteristics Audit*, consists of the description and characterization of the greenway features and street furniture only. An observational checklist and drawings on a base-map were used to categorize the types and location of the greenway features

(landscape features and physical structure features) and the street furniture. *Method 3* consists of the Social Characteristics Audit Observation, which entails on-site observation with observation checks: behavior mapping observation. For each greenway, 4 segments were elected based on the type and quantity of their usage and characteristics (more features and street furniture). Behavior mapping observations were conducted in different periods for each of the 4 segments of each greenways by scanning the entire trail. The observation per segment occurred during 1 hour (week days and weekend days) in three different periods (morning, afternoon and evening). The observation aimed to characterize greenway users during their social interactions, taking place on the greenway features and street furniture. The behavior mapping technique made use of a checklist protocol with field notes and a base-map to record, draw and indicate the locations or places where the users, actors, behaviors (pattern of use/type of activities), interactions, ties/bridges occurred. Additional photographs were taken during the observation to record the greenway social network interactions. The use of photographic camera facilitated the compilation of the check-list protocol for greenway usage especially when it was too crowded to be able to record by hand with accuracy.

In summary, in this dissertation the method 1 will be descriptive only. Method 2 will be descriptive and partially analytical. The other methods (2, 3 and 4) will be descriptive and analytic: illustrated with graphs, thematic maps, tables and pictures. Appendix F: the research main questions, dominant sub-questions, phases and outcomes is a diagram that summarizes the methodology and demonstrates the relationship of the research main questions and dominant sub-questions with each of the methods, their phases and intended outcomes (method 1: protocol, administration and site selection; method 2: social observation/check: behavior mapping; method 3: greenway characteristics observation (features and street furniture) and method 4: survey and mapping exercise. The multi-method approaches of this study provided different perspectives and important information about how greenways were perceived, experienced and used (users' and actors' interaction and behaviors), how often the greenway features (landscape features and the physical structures) and street furniture were used and how the connection, destinations type and

trail characteristics influenced the social aspects, also I was able identify the patterns of use/ types of activity and social network occurrence along the greenway physical environments (trail and off-trail) and finally classify the types of interactions among different users and actors.

4.5. Data Gathering Methods

The data gathering methods are illustrated by the diagram and summary of the methodology of my research study, as illustrated in the Appendix F. Diagram of the Research Methodology and research main questions, dominant sub-questions, Phases and outcomes. Each method is discussed in greater detail in the subsequent sections.

4.5.1. Method 1: Interview

The first method of this study consisted of a personal face-to-face structured interview with the greenway expert of Cary, in which I developed open-ended questions (with different topics) and used the Parks and Recreation folder map (Cary Bicycle/Greenway Map, 2012) for them to draw their most used greenways (03 paved and 03 unpaved trails). The map with the Cary greenway expert drawings identification results about the greenways with the highest volume of use is presented in Appendix S. Below is the description of the interview method that I utilized.

4.5.1.1. Questions/Objectives, Sample, Procedure and Administration

Research questions:

- Appendices E and F.

Objectives:

- to find out the greenway expert viewpoint about the greenway social aspects;
- to find out whether the greenway expert recognizes any user patterns of activity;

- to find out whether the greenway expert agrees that different types of greenway structural networks impact social aspects of the greenway;
- to find out whether they have done reliable research studies and data analysis about users and activity counts;
- to verify what level of data about greenway use already exists;
- to find out about their greenway studies: patterns of use, frequency and intensity;
- to gain some information about greenway design, planning and management (existing ones and the development of future ones);
- to identify the most heavily used paved and unpaved greenways (03 each);

Sample, Procedure and Administration:

The participant was one greenway senior from the Parks and Recreation and Cultural Resources Department of Cary (adult participant) who has many years of experience in the planning, design, development and management of the greenways.

Before the application of the interview I provided a consent form with more information about our study topic and questions and obtained their signature showing their approval in participating in the recorded interview. The expert was interviewed with tape recorder instrument and specific greenway print-map folder (Cary Bicycle/Greenway Map, 2012). The Cary Bicycle/Greenway Map (2012) was used for the greenway expert to indicate the greenways with highest volume of use. The study data (answers and drawings) were collected during the summer of 2011 and took place in the participant' office: (Design Development Division: Department of Parks, Recreation & Cultural Resources – Town of Cary). The interview was transcribed and coded with the initials: Cary Greenways Expert (CGE) in Appendix L. The transcription will be stored on my personal laptop. The voice recording of the interview was erased. The mapping result with the identification of the greenways with highest volume of use is illustrated in Appendix M. The topics covered in the interview questions are illustrated on the table 6 below and questions are presented in Appendix K.

Table 2: The Topics Covered in Greenway Expert Interview.

Source: Pippi (2013).

Topics Covered in Interview Questions
Greenway Major Function expert opinion
Greenway Structural Network Context to verify how they see the nature of the greenway
Greenway Master-Plans plans, implementation and management (to understand about their actual and future greenway development and management/ to verify how they understand as the greenway characteristics: in terms of structural network connections types, surface types, and features types)
Greenway Structural Network and Features expert opinion and perspective on how greenway characteristics influence social interaction
Greenway Social Role expert opinion and perspective in how they see the importance of the social interaction and human behavior studies; also to gain more information in how they think, as a greenway experts, about the social impacts of the greenways, and if they have some studies and analysis about the greenway users, their number, quantity and type of activities
Greenway Studies About Patterns of Users and Use/Type of Activities studies and analysis about the greenway users, their number, quantity and type of activities
Greenway Representative Greenway in Terms of Usage identification of the most representational and most intensively used greenways (their identification by specific locations and trail segments)
Greenways With Highest Volume of Use identification of three paved and three unpaved greenways with the highest volume of users (we asked them to identify on the city greenway print-map folder, that we brought with us, with 2 different colored pens, to make by hand a drawing with a circle of those trails). We asked if they already have data or materials for those greenways and the analysis of their greatest number of users and activities.

4.5.1.2. Instrument

For this first method, the following materials were utilized: interview protocol on a sheet of paper, containing 11 open ended questions and a folder-map of Cary Bicycle/Greenway Map (2012) with key-legend: orange and blue pilot pens for drawings of the greenways trails

with the highest volume of use (paved and unpaved, identified on the base map); a tape recorder: Panasonic RR_US 510 with zoom microphone.

4.5.1.3. Site Selection

The Town of Cary has an extensive greenway system with a number of types of greenways. The Town of Cary volunteer Greenway Committee and the staff counseling of Cary`s Department of Parks, Recreation and Cultural Resources has researched greenway users (number, frequency, intensity) only on weekends for the last 4 years and has had greenway experts working for over 10 years. After the conclusion of the interview, the greenway expert provided a map with the results of this study with information about the location of the most heavily used greenways of Cary, North Carolina, as illustrated in the Appendix I.

Below are listed Cary's Greenways with the Highest Volume of Use as one of the results of our interview with Cary`s Greenway Senior:

- Paved greenways trail with the highest volume of use in *Cary – NC: Black Creek Greenway, American Tobacco Trail (maintained by Town of Cary) and White Oak Creek Greenway*;
- Unpaved greenways trail with the highest volume of use in *Cary - NC: Swift Creek Greenway; Black Creek Greenway and White Oak Creek Greenway;*

Two recreational greenways, mentioned by the Senior of Greenways of Cary (interview answers and mapping draw-identification) were selected for this study as the most representational and the most intensively used by people in Cary - NC: the *Black Creek Greenway (7.4 miles)* and the *White Oak Creek Greenway (5.73 miles)* and also because they present different greenway types of characteristics: features and structural network systems in the Town of Cary (one with a park as a destination, another with a park and a neighborhood as a destination and another with only a neighborhood connection).

Based upon their structural network characteristics and features. this study aims to identify which greenway type (a greenway type that presents an incomplete pattern, because it connects only to a neighborhood; or a greenway type that presents a multiple pattern, with a park as a destination or point of attraction) presents more and less social interaction, and also which greenway is more successful in terms of social interaction. In addition, I aim to identify the places where interactions take place (where people meet and interact, stopping areas and non-stopping areas, where people go, and how the flow or movement of people takes place).

4.5.2. Method 2: Greenway Characteristics Audit

Method 2 was carried out in Stage 3 and consisted of an analysis of the greenway structural network system, the greenway features (landscape features and physical structure features) and the greenway street furniture components in order to enable the categorization of greenway characteristics in terms of their effect on and support of socialization activities (stationary, lingering and moving). This method did not involve human subjects. This data provided a descriptive characterization of greenway areas through the observation features.

The users and actors were not exposed during this data collection. Method 2 was conducted simultaneously with Method 3: Social Characteristics Audit: *behavior mapping* and *stationary observation*. The data allowed me to determine the patterns of the greenway characteristics to verify the types of structural network system (network types, types of connections and trail characteristics) and the types of features (vegetation types, physical structure configuration types and/or street furniture components types) that facilitate and/or promote social interaction (Appendices N and O).

4.5.2.1. Questions/Objectives

Research Questions:

- Appendices E and F.

Objectives:

- Describe existing greenway structural network system;
- Spatialize and describe existing greenway features (landscape features and physical structure features);
- Spatialize and describe existing greenway street furniture components;
- Identify types of structural network system, types of features and types of street furniture components that present (enhance or facilitate) social interaction;
- Identify spatial distribution of greenway characteristics, use and socialization locations;
- Recognize the greenway characteristics that are fundamental for social interaction;

4.5.2.2. Settings and Features Observation Procedure:

Method 2 data were collected and spatialized during the Spring, Summer, Fall and Winter of 2012 and Winter of 2013. General characteristics of the greenway environments (meso-scale) were described in terms of the condition of both greenways: Black Creek Greenway and White Oak Creek Greenway within the Cary`s Greenway Structural Network System. Specific characteristics of greenway environments (micro-scale) were described, categorized and spatialized by landscape features configuration, type and/or area (topography slope degree/slope terrain rating configuration, altimetry and topography elevation; vegetation and natural water resources); physical structure features configuration, type and/or quantity (physical structure features configuration and street furniture components) along the different greenways and their trail segments. Such information and spatialization served as a thematic background map and also were combined with the social information (provided during the stationary observation and behavior mapping data collection).

The *greenway characteristics structural analysis* protocol check list was created and some variables spatialized in GIS to be able to characterize the greenways of this study. The protocol is illustrated in Appendix U and was created based in part on the literature review of this study (Flournoy, 1969; Little, 1990; Flink, 1993; Flink et al., 1993; Flink and Searns, 2001; Lusk 2002a; Lusk 2002b; Gobster, 1995; Gobster and Westphal, 2004; Gobster 2005; Flink, 2006; Hellmund and Simith, 2006; Simonds and Starke, 2006; Moore and Driver, 2005; Fábos et al. 2010; Moore et al, 2010 and Manning, 2011). The *greenway characteristics structural analysis* protocol can be utilized for different perspectives: every type of greenway (urban, suburban and/or rural); in different counties and cities, and in the greenway different stage process (inventory/site assessment, planning, design, mapping, implementation, building/construction, management, renewal/improvements, post-occupation analysis and police norms). Such a check-list protocol helps planners, designers, developers and communities to conduct their greenway characterization based on their physical environment assessment characteristics, with a precise documentation and description of the landscape (natural and man-build) and the greenways physical environment.

After the process of planning, designing and building the greenway environments (Appendix N), the greenway characteristics may impact the social interaction process within individual, community subgroup and group, physical and economic environment (Appendix C) and also affects the human senses based in their interaction values: touch aspects, olfaction aspects, visual aspects, audition aspects, taste aspects and kinesthetic aspects (Appendix C). Such characteristics will also directly influences the greenway perception, usage behavior and interactions which are constructed through the human senses: interacting dimensions, references, meanings, attitudes, preferences, perceptions, affective dimensions, cognitive dimensions, behavior, experiences, memories and values (Appendix G2).

The *greenway characteristics structural analysis* is composed of a set of different main-topics and their variables: *1) features composed by type of landscape features* (topography features configuration and water resources features configuration) and *type of physical*

structure features (physical structure features configuration and street furniture components)*; 2) structural network system composed by type of connection* (network type and trail type of connection by barrier) *and trail characteristics* (destination/point of attraction, trail circulation layout type, type of trail, trail pavement markings, type of activity node, activity node form, type of bridge, type of walking-board, walking-board form and walking-board components), illustrated with more detail in Appendix N.

The *greenway characteristics structural analysis* protocol checklists were utilized in this study to describe the characteristics of both the Black Creek Greenway and the White Oak Creek Greenway. The most prevalent characteristics of this protocol, which were found during the application of Method 2, were spatialized in GIS Arc Map 10. A thematic map of the greenway characteristics was created as background information of the greenways that will be combined with both parts of Method 3 (stationary observation and behavior mapping).

This thematic map contains the greenways structural network system features, such as greenway name; segment type; 2012 Master Plan hierarchy type; network type configuration; segment address; segment length in miles; segment layout type; segment trail surface; segment trail pavement markings; segment physical barrier with connection; segment destination configuration; connectivity to conventional parks type; conventional park name; conventional park area in US acres; greenway structural connection with other areas; activity node configuration; activity node surface type; activity node usage type and use related/associated with the activity node configuration. This information was organized into layers: structural network system and features to elaborate the map background for Methods 2, 3 and 4.

The greenway features were described and spatialized also in the Arc Map 10 attribute table and the thematic map according to the landscape features characteristics:

- *topography slope degree/slope terrain rating configuration, altimetry and topography elevation* (just descriptive and background)*;*
- *vegetation type*: heavily wood forest, lightly wood forest, open meadow, maintained grassy open field, freshwater forested/shrub wetland, lake wetland, fresh pond wetland and riparian vegetation – 30 foot wide) and their area in US acres (descriptive, analytical and background)*,*
- *natural water resources*: lakes, creeks, streams, wetlands and pound (just descriptive and background).

The physical structure features configurations were composed by the *physical structure configuration* and *street furniture components* arrangement with the information of their type and/or quantity (descriptive, analytical and background).

The main-components of the Method 2: Greenway Characteristics Audit observations protocol is illustrated in Appendix N. The 02 paved greenway trails with the heaviest volume of use sites were categorized by their structural network connection type (the ones that directly connect to conventional parks only, the ones that connect to neighborhoods only and the ones that connect to conventional parks and to different neighborhoods) and by their prevalent features (vegetation, water resources, physical structure features configuration and street furniture components). During the *stationary observation* approach, greenway features within 150 feet of the observation stations were described. During the *behavior mapping* approach, greenway locations and features along the entire trail were simultaneously described. The description and specialization of both greenways characteristics are presented in the results of this study method in Chapter 5: Results, item 5.2, 5.2.1, 5.2.2, 5.2.3 and 5.2.3.1.

4.5.2.3. Geographic Information System Mapping of the Structural Network System

A macro-scale descriptive analysis will be carried out of the greenway characteristics of the selected greenways as part of the whole structural network system of the Town of Cary Greenways, situating them among the other greenways. Global greenway environment characteristics will be categorized by their relation to the *structural network system*, into two main topics: 1) *type of connection:* network type, type of connection by barrier; destination/point of attraction, and 2) *trail characteristics:* trail circulation layout type, type of trail, trail pavement markings, type of activity node, activity node form, type of bridge, type of walking-board, walking-board form and walking-board components. This information will be mapped in GIS in Arc Map 10, according to the Appendix N: Protocol Method 2: Greenway Characteristics Audit: Structural Analysis of the Greenway Characteristics.

In terms of the destination/point of attraction variable, both greenways trails were considered connectors, the neighborhoods and the parks were considered major nodes, and the activity node areas, features that present social interaction were considered minor nodes. The GIS Mapping was conducted in two different moments. First, a greenway base map was elaborated for the application of Methods: 2, 3 and 4. Second, GIS thematic maps combining data from Method 2 with Method 3 and Method 4 were elaborated.

In order to carry out this analysis, the different types of conventional parks and the neighborhood type and locations were spatialized using information provided by the Department of Parks, Recreation and Resources of Cary. This information was organized into layers: structural network system, surrounding neighborhoods and buffers to elaborate the base-map for Methods 2, 3 and 4.

Additionally, using ArcMap 10, thematic maps and graphs (statistic programs and excel) were created with the outcomes of *behavior mapping* (Method 3) and *mapping exercise* (Method 4).

4.5.3. Method 3: Social Characteristics Audit: Behavior Mapping

Method 3, Social Characteristic Audit, was conducted with the *behavior mapping* and *stationary observation* approaches, as complementary techniques, to better understand social interactions and behaviors on recreational greenways. The *stationary observation* approach was conducted in addition to the *behavior mapping*, and was recorded and collected in the same season, following the same protocol and using the same variables as the behavior mapping. However, in this dissertation, the *stationary observation* technique will not be included, because of the lack of time. The complete protocol utilized in both observational methods is presented in Appendix O. The *stationary observation* data analysis and results with GIS and statistics will be compiled in future studies, as a continuity of this study.

4.5.3.1. Questions/Objectives, Sample, Procedure and Administration

For the research questions, please refer to Appendices E and F.
Objectives:

- to find out the nature of the interactions that occur on the recreational greenways with the heaviest volume of use;
- to identify the types of social network behaviors and interactions;
- to identify the types of users and actors, their patterns of use/types of activities and their physical activity levels on the recreational greenways;
- to identify the types of social bridges/ties and centralities that take place on recreational greenways;
- to recognize the greenway physical environment locations that present social interaction occurrence;
- To categorize the levels of interaction on the recreational greenways,
- To classify the catalysts of those interactions.

Sample, Procedure and Administration

In this study, the behavior mapping technique was used to explore and quantify individual's relationships to each other and to the physical environments within the recreational greenways. The greenway characteristics (Method 2: Greenway Characteristics Audit) were spatialized in advance with GIS (structural network system and features) and using a base-map matrix to record the location of each individual use across each of the greenway characteristics in a database. This method was used to understand behaviors of users and actors (patterns of use/types of activities) and how they interact on the greenway (occurrence of social ties/bridges), as well as how social contact is related with the greenway physical environments (features).

The behavior mapping consisted of observation checks along the whole trail length of each of the 4 segments on each greenway ("walking-observation" and "biking-observation") as a movable visual scan observation (moving back and forward). The data was recorded on a standard checklist protocol form and on maps of each segment. Data collected were the same as those of the stationary observation protocol, but with extra information about the locations of greenway social behavior and interactions along the entire trail. The *behavior mapping* observations were combined with GIS mapping to create a realistic database of the greenways' relationship between social behavior and interactions and greenway characteristics: structural network system and features. Descriptive statistics with the production of charts, tables and also the GIS maps were utilized to show the behavior mapping database results in each greenway and segment types.

The *behavior mapping* observational approach was conducted during fall 2012 (middle September to middle December), on 3 weekdays and on 3 weekend days. Each week one of the two paved greenways was observed on 3 weekdays and 3 weekend days. Each day 2 segments were observed. Each observation day was comprised of three different observation periods: one in the morning, one in the afternoon and another in the early evening. These observation periods were 2 hours in length (one hour for each segment), with a 30-minute of interval (break) to write down observations when necessary, to relocate to the second observation station and when necessary at the busiest times to set up the

measurement equipment (watch recorder) and photographic camera. The time frames were: Morning period: 8:00 am - 9:00 am; 30-minute interval; 9:30 am – 10:30am. Afternoon period: 12:00 pm - 1:00 pm; 30-minute interval; 1:30 pm – 2:30 pm. Early evening period: 4:00 pm - 5:00 pm; 30-minute interval; 5:30 pm – 6:30 pm. The scheme for the *behavior mapping* is illustrated in Table 3.

Table 3: Observational Approach, Check Count Time Block Period-Week.

Source: Pippi (2013)

Behavior Mapping Approach Check Count Time Block Period – Week 1, 2, 3 or 4					
Greenway Type	**Connection Type**	**Month Day**	**Week**	**Period of Day**	**Time**
Greenway 1: Black Creek Greenway **or** **Greenway 2: White Oak Creek Greenway**	Parks Only, or Neighborhood Only, or Parks and Neighborhoods	Fall 2012: September or October or November or December	Monday or Tuesday or Wednesday or Thursday or Friday (week day)	Morning	8:00 am-9:00 am (1 hour) 30 minutes (interval) 9:30 am-10:30 am (1 hour)
	Parks Only, or Neighborhood Only, or Parks and Neighborhoods			Afternoon	1:00 pm-2:00 pm (1 hour) 30 minutes (interval) 2:30 pm-3:30 pm (1 hour)
	Parks Only, or Neighborhood Only, or Parks and Neighborhoods			Evening	5:00 pm-6:00 pm (1 hour) 30 minutes (interval) 6:30 pm-7:30 pm (1 hour)
	Parks Only, or Neighborhood Only, or Parks and Neighborhoods	Fall 2012: September or October or November or December	Saturday or Sunday (Weekend)	Morning	8:00 am-9:00 am (1 hour) 30 minutes (interval) 9:30 am-10:30 am (1 hour)
	Parks Only, or Neighborhood Only, or Parks and Neighborhoods			Afternoon	1:00 pm-2:00 pm (1 hour) 30 minutes (interval) 2:30 pm-3:30 pm (1 hour)
	Parks Only, or Neighborhood Only, or Parks and Neighborhoods			Evening	5:00 pm-6:00 pm (1 hour) 30 minutes (interval) 6:30 pm-7:30 pm (1 hour)

The main components of the Observational Checklist Form are illustrated in Appendix O: Protocol Method 3: Social Characteristics Audit: Behavior Mapping or Stationary Observation.

The following temporal variable were also recorded: week (week days and weekends), period of day (morning, afternoon and evening), time (8:00 am-9:00 am, 9:30 am-10:30 am, 1:00 pm-2:00 pm, 2:30 pm-3:30 pm, 5:00 pm-6:00 pm and 6:30 pm-7:30 pm) and weather condition (weather, high temperature, low temperature, precipitation chance, wind and humidity). The Calendars of the behavior mapping data Collection of both greenways: Black Creek Greenway (BCGW) and White Oak Creek Greenway (WOCGW) are illustrated respectively bellow in tables 4 and 5.

Table 4: Calendar of the Behavior Mapping Data Collection Related to Weather Condition.

Source: Pippi (2013)

Calendar of the Behavior Mapping Data Collection Related to Weather Condition

Greenway Type	Date	Weather	High Temp.	Low Temp.	Precip. Chance	Wind	Humidity	Week day
BCGW	10/16/12	sunny	73 F	44 F	30%	NNW at 3 to 10 mph	57%	weekday
BCGW	10/23/12	sunny	80 F	46 F	0%	SW at 5 to 10 mph	57%	weekday
BCGW	10/18/12	partly sunny	79 F	48 F	3%	SSE at 10 to 20 mph	73%	weekday
BCGW	10/25/12	sunny	80 F	50 F	0%	ENE at 5 mph	61%	weekday
BCGW	10/20/12	sunny	72 F	46 F	0%	WNW at 5 to 10 mph	80%	weekend
BCGW	10/27/12	cloudy	66 F	62 F	70%	N at 20 to 33 mph	70%	weekend
BCGW	10/21/12	cloudy	68 F	41 F	20%	N at 20 to 30 mph	20%	weekend
BCGW	10/28/12	cloudy	64 F	51 F	20%	N at 20 to 30 mph	66%	weekend
BCGW	12/01/12	partly cloudy	65 F	34 F	0%	NE at 3 mph	70%	weekend
BCGW	12/02/12	partly cloudy	69 F	39 F	0%	WNW at 5 to 10 mph	80%	weekend
BCGW	12/03/12	partly cloudy	76 F	53 F	20%	SW at 5 to 10 mph	64%	weekday
BCGW	12/04/12	partly cloudy	71 F	49 F	20%	SW at 3 to 8 mph	60%	weekday

Table 5: Calendar of the Behavior Mapping Data Collection Related to Weather Condition.

Source: Pippi (2013)

Calendar of the Behavior Mapping Data Collection Related to Weather Condition

Greenway Type	Date	Weather	High Temp.	Low Temp.	Precip. Chance	Wind	Humidity	Week day
WOCGW	10/03/12	partly sunny	86 F	72 F	20%	N at 20 to 30 mph	70%	weekday
WOCGW	10/09/12	partly sunny	57 F	48 F	10%	N at 5 to 8 mph	98%	weekday
WOCGW	10/05/12	sunny	82 F	57 F	0%	NW at 5 mph	59%	weekday
WOCGW	10/11/12	sunny	68 F	46 F	0%	NNE at 5 to 10 mph	53%	weekday
WOCGW	10/06/12	cloudy	84 F	58 F	40%	NNE at 9 mph	83%	weekend
WOCGW	10/13/12	sunny	67 F	42 F	0%	ENE at 5 to 10 mph	52%	weekend
WOCGW	10/07/12	rainy	65 F	50 F	60%	NNE at 5 to 10 mph	73%	weekend
WOCGW	10/14/12	sunny	78 F	44 F	0%	ENE at 5 to 10 mph	52%	weekend
WOCGW	11/12/12	partly cloudy	75 F	39 F	20%	SSE at 10 to 15 mph	73%	weekday
WOCGW	11/16/12	partly sunny	55 F	39 F	0%	NNE at 8 mph	60%	weekday
WOCGW	11/17/12	partly sunny	56 F	44 F	20%	NNE at 12 to 21 mph	67%	weekend
WOCGW	11/1812	partly cloudy	56 F	45 F	40%	NNE at 10 to 20 mph	79%	weekend

The main components of the *behavior mapping* observation checklist form are illustrated in Appendix O. Information collected included locating the places/settings along the entire trail segment where users commonly go, what they do there, where they meet others, with whom they are interacting, how and where they interact, as well as verifying the density of users and actors in different locations (more users, actors and interactions).

The variables utilized for the *behavior mapping* observational approach in the Method 2: Social Characteristics Audit, were created based and inspired on the literature review (Moreno & Jennings, 1937; Warner and Lunt, 1941; Festinger et. al. 1950; Wirth 1964; Goffman, 1963; Goffman, 1967; Goffman, 1981; Hall, 1969; Rummel, 1976; Tajfel and Turner, 1979; Newman, 1980; Tajfel 1982; Putnam, 1993; Gobster, 1995; Gobster and Westphal, 2004; Gobster 2005; Cathcart et al., 1996; Knoke and Kuklinski, 1982; Putnam, 2000; Lusk, 2002a; Lusk, 2002b Carmona et al. 2003; Friedking 2004; Cantle, 2005; Litting and Griessler, 2005; Hilty et. al., 2006; Magnoly, 2006; Hellmund and Smith, 2006; Smith, 2006; Skidmore et al. 2006; Dempsey, 2006; Dempsey et al., 2011; Thwaites and Simkins, 2007; Shaftoe, 2008; Knowe and Yang, 2008; Landry, 2008; Wood and Landry, 2008; Cantle, 2008; Faust, 2009; Scott 2009; Wasserman and Faust, 2009; Carmona et al. 2010; Gehl, 2010; Gehl, 2011; Jacobs, 2011; Manning, 2011; Prell 2012; Ksadushin, 2012) and my general observations of Raleigh and Cary greenways during the years 2010 and 2011. During that time, I carried out two limited pilot test studies of this method: the first one on two of Raleigh's Greenways: *Lake Johnson Park and Greenway Area* and *Reedy Creek Greenway of NC Museum of Art*, and the second one on Three of Cary`s Greenways: *Black Creek Greenway, White Oak Creek Greenway* and *American Tobacco Trail*.

The protocol and variables that were utilized in the *behavior mapping* observational approach in Method 3: Social Characteristics Audit, are illustrated in Appendix O (Protocol Method 3: Social Characteristics Audit: Behavior Mapping or Stationary Observation, and Legend Pattern of Use/Type of Activities and Legend Complementary Behavior, respectively) and Appendix N (Structural Analysis of the Greenway Characteristics) which illustrates the check list used to describe the greenway characteristics and elect the best locations that fit the criteria of this study. These greenway characteristics were spatialized in advance with GIS.

The observational variables (people variables, behavior variables and social interaction variables) utilized in the *behavior mapping* technique are listed below and illustrated in more detail in Method 3: Social Characteristics Audit protocol form in the appendix O:

- ***user type (age):*** *Children (Ch) 00-12 years, Adolescents (As) 13-17 years, Adults (Ad) 18-65 years and Seniors (Sn) over 65 years;*
- ***gender:*** *Male (M) and Female (F);*
- ***pure actor type and pure actor size (pure actors, with inter relationship):*** *I (Individual), D (dyad), T (Triad), Sub-Groups (SB) and Groups (G);*
- ***pattern of use/type of activity:*** *see detailed description of the observed patterns (283 patterns in the behavior mapping and XX patterns in the stationary observations) in Appendix O;*
- ***complementary behavior:*** *pets, stretching, picnicking, sitting, drinking, exercising/yoga, see detailed description of the observed patterns in appendix O;*

- ***physical activity level:*** *see detailed description of the observed patterns in Appendix O - S (Sedentary), M (Moderate), V (Vigorous), SM, SV, MV, SS, MM, VV, SMV ;*
- ***tie/bridge (occurrence):*** *yes, no;*
- ***user tie/bridge (combined pattern of intra-relationship among different users' age categories):*** *observed patterns - ChCh, ChAs, ChAd, ChSn, AsAs, AsAd, AsSn, AdAd, AdSn, SnSn;*
- ***actor tie/bridge (combined pattern of intra-relationship among actors' categories):*** *II, ID, IT, IG, DD, DT, DG, TT, TG and GG ;*
- ***transformative actor type (with new combined pattern of inter-relationship):*** *I, D, T, G;*
- ***transformative actor size (with new combined pattern of inter-relationship):*** *2, 3, 4, more than 4;*
- ***tie/bridge gender types with:*** *observed patterns - MM, FF, MF, MF and FF, MF; MM, MF, FF; MF, FF and MM, and none;*
- ***pattern of interactions:*** *observed patterns, socializing (soc), kinship patterns of socialization (kps), cultural customs sharing (ccs), kps and soc and none;*
- ***interaction physical activity level:*** *S, M, V, SM, SV, MV, SS, MM, VV, SMV;*
- ***interaction types (level of interactions):*** *see detailed description of the observed arrangements (9 different types of interactions distributed by 3 patterns in each of the 3 different levels in the behavior mapping and 21 patterns of interactions, distributed by 3 types in the lowest level and 9 patterns in each of the other levels: moderate and highest levels, in the stationary observation) in Appendix O;*
- ***interaction catalysts:*** *DA, W, CH, CSC, GWF, GWSNS, TA, B, I, UE, DA and TA, GWF and DA, GWF and TA, GWF; and description of multi-catalyst*

observed categories, such as TA and CH; UE and DA; UE and GWF; UE, TA and CH; UE and DA; UE and GWF; W and CH;

- ***centrality occurrence:*** *yes, no,*
- ***central network with:*** *observed patterns - I with D and D, I with I and D, I with I and G, I with I and I, I with I and T, T with D and I, T with I and I, D with D and D, D with D and I, D with D and G, D with I and T, G with D and T and none.*

The 02 greenways and their segments (4 for each greenway) were compared with the statistical programs JMP 10 and SAS 9.3 (SAS Enterprise Miner Workstation 12.1) and with excel 10 to determine the total number of users, actors and interactions and to verify which received the greatest intensity of usage, behavior and interactions. The *Behavior Mapping* data were collected and stored in our personal computer, transcribed to an excel table and then transferred into the GIS program ArcMap10, for creation of maps, and also imported to SAS 9.3 (SAS Enterprise Miner Workstation 12.1) and JMP 10, to generate tables and graphs with the results for the quantitative analysis. The quantitative information was used in the Geographic Information System (GIS) program: ArcMap10 program to produce thematic maps. Also the data records (Method 2 separately, Method 3 separately and then Methods 2 and 3 combined) were merged into one large and complex data set to achieve general results of the variables' importance and validation with statistical program (SAS Enterprise Miner Workstation 12.1).

The *behavior mapping* approach consisted of moving observation checks of user behaviors and interactions that happened along the entire trail route(s) or segment(s), providing more detailed information regarding stationary experiences as

well as moving/kinesthetic experiences. The behavior mapping approach had an advantage over the *stationary observation* approach, because it provided a more complete picture of the greenway social usage along the entire trail segment (users' and actors' moments of pause at different greenway places/settings and features, and different behaviors and interactions during movement). The data were recorded with paper standard protocol sheets and hand-drawings on a base map of the greenway-trail.

The sample population included all greenway users (different ages, different genders and different actors) during the behavior mapping observational checks and mapping. I only observed the greenway users' and actors' behavior and interactions, as an unobtrusive observer. While they were able to see me, I did not make any contact with them (*Method 3).*

During the *behavior mapping* observational approach, I developed a stratified random sampling, for the moving observations, to ensure the representation of all types of actors and users. Each user/actor types was documented once, when they passed by me along the trail. In case the same user/actor changed their activity, all the activities were considered a sequential usage action and behavior. The physical activity levels were also recognized, in case they changed their level of activity, and this was also counted. In addition, if user/actor changed their activity type during the observation check and mapping procedure each of the activity types was counted. However, all of the information documented for one user/actor was recorded under the first and only documentation for that actor/individual. Only if that actor/individual was observed with (an) other user (s) and/or actors were they counted again, because they had changed the pattern of type and quantity of pure actors. In these cases, more than one record of the same individual or actor could be recorded.

4.5.3.2. Instrument

For Method 2, the following materials were utilized: Social Characteristics Audit Form on a sheet of paper size 8.5''x11'; two clip boards size A4; one clip board size A3 for the print base map (A3) annotation and drawings (behavior mapping only); a photographic camera and video camera to be able to record the data; for the photographs: a Canon EOS Digital Rebel XS/EOS 1000D camera with 10.10-megapixel image sensor; Base Map on a sheet of paper size 8.5''x11'; red pilot pens for recording the behavior according to the mapping code elements; and a bicycle with which I was able to move faster and scan the entire trail segment of each greenway according to the protocol.

4.5.4. Method 4: Standardized Survey Questionnaire

4.5.4.1. Questions/Objectives, Sample, Procedure and Administration

Research Questions:

- Appendices E and F.

Objectives:

- Describe how users and actors use the greenway (frequency and intensity);
- Identify the greenway social patterns of use in terms of behavior and interactions;
- Identify which of the greenway physical environments impact social interaction and contact (features and structural network system),
- Identify users/actors' opinions, perceptions, preferences, motivations and experiences in terms of the greenway characteristics,
- Identify users/actors' opinions, perceptions, preferences, motivations and experiences in terms of social aspects.

Sample, Procedure and Administration

The Method 4: Standardized Survey Questionnaire is a supplemental and complementary method of the previous main methods, the Method 2: Greenway Characteristics Audit and Method 3: Social Characteristics Audit. The survey consists of two components: the *survey questionnaire* and *mapping exercise*. These two different surveys and paired data sets were distributed to different number of samples (different people) and different neighborhoods (number of houses) as a convenience sample, according to their accessible and proximity location from the greenways trails.

Both the survey questionnaire and the mapping exercise approaches included a consent form, the survey and a thank-you note at the end (Appendixes W, X and X1). In the printed copy of the consent form which contained a brief introduction of myself, the explanation of the study and my personal/contact information. Survey participants were invited to contribute at the present moment in the standardized survey questionnaire or mapping exercise (method 4) and to provide later extra information to the main methods of this study (methods 2 and 3).

Mail Survey was utilized in order to reach a representative sample of greenway users, through regular mail to neighborhood homes located near the greenways. According to Leedy and Ormrod (2005, p. 147) “a mail survey is efficient for covering a large geographical area.”

In this study, the survey (drop front door/mail back survey) was conducted in neighborhoods that are located within the buffer distance (¼ mile) of the greenway trail as a conventional sample. Figures 18 and 19 illustrate the elected surrounding neighborhoods of the Black Creek Greenway and White Oak Creek Greenway respectively:

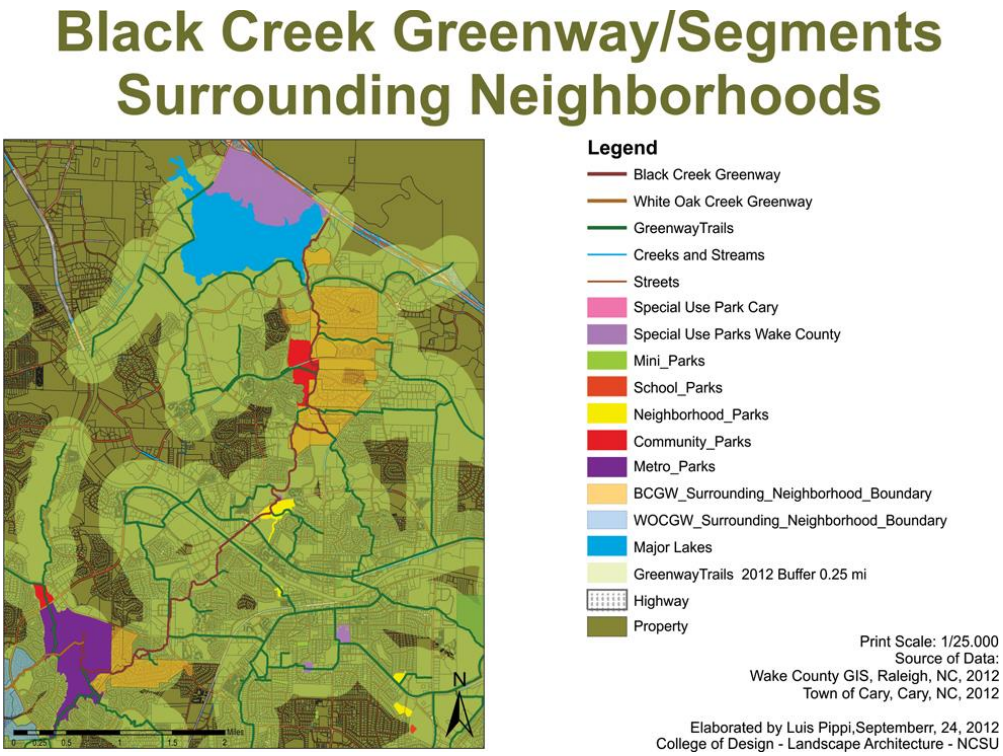

Figure 18: Black Creek Greenway Segments Surrounding Neighborhoods.

Source: Pippi (2013).

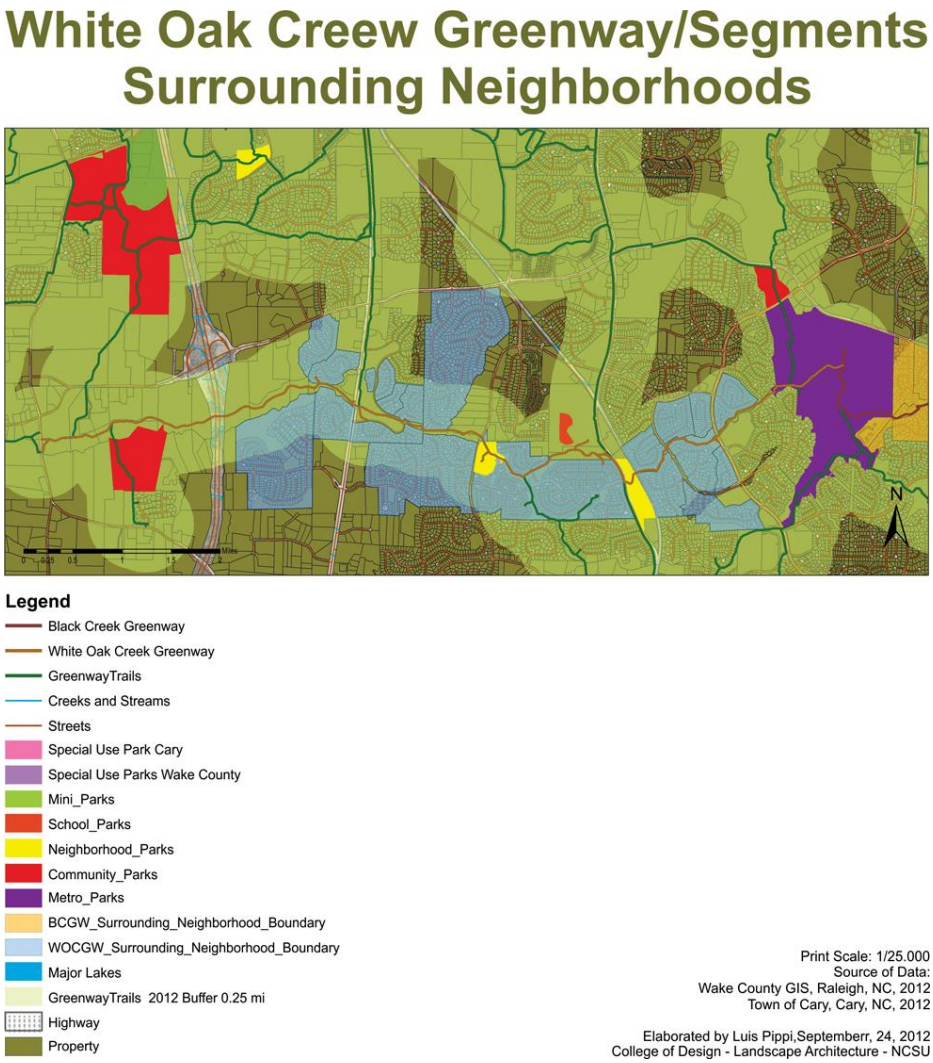

Figure 19: White Oak Creek Greenway Segments Surrounding Neighborhoods.
Source: Pippi (2013).

The mail survey was dropped in front of residents' houses with one copy of the consent form and the survey questionnaire questions or mapping exercise questions. There was no risk for survey respondents. I asked in the consent form for them to return their responses by mail (in this case I provided the envelope and stamp). A stamped envelope with my personal

address was provided to the respondents. The *Standardized Survey Questionnaire* was answered by respondents in their homes, using the printed survey forms. Envelopes and stamps were provided for them to mail back to me their answers. Then the received mail survey was transcribed to an online version of the survey questions, using Survey Monkey in order to retrieve the descriptive statistics information (quantitative responses) and to be able to compile the categorical information (qualitative responses). In order to increase response rate for the survey questionnaire and the mapping exercise instruments, a lottery for an iPod touch 8GB was sent to one drawn respondent from the greenways neighborhoods. All the names and addresses in the detachable area of the bottom of the consent form were destroyed after the lottery result.

Participation in the survey was anonymous. The respondents weren't identified by their names, email or home address. Users were identified only by the name of the neighborhood, the zip code, and some demographic information such as, gender and age. No further information about the participants was stored. The study data were collected during the Fall of 2012 and stored in a personal computer and external HD. The interviewers' identification information was removed after transcription of the survey answers to excel tables and/or survey monkey. The quantitative information of the mapping exercise was used in the GIS program: ArcMap10 and excel 10.

Participants of the *Standardized Survey Questionnaire* (*survey questionnaire and mapping exercise*) were the residents, recreational greenway users: adults (age 18-65) and seniors (over 65), in neighborhoods located within a quarter of a mile (¼ mile) from the greenway trail. The participants were selected by a cluster random sample as a conventional sample. According to Agresti and Finlay (2009, p. 23) "divide the population into a large number of clusters" such as surrounding greenway neighborhoods with different radius distances and "select a simple random sample of the clusters" to be surveyed, "rather than all of them".

The *Standardized Survey Questionnaire* (*survey questionnaire and mapping exercise*) instrument administration process was as follow: 1) each greenway type (BCGW segments:

S1, S2, S3 and S4 and WOCGW segments: S5, S6, S7 and S8) trails were buffered within a quarter of a mile (¼ mile), and all the neighborhoods that were inside or intercepted that boundary area was selected for the *Standardized Survey Questionnaire* distribution. 2) After those neighborhood geographic location area were selected from all the neighborhoods of Cary, their boundary areas with their characteristics were spatialized in GIS (thematic map and attribute table), according to the Town of Cary GIS and Wake County GIS – Raleigh databases. A total of 17 neighborhood areas were selected for the BCGW and 19 neighborhood areas were selected for the WOCGW. 3) A total of 800 *Standardized Survey Questionnaires* were distributed to each of the greenway neighborhoods, in which the residential addresses were randomly elected: 400 for the BCGW (200 survey questionnaire and 200 mapping exercise) and 400 for the WOCGW (200 survey questionnaire and 200 mapping exercise); Clusters of residences situated more close to the greenway trails received 200 *Standardized Survey Questionnaires* divided in equal parts in the neighborhoods located on both greenway trail sides (100 for neighborhoods to the left of the greenway trail which were divided into 25 surveys for each of the 4 segments of each greenway, and 100 for neighborhoods to the right of the greenway trail, which were also divided into 25 surveys for each of the 4 segments of each greenway). Subsequently, for each neighborhood, questionnaires were distributed to the residences with even street numbers and the mapping exercises were distributed to the residences with odd street numbers. The detailed information of the *Standardized Survey Questionnaire* distribution is illustrated in the table 6, below:

Table 6: Survey Questionnaire and Mapping Exercise Structural Distribution.

Source: Pippi (2013)

800	**400 BCGW**	**200 Mapping Exercise**	**100 (s1, s2, s3, s4)** 100%	**25 (s1)**	25%
				25 (s2)	25%
				25 (s3)	25%
				25 (s4)	25%
			100 (s1, s2, s3, s4) 100%	**25 (s1)**	25%
				25 (s2)	25%
				25 (s3)	25%
				25 (s4)	25%
		200 Survey Questionnaire	**100 (s1, s2, s3, s4)**	**25 (s1)**	25%
				25 (s2)	25%
				25 (s3)	25%
				25 (s4)	25%
			100 (s1, s2, s3, s4)	**25 (s1)**	25%
				25 (s2)	25%
				25 (s3)	25%
				25 (s4)	25%
	400 WOCGW	**200 Mapping Exercise**	**100 (s1, s2, s3, s4)**	**25 (s5)**	25%
				25 (s6)	25%
				25 (s7)	25%
				25 (s8)	25%
			100 (s1, s2, s3, s4)	**25 (s5)**	25%
				25 (s6)	25%
				25 (s7)	25%
				25 (s8)	25%
		200 Survey Questionnaire	**100 (s1, s2, s3, s4)**	**25 (s5)**	25%
				25 (s6)	25%
				25 (s7)	25%
				25 (s8)	25%
			100 (s1, s2, s3, s4)	**25 (s5)**	25%
				25 (s6)	25%
				25 (s7)	25%
				25 (s8)	25%

Of the total dropped at the front door (800, as a total from both greenways together), 91 questionnaire responses out of the 400 were collected (47 for the BCGW and 44 for the WOCGW) and 124 of the 400 *mapping exercise* were collected (50 for the BCGW and 74 for the WOCGW). As illustrated in table 7 below:

Table 7: Standardized Survey Questionnaires Distribution and Responses: Both Approaches and Both Greenways.
Source: Pippi (2013)

800 (total from both greenways)	**Mapping Exercise**	**400**	124	(50+74)
	Survey	**400**	91	(47+44)

Taken together: *survey questionnaire* (200) and *mapping exercise* (200), the BCGW total responses were N=97 (50 + 47) and the WOCGW total responses were N=118 (74 + 44). As illustrated in table 8 below:

Table 8: Standardized Survey Questionnaires Distribution and Responses for each Greenway with Both Approaches Combined.
Source: Pippi (2013)

Greenway	**Mapping Exercise + Survey** (400= 200 + 200)	**Total**
BCGW	50 + 47	**97**
WOCGW	74 + 44	**118**

For each greenway (BCGW or WOCGW) and considering each survey approach separately (*survey questionnaire* ***N=200*** *or mapping exercise* ***N=200***) responses were as follow: **1) BCGW N=47** for the *survey questionnaire* for a response rate of **23.50%** and **N=50** for the *mapping exercise* for a response rate of **25.00%**; **2) WOCGW N=44** for the *survey questionnaire* for a response rate of **22.00%** and **N=74** for the *mapping exercise* for a response rate of **37.00%**. As illustrated in tables 9 and 10 below:

Table 9: Standardized Survey Questionnaires Response Rate for the BCGW by each Survey Approach.

Source: Pippi (2013)

Greenway Percentage	Method Approach	Returned Answers Quantity		
BCGW	**Mapping Exercise**	50		25%
		51*	1 No*	25.5%
	Survey	47		23.5%
		50*	3 No*	25%

Table 10: Standardized Survey Questionnaires Response Rate for the WOCGW by each Survey Approach.

Source: Pippi (2013)

Greenway Percentage	Method Approach	Returned Answers Quantity	
WOCGW	**Mapping Exercise**	74	37%
	Survey	44	22%

Survey Questionnaire:

The survey provided information about users' relationship with the greenway: experiences, motivations, interactions, perceptions, attitudes, behavior and greenway characteristic preferences. The survey consisted of a combination of open-ended and multiple choice questions, as illustrated in Appendix Q. Topics covered by the *Survey Questionnaire* are displayed in table 11 below:

Table 11: Topics Covered in Standardized Survey Questionnaire.

Source: Pippi (2013)

Topics Covered in Standardized Survey Questionnaire
Neighborhood Location Proximity of their neighborhood to the greenway (name and zip code area)
Socio-Demographic Information Age, gender and level of education
Geographic Location User origins (city, state, county)
Reasons of Greenway Use General explanation of intentions and motivations
Nature and Frequency of Greenway Use Distinguish between visits by time (year, month, week; hour); frequency and duration of stay
Patterns of Use/Type of Activities in Which Users Engage in the Greenway Preferable activities, frequency and exchange
Type of Interaction in the Greenway Who they come with, meet and interact with, by type of actor and number
Nature and Frequency of Greenway Interactions Frequency and duration of interactions
Greenway as an Opportunistic Place/Environment for Socialization User opinions and preferences
Greenway Potential Opportunities Utilization
Greenway Social Benefits User opinion of social benefits
Greenway Attributes User opinion about positive and negative characteristics
Aspects of Socialization Related to the Greenway Characteristics User opinion about the greenway physical environments that encourage social interaction
Greenway Memorable Moments User memories about their experience with the greenway physical environments and/or people
Greenway Places for Socialization Location of meeting places

Fourteen close-ended questions and 08 open-ended questions were selected, for a total of 22 questions. The Standardized Survey is attached in Appendix Q. Greenway Users Survey.

Completion of the survey was estimated to take around 10-20 minutes. After the surveys were completed and returned, they were transcribed (excel files) and stored on a personal laptop. Once the transcription has been made, the returning surveys questionnaires were erased, without any risk to respondents.

Mapping Exercise:

In the mapping exercise, the respondents used the provided removable color coding labels (stickers with different colors: red, yellow, green and blue; four labels for each color) to indicate on a print colorful base-map (size A4, with the spatialization of the greenway trail, parks and greenway boundary, open space, major lakes, creeks and streams, streets and highway) which are the greenway places they use (preferred greenway features and/or destinations points), where are the places in which they start and end on the greenway trail, and where are located the points in which they meet and interact with other users and actors. They also indicated their neighborhood and zip code. This information was used to indicate points of destination and social network linkages and points of the greenway features that promote meetings and interactions. This information was compiled in the Geographic Information System (GIS) social network thematic maps. The indicated features (landscape features and physical structure features) and destination points and/or activity node areas (major and secondary points) were elected as important greenway places indicators for our analysis and spatialization, as illustrated in Appendix S. This information was also combined in GIS with Method 3: Greenway Characteristics Audit, for the descriptive characterization of greenway structural network system and/or features.

Topics that covered by the *Greenway Standardized Mapping Exercise* are shown below in Table 12:

Table 12: Topics Covered in Standardized Mapping Exercise.

Source: Pippi (2013)

Topics Covered in Standardized Mapping Exercise
Neighborhood Location Proximity of their neighborhood to the greenway (name and zip code area)
Start Location(s) on the Greenway Trail Most frequent location users' start(s) on the greenway trail
End Location(s) on the Greenway Trail Most frequent location users' end(s) on the greenway trail
Destination Location(s) on the Greenway Trail Most frequent location(s) users' consider as a destination(s) on the greenway trail and it/their name
Meeting Location(s) on the Greenway Trail Most frequent location(s) users' often meet(s) with people (know/unknown) on the greenway trail
Interacting Location(s) on the Greenway Trail Most frequent location(s) users' often interact (s) with people (know/unknown) on the greenway trail

Appendix S: Consent Form and Mapping Exercise BCGW and WOCGW.

Completion of the *mapping exercise* survey was estimated to take around 1-2 minutes. After the mapping exercises were completed, they were transcribed (excel files and GIS) and stored on a personal laptop. Once the transcription was made, the *mapping exercise* was deleted.

The responses with the color coding labels (stickers with different colors: red, yellow, green and blue) were transcribed to GIS thematic map. However, some color coding labels were located outside of the greenway trail segments to other areas. All the responses were quantified for each of the color coding labels topics per greenway. The different buffers from the greenway trail (0.25 miles, 1 mile, 5 miles and more than 5 miles) were spatialized to see how far the places from the greenway trail were located (distance information). For each greenway, the number of color coding labels located inside of the greenway trail segments

was quantified with the number of mentions and rate per greenway segments. The number of times mentioned for some areas/places outside of the greenway segments was also counted. Tables were created for the quantification of places outside of the base map.

4.5.4.2. Instrument

Survey Questionnaire:

Cover letter/consent form and survey questions printed on both sides of a single sheet of paper size 8.5''x11''; envelopes and mail-stamps for return postage.

Mapping exercise:

Cover letter/consent form printed on a sheet of paper size 8.5''x11,'' Orthophoto Color Base Map printed on a sheet of paper size 8.5''x11',' Avery Removable Color Coding Labels (stickers), 0.25 Inches, assorted, round, pack of 768 with different four different colors (red, yellow, green and blue) **;** envelopes and mail-stamps for return postage.

CHAPTER 5: RESULTS AND DISCUSSION

This chapter discusses the quantitative and qualitative findings from each method of this study separately: interview; greenway characteristics audit; social characteristics audit – behavior mapping, and standardized survey questionnaire and mapping exercise.

5.1. Findings from the Interview

The greenway expert provided imperative information about the future connection of the Black Creek Greenway with White Oak Creek Greenway and their plan to fill the gaps in that greenway system, especially by providing the future direct-connection of the last segment of the White Oak Creek Greenway with American Tobacco Trail that will implement the most important arterial greenway of Cary. Both greenways and also the American Tobacco Trail were also mentioned as the ones that received the highest volume of usage in terms of leisure-recreational activities. The interview provided an understanding about the importance of the greenways for the Cary community. It also provided an idea about Cary's greenway system planning which was described in its different process stages for the next 20 and 25 years in terms of: design, implementation and management. There was a strong reference to the importance of the structural network in its general capacity to link places, and more specifically to mitigate greenways gaps (connecting and expanding the greenway trails), and to connect conventional parks, schools, neighborhoods, communities, commercial areas, downtown and at a higher scale other Counties as a regional greenway network.

The recreational and transportational functions were more strongly emphasized than the social function. Nevertheless, the social nature of greenway functions is clearly indirectly related to both the recreational and transportational features: "*I say that the main function is a dual function: one is for people to be able to go out and get exercise, recreate, get out in*

nature and observe nature. And the second will be to, is a mode of transportation. So all of our trail system right now, we are trying to connect to the old trail system into a large network in which people can get to a bike and go to schools, go to groceries stores, to shopping centers, to church, etc."

The interview also provided information about the physical structural features, such as the implementation and management of easements. One important finding was that the city of Cary currently is looking to improve features, such as information signs, walking boards and bridges, the greenway identity (with the use of public art) and quality and to provide safe crossing areas over main-roads and rail roads or under-passes. In summary, the development of the structural network system by it connection to different places and also the improvements of the greenway features can influence and impacts on the type and level of social interaction and behaviors.

5.2. Findings from Greenway Characteristic Audit

This section presents the results from the on-site observations of the greenway characteristics and used several approaches (tables and excel charts, thematic maps with GIS: Arc Map 10 and tables and diagrams with SAS Enterprise Miner Workstation 12.1: Data Mining and Decision Tree Analysis) to describe the characteristics of the greenways physical environments for each greenway: Black Creek Greenway and White Oak Creek Greenway (general characteristics) and its segments (specific characteristics). The GIS data that supported and guided some of the spatializations and analysis of this study, were provided by different sources: Town of Cary Parks Recreation and Cultural Resources Department (2012); Wake County GIS (2012) and U.S. Fish and Wildlife Service - National Wetlands Inventory (2013). The description of greenway characteristics is followed by a general discussion and comparison of both greenways. Descriptive and inferential statistics are also presented.

The results presented in this chapter describe and/or spatialize the greenway characteristics: greenway structural network system (illustrated below in figure 20 and described in tables 13 and 14); greenway features (landscape features, illustrated below in figure 21 and physical structure features and street furniture components) of each greenway type and also in their segments, according to the *greenway characteristics structural analysis* protocol check list illustrated in Appendix U. The results of method 2 for the BCGW and the WOCGW will be presented next, followed by a comparison between the two types of greenways.

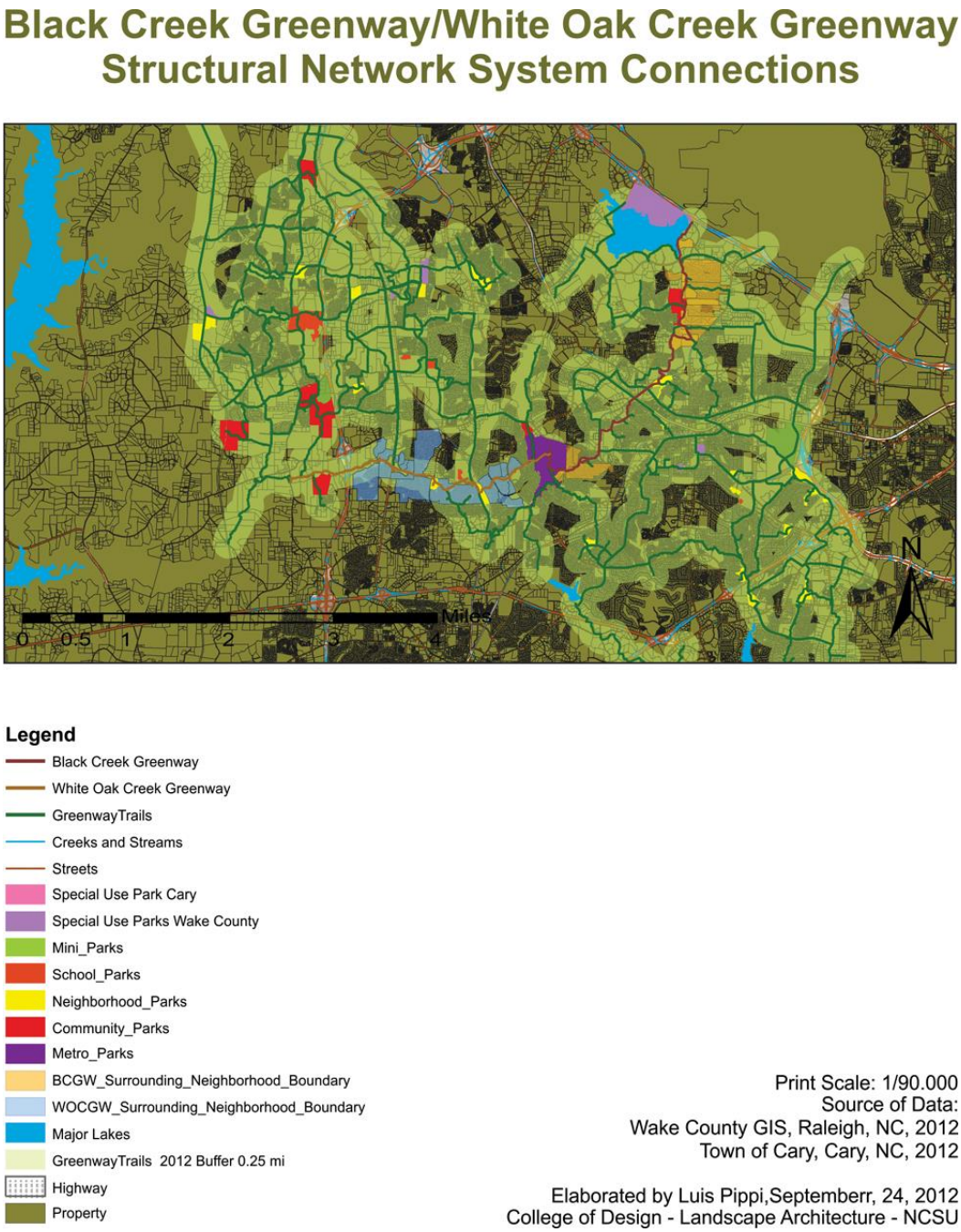

Figure 20: BCGW and WOCGW Structural Network System Connections.

Source: Pippi (2013)

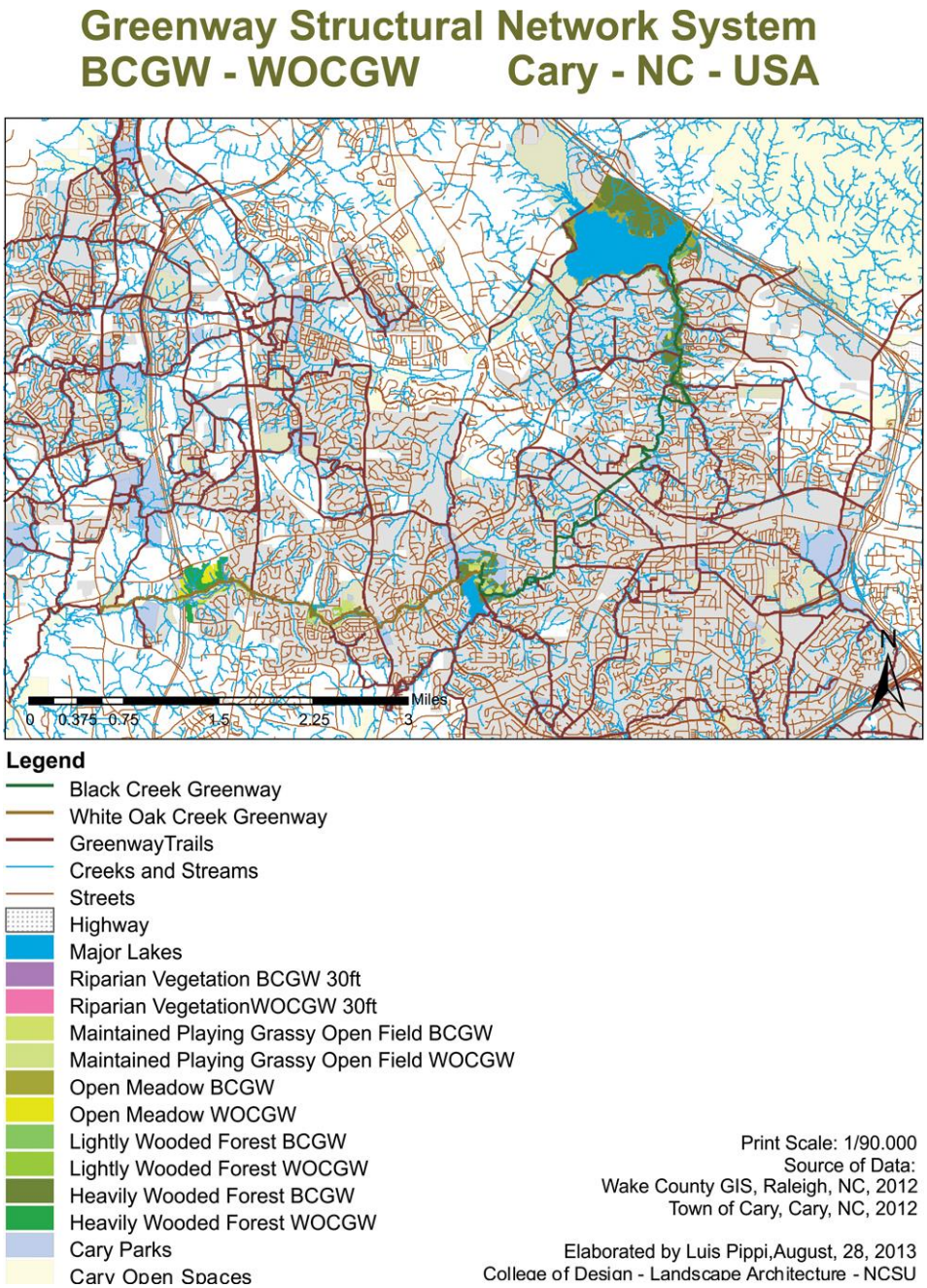

Figure 21: BCGW and WOCGW Landscape Features.

Source: Pippi (2013)

5.2.1. Black Creek Greenway Characteristics: General and Specific Findings for Social Network Interactions and Behaviors Observations

The greenway structural network systems absolutely affect the greenway usage by its users and actors, in terms of usage: leisure-recreation pursuits, alternative transportation and socialization. Pictures are illustrated in Appendix X.

Table 13 below describes the first process of greenway characterization in terms of the structural network system information in two circumstances: 1) to characterize the entire BCGW in a very broad way; 2) select the 4 segments for a more detailed analysis (description and spatialization). The information of the characteristics of each greenway segment were catalogued in the Arc Map 10 attribute table and then imported to an excel file. In yellow are the 4 segments of the BCGW which were utilized in the Method 2: Greenway Characteristic Audit analysis. The entire length of the BCGW is 7.40 miles, from Bond Park Boathouse to Old Reedy Creek Road. Segment 1 was composed of an area of heavy dense neighborhood apartments, some commercial offices and two major parks: the Lake Crabtree County Park which is directly connected to the greenway (s1) and William B. Umstead State Park that is located surrounding the BCGW s1; both are under the Wake County jurisdiction; the other segments of the BCGW (s2, s3 and s4) transverse various neighborhoods with moderate density.

Table 13: BCGW Structural Network Main Characteristics Classification.

Source: Pippi (2013)

Greenway Trail Name	Segments Identification	Greenway Destination/Point of Attraction (Configuration on Meso - Micro Scale)	Greenway Structural Network Connection (Destination - Point of Attractions)
Black Creek Greenway 7.40 miles	**Segment A (s1), 0.77 miles** 40 – Weston Pkwy	Neighborhood and "Park"	Neighborhood "Lake Crabtree County Park" (Special Use Park)
	Segment B (s2), 0.75 miles Weston Pkwy – NW Cary Pkwy	Neighborhood and Park	Neighborhoods North Cary Park (Community Park)
	Segment C (s3), 0.86 miles NW Cary Pkwy – W. Dynasty Dr.	Neighborhood and Park	Neighborhoods North Cary Park (Community Park)
	Segment D, 1.36 miles W. Dynasty Dr. – NW Maynard Rd.	Neighborhood	Neighborhoods
	Segment E, 0.36 miles NW Maynard Rd. – Chapel Hill Rd.	Neighborhood and Park	Neighborhoods Robert V. Godbold Park (Neighborhood Park)
	Segment F, 1.63 miles Chapel Hill Rd. – SW Maynard Rd.	Neighborhood	Neighborhoods
	Segment G, 0.80 miles SW Maynard Rd. – Castalia Dr. (loop trail around pound "private greenway" and other part under construction)	Neighborhood	Neighborhoods
	Segment H (s4), 0.87 miles Castalia Dr. – Bond Park Boathouse	Neighborhood and Park	Neighborhoods Fred G. Bond Metro (Metro Park)

The total length of all four segments was 3.25 miles. Below in figure 22, the length of each segment is illustrated in miles. Segments 4 and 3 were longer, with almost the same mileage, of 0.87 miles and 0.86 miles, respectively. Segment 1 was 0.77 miles and finally, segment 2, the smallest segment, was 0.75 miles.

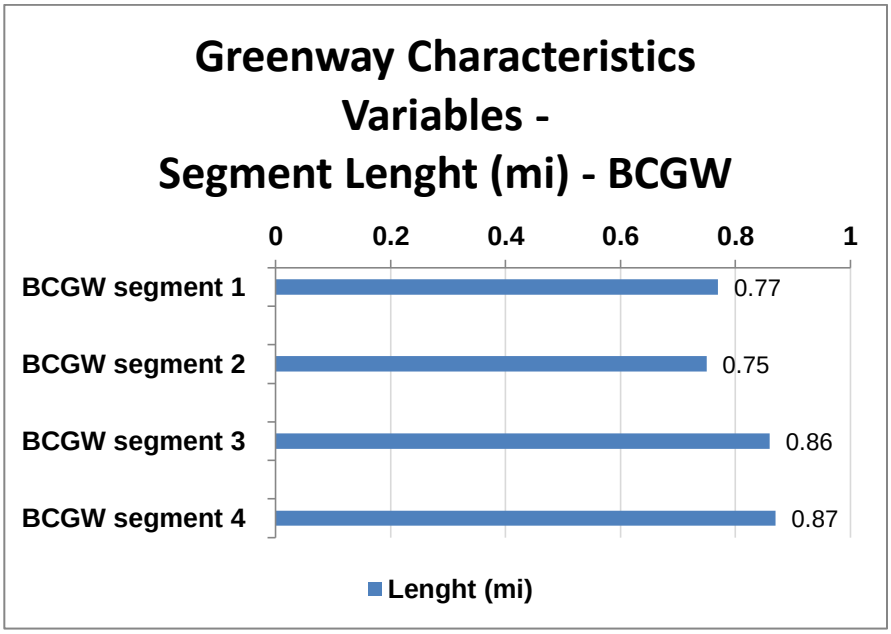

Figure 22: Chart Associating the Segment Length per Segment Type of the BCGW.
Source: Pippi (2013)

In terms of *segment layout type*, the 4 segments of the BCGW (s1, s2, s3 and s4) are similar in their linearity (linear) and sinuosity (sinuous/organic). Segment 2 (s2) presented a small portion that conformed to a zigzag/erratic form situated by the creek branching area, the riparian vegetation with the heavily wood area of the landscape features. The segments' *trail surface* is predominantly asphalt, with only segment 4 (s4), which penetrates Bond Park, presenting different surfaces: asphalt, brick and concrete. This segment (s4), also in terms of *trail pavement markings*, presents information about the trail lanes, trail direction and greenway name.

In terms of *physical barrier with connection*, segments 1 and 2 (s1 and s2) provide a connection only by the trail. The other segments (s3 and s4) promote the connection with the other portions of the BCGW by pedestrian/bikers cross walks. *Destination configuration*

for all four segments (s1, s2, s3 and s4) is presented by a direct connection with neighborhoods and conventional parks. In terms of the *connectivity of those segments with the conventional park types*, the segment 1 (s1) is directly connected to a Special Use Park (the Lake Crabtree County Park, area = 242.97 US acres), the segments 2 and 3 (s2 and s3) are directly connected to a Community Park (North Cary Park, total area = 60.83 US acres, segment 2 area = 28.56 US acres and segment 3 area = 32.27 US acres), finally the segment 4 (s4) is connected to a Metro Park (Fred G. Bond Metro Park, area = 274.99 US acres). In terms of the *structural connection with other areas*, segment 1 (s1) only connects directly to other trails, and the other segments (s2, s3 and s4) directly connects to other trails and other greenways.

The previous analysis of the structural network characteristics of the BCGW is about the categorization of it activity node areas. The *activity node configuration*s differ among the BCGW segments: segment 1 (s1) is made up of multiple activity nodes, including major (kiosk/gazebo, seating areas, information, trash can receptacle and drinking water fountains) and minor ones that are distributed in a sequential and disjointed/offset way. Segment 2 (s2) presented multiple activity nodes with minor size (bridge and seating areas) that were dispersed sequentially and as an expanded trail area. Segment 3 (s3) presented minor sizes and multiple activity nodes (seating areas) that were scattered in a sequential, alternate and disjointed/offset way and also as an expanded trail area. Segment 4 (s4) offered also multiple activity nodes, with major (node of distribution, connection and information) and minor size activity nodes (exercise stations and seating areas) that were uniquely distributed by intersection, and also sequentially and as an expanded trail. The four segments (s1, s2, s3 and s4) differed in terms of the *activity node surface type*: Segment 1 (s1) present a surface of asphalt, concrete and wood; segment 2 (s2) activity nodes surfaces are constituted of natural grass and concrete; segment 3 (s3) is natural grass and gravel surface basalt, and segment 4 (s4) presented a concrete, brick, asphalt and natural grass surfaces.

In terms of *activity node usage type*, segments 1 and 4 (s1 and s4) presented simple and complex activity nodes that respectively afford secluded experiences and/or secluded and socialization experiences. The 4 segments of the BCGW differed in terms of the *use related/associated to the activity node configuration*: segment 1 and 4 (s1 and s4) presented a greater range of different uses related/associated to their activity nodes if compared with the other segments. The segment 1 (s1) is configured by one multi-use node composed of a seating area, kiosk/gazebo, water fountain, trash cans, and information signs and other portions of small activity nodes composed of seating areas to contemplate the scenic view of the Lake Crabtree and its different vegetation features and also picnic grass areas, during the maintenance of the open meadow vegetation. This node as well as the others present uses related/associated with the landscape and contemplation, the presence of scenic view areas, information with signs and buffers for wildlife. The segment 4 (s4) presents more richness in terms of multi-use and single use activity nodes with the presence of exercise stations, picnic tables, trash cans, contemplation and observation of the landscape and people, scenic view areas, information (panel, signs and trail pavement marking signs) and wildlife buffers. The segments 2 and 3 (s2 and s3) presented less use related/associated to their activity node configuration, the segment 2 (s2) is composed of seating areas, trash cans, information signs and wildlife buffers. The segment 3 (s3) presents the same elements of the previous segment 2, except in terms of information, which is absent.

The greenway features: landscape features and physical structure features directly affect greenway usage by its users and actors. Such greenway characteristics are the fundamental attractors for people's recreational and leisure pursuits. They also directly affect the interaction of its users and actors with the greenway physical environment settings, and also affect the social interaction and behaviors.

Figure 23 provides a summary map of each of the BCGW four segments with the characterization of the physical structural features and street furniture in terms of the physical structural features configuration.

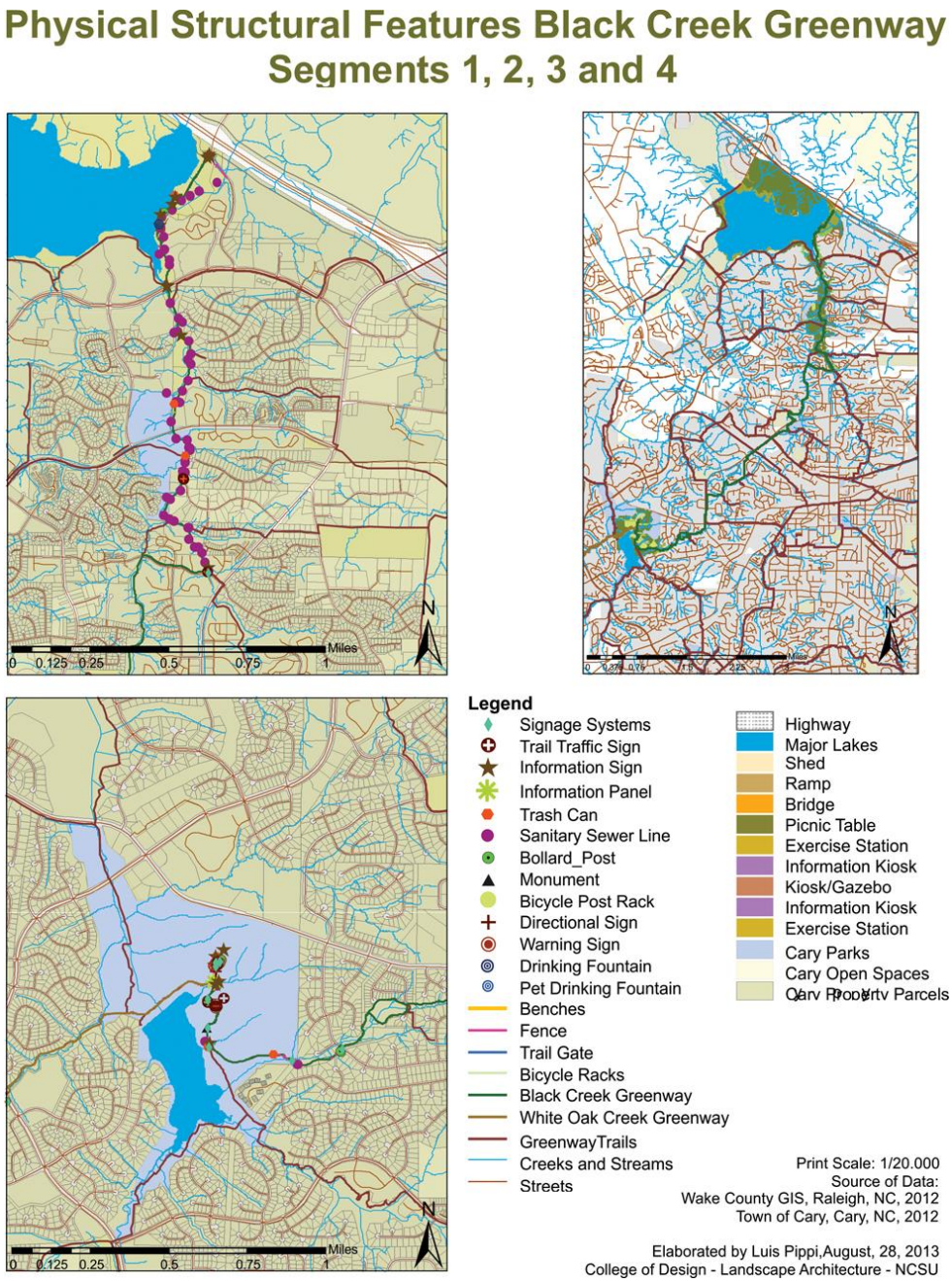

Figure 23: Map of the Physical Structural Features per Segment of the BCGW.

Source: Pippi (2013)

The different types of the physical structure features and street furniture and their quantities are presented below:

- Segment 1 (s1) presented a total of 5 *physical structure features types*: bridges (3), kiosk/gazebo (1), ramps (1), fences (7) and sanitary sewer lines (13). It presented also a total of 7 *street furniture types*, such as benches (6), bollard posts (1), drinking fountain (1), pet drinking fountain (1), trash cans (5), signage system (1), and information signs (10).

- Segment 2 (2) presented a total of 2 *physical structure features types*: bridges (3) and sanitary sewer lines (16). It presented also a total of 2 *street furniture types*, such as benches (5) and trash cans (1).

- Segment 3 (s3) presented a total of 5 *physical structure feature types*: bridges (5), kiosk/gazebo (1), ramps (1), fences (5) and sanitary sewer lines (26). It presented also a total of 10 *street furniture types*: benches (2), bollard posts (1), drinking fountain (1), pet drinking fountain (1), trash cans (3), bollard posts (3), signage system (1), trail traffic signs (3), information sign (1) and trail gates (3).

- Segment 4 (s4) presented a total of 5 *physical structure features types*: picnic tables (9), exercise station (2), information kiosk/gazebo (1), sheds (1) and sanitary sewer lines (4). It present also total of 12 *street furniture types*, such as benches (2), bollard posts (27), trash cans (6), signage system (8), trail traffic signs (6), warning signs (6), directional sign (1), information signs (6), information panel (1), monument (1), trail gates (4) and lighting posts (1).

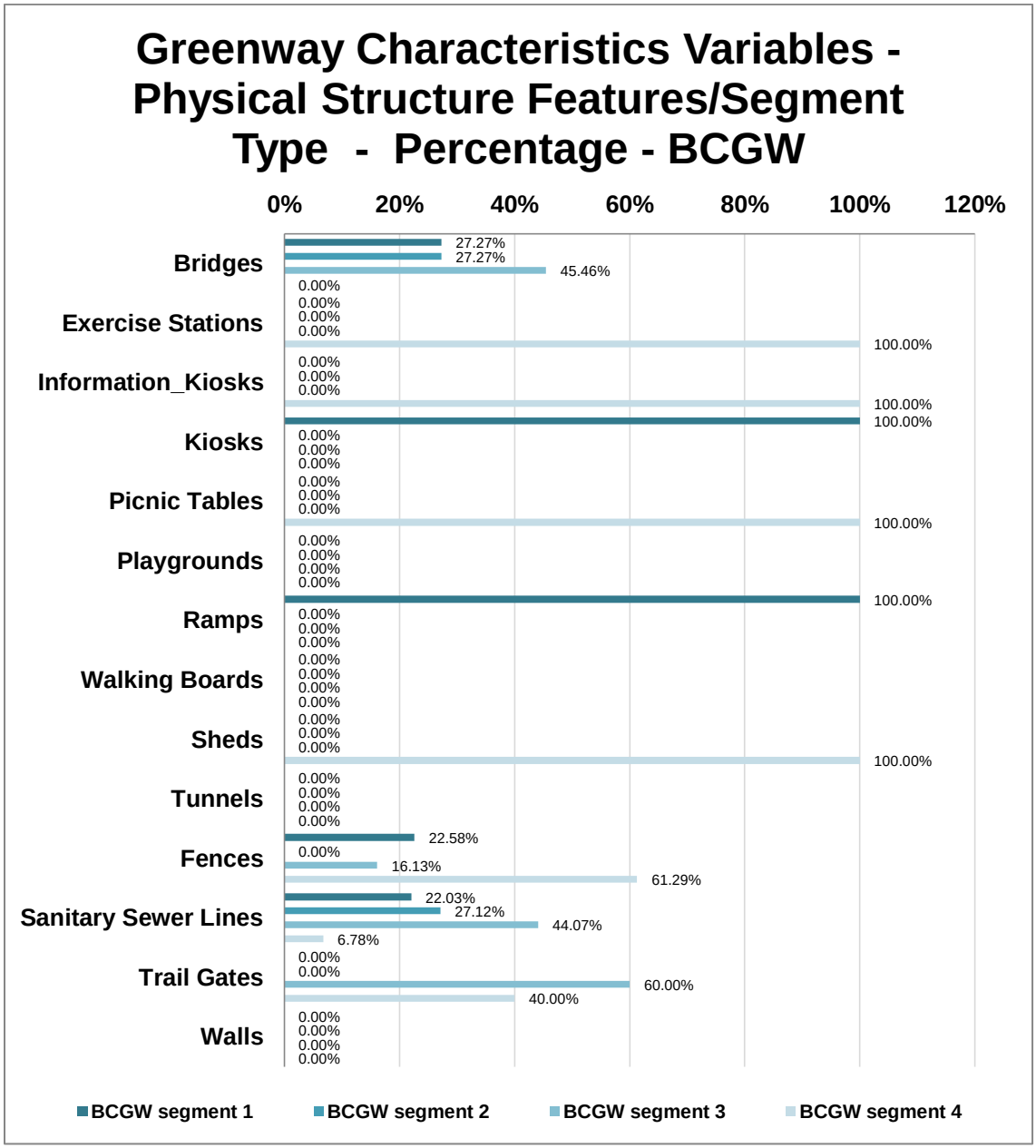

Figure 24: Physical Structure Feature Configuration Types per Segment of the BCGW.

Source: Pippi (2013)

The chart in figure 24 above illustrates the percentage of each of the physical structure features in each of the BCGW segments. Bridges, information kiosks, picnic tables and sheds were encountered only in segment 4 (s4) with 100% for each of these categories. Kiosks and ramps were only found in segment 3 (s3) with 100% for each. Fences were more prevalent in segment 4 (s4) with 61.29%, followed by segment 1 (s1) with 22.58%, segment 3 (s3) with 16.13% and absent in segment 2 (s2). Sanitary sewer lines were more abundant in segment 3 (s3) with 44.07%, followed by segment 2 (s2) with 27.12%, segment 1 (s1) with 22.03% and segment 4 (s4) with 6.78%. Trail gates were more prevalent in segment 3 (s3) with 60%, followed by segment 4 with 40%, and nonexistent in segments 1 and 2 (s1 and s2). Playgrounds, walking boards and tunnels were not observed in any of the BCGW segments, with 0%.

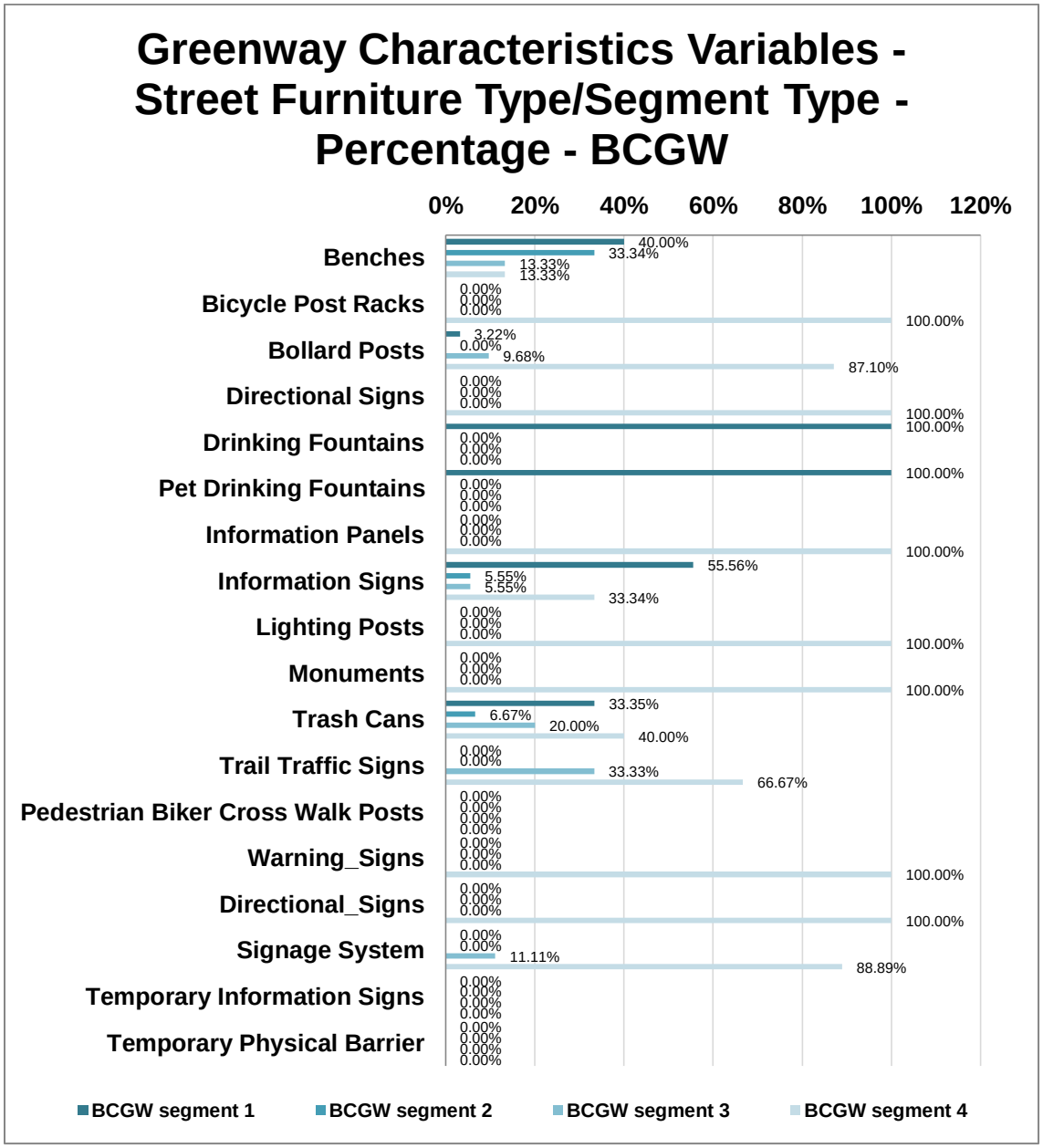

Figure 25: Street Furniture Components Types per Segment of the BCGW.

Source: Pippi (2013)

The chart in figure 25 above illustrates the percentage of each of the street furniture components in each of the BCGW segments. Bicycle post racks, direction signs, information panels, lighting posts, monuments, warning signs and direction signs were only found in segment 4 (s4) with 100% for each of these categories. Drinking fountains and pet drinking fountain were only observed in segment 1 (s1) with 100% for each of these categories. Benches were found in all the four segments, and were more prevalent in segment 1 (s1) with 40%, followed by segment 2 (s2) with 33% and segments 3 and 4 (s3 and s4) with 13% each. Bollard posts were more prevalent in segment 4 (4) with 87.10%, followed by segment 3 (s3) with 9.68% and segment 1 (s1) with 3.22%. Information signs were more abundant in segment 1 (s1) with 55.56%, followed by segment 4 (s4) with 33.33% and segments 2 and 3 (s2 and s3) with 5.55%. Trash cans were observed more in segment 4 (s4) with 40.00%, followed by segment 1 (s1) with 33.33%, segment 3 (s3) with 20% and segment 2 (s2) with 6.67%. Signage systems were only observed in segment 4 (s4) with 88.89% and segment 3 (s3) with 11.11%. Pedestrian/biker cross walk, temporary information signs and temporary physical barrier were not encountered in any of the BCGW segments.

Figure 26 provides a summary map of each of the BCGW four segments with the characterization of the landscape features in terms of the vegetation configuration: vegetation type coverage (area in US acres and percentage of each category) in each greenway segment boundary and also their surrounding areas, which may affect user/actor usage, interaction, behavior and perception of the greenway environments. The chart in figure 27 associates the total area of vegetation type per segment type of the BCGW. The second chart compares the percentage of each vegetation types within each of the four segments of the BCGW.

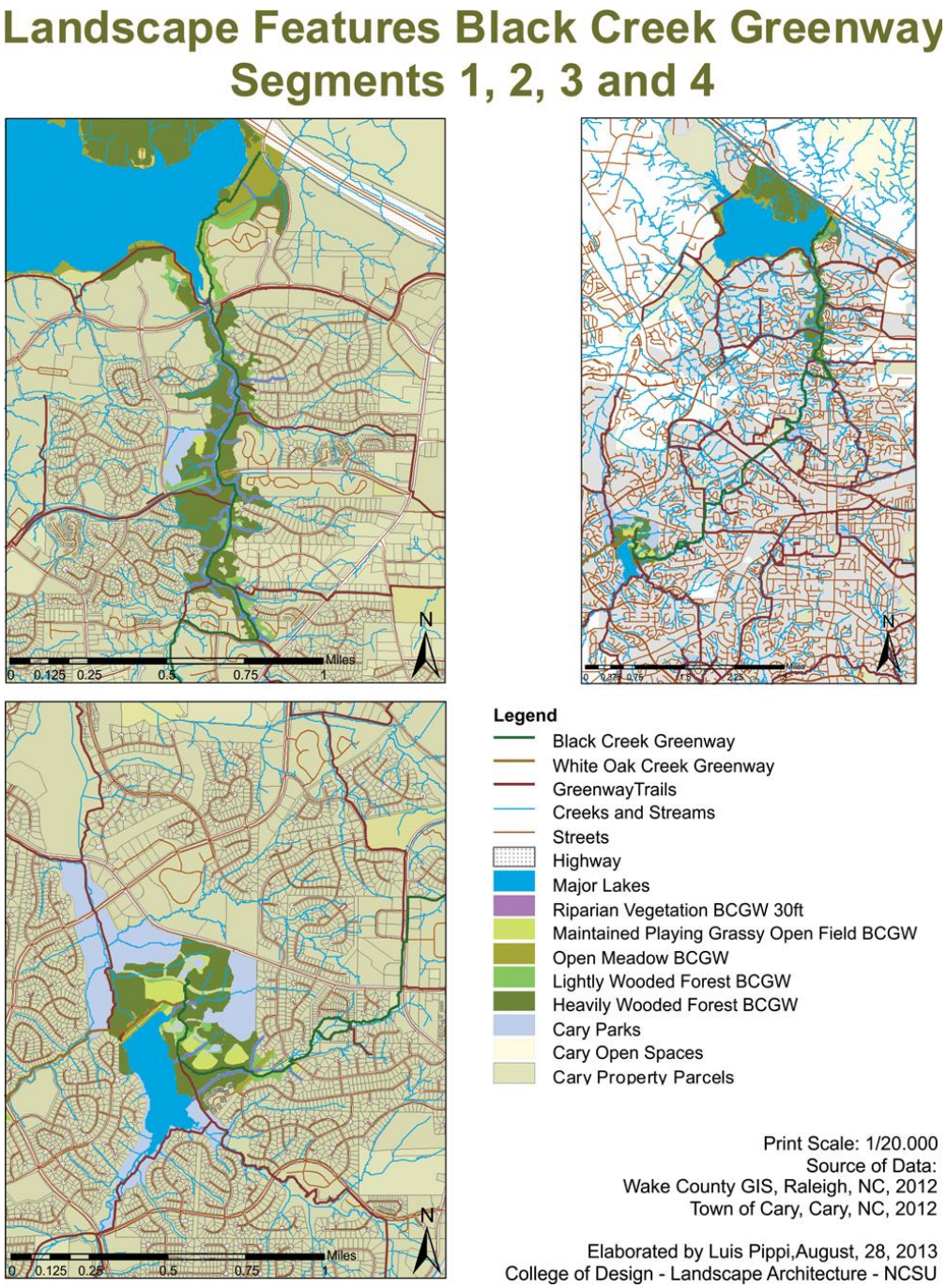

Figure 26: Map of the Vegetation Type per Segment of the BCGW.

Source: Pippi (2013)

The charts in figures 27 and 28 indicate respectively the total area, in acres, and the percentage of each vegetation type per each of the BCGW segments. Segment 1 (s1) presented greater incidence of three vegetation types if compared to the other segments: the heavily wooded forest (A= 258.48 ac. and 58.15% of coverage), freshwater forested/shrub wetland (A=405.47ac. and 99.56% of coverage) and open meadow (A=78.32 ac. and 89.84% of coverage). Lightly wooded forest type was encountered more often in segments 1 (s1) (A=13.47 ac. and 34.62%) and segment 3 (s3) (A=9.83 ac. and 25.26%). Lake wetland (A=34.21 ac. and 100.00% of coverage) was only found in segment 4 (s4). Maintained grassy open field (A=23.93 ac. and 100.00% of coverage) was more prevalent in segment 4 (s4) if compared to the other segments. Riparian vegetation with 30 foot wide type was encountered more often in segments 2 (s2) with (A=13.59 ac. and 36.80%) and segment 3 (s3) with (A=14.08 ac. and 38.13%). Fresh Pond wetland was absent.

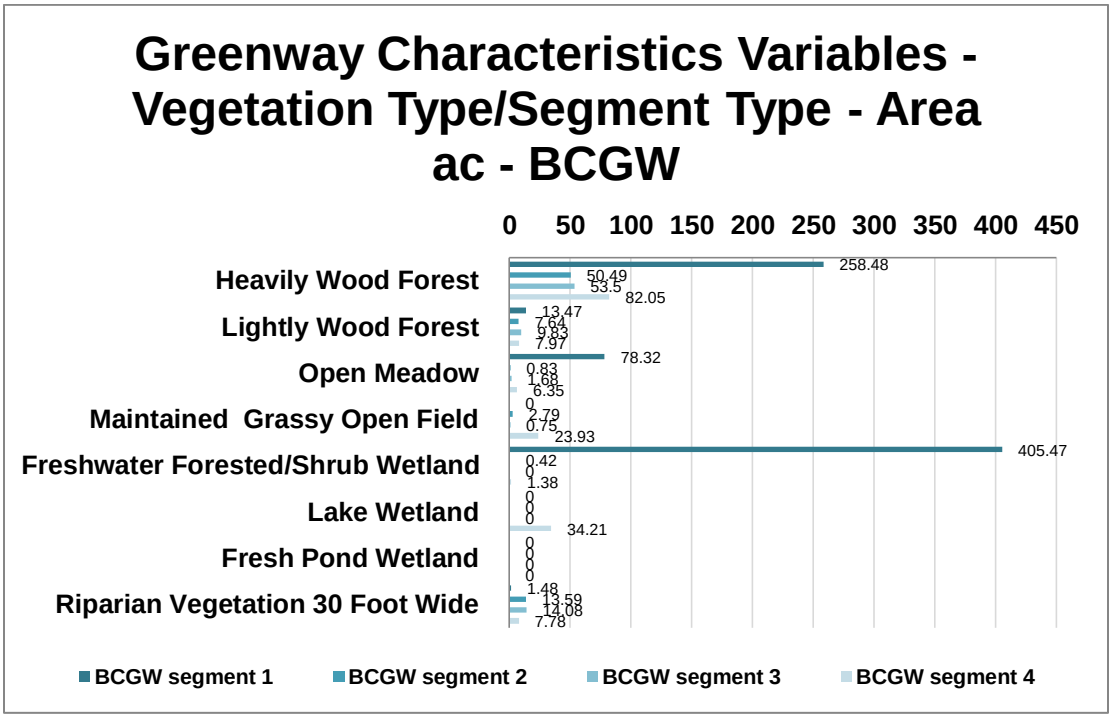

Figure 27: Total Area of Vegetation Type per Segment of the BCGW.

Source: Pippi (2013)

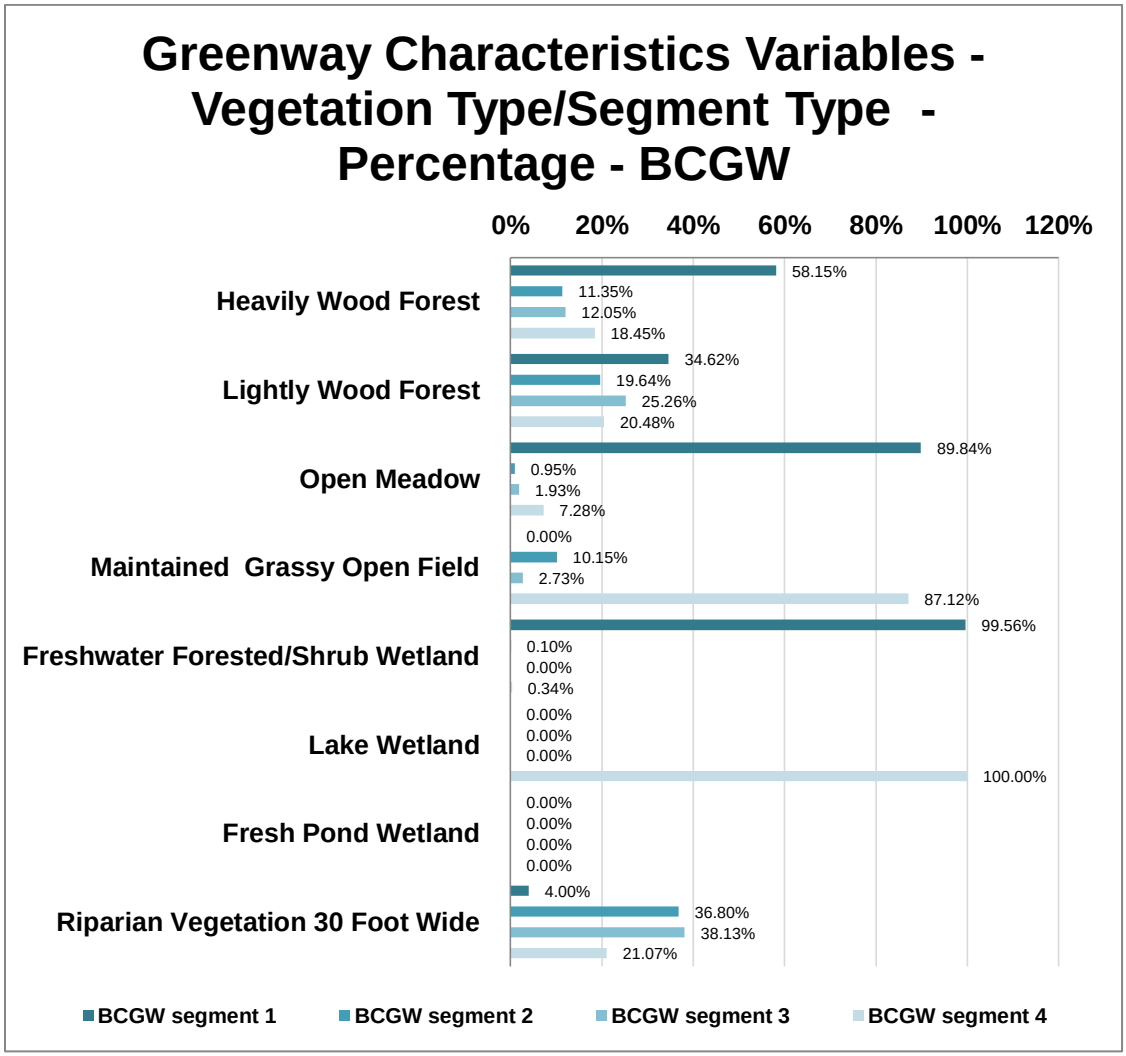

Figure 28: Chart Correlating the Percentage of Vegetation Type per Segment of the BCGW.

Source: Pippi (2013)

5.2.2. White Oak Creek Greenway Characteristics: General and Specific Findings for Social Network Interactions and Behaviors Observations

The entire length of the WOCGW is 5.82 miles, which consists of the section from Davis Drive Park to Green Level Church Road and the section from Bond Park Boathouse to Old Reedy Creek Road. Table 14 describes the procedure of greenway characterization in terms of the structural network system information in two circumstances: 1) to characterize the entire BCGW in a very broad way; 2) select the 4 segments for a more detailed analysis (description and spatialization). The evidence of the characteristics of each greenway segment was classified in the Arc Map 10 attribute table and then imported to an excel file. In yellow are the 4 segments of the WOCGW which were utilized in the Method 2: Greenway Characteristic Audit analysis. The WOCGW transverses different neighborhoods with low and/or moderate density and presents narrow greenway segments, except in segment H (s8) and segment I that presented more vegetation features area. Pictures are illustrated in Appendix X.

Table 14: WOCGW Structural Network Main Characteristics Classification.

Source: Pippi (2013)

Greenway Trail Name	Segments Identification	Greenway Destination/Point of Attraction (Configuration on Meso - Micro Scale)	Greenway Structural Network Connection (Destination - Point of Attractions)
White Oak Creek Greenway 5.82 miles	**Segment A, 0.88 miles** Bond Park Boathouse – SW Cary Pkwy	Neighborhood and Park	Neighborhoods Fred G. Bond Metro (Metro Park) Greenways
	Segment B (s5), 0.38 miles SW Cary Pkwy – MacArthur Dr.	Neighborhood	Neighborhoods (playground and tunnel)
	Segment C, 0.36 miles MacArthur Dr. – Davis Dr. (Barrier without connection – future greenway part construction)	Neighborhood and Park	Neighborhoods Davis Drive Park (Neighborhood Park) *Planned Future Connection*
	Segment D (s6), 0.83 miles Davis Dr. – Castle Hayne Rd. (stream restoration until dec. 2012)	Neighborhood and Park	Neighborhoods Davis Drive Middle School/Park Schools and (pound)
	Segment E (s7), 0.46 miles Castle Hayne Rd. – Jenks Carpenter Rd.	Neighborhood and Park	Neighborhoods White Oak Park (Neighborhood Park)
	Segment F, 0.47 miles Jenks Carpenter Rd. – Park Scene Ln.	Neighborhood	Neighborhoods
	Segment G, 0.37 miles Park Scene Ln. – NC 55 Pkwy	Neighborhood and Park (private park)	Neighborhoods (2 pounds, tunnel) West Park (Neighborhood Park)
	Segment H (s8), 0.94 miles NC 55 Pkwy – Triangle Expressway (trail connection part under construction until dec. 2012)	Neighborhood	Neighborhoods (tunnel and walking board under construction)
	Segment I, 1.13 miles Triangle Expressway – Green Level Church Rd. (trail connection part under construction until dec. 2012)	Neighborhood	Neighborhoods Greenways (lots of walking boards) * Prevision future Park*

The length of the four segments combined yields an extension of 2.61 miles. Figure 29 demonstrates the length of each segment in miles. Segment 8 was the longest segment with 0.94 miles, followed by segment 6 with 0.83 miles. Segments 7 and 5 presented were the shortest, with 0.46 miles and 0.38 miles, respectively.

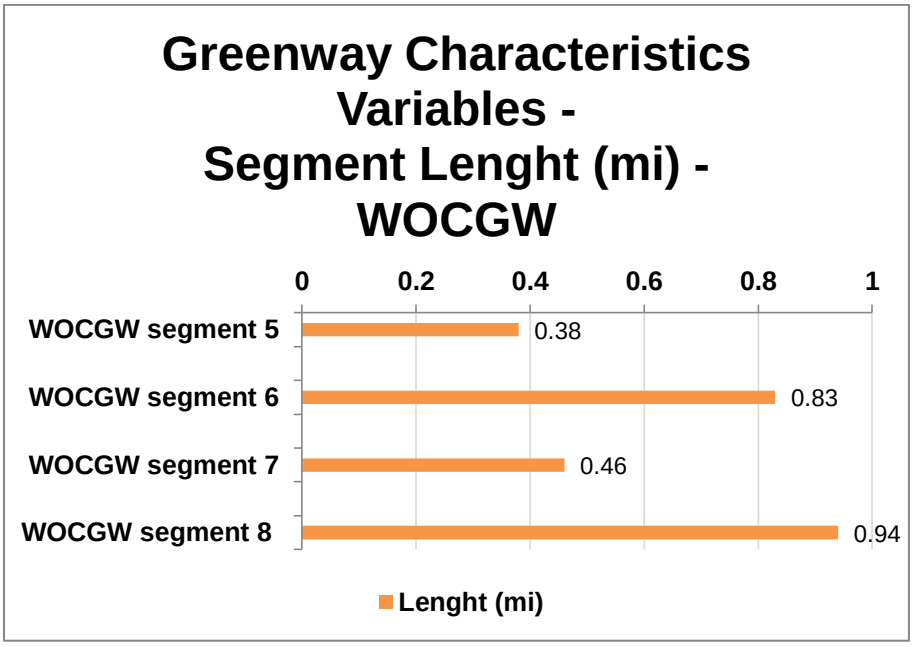

Figure 29: Chart Correlating the Segment Length per Segment Type of the WOCGW.
Source: Pippi (2013)

The *segment layout type*s of the 4 segments of the WOCGW (s5, s6, s7 and s8) are similar in terms of linearity (linear), sinuosity (sinuous/organic) and bifurcating forms that move through different landscape features. The predominant *trail surface* is asphalt, in segments 6 and 7 (s6 and s7). Segment 5 (s5) is paved with asphalt, brick and concrete and segment 8 (s8) consists of asphalt and concrete. None of the WOCGW greenway trail segments (s5, s6, s7 and s8) presented *pavement markings* with information about the trail lanes, trail direction and/or greenway name.

In terms of *physical barrier with connection*, segment 1 (s5) provides a connection with the other segments of the WOCGW by the presence of the pedestrian/biker crosswalk and underpass/tunnel. Segments 6 and 7 (s6 and s7) presented the same type of connection with the other greenway segments with only the pedestrian/biker crosswalk. Segment 8 (s8)

presented two types of connections with the other segments: trail and underpass/tunnel. In terms of *connectivity of those segments with the conventional park types*, segments 5 and 8 (s5 and s8) are connected only to neighborhoods. Segments 6 and 7 (s6 and s7) presented their destination direct connection with neighborhoods and conventional parks, differing only in terms of their conventional park types, where segment 6 (s6) presented a School Park (Davis Drive School Park, area = 5.73 US acres) and segment 7 (s7) is directly connected to a Neighborhood Park (White Oak Park, area = 11.83 US acres). In terms of the *structural connection with other areas*, segment 5 (s5) directly connects to a playground and a tunnel; segment six (s6) directly connects to schools (Elementary and Middle) and pond. Segment 7 (s7) did not present a direct connection with other areas, and segment eight (s8) directly connects to other trails and tunnel.

The *activity node configuration*s differ little among the WOCGW segments: segment 5 (s5) is made up of multiple activity nodes, with a major node (playground) and minor ones (seating areas) that are distributed in a sequential way. Segment 6 (s6) presents minor size nodes (seating areas) that are dispersed sequentially and a pond. Segment 7 (s7) presents minor size activity nodes that are scattered in sequentially and also as an expansion of the trail in some parts. Segment 8 (s8) also presented minor size activity nodes (seating areas), that are distributed in different ways: alternation, bifurcation and also as trail expansion. In terms of *activity node surface types*, segment five (s5) presented 3 types: natural (grass), concrete and wooden pavements. Segments 6 and 8 (s6 and s8) presented both concrete and natural (grass) surfaces. Segment 7 (s7) presented only natural (grass). In terms of *activity node usage types*, segments 5 presented a complex activity node (playground, seating areas, bicycle racks, and trash can receptacle). The other three segments (s6, s7 and s8) present simple activity node usage (seating areas, or trash can receptacle). Only segment 5 (s5) of the WOCGW differed in terms of the *use related/associated to the activity node configuration* in that it was configured by one multi-use node composed of a playground, seating area, bicycle racks and picnic grass area. The following segments (s6, s7 and s8) presented similar use related/associated to their activity node configuration, with the presence of seating areas, trash cans and buffer for wildlife.

Figure 30 provides a summary map of each of the WOCGW four segments with the characterization of the physical structural features and street furniture in terms of the physical structural features configuration.

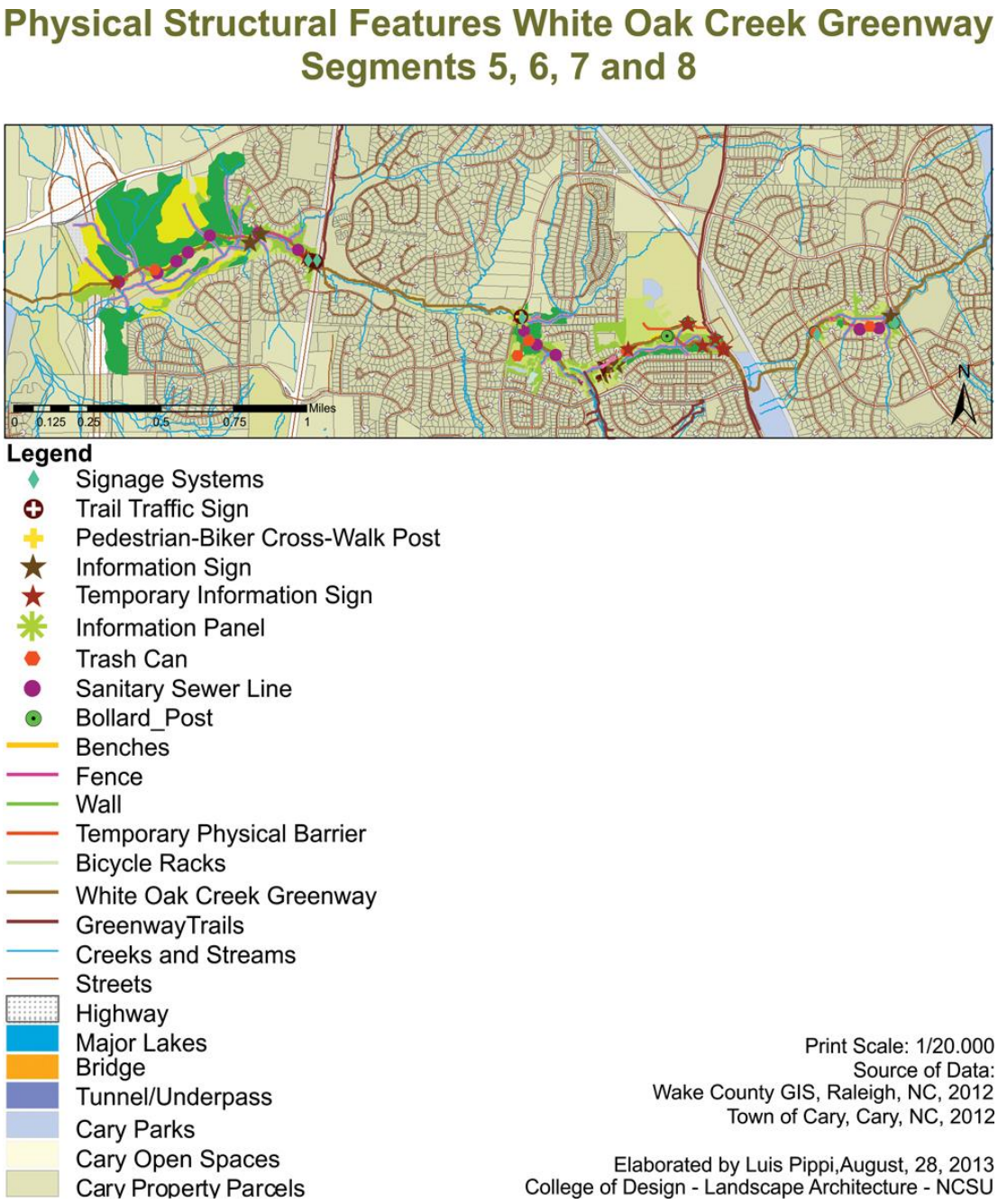

Figure 30: Map of the Physical Structural Features per Segment of the WOCGW.

Source: Pippi (2013)

The WOCGW segments presented diverse types of physical structure features and street furniture components, which are presented below with their quantities:

- Segment 5 (s5) presented a total of 6 *physical structure features types*: bridges (2), playground (1), fences (16), sanitary sewer lines (2), walls (4) and tunnel (1). It presented also a total of 6 *street furniture types*: benches (6), bicycle rack (1), bollard posts (7), trash cans (2), signage system (2), and information sign (1).

- Segment 6 (6) presented a total of 2 *physical structure features types*: fences (9) and trail gate (1). It present also total of 7 *street furniture types*: benches (2), trash cans (2), bollard posts (11), information signs (3), trail traffic sign (1), temporary information sign (9) and temporary physical barrier (9);

- Segment 7 (s7) presented a total of 3 *physical structure features types*: bridge (1), fences (2) and sanitary sewer lines (5). It present also a total of 8 *street furniture types*: bench (1), trash cans (3), bollard posts (15), signage system (1), trail traffic signs (2), temporary information sign (1), information panel (1) and pedestrian/biker cross walk post (1),

- Segment 8 (s8) presented a total of 5 *physical structure features types*: walking board (1), fences (21), walls (4), sanitary sewer lines (7) and tunnel (1). It presented also total of 8 *street furniture types*: benches (3), bollard posts (3), trash cans (4), signage system (2), trail traffic signs (2), temporary information signs (4), information signs (2) and temporary physical barrier (4).

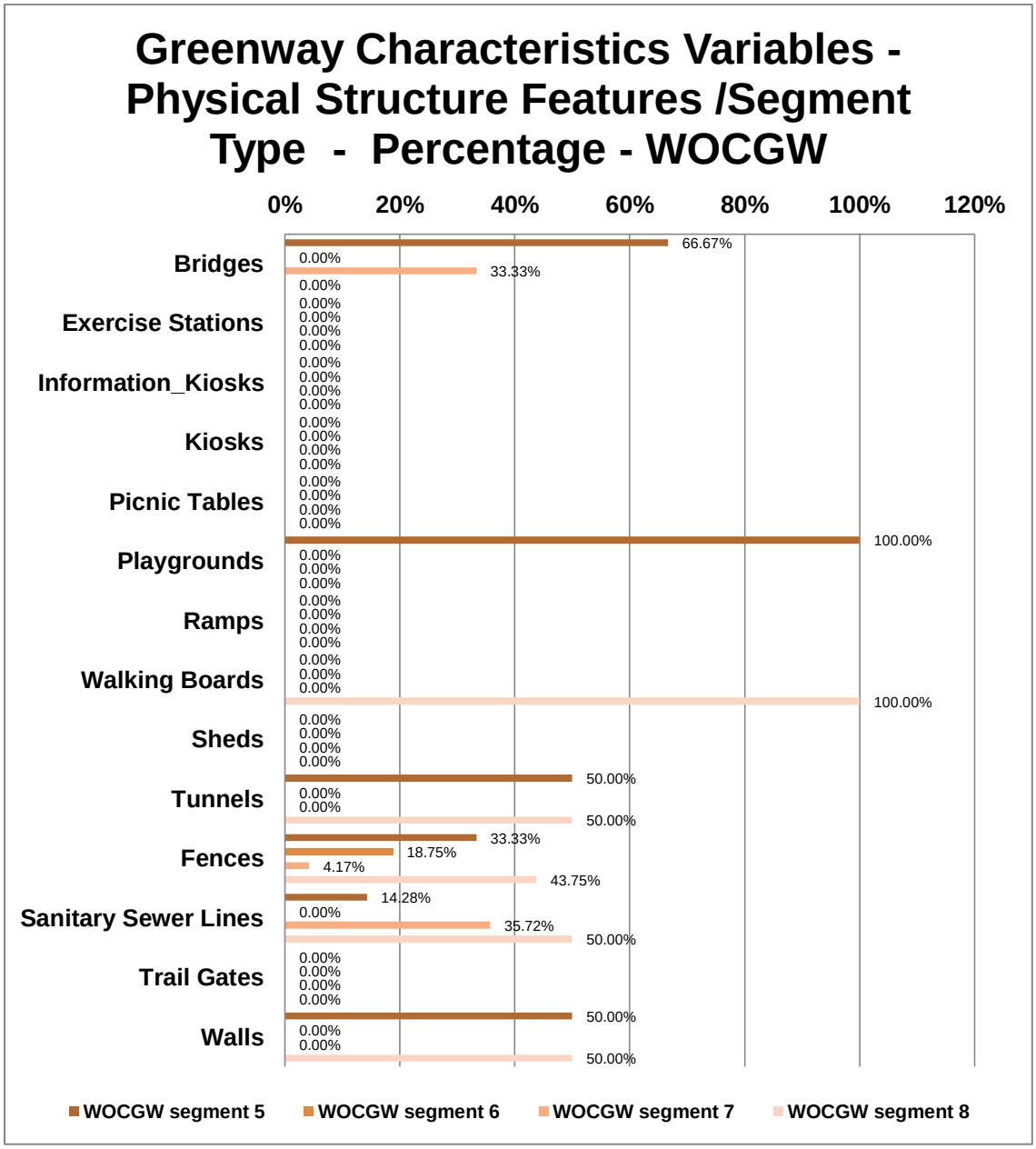

Figure 31: Physical Structure Feature Configuration Types Per Segment of the WOCGW.

Source: Pippi (2013)s

Figure 31 demonstrates the percentage of each of the physical structure features in each of the WOCGW segments. Playground was encountered only in segment 5 (s5) with 100%. Walking boards were found only in segment 8 (s8) with 100%. Tunnels were encountered only in segments 5 and 8 (s5 and s8) with 50% for each. Walls were encountered only in segments 5 and 8 (s5 and s8) with 50% in each category. Fences were more predominant in segment 8 (s8) with 43.75%, followed by segment 5 (s5) with 33.33%, segment 6 (s6) with 18.75 and segment 7 (s7) with 4.17%. Sanitary sewer lines were observed more often in segment 8 (s8) with 50%, followed by segment 7 (s7) with 35.72% and segment 5 (s5) with 14.28%, and were not encountered in segment 6 (s). Exercise stations, information kiosks, kiosks/gazebos, picnic tables, ramps, sheds and trail gates were not observed in any of the WCGW segments.

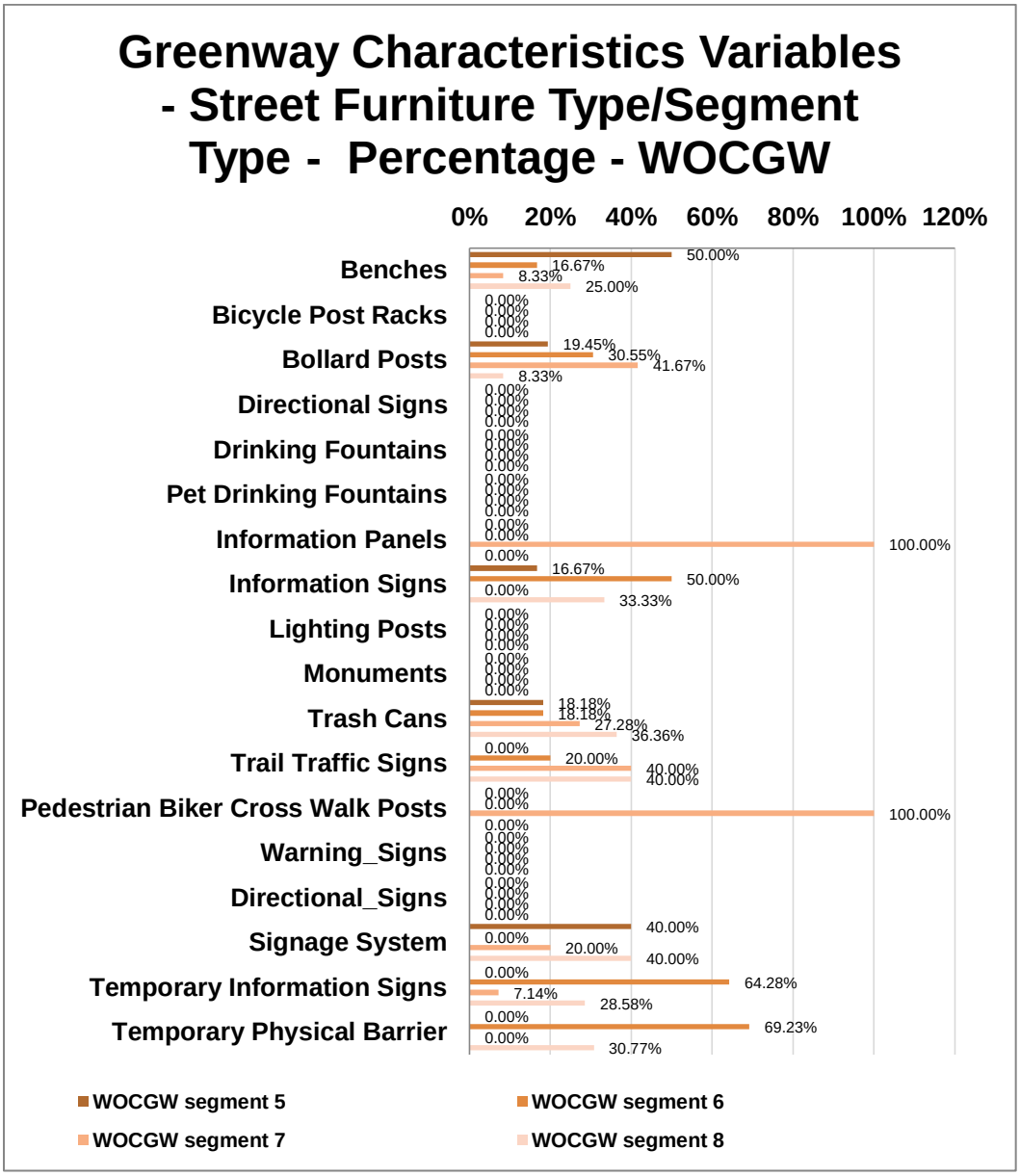

Figure 32: Street Furniture Component Types per Segment of the WOCGW.

Source: Pippi (2013)

Figure 32 demonstrates the percentage of each of the street furniture components in each of the WOCGW segments. Information panel and pedestrian/biker crosswalk were observed only in segment 7 (s7) with 100.00% for each category. Information signs were more prevalent in segment 6 (s6) with 50%, followed by segment 8 (s8) with 33.33% and segment 5 (s5) with 16.67%. Trash cans were more prevalent in segment 8 (s8) with 36.36%, followed by segment 7 (s7) with 27.28% and segments 5 and 6 (s5 and s6) with 18.18% each. Trail traffic signs were perceived more in segments 7 and 8 (s7 and s8) with 40% in each category, followed by segment 6 (s6) with 20%. Signage systems were more predominant in segments 5 and 8 (s5 and s8) with 40% each, followed by segment 7 (s7) with 20%. Temporary information signs were more abundant in segment 6 (s6) with 64.28%, followed by segment 8 (s8) with 28.58% and segment 7 (s7) with 7.14%. Temporary physical barriers were only observed in two segments, with 69.23% in segment 6 (s6) and 30.77% in segment 8 (s8). Bicycle post racks, directional signs, drinking fountains, pet drinking fountains, lighting posts, monuments, warning signs and directional signs barrier were not observed in any of the BCGW segments.

Figures 33 and 34 provide a summary map of each of the WCGW four segments with the characterization of the landscape features in terms of the vegetation configuration: vegetation type coverage (area in US acres and percentage of each category) in each greenway segment and their immediate areas, which may affect user/actor usage, interaction, behavior and perception of the greenway environments. The chart in figure 34 shows the total area of vegetation type per segment of the WOCGW. The second chart in figure 35, associates the percentage of each vegetation type within each of the four segments of the BCGW.

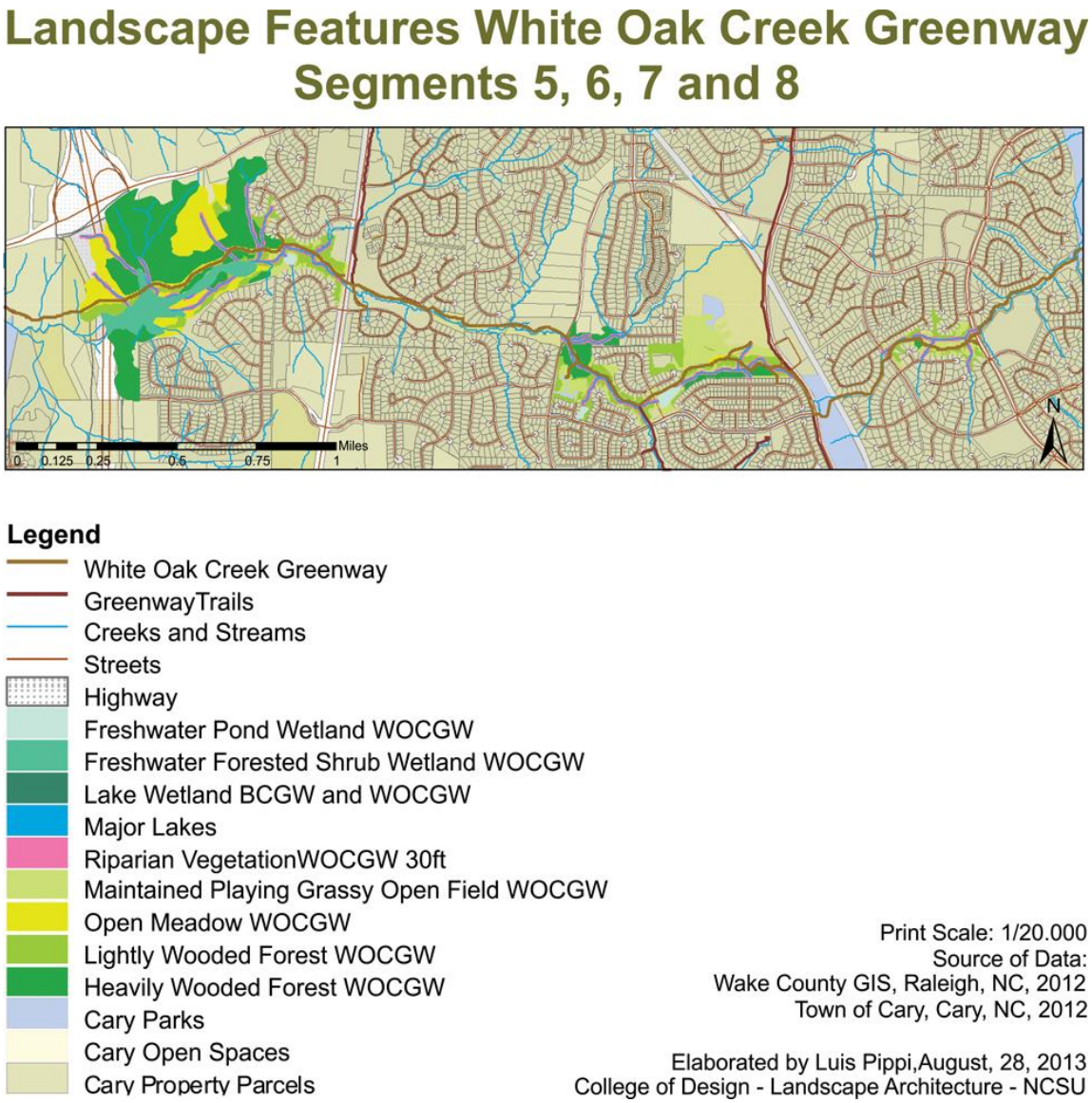

Figure 33: Map of Vegetation Type per Segment Type of the WOCGW.

Source: Pippi (2013)

Figures 34 and 35 indicate the total area, in acres, and the percentage of each vegetation type, respectively, per segment type of the WOCGW. Segment 8 (s8) presented a greater

occurrence of three vegetation types when compared to the other segments: the heavily wooded forest (A= 75.06 ac. and 88.00% of coverage), open meadow (A=34.03 ac. and 95.05% of coverage) and riparian vegetation with 30 foot wide (A=18.38 ac. and 55.63% of coverage). Segment 8 (s8) presented more lightly wooded forest (A=16.80 ac. and 45.08% of coverage) followed by segment 6 (s6) with (A=8.86 ac. and 23.77% of coverage), and segment 7 (s7) with (A=7.11 ac. and 19.08% of coverage). Segment 6 (s6) presented the second greatest ocurrence of open meadow (A=1.38 ac. and 3.85% of coverage). Maintained grassy open field occurred more in segment 6 (s6) (A=7.13 ac. and 49.17% of coverage), followed by segment 7 (s7) (A=6.57 ac. and 18.86% of coverage). Freshwater forested/shrub wetland (A=18.26 ac. and 100.00% of coverage) was only encountered in segment 8 (s8). Fresh pond wetland occurred more in segment 6 (s6) (A=1.49 ac. and 57.30% of coverage), followed by segment 8 (s8) (A=0.63 ac. and 24.23% of coverage). Following segment 8 (s8), segment 7 (s7) presented the second greatest ocurrence of presence of riparian vegetation 30 foot wide type with (A=6.11 ac. and 18.50% of coverage). Lake wetland category was absent in all segments.

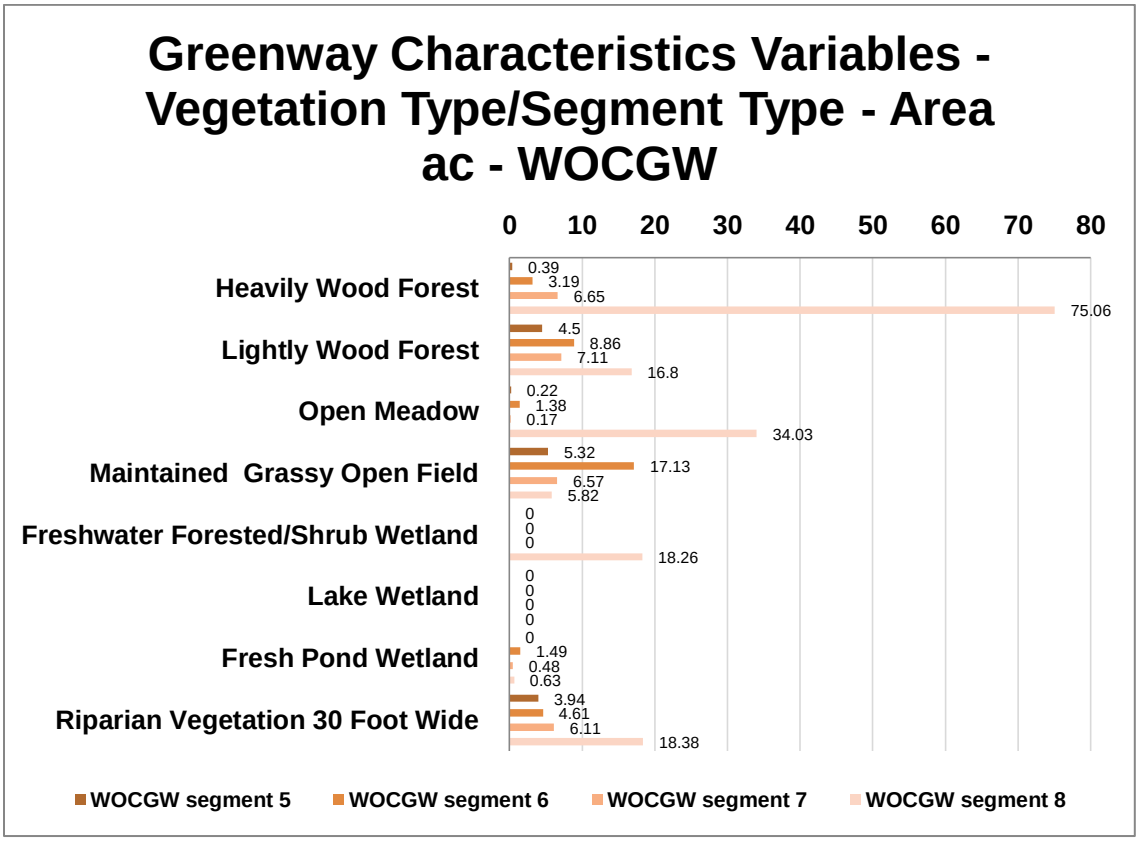

Figure 34: Total Area of Vegetation Type per Segment of the WOCGW.

Source: Pippi (2013)

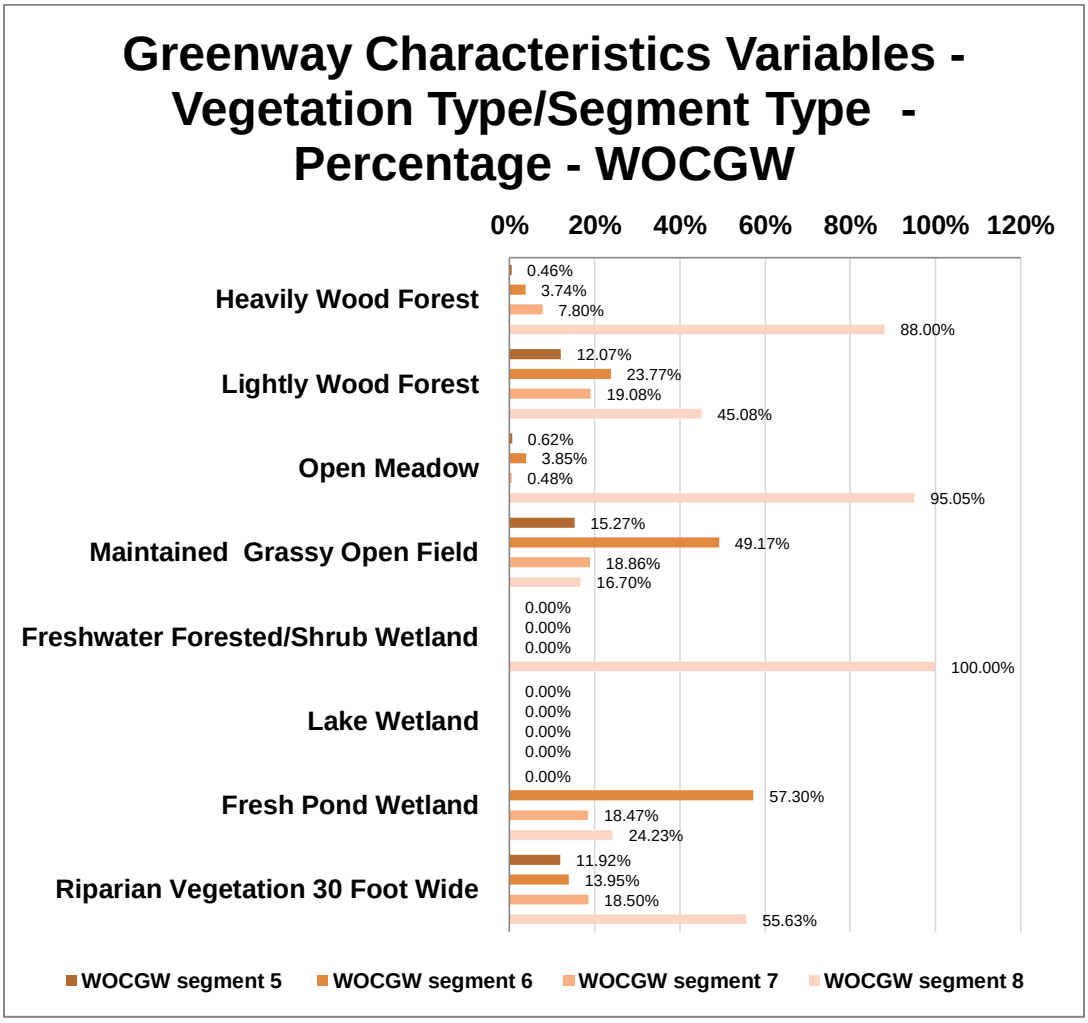

Figure 35: Percentage of Vegetation Type per Segment of the WOCGW.

Source: Pippi (2013)

5.2.3. Greenway Characteristics General Discussion with Comparisons across Both Greenways

5.2.3.1. Greenway Structural Network System and Features

In terms of Greenway Structural Network System characteristics, both greenways share the same 3 facets: 1) they compose together the most important *arterial greenway*, according to the 2012 Master Plan (MPL); 2) in terms of the MPL hierarchy they can be characterized in 2011 as a *primary greenway* (Parks, Recreation and Cultural Resources Facilities Master Plan, 2003), term that was substituted in the 2012 PRCR Master Plan and Parks by the term *greenway trails* that consists in a 10' wide, paved and multi-use trail within a natural physical environment that permeates and penetrates different landscapes (Recreation & Cultural Resources Master Plan, 2012).

Similarly, the BCGW and WOCGW both consist of two *network types*: first, they act as *Penetrators* configuring one interconnected web that functions as a connector for the local system, which attends and spread across different neighborhoods and landscapes of Cary, providing access, alternative transportation, leisure-recreation attractions and visibility to a myriad of people from different neighborhoods, as a way to balance the benefits of greenways throughout the whole population. *Branching* characteristics of the greenways consists of the sub-division of the greenway into segments that branch off from the main arterial greenway that connect the greenway network with other greenways and also may expand the recreational activities, interactions and behaviors, and/or interests in a new direction (destination, point of attraction).

The BCGW and WOCGW presented different types and quantities of the *physical structure features* and *street furniture components*. Both presented a sum of 14 categories for the *physical structure features*, and a sum of 18 categories for the *street furniture components*. Figure 36 the differences of the physical structural features between each greenway type.

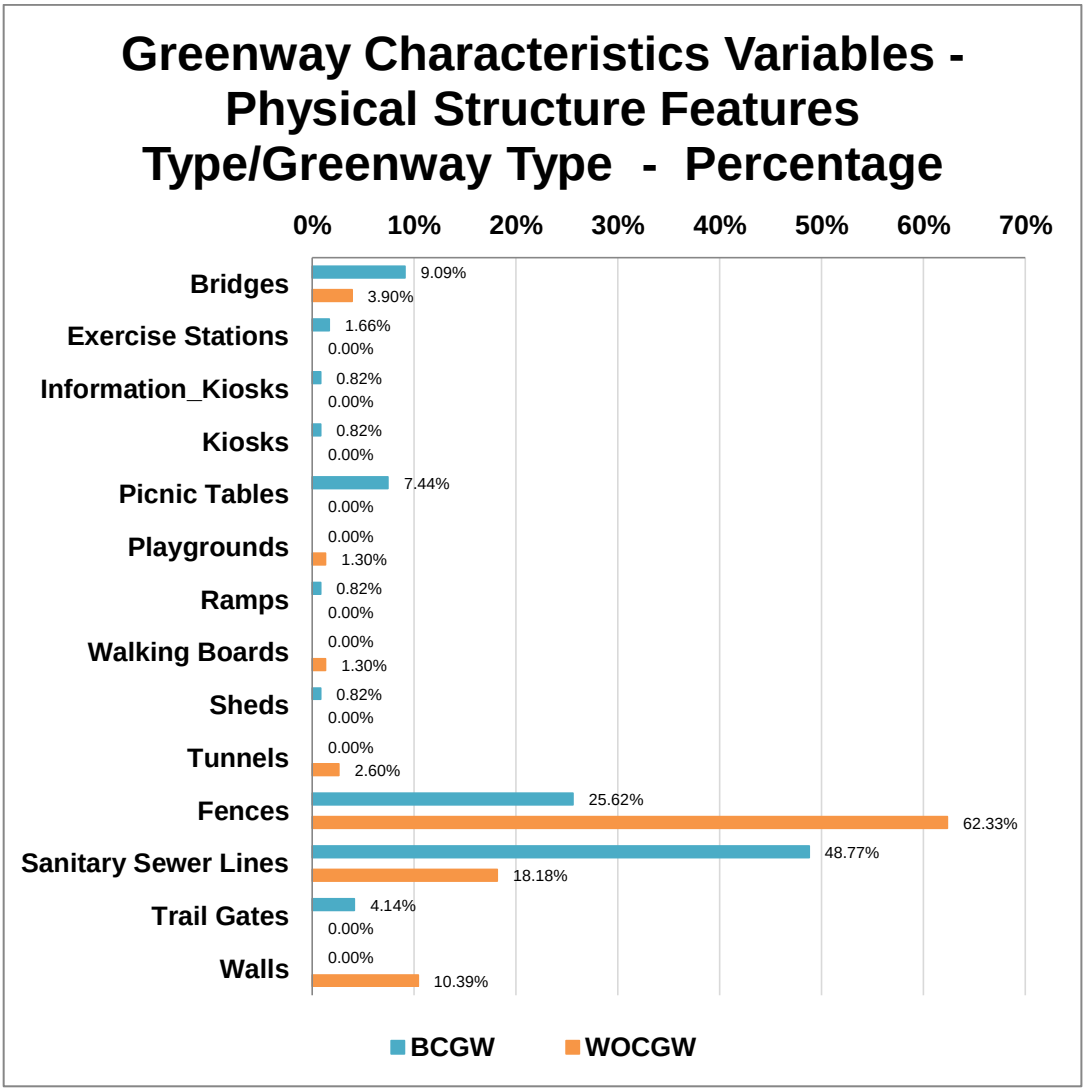

Figure 36: Physical Structure Features Configuration Types per Greenway.
Source: Pippi (2013)

Of all the observed physical structure features in both greenways, the most prevalent feature was the fence, with 62.33% in the WOCGW and 48.77% in the BCGW. Sanitary sewer lines were also largely prevalent in both greenways, with 48.77% in the BCGW and

18.18% in the WOCGW. In moderate quantities, bridges represented 9.09% of BCGW and 3.90% of WOCGW characteristics. Walls and tunnels were only encountered in the WOCGW, respectively with 10.39% and 2.60%. Picnic tables and exercise stations were only observed in the BCGW, respectively with 7.44% and 1.66%. Trail gates were only encountered in the BCGW with 4.14%. Playgrounds and walking boards' categories only were found in the WOCGW with 1.30% for each category. Information kiosks and kiosks/gazebo, ramps and sheds were only found in the BCGW with 0.82% for each category.

Figure 37 shows the difference between both greenways for street furniture components types.

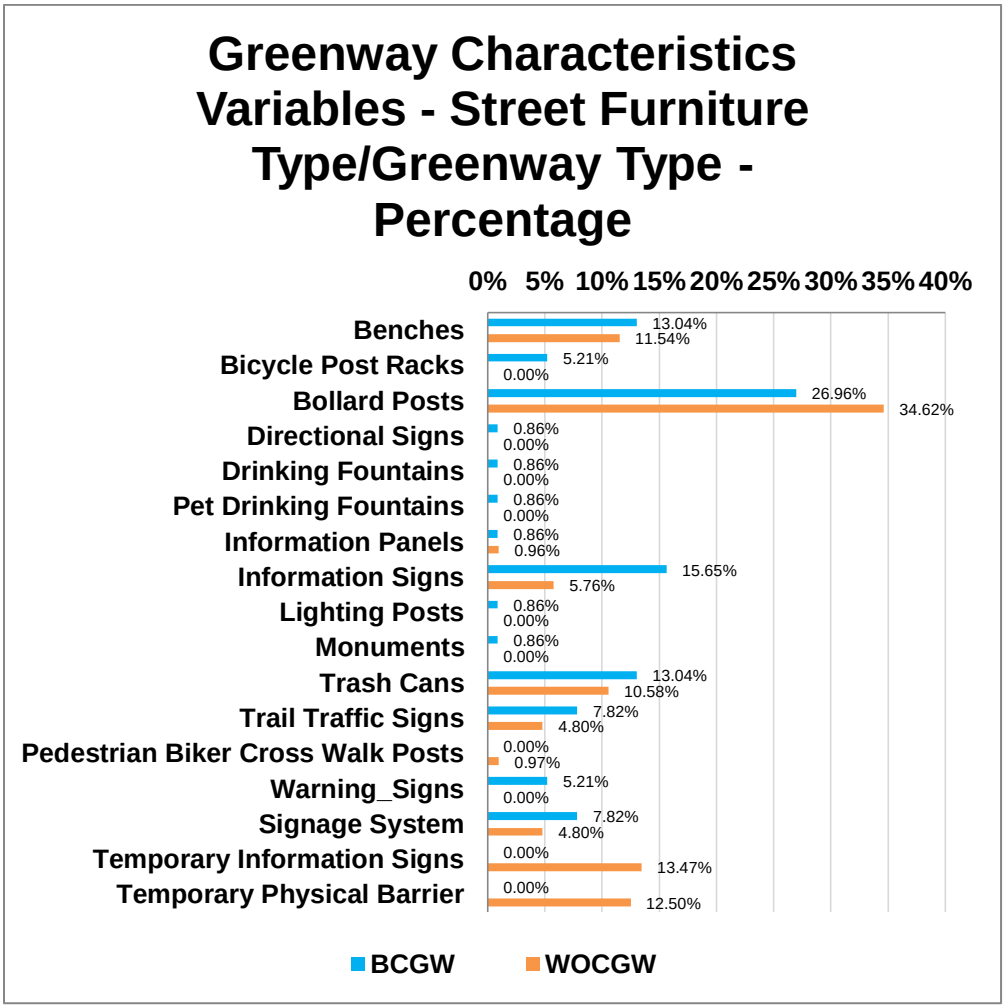

Figure 37: Street Furniture Component Types per Greenway.

Source: Pippi (2013)

Of all the observed street furniture components in both greenways, the most predominant type of furntiture in both greenways was the bollard post, with 34.62% in the WOCGW and 26.96% in the BCGW. Information signs were more dominant in the BCGW with 15.65% but less dominant in the WOCGW with 5.76%. Benches were moderately predominant in the BCGW with 13.04% and with 11.54 in the WOCGW. Trash cans also were moderately predominant in both greenways, with 13.04% in the BCGW and 10.58% in the WOCGW.

Temporary information signs and temporary information barriers were only observed in the WOCGS with respectively 13.47% and 12.50%. Trail traffic signs and signage system categories were higher in the BCGW with 7.82% each, if compared to WOCGW with 4.80% each category. Bicycle post racks and warning signs were only observed in the BCGW with 5.21% each. Pedestrian/biker crosswalk posts were only observed in the WOCGW with 0.97%. Information panels were observed in the WOCGW with 0.96% and for the BCGW with 0.86%. Directional signs, drinking fountain, pet drinking fountain, lighting post and monuments were only found in the BCGW, with 0.86% for each of these categories.

Natural water resources on both greenways included lakes (BCGW segment 1 and 4), creeks/streams (both greenways, all the segments), wetlands (BCGW segment 1 and WOCGW segment 8) and pond (WOCGW segment 6 and 8). The natural water resources were utilized in GIS only as a background for the thematic maps. The creeks/streams shapefile data, served as the basis for the riparian vegetation characterization with a buffer of 30 feet from the water-line.

The characterization of the vegetation features for both greenways consisted in the spatialization of the vegetation types presented in each greenway segments. These greenway boundaries and also their immediate park boundary areas and/or other areas, may affects user/actor usage, interaction, behavior and perception of the greenway environments. The vegetation types were classified in 8 different categories: *heavily wooded forest, lightly wooded forest, open meadow, maintained grassy open field, freshwater forested/shrub wetland, lake wetland, fresh pond wetland and riparian vegetation (30 feet buffer)*.

The categories: *heavily wooded forest, lightly wooded forest, open meadow, maintained grassy open field* were spatialized (on a map-base and then transcribed to GIS) based on my field observation of each category in each of the greenway segments. These areas represented the portions of vegetation with high and moderate ecological areas presenting different functions, such as protecting the open space and providing a high-quality habitat

for fauna and flora communities. The categories: f*reshwater forested/shrub wetland, lake wetland, fresh pond wetland and riparian vegetation* were transcribed and then spatialized in GIS (Arc Map 10) based in the U.S. Fish and Wildlife Service - National Wetlands Inventory (2013) that provided the zoning of each wetland and riparian areas categories based in their classification code and description (area in Acres, image scale 5800). The wetland classification encountered in the BCGW and WOCGW were: *PF01C, PF1/44A, PF01F, PSS1A, PF01C and PUBHh.* Such classifications for both greenways, in terms of water regime, were classified in three sub-categories: A which means temporarily flooded; C which means seasonally flooded and F which means semi permanently flooded. These wetland meadow areas consisted of inundated and/or saturated areas by surface and/or ground water along the year with a variety of vegetation: water-loving grasses, sedges, rushes, wildflowers, trees and/or shrubs (like the Black Ash). These wetland categories present multiple functions: flood reduction by slowing the excess of water runoff, especially in heavy storms/rainfalls; improvement of water quality through the vegetation roots which act as a pollution filter; recreational function: landscape contemplation, wildlife and bird watching, research studies, canoeing, kayaking, hiking, fishing, environmental education and ecotourism. The riparian vegetation area was spatialized from the creeks and streams GIS shapefile, in which was created a buffer of 30 feet of all perennial and intermittent streams of the BCGW and WOCGW that consisted in areas that must be forested and vegetated (U.S. Fish and Wildlife Service - National Wetlands Inventory, 2013; Town of Cary Parks Recreation and Cultural Resources Department, 2012; Bevington, 2006; Environmental and Conservation Law, 1999; Water Epa Gov, 2013; Minnesota Board of Water and Soil Resources, 2013; U.S. Environmental Protection Agency, 2013).

Figures 38 and 39 show that of all the observed and spatialized vegetation types in both greenways, the heavily wooded forest was considerably more predominant in the BCGW (A=444.42 ac. and 41.30% of coverage), if compared with the WOCGW in this category and also with the other categories of vegetation types of the BCGW. The next most prevalent category was the freshwater forested/shrub wetland (A=407.27 ac. and 37.84% of coverage),. Of all vegetation types for the WOCGW, the heavily wooded forest was also the

most prevalent category (A=85.29 ac. and 34.51% of coverage), however it was not as prevalent as that found in the BCGW for this category type. The second most prevalent for the WOCGW was the lightly wooded forest (A=37.27 ac. and 15.08% of coverage), which was more abundant in terms of exposure than the BCGW (A=38.91 ac. and 3.61% of coverage). The amount of area for each category of vegetation types was almost the same for both greenways in terms of area in acres: the BCGW presented A=38.21 ac. Of lightly wooded forest while the WOCGW presented A=37.27 ac. For the maintained grassy open field the BCGW was A=27.47 ac. and the WOCGW A=34.84 ac. For the riparian vegetation 30 foot wide vegetation type, the BCGW presented A=36.93 ac. and for the WOCGW A=33.04 ac. However these three categories differed in terms of percentage coverage: the BCGW presented fewer portions of the lightly wood forest (3.61% of coverage) than the WOCGW (15.08% of coverage). For the maintained grassy open field the quantity of coverage in the BCGW was also smaller (2.55% of coverage) when compared to the WOCGW (14.10% of coverage). Similarly, for the riparian vegetation 30 foot wide vegetation type, the BCGW presented fewer portions (3.43% of coverage) than the WOCGW (13.37% of coverage). The open meadow vegetation type presented greater incidence in area in BCGW (A=87.18 ac.) if compared to the WOCGW (A=35.80 ac.), however it was the opposite in terms of percentage coverage, the WOCGW presented more (14.50% of coverage) than the BCGW (8.09% of coverage). Fresh pond wetland was less predominant if compared to overall vegetation categories types in the WOCGW (A=2.6 ac. and 1.05% of coverage) and absent in the BCGW. Lake wetland was only founded in the BCGW with (A=34.21 ac. and 3.18% of coverage) and absent in the WOCGW.

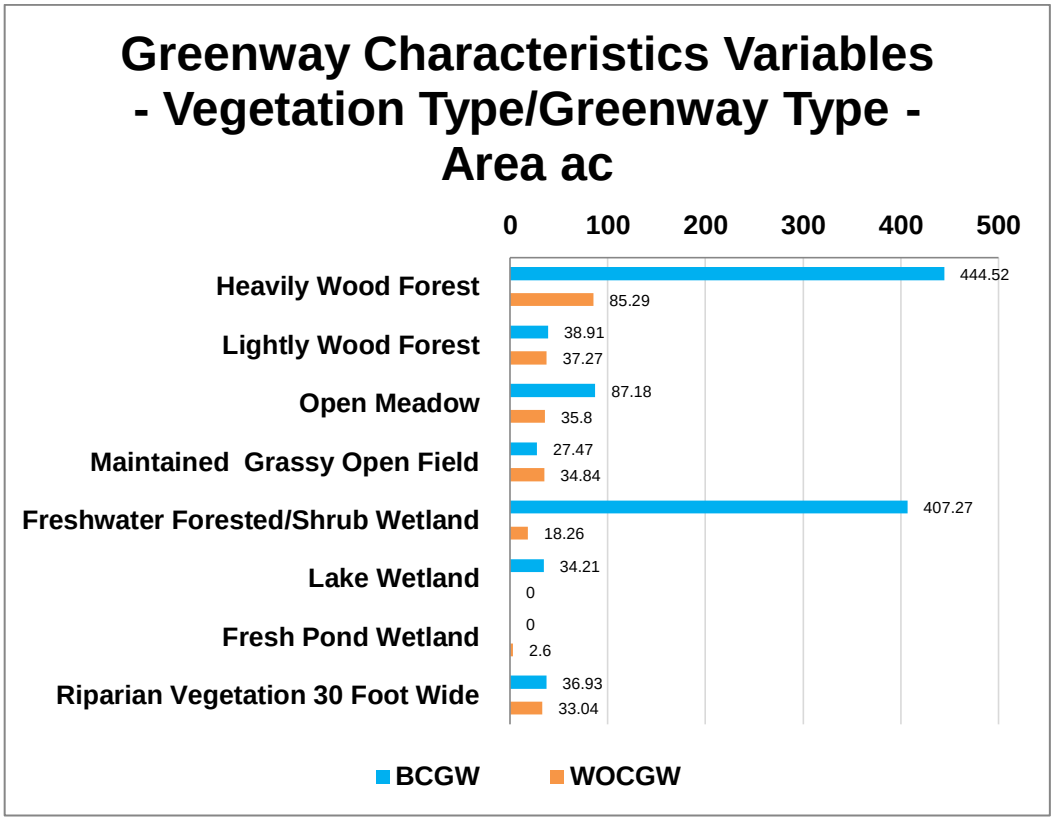

Figure 38: Total Area of Vegetation Type per Greenway Type.

Source: Pippi (2013)

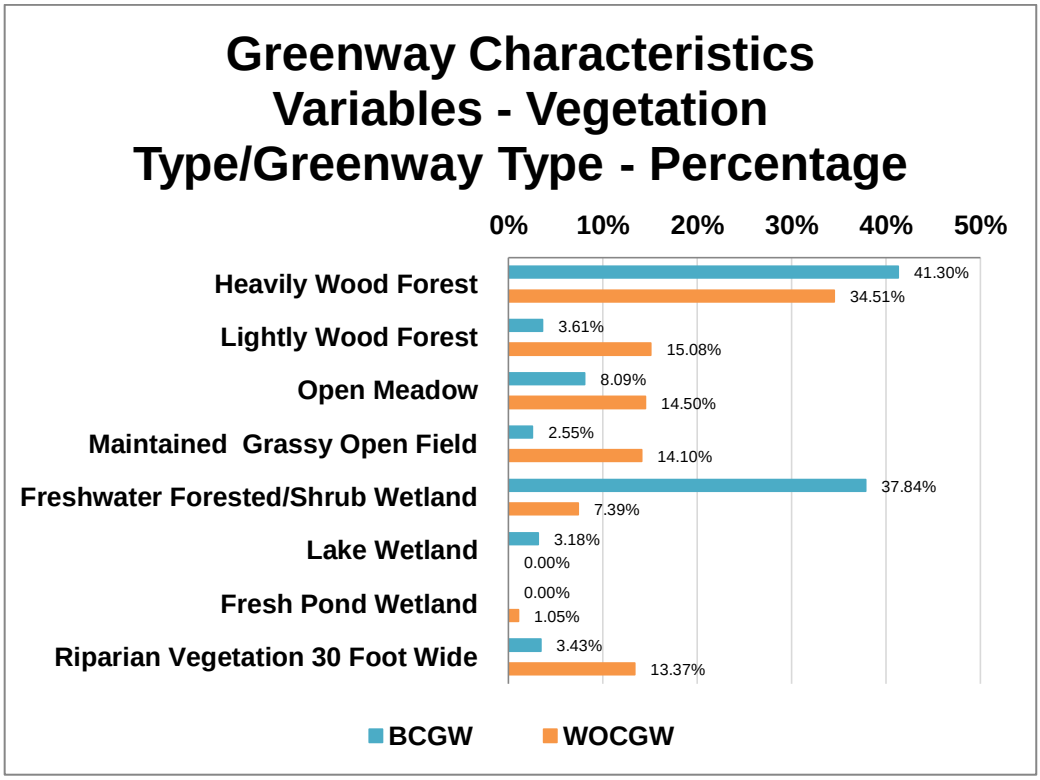

Figure 39: Total Percentage of Vegetation Type per Greenway Type.
Source: Pippi (2013)

As part of the landscape features, the topography features were spatialized in GIS, providing thematic maps for each greenway including segments boundaries and their immediate areas, which may affect user/actor usage, interaction, behavior and perception of the greenway environments. However these maps were not analyzed so as to elucidate how the topography features impacted the results from the behavior mapping and stationary observations, and were used here only to provide a description of the greenway landscape topographic features.

Figures 40 and 41 provide summary maps of each greenway: the BCGW four segments combined and the WCGW four segments combined with the characterization of the topography features and altimetry.

The elevation contour lines were generated with the topography elevation lines of Wake County (Wake County Topo Lines), which presented more accurate contours (with 2, 10, 50, 100 and 500 values). However, these contour lines should only be considered as derived estimates. When the elevation was combined to the raster image information, provided by Wake Co DEM with 20 foot cell size, for x, y = 20, 20 as the smallest cell size with high resolution, and number of band 1 (Wake County DEM 20). Then with the raster elevation data, a hill shade raster image was created with values ranging from high: 254 to low: 0. The slope and calculated and a slope map was generated based on the land elevation characteristics and description. A thematic map of the elevation with stretch values along a color ramp was generated with the values ranging from high: 558.885 to low: 68.90 foot_US (linear unit spatial reference: foot_US and angular unit spatial reference: 0.01745 angular unit).

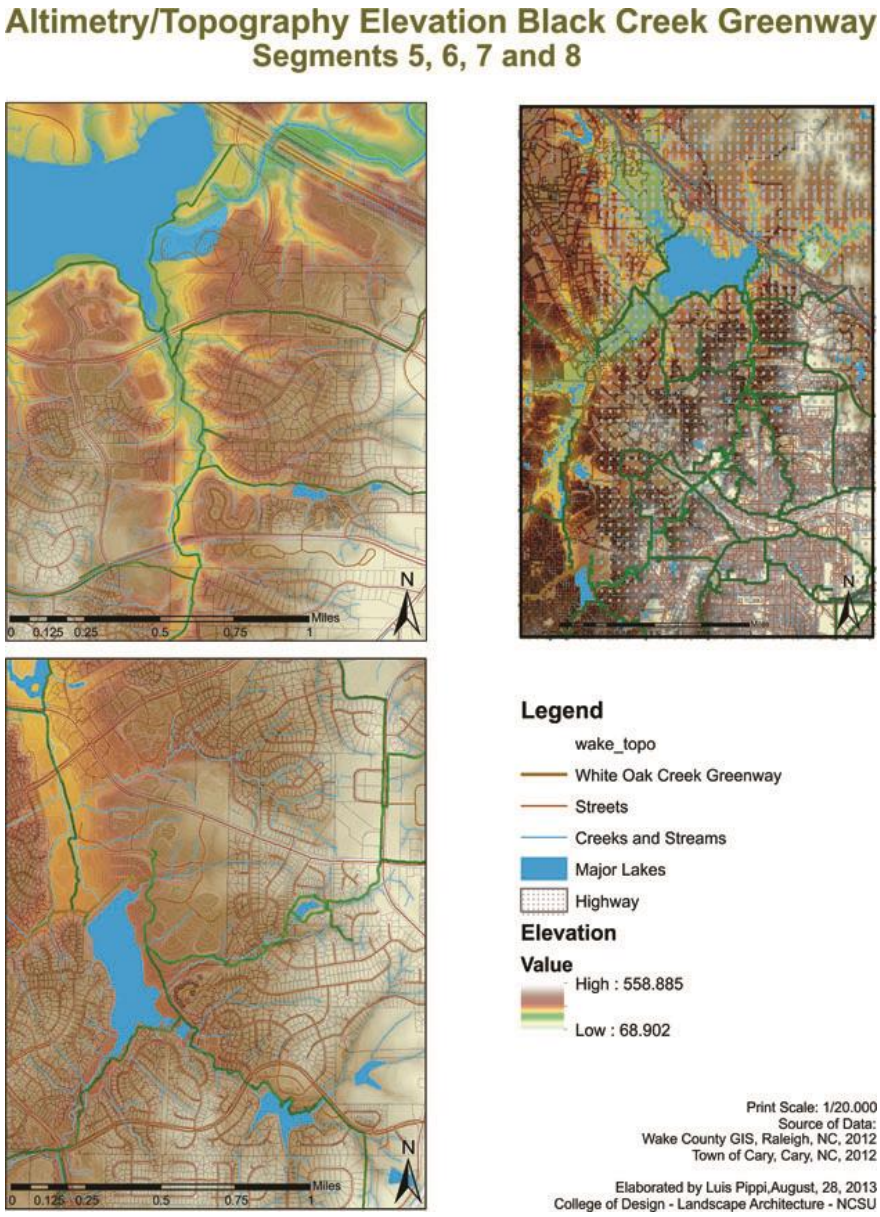

Figure 40: Map of the Altimetry Combined with Topography Elevation of the BCGW.

Source: Pippi (2013)

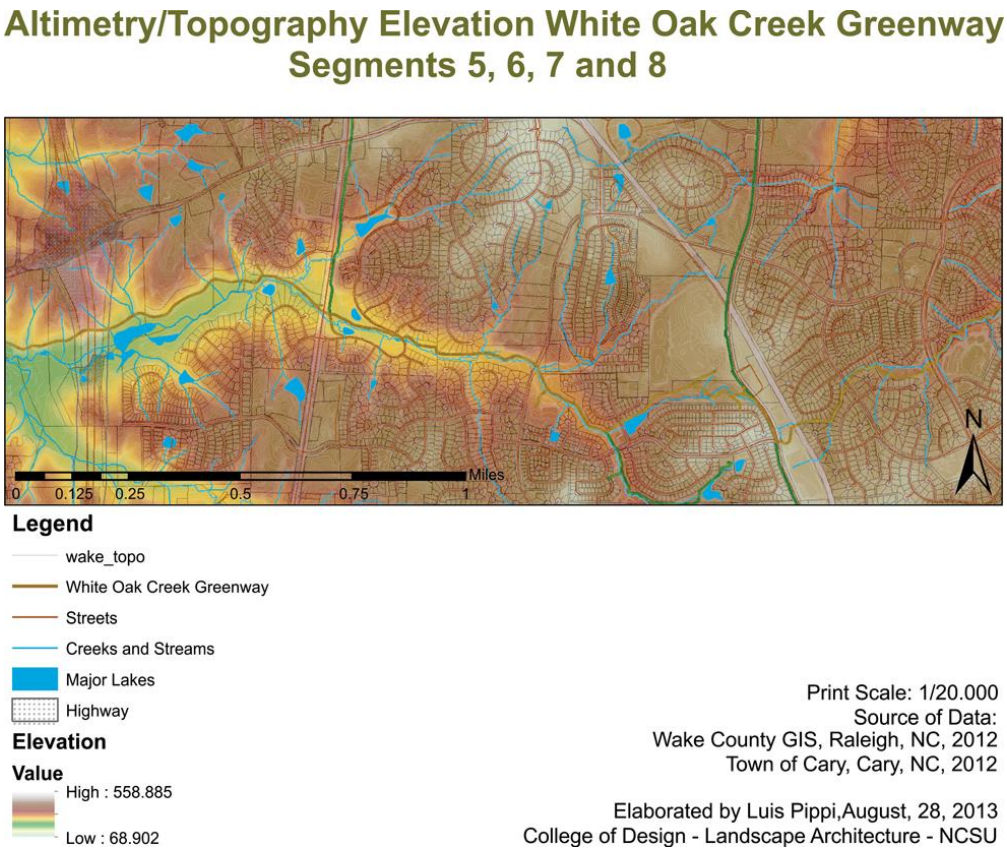

Figure 41: Map of the Altimetry Combined with Topography Elevation of the WOCGW.
Source: Pippi (2013)

Figures 42 and 43 provides summary maps of each greenway and their segments combined with the characterization of the topography slope degree/slope terrain rating configuration, that was classified with 5 different elevation slope degree categories: 1) very gentle (0-15%); 2) gentle (15-25%); moderate (25-35%); steep (35-45%) and very steep (45-more values%).

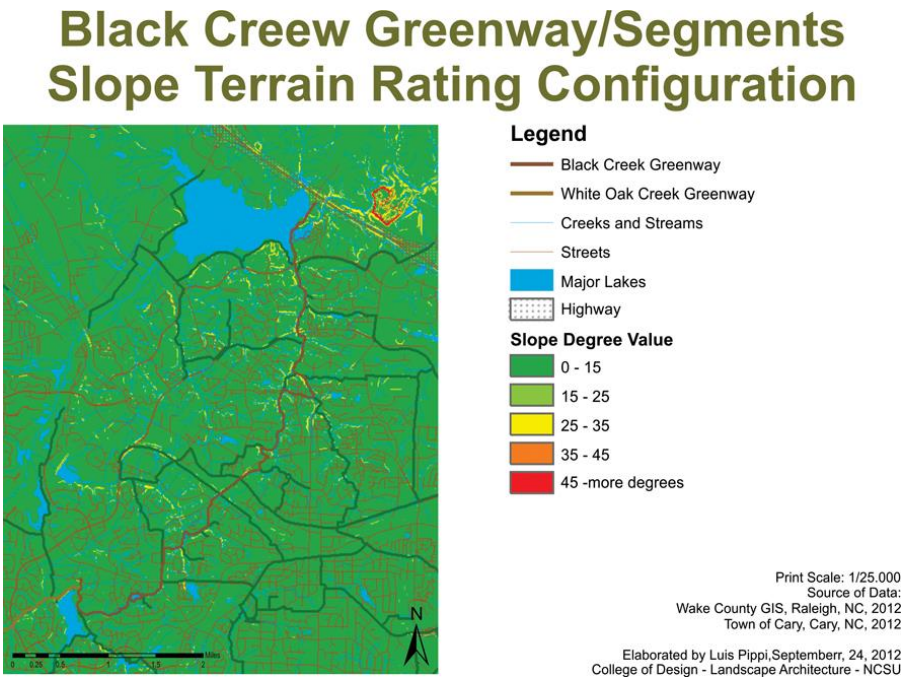

Figure 42: Map of the Topography Slope Degree/Slope Terrain Rating of the BCGW.

Source: Pippi (2013)

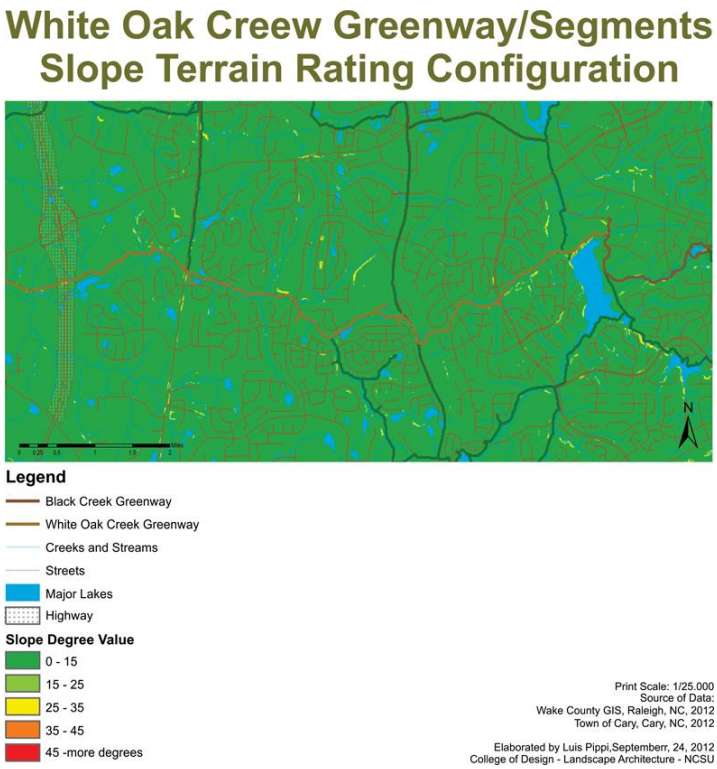

Figure 43: Map of the Topography Slope Degree/Slope Terrain Rating of the WOCGW.
Source: Pippi (2013)

5.3. Findings from Social Characteristics Audit: Behavior Mapping

A Total of 10,205 individuals were observed during the behavior mapping sampling periods (illustrated in the previous chapter in Table 3: Observational Approach, Check Count Time Block Period-Week and Tables 4 and 5: Calendar of the Behavior Mapping Data Collection Related to Weather Condition) across the two greenway study areas combined. Findings for each greenway case are first reported separately and then detailed comparisons are made across cases.

5.3.1. Black Creek Greenway Social Characteristics: General and Specific Findings for Social Network Interactions and Behavior Observations

The Black Creek Greenway (BCGW) presented a total volume of 5,512 individuals of usage. Of the four segments of the BCGW, segment 4 presented the highest volume of usage (32.68%; 1,801 observations), followed by segment 1 (25.96%; 1,431 observations), segment 2 (22.77%; 1,255 observations) and segment 3 with the lowest volume of usage (18.59%; 1,025 observations). Pictures are illustrated in Appendix X.

Of these 5,512 observations, for two of the *temporal variables* (week and period of day): use was typically highest during the weekend (62.20%; 3,430 observations) following by the weekdays (37.80%; 2,082 observations). Use was typically highest during the evening (36.92%; 2,035 observations) following by afternoon (31.08%; 1,713 observations) and morning (32.00%; 1,764 observations).

In terms of *people variables* (user type by gender, user type by age and type of actor), males (55.04%; 3,034 observations) were more prevalent than Females (44.96%; 2,478 observations) and adult presence was highest (84.50%; 4,658 observations) followed by children (8.58%; 473 people), adolescents (4.94%; 272 observations) and seniors with the lowest presence (1.98%; 109 observations). According to the pure actor type, individual presence was highest (44.53%; 2,455 observations) followed by dyads (34.15%; 1,882 observations), and both groups (10.92%; 602 observations) and triads (10.40%; 573 observations) with the lowest presence. Combining Dyads and Triads it is possible to verify that Sub-Groups were more prevalent (44.54%; 2,455 observations) than Groups and equal to the Individual actor category. Of all Group Types (100%; 521 observations), Group of four (G4) were more prevalent (67.50%; 352 observations) followed by Group of six (G6) (13.80%; 72 observations), Group of five (G5) (9.60%; 50 observations), Group of seven (G7) (4.00%; 21 observations), Group of ten (G10) (1.90%; 10 observations), Group of nine (G9) (1.70%; 9 observations) and finally Group of eight (G8) (1.50%; 8 observations).

Of the 5,512 observations, for three of the *social interaction variables* (social ties/bridges, transformative actor type and centrality): the social ties/bridges non-occurrence was most prevalent for the BCGW (79.40%; 4,377 observations) if compared with the occurrence of ties/bridges, (20.60%; 1,135 observations). According to the transformative actor type, the Individual category didn't fit in this new actor categorization (79.40%; 4,377 observations), the Dyad presence was highest (8.60%; 474 observations) followed by both Group (6.17%; 340 observations) and Triad (5.83%; 321 observations) with the lowest presence. Combining Dyads and Triads it was verified that the presence of Sub-Groups was moderate (14.42%; 795 observations) if compared to the Group actor category. Of all Group Types (100%; 340 observations), Group of four (G4) was more prevalent (50.60%; 172 observations) followed by Group of five (G5) (22.05%; 75 observations), Group of six (G6) (7.05%; 24 observations), Group of eight (G8) (7.05%; 24 observations), Group of nine (G9) (5.30%; 18 observations), Group of thirteen (G13) (3.83%; 13 observations) and finally Group of fourteen (G14) (4.12%; 14 observations). Joining those sets of Group types together according to the protocol in Appendix O by their resemblance in terms of quantity of people, G4-5 people was more prevalent (72.65%; 247 observations) followed by G8-10 people (12.35%; 42 observations), G11-15 people (7.95%; 27 observations), G6-7 people (7.05%; 24 observations) and G more than 15 people was absent. The centrality non-occurrence was more prevalent (98.11%; 5,408 observations) if compared with the occurrence of centrality that was typically less prevalent (1.89%; 104 observations).

Figures 49, 50, 51, 52, 53, 54, 55, and 56 documented results for the different variables of the *social interaction*, such as: *user ties/bridges, actor ties/bridges, tie/bridge gender types, interaction physical activity levels, interaction types, interaction catalysts and central network*, in relation to the *occurrence of ties/bridges* for the 4 segments of the BCGW.

Of the 5,512 observations for the BCGW, segment 1 presented a total of 25.96% and 1,431 observations; segment 2 presented a total of 22.77% and 1,255 observations; segment 3 presented a total of 18.59% and 1,025 observations, and segment 4 presented a total of 32.68% and 1,801 observations. The total *non-occurrence of ties/bridges* of the BCGW was

4,377 observations (79.40%), in which each segment presented distinctive outcomes for *non-occurrence of ties/bridges*: segment 1 (s1: with 79.24%; 1,134 observations), segment 2 (s2: with 78.57%; 986 observations), segment 3 (s3: with 77.75%; 797 observations) and segment 4 (s4: with 81.06%; 1,460 observations). The total *occurrence of ties/bridges* of the BCGW was 1,135 observations (20.60%), in which each segment presents different outcomes: segment 1 (s1: with 20.76%; 297 observations), segment 2 (s2: with 21.43%; 269 observations), segment 3 (s3: with 22.24%; 228 observations) and segment 4 (s4: with 18.93%; 341 observations), as illustrated in maps figures 44, 45, 46 and 47.

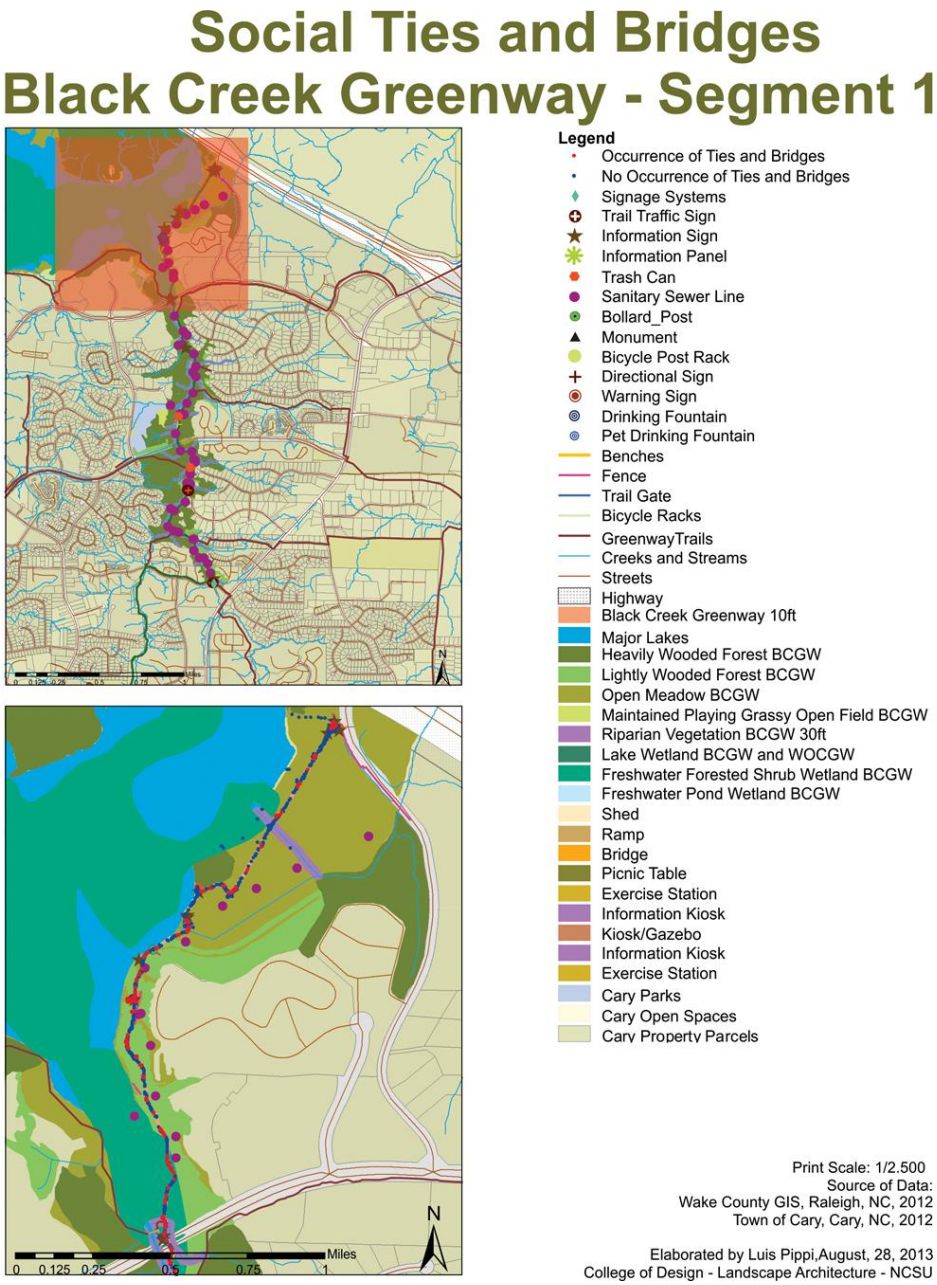

Figure 44: Ties/Bridges in Segment 1 of the BCGW.

Source: Pippi (2013)

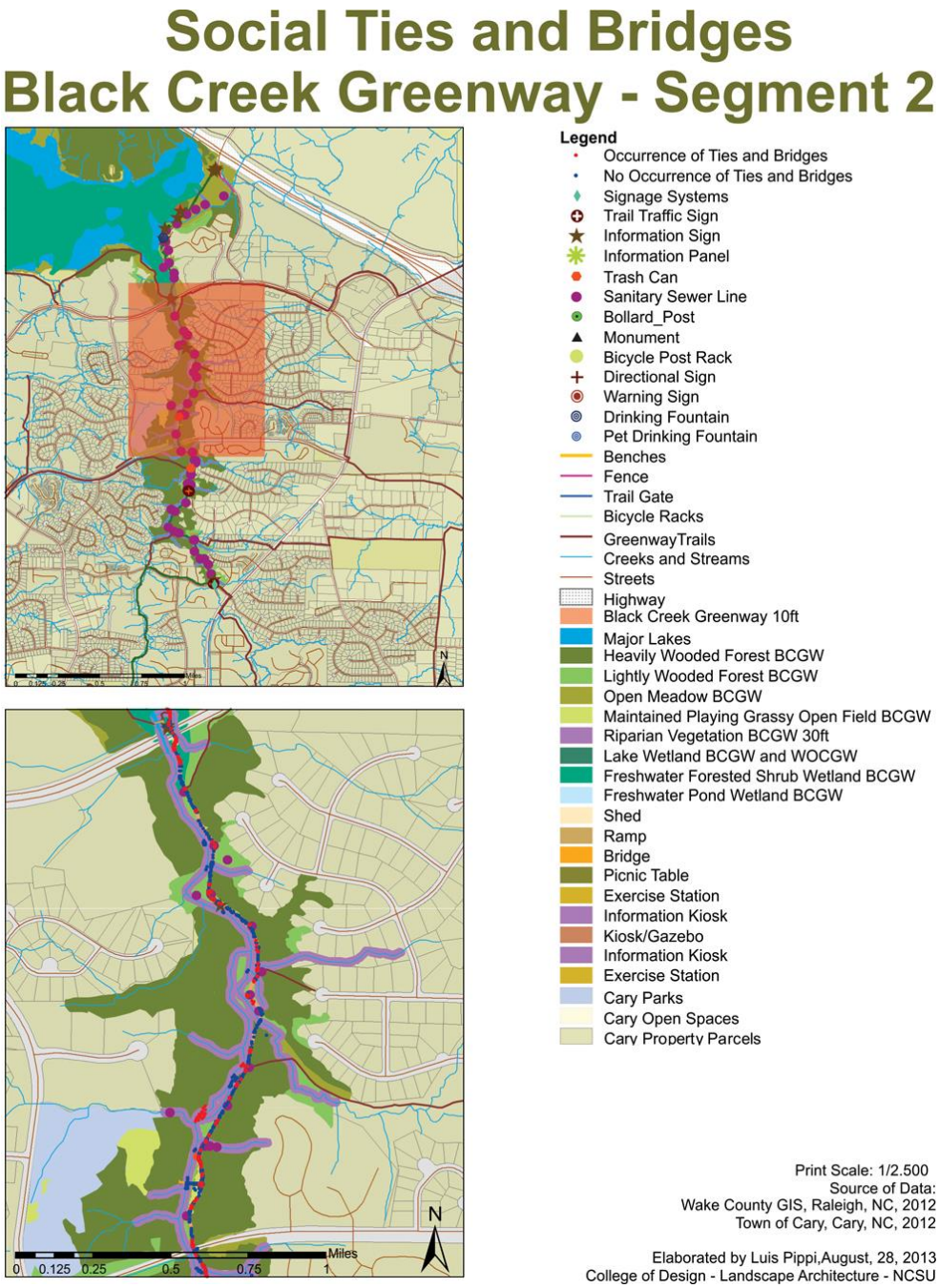

Figure 45: Ties/Bridges in Segment 2 of the BCGW.

Source: Pippi (2013)

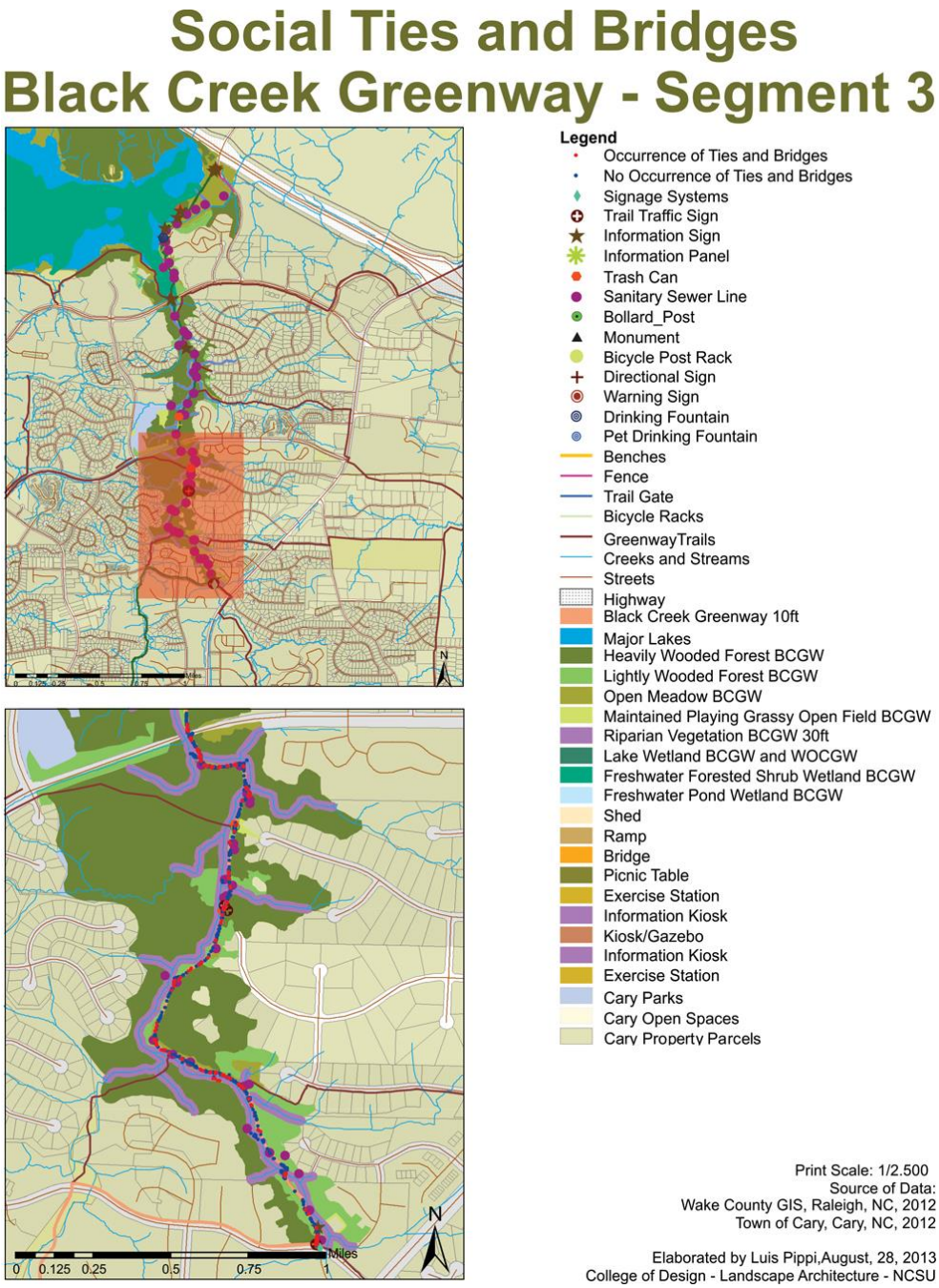

Figure 46: Ties/Bridges in Segment 3 of the BCGW.

Source: Pippi (2013)

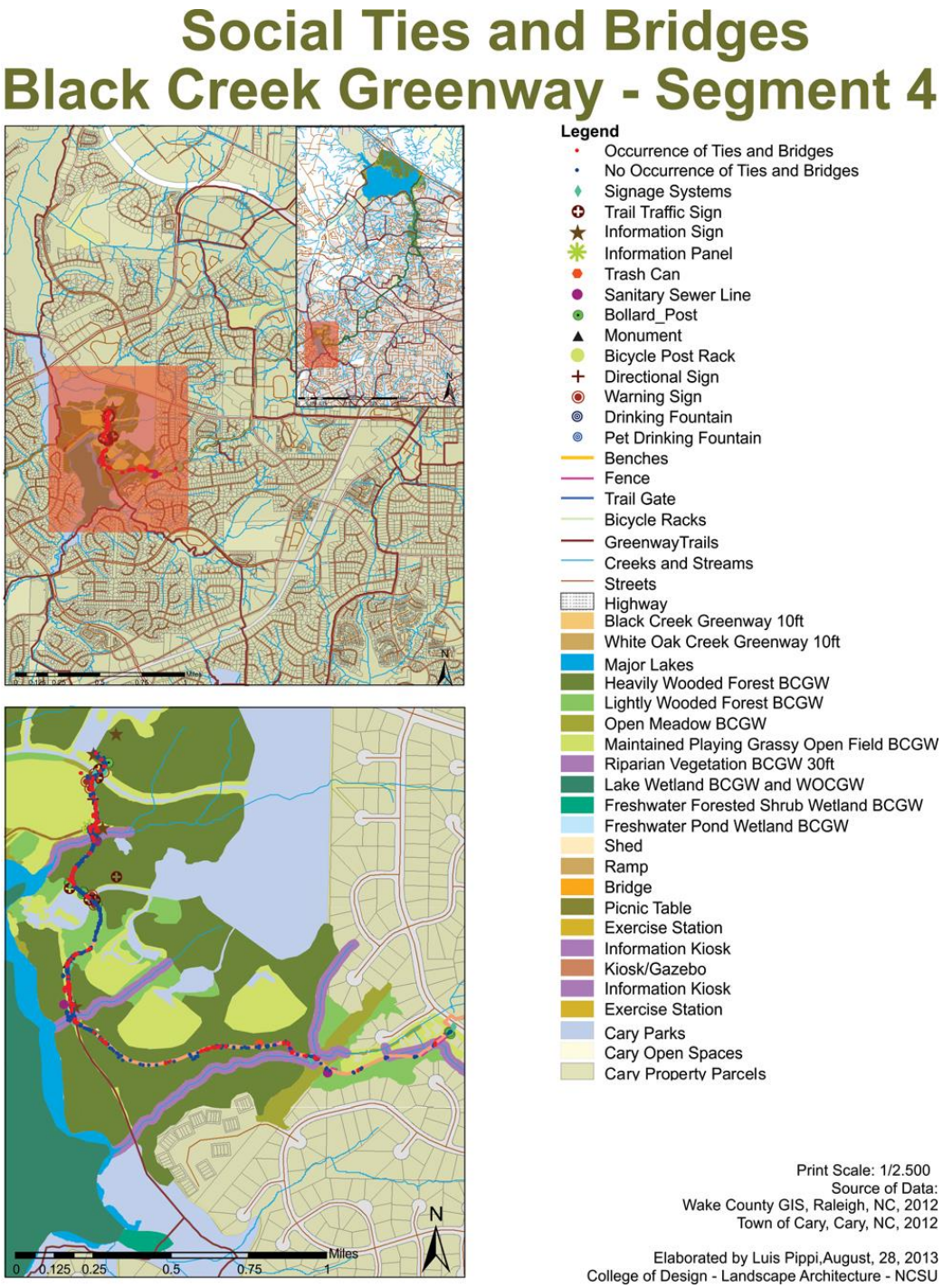

Figure 47: Ties/Bridges in Segment 4 of the BCGW.

Source: Pippi (2013)

Figure 48 shows the correlation of the *non-occurrence* and *occurrence of ties/bridges* in each of the greenway segments. Of the 4 segments of the BCGW, the segment 4 (s4) presented the highest incidence in terms of *non-occurrence* and the lowest incidence in terms of *occurrence of ties/bridges* respectively with 81.07% and 18.93%, respectively, if compared to the other segments. The segment 3 (s3) presented the opposite results, with the lowest incidence in terms of *non-occurrence* and the highest incidence in terms of occurrence of *ties/bridges,* with 77.76% and 22.24%, respectively, when associated to the other segments. Segments 1, 2 and 3 presented similar moderate results in terms of *non-occurrence and occurrence of ties/bridge* respectively*:* segment 1 (s1: with 79.24% and 20.76%, respectively), segment 2 (s2 with 78.57% and 21.43%, respectively) and segment 3 (s3: with 77.76% and 22.24%, respectively). The four segments presented more greater incidence of *non-occurrence of ties/bridges* than of *occurrences of ties/bridges* that are presented (s4: with 81.07%; s1: with 79.24%; s2 78.57%; s3: with 77.76%). On the other hand, in terms of the *occurrences of ties/bridges,* segment 3 presented the highest score (s3: with 22.24%) and segment 4 the lowest score (s4: with 18.93%).

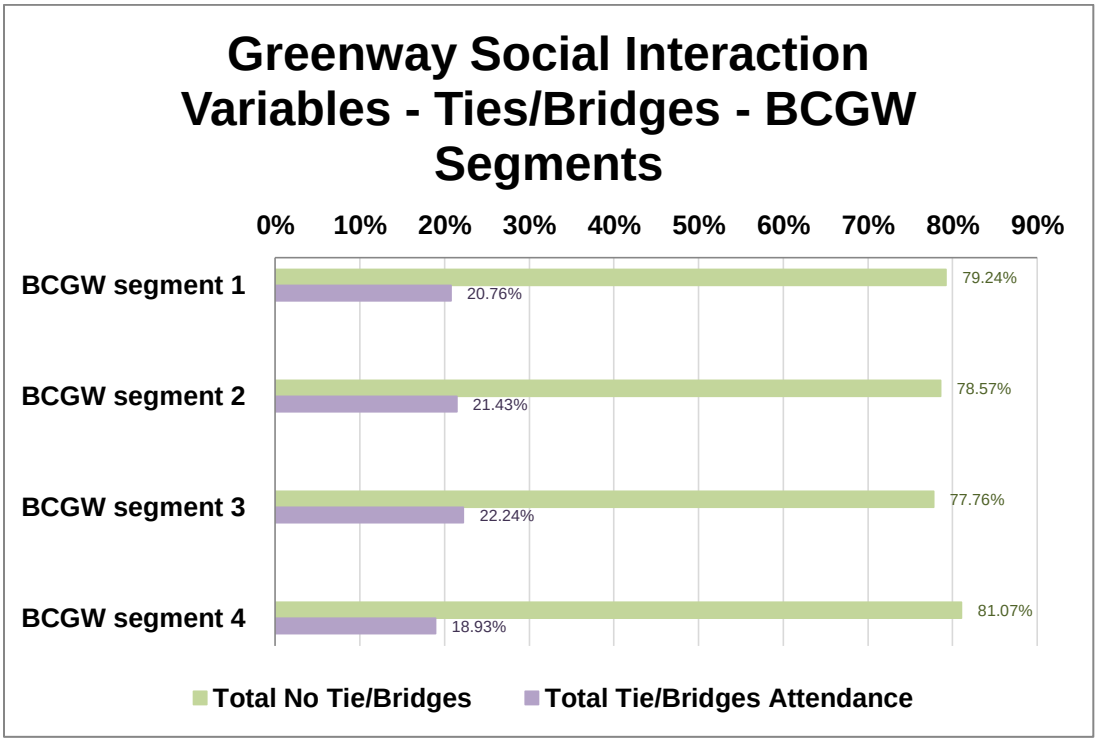

Figure 48: Presence of Tie/Bridges per Segment of the BCGW.

Source: Pippi (2013)

Figures 49, 50, 51, 52, 53, 54, 55 and 56 documented results for the different variables of *social interaction*, such as: *user ties/bridges, actor ties/bridges, tie/bridge gender types, interaction physical activity levels, interaction types, interaction catalysts and central network*, in relation with the occurrence *of ties/bridges attendance* for the 4 segments of the BCGW. Of the 1,135 occurrences *of ties/bridges*, segment 1 (s1), presented 297 observations, segment 2 (s2) presented 269 observations, segment 3 (s3) presented 228 observations and segment 4 (s4) presented 341 observations.

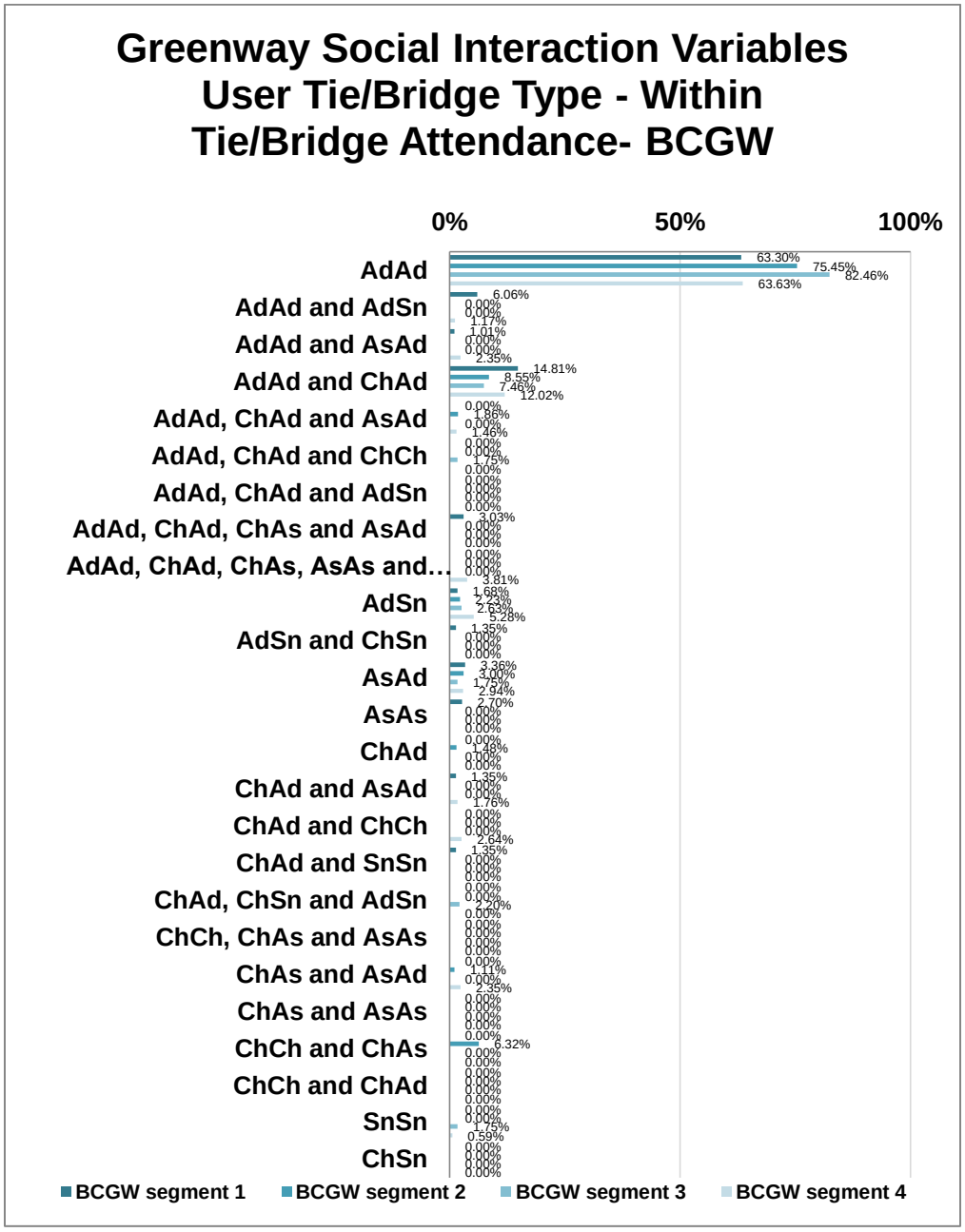

Figure 49: Chart Comparing the User Tie/Bridge Types per Segment Type of the BCGW.

Source: Pippi (2013)

Figure 49 shows the results for the different user ties/bridges categories within the dataset presenting the *occurrence of ties/bridges* for the four segments of the BCGW. The most predominant category was in the Adults with Adults category (AdAd) which presented the highest values in all the four segments, if related to the other relational categories (s3: with 82.46%; 188 observations; s2: with 75.45%; 203 observations; s4: with 63.63%; 217 observations; s1: with 63.30%; 188 observations). The values for segments 1 and 2 were higher when compared with the values in segments 4 and 1.

As illustrated in figure 49, some categories presented moderate values results for all the four segments. The Adults with Adults and Children with Adults (AdAd and ChAd) category is presented in a descending order: s1: with 14.81%; 44 observations; s4: with 12.02%; 41 observations; s2: with 8.55%; 23 observations; s4: with 7.45%; 17 observations. The next relational category in terms of lower user age relation was the Adults with Seniors (AdSn), presented in descending order: s4: with 5.28%; 18 observations; s3: with 2.63%; 6 observations; s2: with 2.23%; 6 observations; s4: with 1.68%; 5 observations. The Adolescents with Adults (AsAd) category consisted of: s1: with 3.36%; 10 observations; s2: with 3.00%; 8 observations; s3: with 2.94%; 4 observations; s4: with 1.75%; 10 observations. The category Children with Children and Children with Adolescents, also with moderate value, was only found in segment 2 (s2: 6.32%; 17 observations). The category of Adults with Adults and Adults with Seniors (AdAd and AdSn) presented a reasonable value, but was only found on segment 1 (s1: with 6.06%; 18 observations).

Figure 49 shows that the other categories presented lower results in terms of relational interactions and that interactions only occurred in one or two segments. Five categories were absent: 1) Children with Children, Children with Adolescent and Adolescent with Adolescent (ChCh, ChAs and AsAs), 2) the Adult with Adult, Children with Adult and Adult with Senior (AdAd, ChAd and AdSn); 3) the Children with Adolescent and Adolescent with Adolescent (ChAs and AsAs), 4) the Children with Children and Children with Adolescent (ChCh and ChAd), 5) the Children with Senior (ChSn).

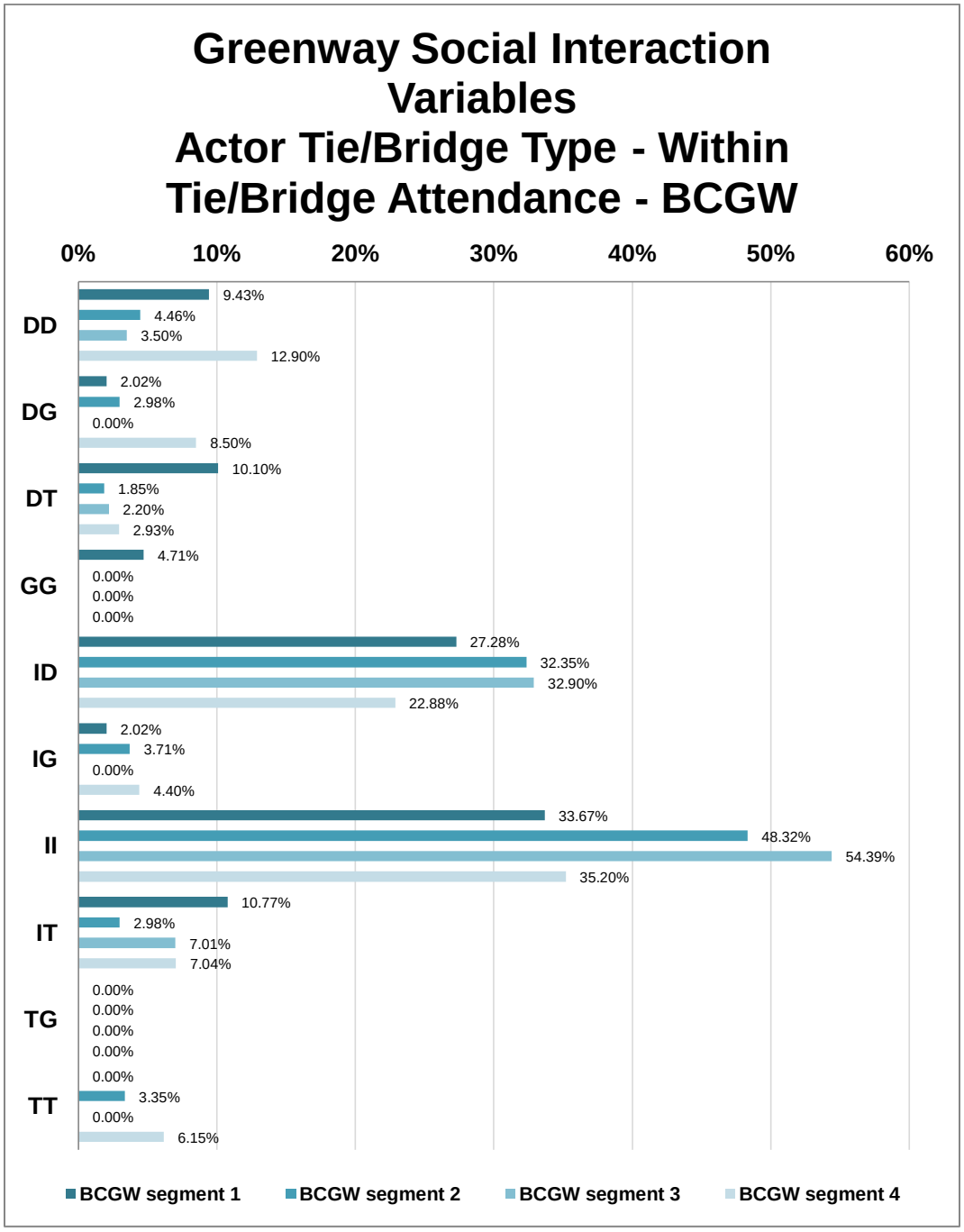

Figure 50: Chart Comparing the Actor Tie/Bridge Types per Segment Type of the BCGW.

Source: Pippi (2013)

The chart in figure 50 associates the presence of actor tie/bridge types within each of the BCGW segment types, within the data set for the *occurrence of ties/bridges*. The most prevalent actor ties/bridges category was Individual with another individual (II) (s3: with 54.39%; 124 observations; s2: with 48.32%; 130 observations; s1: with 33.67%; 100 observations; s4: with 35.20%; 120 observations). For this category, segments 3 and 2 presented the highest results, followed by segments 4 and 1. The category of Individual and Dyad (ID) presented moderate results in all four segments (s3: with 32.90%; 75 observations; s2: with 32.35%; 87 observations; s1: with 27.28%; 81 observations; s4: with 22.88%; 78 observations). The Dyad with Dyad (DD) category presented moderate results in segment 4 (s4: with 12.90%; 44 observations) and segment 1 (s1: With 9.43%; 28 observations). Individual and Triad (IT) relation presented also moderate results in segment 1 (s1: with 10.71%; 32 observations), but lower results in the other segments. Dyad and Triad (DT) category presented moderate results in segment 1 (s1: with 10.10%; 30 observations) but lower results in the other segments. The Group with Group (GG) category only occurred in segment 1 (s1: 4.71%; 14 observations).

Figure 50 shows the categories that presented lower results in terms of actor relational ties/bridges,: Dyad with Dyad (DD), Dyad with Group (DG), Dyad with Triad (DT), Group with Group (GG), Individual and Group (IG), Individual and Triad (IT) and Triad with Triad (TT). The relationship between Groups and Groups were only observed in segment 1. Only the category Triad and Group (TG) was absent.

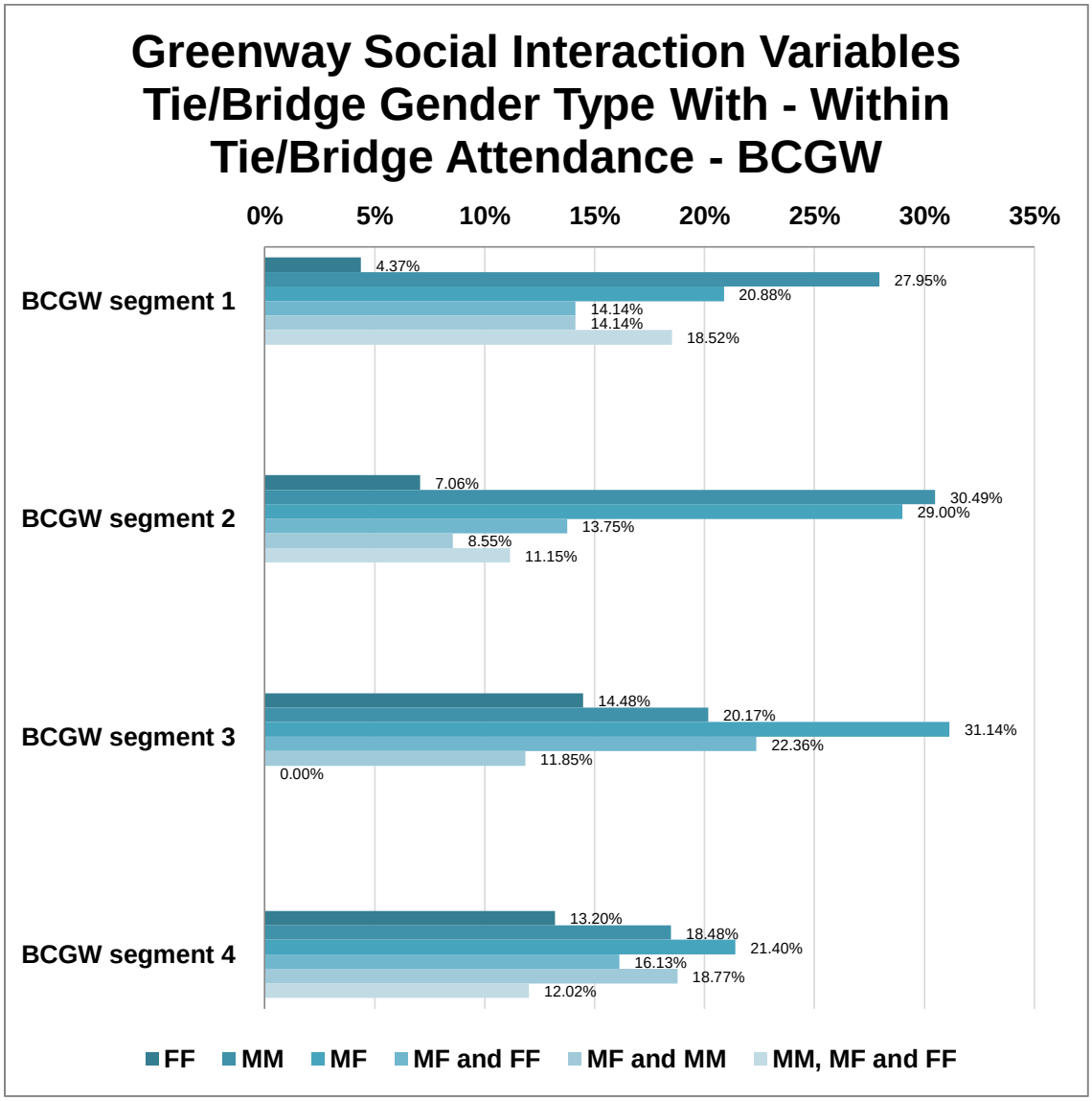

Figure 51: Chart Comparing the Gender Tie/Bridge Types per Segment Type of the BCGW.

Source: Pippi (2013)

The chart in figure 51 shows the results from the data set of *occurrence of ties/bridges* within the different gender categories. Some tie/bridge gender categories are very similar in terms of the minimum difference between each other. For the Males and Females (MF) relation, the segment 3 presented the highest result if compared to all categories and all segments (s3: with 31.14%; 71 observations). In segments 2 and segment 1 the results for the Male with Male (MM) category is higher if compared with the same and the other categories in other segments, segment 1 (s1: with 30.49%; 83 observations) and segment 2 (s2: with 27.95%; 82 observations). Segment 4 presented, after segment 3, greater incidence of Males and Females (s4: with 21.40%; 73 observations). In segment 1 the category of Males and Males, Males and Females with Females and Females (MM, MF and FF) was the highest (s1: with 18.25%; 55 observations) if compared to the other segments that presented lower and similar results. The category of Males and Females with Males and Males (MF and MM) was highest in segment 4, if compared to the other segments (s4: with 18.77%; 64 observations). The category of Females with Females (FF) was more prevalent and in segments 3 and 4 (s3: 14.48%; 33 observations; s4: with 13.20%; 45 observations). The category of Males and Females with Males and Males (MF and MM) was more prevalent in segment 3 (s3: with 22.36%; 27 observations), followed by segment 2 (s2: with 13.75%; 23 observations).

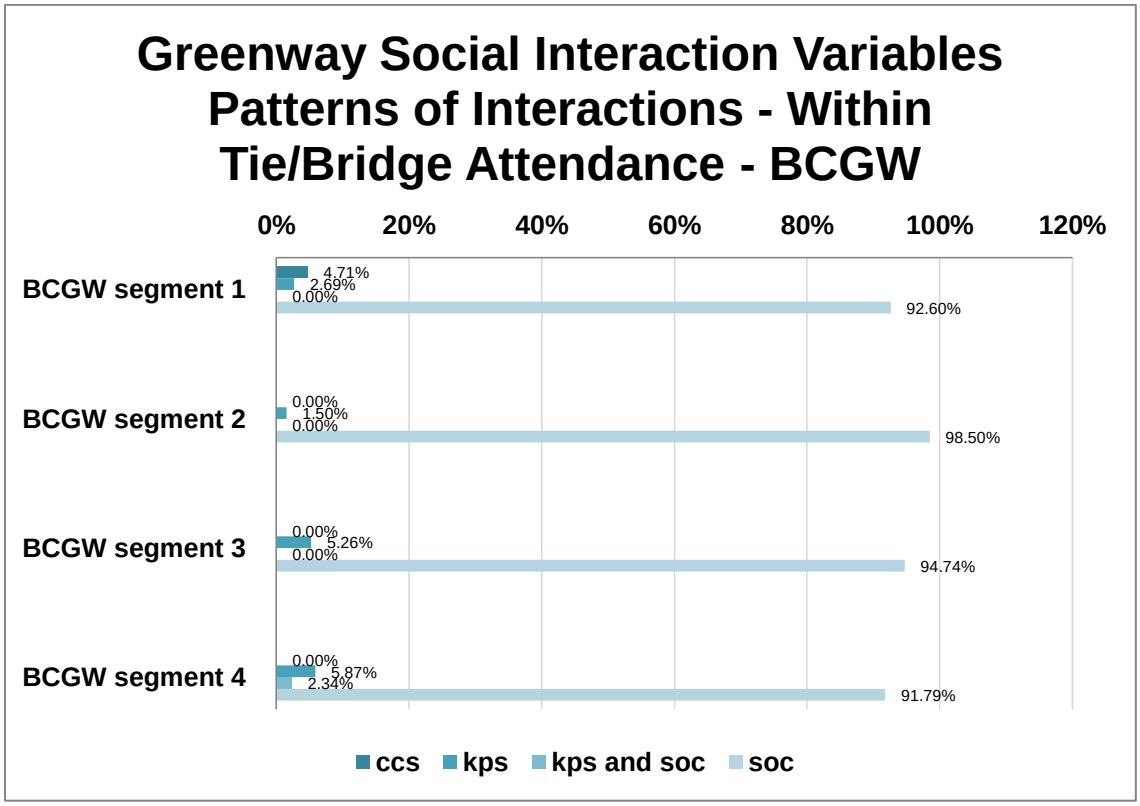

Figure 52: Chart Correlating the Patterns of Interactions Attendance per Segment Type of the BCGW.

Source: Pippi (2013)

Figure 52 presents the patterns of interaction types from the dataset for the *occurrence of ties/bridges*. The four segments presented similar and higher results in the Socializing (soc) category, and are presented in a descending order: s2: with 98.50%; 265 observations; s3: with 94.74%; 216 observations; s1: with 92.60%; 275 observations; s4: with 91.79%; 313 observations. All the other categories presented significantly lower scores if compared to the Socializing (soc) category. The Kinship Pattern of Socialization (kps) occurred in all segments, but was more predominant in segment 4 (s4: with 5.26%; 20 observations) and segment 3 (s3: with 5.87%; 12 observations). The Cultural Customs Sharing category (ccs)

was only found in segment 1 (s1: with 4.71%; 14 observations). The Kinship Pattern of Socialization and Socializing (kps and soc) category were only found in segment 4 (s4: with 2.34%; 8 observations).

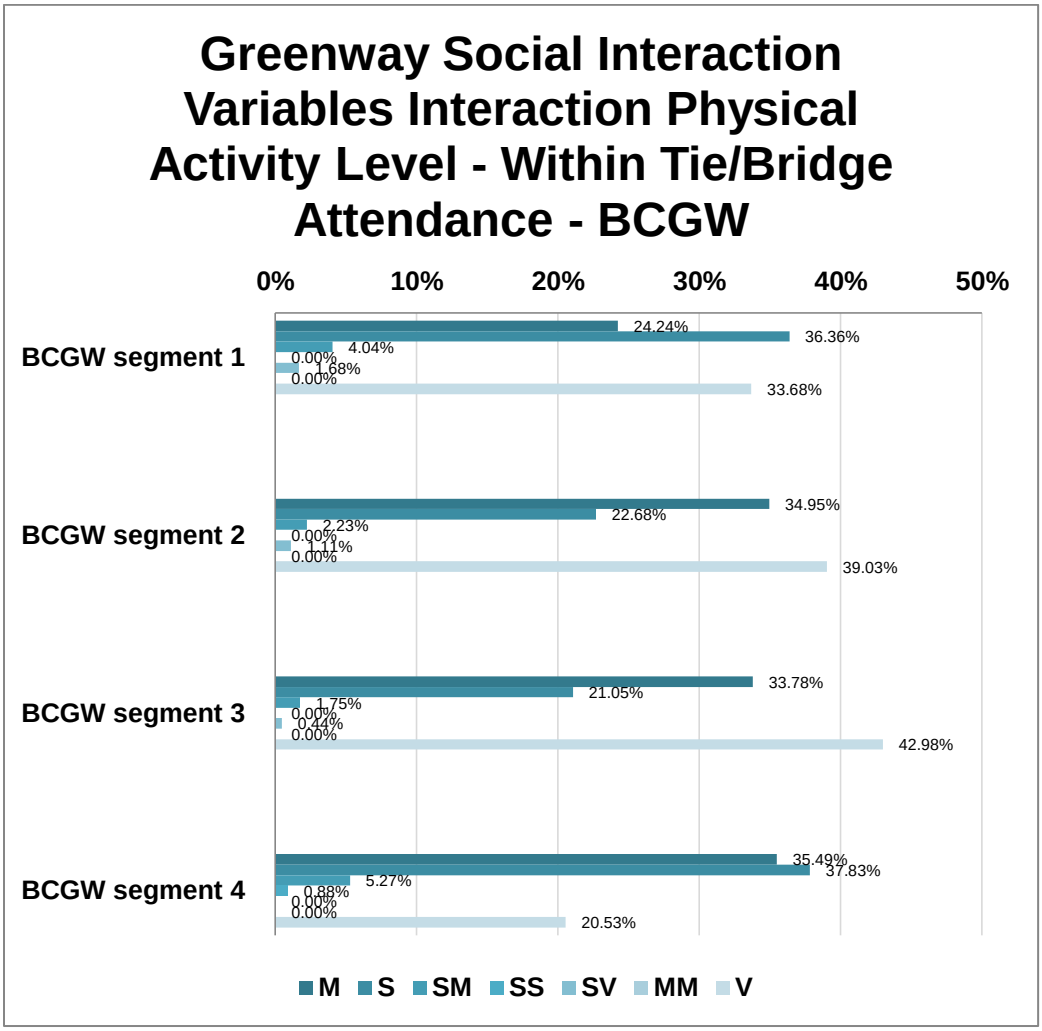

Figure 53: Chart Comparing the Interaction Physical Activity Levels Attendance per Segment Type of the BCGW.

Source: Pippi (2013)

Figure 53 presents the interaction activity level categories from the dataset for the *occurrence of ties/bridges* attendance. Sedentary (S), Moderate (M) and Vigorous (V) categories presented moderate outcomes. The highest values was found in the Vigorous (V) category, for segment 3 and 2 (s3: with 42.98%; 98 observations and s2: with 39.03%; 105 observations), followed by the segments 1 and 4 which presented lower scores (s1: with 33.68%; 100 observations and s4: with 20.53%; 70 observations). Subsequently, the Moderate (M) category also presented high values in segment 4 (s4: 35.49%; 121 observations), followed by segments 2 and 3 (s2: 34.95%; 97 observations and s3: with 33.78%; 77 observations) witch were similar, and lastly the segment 1 (s1: with 24.24%; 72 observations). In the Sedentary (S) category, segments 4 and 1, respectively, presented higher values, in this category, if compared to the other segments (s4: with 37.86%; 129 observations and s1: with 36.36%; 108 observations). The Sedentary and Moderate (SM) categories presented lower scores and were found with greater incidence in segments 4 and 1, respectively (s4: with 5.27%; 18 observations and s1: with 4.04%; 12 observations). The Sedentary with Sedentary (SS) category was only found in segment 4 with a very low score (s4: with 0.88%). The category Sedentary and Vigorous (SV) were found in all segments, except in segment 4, with also lower scores, and was more prevalent in segment 1 and 2 respectively (s1: with 1.68%; 5 observations and s2: with 1.11%; 3 observations). The category of Moderate and Moderate (MM) interaction activity level was absent in all segments.

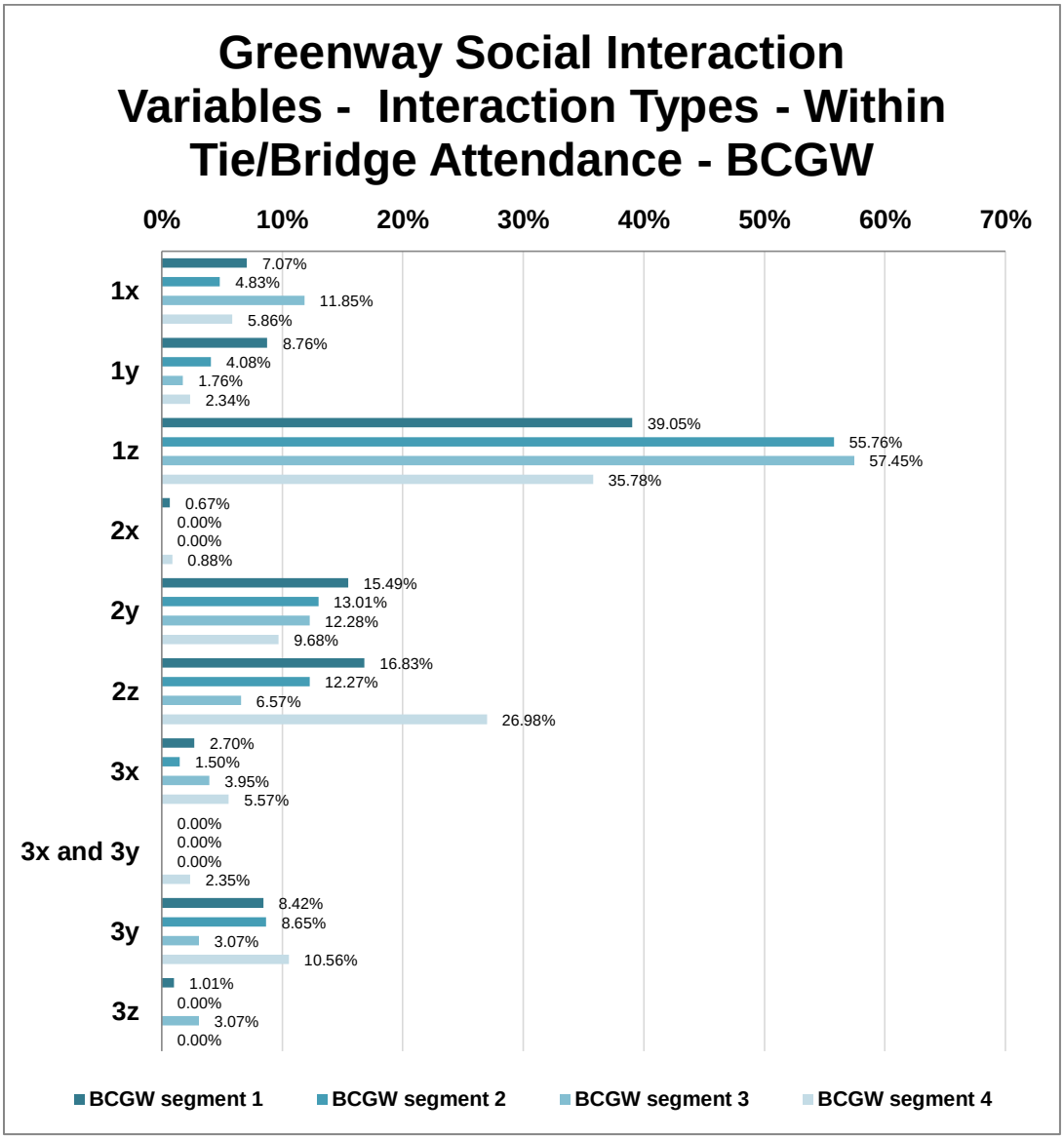

Figure 54: Chart Comparing the Interaction Types per Segment of the BCGW.

Source: Pippi (2013)

Figure 54shows results for the interaction types from the dataset for the *occurrence of ties/bridges*. See Appendix U for an in-depth description of the interaction level categories. The 1z (greeting strangers) category showed the highest outcomes out of the three categories within the lower level of interaction. Two categories 2z (casual meeting between strangers) and 2y (casual meeting between friends) were more prevalent within the moderate level of interaction, and category 3y (shared activity with friends) was more prevalent, out of the four categories of the higher level of interaction. These categories will be described in two ways: within the same level of interaction and across levels. Across all interaction levels, the category 1z (greeting strangers) presented the highest scores in each of the four segments, (s3: with 57.45%; 131 observations; s2: with 55.76%; 150 observations; s1: with 39.05%; 116 observations; s4: with 35.78%; 122 observations). The category 1x (smile/wave), with moderate-low outcomes, was more prevalent for segment 3 (s3: with 11.85%; 27 observations), while category 1y (greeting a friend), also with moderate-low values, was more prevalent in segment 1 (s1: 8.76%; 26 observations).

Figure 54 shows that within the moderate level of interaction, two categories presented moderate results: the category 2z (casual meeting between friends) was more prevalent in segments 4, 1 and 2 (s4: with 26.98%; 92 observations, s1: with 16.83%; 50 observations and s2: with 12.27%; 33 observations). With similar results, category 2y (casual meeting between friends) presented similar scores (s1: with 15.49%; 46 observations, s2: 13.01%; 35 observations and s3: with 12.28%; 28 observations and s4: with 9.68%; 33 observations). Within the higher level of interaction, category 3x (shared activites between family members) presented low occurrence, with segments 4 and 3 being more prevalent (s4: with 5.57%; 19 observations and s3: with 3.95%; 9 observations). Category 3y (Shared activity between friends) presented moderate-low scores if compared to category 3x (shared activity between family members), with greater incidence in three segments (s4: with 10.56%; 36 observations; s2: with 8.65%; 23 observations and s1: with 8.42%; 25 observations). The categories that presented the lowest or absent scores if compared to all the interaction types categories were category 2x (casual meeting between friends) in which the segments 4 and 1 presented the most prevalent lower scores (s4: with 0.88%; 3

observations and s1: with 0.67%; 2 observations) and categories 3x and 3y (shared activity between family and friends, respectively), which presented occurrence only in segment 4 with lower outcomes (s4: with 2.35%; 8 observations).

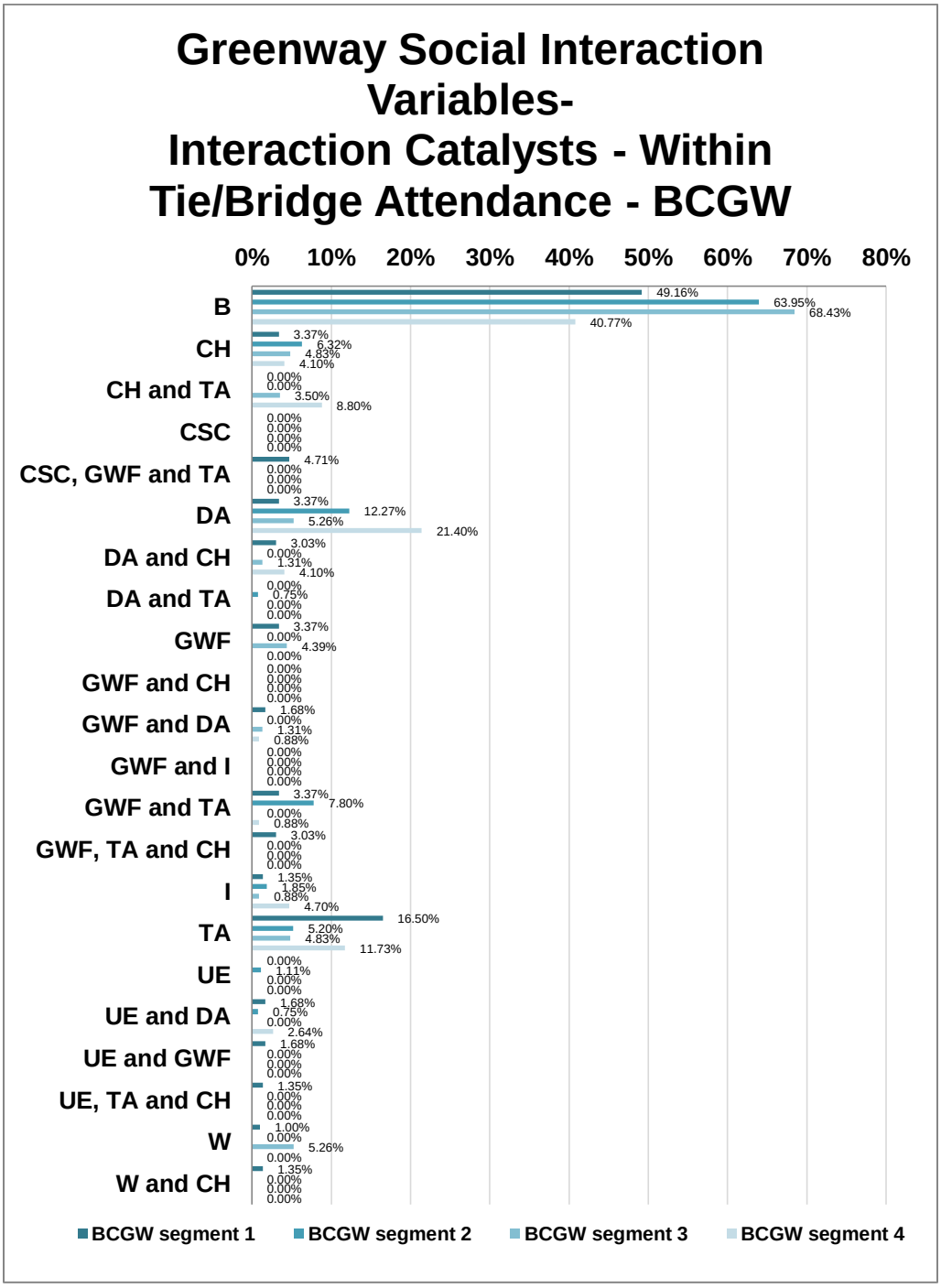

Figure 55: Interaction Catalysts per Segment of the BCGW.

Source: Pippi (2013)

Figure 55 illustrates the results for the different interaction catalyst types within the dataset for the *occurrence of ties/bridges* in the four segments of the BCGW. Of all the catalyst categories, Behavior (B) presented the highest scores in all segments, followed by the Domestic Animals (DA), Type of Activity (TA) and Children (CH), all of which presented moderate-low scores for the four segments. The Behavior (B) category presented the highest values in segments 3 and 2 (s3: with 68.43%; 156 observations and s2: with 63.95%; 172 observations), following by segments 1 and 4 (s1: with 49.16%; 146 observations and s4: with 40.77%; 139 observations). The Domestic Animals (DA) category occurred with greater frequency in segments 4 and 2 (s4: with 21.40%; 73 observations and s2: with 12.27%; 33 observations). The Type of Activity (TA) category was ocurred with greater frequency in segments 1 and segment 4 (s1: with 16.50%; 49 observations and s4: with 11.73%; 40 observations). The Children (CH) category, presented lower values if compared with the previous categories, with greater occurrence in segments 2 and 3 (s2: with 6.32%; 17 observations and s3: with 4.83%; 11 observations).

Figure 55 shows the results for categories presenting lower ocurrence. The information (I) category presented low scores in all segments, the highest occurrence being in segments 4 and 2 (s4: with 4.70%; 16 observations and s2 with 1.85%; 5 observations). The Children and Type of Activity (CH and TA) category was more prevalent in segments 4 and 3 (s4: with 8.80%; 30 observations and s3: with 3.50%; 8 observations). Domestic Animals and Children (DA and CH) category was more prevalent and with low scores in segments 4 and 1 (s4: 4.10%; 14 observations and s1: with 3.03%; 9 observations). The Greenway Features (GWF) presented correspondent lower scores if compared with the previous categories with greater ocurrence in segments 3 and 1 (s3: with 4.39%; 10 observations and s1: with 3.37%; 10 observations). This category merged to the other interaction catalyst categories, generating new categories such as the Greenway Features and Type of Activity (GWF and TA) category that presented moderate-low scores in segments 2 and 1 (s2: with 7.80%; 21 observations and s1: with 3.37%; 10 observations) and low score in segment 4 (s4: with 0.88%; 3 observations). Greenway Features and Domestic Animals (GWF and DA) presented correspondent lower scores in the segments 1, 3 and 4 (s1: with 1.68%; 5

observations, s3: with 1.31%; 3 observations and s4: 0.88%; 3 observations). Greenway Features, Type of Activity and Children (GWF, TA and CH) occurred only in segment one with low score (s1: with 3.03% and 9 observations). Cultural Sharing Customs, Greenway Features and Type of Activity (CSC, GWF and TA) category occurred only in segment 1 with low frequency (s1: 4.71%; 14 observations). Unexpected Experience and Domestic Animals (UE and DA) category occurred in segments 4, 1 and 2, and presented moderate-low scores values in segments 4 and 1 (s4: with 2.64%: 9 observations and s1: with 1.68%; 5 observations). Wildlife (W) category occurred in two segments, with low scores, the segments 3 and 1 (s3: with 5.26%; 12 observations and s1: with 1.00%; 3 observations).

The following activities were only found in one of the BCGW segments: the Domestic Animals and Type of Activity (DA and TA) category was only observed in segment 2 (s2: 0.75%; 2 observations); Unexpected Experience (UE) only in segment 2 (s2: 1.11%; 3 observations); Unexpected Experience and Greenway Features (UE and GWF) only in segment 1 (s1: with 1.68%; 5 observations); Unexpected Experience, Type of Activity and Children (UE, TA and CH) category only in segment 1 (s1: with 1.35%; 4 observations), and Wildlife and Children (W and CH) category only in segment 1 (s1: with 1.35%; 4 observations). There was no occurrence of the Cultural Sharing Customs (CSC), the Greenway Features and Children (GWF and CH) and the Greenway Features and Information (GWF and I) categories, as illustrated in figure 55.

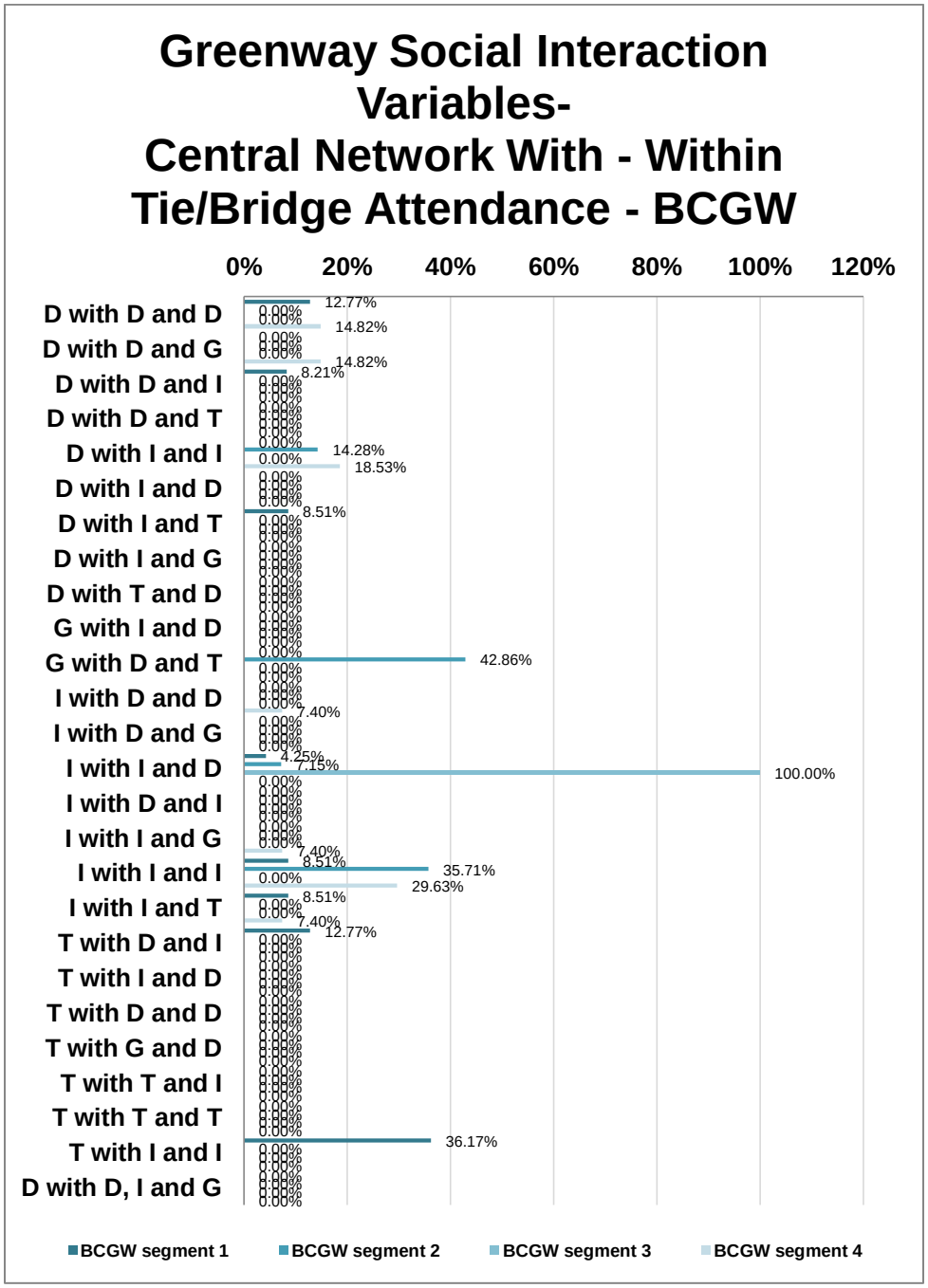

Figure 56: Central Network between Actor Types per Segment of the BCGW.

Source: Pippi (2013)

Figure 56 shows results for the central network categories from the dataset for the *occurrence of ties/bridges*. The central network shows the sequence of interactions in terms of the actor types involved. The category of I with I and D (individual with an individual and a dyad, i.e an individual who interacted with another individual and later with a dyad) presented the highest central network value. This category did not occur in segment 4 and only occurred in segments 2 and 1 with low scores (s2: with 7.15%; 2 observations and s1: with 4.25%; 2 observations). The category of G with D and T (Group with a Dyad and then a Triad) only occurred in segment 2 with moderate scores (s2: 42.86%; 12 observations). The category of I with I and I occurred in three segments and presented moderate values in segments 2 and 4 (s2: with 35.71%; 10 observations and s4: with 29.63%; 8 observations) and low score in segment 1 (s1: with 8.51%; 4 observations). The T with I and I category occurred only in segment 1 (s1: 36.17%; 17 observations). The D with I and I category presented moderate to low values in segments 4 and 2 (s4: with 18.53%; 5 observations and s2: 14.28%; 4 observations). The category D with D and D presented moderate to low scores in segments 4 and 1 (s4: with 14.82%; 4 observations and s1: with 12.77%; 6 observations). The category D with D and G presented moderate-low score only for segment 4 (s4: 14.82%; 4 observations). Also with moderate-low scores was the category T with D and I with occurrence only in segment 1 (s1: with 12.77%; 6 observations). Category D with D and I presented occurrence only in segment one, with low score (s1: with 8.21%; 4 observations), also with similar result the category D with I and T were prevalent in segment 1 (s1: with 8.51%; 4 observations). Comparable with those last two categories is the category I with D and D that was encountered only in segment 4 with low score (s4: 7.40%; 2 observations) and with similar score result the category I with I and G was presented only in segment 4 (s4: 7.40%; 2 observations). Also with low scores, was the category I with I and T that was presented in two segments (s1: with 8.51%; 4 observations and s4: with 7.40%; 2 observations).

The chart in figure 56 illustrates the thirteen central network types that were absent in the BCGW observations: D with D and T; D with I and D; D with I and G; D with T and D; G

with I and D; I with D and G; I with D and I; T with I and D; T with D and D; T with G and D; T with T and I; T with T and T and D with D, I and G.

5.3.2. White Oak Creek Greenway Social Characteristics: General and Specific Findings for Social Network Interactions and Behaviors Observations

The White Oak Creek Greenway (WOCGW) presented a total volume of 4,693 individuals. Of the four segments of the WOCGW, segment 1 presented the highest volume of usage (30.84%; 1,447 observations), followed by the segment 3 (27.61%; 1,296 observations), segment 4 (22.56%; 1,059 observations) and segment 2 (18.99%; 891observations). Pictures are illustrated in Appendix X.

Of these 4,693 observations, for two of the *temporal variables* (week and period of day): use was normally highest during the weekend (57.62%; 2,704 observations) following by the weekday (42.38%; 1,989 observations). Use was typically highest during the evening (37.19%; 1,745 observations) following by morning (32.47%; 1,524 observations) and afternoon (30.34%; 1,424 observations).

Of these 4,693 observations, for three of the *people variables* (user type by gender, user type by age and type of actor): according to user type by gender, Males (55.38%; 2,599 observations) was more prevalent than Females (44.62%; 2,094 observations). According to user type by age, Adult presence was highest (73.23%; 3,437 observations) followed by Children (15.82%; 742 people), Adolescent (8.33%; 391 observations) and Senior with the lowest presence (2.62%; 123 observations). According to the pure actor type, Individual presence was highest (42.85%; 2,011 observations) followed by Dyad (32.30%; 1,516 observations), and both: Triad (13.75%; 645 observations) and Groups (11.10%; 521 observations) with the lowest presence. However, if Dyads and Triads are grouped together, forming the classification of Sub-group, this category showed higher incidence (46.05%; 2,161 observations) either Groups or Individuals actor category. Of the Group Types (100%; 346 observations), Group of four (G4) was more prevalent (36.99%; 128 observations)

followed by Group of five (G5) (28.90%; 100 observations), Group of six (G6) (26.02%; 90 observations) and finally Group of seven (G7) (8.09%; 28 observations).

Of these 4,693 observations, for three of the *social interaction variables* (social ties/bridges, transformative actor type and centrality): social ties/bridges non-occurrence, i.e. the absence of any social tie/bridge or interaction, was more prevalent (73.28%; 3,439 observations) if compared with the occurrence of ties/bridges (26.72%; 1,254 observations). In terms of the transformative actor type, in which an actor was joined by another actor forming a new actor type, Dyads showed the highest incidence (10.27%; 482 observations) followed by Triads (9.07%; 426 observations) and Groups (7.38%; 346 observations with the lowest presence. However, once again if Dyads and Triads are grouped together to from a Sub-Groups category, this category shows the highest incidence (19.34%; 908 observations). Of the Group Types (100%; 346 observations), Group of four (G4) was more prevalent (36.99%; 128 observations) followed by Group of five (G5) (28.90%; 100 observations), Group of six (G6) (26.02%; 90 observations), Group of seven (G7) (8.09%; 28 observations). Combining those sets of different Group types together according to the protocol in Appendix O by their similarity in terms of quantity of people, G4-5 people was more prevalent (65.89%; 228 observations) followed by G6-7 people (34.11%; 118 observations); G8-10 people, G11-15 people and G more than 15 people were absent. Non-occurrence of network centrality was more prevalent (97.16%; 4,560 observations) if compared with the occurrence of centrality (2.84%; 133 observations).

The charts, figures 62, 63, 64, 65, 66, 67, 68 and 69, documented results for the, different variables of the *social interaction variables*, such as: *user ties/bridges, actor ties/bridges, tie/bridge gender types, interaction physical activity levels, interaction types, interaction catalysts and central network with*, in relation with to the *occurrence of ties/bridges* for the 4 segments of the WOCGW.

Of the 4,693 observations for the WOCGW, segment 5 presented a total of 30.84% and 1,447 observations, segment 6 presented a total of 18.99% and 891 observations, segment

7 presented a total of 27.61 and 1,296 observations and segment 8 presented a total of 22.56% and 1,059 observations. The total *non-occurrence of ties/bridges* of the WOCGW was 3,439 observations (73.28%), in which each segment presented distinctive outcomes: segment 5 (s5: with 71.31%; 1,032 observations), segment 6 (s6: with 79.68%; 710 observations), segment 7 (s7: with 74.38%; 962 observations) and segment 8 (s8: with 69.40%; 735 observations). The total *occurrence of ties/bridges* of the WOCGW was 1,254 observations (26.72%), in which each segment presented substantially different outcomes: segment 5 (s5: with 28.69%; 415 observations), segment 6 (s6: with 20.32%; 181 observations), segment 7 (s7: with 25.62%; 334 observations) and segment 8 (s8: with 30.60%; 324 observations), as illustrated in maps figures 57, 58, 59 and 60 below.

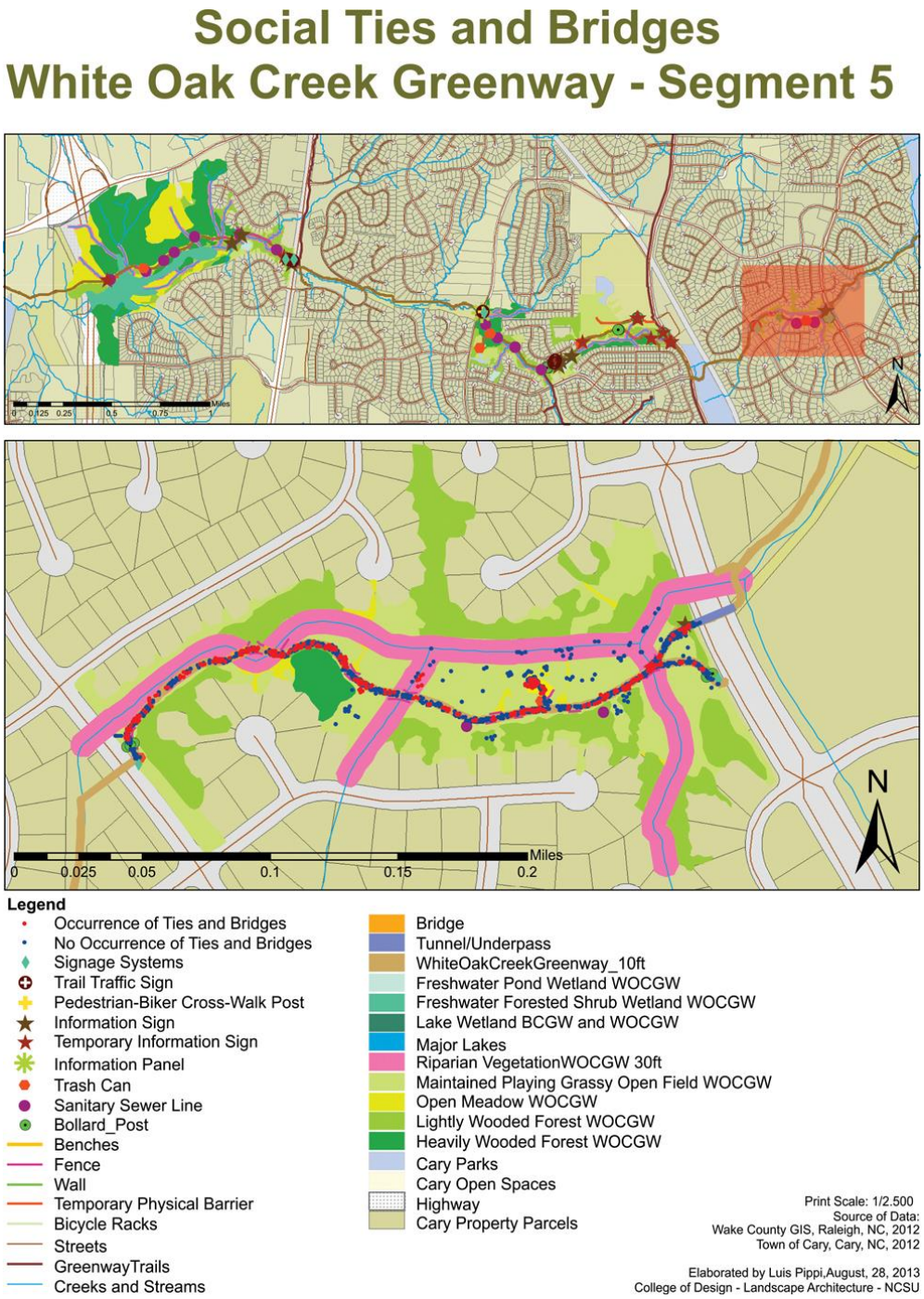

Figure 57: Ties/Bridges in Segment 5 of the WOCGW.

Source: Pippi (2013)

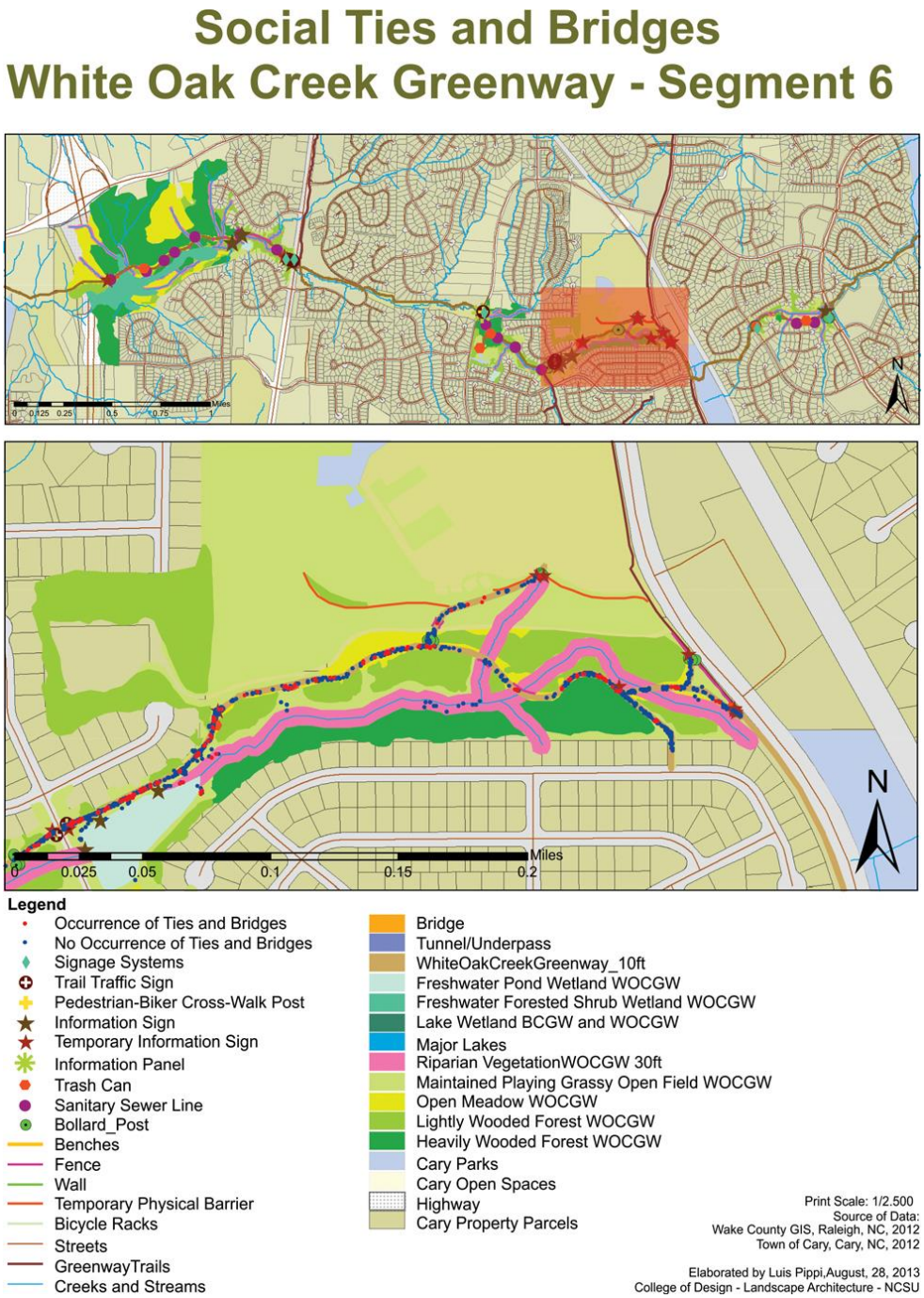

Figure 58: Ties/Bridges in Segment 6 of the WOCGW.

Source: Pippi (2013)

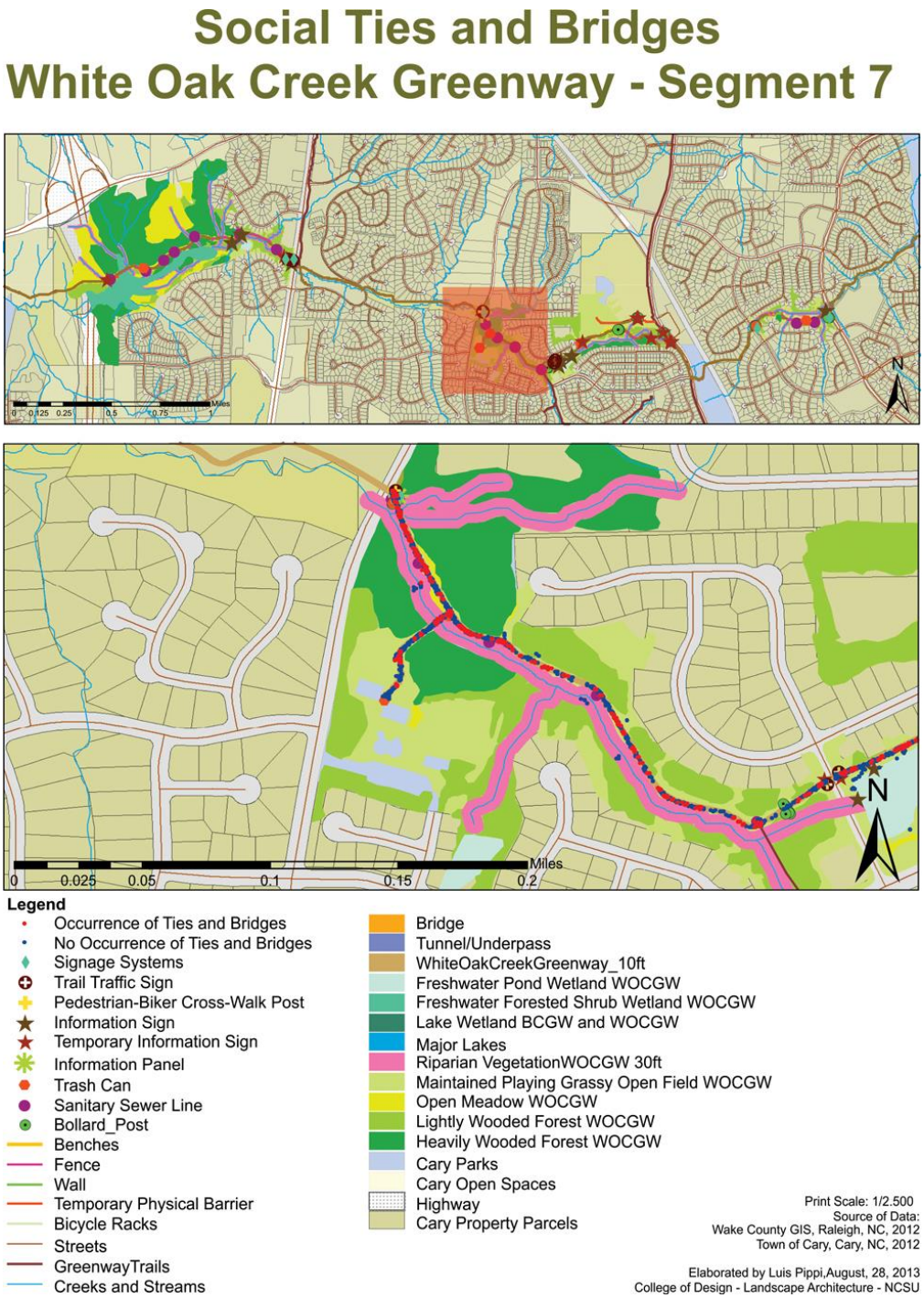

Figure 59: Ties/Bridges in Segment 7 of the WOCGW.

Source: Pippi (2013)

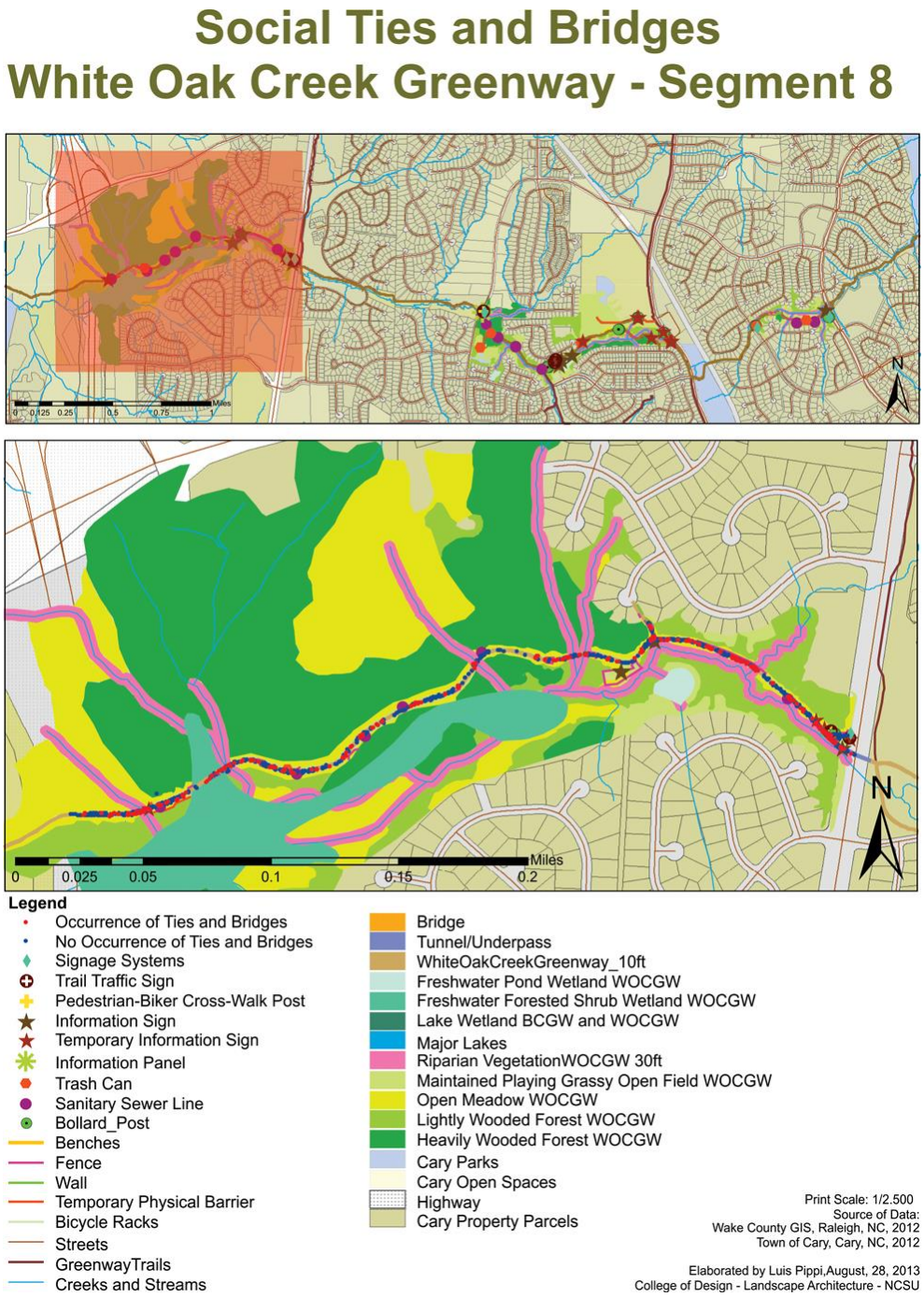

Figure 60: Ties/Bridges in Segment 8 of the WOCGW.

Source: Pippi (2013)

The chart 61 demonstrates the correlation of the *non-occurrence and occurrence of ties/bridges* in each of the greenway segments. Of the 4 segments of the WOCGW, the segments 6 and 7 presented greater *non-occurrence of ties/bridges* respectively with 79.68% and 74.38% if compared to the other segments and also with the *occurrence of ties/bridges* in all segments. Segment 8 and 5 presented respectively the lowest *non-occurrence of ties/bridges* values (s8: with 69.40% and s5: with 71.31%) if compared to the other segments. Segments 8 followed by segment 5 respectively surpassed the others segments in terms of *occurrence of ties/bridges* (s8: with 30.60% and 28.69%). Segment 6 presented the lowest values for the *occurrence of ties/bridges* (s6: with 20.32%) if compared with the other segments in this categories.

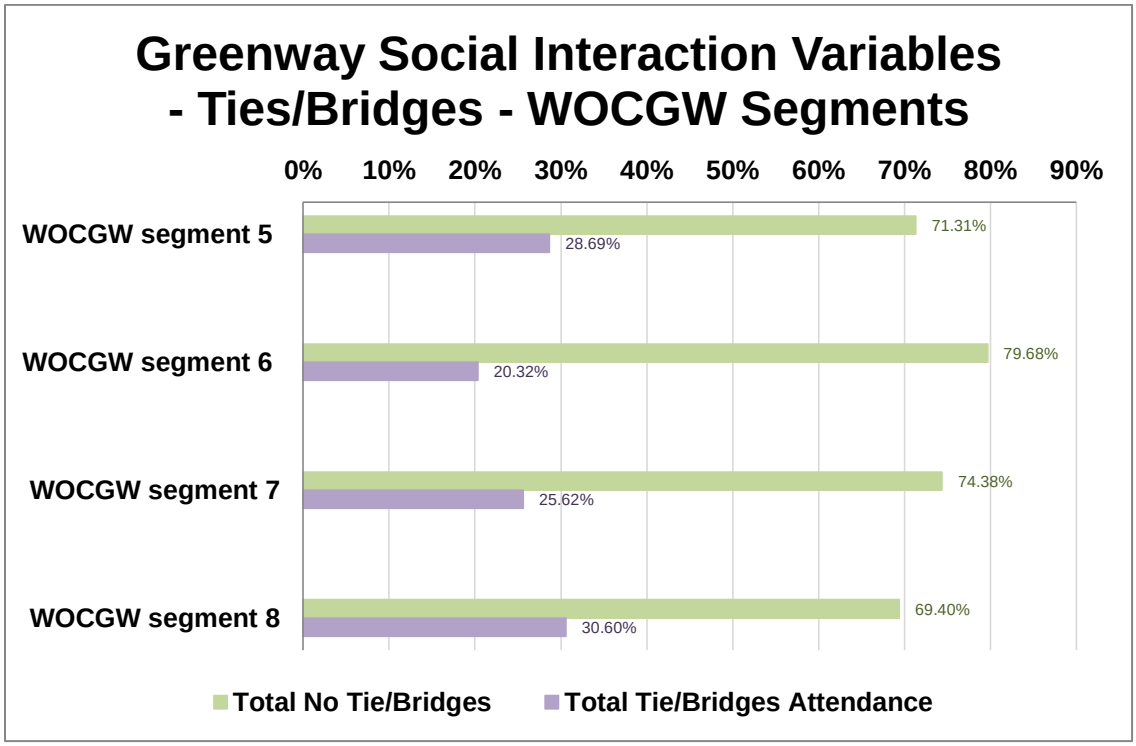

Figure 61: Presence of Tie/Bridges per Segment of the WOCGW.

Source: Pippi (2013)

The charts in figures 62, 63, 64, 65, 66, 67, 68 and 69 documented results for the, different variables of the *social interaction variables*, such as: *user ties/bridges, actor ties/bridges, tie/bridge gender types, interaction physical activity levels, interaction types, interaction catalysts and central network*, in relation with the occurrence *of ties/bridges attendance* for the 4 segments of the WOCGW. Of the 1,254 (Yes: occurrence *of ties/bridges attendance*) segment 5 (s5) presented a total of 415 observations, segment 6 (s6) presented a total of 181 observations, segment 7 (s7) presented a total of 334 observations and segment 8 (s8) presented a total of 324 observations.

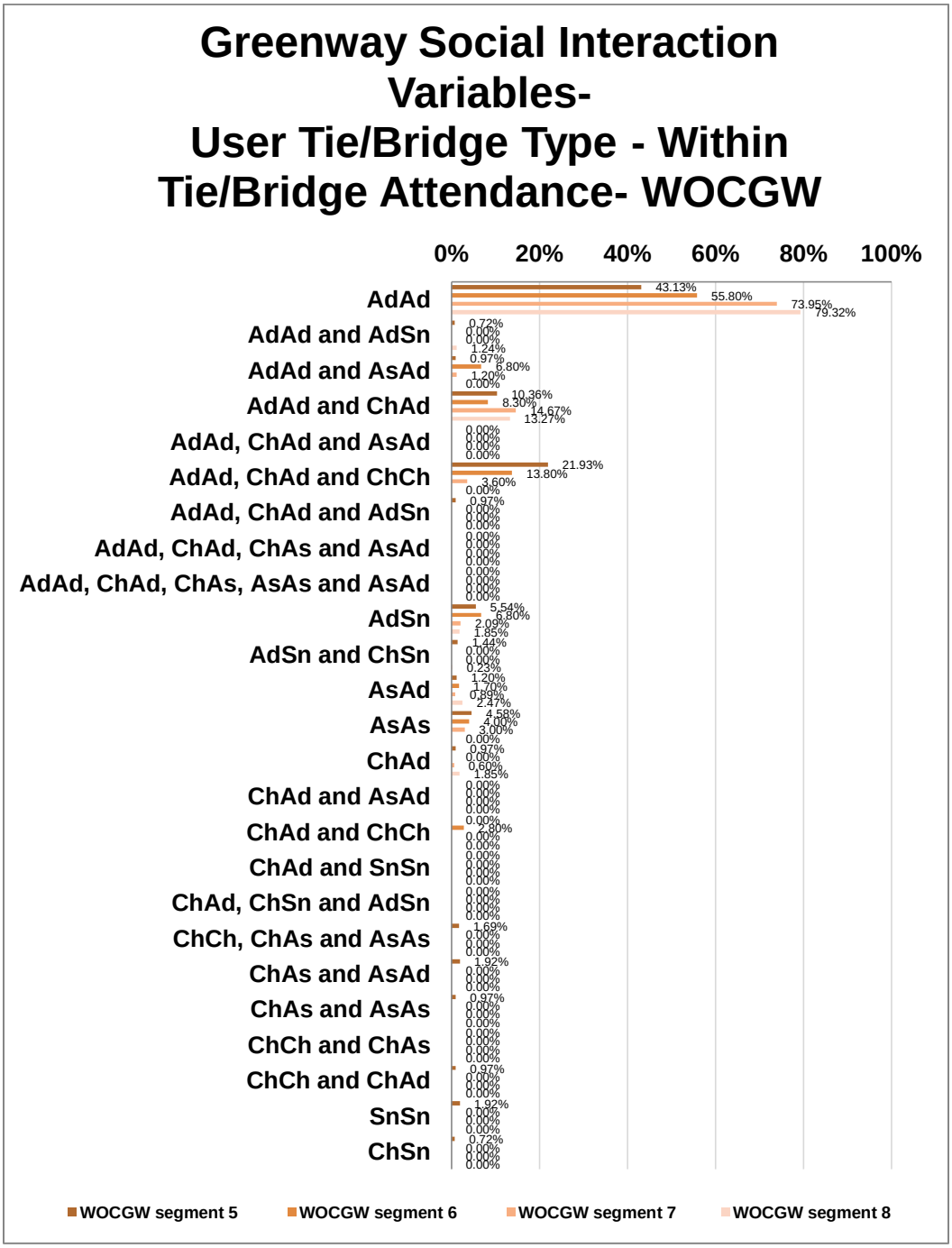

Figure 62: User Tie/Bridge Types per Segment of the WOCGW.

Source: Pippi (2013)

Figure 62 shows the results for the different user ties/bridges categories from the dataset for the *occurrence of ties/bridges* for the four segments of the WOCGW. The most predominant category was in the Adults with Adults (AdAd) category which presented the highest values in all four segments (s8: with 79.32%; 257 observations; s7: with 73.95%; 247 observations; s6: with 55.80%; 101 observations; s5: with 43.13%; 179 observations). The values for segment 8 and 7 (s8 and s7) were higher if compared with the values in segments 6 and 5 (s6 and s5), and segment 8 (s8) was almost twice the value found for segment 5 (s5). The Adult with Adult, Children with Adult and Children with Children category (AdAd, ChAd and ChCh) only occurred in segments 5, 6 and 7 (s5, s6 and s7) with higher values respectively for segments 5 and 6 (s5: with 21.93%; 91 observations and s6: with 13.80%; 25 observations) and lower value for segment 7 (s7: with 3.60%; 12 observations). The category Adult with Adult and Children with Adult (AdAd and ChAd) was found in all the segments and with moderate to low scores (s7: with 14.57%; 49 observations; s8: with 13.27%; 43 observations; s5: with 10.36%; 43 observations; s6: with 8.30%; 13 observations).

As illustrated figure 62, two other categories presented low incidence for all four segments. The Adults with Seniors (AdSn) category had higher values in segments 6 and 5 (s6: with 6.80%; 23 observations; s5: with 5.54%; 12 observations; s7: with 2.09%; 7 observations; s8: with 1.85%; 6 observations); the Adolescent with Adolescent (AsAs) category resulted in similar low scores for segments 5 and 6 (s5: with 4.58%; 19 observations and s6: with 4.00%; 7 observations), followed by segments 7 (s7: with 3.00%; 2 observations). Two categories presented moderate to low scores for segments 8 and 5 (s8 and s5). The Children with Adult (ChAd) category was found in segments 8 and segment 1 (s8: 1.85%; 6 observations and s1: with 0.97%; 4 observations) and the AdAd and AdSn (AdAd and AdSn) category was present in segments 8 and 1 (s8: with 1.24% and s1: 0.72%). The Adult with Senior and Children with Senior (AdSn and ChSn) category was found in segments 5 and 7 with very low scores (s5: 1.44%; 6 observations and s7: 0.23%; 3 observations).

Nine categories presented results only for one segment. The category that presented low scores in segment 6 was the Children with Adult and Children with Children (ChAd and ChCh) (s6: with 2.80%; 5 observations). The categories that presented identical low results for segment 5 were: the Children with Adolescent and Adolescent with Adult (ChAs and AsAd) (s5: with 1.92%; 8 observations) and the Senior with Senior (SnSn) category (s5: with 1.92%; 8 observations), followed by the Children with Children, Children with Adolescent and Adolescent with Adolescent (ChCh, ChAs and AsAs) category (s5: with 1.69%; 7 observations), and the other three categories that presented similar very low scores for segment 5: the Adult with Adult, Children with Adult and Adult with Senior (AdAd, ChAd and AdSn) (s5: 0.97%; 4 observations), the Children with Adolescent and Adolescent with Adolescent (ChAs and AsAs) category (s5: 0.97%; 4 observations) and the Children with Children and Children with Adult (ChCh and ChAd) category with 4 observations), as illustrated in chart, figure 62.

Figure 62, presented the other categories with lower results or that only occurred in one or two segments. Six categories were absent in all of the WOCGW segments: 1) the Adult with Adult, Children with Adult and Adolescent with Adult (AdAd, ChAd and AsAd); 2) the Adult with Adult, Children with Adult, Children with Adolescent and Adolescent with Adult (AdAd, ChAd, ChAs and AsAd); 3) the Adult with Adult, Children with Adult, Children with Adolescent, Adolescent with Adolescent and Adolescents with Adult (AdAd, ChAd, ChAs, AsAs and AsAd); 4) the Children with Adult and Adolescents and Adult (ChAd and AsAd); 5) Children with Adult and Senior with Senior (ChAd and SnSn); 6) the Children with Adult, Children with Senior and Adult and Senior (ChAd, ChSn and AdSn).

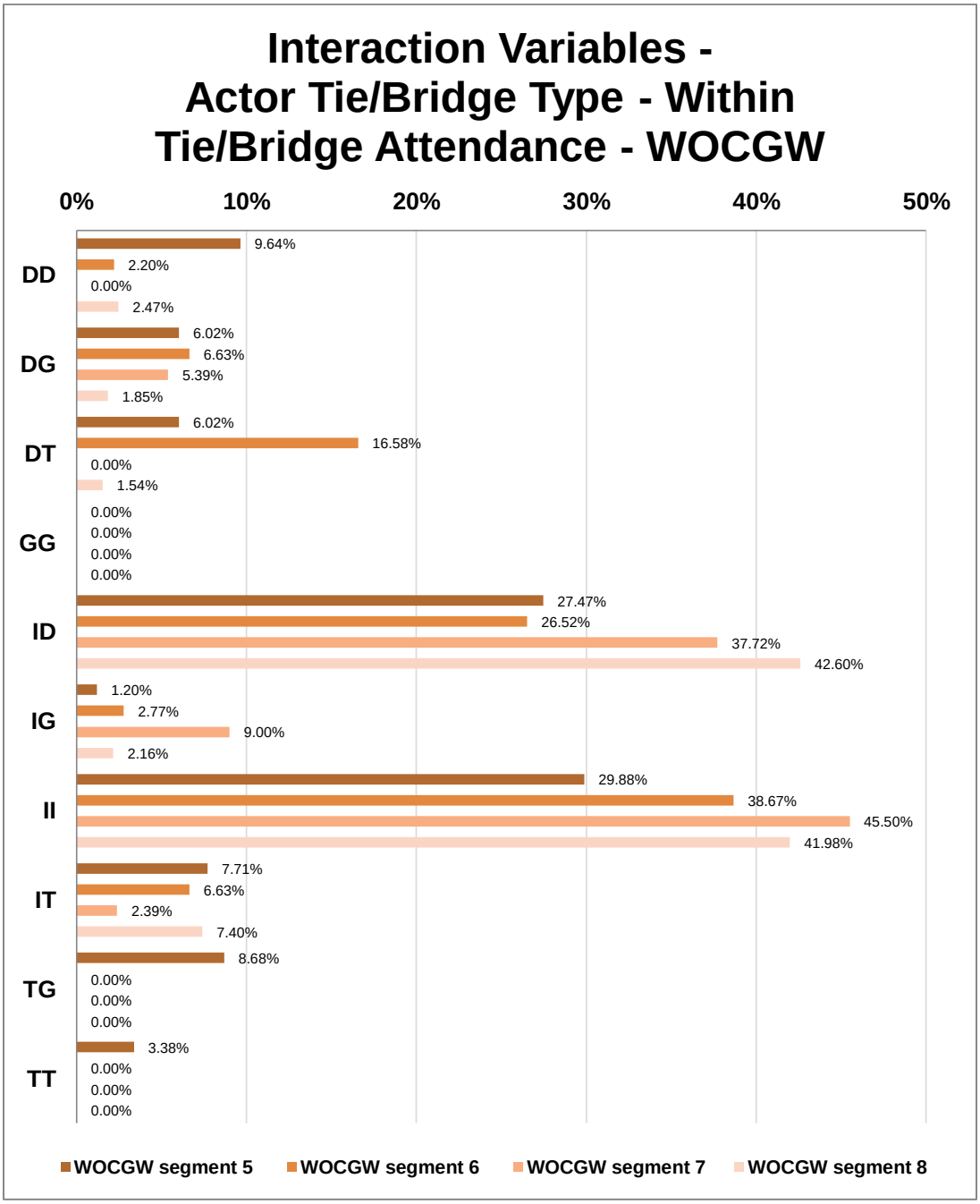

Figure 63: Actor Tie/Bridge Types per Segment of the WOCGW.

Source: Pippi (2013)

Figure 63 shows the results for the different actor ties/bridges categories from the dataset for the *occurrence of ties/bridges* for the four segments of the WOCGW. The most predominant category of all the *occurrence of ties/bridges* categories, with higher values in all four segments, was the Individual with Individual (II) category which showed the highest prevalence in segment 7 (s7: with 45.50%; 152 observations; s8: with 41.98%; 136 observations; s6: with 36.67%; 70 observations; s5: with 29..88%; 124 observations). The Individual and Dyad (ID) category presented the second highest incidence (s8: with 42.60%; 138 observations; s7: with 37.72%; 126 observations, s5: with 27.47%; 114 observations; s6: with 26.52%; 48 observations).

Figure 63 presents the other categories with moderate to low results in terms of actor type relational interactions: the Dyad with Triad (DT) category was more prevalent in segment 6 (s6: with 16.58%; 30 observations); the Dyad with Dyad (DD) category was prevalent in segment 5 (s5: with 9.64%; 40 observations); the Individual with Group (IG) category was more prevalent in segment 7 (s7: 9.00%; 30 observations); the triad with Group (TG) category only occurred in segment 5 (s5: with 8.68%; 36 observations). On the other hand, the categories that presented the lowest results in terms of actor type interactions were: the Individual with Group (IG) category in segments 5 and 6 (s5: with 1.20%; 5 observations and s6: with 2.77%; 5 observations); the Dyad with Triad (DT) category in segment 8 (s8: with 1.54%; 5 observations); the Dyad with dyad (DD) category in segments 8 and 6 (s8: with 2.47%; 8 observations and s6: with 2.20%; 4 observations); the Individual with Group (IT) category in segment 7 (s7: with 2.39%; 8 observations), and the Triad with Triad (TT) category in segment 1 (s1: with 3.38%; 14 observations).

Two categories, the Dyad with Dyad (DD) relation and Dyad with Triad (DT) relation occurred in three segments, in both cases, in segments 5, 6 and 8. Two categories occurred only in one segment, in the segment 5: the Triad with Triad (TT) category (s5: 3.38%; 36 observations) and the Triad with Group (TG) category (s5: 8.68%; 14 observations). Only one category was lacking in all of the WOCGW segments, the Group and Group relation (GG), according to chart in figure 63.

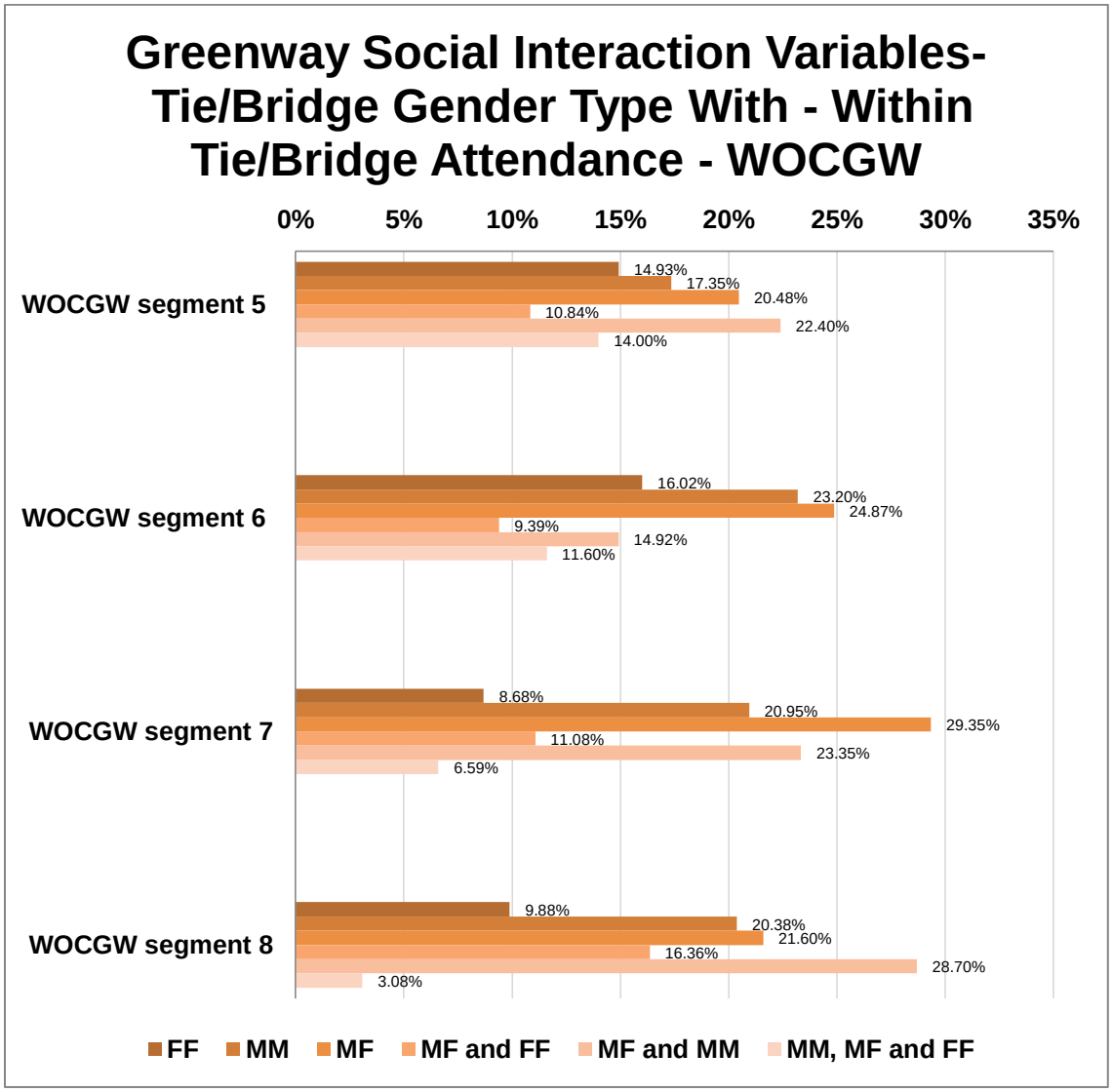

Figure 64: Gender Tie/Bridge Types per Segment of the WOCGW.

Source: Pippi (2013)

The chart in figure 64 shows the results for the different gender categories from the dataset for the *occurrence of ties/bridges*. The different gender categories presented similar moderate results for all four segments. The following categories presented the highest results: segment 7 with the Male and Female (MF) category; segment 8 with the Male with Female and Male with male (MF and MM) category, and segment 6 also with the Male and female (MF) category. The segment 7 presented the highest score of all the categories, which was for the Male with Female (MF) category (s7: with 29.35%; 98 observations). Segment 8 presented the second highest score in the Male with Female and Male with Male (MF and MM) category (s8: with 28.70%; 93 observations). Segment 6 presented the second highest score for the Male with Female (MF) category (s6: with 24.87%; 45 observations). Some tie/bridge gender categories were very similar within the same segment: segment 5 present similar high scores for two categories: the Male with Female and Male with Male (MF and MM) category (s5: with 22.40%; 93 observations) and Male with Female (MF) category (s5: with 20.48%; 85 observations); segment 6 presented similar high scores for the Male with Female (MF) category (s6: with 24.87%; 45 observations) and for the Male with Male (MM) category (s6: with 23.20%; 42 observations); segment 7 presented comparable high-scores for two categories, the Male with Female and Male with Male (MF and MM) category (s7: with 23.35%; 78 observations) and the male with Male (MM) category (s7: with 20.95%; 70 observations), and segment 8 presented comparable high-scores for the Male with Female (MF) category (s8: with 21.60%; 70 observations) and for the Male with Male (MM) category (s8: with 20.38%; 66 observations).

Figure 64 shows Female with Female (FF) presented similar moderate values for all four segments: this category was more prevalent in segments 6 and 5, with correspondent scores (s6: with 16.02%; 29 observations and s5: with 14.93%; 62 observations), followed by segments 8 and 7 that presented respectively similar and moderate-low scores (s8: 9.88%; 32 observations and s7: with 8.68%; 29 observations). The chart also presented in all segments some categories with low scores. Segments 8 and 7 presented the lowest values: Males with Males, Males with Females and Females with Females (MM, MF and FF) described respectively in ascendant order (s8: with 3.08%; 10 observations and s7: with

6.59%; 22 observations). Segments 7, 6 and 5 also presented similar low-scores for the same category: the Male with Female and Female with Female (MF and FF) (s6: with 9.39%; 17 observations, s5: with 10.84%; 45 observations and s7: with 11.08%; 37 observations).

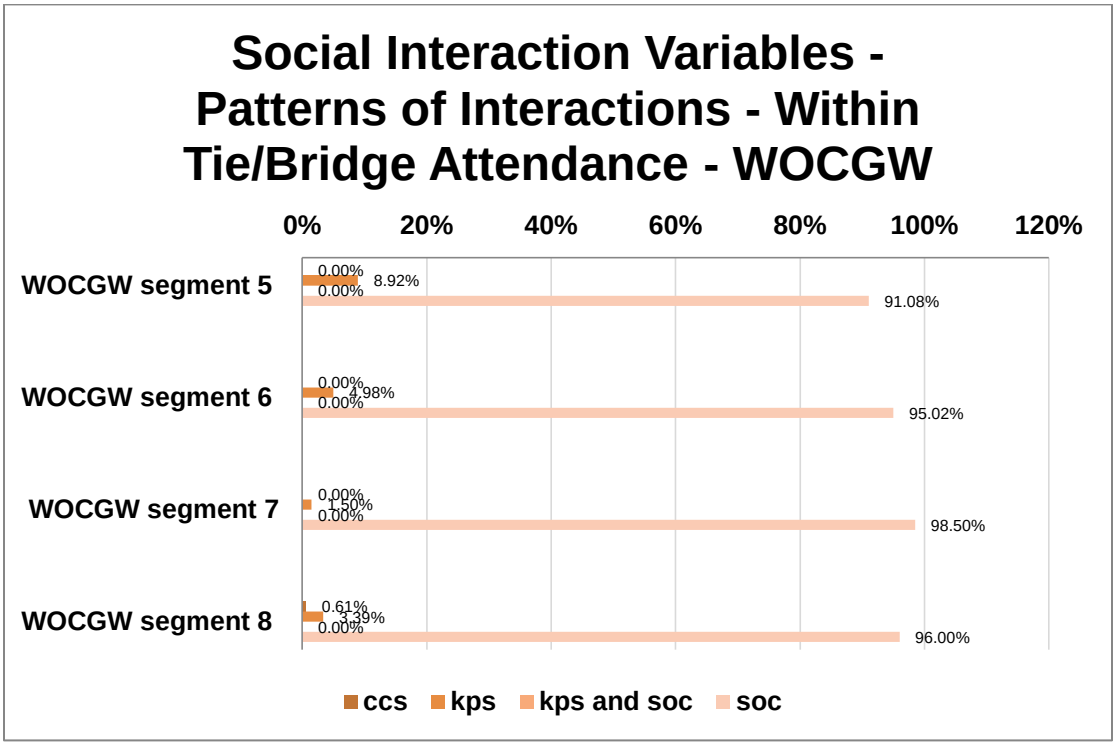

Figure 65: Patterns of Interactions per Segment of the WOCGW.

Source: Pippi (2013)

Figure 65 presents results for the pattern of interaction categories from the dataset for *occurrence of ties/bridges* on the WOCGW. The four segments presented comparable and higher results in the Socializing (soc) category (s7: with 98.50%; 329 observations; s8: with 92.60%; 311 observations; s6: with 91.79%; 172 observations; s5: with 91.08%; 378 observations); the segment 7 presented in this category the highest score of all segments

and all categories. All the other categories presented much lower scores if compared to the Socializing (soc) category. The Kinship Pattern of Socialization (kps) occurred in all segments, but was more predominant in segment 5 (s5: with 8.92%; 37 observations), followed by the segment 6 (s6: with 4.98%; 9 observations), and then with contrasting lower results by the segments 8 and 7 (s8: with 3.39%; 11 observations and s7: with 1.50%; 5 observations). The Cultural Customs Sharing category (ccs) only occurred in segment 8 (s8: with 0.61%; 2 observations) and consisted in the lowest score if compared to all of the other patterns of interactions categories in other segments and also within the segment 8 when compared to the other categories. The Kinship Patterns of Socialization and Socializing (kps and soc) category presented null results in all segments.

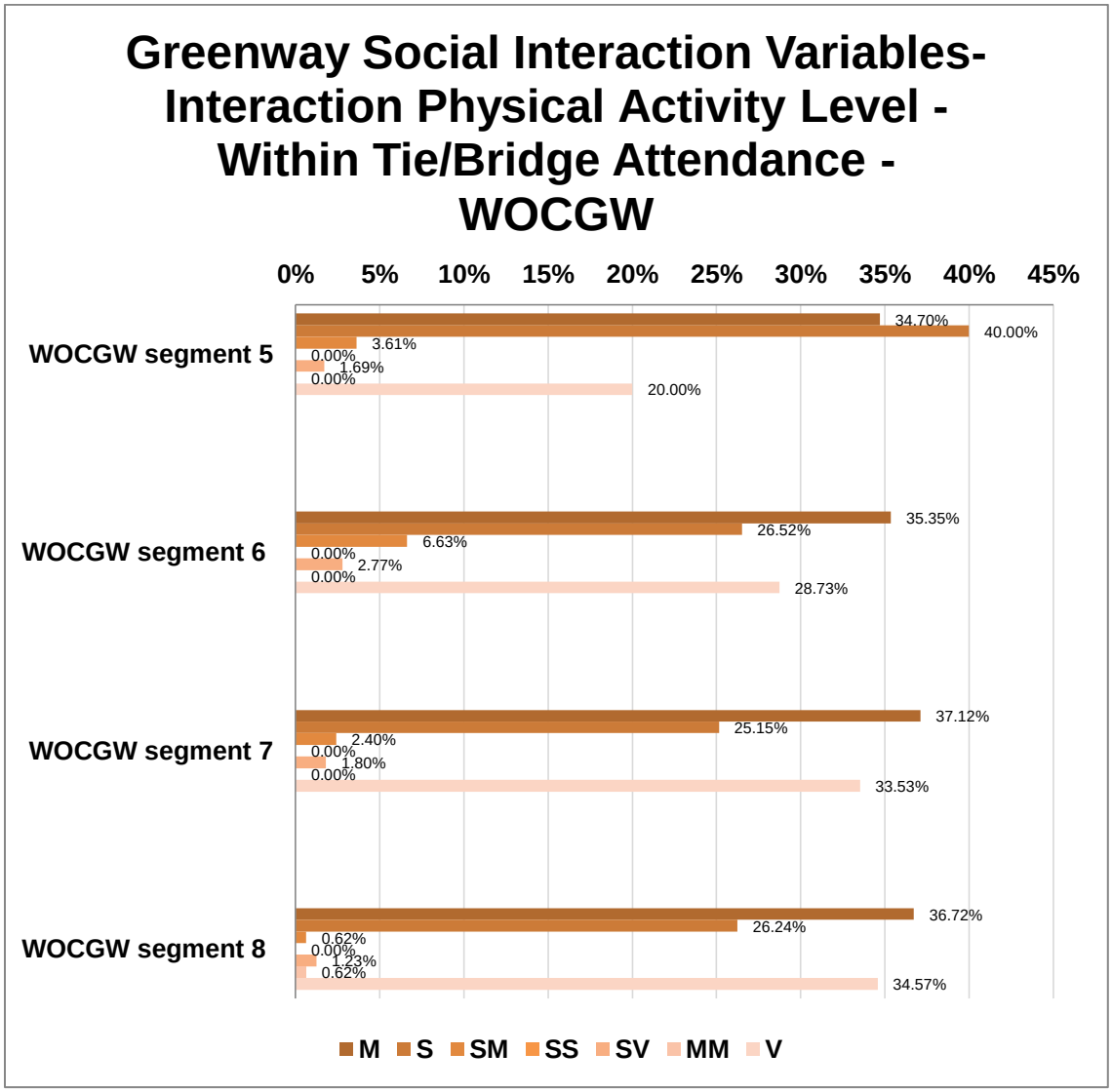

Figure 66: Interaction Physical Activity Levels per Segment of the WOCGW.

Source: Pippi (2013)

Figure 66 illustrates the results for the interaction activity level categories from the dataset for the *occurrence of ties/bridges*. Three categories, the Sedentary (S), Moderate (M) categories and Vigorous (V) interactional activity levels, presented moderate values for all

four segments. The highest score, of all categories and segments was found for the Sedentary (S) category in segment 5 (s5: with 40.00%; 166 observations); segments 6, 8 and 7 presented similar scores for this category (s6: with 26.52%; 48 observations, s8: with 26.24%; 85 observations and s7: with 25.15%; 84 observations). The Moderate (M) category presented the second and third comparable and higher scores across categories as well as within the same category (s7: with 37.12%; 124 observations and s8: with 36.72%; 119 observations; s6: with 35.35%; 64 observations and s5: 34.70%; 144 observations). The Vigorous (V) category presented high and similar scores in segments 8 and 7 (s8: with 36.72%; 112 observations and s7: with 37.12%; 112 observations; s6: with 28.73%; 52 observations and s5: 20.00%; 83 observations). Both, Sedentary and Moderate (SM) and Sedentary and Vigorous (SV) categories presented low values in all segments, and were more prevalent in segment 6 (s6: with 6.63%; 12 observations and s6: with 2.77%; 5 observations). The Moderate and Moderate (MM) and the Sedentary and Moderate (SM) categories presented the same lowest result if associated to all the other segments and categories types and only was encountered in the segment 8 (s8: with 0.62%; 2 observations). The category of Sedentary and Sedentary (SS) interaction activity level was lacking in all segments.

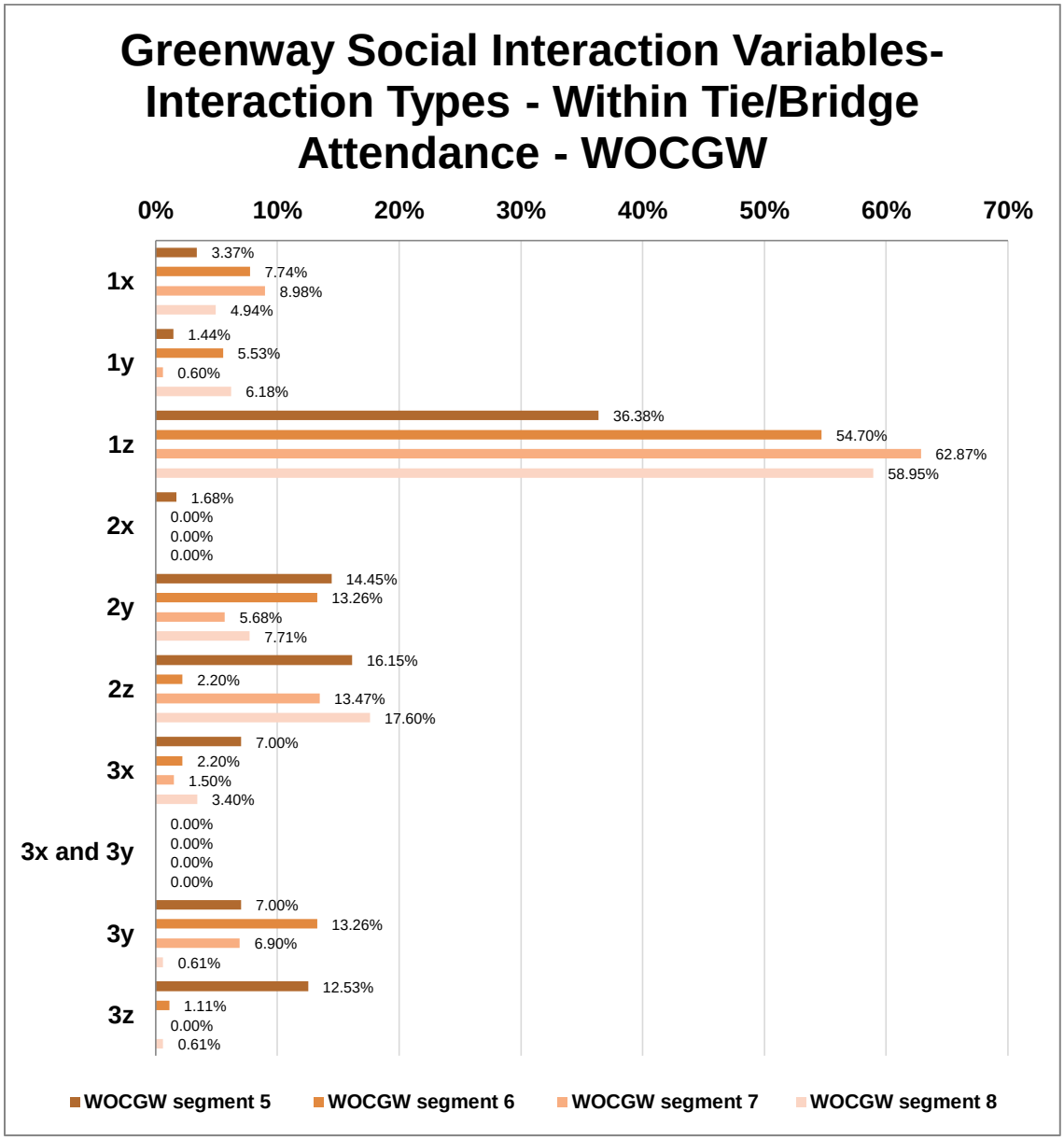

Figure 67: Interaction Types per Segment of the WOCGW.

Source: Pippi (2013)

Figure 67 shows the results for the interaction types from the dataset for the *occurrence of ties/bridges.* The (1z) of the low intensity interaction types (level 1) was the most prevalent interaction type of all the interaction types across all intensity levels. For the moderate level of interaction (level 2), both, (2z) and (2y) were more prevalent. Of the four categories in the higher intensity level of interaction (level 3), both (3x) and (3y), were more prevalent with occurrence in all the four segments. These categories will be described both within their level of interaction group across levels. Category (1z) presented the highest scores in each of the four segments, not only within its interaction level but across levels (s7: with 62.87%; 210 observations; s8: with 58.95%; 191 observations; s6: with 54.70%; 99 observations; s5: with 36.38%; 151 observations). The category (1x), presented moderate to low scores for segments 7 and 6 with similar results (s7: with 8.98%; 28 observations and s6: with 7.74%; 14 observations) and less prevalence in segments 8 and 5 (s8: with 4.94%; 16 observations and s5: with 3.37%; 14 observations). The category (1y), presented low scores, and was more prevalent in segment 8 and 6 (s8: with 6.18%; 20 observations and s6: with 5.53%; 10 observations) and less prevalent in segments 5 and 7 with lower values (s5: with 1.44%; 6 observations and s7: with 0.60%; 2 observations).

According to the chart in figure 67, within the high level of interaction, two categories followed a moderate intensity of usage: The category (3y) presented moderate to low scores if compared to the other categories in this level, with more incidence in segment 6 (s6: with 13.26%; 24 observations), followed by segments 5 and 7 that were similar in terms of results (s5: with 7.00%; 29 observations and s7: with 6.90%; 23 observations) and then the segment 8 that presented the lowest score in this segment and was one of the three categories with lowest result if compared all the other categories (s8: with 0.61%; 2 observations). Within the moderate level of interaction, the category (2y) was more prevalent in 3 segments: 5, 6 and 8 (s5: with 14.45%; 60 observations, s6: with 13.26%; 24 observations and s8: with 7.71%; 25 observations), and less prevalent in segment 7 (s7: with 5.68%; 19 observations). With almost the same intensity of the previous category, the category (2z) presented similar values and greater prevalence in segments 8 and 5, followed by 7, and less prevalence in segment 6 (s8: with 17.60%; 57 observations, s5:

16.15%; 67 observations and s7: with 13.47%; 45 observations and s6: with 2.20%; 4 observations). Within the higher level of interaction, the category (3x) showed low values, with greater prevalence in segments 5 and 8 (s5: with 7.00%; 29 observations and s8: with 3.40%; 11 observations) and less prevalence in segments 6 and 7 (s6: with 2.20%; 4 observations and s7: with 1.50%; 5 observations). In the moderate level of interaction group, (2x) showed the lowest results and was found only in segment 5 (s5: with 1.68%; 7 observations). The categories with the least prevalence, across levels, were (1y) in segment 7 (s7: with 0.60%; 2 observations), and the other two for the high level of interaction group by the (3y) and (3z) categories, both with occurrence in segment 8 and equal results (s8: with 0.61%; 2 observations). Only the (3x and 3y) category presented absent scores in all the segments.

The charts, presented in figures 68 shows the other categories that presented lower rates were: Children (CH); Children and Type of Activity (CH and TA); Cultural Sharing (CSC); Domestic Animals and Children (DA and CH); Domestic Animals and Type of Activity (DA and TA); Greenway Features and Children (GWF and CH); Greenway Features and Domestic Animals (GWF and DA); Greenway Features and Information (GWF and I); Greenway Features and Type of Activity (GWF and TA); Information (I); Unexpected Experience (UE); Unexpected Experience and Domestic Animals (UE and DA), and Wildlife (W). Six of the catalyst types categories were absent in the WOCGW: Cultural Sharing Customs, Greenway Features and Type of Activity (CSC, GWF and TA); Domestic Animals and Type of Activity (DA and TA); Greenway Features, Type of Activity and Children (GWF, TA and CH); Unexpected Experience and Greenway Features (UE and GWF); Unexpected Experience, Type of Activity and Children (UE, TA and CH), and Wildlife and Children (W and CH).

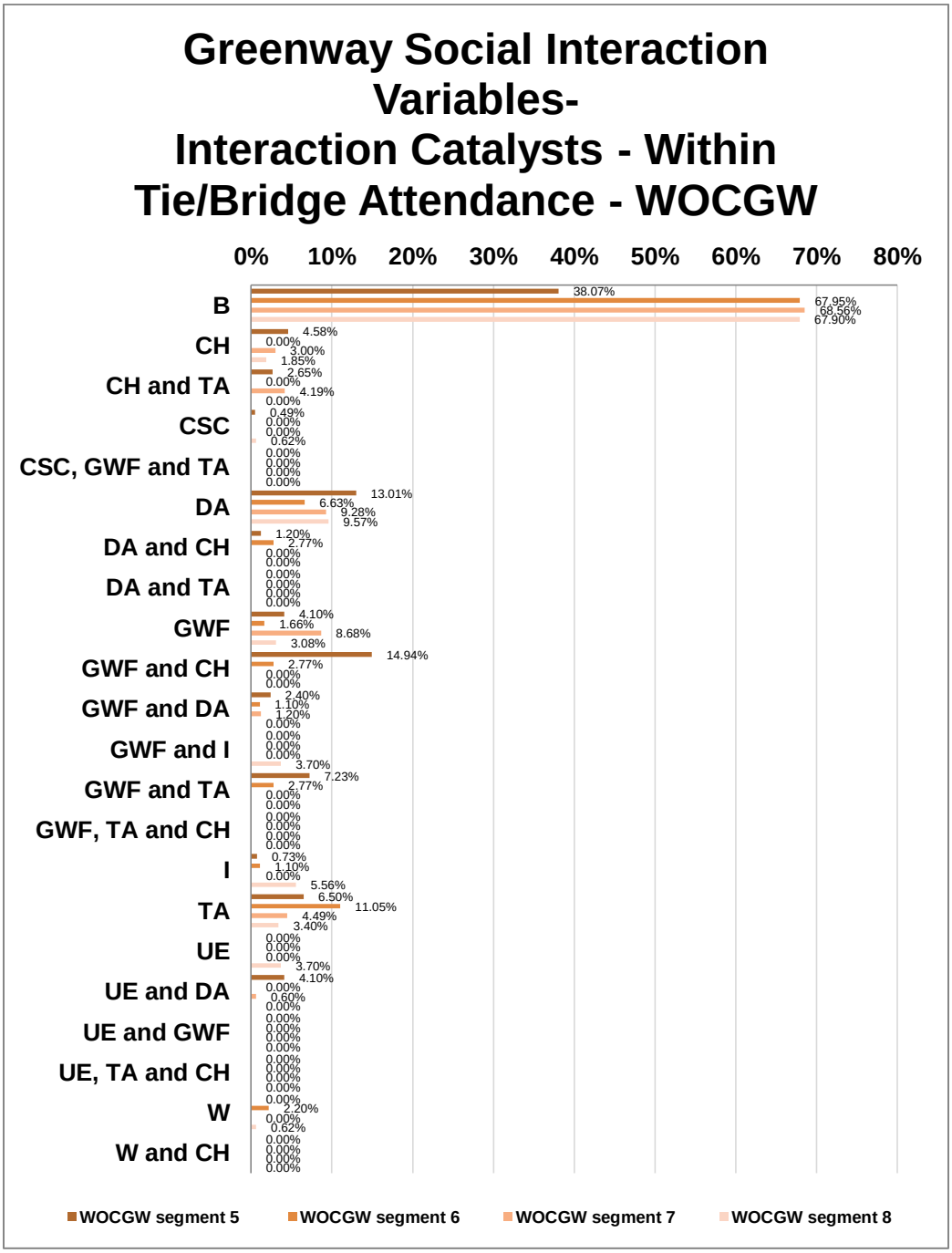

Figure 68: Interaction Catalysts per Segment of the WOCGW.

Source: Pippi (2013)

Figure 68 illustrates the results for the different interaction catalyst categories from the dataset for the *occurrence of ties/bridges* of the WOCGW. Of all the catalyst categories, the Behavior category (B) presented the highest scores in all segments, mainly in segments 7, 6 and 8 that presented similar high scores (s7: with 68.56%; 229 observations, s6: with 67.95%; 123 observations and s8: with 67.90%; 220 observations), followed by segment 5 with a moderate score (s5: with 38.07%; 158 observations). Other three categories, were found in all segments: the Domestic Animals (DA) in segment 5 (s5: with 13.01%; 54 observations) followed by segments 8 and 7 that presented similar results (s8: with 9.57%; 31 observations and s7: with 9.28%; 31 observations); Greenway Features (GWF) in s7 (s7: with 8.68%; 29 observations), and Type of Activity (TA), presented moderate-low scores in segment 6 (s6: with 11.05%; 20 observations). The Greenway Features and Children (GWF and CH) category presented a moderate-low score only for s5 (s5: with 14.94%; 62 observations) and low score for segment 6 (s6: with 2.77%; 5 observations).

Figure 68 shows the interaction catalysts categories that presented lower rates in the *occurrence ties/bridges* dataset. Two categories were found only in three segments: the Children (CH) category in segments 5, 7 and 8 (s5: with 4.58%; 19 observations, s7: with 3.00%; 10 observations and s8: with 1.85%; 6 observations) and Greenway Features and Domestic Animals (GWF and DA) in segments 5, 7 and 6 (s5: with 2.40%; 10 observations, s7: with 1.20%; 4 observations and s6: with 1.10%; 2 observations). Four categories were presented only in two segments: Children and Type of Activity (CH and TA) in segments 7 and 5 (s7: with 4.19%; 14 observations and s5: with 2.65%; 11 observations); Domestic Animals and Children (DA and CH) in segments 6 and 5 (s6: with 2.77%; 5 observations and s5: with 1.20%; 5 observations); Greenway Features; Greenway Features and Children (GWF and CH) with low score in segment 6 (s6: with 2.77%; 5 observations), and Type of Activity (GWF and TA) in segments 5 and 6 (s5: with 7.23%; 30 observations and s6: with 2.77%; 5 observations). Besides the Unexpected Experience and Domestic Animals (UE and DA) and Wildlife (W) categories, two other categories occurred only in one segment and presented lower scores: Greenway Features and Information (GWF and I) in segment 8 (s8: with 3.70%; 12 observations) and Unexpected Experience (UE) in segment 8 (s8: with

3.70%; 12 observations). Results for the other categories that presented the lowest score rates if compared to the overall categories and among all the segments also were presented: the Cultural Sharing (CSC) category in segments 8 and 5 (s8: with 0.62%; 2 observations and s5: with 0.49%; 2 observations) and was absent in segments 6 and 7; Information (I) category in segments 6 and 5 (s6: with 1.10%; 2 observations and s5: with 0.73%; 3 observations); Unexpected Experience and Domestic Animals (UE and DA) in segment 7 (s7: with 0.60%; 2 observations) and Wildlife (W) in segments 6 and 8 (s6: with 2.20%; 4 observations and s8: with 0.62%; 2 observations).

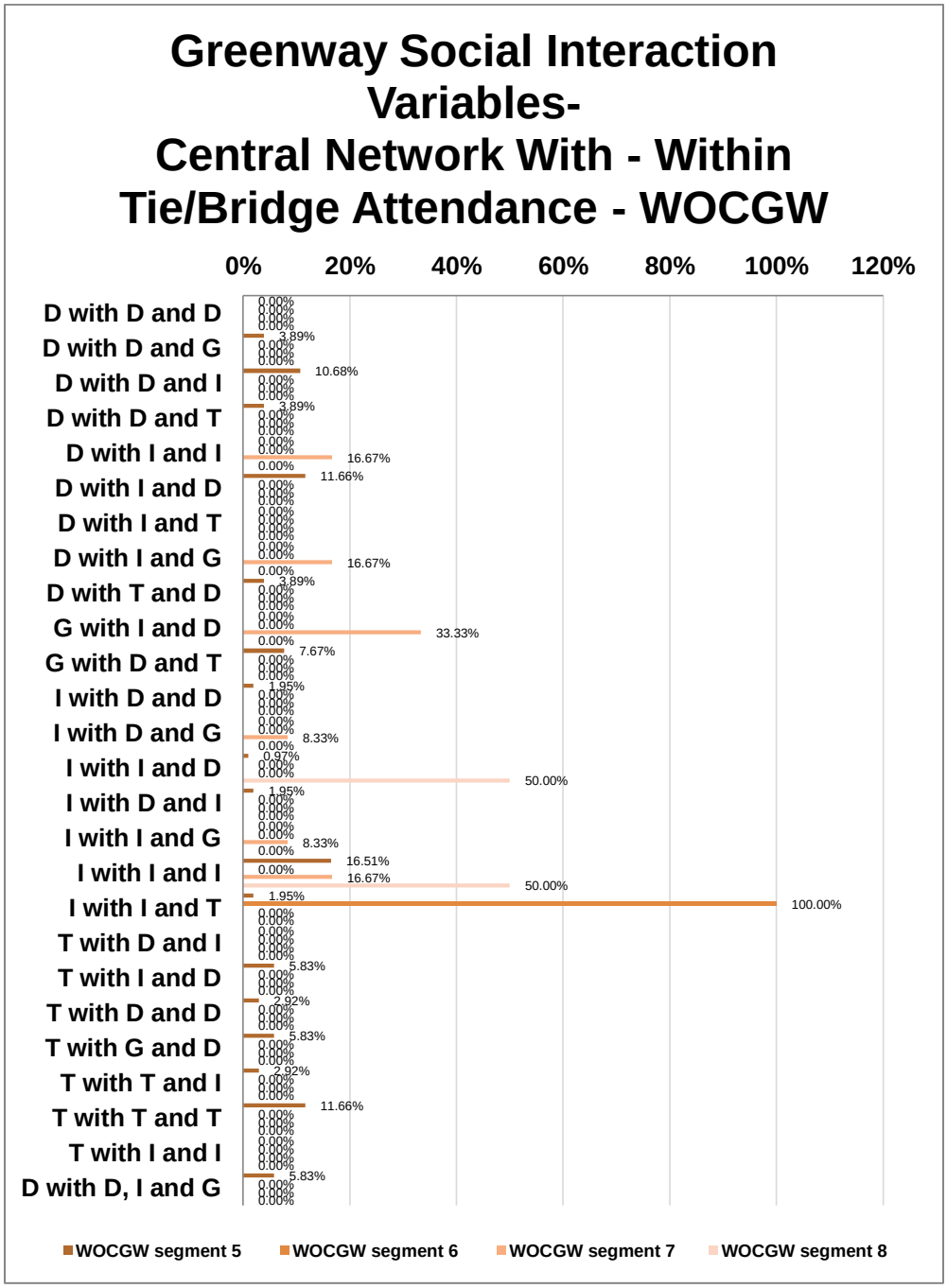

Figure 69: Central Network between Actor Types per Segment of the WOCGW.

Source: Pippi (2013)

Figure 69 shows results for the central network categories from the dataset for the *occurrence of ties/bridges* for the WOCGW. The central network shows the sequence of interactions in terms of the actor types involved. Of a total of 133 observations, 103 were at segment 5, 24 at the segment 7, 4 at segment 8 and 2 at segment 6. Those values were utilized to verify the percentage of occurrence for each category and each segment. Across all categories, I with I and T category (i.e. an Indivdual who interacted with an Individual and then a Triad) presented the highest result and the only occurrence in segment 6 (s6: With 100%; 2 observations), and also a low incidence for segment 5 (s5: with 1.95%; 2 observations). Two categories presented high-moderate results for segment 8: the I with I and I category (i.e. an Individual who encountered an individual and then another individual) (s8: with 50.00%; 2 observations) and I with I and D (Individual encountering Individual and then Dyad) (s8: with 50.00%; 2 observations). Three categories presented moderate results for segment 7: the D with I and I category (Dyad_Individual-Individual) (s7: 16.67%; 4 observations), the D with I and G category (Dyad_Individual-Group) (s7: with 16.67%; 4 observations) and the G with I and D category (Group_Individual-Dyad) (s7: with 33.33%; 8 observations). The I with I and I (Individual_Individual-Individual), besides the segment 8, presented moderate scores for segments 7 and 5 (s7: with 16.67%; 4 observations and s5: with 16.51%; 17 observations).

Twenty categories occurred in only one segment type and also presented moderate to low values,: D with I and D category in segment 5 (s5: with 11.66%; 12 observations); T with T and T category in segment 5 (s5: with 11.66%; 12 observations); D with D and I category in segment 5 (s5: with 10.68%; 11 observations); I with D and G category and I with I and G category both with same occurrence in segment 7 and results (s7: with 8.33%; 2 observations for each category), and G with D and T category in segment 5 (s5: with 7.67%; 8 observations). The other fourteen categories occurred only in one segment and presented low scores: D with D and G category in segment 5 (s5: with 3.89%); D with D and T; D with I and ID with I and T; D with I and G; D with T and D; G with I and D; I with D and D; I with D and I; T with I and D; T with D and D; T with G and D; T with T and I, and D with D, I and G). Out of these fourteen categories, the four lowest scores of all the categories were: the T with

D and D category and the T with T and I category, which were similar in terms of their occurrence in segment 5 and also equivalent low scores (s5: with 2.92%; 3 observations for each category) category, also in segment 5 (s5: with 2.92%;3 observations); the I with D and I category occurred also in segment 5 (s5: with 1.95%; 2 observations), and the I with I and D category occurred only in segment 5 (s5: with 0.97%; 1 observation) as illustrated in the chart in figure 69.

Figure 69 illustrates the three central network categories that were absent in the WOCGW observations: D with D and D; T with D and I, and T with I and I. The centrality phenomena were observed with greater overall frequency in segments 5 and 7.

5.3.3. Social Characteristics General and Specific Discussion with Comparisons across Both Greenways Types:

The Black Creek Greenway presented a total volume of 5,512 individuals while the White Oak Creek Greenway presented a lower volume of 4,693 individuals. Tables 16 and 17 indicate the distribution of observations according to the two *temporal variables*, week and period of day, for each greenway type respectively, as illustrated below:

Table 15: Greenways Observed User Usage Counts and Percentage by Weekly.
Source: Pippi (2013)

Greenway Type	Total Use Counts	Weekday Usage Counts	Weekday Usage (%)	Weekend Usage Counts	Weekend Usage (%)
BCGW	5,512	2,082	37.80%	3,430	62.20%
WOCGW	4,693	1,989	42.38%	2,704	57.62%

Table 15 presents the total usage frequency (counts and percentage) on weekdays and weekends for each greenway type. The BCGW presented the greatest number of usage during the weekend (62.20%; 3,430 observations) if compared to the WOCGW that presented the lowest number of users (57.67%; 2,704 observations). However, during the weekday usage, results were inversed, with greater usage in the WOCGW (42.38%; 1,989 observations). Both greenways presented greater usage during the weekends if compared with the weekdays.

Figure 70 illustrates the *temporal variables* for occurrence during the weekly usage: weekdays and weekends per segment type, by correlating the 4 segments of the BCGW (s1, s2, s3 and s4) and then correlating the 4 segments of the WOCGW (s5, s6, s7 and s8), and finally comparing both greenways. Both greenways presented the highest usage during the weekends, in all of their segments, if compared to the weekdays. BCGW presented particular differences among segments 1 and 4 for the weekdays and weekends, and near-equal distribution in segments 2 and 3 for both, weekdays and weekends. For the BCGW, segment 4 presented the highest score during the weekend (66.75%; 1,202 observations), however it presented the lowest score during the weekdays (33.25%; 599 observations) if compared to all the other segments. Nevertheless, when segment 1 was compared with the other segments, it presented the lowest result score during the weekends (57.10%; 817 observations) and the highest scores during the weekdays (42.90%; 614 people). Segments 2 and 3 presented moderate and similar scores (s2: weekdays with 38.88%; 488 observations and weekends with 61.12%; 767 observations, and s3: weekdays with 37.17%; 381 observations and weekends with 62.83%; 644 observations). WOCGW presented less difference between weekdays and weekends in segments 6 and 7, but presented more difference between segments 5 and 8 and between them and the other two segments for both, weekdays and weekends. For the WOCGW, segment 8 presented the highest score during the weekend (61.66%; 653 observations), however it presented the lowest score during the weekdays (38.34%; 406 observations) if compared to all the other segments. Segment 5 presented comparable results if compared to the segment 8 for both weekends (60.68%; 878 observations) and weekdays (39.32%; 569 observations). Segments 6 and 7

presented moderate and similar scores (s6: weekdays with 46.35%; 413 observations and weekends with 53.65%; 478 observations, and s7: weekdays with 46.37%; 601 observations and weekends with 53.63%; 695 observations).

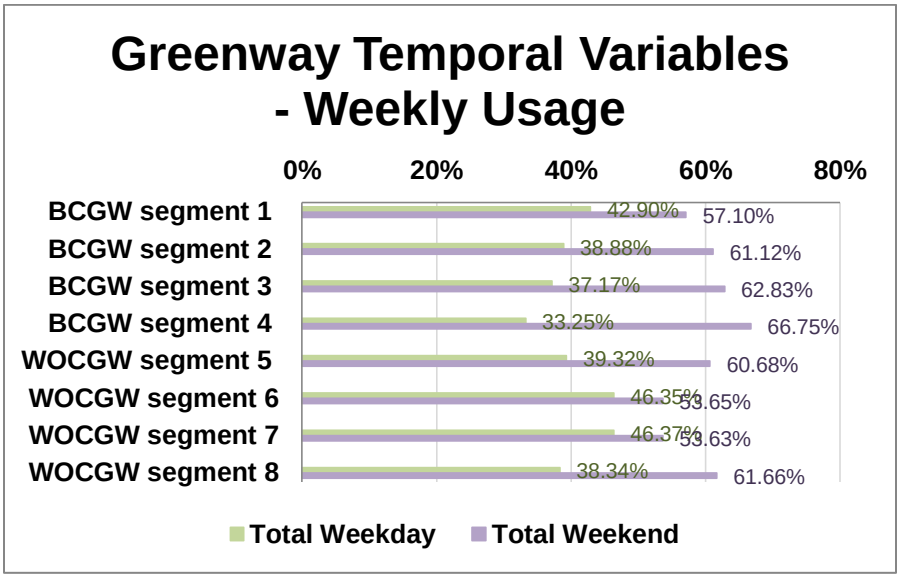

Figure 70: Greenway Weekly Usage per Segment Type.
Source: Pippi (2013)

Table 16 presents the total usage frequency (counts and percentage) by each period of day for each greenway type. Both greenways presented more usage during the evenings if compared with the other periods. The second period of day that presented more usage was the morning periods for both greenways and the afternoon period presented the least usage in both greenways. The WOCGW presented the greatest usage during the evenings (37.19%; 1,745 observations) out of all the periods of the day, and nearly surpassed the BCGW that presented the lowest usage during the evening (36.92%; 2,035 observations). The WOCGW presented near-equal distribution with the BCGW during the morning periods usage, respectively with (32.47%; 1,524 observations and 32.00%; 1,764 observations). In

the afternoon period the BCGW slightly surpassed the WOCGW in terms of usage (31.08%; 1,713 observations and 30.34%; 1,424 observations).

Table 16: Greenways Observed User Usage Counts and Percentage by Period of Day. Source: Pippi (2013)

Greenway Type	Total Use Counts	Morning Usage Counts	Morning Usage (%)	Afternoon Usage Counts	Afternoon Usage (%)	Evening Usage Counts	Evening Usage (%)
BCGW	5,512	1,764	32.00%	1,713	31.08%	2,035	36.92%
WOCGW	4,693	1,524	32.47%	1,424	30.34%	1,745	37.19%

Figure 71, illustrates the *temporal variables* occurrence during morning, afternoon and evening per segment types. Both greenways presented difference in terms of period of day usage across greenways and also among their own greenway segments. In the BCGW the evening periods were more prevalent in segments 1, 3 and 4, while in segment 2 the morning period was more prevalent. In contrast, in the WOCGW, the evening period presented more prevalence in segments 5 and 7, while in segment 6 the afternoon period usage was slightly more prevalent and in segment 8 the morning period was more predominant. In the BCGW, the segment 1 presented the highest score in the evening (s1: with 39.62%; 567 observations) and lowest score in the morning (s1: with 31.59%; 452 observations); segment 2 presented the highest score in the morning (s2: with 35.30%; 443 observations) and the lowest score in the evening (s2: with 34.67%; 435 observations); segment 3 presented moderate scores in all three periods, with similar results in the morning and afternoon periods, and segment 4 presented the highest score for the afternoon period (s4: with 37.03%; 667 observations) and the lowest score in the morning period (s4: with 29.54%; 532 observations). When comparing the four segments and all the period of day usage of the BCGW, segment 1 received the highest score in the evening with 39.62%, and also the lowest score in the afternoon with 28.79%. In the WOCGW, the segment 5

presented the highest score in the evening (s5: with 39.70%; 574 observations), however, segment 8 presented the lowest score in the evening (s8: with 32.58%; 345 observations); segment 8 presented highest score in the morning (s8: with 41.92%; 444 observations) and the lowest score in the afternoon (s8: with 25.50%; 270 observations) however, segment 6 presented the highest score in the afternoon (s6: with 35.80%; 319 observations). When contrasted with the four segments and all the period of day usage of the WOCGW, the segment 8 received the highest score in the morning with 41.92%, and also the lowest score in the afternoon periods with 25.50%.

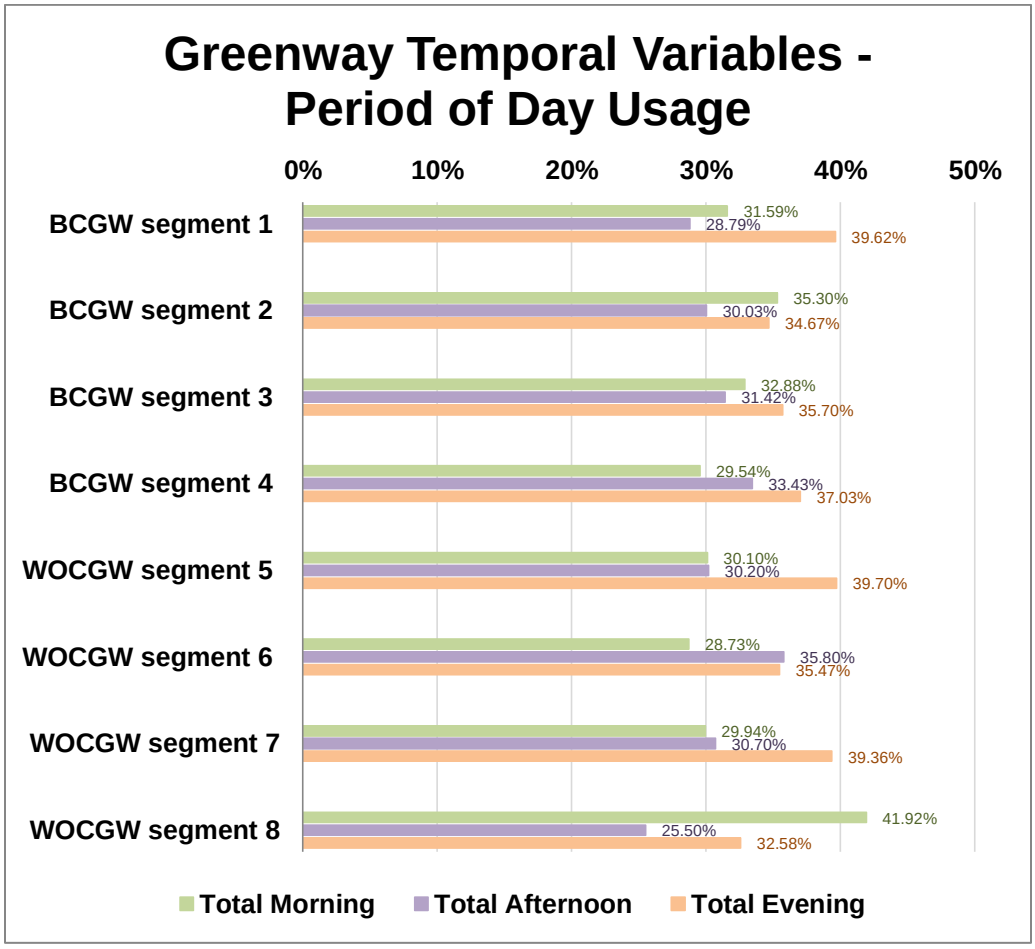

Figure 71: Greenway Usage by the Period of Day per Segment Type.
Source: Pippi (2013)

Table 17 presents the total usage frequency (counts and percentage) by gender type in each greenway type. Both greenways presented more usage of males if compared with females. On the other hand, both genders also presented very similar results. The WOCGW presented the greatest number of male users (55.38%; 2,599 observations) surpassing the number of female users (44.62%; 2,094 observations). In the BCGW the number of male

users (55.04%; 3,034 observations) was more prevalent if compared to the females users (57.67%; 2,704 observations).

Table 17: Greenways Observed User Usage Counts and Percentage by Gender Type.
Source: Pippi (2013)

Greenway Type	Total Use Counts	Male Usage Counts	Male Usage (%)	Female Usage Counts	Female Usage (%)
BCGW	5,512	3,034	55.04%	2,478	44.96%
WOCGW	4,693	2,599	55.38%	2,094	44.62%

The maps figures 72, 73, 74, 75, 76, 77, 78 and 79 illustrates the gender usage spatialization in both greenway segments: BCGW segments 1, 2, 3 and 4 and WOCGW segments 5, 6, 7 and 8.

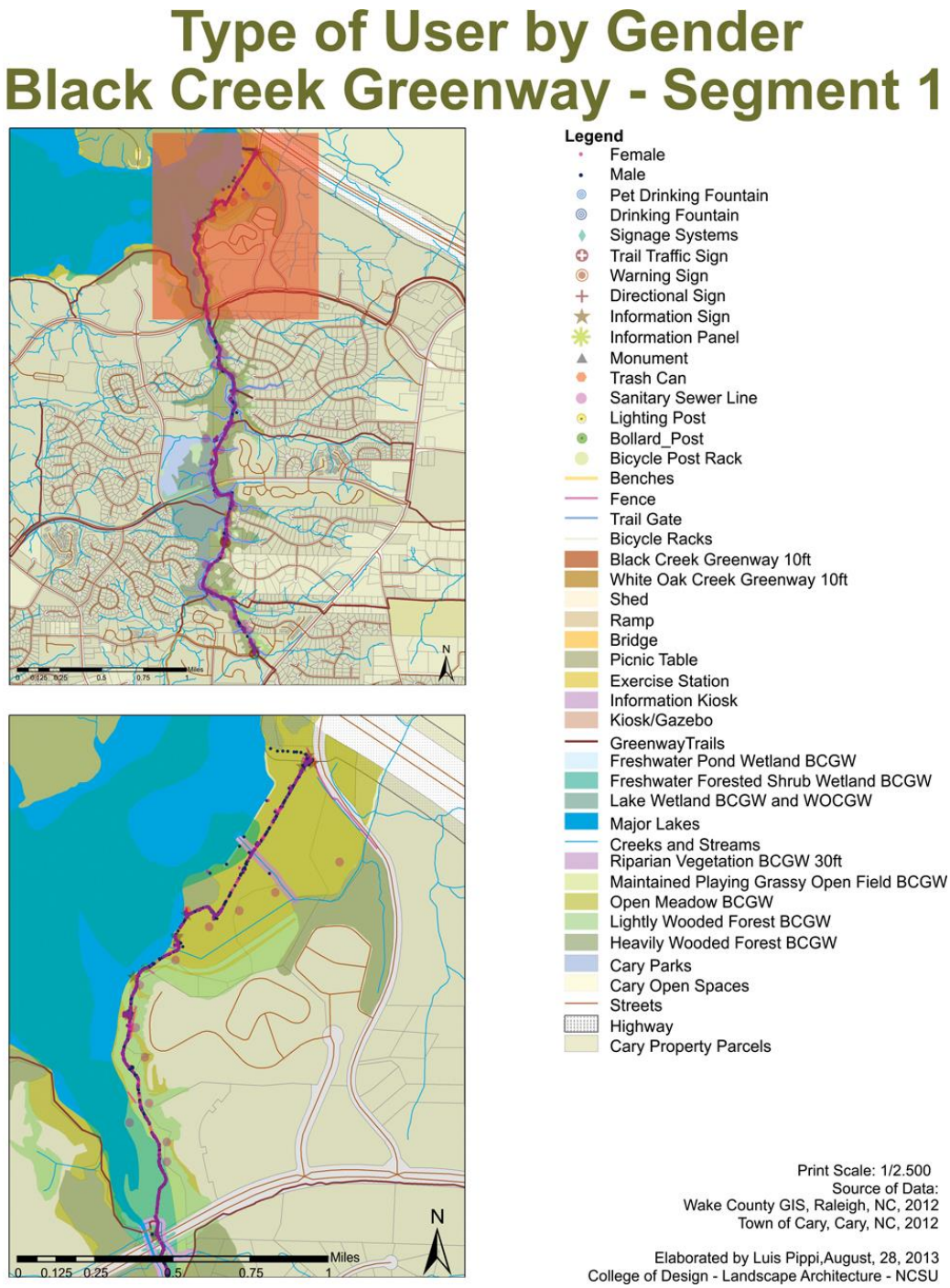

Figure 72: Usage by Gender in Segment 1 of the BCGW.

Source: Pippi (2013)

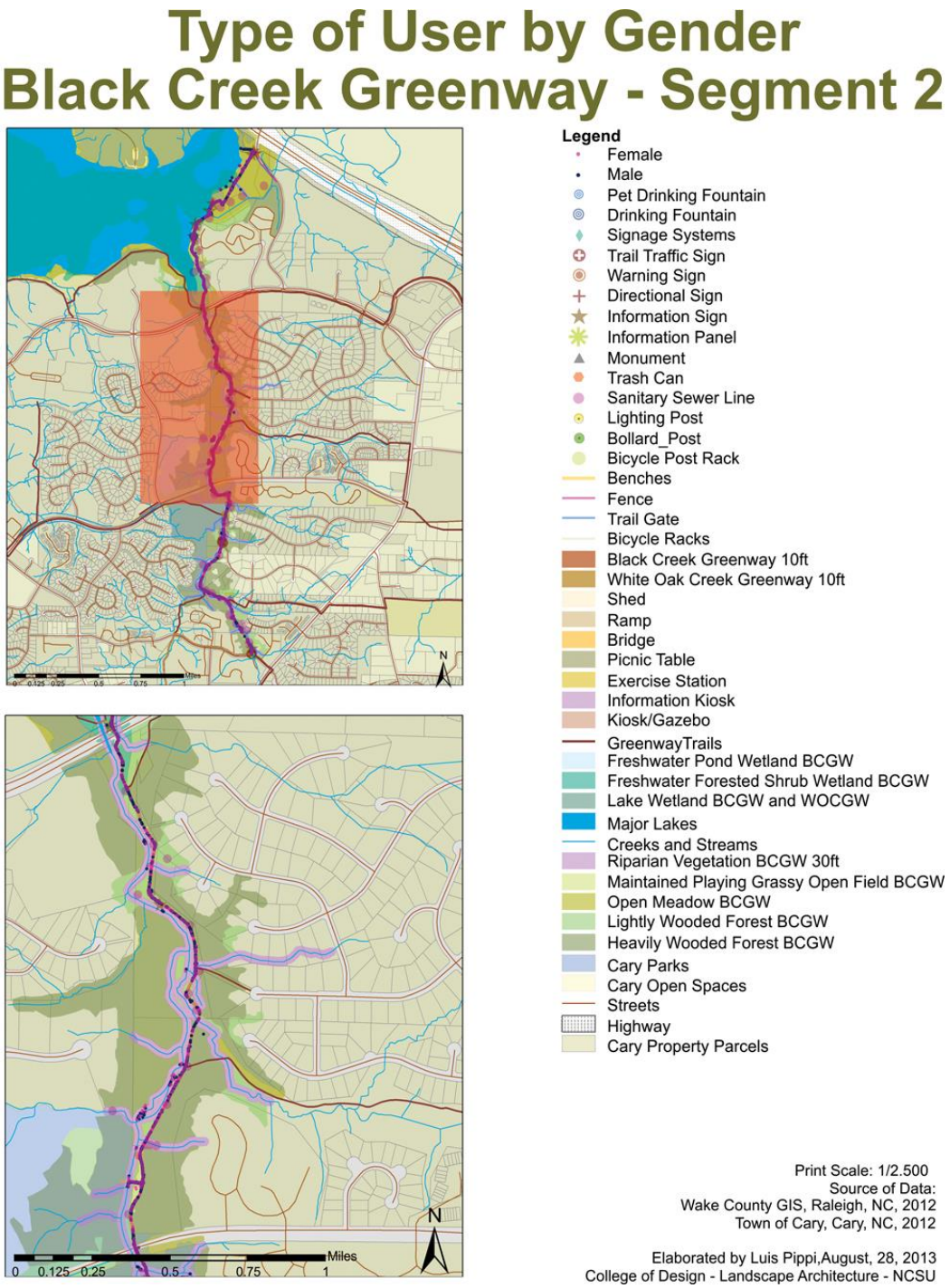

Figure 73: Usage by Gender in Segment 2 of the BCGW.

Source: Pippi (2013)

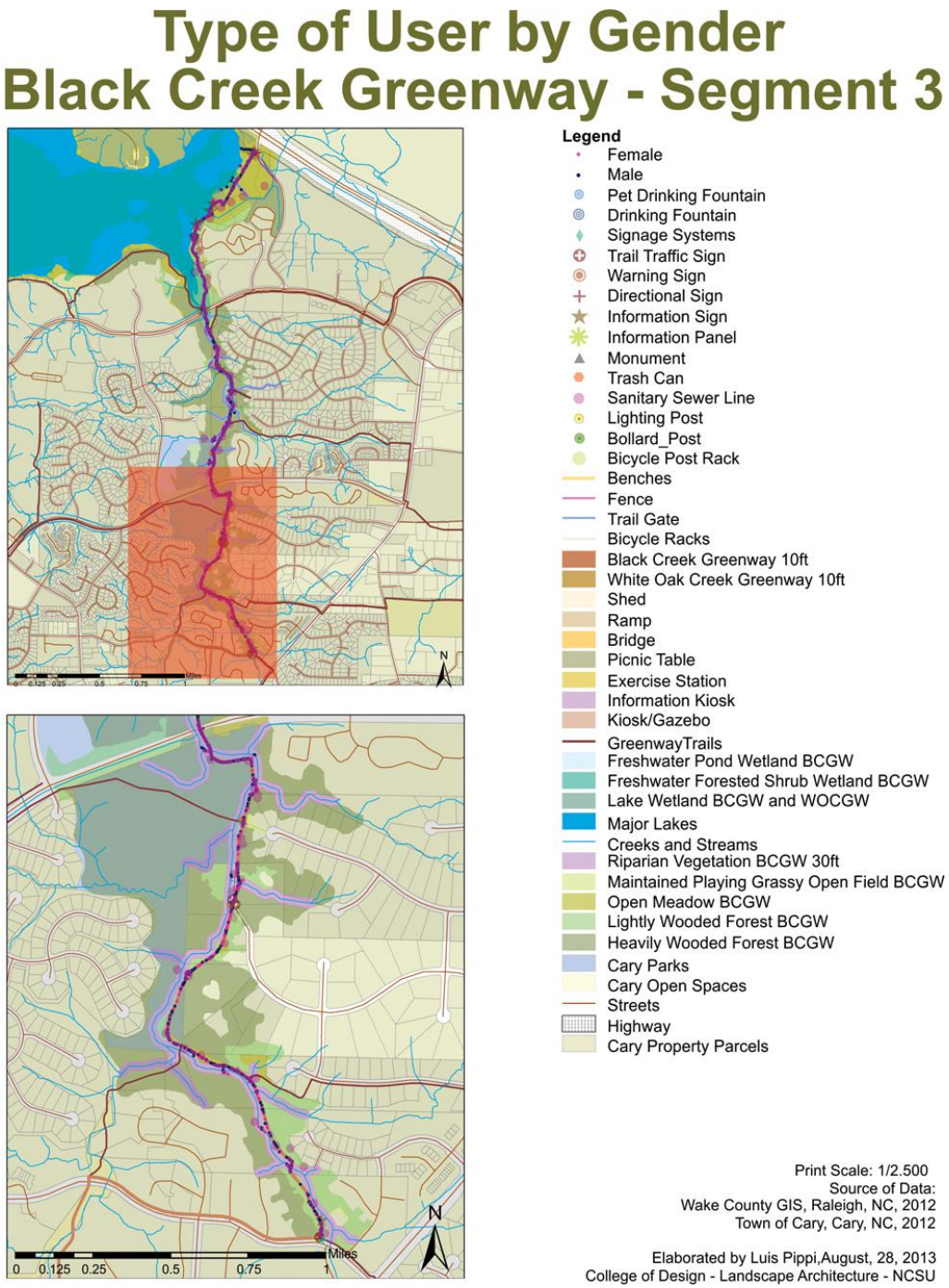

Figure 74: Usage by Gender in Segment 3 of the BCGW.

Source: Pippi (2013)

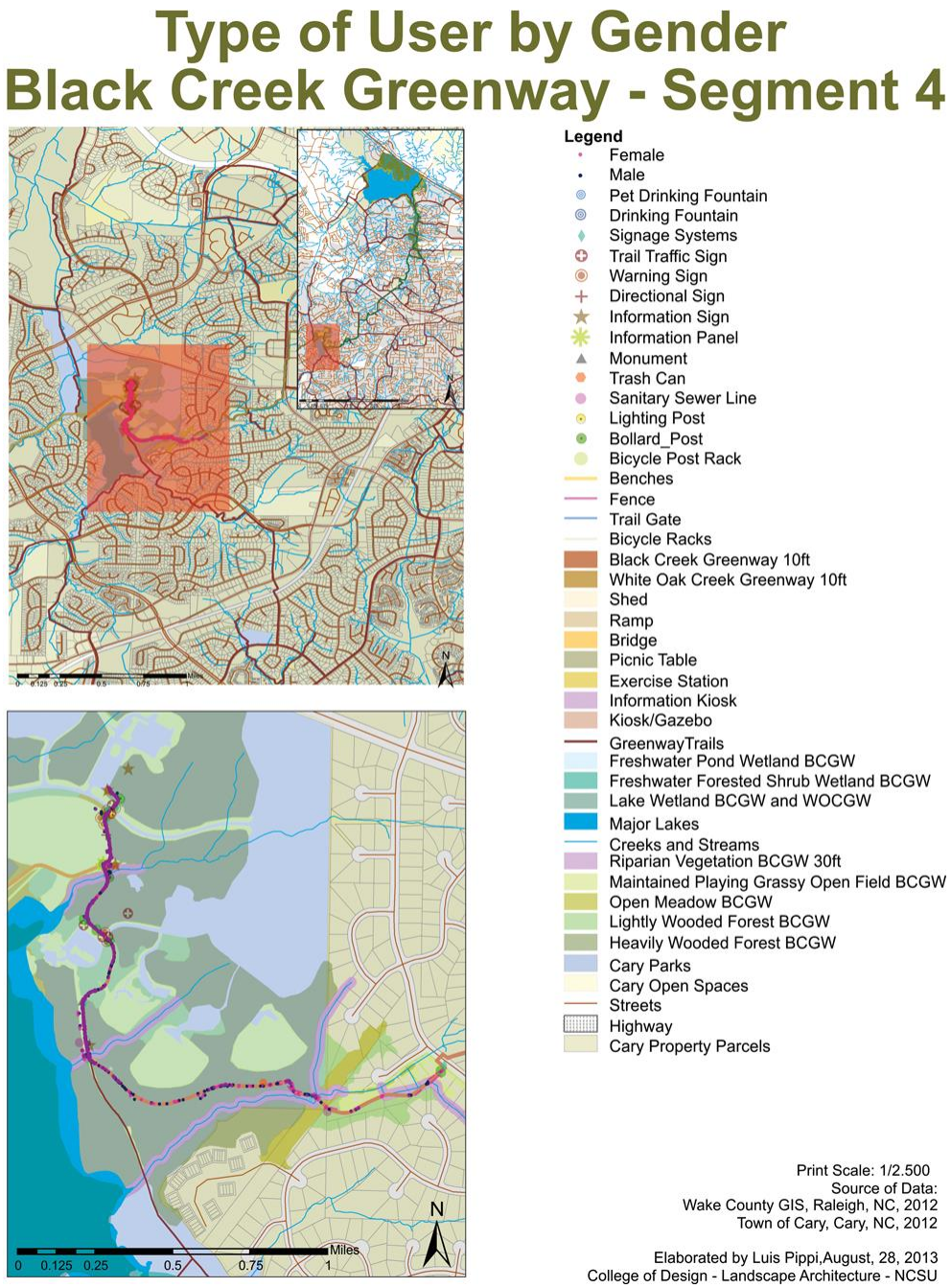

Figure 75: Usage by Gender in Segment 4 of the BCGW.

Source: Pippi (2013)

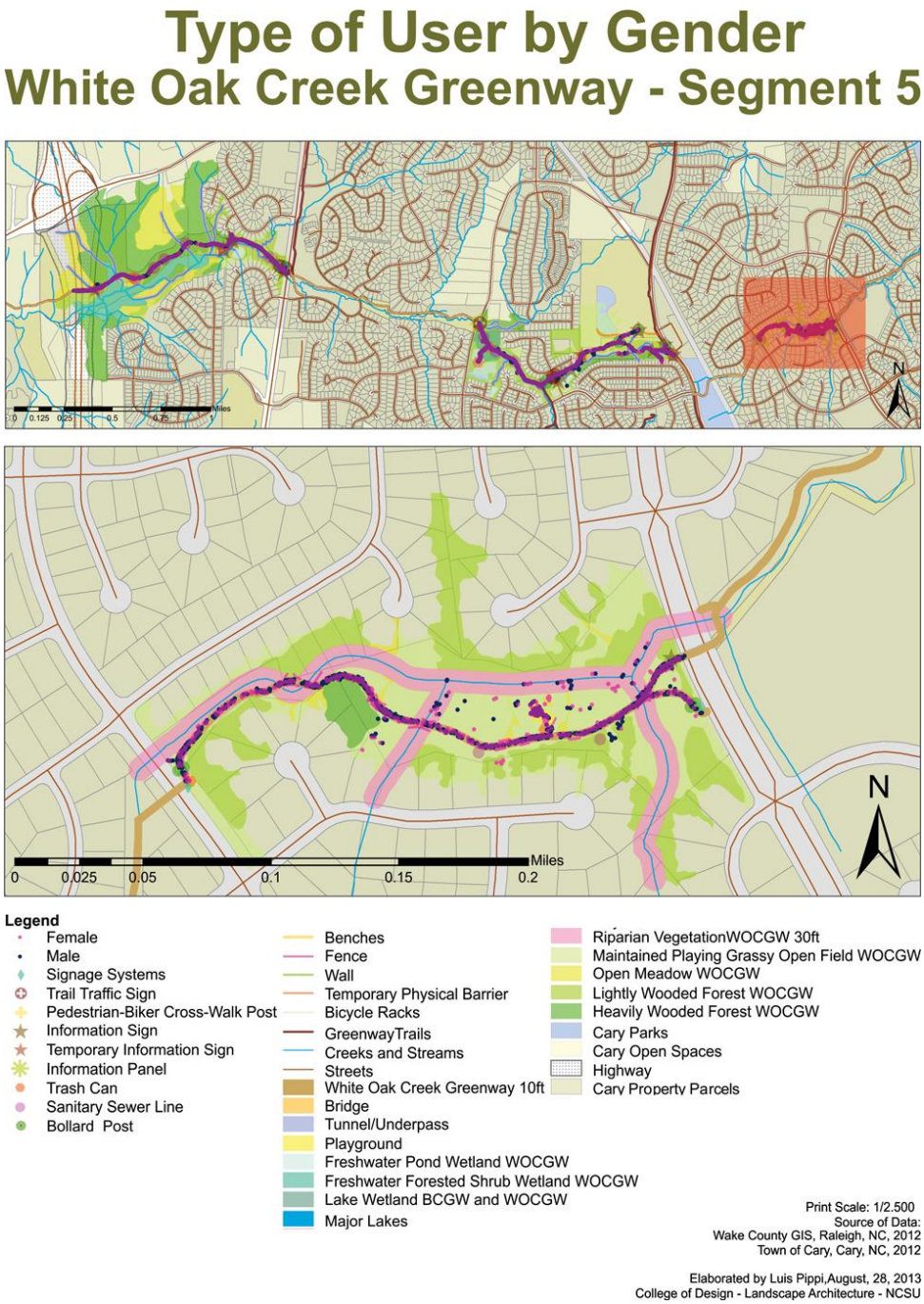

Figure 76: Usage by Gender in Segment 5 of the WCGW.

Source: Pippi (2013)

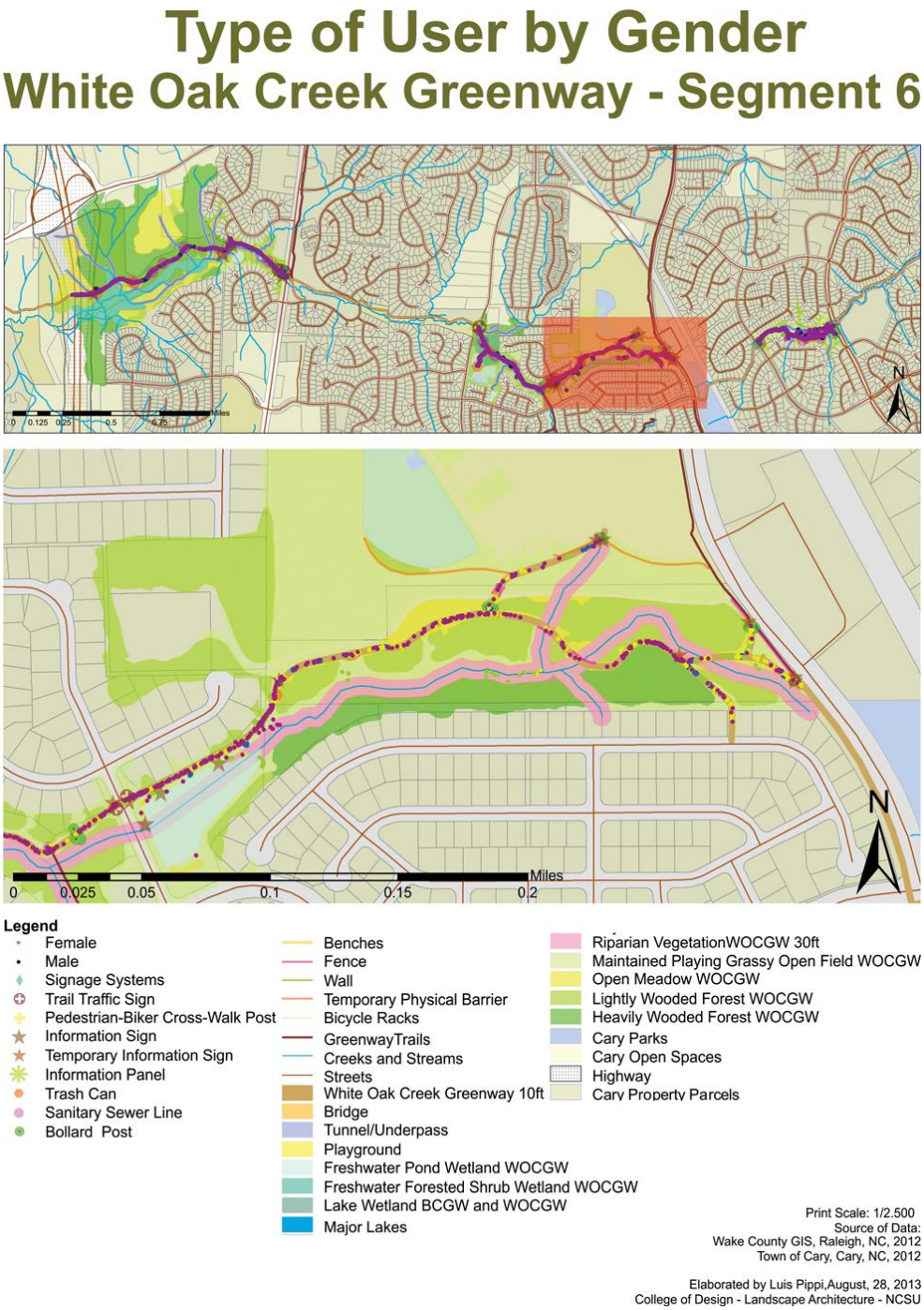

Figure 77: Usage by Gender in Segment 6 of the WCGW.

Source: Pippi (2013)

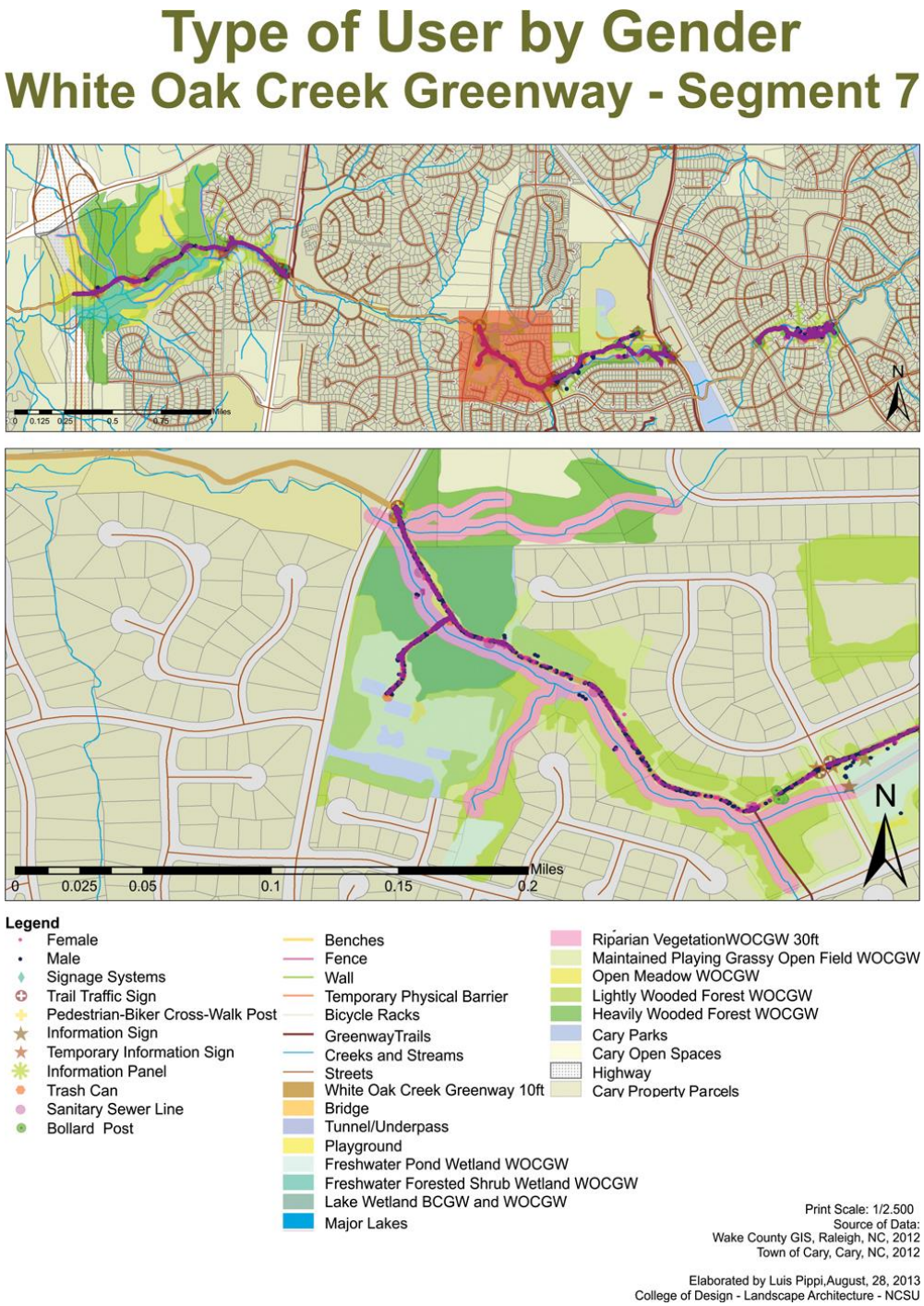

Figure 78: Usage by Gender in Segment 7 of the WCGW.

Source: Pippi (2013)

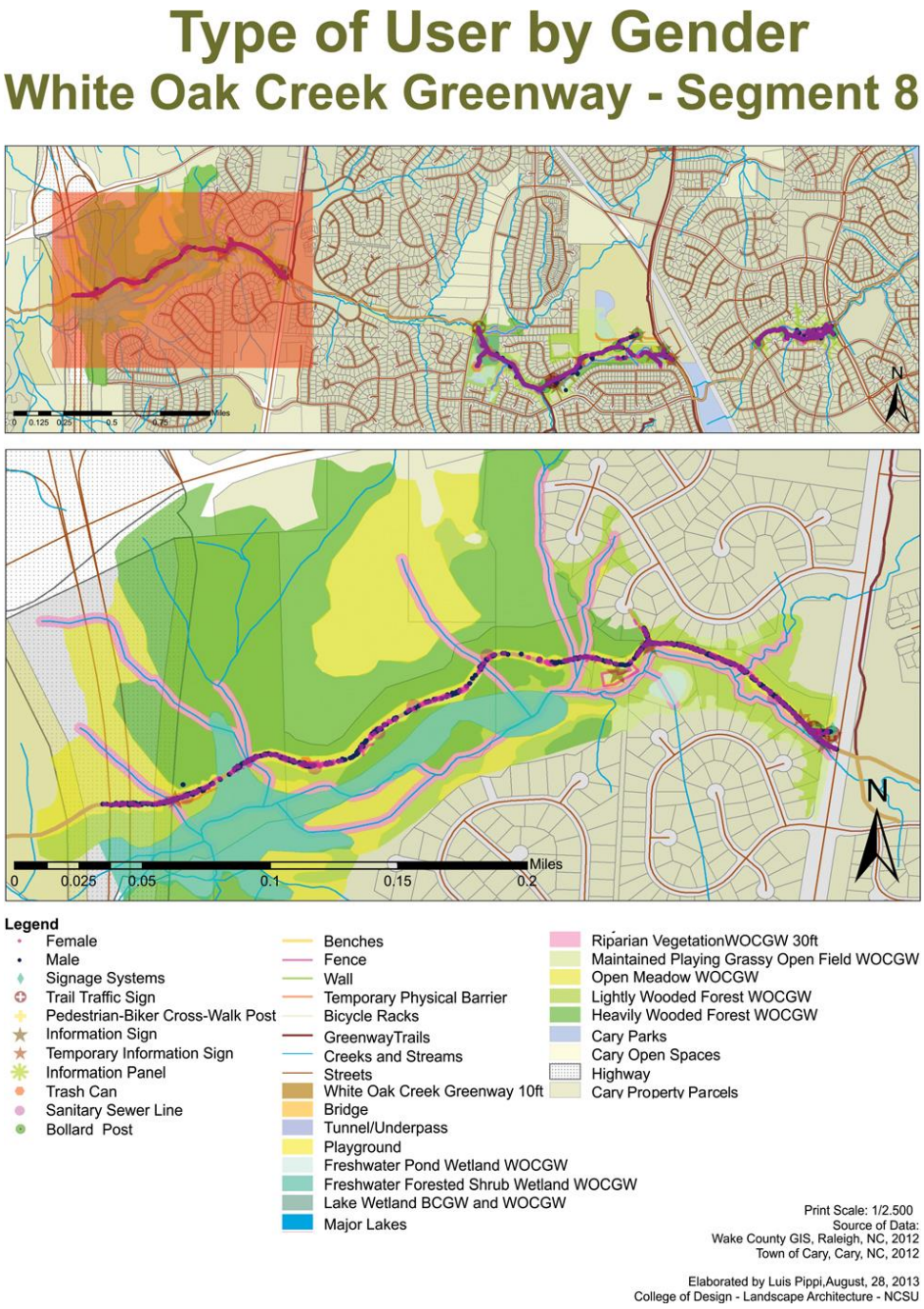

Figure 79: Usage by Gender in Segment 8 of the WCGW.

Source: Pippi (2013)

Figure 80 correlates gender usage in both greenways for all segments. Both greenways presented difference in terms of gender usage between them and also among their own greenway segments, in which the number of males was significantly higher than that of the females in all the segments for both greenways. When comparing the four segments of the BCGW: segment 1 presented the highest score for males (s1: with 59.60%; 853 observations) and the lowest score of females (s1: with 40.40%; 578 observations). In contrast, the segment 4 presented the lowest score for males (s4: with 51.25%; 923 observations) and the highest score of females (s4: with 48.75%; 878 observations). For all four segments of the WOCGW: segments 7 and 8 presented the highest and similar scores for males (s7: with 57.70%; 722 observations and s8: with 57.70%; 611 observations) and only segment 8 presented the lowest score in the female category (s8: with 42.30%; 448 observations). In contrast, segment 5 presented the highest score for females (s5: 46.72%; 676 observations). When comparing both greenways and all the segments together, the segment 1 of the BCGW surpassed all of the other segments in the male category with 59.60%, and the WOCGW exceeded all the other segments in the female category in segment 5 with 46.72%.

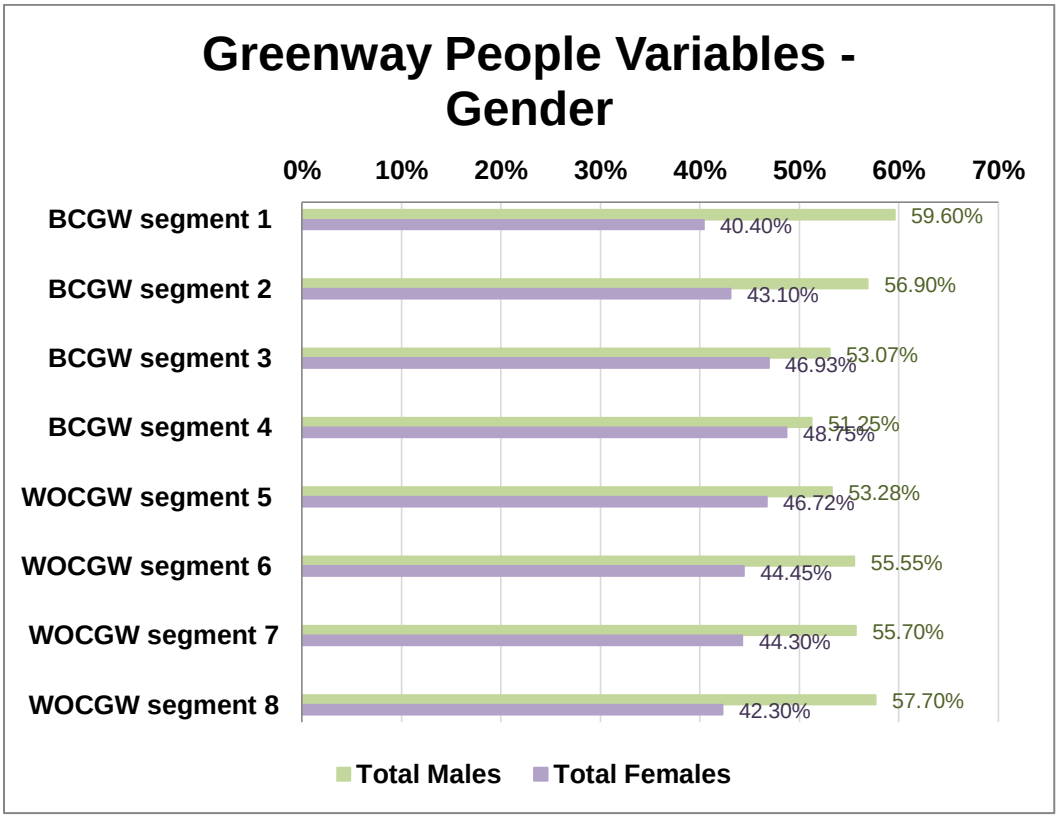

Figure 80: Greenway Gender Usage per Segment Type.

Source: Pippi (2013)

Table 18 shows the total usage frequency (counts and percentage) user age type in each greenway type. Both greenways presented more presence of adults if compared with the other categories, followed, in decreasing order, by children, adolescents and seniors. Of all age categories in both greenways, the senior category presented the least predominance. The BCGW presented the greatest number of adult users (84.50%; 4,658 observations) that exceeded significantly all the other categories. In contrast, the senior category presented the lowest number of users (1.98%; 109 observations). The WOCGW also presented the greatest number of adult users (73.23%; 3,437 observations) that surpassed considerably all the other categories. In contrast, the senior category presented the lowest number of

users (2.62%; 123 observations). When comparing both greenways together, it can be verified that the number of adult users was higher in the BCGW with 84.50% and the number of senior users was higher in the WOCGW with 2.62%; the number of children is higher in the WOCGW with 15.82%, with almost two times more prevalence, if compared to the BCGW with 8.58%, and the number of adolescents is higher in the WOCGW with 8.33% and also almost two times more prevalent, than the BCGW with 4.94%.

Table 18: Greenways Observed Usage Counts and Percentage by User Age Type.
Source: Pippi (2013)

Greenway Type	Total Use Counts	User Type	Usage Counts	Usage (%)
		Children (Ch)	473	8.58%
		Adolescent (As)	272	4.94%
BCGW	5,512	Adult (Ad)	4,658	84.50%
		Senior (Sn)	109	1.98%
		Children (Ch)	742	15.82%
		Adolescent (As)	391	8.33%
WOCGW	4,693	Adult (Ad)	3.437	73.23%
		Senior (Sn)	123	2.62%

The maps figures 81, 82, 83, 84, 85, 86, 87 and 88 illustrates the usage by age spatialization in both greenway segments: BCGW segments 1, 2, 3 and 4 and WOCGW segments 5, 6, 7 and 8.

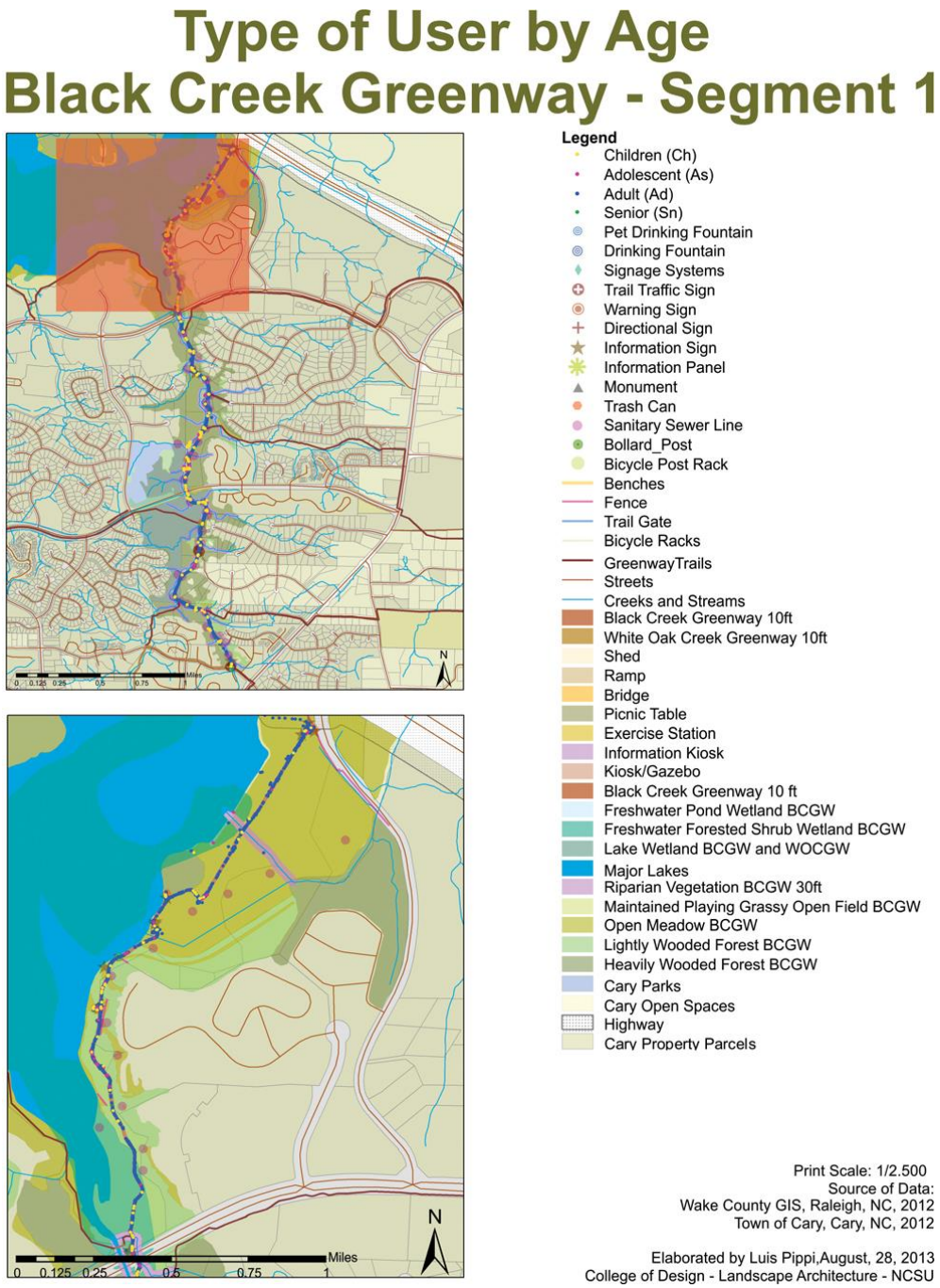

Figure 81: Usage by Age in Segment 1 of the BCGW.

Source: Pippi (2013)

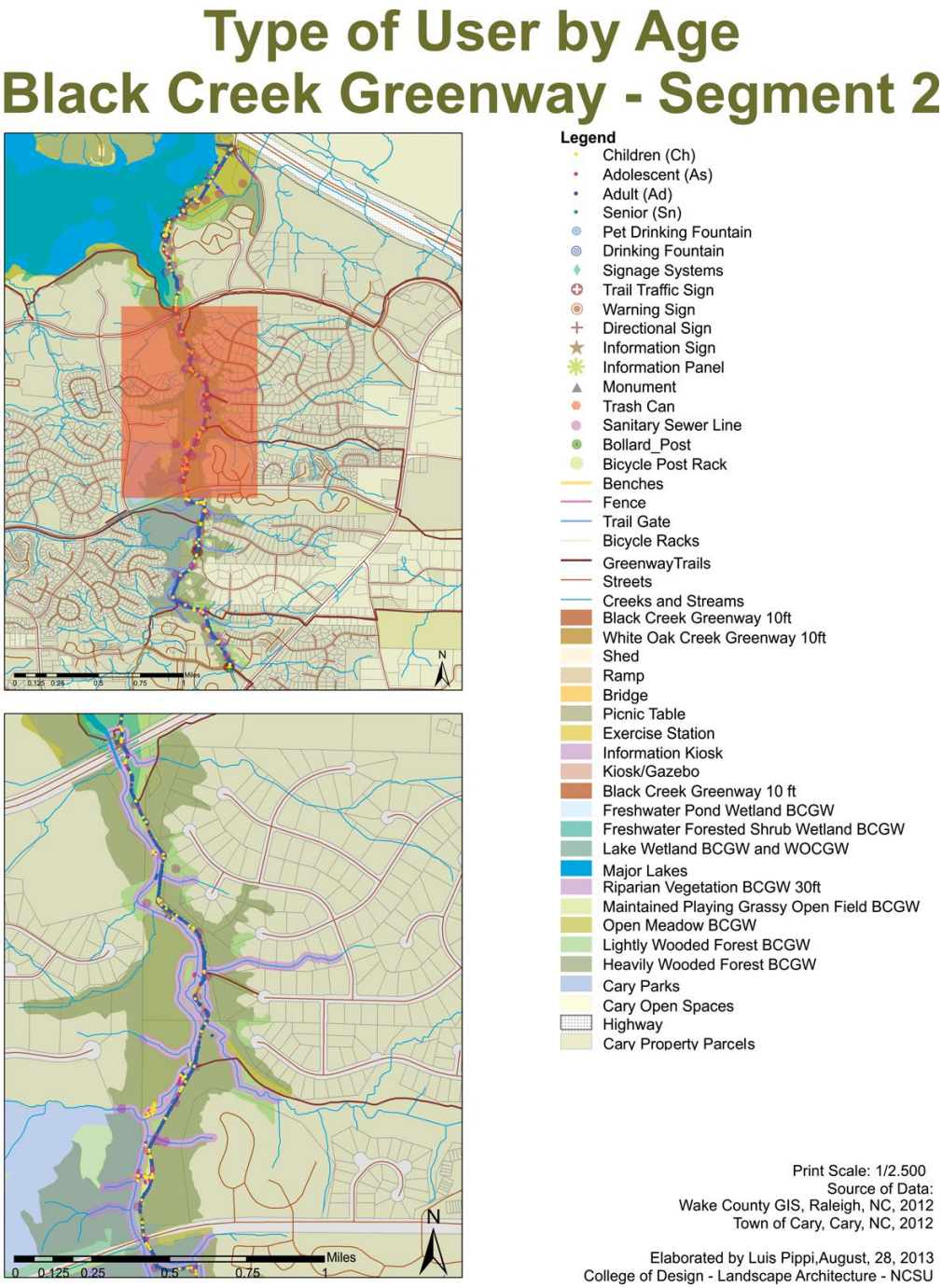

Figure 82: Usage by Age in Segment 2 of the BCGW.

Source: Pippi (2013)

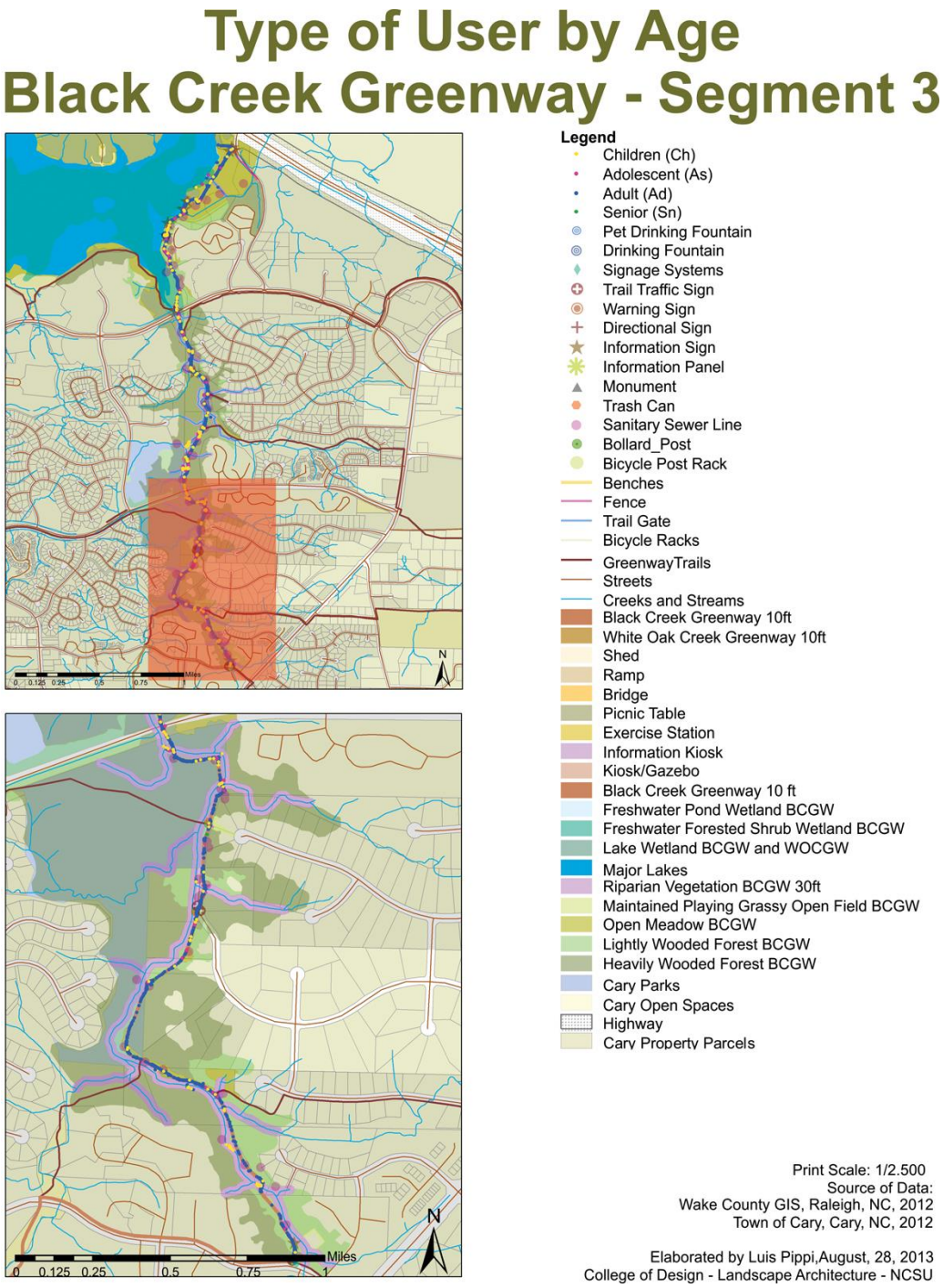

Figure 83: Usage by Age in Segment 3 of the BCGW.

Source: Pippi (2013)

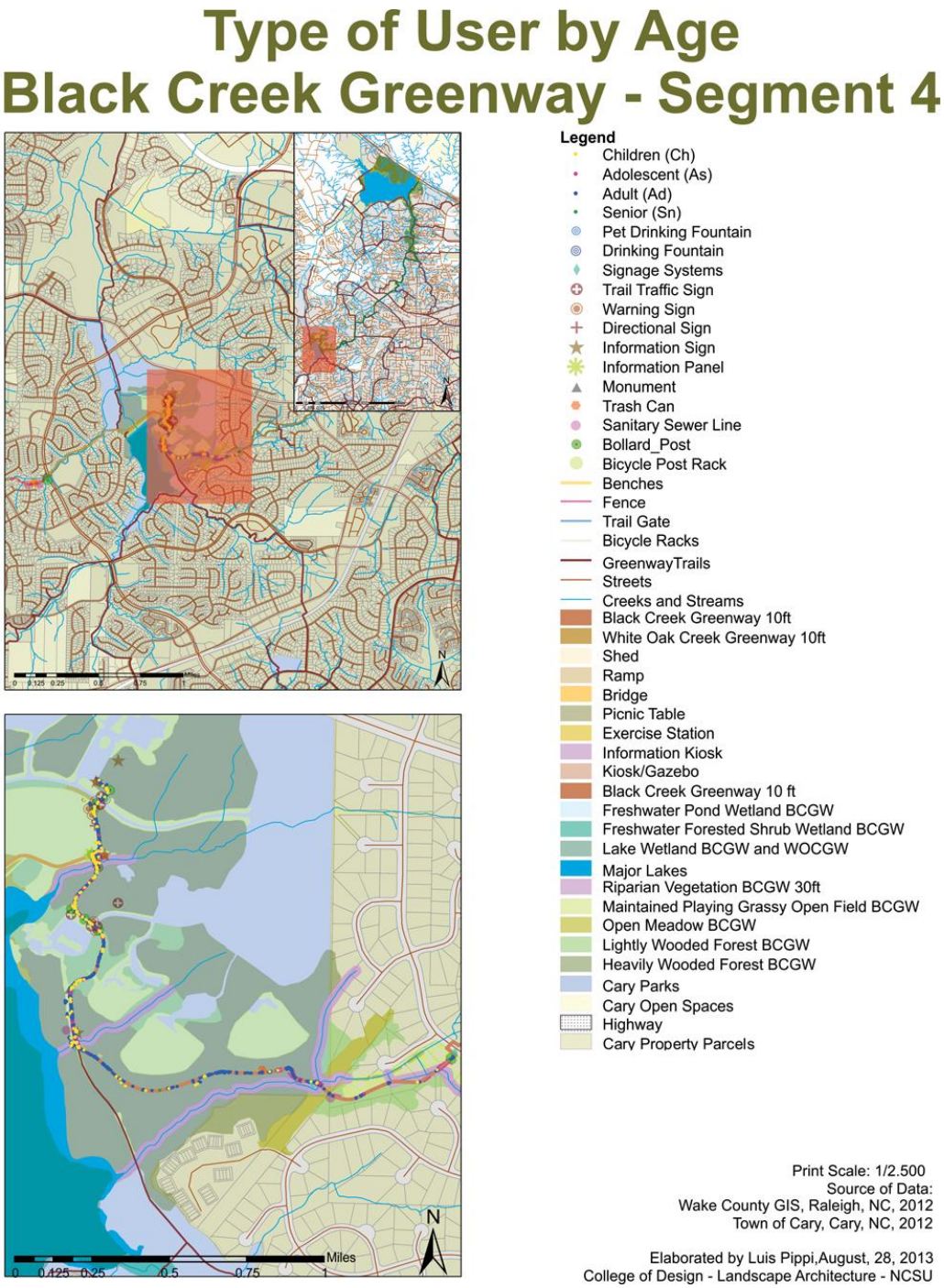

Figure 84: Usage by Age in Segment 4 of the BCGW.

Source: Pippi (2013)

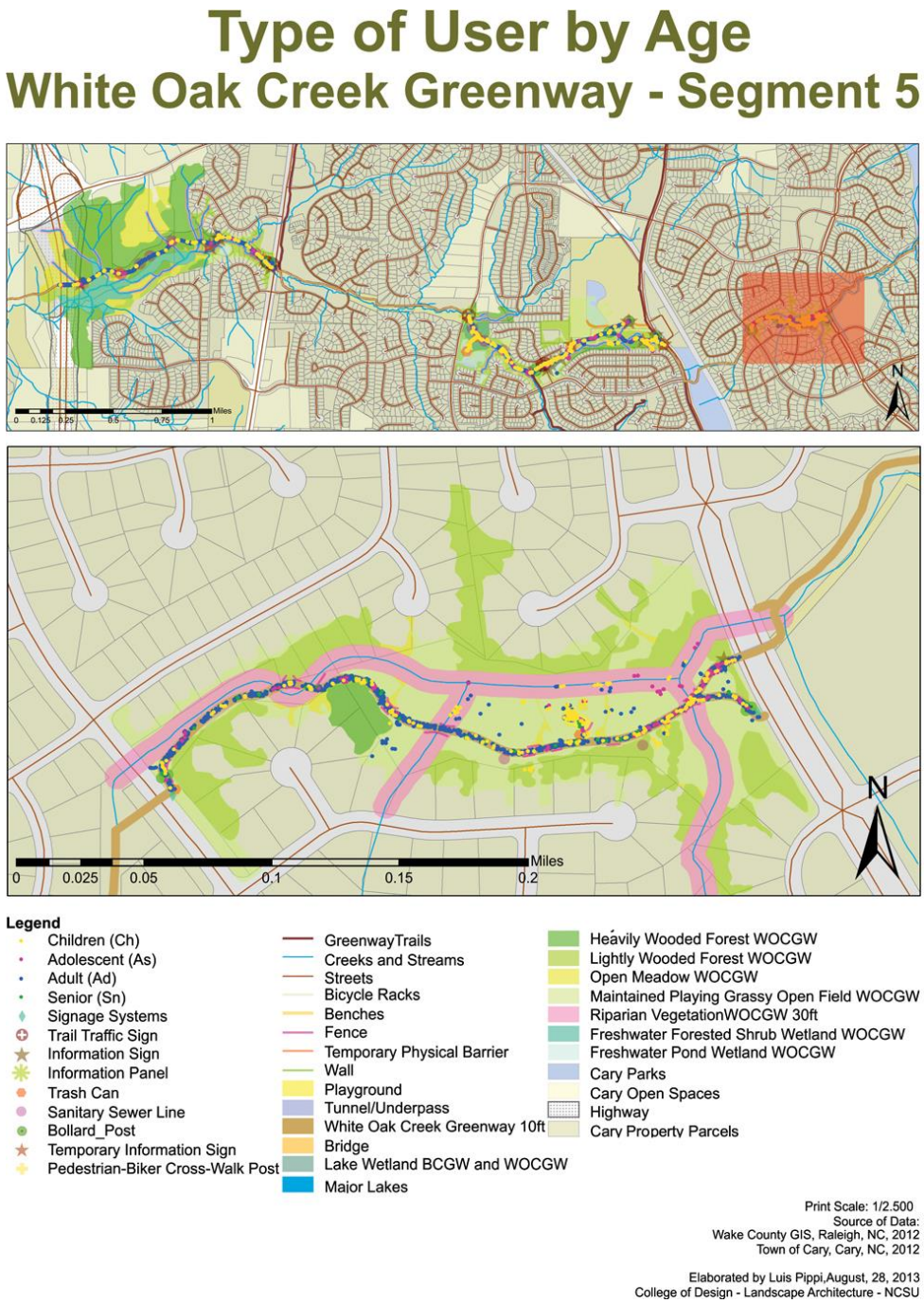

Figure 85: Usage by Age in Segment 5 of the WCGW.

Source: Pippi (2013)

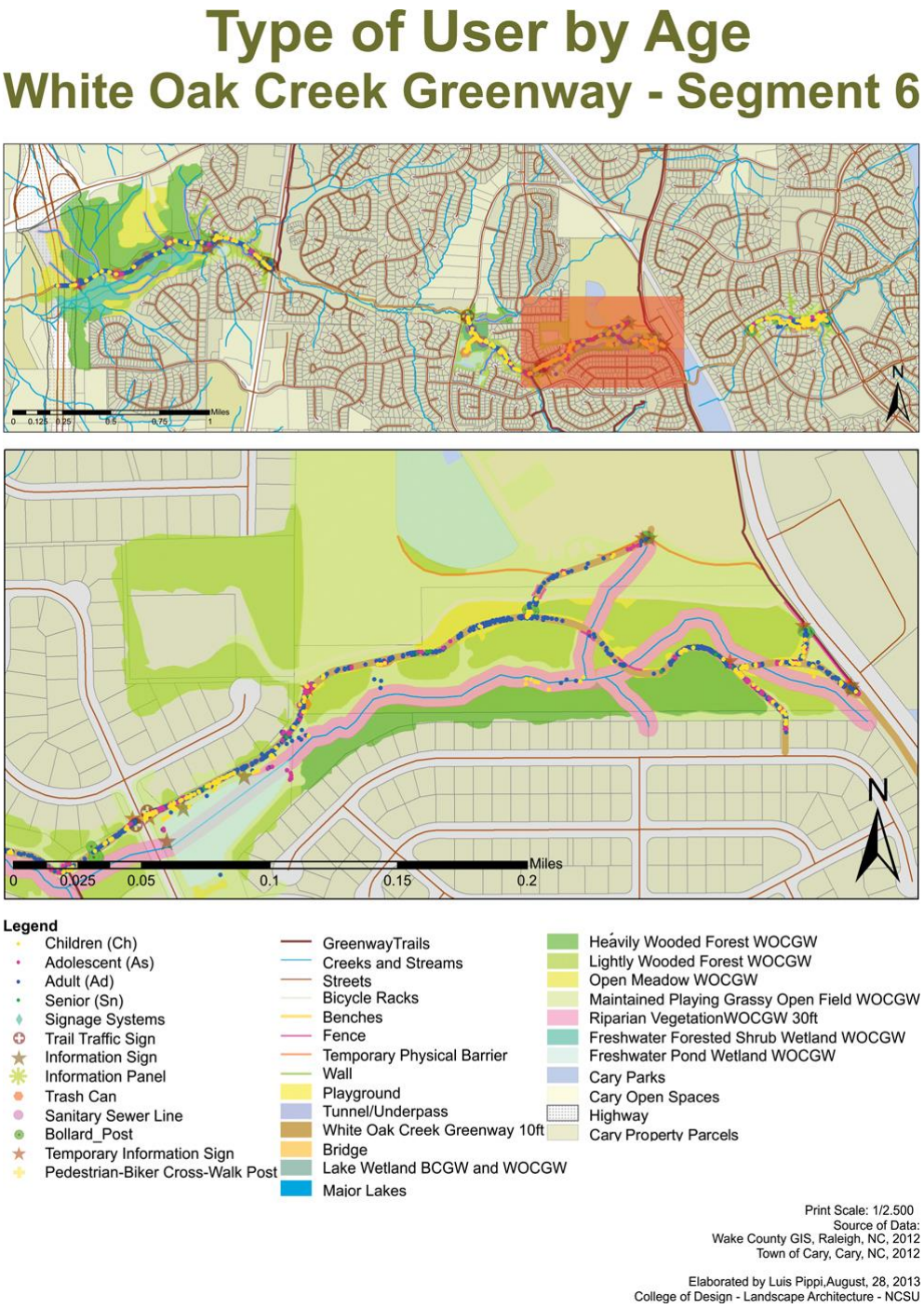

Figure 86: Usage by Age in Segment 6 of the WCGW.

Source: Pippi (2013)

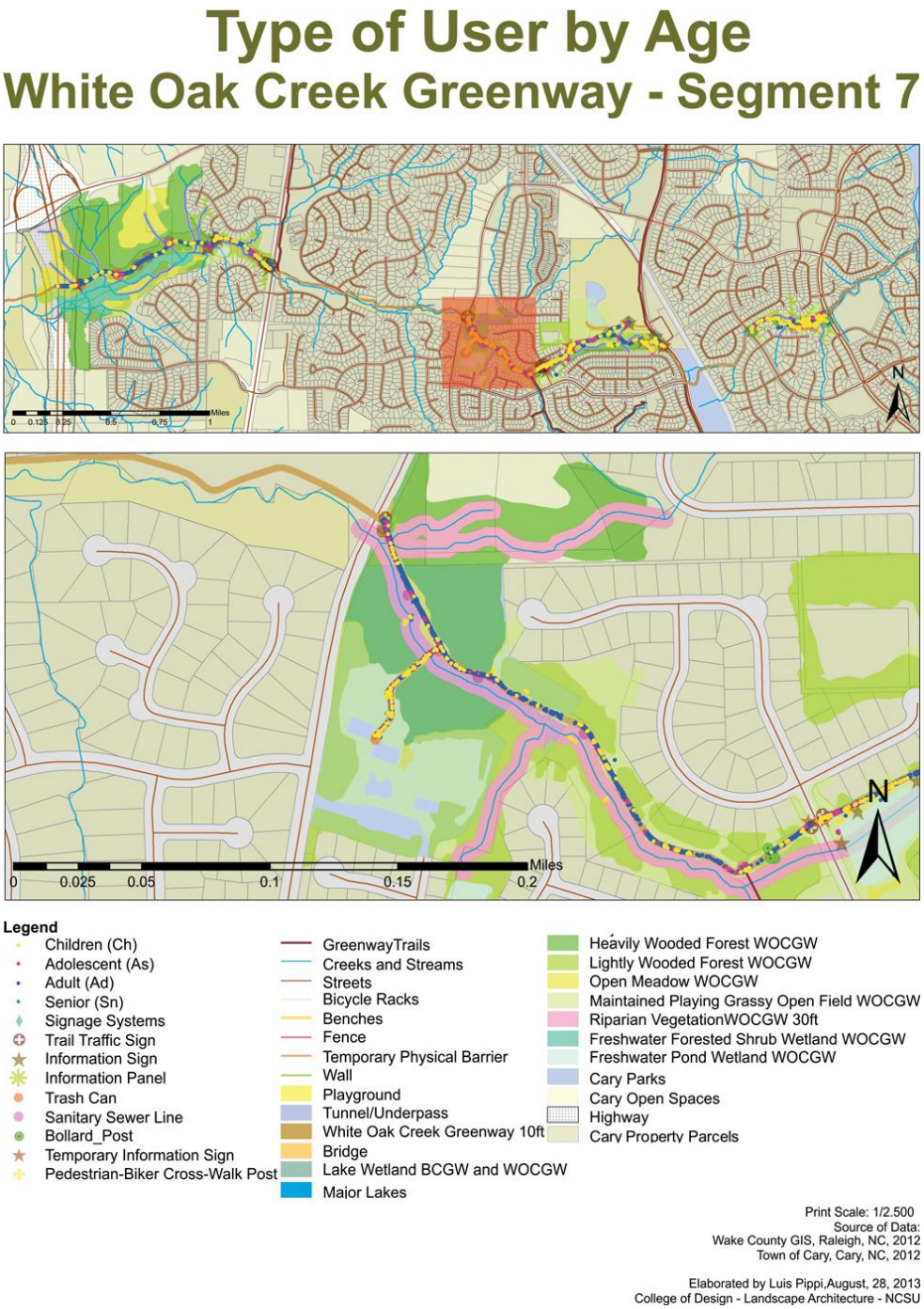

Figure 87: Usage by Age in Segment 7 of the WCGW.

Source: Pippi (2013)

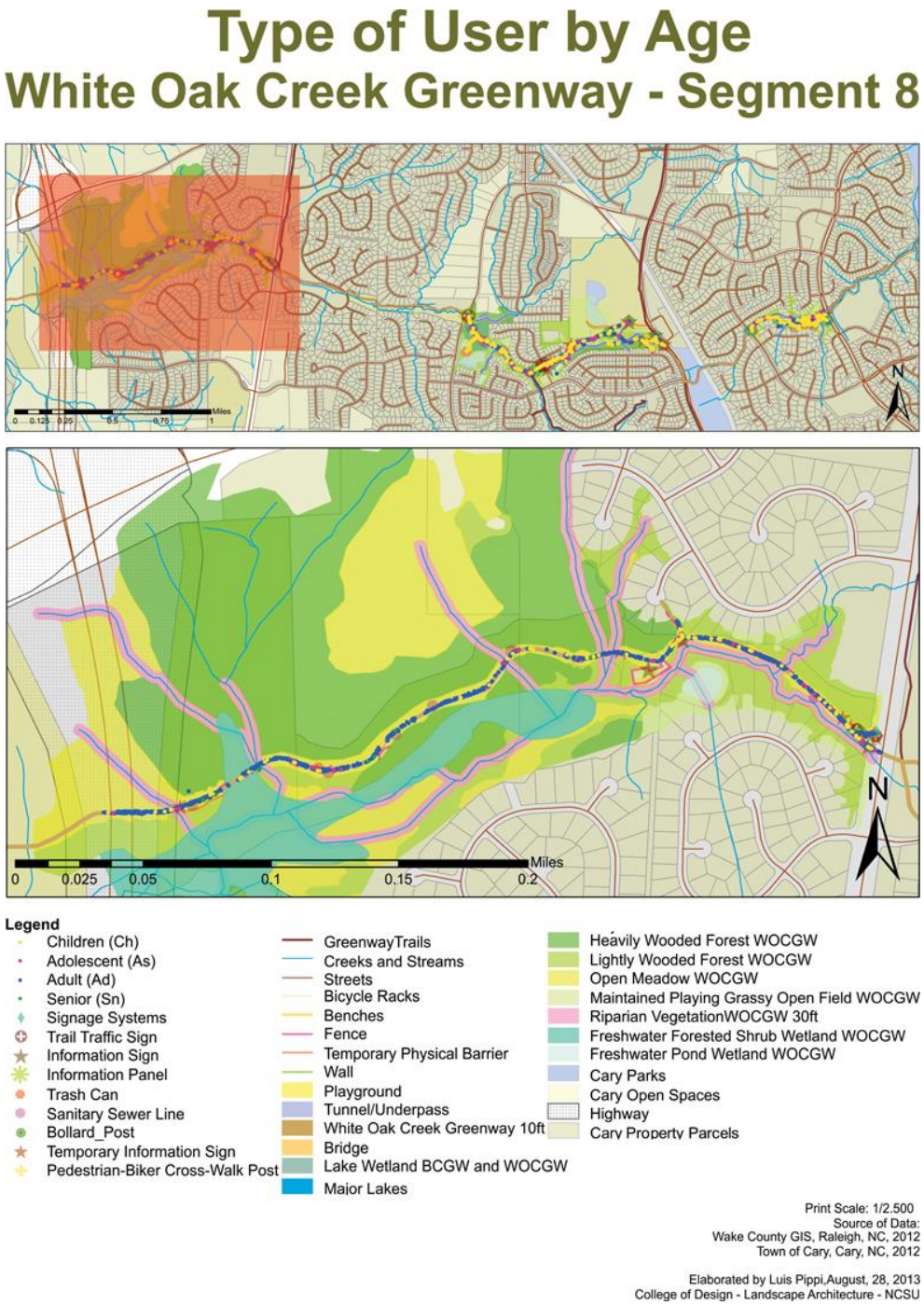

Figure 88: Usage by Age in Segment 8 of the WCGW.

Source: Pippi (2013)

Figure 89 compares the people variables in terms of the user age in both greenways and their segments types. Both greenways presented difference in terms of user age, between them and also among their own greenway segments, in which is significant more predominant the number of adults over all the other categories in all the segments and for both greenways. When the entire user age categories occurrences were compared with each other and within the four segments of the BCGW: the adult category were more prevalent and presented superior score in segment 1 (s1: with 88.75%; 1,270 observations). The segment 4 presented the highest scores for children, adolescent and senior categories, surpassing the other segments. The children category with moderate score (s4: with 12.10%; 1,410 observations), then the adolescent category with low score (s4: 7.39%; 133 observations) and the senior category that presented the lowest score (s4: 2.22%; 40 observations). In contrast, the adult category was less prevalent in segment 4, even though it presented a higher score if compared with the other categories (s4: with 78.29%; 1,410 observations). The children category was less prevalent in segments 3 and 1 that presented similar results (s3: with 7.32%; 75 observations and s1: with 5.45%; 78 observations), followed by the adolescent category that presented a low score in segment 3 (s3: with 3.12%; 32 observations) and then the senior category with the lowest score in segment 2 (s2: with 0.80%; 10 observations). Comparing all age categories this WOCGW dataset, segment 8 presented the highest score for the adult category, with significant difference within this category if compared to the other segments (s8: with 85.74%; 908 observations). Segment 6 presented moderate scores for children and adolescents followed by segment 5 (in the children category: s6: with 20.20%; 180 observations and s5: with 18.93%; 274 observations/ inthe adolescent category (s6: with 14.70%; 131 observations and s5: with 9.20%; 133 observations). The senior category presented the lowest score and was more prevalent in segment 7 (s7: 2.24%; 29 observations). In contrast, the adult category was less prevalent in segment 6, even though it presented superior score if compared with the other categories (s6: with 63.08%; 562 observations). The other categories were less prevalent in segment 8, (children s8: with 8.70%; 92 observations/ adolescent s8: with 4.34%; 46 observations/ senior s8: with 1.22%; 13 observations). When comparing both greenways and all the segments together, the segment 1 of the BCGW surpass all of the

other segments in the adult category with 88.75%, followed by the WOCGW with 85.74% of adults. In contrast the segment 2 of the BCGW yielded the lowest scores in the senior category with 0.80% and for the WOCGW the segment 8 presented the lowest score in the senior category with 1.22%.

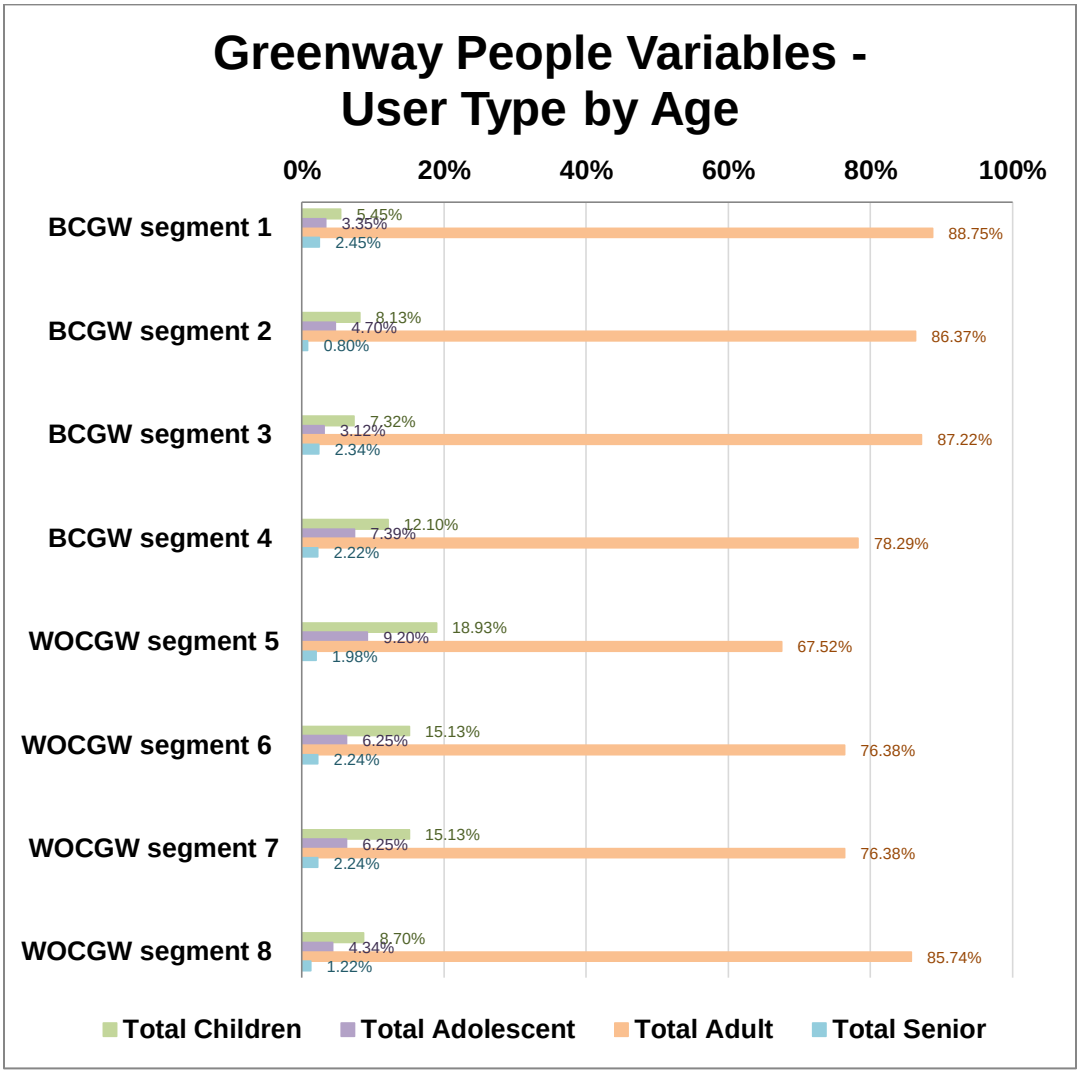

Figure 89: Greenway Usage by Age per Segment.

Source: Pippi (2013)

Table 19 shows the total usage frequency (counts and percentage) for the pure actor categories in each greenway type. Both greenways presented more presence of Individuals (I) if compared with the other categories, however if Dyads (D) and Triads (T) were combined together it generated the Sub Group (SB) category that equaled or slightly surpassed the Individual (I) category. Of all the pure actor categories in both greenways, the Triads (T) and Groups (G) presented the smallest occurrence. The BCGW presented the greatest number of Individuals (with 44.53%; 2,455 observations) significantly exceeding all the other categories, except for the Sub Groups (SB) which presented similar results (with 44.54%; 2,455 observations). In contrast, the Triads (T), followed by the Groups (G) presented the lowest incidence (T: with 10.40%; 573 observations and G: with 10.92%; 602 observations). Individuals was also the most predominant age category on the WOCGW (with 42.85%; 2,011 observations), significantly exceeding all the other categories, except for the Sub Groups (SB) (with 46.05%; 2,161 observations). In contrast, the Groups (G) category, followed by the Triads (T) category presented the lowest results (G: with 11.10%; 521 observations and T: with 13.75%; 645 observations). When compared both greenways together, it can be verified that the number of Individual (I) category is higher in the BCGW with 44.53% and the number of Sub Groups (SB) category is higher in the WOCGW with 46.05%. In terms of low scores presence, the Triads (T) and Groups (G) categories were more prevalent in the BCGW, respectively with 10.40% and 10.92%.

Table 19: Greenway Observed Usage Counts and Percentage by Pure Actor Type.
Source: Pippi (2013)

Greenway Type	Total Use Counts	Pure Actor Type	Usage Counts	Usage (%)
		Individual (I)	2,455	44.53%
		Dyad (D)	1,882	34.15%
BCGW	5,512	Triad (T)	573	10.40%
		Sub Groups (SB)	2,455	44.54%
		Groups (G)	602	10.92%
		Individual (I)	2,011	42.85%
		Dyad (D)	1,516	32.30%
WOCGW	4,693	Triad (T)	645	13.75%
		Sub Groups (SB)	2,161	46.05%
		Groups (G)	521	11.10%

The maps figures 90, 91, 92, 93, 94, 95, 96 and 97 illustrates the pure actor type spatialization in both greenway segments: BCGW segments 1, 2, 3 and 4 and WOCGW segments 5, 6, 7 and 8.

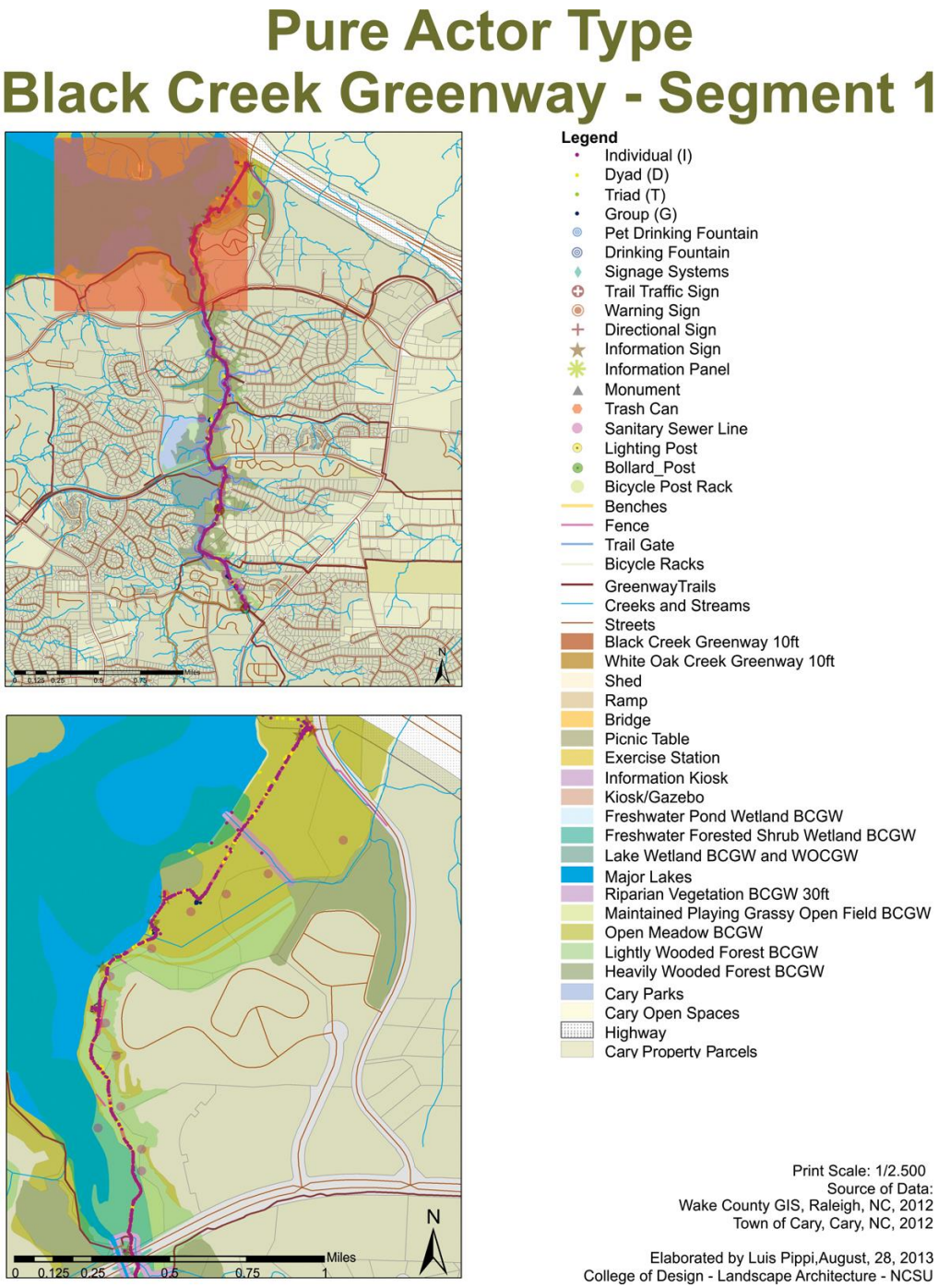

Figure 90: Usage by Pure Actor Type in Segment 1 of the BCGW.

Source: Pippi (2013)

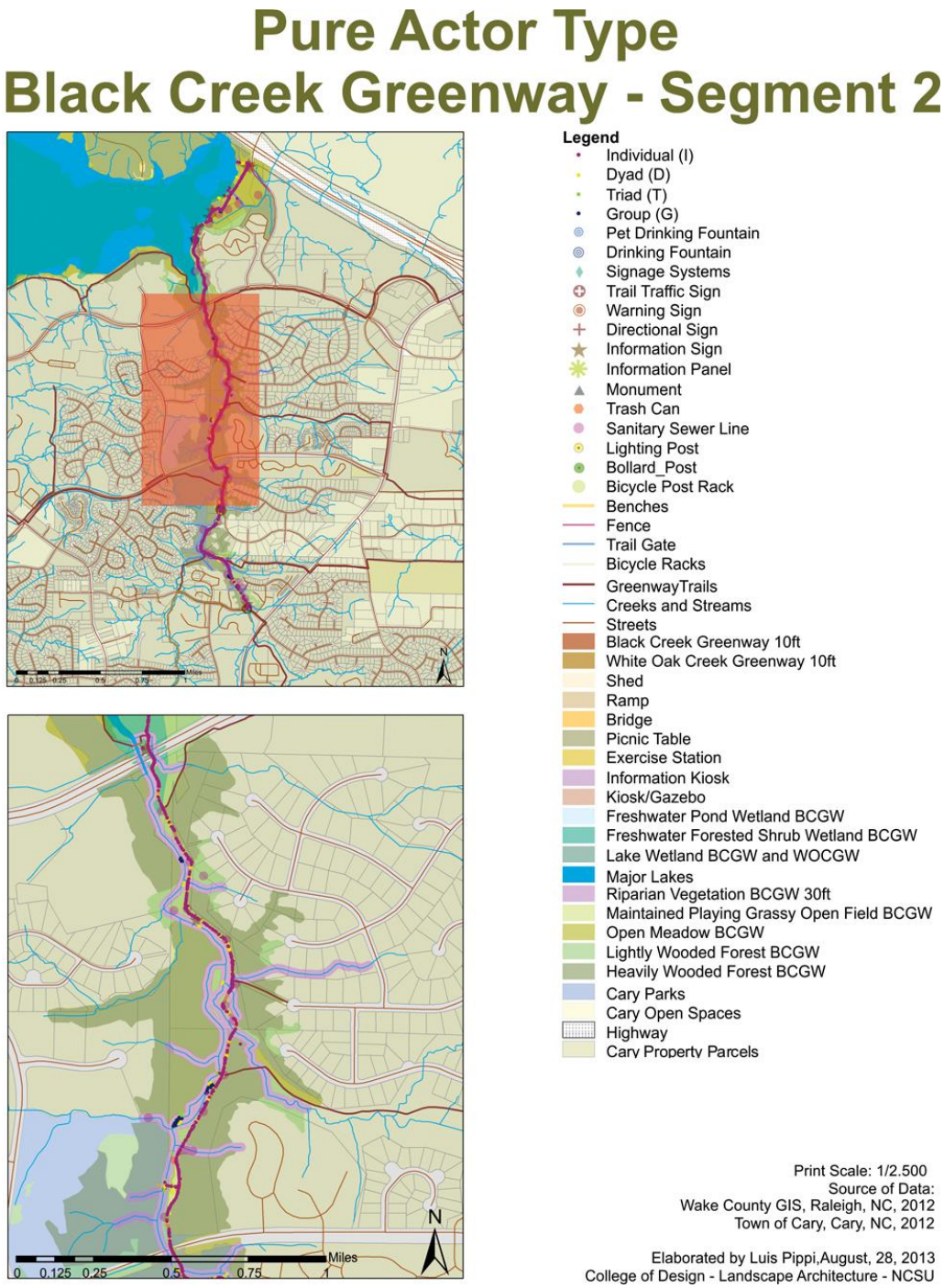

Figure 91: Usage by Pure Actor Type in Segment 2 of the BCGW.

Source: Pippi (2013)

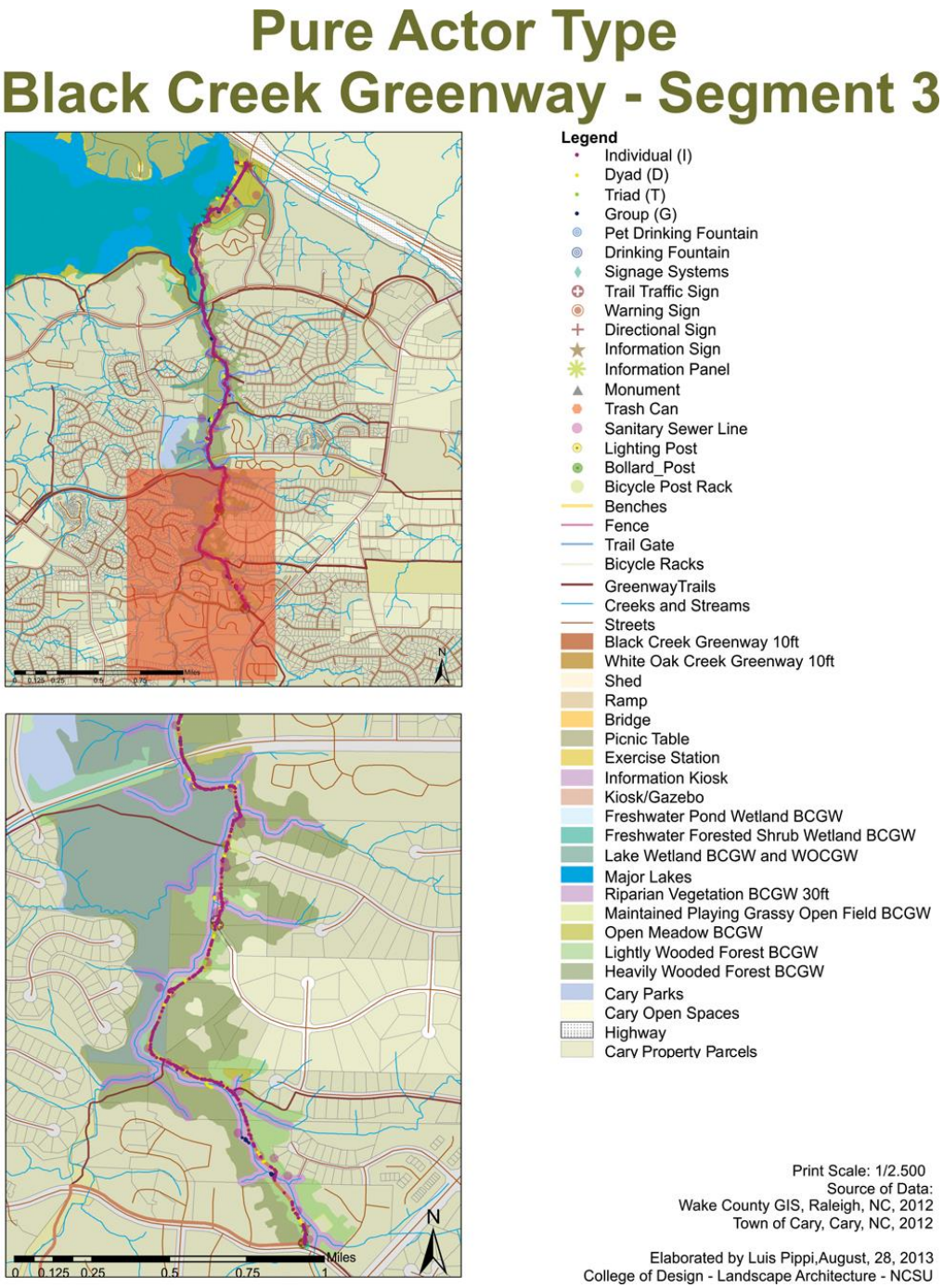

Figure 92: Usage by Pure Actor Type in Segment 3 of the BCGW.

Source: Pippi (2013)

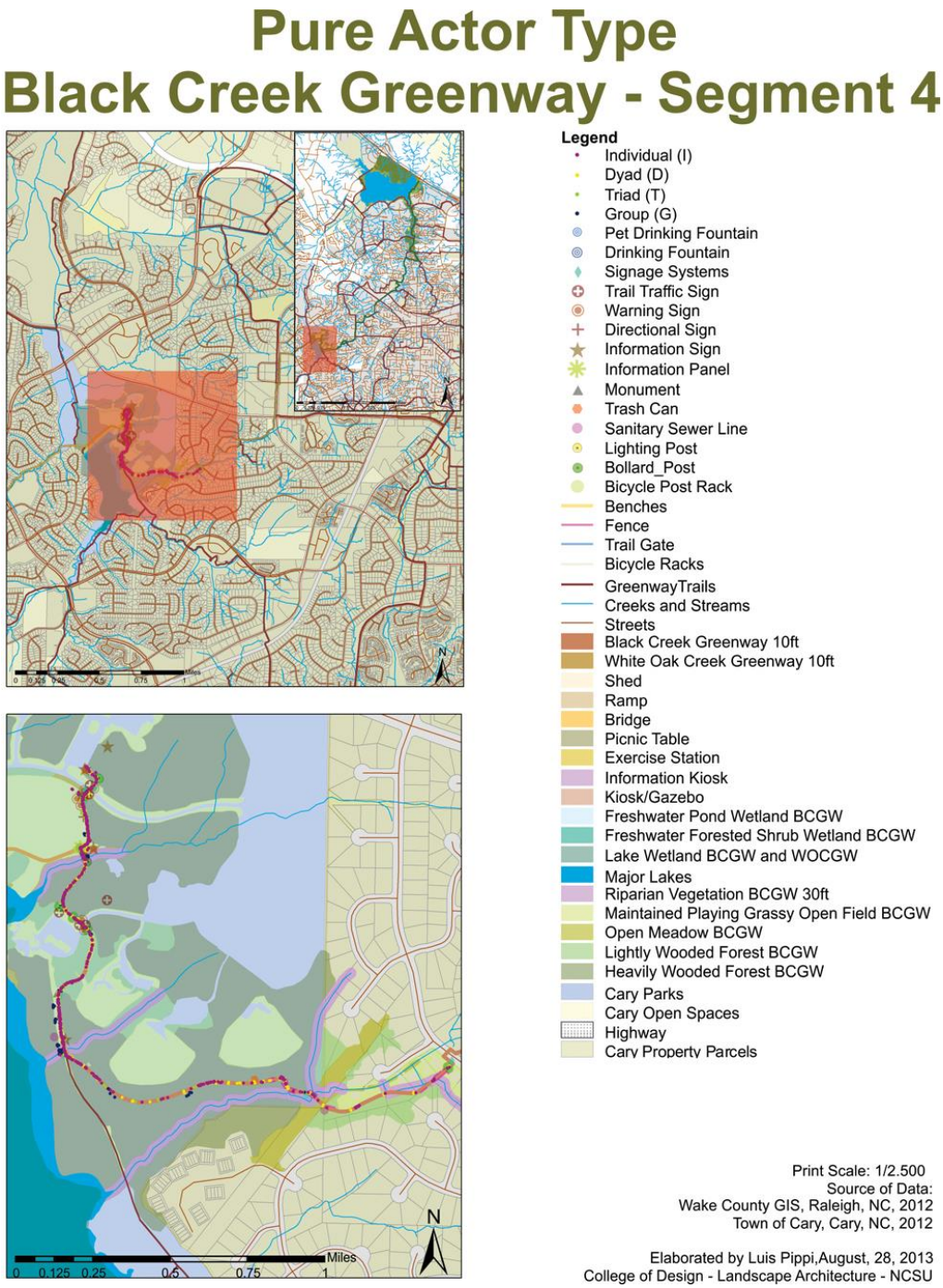

Figure 93: Usage by Pure Actor Type in Segment 4 of the BCGW.

Source: Pippi (2013)

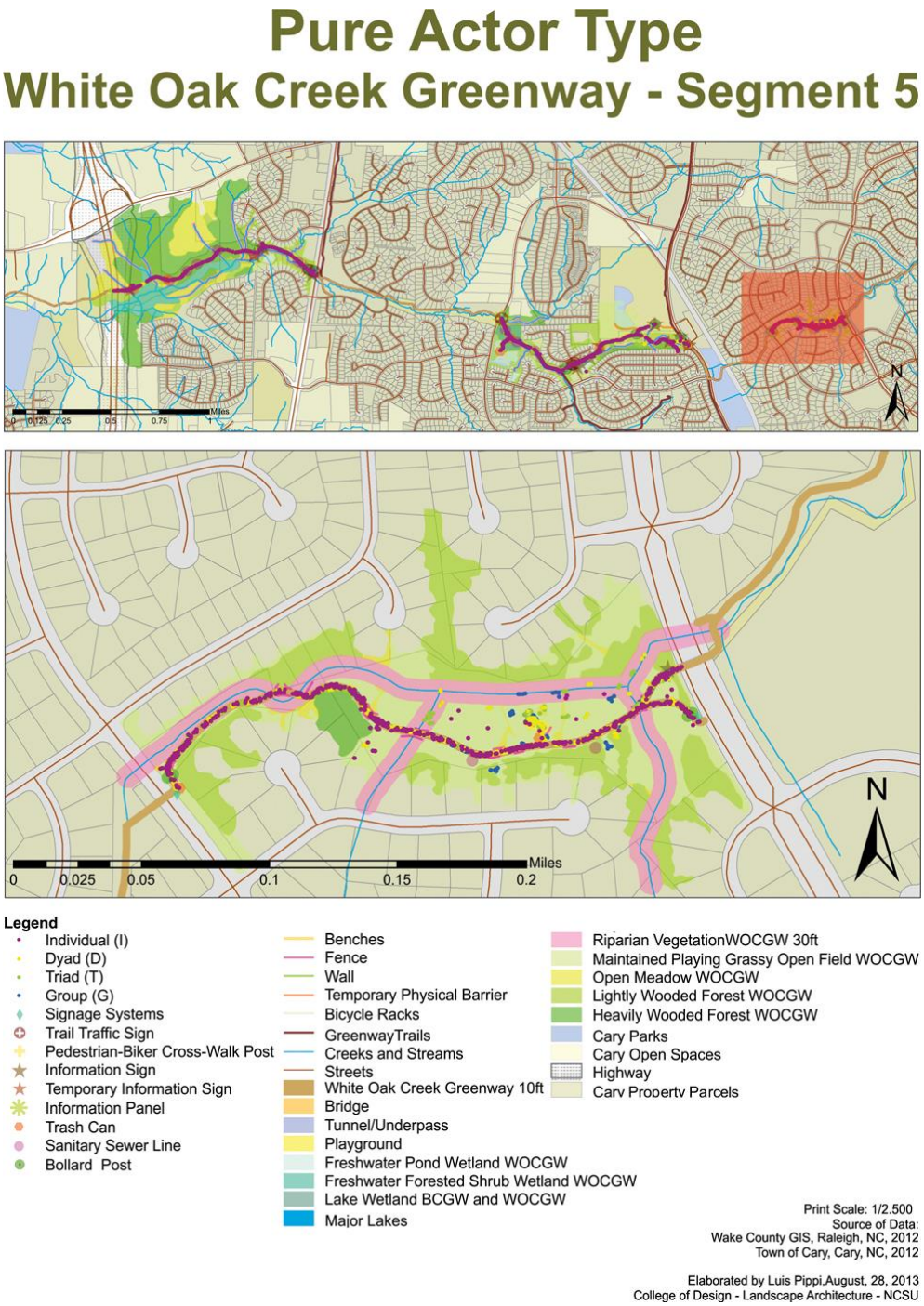

Figure 94: Usage by Pure Actor Type in Segment 5 of the WCGW.

Source: Pippi (2013)

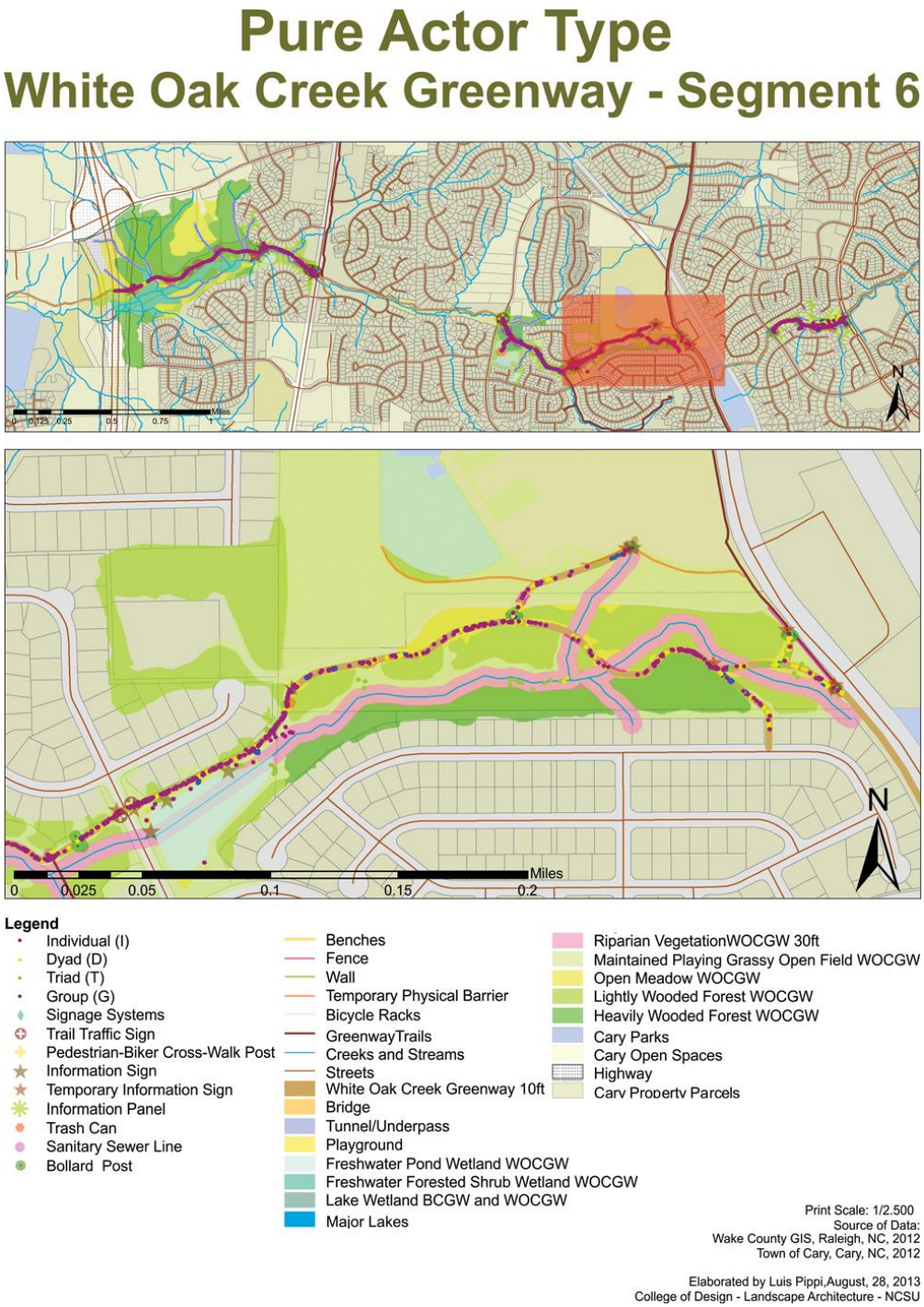

Figure 95: Usage by Pure Actor Type in Segment 6 of the WCGW.

Source: Pippi (2013)

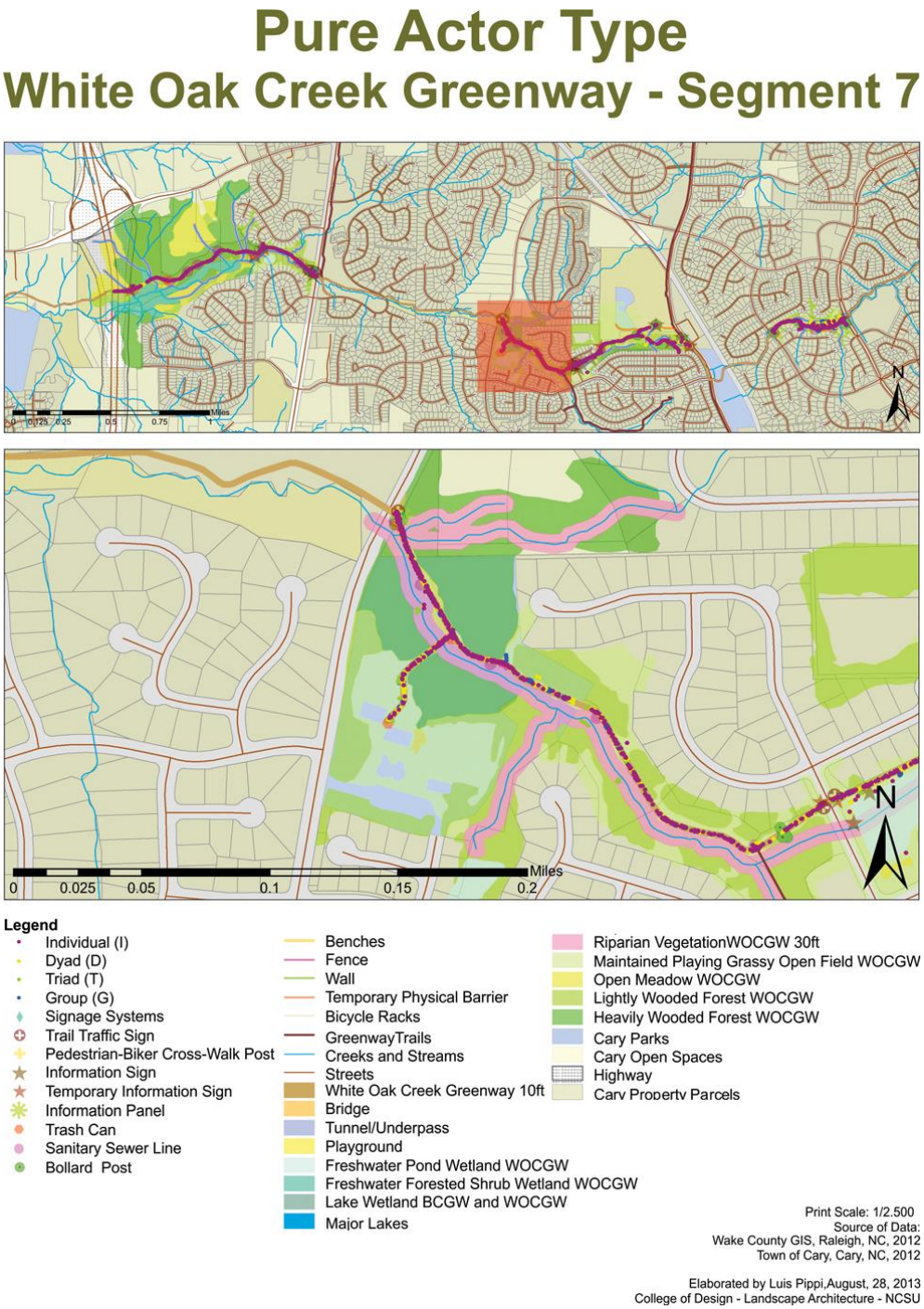

Figure 96: Usage by Pure Actor Type in Segment 7 of the WCGW.

Source: Pippi (2013)

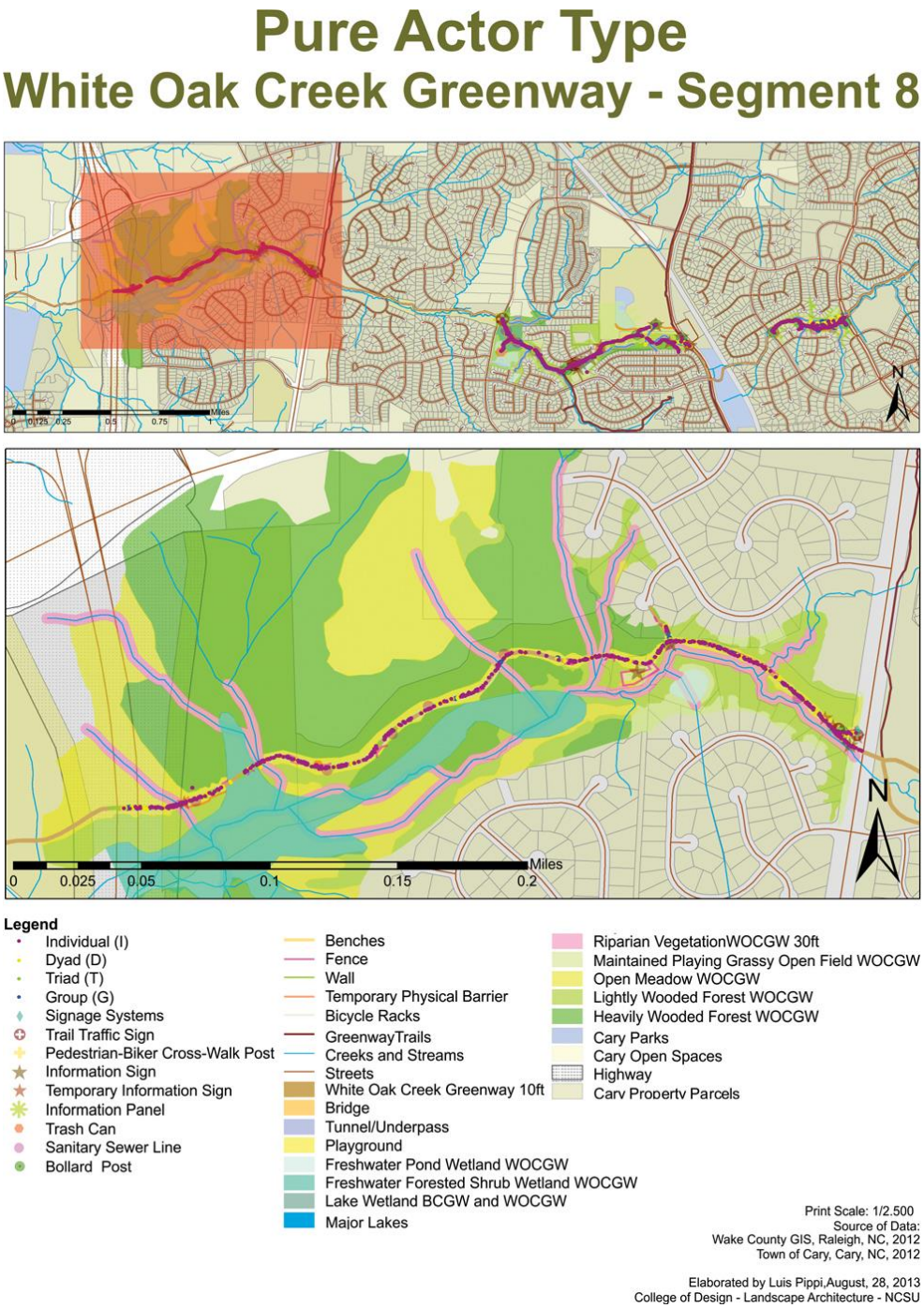

Figure 97: Usage by Pure Actor Type in Segment 8 of the WCGW.

Source: Pippi (2013)

Figure 98 compares pure actor categories for both greenways and their segments. Both greenways presented significant difference in terms of actor type, both across greenways and across segments within each greenway. The number of Individuals (I) and/or Sub Groups (SB) was significantly predominant over all the other categories in all the segments and for both greenways. Across the four segments of the BCGW: the Individuals (I) presented higher scores in segments, 3, 2 and 1 with the highest result in segment 3 (s3: with 56.40%; 578 observations); the Sub Groups (SB) category surpassed the previous category in segment 4 (s4: with 45.70%; 823 observations); the Dyads (D) category was more prevalent in segment 2 (s2: with 35.38%; 444 observations), and the Triads (T) category was more prevalent in segments 1 and 4 with similar moderate-low results (s1: with 11.95%; 171 observations and s4: with 11.50%; 207 observations). In contrast, the Individuals (I) category was less prevalent in segment 4, even though it was higher than the other the other categories (s4: with 34.98%; 630 observations). The Dyads (D) category was less prevalent in segment 3 with moderate results (s3: with 32.00%; 328 observations), followed by the Triads (T) category that was less prevalent in segment 2 with low results (s2: with 8.13%; 102 observations); the Groups (G) category were less prevalent in segment 3 and presented low results (s3: with 2.53%; 26 observations). Finally, the Sub Groups (SB) category was less prevalent also in segment 3, even though it presented a high score (s3: 41.07%; 421 observations).

For the WOCGW segments: the Individuals (I) category were more prevalent in segments 8 and 7 presented with similar and high results (s8: with 47.70%; 505 observations and s7: with 46.07%; 597 observations). The Dyads (D) category was more prevalent in segment 5 with moderate results (s5: with 33.31%; 482 observations), and the Triads (T) category was more prevalent in segments 6 and 5 with similar moderate-low results (s6: with 17.84%; 159 observations and s5: with 17.83%; 258 observations), the Sub Groups (SB) category was more prevalent in segment 5 with high results (s5: with 51.14%; 740 observations). In contrast, the Individuals (I) category was less prevalent in segment 6, even though it presented a higher score if compared with the other categories (s6: with 36.59%; 326 observations). The Dyads (D) category was less prevalent also in segment 6 with moderate

results (s6: with 30.98%; 276 observations), followed by the Triads (T) category that was less predominant in segment 8 with low results (s8: with 9.34%; 99 observations). The Groups (G) category was less predominant in segment 5 and presented low results (s5: with 8.50%; 123 observations), finally the Sub Groups (SB) category was also less prevalent in segment 7, even though it presented a high score (s7: 41.43%; 537 observations).

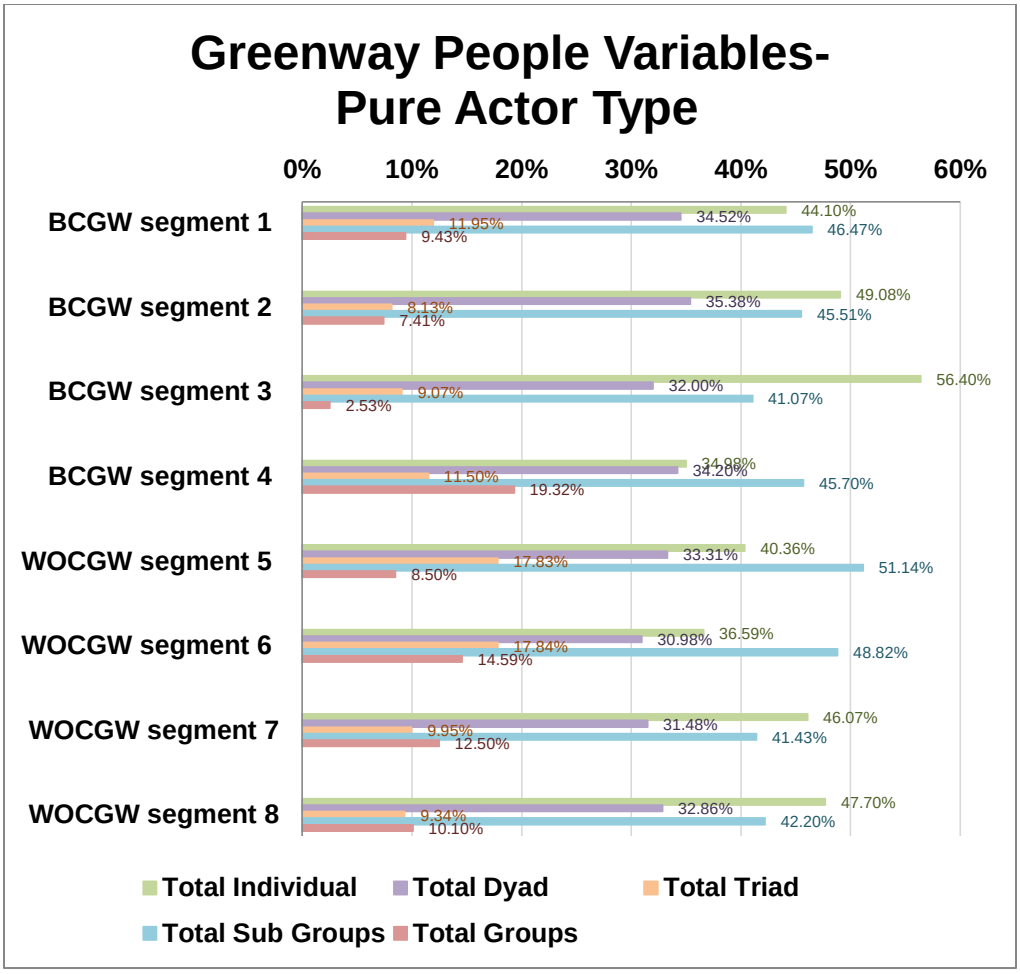

Figure 98: Greenway Pure Actor Usage per Segment.

Source: Pippi (2013)

The maps figures 99, 100, 101, 102, 103, 104, 105 and 106 illustrates the pure actor type density islands spatialization in both greenway segments: BCGW segments 1, 2, 3 and 4 and WOCGW segments 5, 6, 7 and 8.

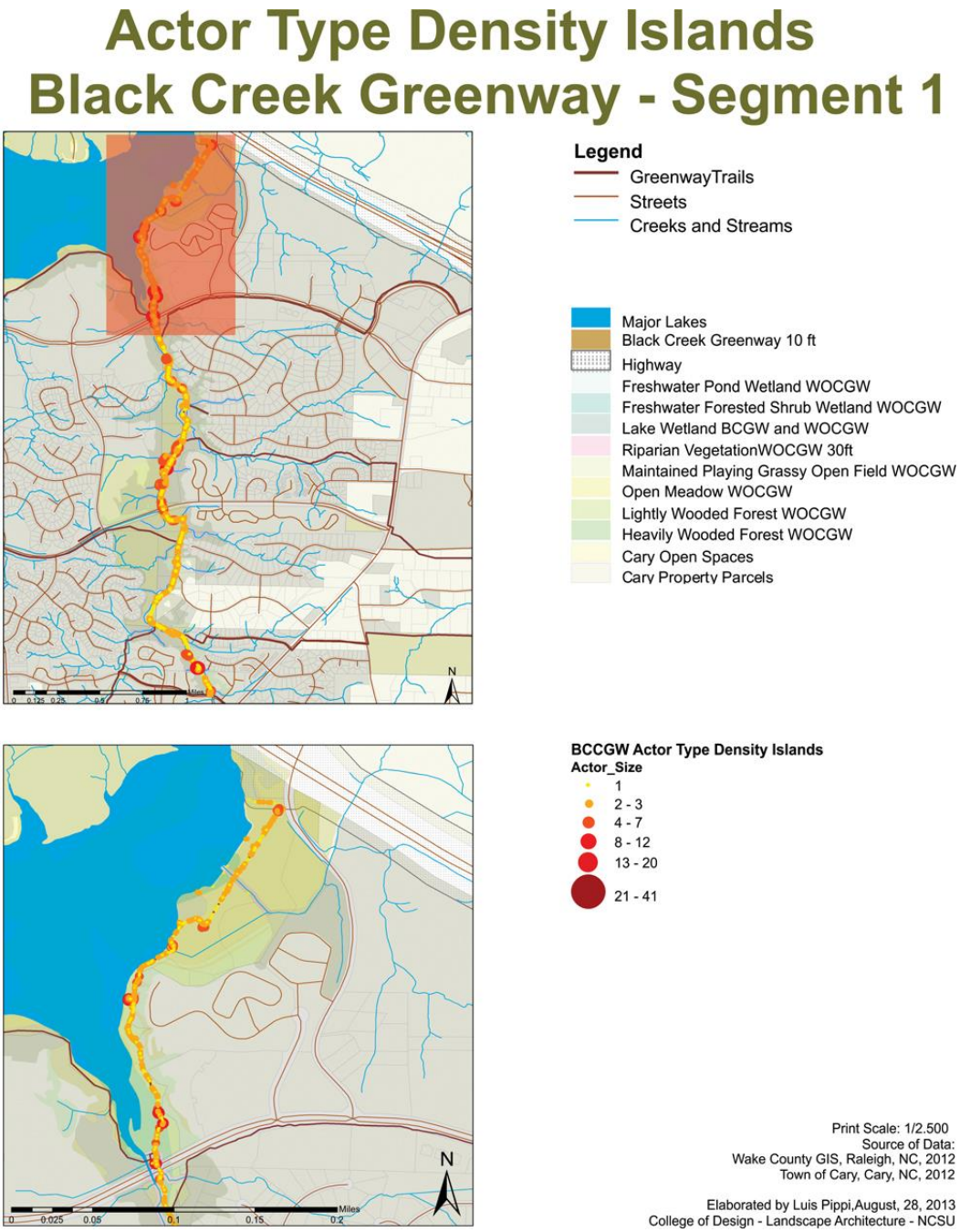

Figure 99: Pure Actor Type Density Islands in Segment 1 of the BCGW.

Source: Pippi (2013)

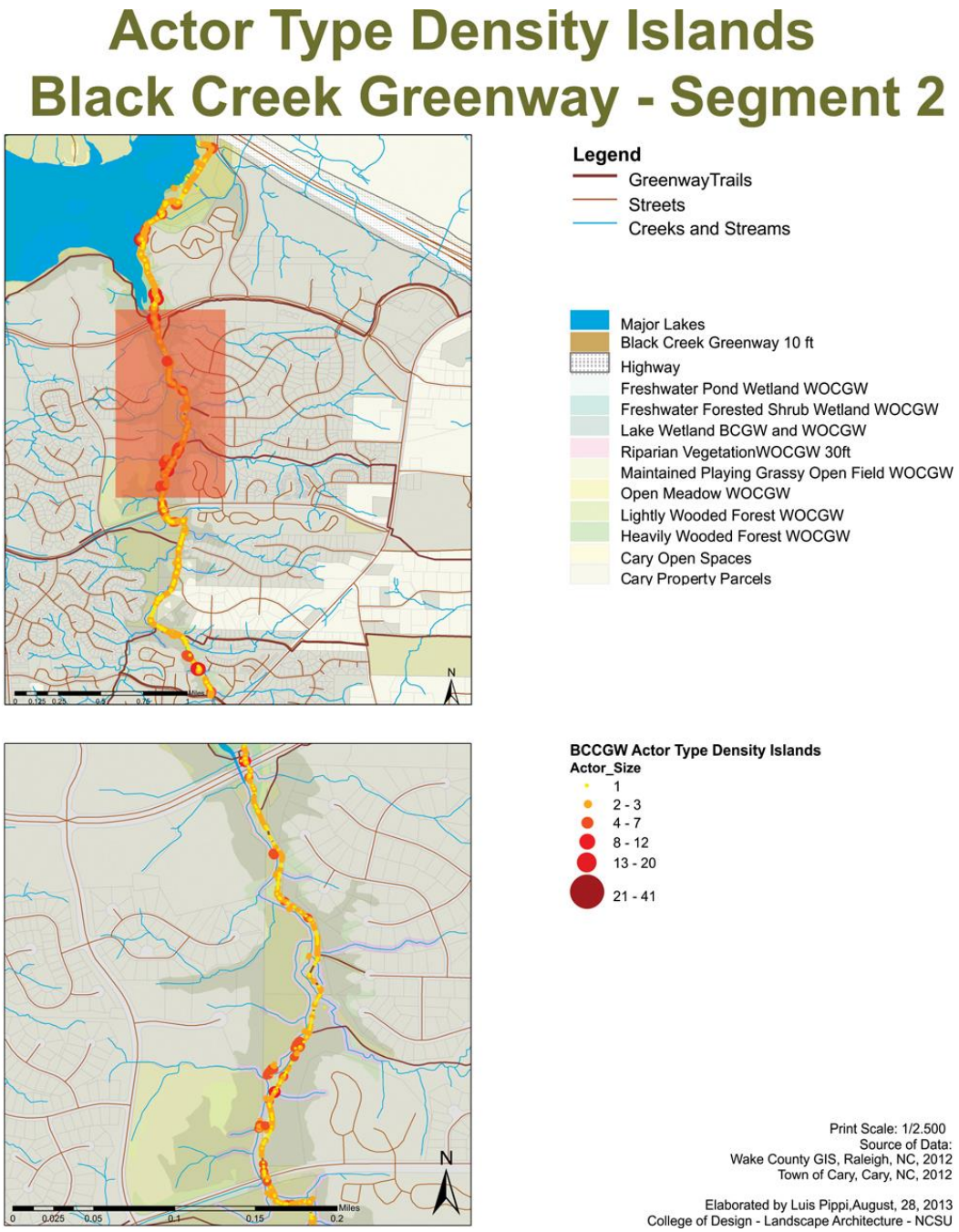

Figure 100: Pure Actor Type Density Islands in Segment 2 of the BCGW.

Source: Pippi (2013)

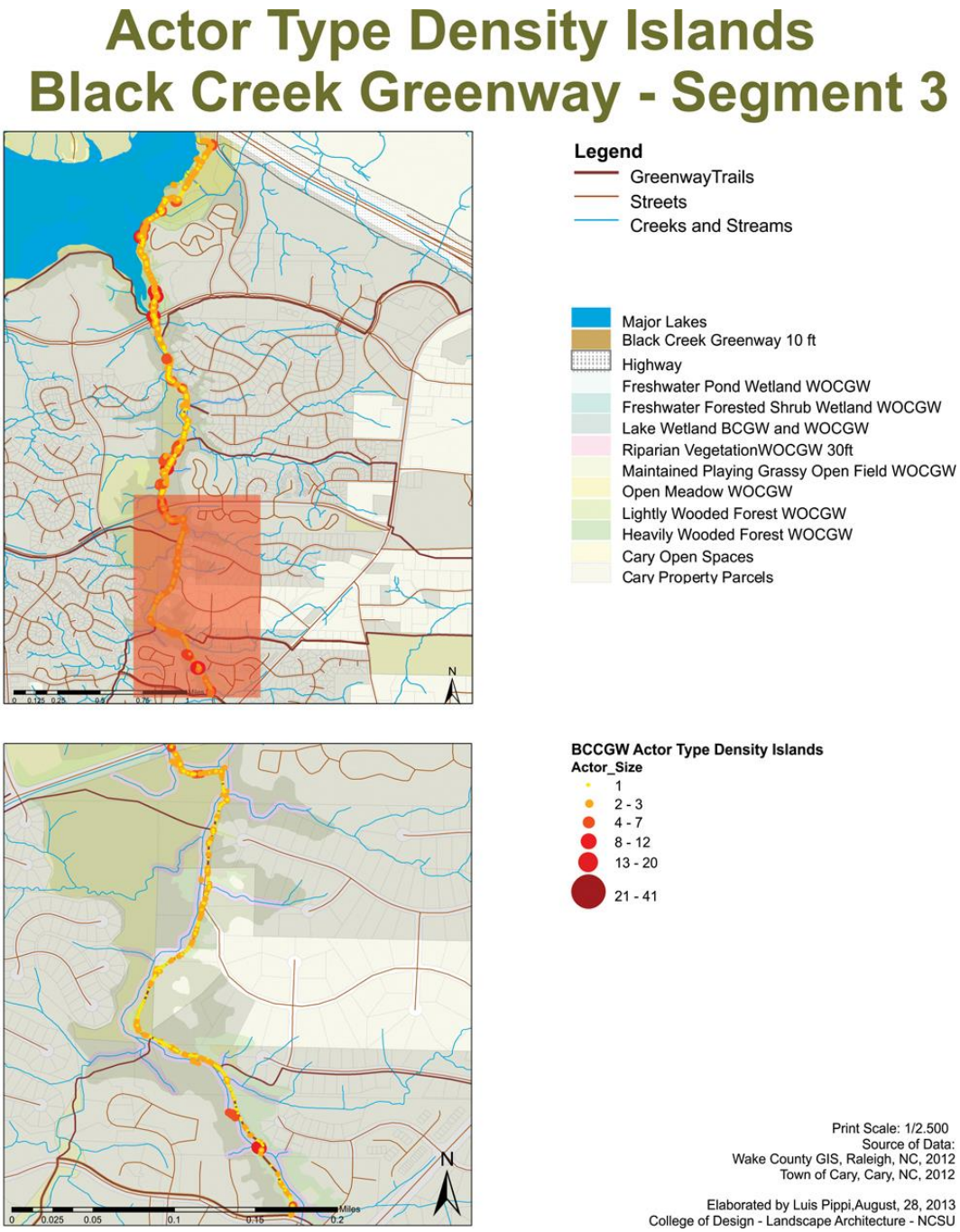

Figure 101: Pure Actor Type Density Islands in Segment 3 of the BCGW.

Source: Pippi (2013)

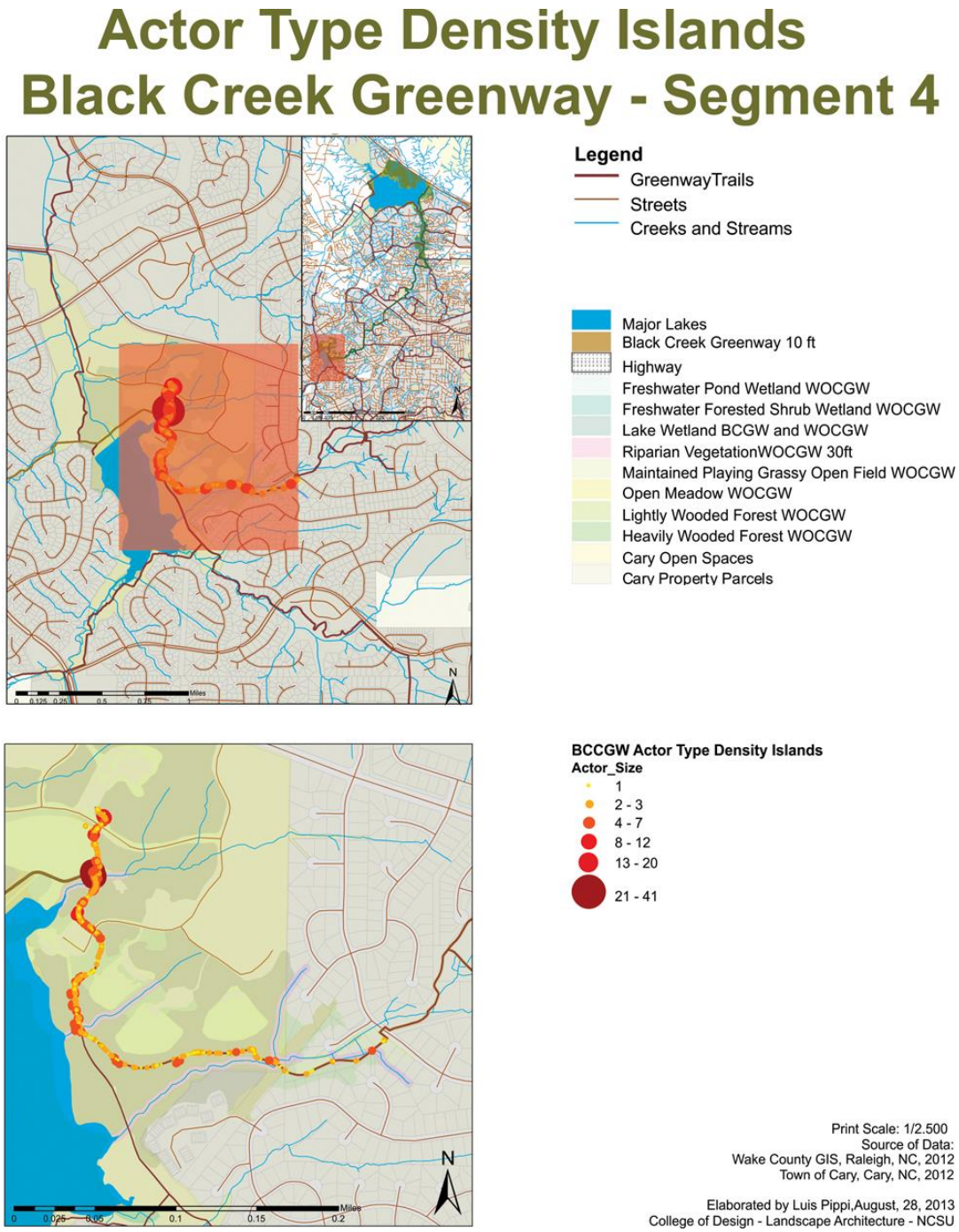

Figure 102: Pure Actor Type Density Islands in Segment 4 of the BCGW.

Source: Pippi (2013)

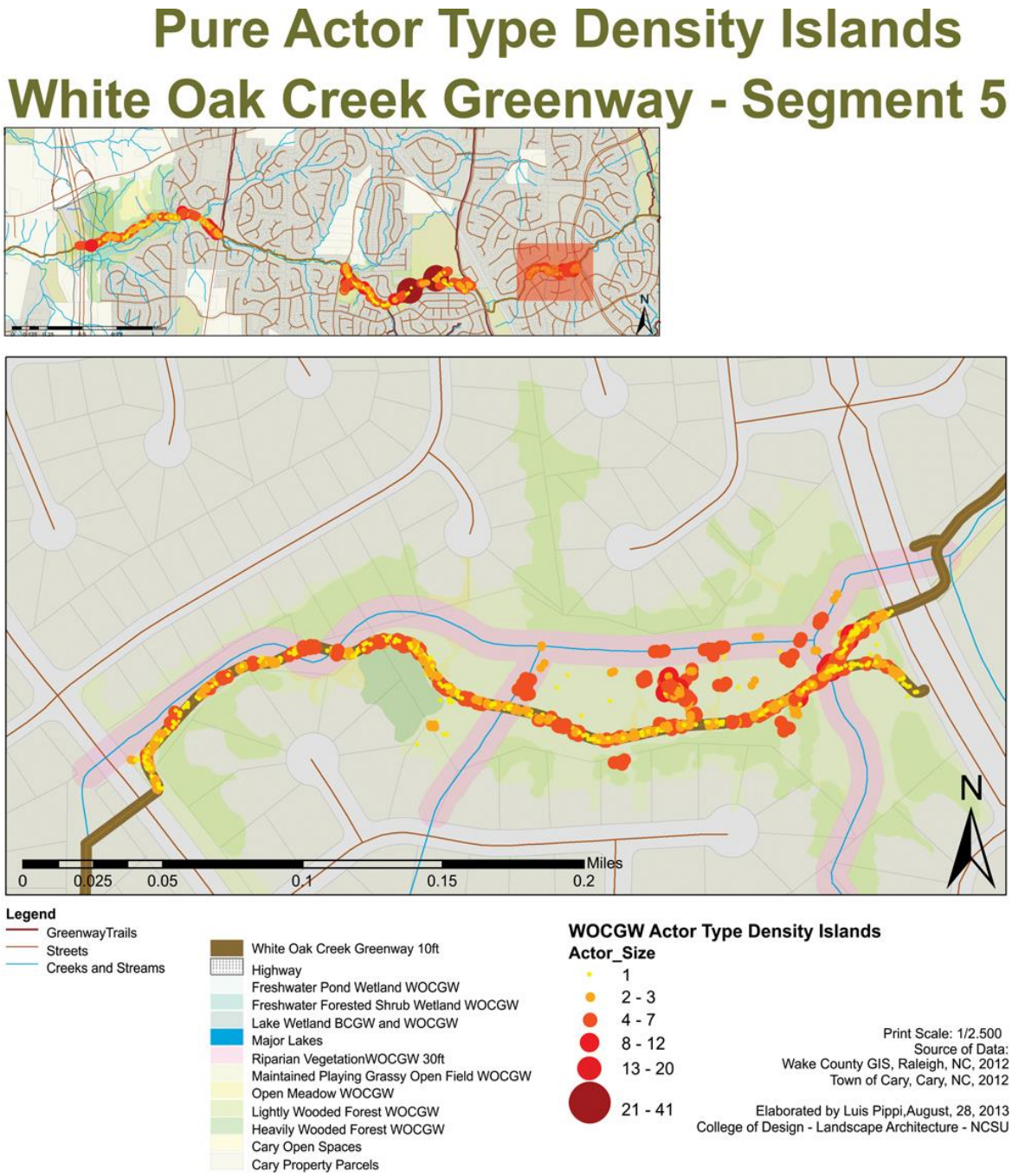

Figure 103: Pure Actor Type Density Islands in Segment 5 of the WOCGW.

Source: Pippi (2013)

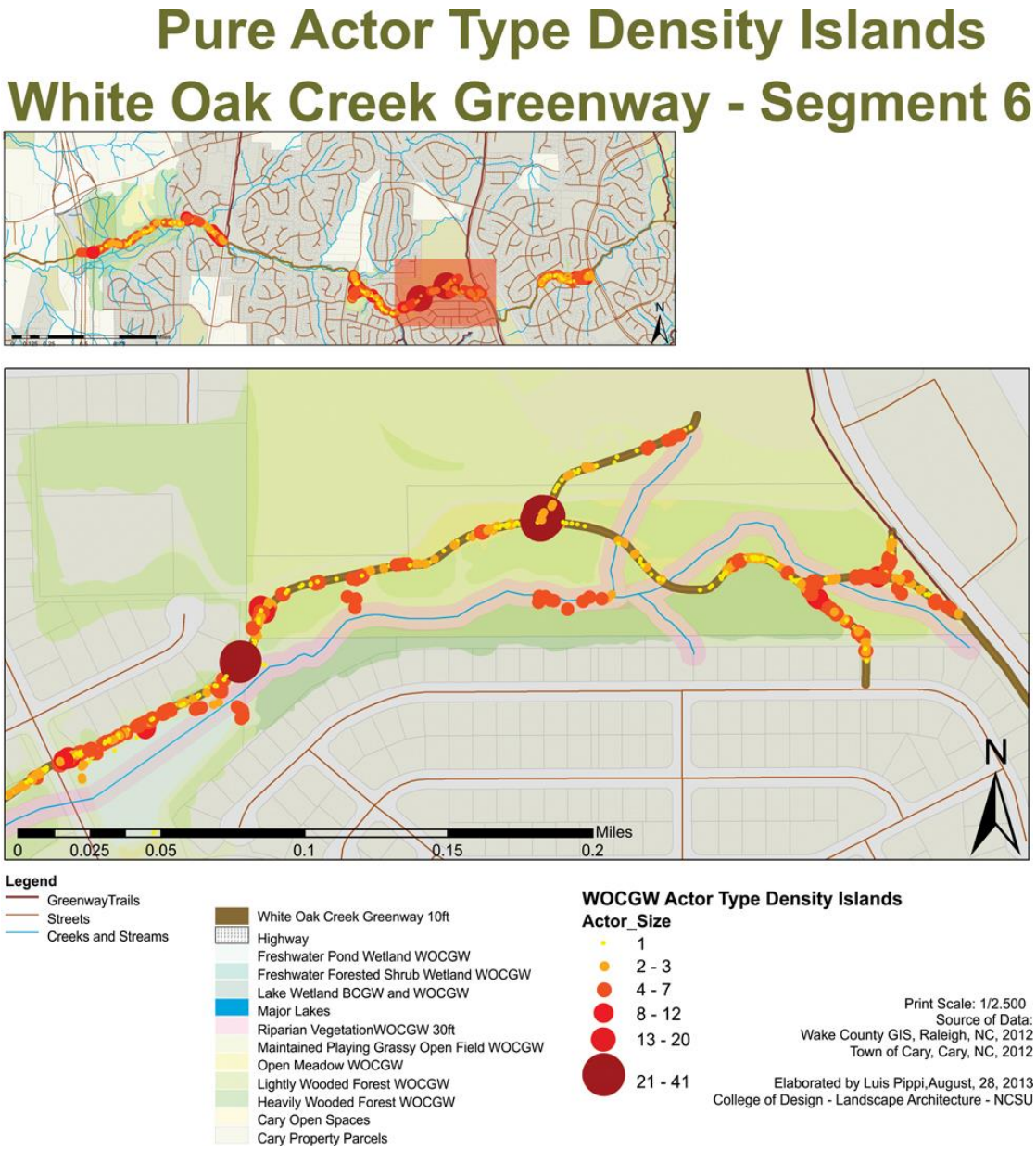

Figure 104: Pure Actor Type Density Islands in Segment 6 of the WOCGW.

Source: Pippi (2013)

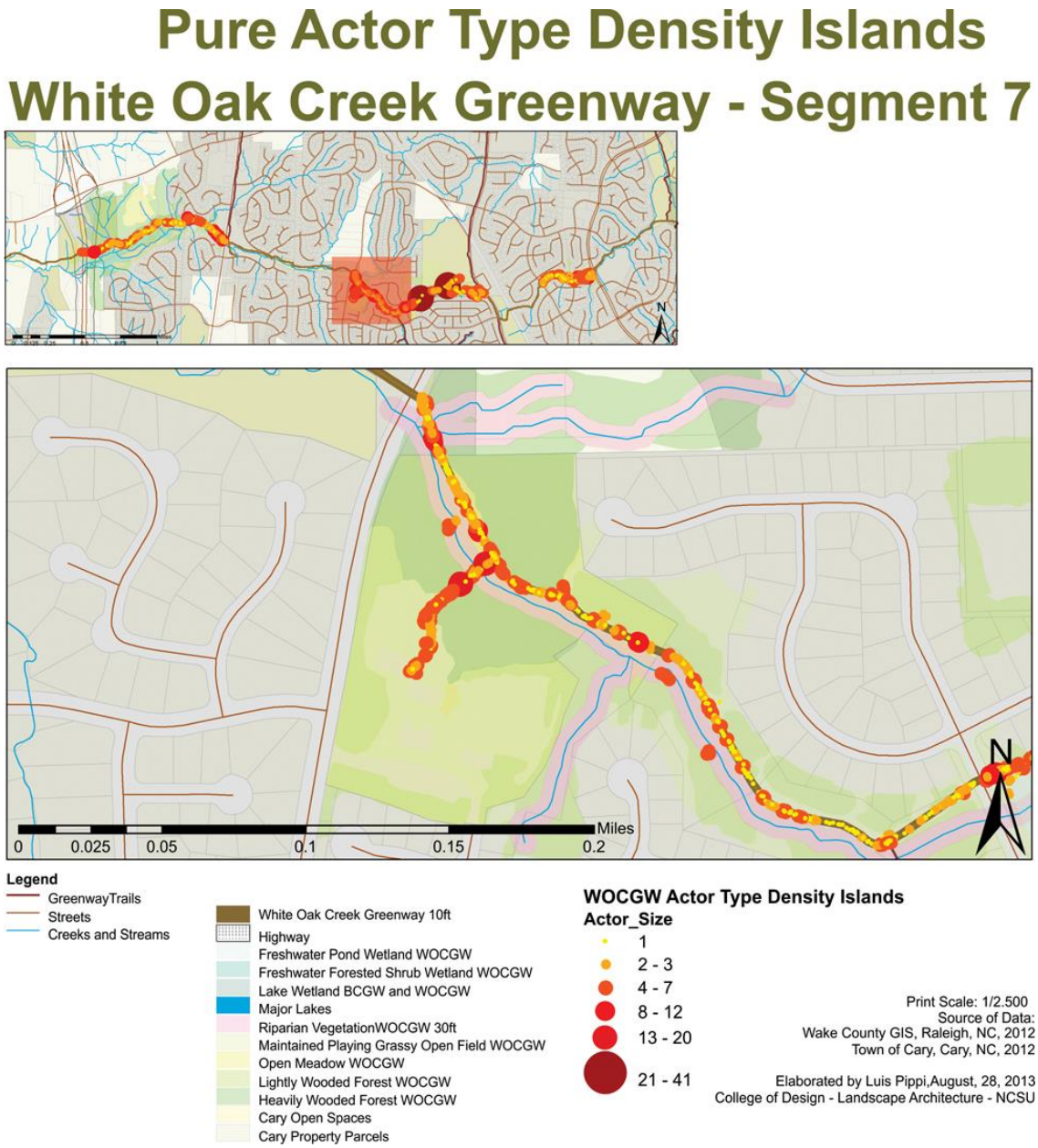

Figure 105: Pure Actor Type Density Islands in Segment 7 of the WOCGW.

Source: Pippi (2013)

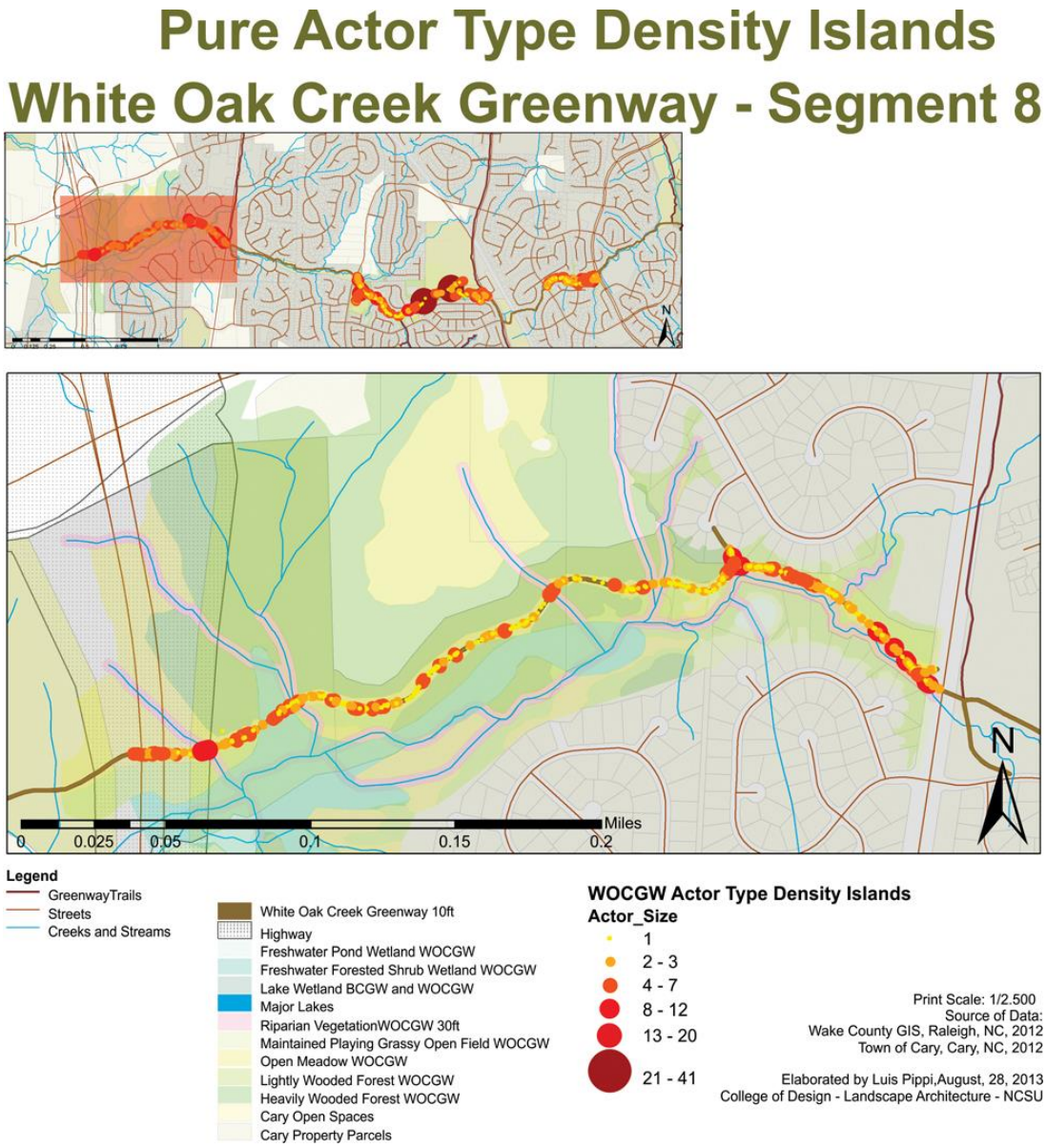

Figure 106: Pure Actor Type Density Islands in Segment 8 of the WOCGW.

Source: Pippi (2013)

Table 20 shows the total usage frequency (counts and percentage) for the pure actor categories of all Group (G) categories in each greenway type (BCGW: with 602 observations and WOCGW: with 521 observations). Both greenways presented more presence of Groups of 4-5 people if compared with the other Group (G) categories, and less prevalence of Groups of 11-15 people, as well as less prevalence of Groups with more than 15 people in the BCGW and absence of this category in the WOCGW. The BCGW presented the greatest number of G4-5 people (with 61.64%; 371 observations), significantly surpassing all the other categories. In contrast, the G11-15 groups were less prevalent and presented the lowest number (with 1.99%; 12 observations). The WOCGW also presented the greatest number of G4-5 people (with 72.65%; 247 observations) significantly exceeding all the other categories, and also surpassing the BCGW in this category. In contrast, the G6-7 people presented the lowest results (with 7.05%; 24 observations), followed by the G11-15 people (with 7.95%; 27 observations). Groups with more than 15 people were absent on the WOCGW.

Table 20: Greenways Observed Usage Counts and Percentage by Pure Actor Type – Overall Group Categories.

Source: Pippi (2013)

Greenway Type	Total Use Counts	Transformative Actor Groups Types	Usage Counts	Usage (%)
BCGW	602	G4-5 people	371	61.64%
		G6-7 people	87	14.45%
		G8-10 people	71	11.78%
		G11-15 people	12	1.99%
		G more than 15 people	61	10.14
WOCGW	521	G4-5 people	247	72.65%
		G6-7 people	24	7.05%
		G8-10 people	42	12.35%
		G11-15 people	27	7.95%
		G more than 15 people	no	no

Figure 107 compares Group (G) types for both greenways and within segments. Both greenways presented significant difference in terms of Group (G) type occurrence, both across greenways and also within each greenway's segments. Groups of 4-5 people were predominant over all the other categories in all the segments and for both greenways. For the four segments of the BCGW: Groups of 4-5 people were more prevalent in segment 2 (with 77.41%; 72 observations) and less prevalent in segment 3 (with 46.16%; 12 observations). Groups of 6-7 people were more prevalent in segment 3 (with 23.07%; 6 observations) and less prevalent in segment 2 (with 12.90%; 12 observations). Groups of 8-10 people were more prevalent in segment 3 (with 30.77%; 8 observations) and less prevalent in segment 2 (with 9.69%; 9 observations). Groups of 11-15 people were only encountered in segment 1 (with 8.88%; 12 observations). Groups with more than 15 people were absent in the BCGW segments. For the four segments of the WOCGW: Groups of 4-5 people were more prevalent in segment 7 (with 87.66%; 142 observations) and less prevalent in segment 8 (with 66.35%; 71 observations). Groups of 6-7 people were more prevalent in segment 8 and presented moderate results (with 33.65%; 36 observations) and less prevalent in segment 6 (with 9.23%; 12 observations). Groups of 8-10 people were only encountered in segment 6 (with 20.77%; 27 observations). Groups of 11-15 people and Groups with more than 15 people were absent in all segments of the WOCGW.

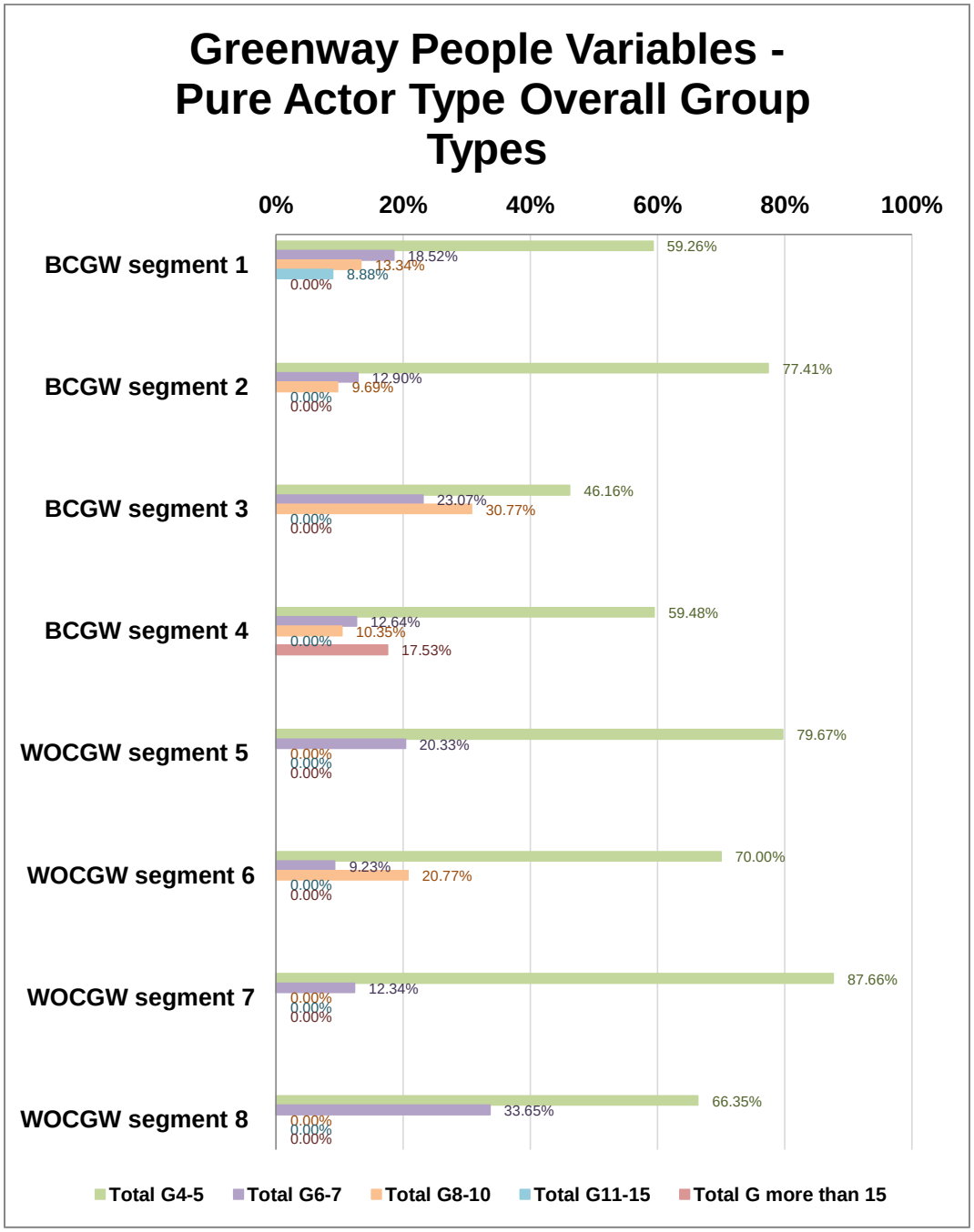

Figure 107: Greenway Group Usage per Segment.

Source: Pippi (2013)

Table 21 shows the total usage frequency (counts and percentage) of ties/bridges types in each greenway. For both greenways, the absence of social ties/bridges occurrence was more prevalent than the occurrence of social ties/bridges. BCGW surpassed the WOCGW in terms of non-socialization (BCGW: with no-occurrence of 79.40%; 4,377 observations versus occurrence of 20.60%; 1,135 observations; WOCGW: with no-occurrence of 73.28%; 3,439 observations and occurrence of 26.72%; 1,254 observations).

Table 21: Greenways Observed Usage Counts and Percentage of Social Ties/Bridges. Source: Pippi (2013)

Greenway Type	Total Use Counts	No Social Ties/Bridges Usage Counts	No Social Ties/Bridges Usage (%)	Social Ties/Bridges Attendance Usage Counts	Social Ties/Bridges Attendance Usage (%)
BCGW	5,512	4,377	79.40%	1,135	20.60%
WOCGW	4,693	3,439	73.28%	1,254	26.72%

Figure 108 compares the social interaction variables in terms of the presence of ties/bridges for both greenways and their segments. Both greenways presented substantial difference in terms of manifestation of social ties/bridges, both across greenways and across segments for each greenway separately. The non-occurrence of *social ties/bridges* was significantly more predominant than the occurrence of social *ties/bridges*. Comparing the data from both greenways in terms of the non-occurrence of *social ties/bridges*, the BCGW presented very similar results in all the four segments and the WOCGW presented greater differences among the four segments. Of the 8 segments, the segment 4 of the BCGW presented the highest value for non-occurrence (s4: with 81.06%; 1,460observations) and the segment 8 of the WOCGW presented the lowest score (s8: with 69.40%; 735 observations).

Using the dataset for the occurrence of *social ties/bridges* attendance on both greenways, the segment 4 of the BCGW presented the lowest score (s4: with 18.94%; 341 observations) and segment 8 of the WOCGW presented the highest score (s8: with 30.60%; 324 observations). Comparing the data across both the dataset for *non-occurrence of social ties/bridges* and that for the occurrence of social *ties/bridges,* within the four segments of the BCGW: the non-occurrence of social ties/bridges was more prevalent in the segment 4 (s4: with 81.06%; 1,460 observations) and less prevalent in the segment 3 (s3: with 77.75%; 797 observations), the segments 1 and 2 presented similar results for both classifications. In contrast, the social *ties/bridges* occurrence was more prevalent in the segment 3 (s3: with 22.25%; 228 observations) and less prevalent in the segment 4 (s4: with 18.94%; 341 observations). Comparing the data across both the dataset for *non-occurrence of social ties/bridges* and that for the occurrence of social *ties/bridges,* within the four segments of the WOCGW: the non-occurrence of social ties/bridges was more prevalent in the segment 2 (s2: with 79.69%; 710 observations) and less prevalent in the segment 8 (s8: with 69.40%; 735 observations). In contrast, the occurrence of social *ties/bridges* was more prevalent in the segment 8 (s8: with 30.60%; 324 observations) and less prevalent in the segment 2 (s2: with 20.31%; 181 observations), as illustrated in the chart bellow in figure XX.

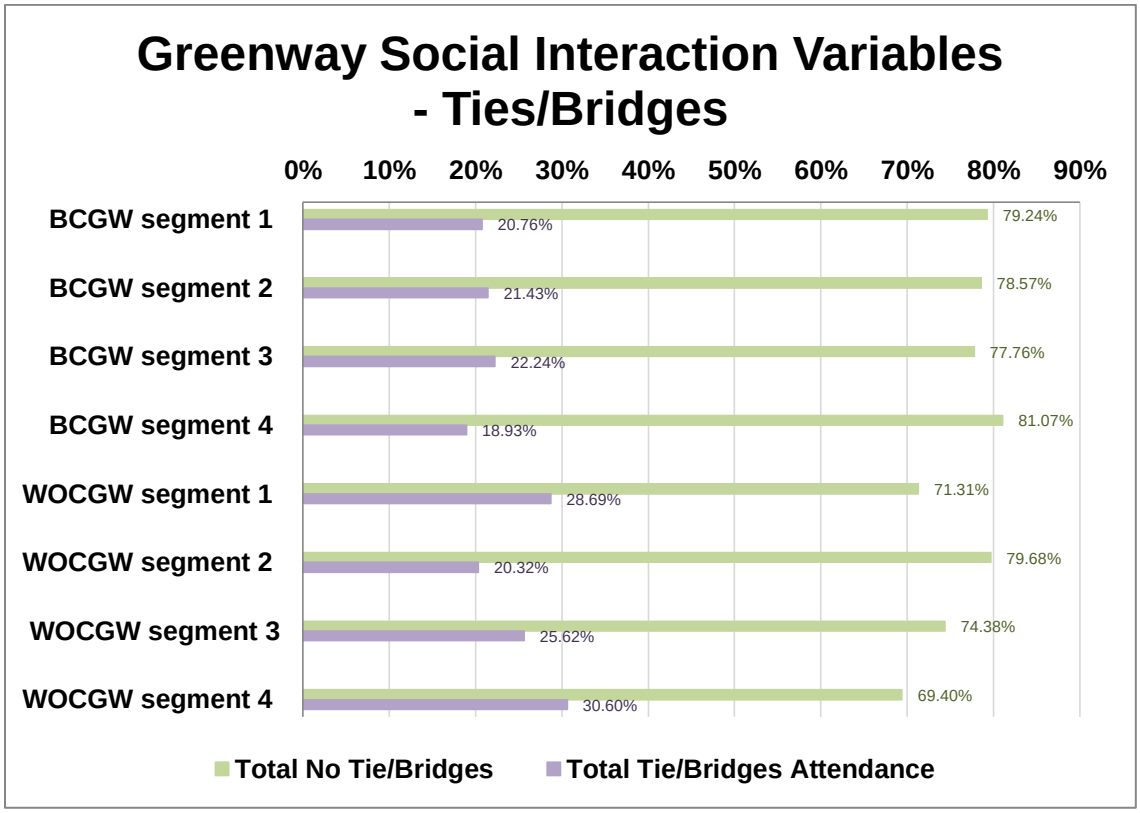

Figure 108: Chart Correlating the Greenway Segments Types by the Presence of Tie/Bridges per Segment Type.

Source: Pippi (2013)

Table 22 reveals the total usage frequency (counts and percentage) for the transformative actor type categories in each greenway type. Even though the table presented the information of the Individuals (I) category, this information is only for comparative purposes since it is not applicable to the actor type transformation in that individuals who did not interact with others did not transform their actor type (the frequency was considered only by the percentage and number of observations within the observations for each greenway, however, they received a null value of “0”) but when one Individual (I) interacted with the other Individual (I) then become a Dyad (D) and a transformative actor category. The

presence of Individual (I), as a non-transformative actor type, was more prevalent in both greenways, if compared to the transformative actor categories, with higher results in the BCGW (with 79.40%; 4,377 observations) and lower results in the WOCGW (with 73.38%; 3,439 observations). If Dyads (D) and Triads (T) categories were combined together, a Sub Groups (SB) category was generated that surpassed the scores of the original transformative actor categories (of D and T). Of all the transformative actor categories in both greenways, the Triads (T) and Groups (G) presented the smallest predominance. The BCGW presented the greatest frequency of Dyads (D) (with 8.60%; 474 observations) that exceeded significantly all the other transformative actor type categories, except for the Sub Groups (SB) category that presented similar results (with 14.42%; 795 observations). In contrast, the Triads (T) category, followed by the Groups (G) category presented the lowest and similar number (T: with 5.83%; 321 observations and G: with 6.17%; 340 observations). The WOCGW also presented a greater number of Dyads (D) (with 10.27%; 426 observations), significantly exceeding all the other transformative actor categories, except for the Sub Groups (SB) category that presented superior results (with 19.34%; 908 observations). In contrast, the Groups (G) category, followed by the Triads (T) category presented the lowest results (G: with 7.38%; 346 observations and T: with 9.07%; 426 observations). When compared both greenways together, it can be verified that the frequency of the Sub Groups (SB) category is higher in the WOCGW with 19.34% than the frequency of the same category in the BCGW with 14.42%. In terms of low scores, the Triads (T) was less prevalent in the BCGW and Groups (G) categories were less prevalent in the WOCGW, respectively with 5.83% and 7.38%.

Table 22: Greenways Usage Counts and Percentage by Transformative Actor Type.
Source: Pippi (2013)

Greenway Type	Total Use Counts	Transformative Actor Type	Usage Counts	Usage (%)
		Individual (I)	4,377 (n/a)	79.40% (n/a)
		Dyad (D)	474	8.60%
BCGW	5,512	Triad (T)	321	5.83%
		Sub Groups (SB)	795	14.42%
		Groups (G)	340	6.17%
		Individual (I)	3,439 (n/a)	73.28% (n/a)
		Dyad (D)	482	10.27%
WOCGW	4,693	Triad (T)	426	9.07%
		Sub Groups (SB)	908	19.34%
		Groups (G)	346	7.38%

Figure 109 compares the people variables in terms of the transformative actor type for both greenways and their segments. Both greenways presented significant difference in terms of transformative actor type presence, across them and also across segments for each greenway individually. The number of Individuals (I) was significantly more predominant (no occurrence of transformative actor type) in both greenways and their segments. The Sub Groups (SB) category was more prevalent than all the other categories in all the segments and for both greenways with significant differences among them. Shown in descending order of prevalence, the original transformative actor types were also identified by greenway type and segments: Dyads (D), Triads (T) and Groups (G) in the segments 2 and 3 of the BCGW and in the segments 6 and 7 of the WOCGW; Groups (G), Dyads (D), and Triads (T) in the segment 1 of the BCGW and in the segment 5 of the WOCGW; Dyads (D), Groups (G) and Triads (T) only in segment 4 of the BCGW and Dyads (D) and Triads (T) with similar results and Groups (G) only on segment 8 of the WOCGW. Of all transformative actor categories, the segment 4 of the BCGW presented the highest result of total of Individual (no) (s4: with 81.06%; 1,460 observations) and the segment 3 of the BCGW presented the lowest result for the total of Groups (s3: with 2.83%; 29 observations).

When all transformative actor categories were compared with each other and within the four segments of the BCGW: the Dyads (D) category was more prevalent in segment 2 with moderate-low results (s2: with 10.36%; 130 observations) and less prevalent in segment 4 with low results (s4: with 6.67%; 120 observations); the Triads (T) category was more prevalent in segments 3 (s1: with 7.32%; 75 observations) and less prevalent in 4 with similar low results (s4: with 4.33%; 78 observations); the Sub Groups (SB) category surpassed the previous categories in all the segments, with more prevalence in segment 3 with moderate results (s3: with 19.42%; 199 observations) and less prevalent in segment 4 (s4: with 11.00%; 198 observations); the Groups (G) category was more evident in segment 1 (s1: with 8.10%; 116 observations) and less evident in segment 3 with lower results (s3: with 2.83%; 29 observations. When all transformative actor categories were compared across all of the WOCGW segments: the Dyads (D) category was more evident in segment 8 with moderate-low results (s8: with 12.85%; 136 observations) and less evident in segment 6 with low results (s6: with 7.86%; 70 observations); the Triads (T) category was more in segment 8, very similar to the previous category (s8: with 13.03%; 138 observations) and less prevalent also in 6 with low results (s6: with 5.38%; 48 observations); the Sub Groups (SB) category surpassed the previous categories in all the segments, with more evidence in segment 8 with moderate results (s8: with 25.88%; 274 observations) and less prevalent in segment 6 with moderate-low results (s6: with 13.24%; 118 observations); the Groups (G) category was more evident in segment 5 with moderate-low results (s5: with 12.23%; 177 observations) and less evident in segment 7 with low results (s7: with 4.32%; 56 observations), as illustrated in the chart in figure 109.

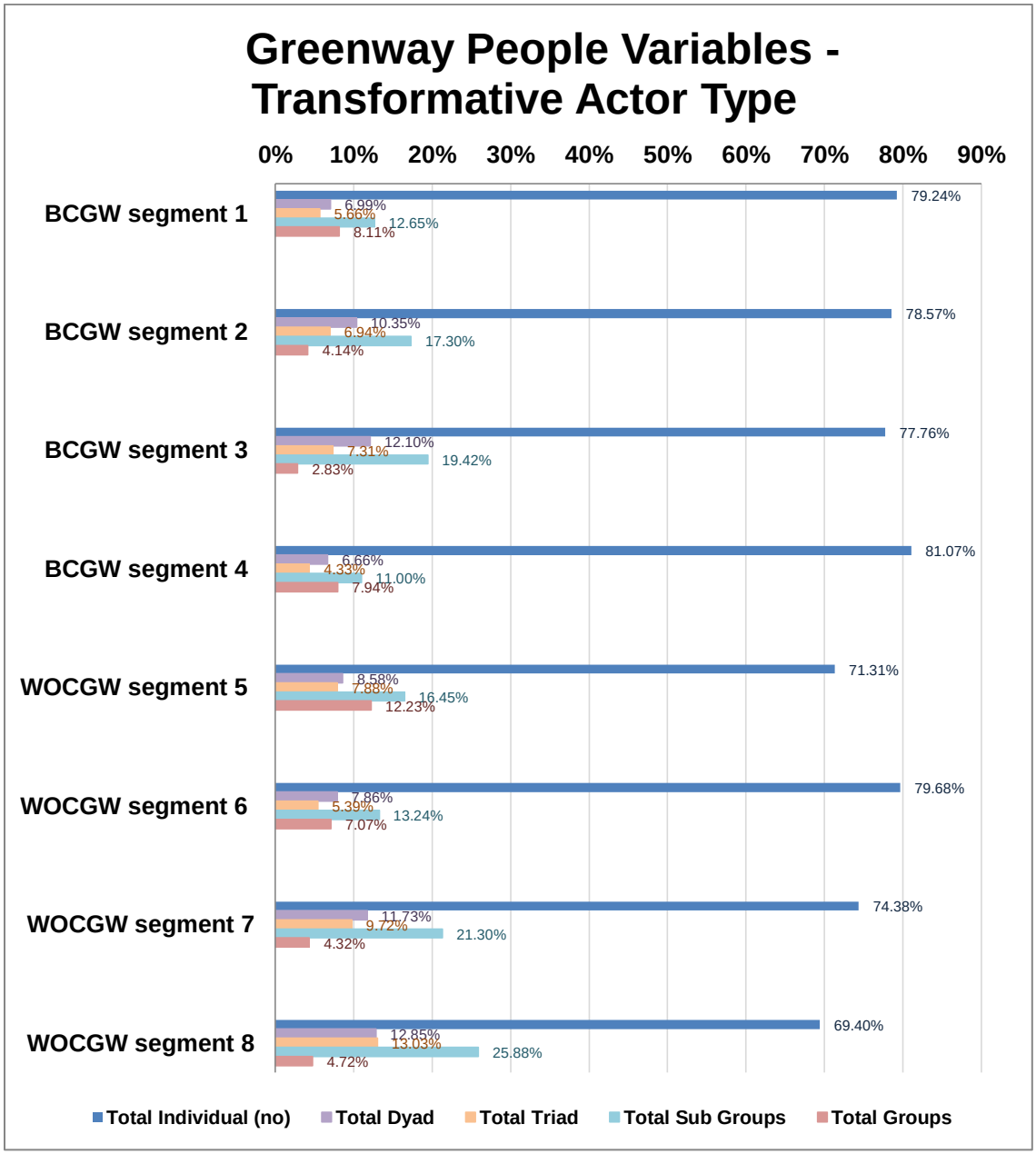

Figure 109: Greenway Presence of Transformative Actor Types per Segment.

Source: Pippi (2013)

The maps figures 110, 111, 112, 113, 114, 115, 116 and 117 illustrates the transformative actor type density islands spatialization in both greenway segments: BCGW segments 1, 2, 3 and 4 and WOCGW segments 5, 6, 7 and 8.

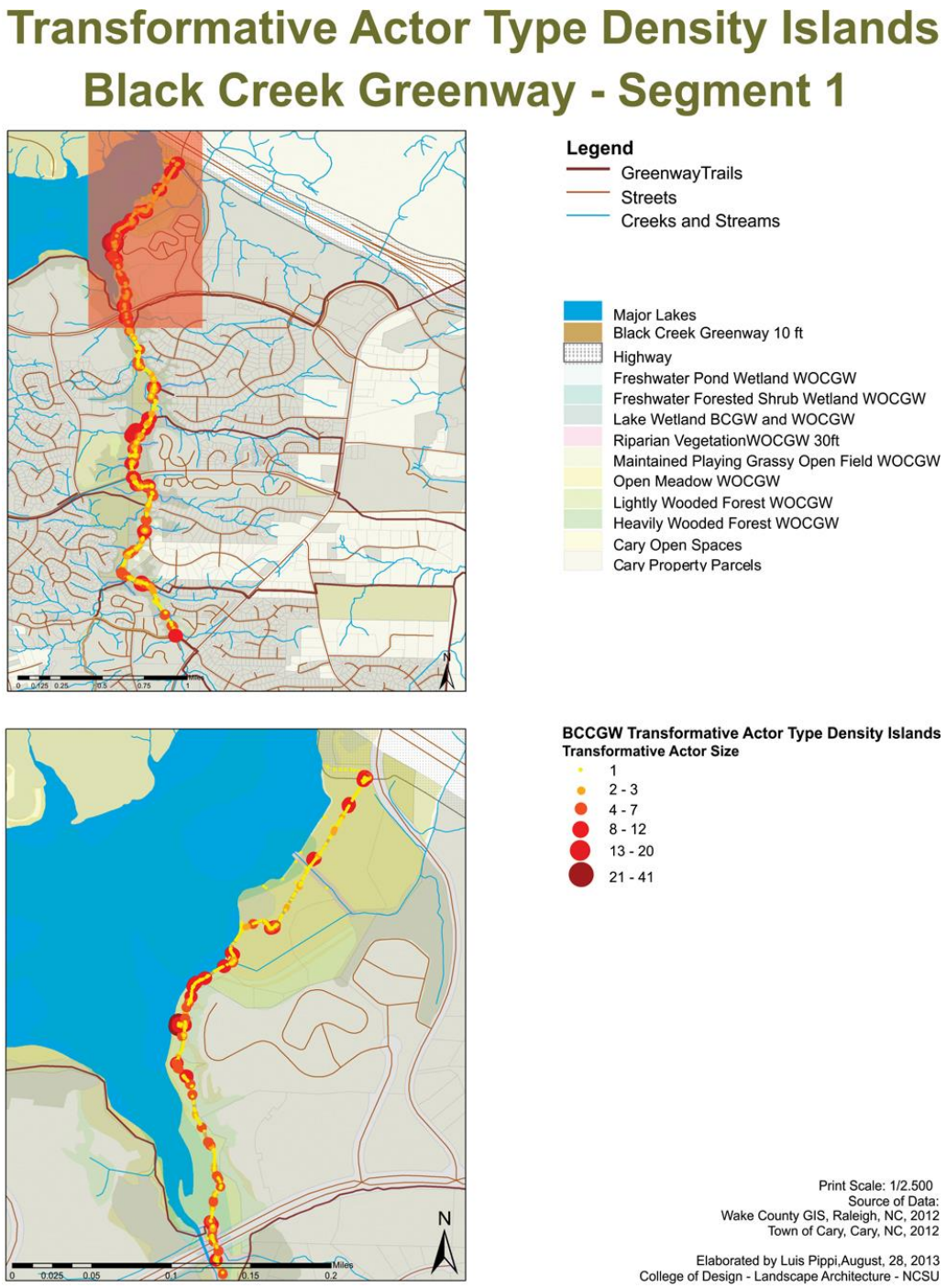

Figure 110: Transformative Actor Type Density Islands in Segment 1 of the BCGW.

Source: Pippi (2013)

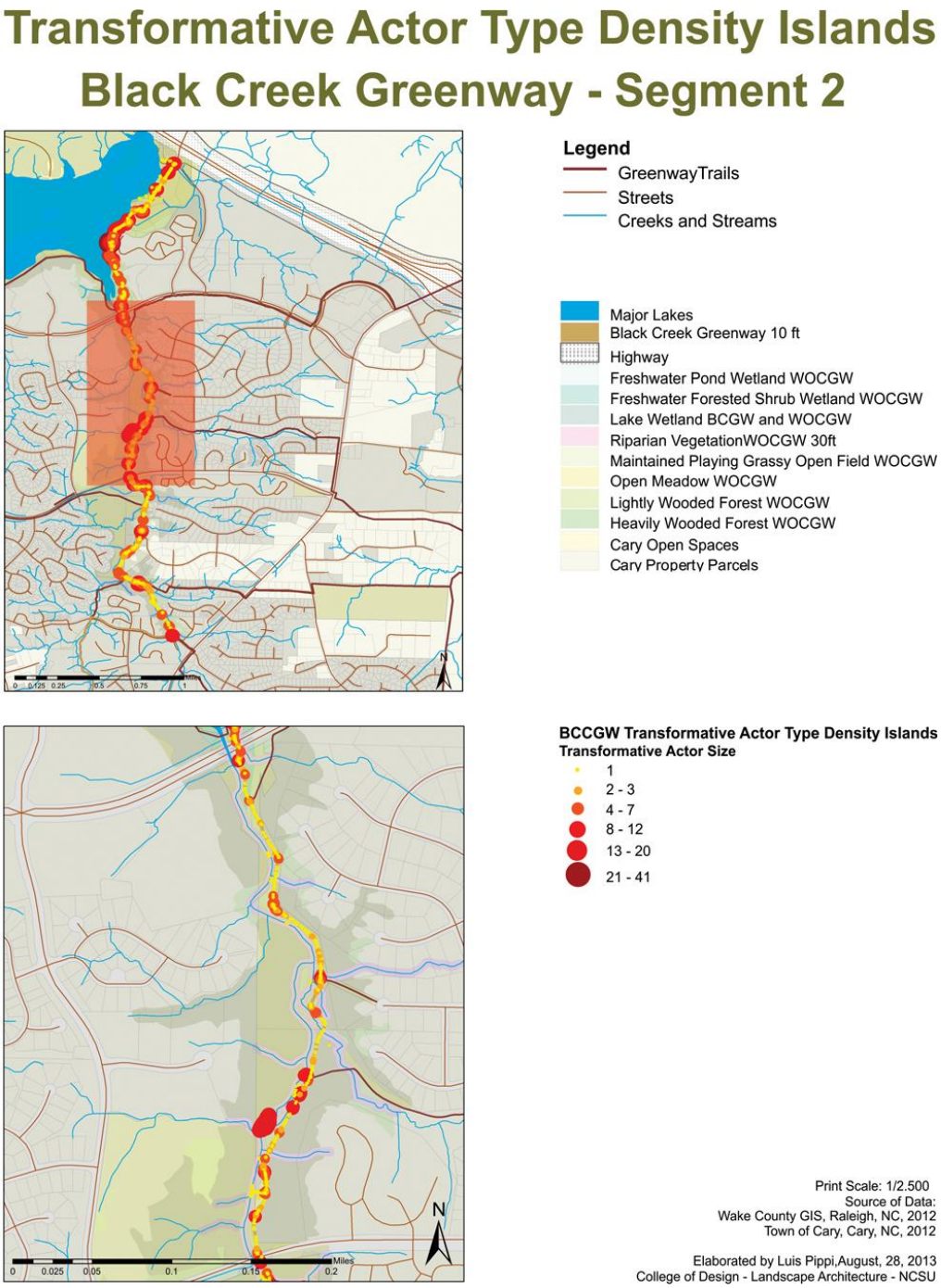

Figure 111: Transformative Type Density Islands in Segment 2 of the BCGW. Source: Pippi (2013)

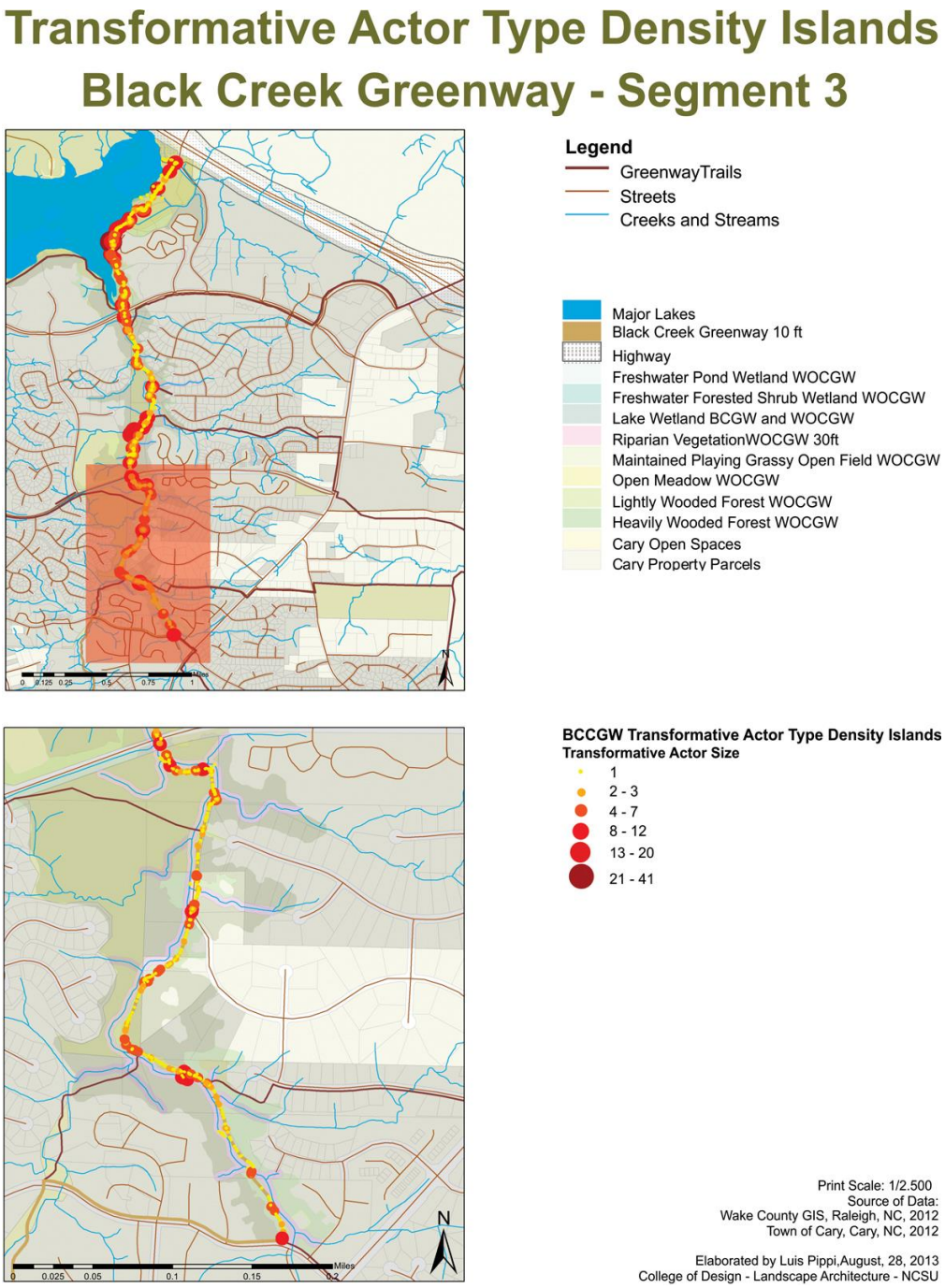

Figure 112: Transformative Type Density Islands in Segment 3 of the BCGW. Source: Pippi (2013)

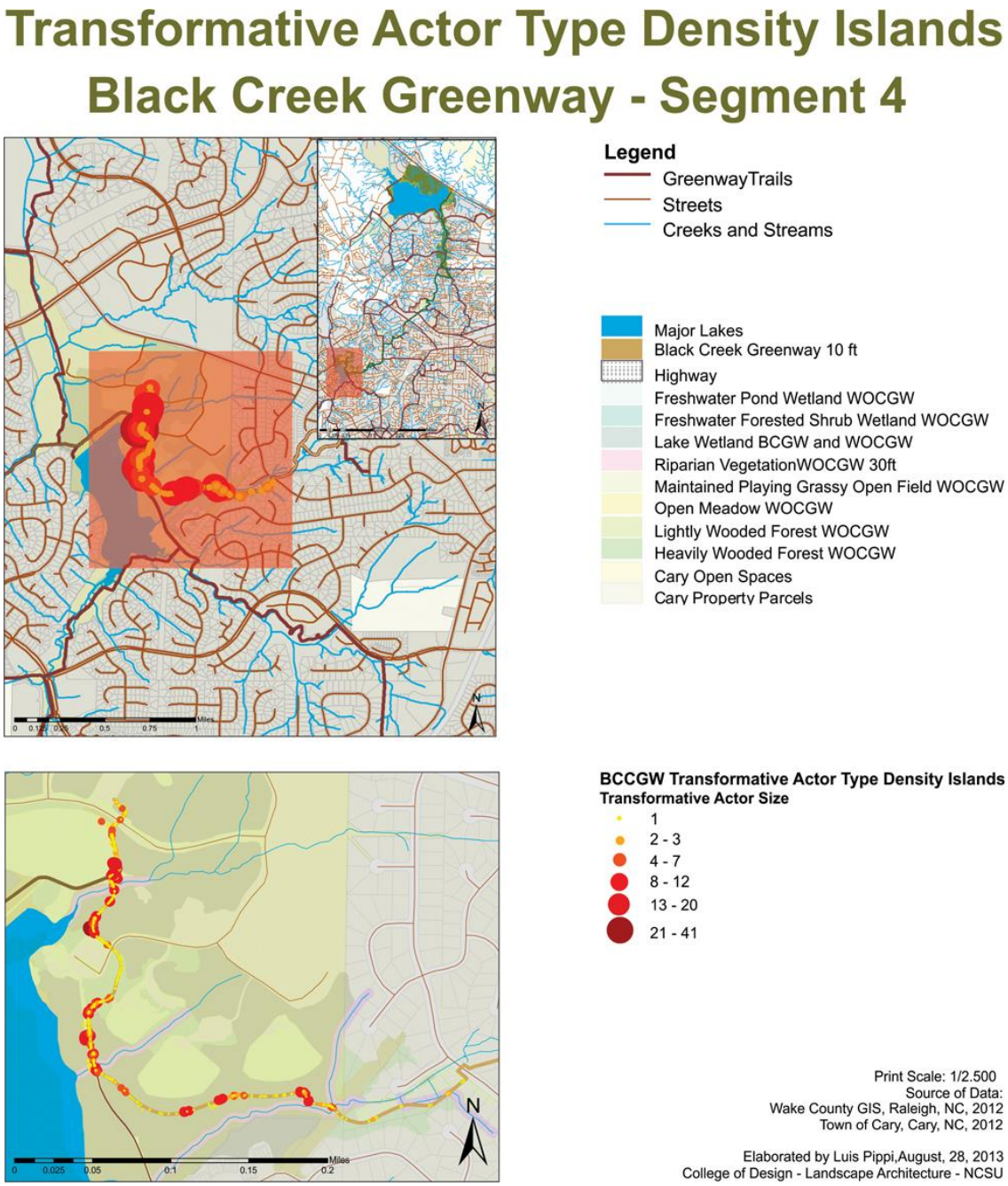

Figure 113: Transformative Type Density Islands in Segment 4 of the BCGW. Source: Pippi (2013)

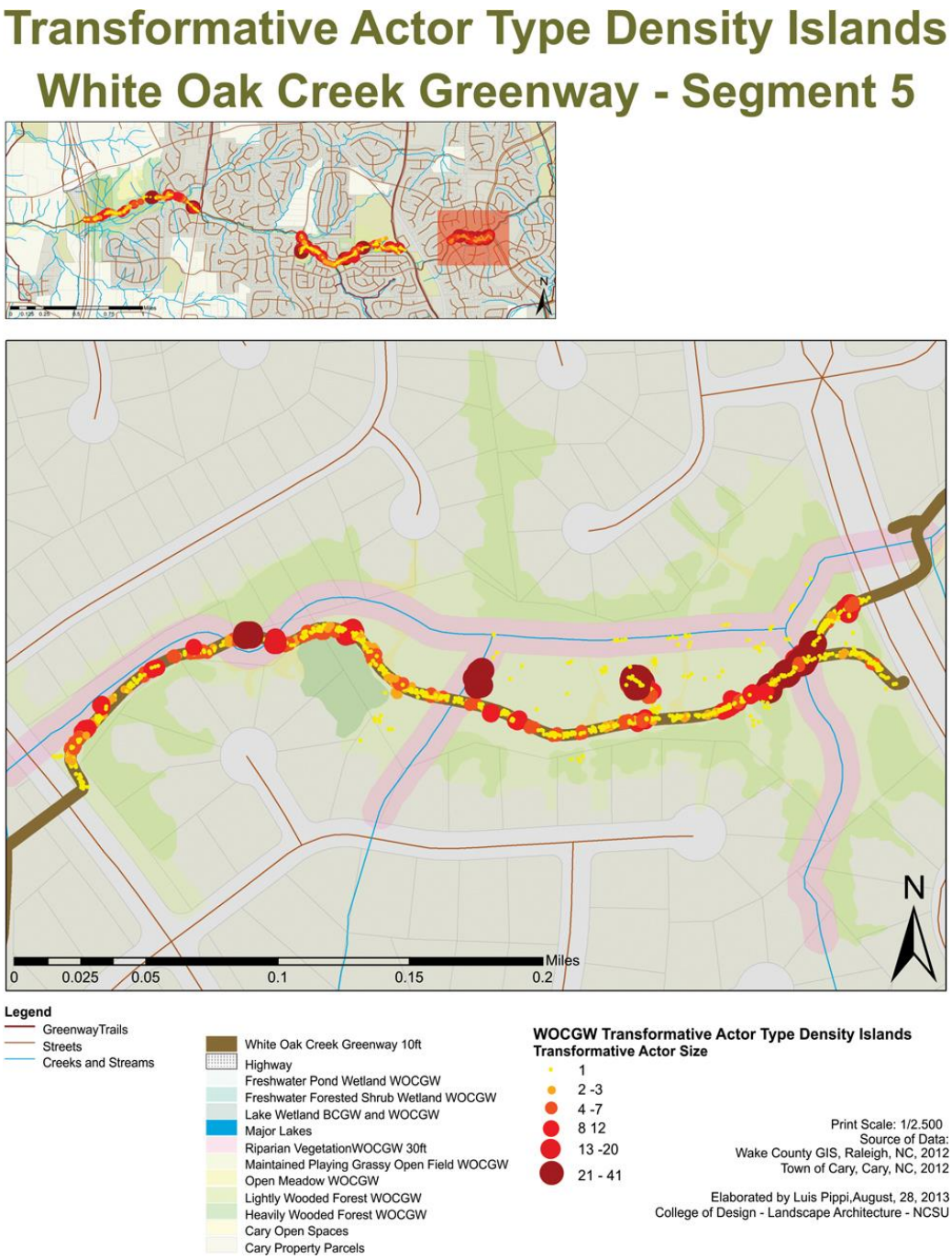

Figure 114: Transformative Type Density Islands in Segment 5 of the WOCGW. Source: Pippi (2013)

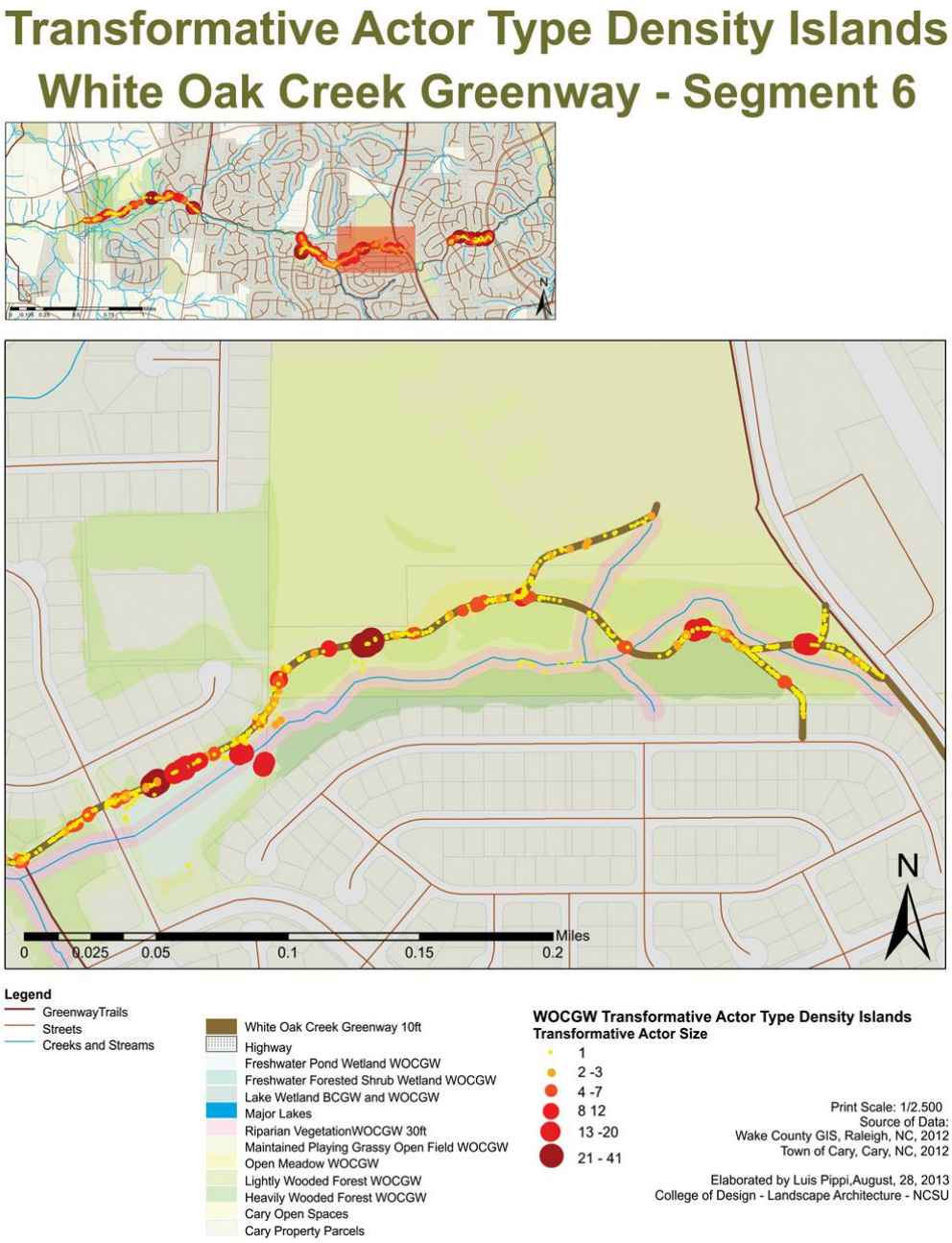

Figure 115: Transformative Type Density Islands in Segment 6 of the WOCGW. Source: Pippi (2013)

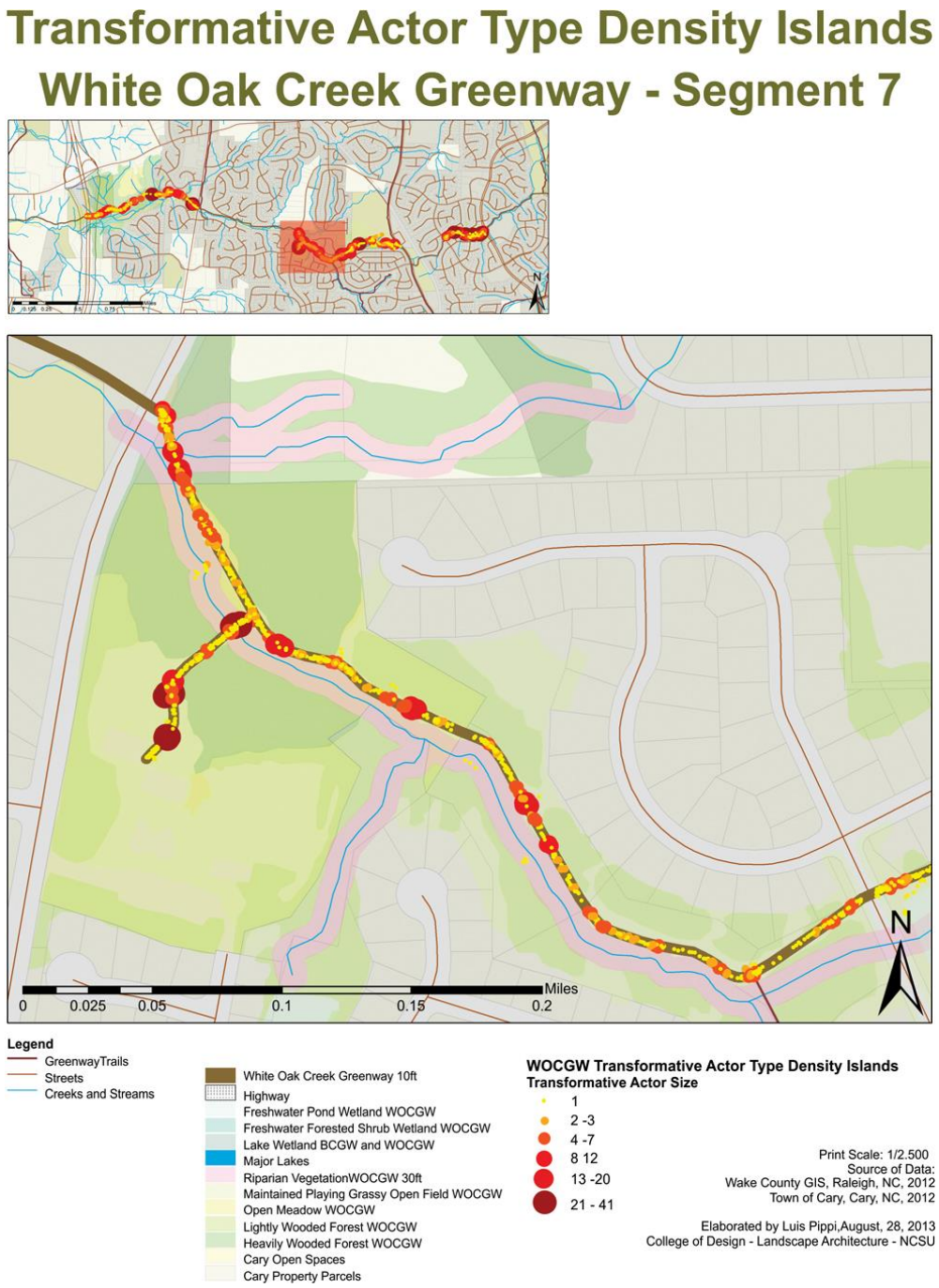

Figure 116: Transformative Type Density Islands in Segment 7 of the WOCGW. Source: Pippi (2013)

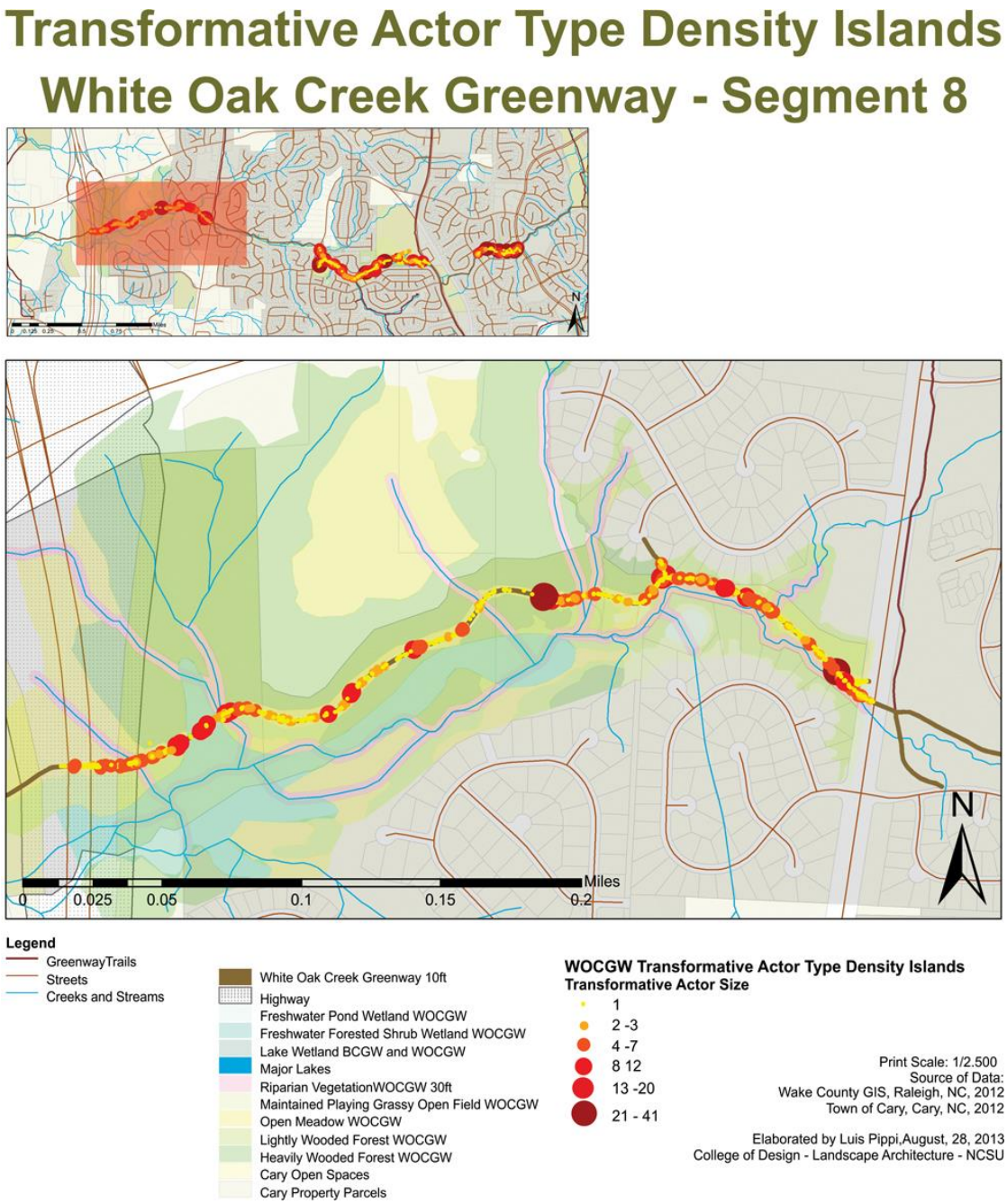

Figure 117: Transformative Type Density Islands in Segment 8 of the WOCGW. Source: Pippi (2013)

Table 23 shows the total usage frequency (counts and percentage) for the transformative actor categories for all Groups (G) categories in each greenway type (BCGW: with 340 observations and WOCGW: with 346 observations). Both greenways presented more presence of Groups of 4-5 people if compared with the other Groups (G) categories, and less prevalence of Groups of 6-7 people in both greenways if compared to the previous category. The BCGW presented the greatest number of G4-5 people (with 72.65%; 247 observations) that surpass significantly all the other categories and the same category in the WOCGW with a greatest score but inferior to the BCGW (with 65.89%; 228 observations). In contrast, the G6-7 people were less prevalent and presented the lowest scores for both greenways, with less evidence in the BCGW (with 7.95%; 27 observations) and more evident in the WOCGW (with 8.60%; 118 observations). G8-10 people was only encountered in the BCGW, surpassing the G6-7 and G11-15 categories (with 12.35%; 42 observations). The G8-10, G11-15 and G with more than 15 people categories were absent in the WOCGW. The G with more than 15 people category was absent in the BCGW.

Table 23: Greenways Usage Counts and Percentage by Transformative Actor Type – Overall Groups Types Categories.

Source: Pippi (2013)

Greenway Type	Total Use Counts	Transformative Actor Groups Types	Usage Counts	Usage (%)
BCGW	340	G4-5 people	247	72.65%
		G6-7 people	24	7.05%
		G8-10 people	42	12.35%
		G11-15 people	27	7.95%
		G more than 15 people	no	no
WOCGW	346	G4-5 people	228	65.89%
		G6-7 people	118	8.60%
		G8-10 people	no	no
		G11-15 people	no	no
		G more than 15 people	no	no

Figure 118 compares the people variables in terms of the Groups (G) transformative actor types for both greenways and their segments. Both greenways offered significant difference in terms of Groups (G) type presence, across them and also within each greenway's segments. The number of Groups of 4-5 people was significantly higher than all the other groups' categories in all the segments and for both greenways. When compared together all the segments of both greenways with the different groups categories, the total G4-5 people category was more evident with the highest score in segment 3 of the BCGW (with 100%; 29 observations), however this segment lacked in terms of the evidence of the other group category. The lowest score was encountered in the total G6-7 people, in segment 4 of the BCGW (with 8.39%; 12 observations). The total G6-7 people category was encountered in segment 1 of the BCGW, which received the greatest moderate score in this category (with 10.34%; 12 observations) and was absent in segments 2 and 3. The total G8-10 people category was encountered only in segments 2 and 4 of the BCGW, respectively with high-moderate scores and moderate scores (s2: with 32.69%; 17 observations and s4: with 17.49%; 25 observations). The total G11-15 category was only presented in segments 1 and 4 of the BCGW with moderate and moderate-low scores (s1: with 12.07%; 14 observations and s4: with 9.09%; 13 observations). The Groups of 4-5 people and the Groups of 6-7 people categories were encountered in all of the WOCGW segments, the Groups of 4-5 people was more evident in segment 6 with higher scores (s6: with 80.95%; 51 observations) and less evident in segment 5 with lower scores (s5: with 57.62%; 102 observations); the Groups of 6-7 people category was more evident in the segment 5 with superior scores (s5: 42.38%; 75 observations) and less evident in segment 6 with lower scores (s6: with 19.05%; 12 observations), in both cases surpassing the segments 1 and 4 of the BCGW.

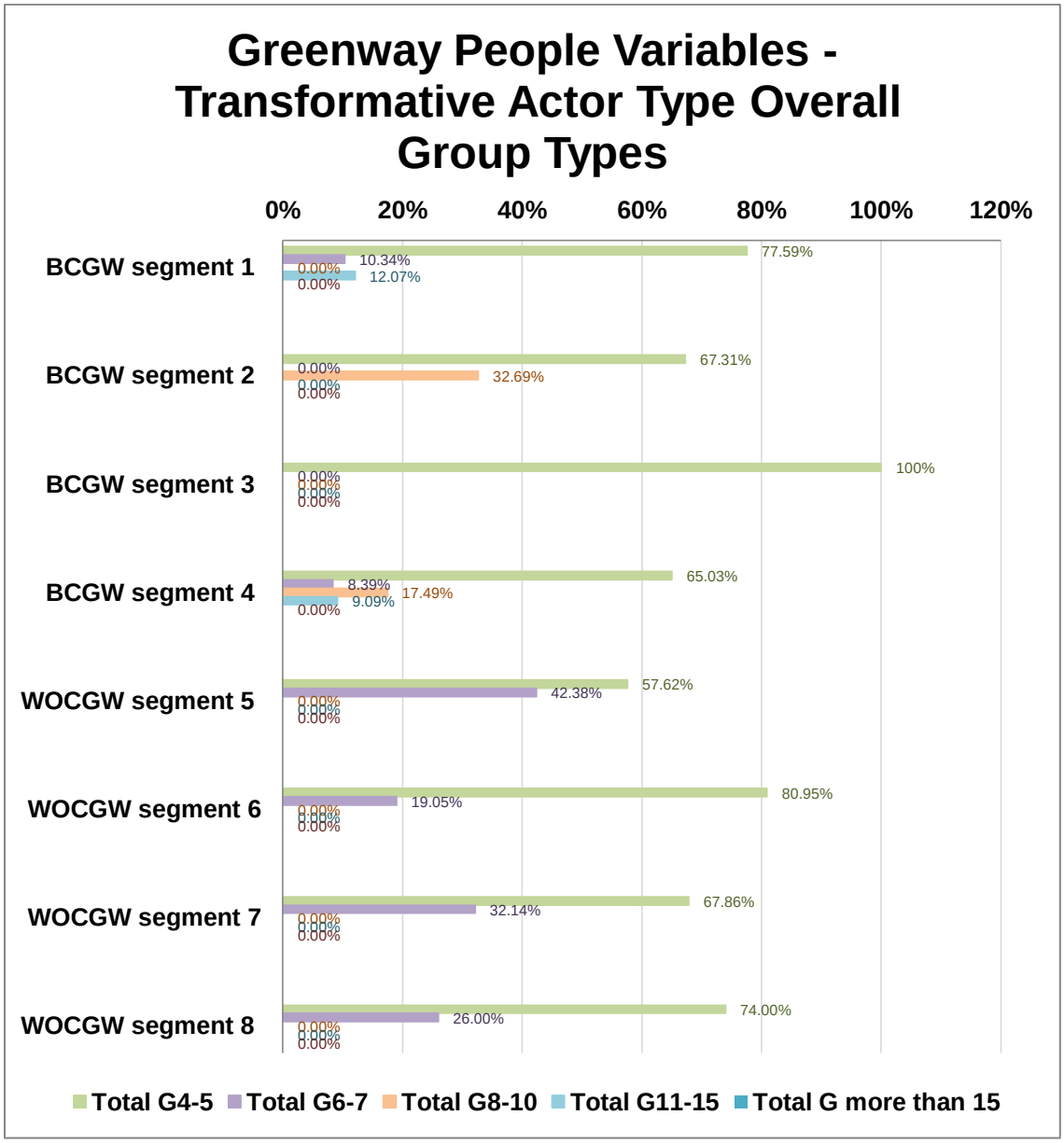

Figure 118: Greenway Presence of Transformative Actor Group Usage per Segment.

Source: Pippi (2013)

Table 24 shows the total usage frequency (counts and percentage) for network centrality occurrence in each greenway type (BCGW: with 1.89%; 104 observations and WOCGW: with 2.84%; 133 observations). The WOCGW exceeded the BCGW in terms of centrality incidence. Both greenways presented more presence of non-occurrence of centrality in both greenways, with higher results in the BCGW than the WOCGW but with little difference (BCGW with 98.11%; 5,408 observations and WOCGW with: 97.16%; 4,693 observations).

Table 24: Greenways Observed Centrality Usage Counts and Percentage.
Source: Pippi (2013)

Greenway Type	Total Use Counts	No Centrality Usage Counts	No Centrality Usage (%)	Centrality Usage Counts	Centrality Usage (%)
BCGW	5,512	5,408	98.11%	104	1.89%
WOCGW	4,693	4,560	97.16%	133	2.84%

Figure 119 compares the social interaction variables in terms of the network centrality types for both greenways and their segments. The non-occurrence of centrality surpassed the occurrence of centrality in both greenways and in all segments, with the highest score in the segment 3 of the BCGW (with 99.80%; 1,023 observations) and the lowest score in the segment 5 of the WOCGW (with 92.88%; 1, 344 observations). In contrast, with enormous difference, the occurrence of centrality was more prevalent in segment 5 of the WOCGW with a low value (with 7.12%; 103 observations) and less prevalent in the segment 3 of the BCGW with the lowest score (with 0.20%; 2 observations), followed by the segment 6 of the WOCGW with a similar result (with 0.23%; 2 observations).

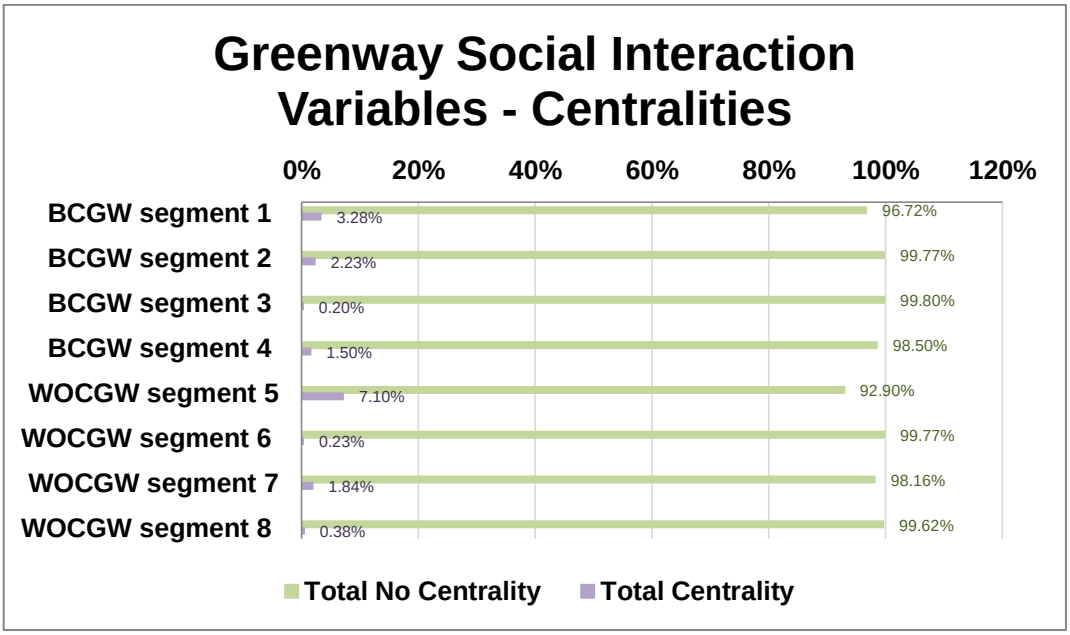

Figure 119: Comparison of the Greenway Segments for the Presence of Centrality Relations per Segment.
Source: Pippi (2013)

5.3.3.1. Data Mining Statistical Analisys

This section presents a summary of the behavior mapping results, first for each greenway separately (BCGW: with 5,512 observations and WOCGW: with 4,693 observations), followed by a second summary of both greenways combined (total of 10,205 observations). The entire dataset from this study was analyzed with SAS 9.3 (SAS Enterprise Guide 5.1 and SAS Enterprise Miner Workstation 12.1) and (JMP 10) using the variables that are described below, and are also shown in Appendix I: Structure of the Study Variables.

The pattern of use/type of activity of both greenways and in each segment were compiled in GIS and transcribed into the attribute table, however in the results of this study they were

compiled and analyzed together in both greenways: BCGW and WOCGW (total of 10,205 observations and a total of 283 different patterns of use/types of activities) which was illustrated in more detail in Appendix U.1. Such patterns were spatialized in GIS, in both greenways and their segments, but with no difference among the legend colors. Each of the 283 “old” patterns of use/types of activities (Appendix O) were analyzed with SAS 9.3 (SAS Enterprise Guide 5.1) and then imported to Excel 10 to determine which received the greatest and smallest intensity of usage.

To facilitate the interpretation of the patterns of use/types of activities, with the use of the SAS 9.3 (SAS Enterprise Guide 5.1), a “new” pattern of use/types activity list was created, which folded the prevalent themes from the “old” list, into a “new” list of 72 different patterns of use/types of activities. The reduction was defined based on the following components:

- alone (one person or individual without interacting),
- with children (inner-interaction with children, as a kinship pattern of socialization);
- with dog (interacting with pets, such as dogs, cats and others);
- with other activities (the original pattern of activity, which is more prevalent, is merged in sequence with other activities);
- interacting (interacting with others: people they know and/or unknown, as a socializing pattern);

Such components when combined together were also defined as extra-different components:

- with children and interacting;
- with children and doing other activities;
- with dog and interacting;
- with dog and doing other activities;
- interacting and doing other activities;

- with children, with dog and interacting;
- with children, dog and doing other activities;
- with dog, interacting and doing other activities;
- tourism, interacting and doing other activities;

The original main patterns of use/types of activity (major categorization of each patterns of use/types of activity) were retained and combined to different original or new components. Only the Other category remained the same in both the “old” and “new” lists.

Table in appendix U shows the comparative result of the “old” patterns of use/types of activities list with the “new” patterns of use/types of activities list and also shows how each category of the “old” patterns of use/types of activities fits in the new” patterns of use/types of activities, which were analyzed with SAS 9.3 (SAS Enterprise Guide 5.1), with frequency, percent, cumulative frequency and cumulative percent information.

Table 25 shows the classification and results of “New” patterns of use/types of activities with a comparison among the different patterns with the frequency, percent, cumulative frequency and cumulative percent information. Fifteen prevalent patterns of use/types of activities that presented high, moderate and moderate-low scores were elected and are presented here in decreasing order, according to their occurrence: walking and interacting (with 23.19%; 2,367 observations); biking alone (with 14.91%; 1,522observations); walking alone (with 13.80%; 1,408 observations); running alone (with 12.46%; 464 observations); biking and interact (with 6.79%; 693 observations); walking with dog (with 4.55%; 1,522observations); walking with dog and interacting (with 3.68%; 376 observations); running and interacting (with 2.82%; 288 observations); walking and doing other activities (with 2.18%; 222 observations); sit alone (with 1.52%; 155 observations); walking with dog and doing other activities (with 1.35%; 138 observations); playing with natural elements and interacting (with 1.32%; 135 observations); Walking with dog, interacting and doing other activities (with 1.31%; 134 observations); sitting and interacting (with 1.30%; 133

observations), and Playing on structural features and interacting (with 0.92%; 94 observations).

Table 25: New Pattern of Use/Type of Activity Categorization.

Source: Pippi (2013)

New Pattern of Use/Type of Activities	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Biking alone	1522	14.91	1522	14.91
Biking with children	1	0.01	1523	14.92
Biking with dog and interacting	5	0.05	1528	14.97
Biking and interact	693	6.79	2221	21.76
Biking and doing other activities	37	0.36	2258	22.13
Biking with dog	17	0.17	2275	22.29
Exercising, interacting and doing other activities	11	0.11	2286	22.4
Exercising on structural features and interacting	3	0.03	2289	22.43
Exercise alone	2	0.02	2291	22.45
Exercise on structural features	7	0.07	2298	22.52
Fishing alone	11	0.11	2309	22.63
Fishing and interacting	15	0.15	2324	22.77
Gardening alone	6	0.06	2330	22.83
Gardening and interacting	4	0.04	2334	22.87
In-line skating alone	14	0.14	2348	23.01
In-line skating with dog	1	0.01	2349	23.02
In-line skating and interacting	8	0.08	2357	23.1
Other	73	0.72	2430	23.81
Playing with dog and interacting	6	0.06	2436	23.87
Playing on structural features alone	27	0.26	2463	24.14
Playing on structural features and interacting	94	0.92	2557	25.06
Play natural elements alone	47	0.46	2604	25.52
Playing with natural elements and dog	1	0.01	2605	25.53
Playing with natural elements, with dog and interacting	3	0.03	2608	25.56
Playing with natural elements and interacting	135	1.32	2743	26.88
Playing self-organized alone	7	0.07	2750	26.95
Playing self-organized and interacting	14	0.14	2764	27.08
Running alone	1272	12.46	4036	39.55
Running with children	13	0.13	4049	39.68
Running with children, with dog and interacting	1	0.01	4050	39.69
Running with children and interacting	4	0.04	4054	39.73
Running with children and doing other activities	1	0.01	4055	39.74
Running with dog	57	0.56	4112	40.29

Table 25 Continued

Running with dog and interacting	5	0.05	4117	40.34
Running with dog and doing other activities	4	0.04	4121	40.38
Running and interacting	288	2.82	4409	43.2
Running and doing other activities	27	0.26	4436	43.47
Scootering, interact and doing other activities	8	0.08	4444	43.55
Scootering and interacting	45	0.44	4489	43.99
Sitting alone	155	1.52	4644	45.51
Sitting, interacting and doing other activities	4	0.04	4648	45.55
Sitting and interacting	133	1.3	4781	46.85
Sitting and doing other activities	38	0.37	4819	47.22
Skating alone	15	0.15	4834	47.37
Skating and interacting	26	0.25	4860	47.62
Skating and doing other activities	6	0.06	4866	47.68
Standing, interacting and doing other activities	14	0.14	4880	47.82
Standing and doing other activities	57	0.56	4937	48.38
Stretching alone	3	0.03	4940	48.41
Stretching and interacting	4	0.04	4944	48.45
Stretching, interacting and doing other activities	4	0.04	4948	48.49
Stretching and doing other activities	1	0.01	4949	48.5
Doing tourism, interacting and doing other activities	5	0.05	4954	48.54
Tricycling	1	0.01	4955	48.55
Unicycling	1	0.01	4956	48.56
Walking alone	1408	13.8	6364	62.36
Walking with children	39	0.38	6403	62.74
Walking with children and dog	2	0.02	6405	62.76
Walking with children, dog and interacting	2	0.02	6407	62.78
Walking with children, dog and doing other activities	3	0.03	6410	62.81
Walking with children and interacting	74	0.73	6484	63.54
Walking with children, interacting and doing other activities	11	0.11	6495	63.65
Walking with children and doing other activities	2	0.02	6497	63.66
Walking with dog	464	4.55	6961	68.21
Walking with dog and interacting	376	3.68	7337	71.9
Walking with dog, interacting and doing other activities	134	1.31	7471	73.21
Walking with dog and doing other activities	138	1.35	7609	74.56
Walking and interacting	2367	23.19	9976	97.76
Walking and doing other activities	222	2.18	10198	99.93
Practicing yoga alone	2	0.02	10200	99.95
Practicing yoga and interacting	4	0.04	10204	99.99
Practicing yoga and doing other activities	1	0.01	10205	100.00

Figure 120 showed another classification and results based on the “New” patterns of use/types of activities described in table 22, which grouped the patterns of use/types of

activities, into 21 categories, with a comparison among them according to their percentage. Frequencies are as follow: biking (with 2,275 observations), exercising (with 23 observations), fishing (with 26 observations), gardening (with 10 observations), in-line skating (with 23 observations), other (with 73 observations), playing with dog (with 6 observations), playing on structural features (with 121 observations), playing with natural elements (with 186 observations), playing self-organized (with 21 observations), running (with 1,672 observations), scootering (with 53 observations), sitting (with 330 observations), skating boarding (with 47 observations), standing (with 71 observations), stretching (with 12 observations), doing tourism (with 5 observations), tricycling (with one observation), unicycling (with 1 observation), walking (with 5,242 observations) and practicing yoga (with 7 observations).

Figure 120 showed that three out of the twenty-one categories were more prevalent: walking presented the highest incidence with 51.36%, followed by running with 16.38% and biking with 22.30%. Five categories out of the twenty-one categories presented the lowest incidence: tricycling and unicycling with 0.03% each, followed by the doing tourism category with 0.06%, then playing with dog with 0.08%, and practicing yoga with 0.09%.

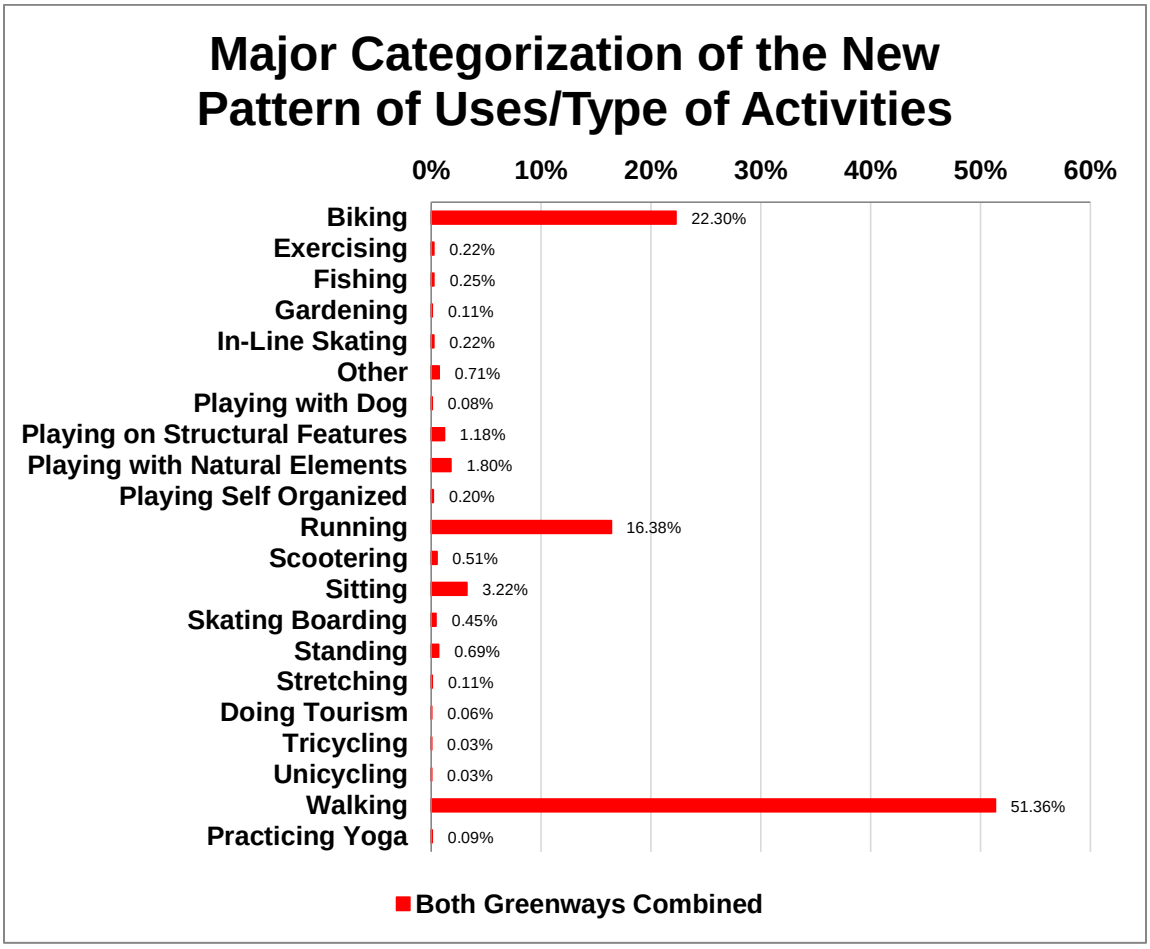

Figure 120: Comprehensive Categorization of the New Patterns of Uses/Types of Activities for the BCGW and WOCGW Combined.

Source: Pippi (2013)

Table 26 outlines complementary behaviors which serve to provide a more in-depth description of the activities that involves pets, stretching, picnicking, sitting, drinking, exercising/yoga for both greenways. These categories were also compiled in GIS and transcribed into the attribute table. For this work, they were assembled and investigated for both greenways: BCGW and WOCGW together (total of 10,205 observations and a total of

50 different complementary behaviors plus one more category that included the “no” presences of complementary behavior, those categories were illustrated in more detail in Appendix U.1. Such patterns were also spatialized in GIS, in both greenways and their segments, but with no difference in legend colors. Each of the 51 patterns complementary behaviors were analyzed with JMP 10 histogram and then imported to Excel 10 to determine which received the greatest and smallest intensity of usage.

Table 26 provides a comparison among the different complementary behavior patterns with the indication of the pattern level, their counts, estimated probability, hypothetic probability, lower CI and upper CI and also the 1-alpha value with confidence interval of 0.95. The DF utilized was 50 and also prob.>chisq 1.0000. Prevalent patterns of the complementary behavior were presented with high, moderate-low and low scores, in which were elected five categories with the higher and moderate-low results that are presented here in sequential and descending way, according to their occurrence: none (with 84.12%; 8,584 observations); pets a (with 10.93%; 1,115 observations); sitting e (with 1.44%; 147 observations), sitting b (with 0.90%; 92 observations), and pets b (with 0.58%; 59 observations). Also are presented the thirteen categories that presented the lowest scores, in which each of them presented results (0.01%; 1 observation): exercising d; pets a and sitting b, pets a and drinking ab, pets b and sitting c, pets c, pets I, sitting be, sitting c, sitting f, stretching bo, stretching c, stretching l, and stretching r. Each of those patterns is described in Appendix U.1.

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Table 26: Complementary Behavior Categorization.

Source: Pippi (2013)

Level	Count	Estim. Prob.	Hypoth Prob.	Lower CI	Upper CI	1-Alpha
none	8584	84.12%	0.84116	0.833936157	0.848119689	0.95
Pets a	1115	10.93%	0.10926	0.103353867	0.115460527	0.95
Sitting e	147	1.44%	0.0144	0.012268889	0.016905965	0.95
Sitting b	92	0.90%	0.00902	0.007357156	0.011042724	0.95
Pets b	59	0.58%	0.00578	0.00448505	0.007449846	0.95
Sitting g	20	0.20%	0.00196	0.001269088	0.003025372	0.95
Sitting a	17	0.17%	0.00167	0.001040374	0.00266636	0.95
Sitting bo	16	0.16%	0.00157	0.000965339	0.002545487	0.95
Sitting k	16	0.16%	0.00157	0.000965339	0.002545487	0.95
Sitting l	12	0.12%	0.00118	0.000672809	0.002054382	0.95
Sitting p	10	0.10%	0.00098	0.000532371	0.001803003	0.95
Stretching f	9	0.09%	0.00088	0.000464062	0.001675403	0.95
Sitting h	8	0.08%	0.00078	0.000397288	0.001546268	0.95
Stretching b	7	0.07%	0.00069	0.000332313	0.001415335	0.95
Sitting d	6	0.06%	0.00059	0.000269488	0.001282251	0.95
Stretching o	6	0.06%	0.00059	0.000269488	0.001282251	0.95
Drinking c	5	0.05%	0.00049	0.000209298	0.001146533	0.95
Sitting a and Picnicking d	5	0.05%	0.00049	0.000209298	0.001146533	0.95
Drinking a	4	0.04%	0.00039	0.000152438	0.001007484	0.95
Exercising and Yoga a	4	0.04%	0.00039	0.000152438	0.001007484	0.95
Exercising b	4	0.04%	0.00039	0.000152438	0.001007484	0.95
Picnickin d	4	0.04%	0.00039	0.000152438	0.001007484	0.95
Sitting m	4	0.04%	0.00039	0.000152438	0.001007484	0.95
Sitting q	4	0.04%	0.00039	0.000152438	0.001007484	0.95
Pets a and Sitting j	3	0.03%	0.00029	9.99825E-05	0.000864031	0.95

Table 26 Continued

Pets b, Sitting j and Picnicking a	3	0.03%	0.00029	9.99825E-05	0.000864031	0.95
Level	**Count**	**Estim. Prob.**	**Hypoth Prob.**	**Lower CI**	**Upper CI**	**1-Alpha**
Sitting a and Pets bih	3	0.03%	0.00029	9.99825E-05	0.000864031	0.95
Sitting j and Picnicking a	3	0.03%	0.00029	9.99825E-05	0.000864031	0.95
Stretching i	3	0.03%	0.00029	9.99825E-05	0.000864031	0.95
Stretching q	3	0.03%	0.00029	9.99825E-05	0.000864031	0.95
Exercising and Yoga c	2	0.02%	0.0002	5.37471E-05	0.000714358	0.95
Pets b, h and i	2	0.02%	0.0002	5.37471E-05	0.000714358	0.95
Pets g	2	0.02%	0.0002	5.37471E-05	0.000714358	0.95
Sitting a, Picnicking d, Pets a	2	0.02%	0.0002	5.37471E-05	0.000714358	0.95
Sitting j and Picnicking b	2	0.02%	0.0002	5.37471E-05	0.000714358	0.95
Stretching b and Sitting b	2	0.02%	0.0002	5.37471E-05	0.000714358	0.95
Stretching hl	2	0.02%	0.0002	5.37471E-05	0.000714358	0.95
Stretching j	2	0.02%	0.0002	5.37471E-05	0.000714358	0.95
Exercising d	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Pets a and Sitting b	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Pets a and Drinking ab	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Pets b and Sitting c	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Pets c	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Pets i	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Sitting be	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Sitting c	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Sitting f	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Stretching bo	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Stretching c	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Stretching l	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Stretching r	1	0.01%	0.0001	1.72981E-05	0.000554898	0.95
Total	10205					

This section describes a set of tables that summarize the results of the behavior mapping observation in terms of making comparissons across the different people variables to achieve a better understanding of the social interaction that tooked place in both greenways. The behavior mapping observation data was analyzed with SAS 9.3 (SAS Enterprise Miner Workstation 12.1) that facilitated the correlations and made it possible to understand associations across segments within each separate greenway and also across both greenways, elucidating the different types and amount of interactions (ties/bridges) among different people variables (user type by age, user type by gender, pure actor type and transformative actor type) at different greenway locations.

The tables present information found for each greenway separately as well as some information found when both datasets were combined. Both greenways combimed together presented a total sample size of 10,205 observations: the BCGW sample size with 5,512 observations and WOCGW sample size with 4,693 observations.

Tables 27 and 28 describe the creation of the transformative actor type categories, resulting from the combination of two different sets of the pure actor types. Both tables show the two sets of pure actor types in the first column (i.e. DD signifies two separate dyads which interacted to transform into a group category). The second column indicates the new pattern or transformative actor type categories that emerged from the interactions (ties/bridges) (i.e. in the example above, the two Dyads (DD) transformed into a group (G). The third column indicates the final transformative actor category size, which ranged from 2 to more than 15 people. The fourth column indicates the total frequency of occurrence within this new pattern or transformative actor type. The frequency number counts each individual as one instance, therefore the actual number of groups that this frequency value represents can be verified by dividing the frequency value by the Transformative Actor Size value (column 4 divided by column 3). For example, in first row of Table 29, a Dyad (D) pure actor category (made up of 2 people) met another Dyad (D) pure actor category (made up of 2 people), transforming into a Group (G) transformative actor type (made up of 4 people, which is the transformative actor size) and this occurred with a total frequency of 92 individuals (92 individuals were

involved in this type of transformation). Thus, if 92 is divided by the transformative actor size, in this case 4 people, it will result in 23 Groups (G), which is the actual number of 4-person groups that occurred through the meeting of two dyads. Column 5 shows the percentage of each category. The procedure described here to find the actual number of groups involved in any given category can be used not only for tables 27 and 28, but also to aid in understanding the protocol in chapter 4, item 4.5.3. Method 3: Social Characteristics Audit: Behavior Mapping and the Appendices O.

Table 27 presented the results for the presence of the Transformative Actor Type on the BCGW. The non-occurrence of ties/bridges was superior (79.41%; 4,377 observations) when compared to the occurrence of ties/bridges within the different categories. Within dataset for the occurrence of ties/bridges, the Individual with Individual (II) actor tie/bridge category (resulting in the Dyad (D) transformative actor type with size of 2 people) presented the highest incidence if compared to all the other categories, although it was a low value (with 8.60%; 474 individuals, or 237 actual dyad). The second category in terms of dominance was the Individual with Dyad (ID) actor tie/bridge category, resulting in the Triad (T) transformative actor type, which also presented low scores (with 5.82%; 321 individuals observed), followed by the third most prevalent category, which was the Dyad with Dyad (DD) actor tie/bridge category, resulting in the Group (G) transformative actor type, which presented low scores (1.67%/ 92 observations). In contrast, the categories that presented the lowest scores were the Individual with Group (IG) actor tie/bridge category, resulting in the Group (G) transformative actor type (Group with size 6), which presented lowest scores (0.11%; 6 observations), followed by the Triad and Group (TG) category (with size 8) (0.15%; 8 observations).

Table 27: Frequency Comparison of the Actor Ties/Bridges Composition for the Transformative Actor Types on the BCGW.
Source: Pippi (2013)

Actor_TieB	TranActTyp	TranActSiz	Frequency	Percent	Cumulative Frequency	Cumulative Percent
DD	Group (G)	4	92	1.67	92	1.67
DG	Group (G)	6	18	0.33	110	2.00
DG	Group (G)	8	16	0.29	126	2.29
DG	Group (G)	9	9	0.16	135	2.45
DT	Group (G)	5	50	0.91	185	3.36
GG	Group (G)	14	14	0.25	199	3.61
ID	Triad (T)	3	321	5.82	520	9.43
IG	Group (G)	5	25	0.45	545	9.89
IG	Group (G)	6	6	0.11	551	10.00
II	Dyad (D)	2	474	8.60	1025	18.60
IT	Group (G)	4	80	1.45	1105	20.05
TG	Group (G)	8	8	0.15	1113	20.19
TG	Group (G)	9	9	0.16	1122	20.36
TG	Group (G)	13	13	0.24	1135	20.59
no	no	0	4377	79.41	5512	100.00

Table 28 presents the Transformative Actor Types on the WOCGW. The non-occurrence of ties/bridges was superior (73.28%; 3,439 observations) when compared to the occurrence of ties/bridges within the different categories. Within the dataset for the occurrence of ties/bridges in the Individual with Individual (II) actor tie/bridge category, resulting in the Dyad (D) transformative actor type, showed the highest low scores if compared to all the other categories (with 10.27%; 482 observations. The second most prevalent category was the Individual with Dyad (ID) actor tie/bridge category, resulting in the Triad (T) transformative actor type, which showed moderate-moderate to low scores (with 9.08%; 426 observations), followed by the Dyad with Triad (DT) actor tie/bridge category, which resulted in the Group (G) transformative actor type (with size 5), with low scores (1.28%/ 60 observations). The categories that showed the lowest scores were the Dyad with Group (DG) actor tie/bridge category, with, only one case of a transformative group of size 7

(0.15%; 7 observations), followed by the Individual and Group (IG) category, also with only one case with a group size 7 (0.15%; 8 observations).

Table 28: Frequency Comparison of the Actor Ties/Bridges Composition for the Transformative Actor Types on the WOCGW.
Source: Pippi (2013)

Actor_TieB	TranActTyp	TranActSiz	Frequency	Percent	Cumulative Frequency	Cumulative Percent
DD	**Group (G)**	**4**	52	1.11	52	1.11
DG	**Group (G)**	**6**	54	1.15	106	2.26
DG	**Group (G)**	**7**	7	0.15	113	2.41
DT	**Group (G)**	**5**	60	1.28	173	3.69
ID	**Triad (T)**	**3**	426	9.08	599	12.76
IG	**Group (G)**	**5**	40	0.85	639	13.62
IG	**Group (G)**	**7**	7	0.15	646	13.77
II	**Dyad (D)**	**2**	482	10.27	1128	24.04
IT	**Group (G)**	**4**	76	1.62	1204	25.66
TG	**Group (G)**	**7**	14	0.30	1218	25.95
TT	**Group (G)**	**6**	36	0.77	1254	26.72
no	**no**	**0**	3439	73.28	4693	100.00

When comparing tables 27 and 28, the non-occurrence of ties/bridges was greater on the BCGW with 79.41% if compared to the WOCGW with 73.28%. Overall, the Dyad with Diad (DD) and Individual with Triad (IT) categories were more prevalent in the BCGW, however the Dyad with Triad (DT), Individual with Diad (ID), Individual with Group (IG) size of 5, and Individual with Individual (II) categories were superior in the WOCGW. Dyad with Group (DG) categories with sizes 8 and 9 were only encountered in the BCGW, while the Dyad with Group (DG) categories with sizes 6 and 7 where only encountered in the WOCGW. Group with Group (GG) category was only encountered in the BCGW. The Triad with Group (TG) categories with sizes 8, 9 and 13 were only encountered in the BCGW, while the Triad with Group (TG) category with size 7 was only encountered in the WOCGW. The Triad with

Triad (TT) category was only encountered in the WOCGW. The Individual with Individual (II) actor tie/bridge category presence was superior in the WOCGW with 10.27% if compared to the BCGW with 8.60%; the Individual with Dyad (ID) actor tie/bridge category in the WOCGW with 9.09% surpassed the BCGW with 5.82%. The Individual and Group (IG) can be compared only for size 5, which was more prevalent in the WOCGW with 0.85% than the BCGW with 0.45%, however the (IG) size 7 only occurred in the BCGW, and the (IG) size 6 only occurred in the BCGW.

Table 29 presents the results for the *actor ties/bridges composition categories* across both greenways and for both the *non-occurrence* and *occurrence* datasets. It also presents the total results of each category (percentage and observations) for each of the greenways types. In the Dyad with Dyad (DD) category presented almost two times the\ prevalence on the BCGW when compared to the WOCGW, which presented one of the lowest scores within the WOCGW if compared to the other categories (BCGW: with 63.89%; 92 observations and WOCGW: with 36.11%; 52 observations); the Dyad with Group (DG) category presented the second highest frequency and was more prevalent in the WOCGW if compared to the BCGW which presented moderate scores in this category (WOCGW: with 58.65%; 61 observations and BCGW: with 41.35%; 43 observations); the Group with Group (GG) category, was only found in the BCGW (with 100%; 14 observations); The Individual with Dyad (ID) category presented the third highest scores in the WOCGW (with 57.03%; 426 observations); The Individual with Group (IG) category was more evident in the WOCGW than the BCGW which presented moderate scores, and presented higher scores when compared to the other categories within the WOCGW (WOCGW: with 60.26%; 47 observations and BGGW: with 39.74%; 31 observations); the Triad with Group (TG) category was more evident in the BCGW, than the WOCGW, where it presented one of the lowest scores for this category, and, in contrast, presented higher scores in the BCGW when compared to the other categories (BCGW: with 68.18%; 30 observations and WOCGW: with 31.82%; 14 observations); The triad with Triad (TT) category only occurred in the WOCGW (with 100%; 36 observations), finally the *non-occurrence of actor ties/bridges* was more evident in the BCGW with high-moderate scores, if compared to the WOCGW that

presented moderate scores (BCGW: with 56.00%ç 4,377 observations and WOCGW: with 44.00%; 3,439 observations).

According to table 29, when correlating the total frequency of each catagory for the *actor ties/bridges occurrence* and *non-occurrence* datasets, the *non-occurrence of actor ties/bridges* was drastically superior than the *occurrence of actor ties/bridges* categories (with 76.59%; 7,816 observations). In the *occurrence of actor ties/bridges,* the Individual with Individual (II) presented the second highest score, even though it was a low incidence (with 9.37%; 956 observations), followed by the Individual with Dyad (ID) category in the third position and with low scores (with 7.32%; 747 observations) and the Individual with Triad (IT) category in the fourth position, with lower scores (with 1.53%; 156 observations). The categories that presented the lowest scores were: the Dyad with Dyad (DD) (with 1.41%; 144 observations), the Individual with Group (IG) (with 0.76%; 78 observations), the Triad with Group (TG) (with 0.43%; 44 observations), the Triad with Triad (TT) (with 0.35%; 36 observations) and the Group with Group (GG) (with 0.14%; 14 observations).

Table 29: Frequency Comparison of the Actor Ties/Bridges Composition on Both Greenways.

Source: Pippi (2013)

Table of Greenway_Name by Actor_TieB												
Greenway_Name (Greenway_Name)	**Actor_TieB(Actor_TieB)**											
Frequency Percent Row Pct Col Pct	**DD**	**DG**	**DT**	**GG**	**ID**	**IG**	**II**	**IT**	**TG**	**TT**	**no**	**Total**
Black Creek Greenway	92 0.90 1.67 63.89	43 0.42 0.78 41.35	50 0.49 0.91 45.45	14 0.14 0.25 100.00	321 3.15 5.82 42.97	31 0.30 0.56 39.74	474 4.64 8.60 49.58	80 0.78 1.45 51.28	30 0.29 0.54 68.18	0 0.00 0.00 0.00	4377 42.89 79.41 56.00	5512 54.01
White Oak Creek Greenway	52 0.51 1.11 36.11	61 0.60 1.30 58.65	60 0.59 1.28 54.55	0 0.00 0.00 0.00	426 4.17 9.08 57.03	47 0.46 1.00 60.26	482 4.72 10.27 50.42	76 0.74 1.62 48.72	14 0.14 0.30 31.82	36 0.35 0.77 100.00	3439 33.70 73.28 44.00	4693 45.99
Total	144 1.41	104 1.02	110 1.08	14 0.14	747 7.32	78 0.76	956 9.37	156 1.53	44 0.43	36 0.35	7816 76.59	10205 100.00

Table 30 shows the results for both greenways individually and combined in the overall 10,205 observations. Table 32 presents the inverse of tables 29 and 30, which showed first the pure actor types involved in a social bridge, followed by the resulting transformative actor type. Instead, table 32 shows the two pure actor types in each category and breaks down the data for each actor type separately. Thus the second column shows the pure actor composition of each transformative actor type and the third column shows each actor type individually. For example, for a Dyad (D) and Group (G), there will be two rows of information. The first column for both of these rows will show (DG), while the third column will show (D) in the first row and (G) in the second row. The fourth column indicates the frequency (number of observations) for each type of actors involved in that decomposition, and the fifth column presents their percentage.

In table 30, the *non-occurrence* of each actor type was significantly more prevalent in both greenways for all the actor categories types, with significant difference between the greenways. When compared to the WOCGW the BCGW presented higher scores in the Individual (I), Dyad (D) and Group (G) categories and lower scores in the Triad (T) category. The BCGW presented the highest scores in the Individual (I) category (with 18.13%; 1,850 observations), followed by the Dyad (D) category (with 15.11%; 1,542 observations) and with low scores the Group (G) category (with 5.01%; 511 observations) and the Triad (T) category with the lowest score (4.64%; 474 observations). The WOCGW presented the highest scores in the Individual (I) category (with 13.32%; 1359 observations), followed by the Dyad (D) category (with 11.13%; 1,136 observations), than with lower scores the Triad (T) category (with 5.00%; 510 observations), followed by the Group (G) category (with 4.25%; 434 observations). In terms of the *occurrence* of ties/bridges for each actor type, the WOCGW presented higher scores in the Individual with Individual (II) and Individual with Dyad (ID) categories than the BCGW. In the BCGW, the Individual (II) category was the most prevalent (with 4.63%; 472 observations + 0.02%, 2 observations = 4.65%; 474 observations), followed by Individual with Dyad (ID) (D: with 2.10%; 214 observations and I: with 1.05%; 107 observations). The third most prevalent category, with lower scores, was the Triad with Group (TG) category (G: with 0.21%; 21 observations and T: with 0.09%; 9 observations).

In the WOCGW, the Individual (II) category was also the most prevalent and very similar with the BCGW scores (with 4.72%; 482 observations), followed by the Individual with Dyad (ID) category (D: with 2.78%; 284 observations and I: with 1.39%; 142 observations). The third most prevalent, thought with lower scores, and different from the BCGW, was the Individual with Group (IG) category (G: with 0.37%; 38 observations and I: with 0.09%; 9 observations).

Table 30: Frequency Comparison of the Actor Ties/Bridges Composition for Transformative Actor Types on Both Greenways.

Source: Pippi (2013)

Greenway_Name	Actor_TieB	Actor_Type	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Black Creek Greenway	DD	Dyad (D)	92	0.90	92	0.90
Black Creek Greenway	DG	Dyad (D)	12	0.12	104	1.02
Black Creek Greenway	DG	Group (G)	31	0.30	135	1.32
Black Creek Greenway	DT	Dyad (D)	20	0.20	155	1.52
Black Creek Greenway	DT	Triad (T)	30	0.29	185	1.81
Black Creek Greenway	GG	Group (G)	14	0.14	199	1.95
Black Creek Greenway	ID	Dyad (D)	214	2.10	413	4.05
Black Creek Greenway	ID	Individual (I)	107	1.05	520	5.10
Black Creek Greenway	IG	Group (G)	25	0.24	545	5.34
Black Creek Greenway	IG	Individual (I)	6	0.06	551	5.40
Black Creek Greenway	II	Individual (I)	2	0.02	553	5.42
Black Creek Greenway	II	Individual (I)	472	4.63	1025	10.04
Black Creek Greenway	IT	Individual (I)	20	0.20	1045	10.24
Black Creek Greenway	IT	Triad (T)	60	0.59	1105	10.83
Black Creek Greenway	TG	Group (G)	21	0.21	1126	11.03
Black Creek Greenway	TG	Triad (T)	9	0.09	1135	11.12
Black Creek Greenway	no	Dyad (D)	1542	15.11	2677	26.23
Black Creek Greenway	no	Group (G)	511	5.01	3188	31.24
Black Creek Greenway	no	Individual (I)	1850	18.13	5038	49.37
Black Creek Greenway	no	Triad (T)	474	4.64	5512	54.01
White Oak Creek Greenway	DD	Dyad (D)	52	0.51	5564	54.52
White Oak Creek Greenway	DG	Dyad (D)	20	0.20	5584	54.72
White Oak Creek Greenway	DG	Group (G)	41	0.40	5625	55.12
White Oak Creek Greenway	DT	Dyad (D)	24	0.24	5649	55.36
White Oak Creek Greenway	DT	Triad (T)	36	0.35	5685	55.71
White Oak Creek Greenway	ID	Dyad (D)	284	2.78	5969	58.49
White Oak Creek Greenway	ID	Individual (I)	142	1.39	6111	59.88
White Oak Creek Greenway	IG	Group (G)	38	0.37	6149	60.25
White Oak Creek Greenway	IG	Individual (I)	9	0.09	6158	60.34
White Oak Creek Greenway	II	Individual (I)	482	4.72	6640	65.07
White Oak Creek Greenway	IT	Individual (I)	19	0.19	6659	65.25
White Oak Creek Greenway	IT	Triad (T)	57	0.56	6716	65.81
White Oak Creek Greenway	TG	Group (G)	8	0.08	6724	65.89
White Oak Creek Greenway	TG	Triad (T)	6	0.06	6730	65.95

Table 30 Continued

Greenway_Name	Actor_TieB	Actor_Type	Frequency	Percent	Cumulative Frequency	Cumulative Percent
White Oak Creek Greenway	**TT**	**Triad (T)**	36	0.35	6766	66.30
White Oak Creek Greenway	**no**	**Dyad (D)**	1136	11.13	7902	77.43
White Oak Creek Greenway	**no**	**Group (G)**	434	4.25	8336	81.69
White Oak Creek Greenway	**no**	**Individual (I)**	1359	13.32	9695	95.00
White Oak Creek Greenway	**no**	**Triad (T)**	510	5.00	10205	100.00

Tables 31 and 32 show the presence of each of the pure actor categories quantity. The *non-occurrence* of the actor type surpassed the *occurrence* in both greenways in all the actor categories types with significant difference between the greenways, however, for the *occurrence* results there were few differences across the greenways. The total of *non-occurrence* is superior in the BCGW (79.41%; 4,377 observations) if compared to the WOCGW (73.28%; 3,439 observations), however, the total *occurrence* was superior in the WOCGW (26.72%; 1,254 observations) if compared to the BCGW (20.59%; 1,135 observations). Both greenways presented similarity in the non-occurrence of the actor type categories: for both Individual (I) was most prevalent, followed by the Dyad (D), however they differed in terms of the third position, which was Groups (G) followed by Triad (T) for the BCGW and Triad (T) followed by Group (G) for the WOCGW. The Individual (I) category presented greater scores in both greenways with similar results (BCGW: with 44.54%; 2,455 and the WOCGW: with 42.85%; 2,011 observations), followed by the Dyad (D) category also with similar scores (BCGW: with 34.14%; with 1,882 observations and the WOCGW: with 32.30%; 1,516 observations).

Table 31: Frequency Comparison of the Pure Actor Type Related to the Ties/Bridges Occurrence on the BCGW.

Source: Pippi (2013)

Table of Actor_Type by Tie_Bridge			
Controlling for Greenway_Name=Black Creek Greenway			
Actor_Type(Actor_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Dyad (D)	1542 27.98 81.93 35.23	340 6.17 18.07 29.96	1882 34.14
Group (G)	511 9.27 84.88 11.67	91 1.65 15.12 8.02	602 10.92
Individual (I)	1850 33.56 75.36 42.27	605 10.98 24.64 53.30	2455 44.54
Triad (T)	474 8.60 82.72 10.83	99 1.80 17.28 8.72	573 10.40
Total	4377 79.41	1135 20.59	5512 100.00

Table 32: Frequency Comparison of the Pure Actor Type Related to the Ties/Bridges Occurrence on the WCGW.

Source: Pippi (2013)

Table of Actor_Type by Tie_Bridge			
Controlling for Greenway_Name=White Oak Creek Greenway			
Actor_Type(Actor_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Dyad (D)	1136 24.21 74.93 33.03	380 8.10 25.07 30.30	1516 32.30
Group (G)	434 9.25 83.30 12.62	87 1.85 16.70 6.94	521 11.10
Individual (I)	1359 28.96 67.58 39.52	652 13.89 32.42 51.99	2011 42.85
Triad (T)	510 10.87 79.07 14.83	135 2.88 20.93 10.77	645 13.74
Total	3439 73.28	1254 26.72	4693 100.00

Tables 33, 34, 35 and 36 show the incidence of each of the user categories related to the pure actor type for both the datasets for non-occurrence and occurrence as well as the combined data in the BCGW. All four tables showed significant differences between *non-occurrence* and *occurrence* within the pure actor categories. For the combined dataset, the BCGW presented the following data for the *Individual category:* Adult (Ad: with 97.27%; 2,388 observations), Senior (Sn: with 1.38%; 34 observations), Adolescent (As: with 1.30%; 32 observations) and Children (Ch: with 0.04%, 1 observation); in the *Dyad category:* the Adult (Ad: with 84.54%; 1,591 observations), Children (Ch: with 7.39%, 139 observations), Adolescent (As: with 5.47%; 103 observations) and Senior (Sn: with 2.60%; 49 observations); in the *Triad category:* the Adult (Ad: with 60.38%; 346 observations), Children

(Ch: with 25.48%, 146 observations), Adolescent (As: with 12.39%; 71 observations) and Senior (Sn: with 1.75%; 10 observations), and in the in the *Group category:* the Adult (Ad: with 55.32%; 333 observations),Children (Ch: with 31.06%, 187 observations), Adolescent (As: with 10.96%; 66 observations) and Senior (Sn: with 2.66%; 16 observations).

In the BCGW for the *non-occurrence* data*,* the Individual (I) category presented greater frequency for Children, followed by the Adolescents (Ch: with 100.00%; 1 observation and As: with 78.13%; 25 observations) but the Senior was less prevalent (Sn: with 52.94%; 18 observations). On the other hand, for the *occurrence* dataset, the Senior (Sn) category (Sn: with 47.96%; 16 observations) was more prevalent, followed by the Adolescent (Ad: with 21.88%; 7 observations), and the children category was absent. In the Dyad (D) category for the *non-occurrence*, the Adult category was more prevalent (Ad: with 82.84%; 1,318 observations) and the least predominant category was Senior (Sn: with 71.43%; 35 observations). On the other hand for the *occurrence* dataset, the Senior category was more prevalent (Sn: with 28.57%/ 14 observations) and the Adult category the least evident (As: 17.16%; 273 observations); in the Triad (T) category for the *non-occurrence* the Adolescent category was more predominant (As: with 88.73%; 63 observations) and the Senior category was less predominant (Sn: with 80.00%; 8 observations). On the other hand, for the *occurrence* dataset, the Senior category was more evident (Sn: with 20.00%; 2 observations) and the Adolescent category the least evident (As: 11.27%; 8 observations). In the Group, category for the *nonoccurrence,* the Adult category was more predominant (Ad: with 87.69%; 292 observations) and the Adolescent category less predominant (Ad: with 66.67%; 44 observations). On the other hand, for the *occurrence* dataset, the Adolescent category was more evident (Ad: with 33.33%; 22 observations) and the Adult category the least evident (Ad: 12.31%; 41 observations),as illustrated in tables 33, 34, 35 and 36.

Table 33: Frequency Comparison of the User Type by Age Related to the Ties/Bridges Individuals Occurrence on the BCGW.

Source: Pippi (2013)

Table of User_Type by Tie_Bridge			
Controlling for Greenway_Name=Black Creek Greenway Actor_Type=Individual (I)			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	25 1.02 78.13 1.35	7 0.29 21.88 1.16	32 1.30
Adult (Ad)	1806 73.56 75.63 97.62	582 23.71 24.37 96.20	2388 97.27
Children (Ch)	1 0.04 100.00 0.05	0 0.00 0.00 0.00	1 0.04
Senior (Sn)	18 0.73 52.94 0.97	16 0.65 47.06 2.64	34 1.38
Total	1850 75.36	605 24.64	2455 100.00

Table 34: Frequency Comparison of the User Type by Age Related to the Ties/Bridges Dyads Occurrence on the BCGW.

Source: Pippi (2013)

Table of User_Type by Tie_Bridge			
Controlling for Greenway_Name=Black Creek Greenway Actor_Type=Dyad (D)			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	82 4.36 79.61 5.32	21 1.12 20.39 6.18	103 5.47
Adult (Ad)	1318 70.03 82.84 85.47	273 14.51 17.16 80.29	1591 84.54
Children (Ch)	107 5.69 76.98 6.94	32 1.70 23.02 9.41	139 7.39
Senior (Sn)	35 1.86 71.43 2.27	14 0.74 28.57 4.12	49 2.60
Total	1542 81.93	340 18.07	1882 100.00

Table 35: Frequency Comparison of the User Type by Age Related to the Ties/Bridges Triads Occurrence on the BCGW.

Source: Pippi (2013)

Table 4 of User_Type by Tie_Bridge			
Controlling for Greenway_Name=Black Creek Greenway Actor_Type=Triad (T)			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	63 10.99 88.73 13.29	8 1.40 11.27 8.08	71 12.39
Adult (Ad)	283 49.39 81.79 59.70	63 10.99 18.21 63.64	346 60.38
Children (Ch)	120 20.94 82.19 25.32	26 4.54 17.81 26.26	146 25.48
Senior (Sn)	8 1.40 80.00 1.69	2 0.35 20.00 2.02	10 1.75
Total	474 82.72	99 17.28	573 100.00

Table 36: Frequency Comparison of the User Type by Age Related to the Ties/Bridges Groups Occurrence on the BCGW.

Source: Pippi (2013)

Table of User_Type by Tie_Bridge			
Controlling for Greenway_Name=Black Creek Greenway Actor_Type=Group (G)			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	44 7.31 66.67 8.61	22 3.65 33.33 24.18	66 10.96
Adult (Ad)	292 48.50 87.69 57.14	41 6.81 12.31 45.05	333 55.32
Children (Ch)	163 27.08 87.17 31.90	24 3.99 12.83 26.37	187 31.06
Senior (Sn)	12 1.99 75.00 2.35	4 0.66 25.00 4.40	16 2.66
Total	511 84.88	91 15.12	602 100.00

The tables 37, 38, 39 and 40 show the incidence of each of the user categories related to the pure actor type for both the datasets for non-occurrence and occurrence as well as the combined data in the WOCGW. All four tables showed substantial differences between the *non-occurrence* with the *occurrence* datasets. Based on the combined datasets, the WOCGW presented the following results for the *Individual category:* Adult (Ad: with 93.59%; 1,882 observations), Adolescent (As: with 3.28%; 66 observations), Senior (Sn: with 2.19%; 44 observations), and Children (Ch: with 0.94%, 19 observations); in the *Dyad category:* the Adult (Ad: with 71.90%; 1,090 observations), Children (Ch: with 13.92%, 211 observations), Adolescent (As: with 9.76%; 148 observations) and Senior (Sn: with 4.42%; 67 observations); in the *Triad category:* the Children (Ch with 44.96%; 290 observations), Adult

(Ad: with 41.86%, 270 observations), Adolescent (As: with 11.94%; 77 observations) and Senior (Sn: with 1.24%; 8 observations), and in the in the *Group category:* Children (Ch: with 42.61%, 222 observations), the Adult (Ad: with 37.43%; 195 observations), Adolescent (As: with 19.19%; 100 observations) and Senior (Sn: with 0.77%; 4 observations).

In the WOCGW for the *non-occurrence* dataset in the Individual (I) category, the Children category showed the greatest prevalent (Ch: with 94.74%; 18 observations) while the Senior category showed the least prevalence (Sn: with 65.91%; 29 observations). On the other hand, for the *occurrence* datset, the opposite occurred, where the Senior (Sn) category was the most prevalent (Sn: with 34.09%; 15 observations) and the Children category was the least prevalent Ch: with 5.26%; 1 observation). In the Dyad (D) category for the *non-occurrence* dataset, the most predominant was Adolescent (As: with 81.08%; 120 observations) and the least predominant was Senior category (Sn: with 61.19%; 41 observations). On the other hand, for the *occurrence* dataset, the opposite occurred, where the Senior category was the most evident (Sn: with 38.81%/ 26 observations) and the Adolescent category was the least evident (As: 18.92%; 28 observations). For *non-occurrence* Triad (T) Children was more prevalent (Ch: with 81.03%; 235 observations) and Senior was least predominant (Sn: with 62.50%; 5 observations), while for the *occurrence* dataset Adult was more evident (Ad: with 22.22%; 60 observations) and Children least evident (Ch: 18.97%; 55 observations). In the Group, *non-occurrence,* the Senior and the Adolescent categories (Sn: with 100.00%; 4 observations and As: with 96.00%; 96 observations) were more predominant, while the Adult category (Ad: with 77.95%; 152 observations) was least predominant. On the other hand, for the Group *occurrence* dataset, Adult category was more evident (Ad: with 22.05%; 43 observations) and the Adolescent category the least evident (As: 4.60%; 4 observations) and the Senior category was absent, as illustrated in the tables 35, 36, 37 and 38.

Table 37: Frequency Procedure Comparison of the User Type by Age Related to the TieFs/Bridges Individuals Occurrence on the WOCGW.

Source: Pippi (2013)

Table of User_Type by Tie_Bridge			
Controlling for Greenway_Name=White Oak Creek Greenway Actor_Type=Individual (I)			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	54 2.69 81.82 3.97	12 0.60 18.18 1.84	66 3.28
Adult (Ad)	1258 62.56 66.84 92.57	624 31.03 33.16 95.71	1882 93.59
Children (Ch)	18 0.90 94.74 1.32	1 0.05 5.26 0.15	19 0.94
Senior (Sn)	29 1.44 65.91 2.13	15 0.75 34.09 2.30	44 2.19
Total	1359 67.58	652 32.42	2011 100.00

Table 38: Frequency Procedure Comparison of the User Type by Age Related to the Ties/Bridges Dyads Occurrence on the WOCGW.

Source: Pippi (2013)

Table of User_Type by Tie_Bridge			
Controlling for Greenway_Name=White Oak Creek Greenway Actor_Type=Dyad (D)			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	120 7.92 81.08 10.56	28 1.85 18.92 7.37	148 9.76
Adult (Ad)	817 53.89 74.95 71.92	273 18.01 25.05 71.84	1090 71.90
Children (Ch)	158 10.42 74.88 13.91	53 3.50 25.12 13.95	211 13.92
Senior (Sn)	41 2.70 61.19 3.61	26 1.72 38.81 6.84	67 4.42
Total	1136 74.93	380 25.07	1516 100.00

Table 39: Frequency Procedure Comparison of the User Type by Age Related to the Ties/Bridges Triads Occurrence on the WOCGW.

Source: Pippi (2013)

Table of User_Type by Tie_Bridge			
Controlling for Greenway_Name=White Oak Creek Greenway Actor_Type=Triad (T)			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	60 9.30 77.92 11.76	17 2.64 22.08 12.59	77 11.94
Adult (Ad)	210 32.56 77.78 41.18	60 9.30 22.22 44.44	270 41.86
Children (Ch)	235 36.43 81.03 46.08	55 8.53 18.97 40.74	290 44.96
Senior (Sn)	5 0.78 62.50 0.98	3 0.47 37.50 2.22	8 1.24
Total	510 79.07	135 20.93	645 100.00

Table 40: Frequency Procedure Comparison of the User Type by Age Related to the Ties/Bridges Groups Occurrence on the WOCGW.

Source: Pippi (2013)

Table of User_Type by Tie_Bridge			
Controlling for Greenway_Name=White Oak Creek Greenway Actor_Type=Group (G)			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	96 18.43 96.00 22.12	4 0.77 4.00 4.60	100 19.19
Adult (Ad)	152 29.17 77.95 35.02	43 8.25 22.05 49.43	195 37.43
Children (Ch)	182 34.93 81.98 41.94	40 7.68 18.02 45.98	222 42.61
Senior (Sn)	4 0.77 100.00 0.92	0 0.00 0.00 0.00	4 0.77
Total	434 83.30	87 16.70	521 100.00

When correlated both greenways in terms of results for the relation between user type and actor type, as presented in the previous eight tables above, there were substantial differences between the scores for the *non-occurrence* of ties/bridges, for the *occurrence of* ties/bridges and for both datasets combined.

Within the Individual (I) category there was *no occurrence* of ties/bridges mostly in the Children and Adolescent categories in the BCGW (Ch: with 100% and As: with 78.13%) and also for the same categories in the WOCGW (Ch: with 94.74% and As: with 81.82%). Within the Dyad (D) category there was *no occurrence* of ties/bridges in the Adult and Adolescent categories in the BCGW (Ad: with 82.84% and As: with 79.61%) and also for the same

categories but opposite order in the WOCGW (As: with 81.08% and Ad: with 74.95%). Within the Triad (T) category there was *no occurrence* of ties/bridges in the Adolescent and Adult categories in the BCGW (As: with 88.73% and Ad: with 81.79%) and in the Children and Adolescent categories in the WOCGW (Ch: with 81.03% and As: with 77.92%). Within the Group (G) category there was *no occurrence* of ties/bridges in the Adult and Children categories in the BCGW (Ad: with 87.69% and Ch: with 87.17%) and in the Senior and Adolescent categories in the WOCGW (Sn: with 100.00% and As: with 96.00%).

Within the Individual (I) category there was *occurrence* of ties/bridges mostly in the Senior and Adult categories in the BCGW (Sn: with 47.06% and Ad: with 24.37%) and also for the same categories in the WOCGW (Sn: with 34.09% and Ad: with 31.03%). Within the Dyad (D) category there was *occurrence* of ties/bridges in the Senior and Children categories in the BCGW (Sn: with 28.57% and Ch: with 23.02%) and also for the same categories in the WOCGW (Sn: with 38.81% and Ch: with 25.12%). Within the Triad (T) category there was *occurrence* of ties/bridges in the Senior and Adult categories in the BCGW (Sn: with 20.00% and Ad: with 18.21%) and in the Adult and Adolescent categories in the WOCGW (Ad: with 22.22% and As: with 22.08%). Within the Group (G) category there was *occurrence* of ties/bridges in the Adolescent and Senior categories in the BCGW (As: with 33.33% and Sn: with 25.00%) and in the Adult and Children categories in the WOCGW (Ad: with 22.05% and Ch: with 18.02%).

Within the Individual (I) category for the combined dataset, the greatest frequency was for Adult and Adolescent categories in the BCGW (Ad: with 92.27% and Sn: with 1.38%) and for the Adult and Senior categories in the WOCGW (Ad: with 93.59% and As: with 3.28%). Within the Dyad (D) category in the combined dataset, there was greater frequency in the Adult and Children categories in the BCGW (Ad: with 84.54% and Ch: with 7.39%) and also for the same categories in the WOCGW (Ad: with 71.90% and Ch: with 13.92%). Within the combined dataset Triad (T) category there greater frequency in the Adult and Children categories in the BCGW (Ad: with 60.38% and Ch: with 25.48%) and in the WOCGW the same categories but in opposite order (Ch: with 44.96% and Ad: with 41.86%). Within the

combined dataset Group (G) there was greater frequency in the Adult and Child in the BCGW (Ad: with 55.32% and Ch: with 31.06%) and in the WOCGW the same categories but in opposite order (Ch: with 42.61% and Ad: with 37.43%).

Tables 41, 42, 43 and 44 show the incidence of each of the user gender categories related to the user gender type and also correlated with both non-occurrence and occurrence of the ties/bridges relations and the total score of both of them combined in the BCGW and then in the WOCGW. All four tables presented significant differences between the scores of the *non-occurrence* and *occurrence*.

In *combined datasets*, the BCGW presented the following results in the *Female category:* Adult (Ad: with 85.35%; 2,115 observations), Children (Ch: with 7.91%, 196 observations), Adolescent (As: with 4.80%; 119 observations) and Senior (Sn: with 1.94%; 48 observations); in the *Male category*, with similar results: the Adult (Ad: with 83.82%; 2,543 observations), Children (Ch: with 9.13%, 277 observations), Adolescent (As: with 5.04%; 153 observations) and Senior (Sn: with 2.01%; 61 observations). In the BCGW *non-occurrence set,* the *Female category* presented Children as most prevalent (Ch: with 81.12%; 159 observations) and the Senior category as least prevalent (Sn: with 62.50%; 30 observations). On the other hand for the *occurrence* dataset, the Senior category (Sn: with 37.50%; 18 observations) was most prevalent and the children category least prevalent (Ch: with 18.88%; 37 observations). In the *Male category* for the *no occurrence* Children category (Ch: with 83.75%; 232 observations) was also most prevalent and the Senior category (Sn: with 70.49%; 43 observations) also least predominant. On the other hand, for the *occurrence* set, the opposite occurred, where the Senior category was more evident (Sn: with 29.51%/ 18 observations) and the Children category the least evident (Ch: with 16.25%; 45 observations), according to the tables 41 and 42.

In the combined datasets, the WOCGW presented in the *Female category:* Adult (Ad: with 78.08%; 1,635 observations), Children (Ch: with 12.37%; 259 observations), Adolescent (As: with 6.26%; 131 observations) and Senior (Sn: with 3.30%; 69 observations); in the

Male category: the Adult (Ad: with 69.33%; 1,802 observations), Children (Ch: with 18.58%, 483 observations), Adolescent (As: with 10.00%; 260 observations) and Senior (Sn: with 2.08%; 54 observations). In the WOCGW for the *non-occurrence,* set, the *Female category* presented Adolescent as the most prevalent (As: with 82.44%; 108 observations) and the Senior as least prevalent (Sn: with 60.87%; 18 observations). On the other hand, for the *occurrence* Female set, the Senior category was more prevalent (Sn: with 39.13%; 27 observations) and the Adolescent category was least prevalent (As: with 17.56%; 23 observations). In the *Male category:* for the *non-occurrence* Adolescent category (As: with 85.38%; 222 observations) was most predominant and the Senior category (Sn: with 68.52%; 37 observations) was least predominant. On the other hand for *occurrence* Male set, the opposite occurred, where the Senior category was most evident (Sn: with 31.48%/ 17 observations) and the Adolescent category the least evident (As: 14.62%; 38 observations) as illustrated in tables 43 and 44.

Table 41: Frequency Comparison of the User Type for Female Gender Related to the Ties/Bridges Groups Occurrence on the BCGW.

Source: Pippi (2013)

Table of User_Type by Tie_Bridge			
Controlling for Greenway_Name=Black Creek Greenway Gender=Female			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	92 3.71 77.31 4.66	27 1.09 22.69 5.36	119 4.80
Adult (Ad)	1693 68.32 80.05 85.76	422 17.03 19.95 83.73	2115 85.35
Children (Ch)	159 6.42 81.12 8.05	37 1.49 18.88 7.34	196 7.91
Senior (Sn)	30 1.21 62.50 1.52	18 0.73 37.50 3.57	48 1.94
Total	1974 79.66	504 20.34	2478 100.00

Table 42: Frequency Comparison of the User Type for Male Gender Related to the Ties/Bridges Groups Occurrence on the BCGW.

Source: Pippi (2013)

Table of User_Type by Tie_Bridge			
Controlling for Greenway_Name=Black Creek Greenway Gender=Male			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	122 4.02 79.74 5.08	31 1.02 20.26 4.91	153 5.04
Adult (Ad)	2006 66.12 78.88 83.48	537 17.70 21.12 85.10	2543 83.82
Children (Ch)	232 7.65 83.75 9.65	45 1.48 16.25 7.13	277 9.13
Senior (Sn)	43 1.42 70.49 1.79	18 0.59 29.51 2.85	61 2.01
Total	2403 79.20	631 20.80	3034 100.00

Table 43: Frequency Comparison of the User Type for Female Gender Related to the Ties/Bridges Groups Occurrence on the WOCGW.

Source: Pippi (2013)

Table of User_Type by Tie_Bridge			
Controlling for Greenway_Name=White Oak Creek Greenway Gender=Female			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	108 5.16 82.44 7.07	23 1.10 17.56 4.06	131 6.26
Adult (Ad)	1181 56.40 72.23 77.29	454 21.68 27.77 80.21	1635 78.08
Children (Ch)	197 9.41 76.06 12.89	62 2.96 23.94 10.95	259 12.37
Senior (Sn)	42 2.01 60.87 2.75	27 1.29 39.13 4.77	69 3.30
Total	1528 72.97	566 27.03	2094 100.00

Table 44: Frequency Comparison of the User Type for Male Gender Related to the Ties/Bridges Groups Occurrence on the WOCGW.

Source: Pippi (2013)

Table of User_Type by Tie_Bridge			
Controlling for Greenway_Name=White Oak Creek Greenway Gender=Male			
User_Type(User_Type)	Tie_Bridge(Tie_Bridge)		
Frequency Percent Row Pct Col Pct	no	yes	Total
Adolescent (As)	222 8.54 85.38 11.62	38 1.46 14.62 5.52	260 10.00
Adult (Ad)	1256 48.33 69.70 65.72	546 21.01 30.30 79.36	1802 69.33
Children (Ch)	396 15.24 81.99 20.72	87 3.35 18.01 12.65	483 18.58
Senior (Sn)	37 1.42 68.52 1.94	17 0.65 31.48 2.47	54 2.08
Total	1911 73.53	688 26.47	2599 100.00

When correlated both greenways in terms of results for the relation between user gender type and actor type, as presented in the previous four tables above, there were considerable differences of the scores for the *no occurrence* of ties/bridges, for the *occurrence of* ties/bridges and in both combined.

Within the *Female category* there was *non-occurrence* of ties/bridges mostly in the Children and Adult categories in the BCGW (Ch: with 81.12% and Ad: 80.) while in the WOCGW it was predominantly in the Adolescent category (As: with 82.44%). Within the *Male category* there was *non-occurrence* of ties/bridges predominantly in the Children and Adolescent

categories in the BCGW (Ch: with 83.75% and As: 79.74%) and also in the WOCGW for both of those categories but in opposite order (As: with 85.38% and As: with 81.99 %).

Within the *Female category* there was *occurrence* of ties/bridges predominantly in the Senior and Adolescent categories in the BCGW (Sn: with 37.50% and As: with 22,69%) and for the Senior and Adult categories in the WOCGW (Sn: with 39.13% and Ad: with 27.77%). Within the *Male category* there was greater *occurrence* of ties/bridges in the Senior and Adult categories in the BCGW (Sn: with 29.51% and Ad: with 21.12%) and also for the same categories in the WOCGW (Sn: with 31.48% and Ad: with 30.30%).

Within the *Female* category there was greater total frequency (combined datasets) mostly in the Adult and Children categories in the BCGW (Ad: with 85.35% and Ch: with 7.91%) and also the same categories in the WOCGW (Ad: with 78.08% and As: with 12.37%). Within the *Male category* there was greater total frequency in the Adult and Children categories in the BCGW (Ad: with 83.82% and Ch: with 9.13%) and also for the same categories in the WOCGW (Ad: with 69.33% and Ch: with 18.58%).

In this section, for the statistical analysis (SAS Enterprise Miner Workstation 12.1: decision trees, variable clusterings, clusters and regressions) the BCGW and the WOCGW were combined together (total of 10,205 observations) in orther to present the most global outcome available from this study.

Figure 120 illustrates the diagram of the two main decision trees that were used to characterize the data of the behavior mapping of the total of 10,205 observations, which were described in two instances (*original behavior* and the *greenway characteristics*) and in relation with the *presence of ties/bridges (yes and no occurrences, that is the target)*. The first decision tree consisted in the combination of different independent variable sets (*inputs: greenway type variable; greenway segments variable; temporal variables; people variables with exclusion of the transformative actor type and transformative actor size, and behavior variables) with the main-dependent variable (target: social interaction variable*) that was the

ties/bridges. The second decision tree consisted in the combination of different independent variable sets (*inputs: greenway type variable, greenway segments variable and greenway characteristics variable*) also with the main-dependent variable (*target: social interaction variable*) that was the ties/bridges.

For the diagram of the *two main-decision trees*, as shown in figure 121, some general properties were defined in advance, to be able to run the decision trees sucessfully. These were: for the *input data (left nodes)* train with role (raw), train output type (view), train return (no), train summarize (no), train drop map variables (yes); for the *data partition (middle node)*, train with randon seed (12345), data set allocation (training 70.0 and validation 30.0) and report (yes for the interval targets and yes for the class targets), and for the *decision tree (right node):* train with precision (4); splitting rule with: interval criterion (ProbF), nominal criterion (ProbChisq), ordinal criterion (Entropy), significance level (0.2), maximum branch (2), maximum depth (6), minimum categorical size (5) and split precision (4); node: leaf size (5), number of rules (5); subtree: method (assessment), number of leaves (1), assessment measure (misclassification) and assessment fraction (0.25). The data set in all the decision trees was portioned into two subserts: 70% for training, and 30% for validation.

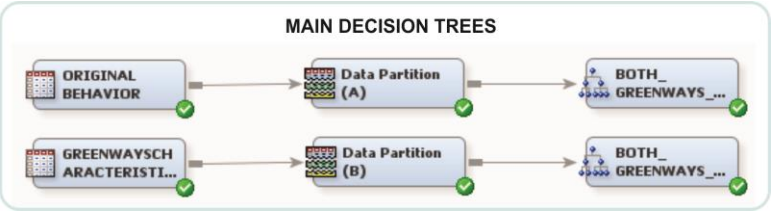


Figure 121: Diagram of the Two Main Decision Trees.

Source: Pippi (2013)

Figure 122 and tables 45, 46 and 47 illustrate the *classification results* only for the *original behavior* decision tree, which presents the effective relational patterns between the target with the selected set of independent variables groups, and also predicts a model in which the set of variables are used to classify the variable of interest. The second main decision tree, the *greenway characteristics*, failed to provide elucidative information of the variables' relations, and wasn't a good predictor in terms of providing precise probability for the possible outcomes, because the entire set of independent variables was rejected. The resulting tree, in figure 121, presented a total of 23 structural nodes that were divided into Training and Validation. The node 1 (root node) presented the total frequency of the ties/bridges (train and validation for no: with 76.6%; 7,141 observations and the train and validation for yes: with 23.4%; 3,064 observations). For the following nodes (pair nodes, leaves of the tree) outcomes were presented as every outcome of the decision tree, always with its own node pair. Each path of one of the leaves represent a decision (prediction) based on the variables defined as the input variables. In the leaves, the lower the yes/no, the more "dubious" is the node, because the average of ties/bridges within that node had a higher winning ratio (1.0000 or more) comparing to the other nodes. In this tree only the the bold lines, in the graph, showed the most important decision (prediction) path that was significant in order to differentiate between the ties/bridges interaction and behaviors, even though the other path presented also another decision (prediction).

It was essential to make a choice between the pair nodes, to be able to generate reliable conclusions. This was done by always following the bold lines and blue node (leaves), and with respect to the variables of importance and only accepting the nodes that presented a minimum count of 1.000 observations. According to the graph in figure 122, following the signinficant path, the node 3 showed the number and types of pattern of use/types of activities of the ties/bridges percentages in relation to the ties/bridges *no occurrence* and *occurrence*. This shows the outcomes for when people were utilizing the greenways for each type of activity (RDD, RLM, B, W, WDT, WT and WLM), in terms of the amount of *no occurrence* and *occurrence* of ties/bridges in the training data set (with 81.5% no and with

18.5% yes, and a total of 6,675 observations) and the validation data set (with 81.1% no and with 18.9% yes, and a total of 2,872 observations).

According to figure 122, among those pattern of use/types of activities (described in all the other nodes), the results for Individuals in node 6 tend to be lower in the *no occurrence* but higher in the *occurrence* of ties/bridges, if compared to the results of other actor types combined in node 7: Dyad (D), Triad (T) and Groups (G). For the Individuals (I) actor type, the amount of *no occurrence* and *occurrence* of ties/bridges was 76.1% no and 23.9% yes in the training data set (with a total of 2,949 observations) and 75.8% no and 24.2% in the validation data set (with a total of 1,255 observations). In the Dyad (D), Triad (T) and Groups (G) the amount of *no occurrence* and *occurrence* of ties/bridges was 85.7% no and 14.3% yes (with a total of 3,726 observations) in the training set and 85.3% no and 14.7% yes (with a total of 1,617 observations) in the validation set. As indicated in node 13, Individuals (I) tended to do the following types of activities: B, W, WT, R, WD and BD, with 73.9% no ties/bridges and 26.1% yes (with a total of 2,726 observations) in the training set and 73.8% no and with 26.7% yes (with a total of 1,108 observations) in the validation set. In this node, the no scores decreased and the yes scores increasead, if compared to the previous linked node. The description of each of the mentioned patterns of use/types of activities is illustrated in Appendices O and U.

As indicated in figure 122, for node 19, Individuals (I) tended to perform activities at different activity levels: Vigorous, Moderate and Sedentary (with 74.5% no ties/briges and 25.5% yes in the training set (with a total of 2,564 observations) and 74.4% yes and 25.6% no (with a total of 1,083 observations) for the validation set. The *no* scores increasead and the *yes* scores decreased, when compared to the previous linked node. On the other hand, node 14, which was linked to the previous node 7, presented the following types of activities: B, W, WDT, WT, RT, BT, R, PNE, SIT, WD, WSTRT, WR, ISK, RSTR, WDD, SKBT, OT, RSTPSTST, STTOL, EXST, WSTR, PNET, WDDT, SITTOPOL, SCTT, PEXSE, TOURWTSTPTP, SITTPTP, WTSTPSTLIS, which were more prevalent in the Dyad (D), Triad (T) and Groups (G) (87.5% no ties/bridges and 14.3% yes in the training set (with a

total of 3,726 observations versus 87.0% no and 13.0% yes in the validation set (total of 1,558 observations). The *no* scores increasead and *yes* scores results decreased, when compared to the previous linked node 7. The report of each of the stated pattern of use/types of activities is illustrated in Appendices O and U.

For both terminator blue nodes (leaves) 14 and 19 linked to the other leaves by the bold lines, the decision tree generated the output that described the scoring model with interpretable English Rules, about the relation of the pattern of use activity/type of activity (P_Use Activ) with the actor type categories (Actor_Type): for the node 14, if P_UseActiv is one of: B, W, WDT, WT, RT, BT, R, PNE, SIT, WD, WSTRT, WR, ISK, RSTR, WDD, SKBT, OT, RSTPSTST, STTOL, EXST, WSTR, PNET, WDDT, SITTOPOL, SCTT, PEXSE, TOURWTSTPTP, SITTPTP, WTSTPSTLIS, and Actor_Type is one of: DYAD (D), TRIAD (T), GROUP (G) or MISSING, then the Tree Node Identifier = 14, the Number of Observations = 3530; Predicted: Tie_Bridge=no = 0.88 and Predicted: Tie_Bridge=yes = 0.12. For the node 19, if P_UseActiv is one of: B, W, WT, R, WD, BD or MISSING, and P_ActLevel IS ONE OF: V, M, S and Actor_Type IS ONE OF: INDIVIDUAL (I), then the Tree Node Identifier = 19, Number of Observations = 2564, Predicted: Tie_Bridge=no = 0.75 and Predicted: Tie_Bridge=yes = 0.25. The explanation of each of the stated pattern of use/types of activities is illustrated in Appendices O and U.

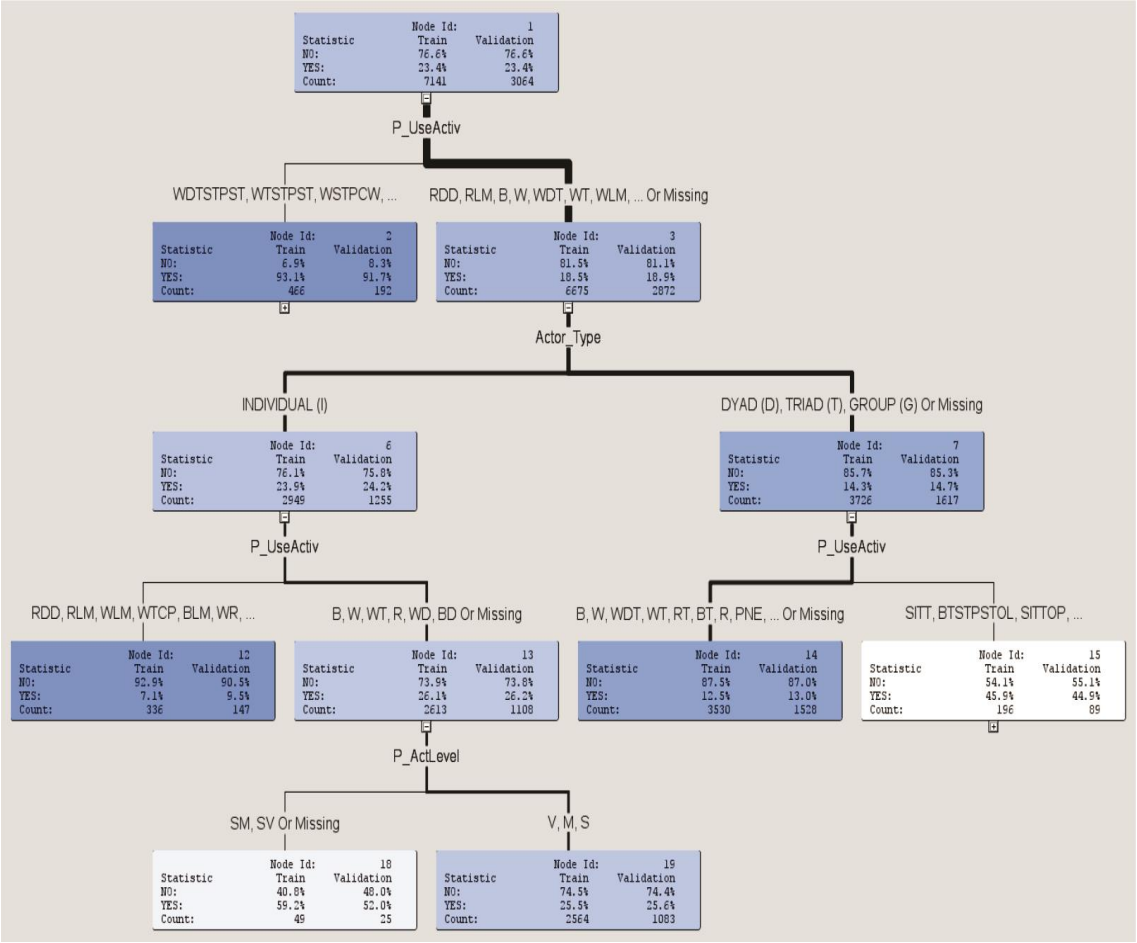


Figure 122: Decision Tree Diagram of the Potential Ties/Bridges Occurrence.
Source: Pippi (2013)

Table 45 presented the total summary for the *original behavior* selected variables, out of the global variables of the study, and presented information of the input, rejected and target variables and also their measurement level (interval or nominal) and frequency count.

Table 45: Variable Summary for the Original Behavior.

Source: Pippi (2013)

Variable Summary		
Role	**Measurement Level**	**Frequency Count**
Input	Interval	3
Input	Nominal	16
Rejected	Interval	31
Rejected	Nominal	40
Target	Nominal	1

Table 46 presents the group of six variables that were selected from the nineghteen variables (inputs) in terms of the best set variables that strongly associated with the target variable. In terms of the results for the variable of importance, the *P_UseActiv* variable (node 3) presented the highest score in terms of importance (1.0000) and ratio (1.0000) if compared to the following variables, the Actor Type (nodes 6 and 7) with the second score in terms of importance (0.2375) and ratio (1.0252), and the P_ActLevel (nodes 18 and 19) with the third variable in terms of importance (0.1413) and ratio (0.8575). Table 47 showed the fit statistical results for the *target: tie/bridge in relation to the original behavior variables*, that provided statistical information about: *sum of frequencies, misclassification rate* (it was selected the tree that has the smallest average misclassification rate)*, maximum absolute error, sum of squared errors, average squared errors* (it was selected the tree that has the smallest average square error)*, root average squared error, divisor for ASE and total degrees of freedom* for both train and validation.

Table 46: Variable Importance for the Original Behavior.

Source: Pippi (2013)

Variable Importance						
Obs	**Name**	**Label**	**N_Rules**	**Importance**	**V_Importance**	**Ratio**
1	P_UseActiv	P_UseActiv	3	1.0000	1.0000	1.0000
2	Actor_Type	Actor_Type	1	0.2375	0.2435	1.0252
3	P_ActLevel	P_ActLevel	1	0.1413	0.1211	0.8575
4	Week	Week	1	0.1252	0.1748	1.3959
5	Precipit_C	Precipit_C	1	0.1112	0.1168	1.0504
6	Actor_Size	Actor_Size	1	0.0894	0.0272	0.3041

Table 47: Fit Statistics for the Original Behavior.

Source: Pippi (2013)

Fit Statistics			
Target=Tie_Bridge Target Label=Tie_Bridge			
Fit Statistics	**Statistics Label**	**Train**	**Validation**
NOBS	Sum of Frequencies	7141.00	3064.00
MISC	Misclassification Rate	0.17	0.18
MAX	Maximum Absolute Error	0.95	0.95
SSE	Sum of Squared Errors	1950.66	859.12
ASE	Average Squared Error	0.14	0.14
RASE	Root Average Squared Error	0.37	0.37
DIV	Divisor for ASE	14282.00	6128.00
DFT	Total Degrees of Freedom	7141.00	.

Figure 123 illustrates the diagram process of the five clusters and regression analysis of the behavior mapping of the total of 10,205 observations, which were described in two instances (*original behavior* and the *greenway characteristics*) and in relation with the *presence of ties/bridges (yes and no occurrences, which is the target variable)*: each cluster and regression consisted in the analysis of the relation of the *main-dependent variable (target: social interaction variable)* with each of the different *independent variable sets* (*inputs: greenway type variable; greenway segment variable; temporal variables; people variables*

with exclusion of the transformative actor type and transformative actor size, and behavior variables).

As illustrated in the diagram in figure 123, for all the *cluster* analyses, a procedure-log, was created, where some general properties were defined in advance, to be able to run sucessfully the *clusters*: the train cluster variable role (segment); internal standardization (standardization); number of clusters with specification method (user specify) and maximum nimber of clusters (6), and score cluster variable with score (segment).

Results presented information about the output of each cluster: *segment size, segment identity, cluster distance plot, segment plot, variable summary, variable importance and mean statistics*. The *cluster distance* presents the distances between the created cluster means that are summarized in the cluster plot according to their size, relationship and distances. The asterisk represents the cluster centers and the radii are represented by circles. One asterisk represents a cluster that comprises only one case. Each cluster radius depends of the distance in that cluster related to its distribution in relation with other clusters. The *segment plot*, presents the graphic description of each segment (clustering) in the data set and presents information of the variables with superior importance scores. However, not all the variables will appear in the segment plot. The input cluster variables that presented a score of zero are the nondiscriminating variables which are not included because they did not contribute to the clustering. The *variable importance* shows a table with the selected variables, containing the information about the number of splitting rules, number of surrogate rules, and importance of each variable (SAS Institute Inc., 2012).

For all the *regression* analyses, illustrated in the diagram in figure 123, a procedure-log was created, with some general properties defined in advance, to be able to run sucessfully the *regressions*: train with class targets regression stype (logistic regression); link function (logit), model options with input coding (deviation); model selection with selection model (stepwise) and selection criterion (default) and use selection defaults use (yes); output options (no); score secluded variables (reject).

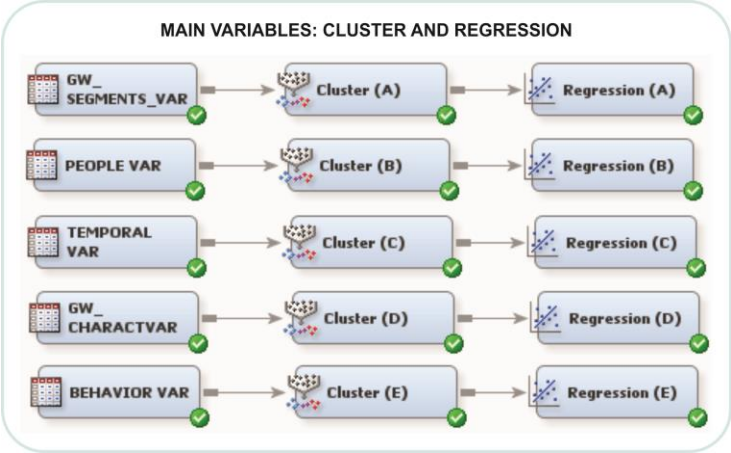


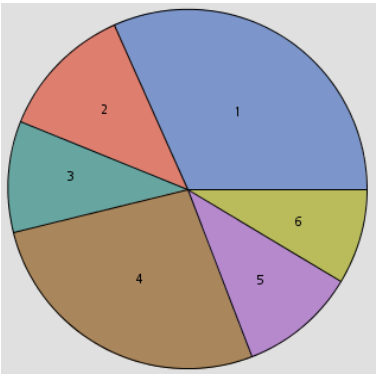
Figure 123: Diagram of the Five Main Variables with Cluster and Regression.
Source: Pippi (2013)

As indicated in the figure 123 above, the *Cluster A and Regression A* utilized the following variable analysis *(target: social interaction variable)* with each of the different *independent variables sets* (*inputs: greenway type variable and the greenway segments variable)*.

Figure 124 presents the information of the segment size, identity and the cluster distance, followed by the description of each cluster frequency. The chart respresnts the 6 segments (clusterings) in which segments 1 and 4 presented higher frequencies (s1: with 32.32% and s4: with 27.43%) followed by segments 2, 5, 3 and 6 (s2: with 12.55%, s5: with 10.59%, s3: with 10.25% and s6: with 8.91%). The cluster distance chart presents the graphic characterization of each of the six segments (clusters) in terms of cluster distance and cluster sistance plot: the nearest segment to the segment 1 is the segment 2; for segment 1 it is the segment 1; for segment 3 it is the segment 1; for the segment 4 it is the segment 5; for the segments 5 and 6 it is the segment 4). Segments 4, 5 and 6 presented a congregating dimension of 1 to the left (-1.0 to -0.5) if compared to the other clusters that were congregated 1 to the right (0.5 to 1.0). In terms of dimension 2, the segments were

distributed in the graph segment 4 (0.5), segments 6 and 5 (-0.2), segment 2 (0.7), segment 1 (-0.1) and segment 3 (-0.9).

Segment Size and Segment Id **Cluster Distance Plot**



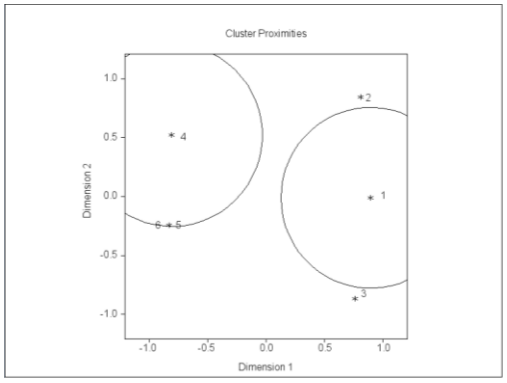


Figure 124: Chart and Plot of Cluster A.
Source: Pippi (2013)

The *Segment plot* in Appendix V, shows the results of each of the six segments (identification and frequency) related to the selected input variables (*greenway type variable and the greenway segments variable*) as illustrated in table 48, by the output for the variable summary for cluster A, in relation to the target variable *(social interaction variable: social ties/bridges*). The output is the variable of interest that defines the cluster. Table 49 illustrated the output results for the elected *variables of importance*, in which the segment input variable presented the highest level of importance (1.00000) followed by the greenway type (0.52168). The *first segment plot* presented results for the *greenway type variables*, which consisted in the segment variables 1, 2 and 3 for the BCGW that presented a percent sum of 100% and the segments variables 4, 5 and 6 presented equivalent score for the WOCGW. The *second plot* presented more interesting scores for the *greenway segment*

type variables, because they differed for each cluster and also provided scores for the 8 greenway segments (segments 1, 2, 3 and 4 for the BCGW and segments 5, 6, 7 and 8 for the WOCGW). The segment variable 1 presented scores for the BCGW segments 4 and 1 (s4: with percent sum of 55.72% and s1: with percent sum of 44.27%), the segments variable 2 followed by segment variable 3 presented for the BCGW segments 2 and 3 the same higher score (with percent sum of 100.00% each). The segment variable 4 presented a higher score for the WOCGW in segment 5, followed by segment 7 (s5: with 47.24% and s5: with 52.75%) and the segment variable 5 folowed by segment variable 6 presented for the WOCGW segments 8 and 6 the same higher score (with percent sum of 100.00% each).

Table 48: Variable Summary for Cluster A.

Source: Pippi (2013)

Variable Summary		
Role	**Measurement Level**	**Frequency Count**
Input	Interval	2
Rejected	Interval	35
Rejected	Nominal	34

Table 49: Variable Importance Report Output for Cluster A.

Source: Pippi (2013)

Variable Importance				
Name	**Label**	**N_Rules**	**N_Surrogates**	**Importance**
Segment	Segment	4	1	1.00000
Greenway_Name	Greenway_Name	1	1	0.52168

In *Regression A*, table 50 shows the two independent variables selected as inputs (*greenway type variable and the greenway segments variable*), in relation to the target variable *(social interaction variable*: *ties/bridges*) to be able to predict the probability of the target variable as dependent of those particular independent variables. Of all subsets of independent variables, table 51 shows that in terms of the *3 analyses of effects for regression*, the segment 7 (WOCGW) was the only one that presented Pr>ChiSq, <.0001.

Table 50: Measurement Frequency for Regression A.

Source: Pippi (2013)

Variable Summary		
Role	**Measurement Level**	**Frequency Count**
Input	Interval	2
Rejected	Interval	36
Rejected	Nominal	35
Target	Nominal	1

Table 51: Type 3 Analysis of Effects for Regression A.

Source: Pippi (2013)

Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr>ChiSq**
Segment	7	90.0490	<.0001

Table 52 showed the regression results in terms of the *odds ratio estimates*, which consist in a measure of the characteristics and strength of an association, helping with the understanding of the associations implied in the stepwise model of the logistic regression. The results showed only the association between the segments, and rejected the comparison between the greenway types. The most important results in the point of estimates are the scores less than 1 (< than 1). The value tells about the percentages that are compared with each of the selected sub-set variables (within the selected independent variable category), represented by segments (1, 2, 3, 4, 5, 6 and 7) with the last sub-set variable, in this case the segment 8, because it was the last category; it shows the likelihood of the previous different segments having ties/bridges occurrence if compared to segment 8. In terms of ties/bridges interaction: in the segment 1 (BCGW), in relation of segment 8 (WOCGW), has less likelihood of presenting ties/bridges interactions (with 59.00%) than the segment 8; the segment 2 (BCGW) has less likelihood of presenting the ties/bridges interactions (with 61.00%) than the segment 8 (WOCGW); segment 3 (BCGW) has less likelihood of presenting the ties/bridges interactions (with 64.00%) than the segment 8 (WOCGW); the segment 4 (BCGW) has less likelihood of presenting the ties/bridges interactions (with 53.00%) than the segment 8 (WOCGW); the segment 5 (WOCGW) has less likelihood of presenting the ties/bridges interactions (with 91.00%) than the segment 8 (WOCGW); the segment 6 (WOCGW) has less likelihood of presenting the ties/bridges interactions (with 57.00%) than the segment 8 (WOCGW), and the segment 7 (WOCGW) has less likelihood of presenting the ties/bridges interactions (with 78.00%) than the segment 8 (WOCGW). In summary, segments 4 (BCGW) and 6 (WOCGW) presented more likelihood and segment 5 (WOCGW) the least likelihood to have interactions then the other segments if compared to segment 8.

Table 52: Odds Ratio Estimates for Regression A.

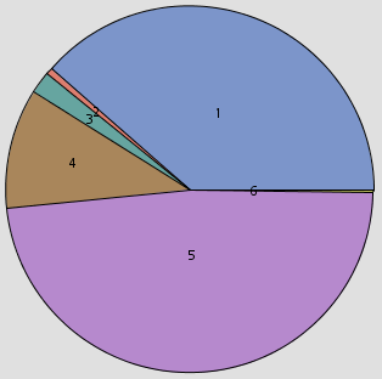
Source: Pippi (2013)

Odds Ratio Estimates			
Effect		**Tie_Bridge**	**Point Estimate**
Segment	S1 vs S8	yes	0.594
Segment	S2 vs S8	yes	0.619
Segment	S3 vs S8	yes	0.649
Segment	S4 vs S8	yes	0.530
Segment	S5 vs S8	yes	0.912
Segment	S6 vs S8	yes	0.578
Segment	S7 vs S8	yes	0.788

As indicated in the figure 125, the *Cluster B and Regression B* established the following variables analysis *(target: social interaction variable)* with each of the different *people independent variables* (*inputs: gender type variables, actor size variables, actor type variables and user age type variables*).

Figure 125 presents the information of the segment size, identity and the cluster distance, followed by the description of each cluster frequency for the *Cluster B.* The chart respresnts the 6 segments (clusterings) in which segments 5 and 1 presented the higher frequencies (s5: with 49.17% and s1: with 39.53%) followed by segments 4, 3, 2 and 6 (s4: with 10.67%, s3: with 2.12%, s3: with 0.41% and s6: with 0.15%). The cluster distance chart presents the graphic characterization of each of the six segments (clusters) in terms of cluster distance and cluster sistance plot: the nearest segment to the segment 1 is segment 5; for segment 2 it is the segment 6; for segment 3 it is the segment 6; for the segment 4 it is the segment 5; for the segment 5 it is the segment 1 and for the segment 6 it is the segment 3). Segment 2 presented a more distant dimension 1 (30-32) if compared to the other clusters that were more congregated in terms of dimension 1 (-10 to 0). In terms of dimension 2 all segments were in the almost in the same allocation, the segments 3, 1 and 6 (0) and segments 4 and 5 (2 to 3).

Segment Size and Segment Id **Cluster Distance Plot**



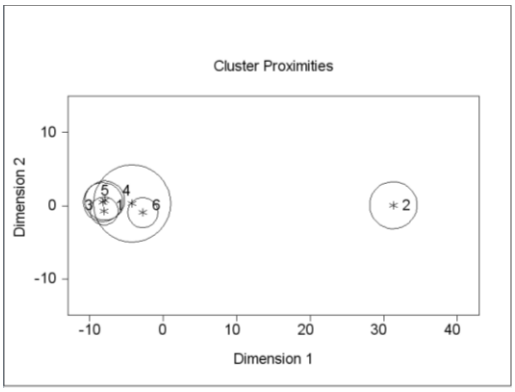


Figure 125: Chart and Plot of the Cluster B.
Source: Pippi (2013)

The *Cluster B* Segment plot, in Appendix V, shows the results of each of the six segments (identification and frequency) related to the selected input *people variables* (*gender type variable, actor size, actor type and user type*) as illustrated in table 53, by the output for the variable summary for the cluster B, relative to the target variable *(social interaction variable: social ties/bridges*). Table 54 illustrated the output results for the elected *variables of importance*, in which the Gender input variable presented the highest level of importance (1.00000) followed by the actor size (0.95116), actor type (0.94846) and then user type (0.27910). The *first plot* presented results for the *actor size variable* and presented results for the Group sizes between 1:6 people with higher frequency in segments 1, 3 and 5 (with 100.00% each), followed by segments 4 and 6 (s4: with 84.53% and s6: with 53.33%). The Group sizes between 34:41 people only occurred in the segment 2 (s2: with 100%). The Group sizes between 11:16 people only occurred in segments 6 with low frequency and 4 with lower frequency in segment 4 (s6: with 13.33% and s4: with 0.93%). The Group category of size between 6:11 people occurred only in segment 6 with moderate percentage

and 4 with low percentages (s6: with 33.33% and s4: with 12.65%). The group category with size between 16:21 people occurred only in segment 4 with lower percentage (s4: with 1.87%).

The *second plot*, in Appendix V, presented results for the *actor type variable* and presented superior frequency for the Group category in segments 2, 4 and 6 (with 100% each). The next category with moderate results was the Dyad category that presented superior frequencies in segments 3 and 2 (s3: with 54.71% and s1: with 44.75%) and inferior frequency in segment 5 (s5: with 30.77%). The Individual category also presented moderate frequencies that was more evident in segment 5 followed by segment 1 and then segment 3 (s5: with 55.88%, s1: with 41.48% and s3: with 36.79%). The Triad category presented the lowest frequencies that were similar in segments 1 and 5 and followed by segment 3 (s1: with 13.76%, s5: with 13.34% and s3: with 8.49%). The third plot, consisted in the *Gender variable* that presented very similar and balanced results for the Male and Female categories. The Female category presented higher percentage in segment 1 (with 100%) followed by moderate percentages respectively in segments 6, 2, 3 and 4 (s6: with 53.33%, s2: with 51.22%, s3: with 50.00% and s4: with 45.37%). The Male category presented higher frequencies in segment 5 (with 100.00%) followed by moderate frequencies respectively in segments 4, 3, 2 and 6 (s4: with 54.63%, s3: with 50.00%, s2: with 48.78% and s6: with 46.67%).

The *fourth plot*, in Appendix V, presented results for the *user age type variable*. The Senior category only occurred in three segments and presented superior frequency in segments 3 and 6 (with 100% each) and inferior frequency in segment 2 (with 12.19%). The Adult category presented also higher frequencies in segments 1 and 5 (s1: 87.80% and s5: with 83.30%) and moderate frequencies in segment 2 and 4 (s2: with 51.21% and s4: with 47.51%). The Children category presented moderate frequencies in segments 4 and 2 (s4: 37.48% and s2: 21.95%) and low percentages in segments 5 and 1 (s5: 10.45% and s1: 7.38%). The Adolescent category presented low and similar frequencies for segments 4 and

2 (s4: with 14.99% and s2: with 14.65%) and low frequencies in segments 5 and 1 (s5: with 6.24% and s1: with 4.80%).

Table 53: Variable Summary for Cluster B.

Source: Pippi (2013)

Variable Summary		
Role	**Measurement Level**	**Frequency Count**
Input	Interval	1
Input	Nominal	3
Rejected	Interval	35
Rejected	Nominal	34

Table 54: Variable Importance Report Output for Cluster B.

Source: Pippi (2013)

Variable Importance				
Name	**Label**	**N_Rules**	**N_Surrogates**	**Importance**
Gender	Gender	1	0	1.00000
Actor_Size	Actor_Size	1	2	0.95116
Actor_Type	Actor_Type	1	1	0.94846
User_Type	User_Type	2	0	0.27910

In the *Regression B*, table 55 shows the four independent variables selected as inputs (*gender type variable, actor size, actor type and user type*), in relation to the target variable *(social interaction variable*: *ties/bridges*) to be able to predict the probability of the target variable as dependent of those particular categories of independent variables.

Table 55: Measurement Frequency for Regression B.

Source: Pippi (2013)

Variable Summary		
Role	**Measurement Level**	**Frequency Count**
Input	Nominal	3
Rejected	Interval	36
Rejected	Nominal	34
Target	Nominal	1

Overall the four independent variables, table 56 shows that in terms of the *3 analysis of effects for the regression*, the Actor Type and User Type presented Pr>ChiSq: <.0001, the Actor Size presented Pr>ChiSq: 0.0047 and the Gender Type was eliminated.

Table 56: Type 3 Analysis of Effects for Regression B.

Source: Pippi (2013)

Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr>ChiSq**
Actor_Size	1	7.9931	0.0047
Actor_Type	3	24.7170	<.0001
User_Type	3	21.3477	<.0001

The table 57 shows the regression outcomes in terms of the *odds ratio estimates*. The items selected in red in the table, failed in providing the association between the sub-set variables and also probability, because they presented values superior of 1 (100.00%). The actor size did not showed the association between the different sizes even thought presented a score of 0.920 (< than 1) with (with 92.00%). The results showed only the association between the actor types and user types, and rejected the comparison between the actor size types. The most important results in the point of estimates is the scores less than 1 (< than 1) and also rejected the association between two sub-set categories of the actor type category: the Actor_Type Individual (I) with Triad (T) and the Actor_Type Diad (D) with Triad (T) that presented a value superior than 1, respectively with 1.379 and 1.022. The value tells

about the percentages that are compared with each of the selected sub-set variables (within the selected independent variable category), represented by: actor types such as Individual, Dyad and Group (I, D and G) with the last sub-set variable, in this case the Triad (T), because it was the last category and for the user types, such as Children, Adolescent and Adult (Ch, As and Ad) with the last sub-set variable, in this case the Senior (Sn), which shows what is the likelihood the previous different segments of having ties/bridges occurrence if compared respectively to Triad (T) and then for Senior (Sn). In terms of ties/bridges interaction for the actor type: theGroup (G) in relation to Triad (T), has less likelihood of presenting the ties/bridges interactions (with 99.00%). and the Individual (I) has less probability of presenting the ties/bridges interactions (with 61.00%) than the Triad (T). In terms of ties/bridges interaction for the actor type: the Adolescents have less probability to interact (with 46.00%) than Seniors, the Adults and Children have moderate probability to interact (with 54.00% each) than the Seniors. If compared to the observations in the behavior mapping even though the Seniors presented the lower scores (number of observaqtions in both greenways) they was the category of the user type by age that interact most.

Table 57: Odds Ratio Estimates for Regression B.

Source: Pippi (2013)

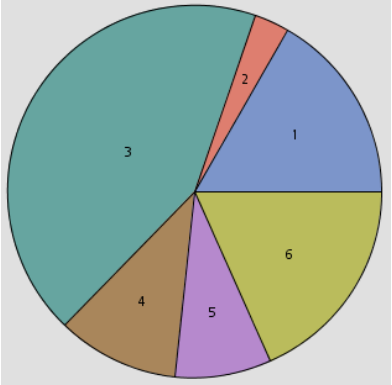
Odds Ratio Estimates		
Effect	**Tie_Bridge**	**Point Estimate**
Actor_Size	yes	0.920
Actor_Type Dyad (D) vs Triad (T)	yes	1.022
Actor_Type Group (G) vs Triad (T)	yes	0.995
Actor_Type Individual (I) vs Triad (T)	yes	1.379
User_Type Adolescent (As) vs Senior (Sn)	yes	0.464
User_Type Adult (Ad) vs Senior (Sn)	yes	0.541
User_Type Children (Ch) vs Senior (Sn)	yes	0.547

As indicated in the figure 126, the *Cluster C and Regression C* utilized the following variables analysis *(target: social interaction variable)* with each of the different *temporal independent variables sets* (*inputs: week variables, period of day variables and weather condition variables)*.

The figure 126 below demonstrates the information of the segment size, identity and the cluster distance, followed by the report of each cluster frequency in *Cluster C*. The chart respresnts the 6 segments (clusterings) in which segment 3 presented the greater frequency (s3: with 43.93%) followed by segments 6 and 1 with moderate frequencies (s6: with 18.83% and s1: with 17.12%) and with lower frequencies the segments 5 and 2 (s5: with 8.37% and s2: with 2.98%).

The cluster distance chart, also in figure 126, presents the graphic information of each of the six segments (clusters) classification in terms of cluster distance and cluster sistance plot: the nearest clusters (for the segment 1 is the segment 6; for segment 2 is the segment 4; for segment 3 is the segment 1; for the segment 4 is also the segment 1; for the segments 5 the segment 3 and for the segment 6 is the also the segment 1), distance to near clusters. In terms of the dimension 1, segments 4 and 5 presented a congregating dimesion in the extreme sides (-4) if compared to the other clusters. Segment 6 (-11) situated in the right side. Segment 1 (-2), segment 2 (4) and segment 3 (7) that were congregated in the middle area (0.5 to 1.0). In terms of dimension 2 the segments were distributed in the graph segments 4 and 5 are similar (-4), segment 2 (-3), segment 6 (2) and segments 1 and 3 were similar (5).

Segment Size and Segment Id **Cluster Distance Plot**



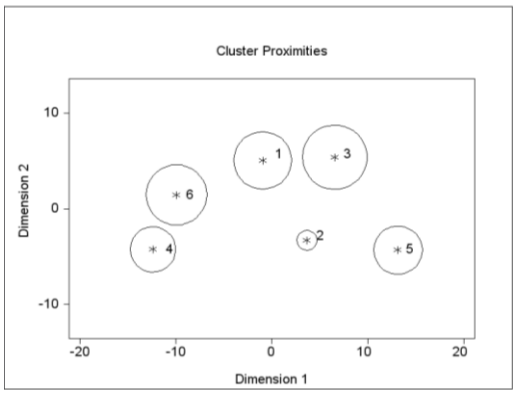


Figure 126: Chart and Plot of the Cluster C.
Source: Pippi (2013)

The *Cluster C segment plot*, in Appendix V shows the results of each of the six segments (identification and frequency) related to the selected input *temporal variables* (*week variables, period of day variables and weather condition variables*) composed by 8 inputs sub-set of variables (four interval and four nominal) as illustrated in the table 58, by the output for the variable summary for the *Cluster C*, relative to the target variable *(social interaction variable: social ties/bridges*). The table 59 illustrated the output results for the elected *variables of importance*, in which the Wind input variable presented the highest level of importance (1.00000) followed by the High Temp (0.89527), Low Temp (0.85384) and Weather (0.83079) and with moderate level the Humindity (0.78476) followed by Week (0.65264) and Precipitation C. (0.54249) and with the lowest value the Period_Day (0.14949). The categories of *high temperature, humidity, low temperature, precipitation likelihood, weather* and *wind* presented plots with more diversity of sub-set categories for each segments. The categories of *period of day* and *weekend* presented plots with more stable sub-set of categories in the segments.

Table 58: Variable Summary for Cluster C.

Source: Pippi (2013)

Variable Summary		
Role	**Measurement Level**	**Frequency Count**
Input	Interval	4
Input	Nominal	4
Rejected	Interval	31
Rejected	Nominal	32

Table 59: Variable Importance Report Output for Cluster C.

Source: Pippi (2013)

Variable Importance				
Name	**Label**	**N_Rules**	**N_Surrogates**	**Importance**
Wind	Wind	0	7	1.00000
Hightemp	Hightemp	2	3	0.89527
Lowtemp	Lowtemp	0	4	0.85384
Weather	Weather	2	3	0.83079
Humidity	Humidity	1	3	0.78476
Week	Week	1	0	0.65264
Precipit_C	Precipit_C	1	1	0.54249
Period_Day	Period_Day	1	0	0.14949

The Appendix V show the different plots for *Cluster C,* the *first plot* presented results for the *high temperature variable* and presented outcomes for the different ranges of high temperatures. In the category of temperature of 55F-58F, in segment 5 presented the highest frequency (s5: with 100.00%), moderate frequency in segment 3 and low frequency in segment 1 (s3: with 17.25% and s1: with 6.48%). Segment 2 presented the highest frequency for the 70F-74F temperature (s2: with 100.00%) The category of temperature of 82F-86F presented also a high frequency in segment 4, but a moderate-low frequency in segment 6 (s4: with 66.73% and s6: with 16.25%). The segment 1 presented a moderate frequency in temperature of 74F-78F and a low frequency for the 66F-77F temperature (s1: with 38.37% and 9.57%). Segment 3 presented a moderate frequency for the 62F-66F

temperature (s3: with 37.00%). Segment 6 presented for the temperature of 74F-78F a low percentage (s6: with 7.27%).

The *second plot*, in Appendix V, presented results for the *humidity variable*. However, it was difficult to interpret the results, because of the description with only numbers of each sub-set categories formatted values in the legend. Generaly, the segment 2 presented the superior frequency; the segments 1, 4, 5 and 6 presented moderate frequencies, and the segment 3 presented the more diversity among the sub set categories. The *third plot*, consisted in the *low temperature variable* that presented ore diversity of the sub-set categories in segments 3 and 6. The higher percentage in the segment 2 for the 48F-53F temperature, in segment 4 for the 57F-62F temperature and for the segment 5 for the 43F-48F temperature. The low-moderate temperature occurred for the 67F-72F in segment 6 and for lowest temperature for the 48F-53F in segment 3 (s6: with 16.25% and s3: with 9.65%). The *fourth plot*, presented results for *period of day variable*, all the sub-set categories is very balanced in terms of the results in the overall plot. The morning presented respectively a moderate frequency in the segment 4 and a low frequency in the segment 1 (s4: with 41.49% and s1: with 25.40%); the afternoon presented respectively the moderate frequency in the segment 6 and the moderate-low frequency in segment 1 (s6: with 40.41% and s1: with 19.45%), and the evening presented the highest score of all the subset categories, all the segments and also in the segment 1 (with 55.14%) and presented a medium score in the segment 6 (with 28.57%).

The *fifth plot*, in Appendix V, presented results for the *precipitation likelihood variable*. However, it was problematic to interpret the results, because of the description with only numbers of each sub-set categories formatted values in the legend. Generaly, the segment 2 presented the superior frequency; the segments 3, 4, 5 and 6 presented moderate frequencies, and the segment 1 presented the more diversity among the sub set categories and also the lowest frequencies. The *sixth plot*, presented results for the the *weather variable,* that presented more diversity of the sub-set categories in segments 1, 3 and 6. The raynny sub-set category presented the highest frequency and only occurred in segment 2

(s2: with 100.00%). The cloudy sub-set category presented the highest frequency in segment 4 and a low frequency in segment 3 (s4: with 100.00% and s3: with 18.82%). The sunny sub-set category presented repectivaly the highest frequency in the segment 6 and a low frequency in segment 1 (s6: with 76.47% and s1: with 18.86%). The partly sunny sub-set category presented a moderate frequency in segment 1 and a low frequency in segment 6 (s1: with 27.40% and s6: with 16.25%). The partly cloudy presented repectivaly the highest frequency in the segment 5 and a low frequency in segment 6 (s5: with 100.00% and s6: with 7.27%).

The *seventh plot*, in Appendix V, presented results for the the *week variable,* that presented both sub-set categories (weekday and weekends) in segments 3 and 5. The weekday sub-set category presented the highest frequencies in segments 1 and 6 (s1 and s6: with 100.00% each) and presented the lowest frequency in segment 3 (s3: with 4.41%). The weekend sub-set category presented the highest frequencies in segments 2, 4 and 3 (s2: with 100.00%, s4: with 100.00% and s3: with 95.58%) and presented a moderate frequency in segment 5 (s5: with 66.30%). The *eighth plot*, in Appendix V, showed results for the the *wind variable,* that presented the segment 1 presented more diversity among the sub-set categories and also with the lower frequencies in segments 1 and 6. However, some sub-set categories were not showed noticeably in the plot graph, probably because it presented the lowest frequencies only in bold lines or lines. It it only be presented the results for the noticeably sub-set categories. The NNe 5 to 10 mph sub-set category presented respectively a highest frequency in segment 2 and a low frequency in segment 1 (s2: with 100.00% and s1: with 9.57%). The NNE at 9 mph sub-set category presented a high-moderate frequency and only occurred in segment 4 (s4: with 66.30%). The NNE at 10 to 20 mph sub-set category presented also high-moderate frequency and only occurred in segment 5 (s5: with 66.30%). The SSE at 10 to 15 mph only was present with moderate frequency in segment 1 (s1: with 24.24%); also only presented in segment 1 and with moderate frequency the SSE at 10 to 20 mph sub-set category (s1: 20.91%). With moderate result and moderate-low frequency was the SW at 5 to 10 mph sub-set category in segment 1 (s1: with 24.96% and 14.13%). Also with moderate-loe frequency was the SW at 3 to 8

mph sub-set category that was present only in segment 1 (s1: with 15.36%). The ENE at 5mph sub-set category with moderate-low frequency only was encountered in segment 6 (s6: with 20.23%), and occurrence in the same segment, but with moderate frequency was the NW at 5mph sub-set category (s6: with 20.23%). N at 20 to 30 mph was presented with moderate-low frequencies in segments 3 and 6 (s3: with 18.82% and s6: with 16.25%). NWW at 3 to 10 was encountered in segments 6 and 1 with low frequencies (s6: with 10.72% and s1: with 9.28%). The NNE at 8 mph presented the lowest scores if compared to all the other sub-set categories and was presented respectively in segments 1 and 3 (s1: with 6.48% and s3: with 4.41%).

In the *Regression C*, table 60 shows the independent variables selected as inputs (*week variables, period of day variables and weather condition variables*), in relation to the target variable *(social interaction variable*: *ties/bridges*) to be able to predict the probability of the target variable as dependent of those particular independent variables. The other independent variables were rejected.

Table 60: Measurement Frequency for Regression C.
Source: Pippi (2013)

Variable Summary		
Role	**Measurement Level**	**Frequency Count**
Input	Interval	4
Input	Interval	4
Rejected	Nominal	32
Rejected	Nominal	33
Target	Nominal	1

Of the four independent variables, table 61 shows the *3 analyses of effects for the regression*, in which were selected the Period of Day, Week and Wind variables that presented Pr>ChiSq: <.0001.

Table 61: Type 3 Analysis of Effects for Regression C.

Source: Pippi (2013)

Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr>ChiSq**
Period_Day	2	30.4401	<.0001
Week	1	21.3407	<.0001
Wind	18	124.0103	<.0001

Table 62 showed the regression outcomes in terms of the *odds ratio estimates*. The items selected in red in the table failed to provide an association or probability between the sub-set variables, because they presented values superior to 1 (100.00%). The results showed only the association between the *period of day* types, *week* types and *wind* types. The most important results in the point of estimates are the scores less than 1 (< than 1) and all the other associations, highlighted with red, were rejected because they presented scores superior to 1. In terms of ties/bridges interaction for the *period of day* types: the Afternoon period has less probability to present interaction than the morning period (with 81.00%), and the evening period has also less probability to present interactions than the morning period (with 73.00%). Morning periods presented the highest incidence of interactions and the evening presented the second period with incidence of interactions and the afternoon the period with the lowest incidence. In terms of ties/bridges interaction for the *week* types: weekdays have less probability to present interactions than weekends (with 44.00%). In terms of ties/bridges interaction for the *wind* types: five sub-set categories presented the high scores with less probability to present interaction than the last wind category (WNW at 5 to 10 mph) these sub-set categories scores were: Wind NW at 5 mph (with 99.00%), Wind SW at 3 to 8 mph (with 95.00%), Wind NNE at 5 to 10 mph (with 93%), Wind NE at 3 mph (with 92.00%) and Wind N at 20 to 33 mph (with 91.00%). The other five sub-set categories presented the moderate scores with less probability to present interaction than the last wind category (WNW at 5 to 10 mph) these sub-set categories scores were: Wind NNE at 9 mph (with 88.00%), Wind NNE at 10 to 20 mph (with 87.00%), Wind NNE at 12 to 21 mph (with 68.00%), Wind ENE 5 to 10 mph (with 53.00%) and Wind NNE 5 to 10 mph (with 51.00%),

which means that the lower the score frequency the more probability of interaction occurrence.

Table 62: Odds Ratio Estimates for Regression C.

Source: Pippi (2013)

Odds Ratio Estimates		
Effect	**Tie_Bridge**	**Point Estimate**
Period_Day Afternoon vs Morning	yes	0.819
Period_Day Evening vs Morning	yes	0.734
Week Weekday vs Weekend	yes	0.449
Wind ENE 5 to 10 mph vs WNW at 5 to 10 mph	yes	0.533
Wind ENE at 5 mph vs WNW at 5 to 10 mph	yes	2.134
Wind N at 20 to 30 mph vs WNW at 5 to 10 mph	yes	1.081
Wind N at 20 to 33 mph vs WNW at 5 to 10 mph	yes	0.918
Wind N at 5 to 8 mph vs WNW at 5 to 10 mph	yes	1.540
Wind NE at 3 mph vs WNW at 5 to 10 mph	yes	0.927
Wind NNE 5 to 10 mph vs WNW at 5 to 10 mph	yes	0.512
Wind NNE at 10 to 20 mph vs WNW at 5 to 10 mph	yes	0.877
Wind NNE at 12 to 21 mph vs WNW at 5 to 10 mph	yes	0.689
Wind NNE at 5 to 10 mph vs WNW at 5 to 10 mph	yes	0.939
Wind NNE at 8 mph vs WNW at 5 to 10 mph	yes	1.740
Wind NNE at 9 mph vs WNW at 5 to 10 mph	yes	0.887
Wind NNW at 3 to 10 mph vs WNW at 5 to 10 mph	yes	1.587
Wind NW at 5 mph vs WNW at 5 to 10 mph	yes	0.991
Wind SSE at 10 to 15 mph vs WNW at 5 to 10 mph	yes	1.483
Wind SSE at 10 to 20 mph vs WNW at 5 to 10 mph yes	yes	1.494
Wind SW at 3 to 8 mph vs WNW at 5 to 10 mph	yes	0.956
Wind SW at 5 to 10 mph vs WNW at 5 to 10 mph	yes	2.015

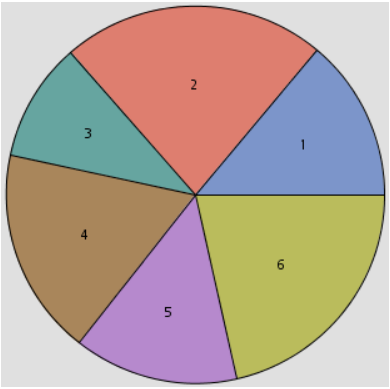
As indicated in figure 127, the *Cluster D and Regression D* analyzed the *social interaction variable as target* with each of the different *greenway characteristics independent variables* (*inputs: activity node configuration, activity node surface type, activity node usage type, bycicle post racks, connectivity to conventional parks, fresh pond wetland area ac,*

freshwater forest shrub wetland, greenway structural connection with, heavily wood forest area ac, lake wetland area ac, lightly wood forest area ac, maintained grassy open field area ac, number sheds, number benches, number of bollard posts, number of bridges, number of directional signs, number of drinking fountains, number of exercise stations, number of fences, number of information kiosks, number of information panels, number of information signs, number of kiosks, number of lighting posts, number of monuments, number of pedestrian and biker cross walk, number of picnic tables, number of playgrounds, number of ramps, number of tunnels, number of walking boards, open meadow area ac, riparian vegetation 30 foot wide, segment destination configuration, segment layout type, segment length mile, segment physical barrier with connection, segment trail pavement markings, segment trail surface type and use related and associated with activity node type).

Figure 127 demonstrates the information of the segment size, identity and the cluster distance, followed by the report of each cluster frequency in *Cluster D*. The chart respresents the 6 segments (clusterings) in which segment 1 presented the greatest frequency (s1: with 22.80%) followed by segments 6 and 4 with moderate frequencies (s6: with 21.87% and s4: with 14.47%) and segments 5 and 1 with similar lower moderate frequencies (s5: with 14.31% and s1: with 14.47%).

The cluster distance chart, also in figure 127, presents the graphic characterization of each of the six segments (clusters) in terms of cluster distance and cluster sistance plot: the nearest cluster for the segment 1 was the segment 2; for segment 2 it was segment 6; for segment 3 it was segment 2; for segment 4 it was also segment 6; for segments 5 2 and 6 was segment 2.. In terms of the dimension 1, on the right side of the plot, the segment 1 was situated very distant from the other segments (380). On the left side of the plot, the segments 5 and 6 were in the same position (-100), followed by segment 2 (-90), segment 4 (-70) and segment 3 (-50). In terms of dimension 2 the segments showed a larger distribution in the graph, with segments 5 and 6 presenting lower scores (-30 and -20), followed by segments 1 (10), 2 (20), and finally segments 3 and 4 (30 and 50) with higher scores.

Segment Size and Segment Id **Cluster Distance Plot**



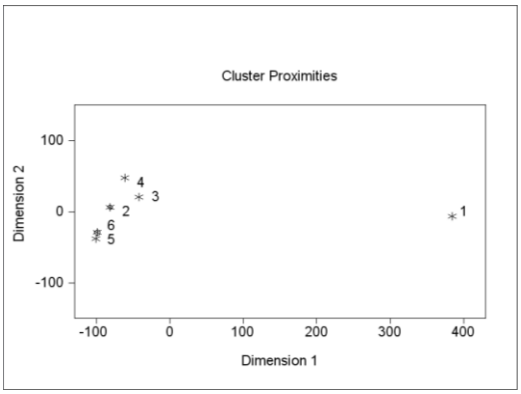


Figure 127: Chart and Plot of Cluster D.
Source: Pippi (2013)

The segment plot in Appendix V did not provided legend of the sub-set categories in relation to the segments. All the graphs presented insignificant results and could not be analyzed. This model needs to be refined with a reduced set of variables in order to better enable the clustering association and classification according to the variables.

Table 63 shows the variable summary for the cluster D that illustrates the utilized variables: the selected input greenway characteristics variables mentioned before (29 interval and 12 nominal) and their association with the target variable (social interaction variable: social ties/bridges).

Table 63: Variable Summary for Cluster D.

Source: Pippi (2013)

Variable Summary		
Role	**Measurement Level**	**Frequency Count**
Input	Interval	29
Input	Nominal	12
Rejected	Interval	5
Rejected	Nominal	24

Table 64 illustrated the output results for the elected variables of importance, in which the Heavily Wood Forest input variable presented the highest level of importance (1.00000) followed by the Mantained Grassy Open Field (0.91732). By other hand, the variables that presented the lowest and equivalent levels were: number of walking boards, number of fences and number of tunnels (0.44145 each).

Table 64: Variable Importance Report Output for Cluster D.

Source: Pippi (2013)

Variable Importance				
Name	**Label**	**N_Rules**	**N_Surrogates**	**Importance**
Heavily Wood Forest	Heavily Wood Forest	0	4	1.00000
MantainedGrassyOF.	MantainedGrassyOF.	0	3	0.91732
Number Bollard Posts	Number Bollard Posts	0	2	0.78257
Riparian_Vegetation	Riparian Vegetation	0	2	0.75898
Activity Node Configur.	Activity Node Configur.	0	2	0.71478
Lightly Wood Forest	Lightly Wood Forest	0	2	0.65739
Freshwater Forest SW.	Freshwater Forest SW.	0	2	0.65111
Number_Bridges	Number_Bridges	0	1	0.58204
Fresh Pond Wetland	Fresh Pond Wetland	1	0	0.58204
Bicycle Post Racks	Bicycle Post Racks	1	0	0.52310
Segment Trail Pav. M.	Segment Trail Pav. M.	0	1	0.52310
Activity Node Surf. T.	Activity Node Surf. T.	0	1	0.52310
Number Benches	Number Benches	0	1	0.48711
Number Playgrounds	Number Playgrounds	1	0	0.48711
Number Drinking F.	Number Drinking F.	1	0	0.47861
Number Information S.	Number Information S.	0	1	0.47861
Number Kiosks	Number Kiosks	0	1	0.47861
Number Walking B.	Number Walking B.	0	1	0.44145
Number Fences	Number Fences	0	1	0.44145
Number Tunnels	Number Tunnels	1	0	0.44145

In the *Regression C*, table 65 above shows the independent variables selected as inputs that were listed before, in relation to the target variable *(social interaction variable*: *ties/bridges*) to be able to predict the probability of the target variable as dependent of those particular categories of independent variables. Of the four independent variables, table 66 shows that in terms of the *3 analyses of effects for the regression*, only the Connectgivity_Conventional_Parks was selected, and this may be due to having too many variables to run the model. This unique sub-set variable presented DF 5, Wald Chi-square of 88.6557 and Pr>ChiSq: <.0001.

Table 65: Measurement Frequency for Regression D.

Source: Pippi (2013)

Variable Summary		
Role	**Measurement Level**	**Frequency Count**
Input	Interval	29
Input	Nominal	12
Rejected	Interval	6
Rejected	Nominal	25
Target	Nominal	1

Table 66: Type 3 Analysis of Effects for Regression D.

Source: Pippi (2013)

Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr>ChiSq**
Connectivity_Conventional_Parks_	5	88.6557	<.0001

Table 67 showed the regression outcomes in terms of the *odds ratio estimates*. The items selected in red in the table, failed to provide the association or probability between the sub-set variables, because they presented values superior to 1 (100.00%). In terms of ties/bridges interaction for the *connectivity to conventional parks types*: the Metro Park has

less probability to present interaction than the Special Use Park (with 89.00%), and the School Park has also less probability to present interactions than the Special Use Park (with 97.00%).

Table 67: Odds Ratio Estimates for Regression D.

Source: Pippi (2013)

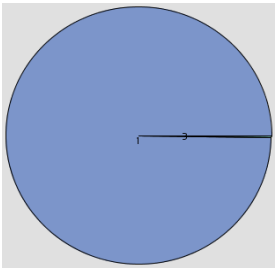
Odds Ratio Estimates		
Effect	**Tie_Bridge**	**Point Estimate**
Connectivity Conventional Parks Community Park vs Special Use Park	yes	1.064
Connectivity Conventional_Parks Metro Park vs Special Use Park	yes	0.892
Connectivity Conventional Parks Neighborhood Park vs Special Use Park	yes	1.326
Connectivity Conventional_Parks None vs Special Use Park	yes	1.597
Connectivity Conventional Parks School Park vs Special Use Park	yes	0.973

As indicated in figure 128, the *Cluster E and Regression E* analyzed the *social interaction variable as target for* each of the different behavior *independent variables* (*inputs: new pattern of use/type of activity, complementary behavior and pattern of activity levels)*.

Figure 128 presents the information of the segment size, identity and the cluster distance, followed by the description of each cluster frequency for the *Cluster B.* The chart did not properly represent the different 6 segments (clusterings). However the frequency for each cluster was provided in the mean statistics output. Segments 2 and 6 presented similar higher frequencies (s2: with 22.80% and s6: with 21.87%) followed by segments 4, 5, 1 and 3 (s4: with 18.01%, s5: with 14.47%, s1: with 14.31% and s3: with 10.59%). The cluster distance chart presents the graphic evidence of each of the six segments (clusters) classification in terms of cluster distance and cluster sistance plot: the nearest segment to the segment 1 was the segment 2; for segment 2 it was the segment 6; for segment 3 it was the segment 2; for the segment 4 it was the segment 6; for the segments 5 and 6 it was the segment 2). Segment 3 presented a more distant dimension 1 to the right (1.25) if

compared to the other clusters that were distributed in the middle and right section of the cluster distance plot. Segments 1 and 6 presented the same position (0.5); with negative values to the left section of the plot: segment 5 (-0.5) followed by segment 2 (-0.75) and segment 4 (-1.25). In terms of dimension 2, segment 5 (-1.25) presented lower and negative values, while segment 6 and 1 was slightly higher, but still presented low and negative values (-1.25 and -0.25, respectively). The following segments showed positive values in the dimension 2: segment 2 (0.25) followed by segments 4 and 3 (0.75 and 1.0).

Segment Size and Segment Id **Cluster Distance Plot**



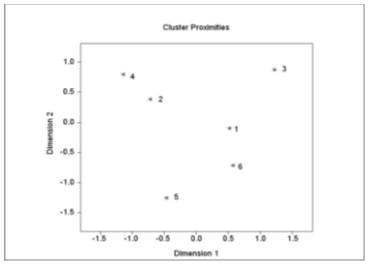


Figure 128: Chart and Plot of the Cluster E.
Source: **Pippi (2013)**

Cluster E segment plot, in Appendix V, shows the results of each of the six segments (identification and frequency) related to the selected input *behavior variables* (*new pattern of use/type of activity, complementary behavior and pattern of activity levels*) as illustrated in table 68, by the output for the variable summary for the cluster E, relative to the target variable *(social interaction variable: social ties/bridges*). Table 69 illustrated the output results for the elected *variables of importance*, in which the Pattern of Activity Level presented the highest level of importance (1), that were completely different score result if compared with the previous clusters variables of importance tables. Other problem in the three segment plots was the fact thet even though it was provided a legend of all the sub-set

variables, many of them presented the same color legend and also many of them did not appeared in the graph segment plots, and when presented, some of them were hard to provide the identification and frequency results, because it was represented and/or collapsed into lines and bold lines. The first and second clusters for the *new pattern of use/type of activity* and *complementary behavior variables* presented more diversity in terms of the representation of the sub-set categories with high and moderate scores only, but failed to show the ones that presented low scores. Because of this, the analysis of the two segment plots was rejected. Even though the segment plot number three segment presented the different 8 categories for the *pattern activity level*, it also did not provide too much difference in terms of the representation of the range of the sub-categories within the different segment types, and because of this condition, it was not significant and failed in terms of providing consistent information.

Table 68: Variable Summary for Cluster E.

Source: Pippi (2013)

Variable Summary		
Role	**Measurement Level**	**Frequency Count**
Input	Nominal	3
Input	Interval	35
Rejected	Nominal	33

Table 69: Variable Importance Report Output for Cluster E.

Source: Pippi (2013)

Variable Importance				
Name	**Label**	**N_Rules**	**N_Surrogates**	**Importance**
P ActLevel	P ActLevel	1	0	1

In *Regression E*, table 70 shows the three independent variables selected as inputs (*complementary behavior variable, new pattern of use/type of activity variable and pattern of activity variable*), in relation to the target variable *(social interaction variable*: *ties/bridges*) to be able to predict the probability of the target variable as dependent of those particular categories of independent variables. A total of 39 sub-set variables were elected for the independent varaibles as inputs (3 nominal and 36 interval). Of the three independent variables, table 71 shows that in terms of the *3 analyses of effects for the regression*, *complementary behavior variable, new pattern of use/type of activity variable and pattern of activity level variables* presented Pr>ChiSq: <.0001.

Table 70: Measurement Frequency for Regression E.

Source: Pippi (2013)

Variable Summary		
Role	**Measurement Level**	**Frequency Count**
Input	Nominal	3
Input	Interval	36
Rejected	Nominal	34
Target	Nominal	1

Table 71: Type 3 Analysis of Effects for Regression E.

Source: Pippi (2013)

Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr>ChiSq**
Compl_Beha	15	308051.654	<.0001
NewP_use_Activ	68	303.0280	<.0001
P_ActLevel	8	2866.3379	<.0001

Table 72 showed the regression outcomes in terms of the *odds ratio estimates*. The items selected in red in the table, failed to provide the association between the sub-set variables and also reliable probability, because they presented scores superior to 1 (100.00%) or

presented no point estimate scores. All probabilities may be affected by the lack of information, since the regression analysis did not accept the sub-set variables with greater and moderate occurrence, as illustrated in table 25: New Pattern of Use/Type of Activity, because it only compared the sub-set category denominated *other* (0.72%; 73 observations) with also sub-set categories with much more lower frequencies.The regression analysis also did not accept the sub-set variables with greater and moderate occurrence, as illustrated in table 28: Complementary Behavior Categorization, as instead of correlating the sub-set variables together, it correlated them in relation with the *none* category that presented superior frequency (84.12%; 8,584 observations), not providing reliable comparative information, because it only compared the sub-set category denominated *other* (0.72%; 73 observations), also with sub-set categories with lower frequencies. Therefore, all of the probabilities within those categories may be affected in terms of frequency, because of the large amount of sub-set of variables. To mitigate this problem, new classifications in those two input categories are necessary to reduce the scope in the large data set and then reduce the dimensionality within the variables categories, refining the analysis by shifting in the procedure log the sub-set variables for comparison, with the substitution of the *other* and *none* categories for other categories with superior occurrence.

The only regression outcome that provided consistent frequency results in table 72 was the *pattern of activity level variables*, but also they loosed their rule of information because they are directly associated to the other two behavior variables. Also the method needs to be refined in terms of analysis by shifting in the procedure log the sub-set variables for comparison, with the substitution of the *V (Vigorous) variable* as the last variable of this group in the effect column, for any of the another categories of this group to provide more reliable comparison in terms of frequency results.

Table 72: Odds Ratio Estimates for Regression E.

Source: Pippi (2013)

Odds Ratio Estimates			
Effect		**Tie_Bridge**	**Point Estimate**
Compl_Beha	Drinking a vs none	yes	999.000
Compl_Beha	Drinking c vs none	yes	<0.001
Compl_Beha	Exercising and Yoga c vs none	yes	<0.001
Compl_Beha	Exercising and Yoga a vs none	yes	<0.001
Compl_Beha	Exercising b vs none	yes	1.636
Compl_Beha	Exercising d vs none	yes	<0.001
Compl_Beha	Pets a vs none	yes	4.008
Compl_Beha	Pets a and Sitting b vs none	yes	<0.001
Compl_Beha	Pets a and Drinking ab vs none	yes	999.000
Compl_Beha	Pets a and Sitting j vs none	yes	999.000
Compl_Beha	Pets b vs none	yes	1.588
Compl_Beha	Pets b and Sitting c vs none	yes	<0.001
Compl_Beha	Pets b, Sitting j and Picnicking vs none	yes	999.000
Compl_Beha	Pets b, h and i vs none	yes	<0.001
Compl_Beha	Pets c vs none	yes	<0.001
Compl_Beha	Pets g vs none	yes	9.609
Compl_Beha	Pets i vs none	yes	4.008
Compl_Beha	Picnickin d vs none	yes	<0.001
Compl_Beha	Sitting a vs none	yes	1.619
Compl_Beha	Sitting a and Pets bih vs none	yes	<0.001
Compl_Beha	Sitting a and Picnicking d vs none	yes	<0.001
Compl_Beha	Sitting a, Picnicking d, Pets a vs none	yes	<0.001
Compl_Beha	Sitting b vs none	yes	0.405
Compl_Beha	Sitting be vs none	yes	<0.001
Compl_Beha	Sitting bo vs none	yes	0.825
Compl_Beha	Sitting c vs none	yes	<0.001
Compl_Beha	Sitting d vs none	yes	0.511
Compl_Beha	Sitting e vs none	yes	0.538
Compl_Beha	Sitting f vs none	yes	<0.001
Compl_Beha	Sitting g vs none	yes	0.604
Compl_Beha	Sitting h vs none	yes	0.991
Compl_Beha	Sitting j and Picnicking a vs none	yes	<0.001
Compl_Beha	Sitting j and Picnicking b vs none	yes	3.997
Compl_Beha	Sitting k vs none	yes	0.180
Compl_Beha	Sitting l vs none	yes	<0.001
Compl_Beha	Sitting m vs none	yes	0.310

Table 72 Continued

Compl_Beha	Sitting p vs none	yes	0.333
Compl_Beha	Sitting q vs none	yes	0.571
Compl_Beha	Stretching b vs none	yes	<0.001
Compl_Beha	Stretching b and Sitting b vs none	yes	999.000
Compl_Beha	Stretching bo vs none	yes	<0.001
Compl_Beha	Stretching c vs none	yes	999.000
Compl_Beha	Stretching f vs none	yes	<0.001
Compl_Beha	Stretching hl vs none	yes	<0.001
Compl_Beha	Stretching i vs none	yes	<0.001
Compl_Beha	Stretching j vs none	yes	<0.001
Compl_Beha	Stretching l vs none	yes	<0.001
Compl_Beha	Stretching o vs none	yes	<0.001
Compl_Beha	Stretching q vs none	yes	<0.001
Compl_Beha	Stretching r vs none	yes	999.000
NewP_use_Activ	B_alone vs yoga_other	yes	0.358
NewP_use_Activ	B_children vs yoga_other	yes	<0.001
NewP_use_Activ	B_dog_interacting vs yoga_other	yes	0.081
NewP_use_Activ	B_interacting vs yoga_other	yes	0.357
NewP_use_Activ	B_other vs yoga_other	yes	1.308
NewP_use_Activ	Bike_dog vs yoga_other	yes	0.100
NewP_use_Activ	ex_interact_other vs yoga_other	yes	999.000
NewP_use_Activ	ex_struct_interact vs yoga_other	yes	4.072
NewP_use_Activ	exercise_alone vs yoga_other	yes	<0.001
NewP_use_Activ	exercise_structure vs yoga_other	yes	0.724
NewP_use_Activ	fishing_alone vs yoga_other	yes	<0.001
NewP_use_Activ	fishing_interacting vs yoga_other	yes	0.254
NewP_use_Activ	gardening_alone vs yoga_other	yes	<0.001
NewP_use_Activ	gardening_interacting vs yoga_other	yes	0.725
NewP_use_Activ	inline_skating_alone vs yoga_other	yes	<0.001
NewP_use_Activ	inline_skating_dog vs yoga_other	yes	<0.001
NewP_use_Activ	inline_skating_interact vs yoga_other	yes	0.775
NewP_use_Activ	other vs yoga_other	yes	0.187
NewP_use_Activ	play_dog_interact vs yoga_other	yes	0.884
NewP_use_Activ	play_structure_alone vs yoga_other	yes	<0.001
NewP_use_Activ	play_structure_interact vs yoga_other	yes	2.797
NewP_use_Activ	pne_alone vs yoga_other	yes	<0.001
NewP_use_Activ	pne_dog vs yoga_other	yes	999.000
NewP_use_Activ	pne_dog_interact vs yoga_other	yes	<0.001
NewP_use_Activ	pne_interact vs yoga_other	yes	0.677

Table 72 Continued

NewP_use_Activ pso_alone vs yoga_other	yes	<0.001
NewP_use_Activ r_alone vs yoga_other	yes	0.278
NewP_use_Activ r_children vs yoga_other	yes	0.428
NewP_use_Activ r_children_dog_interact vs yoga_other	yes	<0.001
NewP_use_Activ r_children_interacting vs yoga_other	yes	0.431
NewP_use_Activ r_children_other vs yoga_other	yes	999.000
NewP_use_Activ r_dog vs yoga_other	yes	0.064
NewP_use_Activ r_dog_interacting vs yoga_other	yes	0.644
NewP_use_Activ r_dog_other vs yoga_other	yes	999.000
NewP_use_Activ r_interacting vs yoga_other	yes	0.164
NewP_use_Activ r_other vs yoga_other	yes	0.385
NewP_use_Activ scootering_interact_other vs yoga_other	yes	0.257
NewP_use_Activ scootering_interacting vs yoga_other	yes	0.092
NewP_use_Activ sit_alone vs yoga_other	yes	0.130
NewP_use_Activ sit_interact_other vs yoga_other	yes	<0.001
NewP_use_Activ sit_interacting vs yoga_other	yes	0.733
NewP_use_Activ sit_other vs yoga_other	yes	0.041
NewP_use_Activ skating_alone vs yoga_other	yes	0.092
NewP_use_Activ skating_interacting vs yoga_other	yes	0.169
NewP_use_Activ skating_other vs yoga_other	yes	999.000
NewP_use_Activ stand_interact_other vs yoga_other	yes	0.169
NewP_use_Activ stand_other vs yoga_other	yes	0.130
NewP_use_Activ strecht_alone vs yoga_other	yes	1.036
NewP_use_Activ stretch_interacting vs yoga_other	yes	1.463
NewP_use_Activ stretch_interacting_other vs yoga_other	yes	<0.001
NewP_use_Activ stretch_other vs yoga_other	yes	<0.001
NewP_use_Activ tour_interact_other_activ vs yoga_other	yes	<0.001
NewP_use_Activ tricycling vs yoga_other	yes	<0.001
NewP_use_Activ unicycling vs yoga_other	yes	<0.001
NewP_use_Activ walk_alone vs yoga_other	yes	0.868
NewP_use_Activ walk_children vs yoga_other	yes	0.241
NewP_use_Activ walk_children_dog vs yoga_other	yes	<0.001
NewP_use_Activ walk_children_dog_interac vs yoga_other	yes	<0.001
NewP_use_Activ walk_children_dog_other vs yoga_other	yes	999.000
NewP_use_Activ walk_children_interact vs yoga_other	yes	0.367
NewP_use_Activ walk_children_interact_ot vs yoga_other	yes	0.499
NewP_use_Activ walk_children_other vs yoga_other	yes	0.236
NewP_use_Activ walk_dog vs yoga_other	yes	0.146
NewP_use_Activ walk_dog_interact vs yoga_other	yes	0.098

Table 72 Continued

NewP_use_Activ walk_dog_interact_other vs yoga_other		yes	0.781
NewP_use_Activ walk_dog_other vs yoga_other		yes	0.916
NewP_use_Activ walk_interacting vs yoga_other		yes	0.405
NewP_use_Activ walk_other vs yoga_other		yes	.
NewP_use_Activ yoga_alone vs yoga_other		yes	.
NewP_use_Activ yoga_interact vs yoga_other		yes	.
P_ActLevel	M vs V	yes	0.461
P_ActLevel	MM vs V	yes	4.847
P_ActLevel	MMV vs V	yes	<0.001
P_ActLevel	MV vs V	yes	0.225
P_ActLevel	S vs V	yes	2.546
P_ActLevel	SM vs V	yes	6.904
P_ActLevel	SMM vs V	yes	0.552
P_ActLevel	SMV vs V	yes	3.367
P_ActLevel	SS vs V	yes	<0.001
P_ActLevel	SSV vs V	yes	999.000
P_ActLevel	SV vs V	yes	6.265

5.4. Findings from Standardized Survey Questionnaire and Mapping Exercise

This section reports the findings from the Standardized Survey Questionnaire used to understand how users and actors use the greenway in terms of social interaction and social contact with the greenway physical environments (features and structural network system). The questionnaire aimed to provide information complementary to the behavior mapping observations in order to connect users/actors' opinions, perceptions, preferences, interactions, attitudes, behaviors, motivations and social experiences.

The mapping exercise also provided a information complementary to the behavior mapping observation and greenway characteristic observation with the respondents' reports about which greenway places they used, including the start and end on the greenway trail and the location of points in which they met and interacted with other users and actors. Such information was used to indicate points of destination and social network linkages and/or

points of greenway features that promoted meetings and interactions, in Geographic Information System (GIS): Arc Map 10, also to promote additional understanding of the greenway characteristics (structural network system and features) in terms of their function and people usage and flow.

5.4.1. Survey Results with General Discussion and Comparisons Across Both Greenways

The survey results are presented based on different topics: *neighborhood location; socio-demographic information; geographic location; reasons for greenway use; nature and frequency of greenway use; patterns of use/type of activity in which users engage in the greenway; type of interaction in the greenway; nature and frequency of greenway interactions; greenway opportunistic place; environment for socialization; aspects of the greenway that inhibit the socialization; greenway potential opportunities; greenway types of connection; greenway benefits; greenway social benefits; user motivations for using the greenway; greenway attributes; greenway users attributes related to the greenway characteristics; greenway attachment; greenway success; greenway features; greenway user expectations, and greenway places for socialization*. Appendix R presents the questionnaire responses.

1. *neighborhood location:*

A total of 47 total responses mentioned 12 different neighborhoods surrounding the BCGW: Weston Manor, Weston Lakeside, Harrison Place, Trappers Run, Red Fox, Oxford Hunt, Harrison Trace, Homestead, Hermitage at Beenchtree, Cambridge Forest and Fox Run; and the mentioned Zip code location was: 27513. A total of 44 total responses mentioned 08 different neighborhoods surrounding the WOCGW: Westpark, Park Village, Chesney Glen, MacArthur Park – Canterbury Sub. Div., Ashley Woods Sub., Camelot Section of the MacArthur Park and Avalon II; and the mentioned Zip codes were: 27519 and 27513.

1) *socio-demographic information:*

Of the total of 47 respondents for the BCGW, 57.00% were females (n=27) and 43.00% were males (n=20). Of the total of 44 respondents for the WOCGW, 50.00% were females (n=20) and 50.00% were males (n=20).

Of the total of 47 respondents for the BCGW, 91.00% were adult users and with ages between 18-65 years old (n=43) and 9.00% were seniors (over 65 years old, n=4). Of the total of 44 respondents for the WOCGW, 93.00% were adult users (18-65 years old, n=41) and 7.00% were seniors and (over 65 years old, n=3). The proportion of adult and senior respondents were in both greenways, however the BCGW presented slightly more frequency in the senior user responses than the WOCGW.

Of the total of 47 respondents for the BCGW, the respondents that completed their undergraduate degree were more prevalent with 48.00% (n=21), followed by 30.00% (n=13) that had completed a graduate degree, with 13.00% (n=6) who had completed some college or vocational school and 9.00% who had completed a professional degree (n=4). Of the total of 44 respondents for the WOCGW, the respondents who completed undergraduate degrees were more prevalent 55.00% (n=22), followed by 25.00% (n=10) that completed their graduate degree, 13.00% who had completed professional degrees (n=5) and 8.00% (n=3) who had completed some college or vocational school. The respondents with graduate degrees and college/vocational school presented greater frequency in the BCGW than the WOCGW. On the other hand the respondents with undergraduate degrees and professional degrees presented more frequency in the WOCGW than the BCGW.

2) *geographic location:*

Of the total of 47 respondents for the BCGW, 89.00% (n=42) of the respondents were born in the U.S.A and 11.00% (n=5) in other countries (China, India, France, England and Turkey). Of the total of 44 respondents for the WOCGW, 80.00% (n=35) of the respondents

born in the U.S.A and 20.00% (n=9) in other countries (India, Canada, Sweden, Lebanon, Mexico, United Kingdom and Germany).

3) *reasons of greenway use, user motivations for use the greenway and greenway potential opportunities*, according to Appendix Q and Appendix R*:*

When respondents listed the name of the three greenways near to their house that they utilized most during the last 12 months, for the BCGW respondents the *Black Creek Greenway* received the highest frequency with 54.42% (n=43), followed by the White Oak Creek Greenway that received low-moderate frequency with 8.86% (n=7) and the Lake Pine Trail and the Oxford Hunt Greenway received equivalent low frequencies with 2.53% each (n=2 each). For the WOCGW respondents the *White Oak Creek Greenway* received the highest frequency with 42.45% (n=45), followed by the Black Creek Greenway that received moderate frequency with 16.99% (n=18) and the lake Pine Trail and the Davis Drive Street-Side Trail received equivalent low frequencies with 1.89% each (n=2 each) *(Introduction)*.

In terms of reason for utilizing the greenways, physical activity/fitness were the most mentioned by both greenway respondents with high frequencies: 98.00% (n=45) in the BCGW and 93.00% (n=41) in the WOCGW. Enjoyment was the second most mentioned reason in both greenways with high frequencies: 89.00% (n=41) in the BCGW and 70.00% (n=31) in the WOCGW, the proximity of my residence was found to be the second most frequent reason, with high frequency of 70.00% (n= 31). For the BCGW respondents, the proximity to my residence was the third most frequent response, with high frequency 80.00% (n=37). The third reason mentioned the WOCGW respondents was the family together with high-moderate frequency 64.00% (n=30). The fourth reason cited by the BCGW respondents was the appreciation/interaction with nature with high-moderate frequency 59.00% (n=35). The fourth reason mentioned by the WOCGW respondents was the appreciation/interaction with nature, with high-moderate frequency 59.00% (n=26). On the other hand, neighborhood activities and learning received the lower frequencies by the BCGW respondents with 2.00% each (n=1 each). For the WOCGW respondents the

community programs and neighborhood activities presented the lower frequencies with 2.00% each (n=1 each). In terms of greenway connection reasons. The *others* type of reasons were only mentioned by the WOCGW respondents, which were: connection to school and walking to schools with 9.00% (n=4). Two reasons were absent in the responses of both greenways: connection with historical areas/places and educational programs *(Question 2)*.

In terms of the greenway characteristics, the topic connectivity as a reason for utilizing the greenways was listed by respondents of both greenways with moderate frequencies: connection with parks (BCGW: with 67.00%/31 and WOCGW with 43%/19), connection with playgrounds (BCGW: with 33.00%/15 and WOCGW with 27.00%/12) and connection with other neighborhoods (BCGW with 15.00%/7 and WOCGW with 20.00%/9). Landscape features received more attention in the BCGW responses for observation and contemplation with moderate frequency of 28.00% (n=13). In terms of the greenway physical structure features, the WOCGW respondents mentioned the presence of good facilities/services with moderate frequency of 20.00% (n=9). In terms of the greenway social aspects, the topics of interactions and ties/bridges were mentioned by the greenways respondents: family togetherness with high-moderate frequency (BCGW: with 65.00%/30 and WOCGW with 64.00%/28) and with moderate frequencies were: social interactions (BCGW: with 65.00%/16 and WOCGW with 64.00%/16), friendship ties (BCGW: with 22.00%/10 and WOCGW with 34.00%/15), meeting new people (WOCGW: with 20.00%/9, but in the BCGW received low frequency with 4.00%/2), join my neighborhoods (BCGW: with 13.00%/6 and WOCGW with 16%/7). With low frequencies, were responses for: join people from other neighborhoods (BCGW: with 4.00%/2 and WOCGW with 7.00%/3) and social events (only mentioned by the WOCGW respondents with 11.00%/5) *(Question 2)*.

4) *nature and frequency of greenway use,* according to Appendix R:

In terms of frequency of use, respondents of both greenways mentioned first, 1-3 times a week with high-moderate frequency (BCGW with 50.00%/23 and WOCGW with 53.00%/23),

followed by everyday usage (BCGW with 17.00%/8 and WOCGW with 20.00%/9). On the other hand, the category others (BCGW with 7.00%/3 and WOCGW with 5.00%/2) and 1 time a year (only mentioned by WOCGW respondents with 2.00%/1) were the least mentioned. For the others category, BCGW respondents included the alternative '5 days per week'; For the WOCGW respondents, the others alternative included: '4-5 times a week, Fall/ 3 times/week, Spring and 1 time/week, Summer/Winter' and 'more than 1-3 times/week' *(Question 3)*.

In terms of weekday and weekend frequency of use, respondents of both greenways mentioned first, others with moderate frequency (WOCGW: with 39.00%/17 and BCGW with 37%/17). For the BCGW respondents, the others category included: weekday and weekend; weekday and vacation; weekday, weekend, holiday and vacation; weekend, holiday, vacation and special events; and weekend and weekdays in summer. For the WOCGW, others included: weekday and weekend; weekday, weekend, holiday and vacation; and weekend and holiday. Weekdays also were mentioned by respondents of both greenways with moderate frequency (BCGW with 37%/17 and WOCGW with 32%/14). Curiously, the weekend received low-moderate responses, in the third place in terms of frequency and after the weekday and others (WOCGW: 27.00%/12 and BCGW: with 26.00%/12). Holidays were only mentioned by the WOCGW respondents with 2.00% (n=1). Only special events and only vacation were not mentioned *(Question 4)*.

In terms of time of the day frequency of use, the evening (5-8p.m) received the highest number of mentions by the respondents of both greenways (BCGW: with 39.00%/18 and WOCGW: with 28.00%/12), the afternoon (12-4p.m) receiving moderate number of mention in the BCGW (with 28.00%/13) but low-moderate in the WOCGW (with 16.00%/7). The others category also received moderate number of mentions by both greenways respondents (BCGW: with 20.00%/9 and WOCGW: with 30.00%/13). The others category for the BCGW respondents included: morning and afternoon; morning and evening; afternoon and evening, and morning, afternoon and evening; and for the WOCGW were:

morning and afternoon; morning and evening; morning, afternoon and evening. None of the respondents used the greenways at night (after 9 p.m) *(Question 5)*.

In terms of length of stay on a greenway, the response with the greatest frequency was 31 minutes-1 hour, with high and similar frequencies in both greenways (BCGW: 82.00%/39 and WOCGW: 81.00%/34). The least frequent time selected in the BCGW was 10-30 minutes (9.00%/4) and 2-3 hours (9.00%/4). The least frequent time selected in the WOCGW was 2-3 hours (5.00%/2). No one stayed more than 3 hours on the greenways *(Question 6)*.

5) *patterns of use/type of activity in which users engage in the greenway,* according to the Appendix R*:*

The pattern of activities that were more prevalent in both greenways were: walking, running and bicycling. Walking was the most frequent response with a moderate percentage in both greenways (BCGW: with 27.42%/34 and WOCGW: with 25.62%). In the second position, for the BCGW was running with moderate frequency (with 23.39%/29) but for the WOCGW was bicycling with moderate frequency (21.49%/26). In the third position, for the BCGW was bicycling with low-moderate frequency (with 15.33%/19) but for the WOCGW was running with moderate frequency (with 23.39%/29). The walking-family kinship were the category with the lowest frequency in the BCGW (with 1.61%/2), however this category wasn't mentioned by the WOCGW respondents. For the WOCGW five different activities presented the lowest and equivalent frequency: watch/observe people, interact/explore nature, skating, walking-running and playing with kids (with 1.65%/2 each); these activities were not mentioned by the BCGW respondents. Socializing activities were only presented with low frequency in the WOCGW (with 3.23%/3). Four activities were only mentioned by the BCGW respondents: wildlife observation/contemplation, landscape observation/contemplation, socializing, and meditate/doing yoga *(Question 7)*.

New patterns emerged in the others category in both greenways: for the BCGW other included: wildlife photography; bird watching; ride scooters with kids; people watch and dog watch; hike with sons; spend time with husband, and sitting and picknicking. For the WOCGW were watching kids playing; adventuring and playing with kids; exercising; pet walking; walking dog; fitness walking; walk and stretching; walking with stroller; walking and stretching; people and wildlife watching; wildlife photography; picknicking; in-line skating, and taking kids on their riding toys *(Question 7)*.

6) *type of interaction in the greenway and nature and frequency of greenway interactions* according to Appendix R:

In terms of information of the greenway usage with, the respondents of both greenways use the greenway alone was the most mentioned category (WOCGW: with 77.00%/30 and the BCGW: with 64.00%/34), with the WOCGW presenting the greatest number cases of individuals using the greenway alone. The second most mentioned response for both greenways was 'with family' (WOCGW: with 73.00%/32 and BCGW: with 51.00%/24), with the WOCGW presenting more cases of individuals using the greenway with family. In third place, was mentioned for the BCGW with moderate frequency: with conjugate/mate (with 49.00%/23) and for the WOCGW with moderate frequency: with pets (with 48.00%/21). Two categories received the moderate responses in both greenways, but with greater incidence in the BCGW: with friend and with children (BCGW: with 43.00%/20 each and WOCGW: with 34.00%/15 each). With lower frequencies, for the BCGW were the categories with parents (for the BCGW: with 6.00%/3 and for the WOCGW: with 2.00%/1) with strangers in the WOCGW (with 2.00%/1) and for the BCGW the others category, which indicated with grandchildren (with 2.00%/1) *(Question 8)*.

Respondents of both greenways mentioned with greatest rate that they go together with one person only to the greenway, conforming a Dyadic inner-interaction, with higher moderate frequencies and with greater incidence in the BCGW (BCGW: with 44.00%/21 and WOCGW: with 34.00%/15). Also for the WOCGW the no one category, indicating that the

respondent used the greenway alone, received a moderate frequency (with 34.00%/15). In the second place for the WOCGW was also the no one category (with 26.00%/12). In the second place for the WOCGW, with greater incidence than the BCGW, and third place for the BCGW was the 2 persons categories, meaning that each respondent conforming with others a Triadic inner-interaction, respectively with moderate frequencies (WOCGW: with 23.00%/10 and BCGW: with 17.00%/8). Both greenways presented low frequencies for Groups inner-interaction relations, the BCGW presented greater incidence for the 3-4 persons category than the WOCGW (BCGW: with 13.00%/6 and WOCGW: with 7.00%/3). The category of more than 4 persons, as a bigger Groups inner-interaction relation, only was mentioned by the WOCGW respondent (with 2.00%/1) *(Question 9)*.

In terms of arranging to meet people they knew at the greenway, 60.00% (n=28) of the BCGW respondents and 75.00% (n=33) of the WOCGW respondents do not plan in advance the interactions with people they know. However, 40.00% (n=19) of the BCGW respondents and 25.00% (n=11) of the WOCGW respondents intended to meet people (family, relatives and friends) at the greenway. In those encounters, the number of people presented different results according to the greenway type and also the actor size types. With higher incidence, the WOCGW users tended to meet only one person, conforming a Dyadic inner-relation (with 64.00%/7). When compared to the WOCGW users, the BCGW users presented lower incidence in terms of meeting 1 or 2 persons at the greenway, conforming a Dyadic or a Triadic inner-relationship (with 47.00%/9 each). The greenway users of both greenways tended to meet least with 3-4 persons at the greenways, conforming a inner-Group relation (BCGW: with 6.00%/1 and WOCGW: with 9.00%/1). No one tended to meet bigger groups of people (more than 4 persons) at the greenways *(Question 10a)*.

For the length of interactions among people who the users met on the greenways, the most mentioned time-frame was between 31 minutes-1 hour in the BCGW (BCGW: 46.00%/11) and between 31 minutes-1 hour or 10-30 minutes in the WOCGW (45.00%/5 each). The WOCGW users reported fewer interactions for the short time-frame of 1-5 minutes with

9.00% (n=1). The BCGW users also reported fewer interactions in the shorter or greater time-frames, such as less than 1 minute; 1-5 minutes; and 2-3 hours with 4.00% each (n=1 each) *(Question 10b)*.

In terms of the users having unplanned meetings with acquaintances, users of both greenways reported meeting occasionally, with moderate scores and few difference in rate of mention (WOCGW: with 39.00%/17 and BCGW: with 36.00%/17). In contrast, both greenways presented the lowest scores for frequent meetings with people they know, with greatest response in the BCGW (BCGW: with 15.00%/7 and WOCGW: with 7.00%/3) *(Question 10c)*.

In terms of the greenway users incidence of interactions with new people on the greenways, they also tended to meet occasionally in both greenways, with the moderate scores and few differences (BCGW: with 45.00%/21 and WOCGW: with 39.00%/19). The second most mentioned response was for rarely interacting with new people on the greenways in both greenways, with greater occurrence for the BCGW than the WOCGW (BCGW: with 32.00%/15 and WOCGW: with 25.00%/11). 'Frequently meetings with strangers' received low-moderate results for both greenway, which demonstrates that the greenway environment can provide a democratic arena for interaction strangers (WOCGW: with 18.00%/8 and BCGW: with 17.00%/8). In line with this, both greenways presented the lowest scores for the 'never meeting with new people', which was higher for the WOCGW (WOCGW: with 6.00%/3 and BCGW: with 14.00%/6) *(Question 11a)*.

In terms of number of interactions with people newly met on the greenways, the users from both greenways tended to interact mostly with 1 newly met person, conforming a Dyadic inner-interaction relation, with superior frequency in the BCGW, followed by the WOCGW (BCGW: with 45.00%/21 and WOCGW: with 34.00%/15). There was also a moderate though lower frequency for both greenway respondents to interact with 2 persons, conforming a Triadic inner-interaction relation. This response was slightly higher on the WOCGW (WOCGW: with 25.00%/11 and BCGW: with 19.00%/9). On the other hand, the

users of both greenways tended to interact the least with more than four unknown people, conforming a Group inner-interaction relation, which presented low frequencies on both greenways but with inferior scores in the BCGW (WOCGW: with 11.00%/5 and BCGW: with 6.00%/3) *(Question 11b)*.

The length of interaction of the users from both greenways with people newly met on greenway, presented an opposite result in terms of time-frame interaction if compared to the time-frame for interaction with people they already knew (previous response 10b). In the interaction with newly met people the shorter time-frames were more prevalent. For the length of interactions among people newly met, the most frequent response for both greenways was for less than 1 minute, with a slightly greater score in the WOCGW (WOCGW: with 44.00%/15 and BCGW: with 41.00%/16). The second most mentioned response for interactions with newly met people was between 1-5 minutes with greater incidence in the BCGW than the WOCGW (BCGW: with 38.00%/15 and WOCGW: with 32.00%/11). In contrast, interactions between 10-30 minutes presented lower scores, and with greater incidence in the WOCGW than the BCGW (WOCGW: with 9.00%/3 and BCGW: with 3.00%/1). For both greenways the categories for longer time-frames were absent: 31 minutes-1 hour; 2-3 hours, and more than 3 hours *(Question 11c)*.

In terms of the greenway users view about the importance to meet and socialize with acquaintainces, the greenway respondents mentioned more that is not all important, if compared to the other altenatives, which presented superior moderate scores in both greenways and with higher frequency in the WOCGW than the BCGW *(WOCGW: 32.00%/14 and BCGW: with 28.00%/13).* In contrast, the users from both greenways mentioned that meeting and socializing with people they already know that is very important, with superior low frequency in the BCGW than the WOCGW (BCGW: with 13.00%/6 and WOCGW: with 9.00%/4) *(Question 12a)*.

In terms of the greenway users opinion about the importance to meet and socialize with new people, the greatest response for the BCGW was ‘not at all important’, with a moderate

score (with 40.00%/19). For the WOCGW, the greatest response was ‘neither important/nor unimportant’, with moderate frequency (with 34.00%/15). On the other hand, the response ‘very important to interact with new people’ received a low response rate for the WOCGW and very low response rate for the BCGW (WOCGW: with 9.00%/4 and BCGW: with 2.00%/1) *(Question 12b)*.

In terms of achieving information about the greenway physical environment as a democratic arena in providing the interaction among people from the same neighborhood, interesting results emerged in terms of the neighbors interactions. With similar and higher response rates, users from both greenways interacted with their neighbors in the past 2 weeks (14 days) (BCGW: with 62.00%/29 and WOCGW: with 59.00%/26). On the other hand, with inferior moderate scores, users from both greenways tend to not interact with their neighbors when they utilized the greenways (WOCGW: with 41.00%/18 and BCGW: with 38.00%/18) *(Question 13)*.

To better understand the interactions that took place among people from the same neighborhood, it was necessary to obtain some additional information in terms of the frequency and quantity of those interactions, the types, interaction levels and the length of those interactions *(Question 13)*.

In terms of frequency of interactions with neighbors, the category 1-3 times in the past week presented the highest response rate for both greenways, with high-moderate to high scores, but with more incidence in the BCGW than the WOCGW (BCGW: with 72.00%/21 and WOCGW: with 58.00%/15), followed by the 7-12 times, with moderate to low-moderate rate in broth greenways (WOCGW: with 19.00%/5 and BCGW: with 17.00%/5). On the other hand, interacting more than 12 times was only reported for the WOCGW with the lowest frequency (with 8.00%/2). In terms of quantity of neighbor interaction, for the BCGW users, interacting with 2 persons, configuring a Triadic intra-interaction relationship, received the highest response rate (with 46.00%/14). For the WOCGW, three categories received the same response rate: interacting with 1 person, configuring a Dyadic intra-interaction

relationship, and interacting with 2 persons, configuring a Triadic intra-interaction relationship, and with 3-4 persons, configuring a Group intra-interaction relationship (with 28.00% each/7 each). On the other hand, the bigger the Group intra-interaction relationship, the lower the interaction in both greenways, with low-moderate incidence in the WOCGW and lower incidence in the BCGW (WOCGW: with 16.00%/4 and BCGW: with 3.00%/1) *(Question 13)*.

In terms of the level of interaction with neighbors, for both greenways, the lowest levels of interactions received a greater response, followed by moderate levels of interactions. Greeting a friend without stopping the activity (low level) presented the highest rate of response in both greenways with superior scores in the WOCGW (WOCGW: with 81.00%/21 and BCGW: with 76.00%/22). The WOCGW users also tended to greet a stranger without stopping their activities, with high frequency (with 73.00%/19) and smile/wave with high-moderate frequency (with 58.00%/15). The BCGW users also tended to smile/wave with high-moderate frequency (with 62.00%/18), and to greet a stranger without stopping their activities, with moderate frequency (with 41.00%/12). The users of both greenways were inclined to have casual/informal meeting with friends with high-moderate scores, with a slightly greater response rate on the WOCGW than the BCGW (WOCGW: with 58.00%/4 and BCGW: with 55.00%/3). The WOCGW users were inclined to have casual/informal meetings with strangers with moderate frequency (with 50.00%/13). For the higher levels of interactions with neighbors, the frequencies reduced considerably in both greenways, with moderate frequencies for meeting/doing activities together with friends, with similar response rates in both greenways (WOCGW: with 23.00%/6 and BCGW: with 24.00%/7), followed by the category of meeting/doing activities together with family with more incidence in the BCGW than the WOCGW (BCGW: with 14.00%/4 and WOCGW: with 12.00%/3), and with the lowest score was the category of meeting/doing activities together with strangers, only by the BCGW users (with 3.00%/1) *(Question 13)*.

In terms of the length of the interaction among neighbors, for both greenways 1-30 minutes time-frame was more prevalent, with high frequency in both greenways and greater

response rate in the BCGW than the WOCGW (BCGW: with 74.00%/17 and WOCGW: with 67%/16). Quick interactions (less than 1 minute) among neighbors presented moderate frequencies in both greenways (BCGW: with 26.00%/6 and WOCGW: with 21.00%/5). On the other hand, extended interactions (longer than 30 minutes) were rare and only occurred in the WOCGW with low frequency (with 12.00%/3) *(Question 13)*.

For the BCGW, there was a higher incidence of neighbors who had never had long conversations with each other (72.00%, n=21), followed of those who had never met new people (59.00%, n=17). However, there was a high occurrence of users that had short conversation with their neighbors 1-3 times (66.00%, n=19), followed by those who had greeted people from their neighborhood (48.00%, n=14). On the other hand, with the lowest occurrence and scores were: meet new people of my neighborhood 7-12 times with 3.00% (n=1), have long conversation with my neighbors 4-6 times with 3.00% (n=1), have short conversation with my neighbors 7-12 times with 7.00% (n=2) and never greet people from my neighborhood with 3.00% (n=1). For the WOCGW, there was a higher incidence users who had short conversation 1-3 times with neighbors (with 58.00%, n=15). On the other hand there was moderate incidence of the non-occurrence of long conversations with and meeting new people from the neighborhood, with 50.00% (n=13) and 46.00% (n=12) respectively. The WOCGW users reported moderate incidence of greeting their neighbors with 38.00% (n=10), but the response rate for this level of interaction reduced significantly, with low-moderate frequency, for the frequency of of 7-12 times with 15.00% (5). In terms of having long conversation 4-6 times, there was 8.00% (n=2) of response rate. Only 4.00% (n=1) had a short conversation more than 12 times in the past two weeks. Also only 4.00% (n=1) met new people from the neighbor in the past 2 weeks *(Question 13)*.

Interesting results were found related to the capacity of the greenway physical environment as a democratic arena in terms of the responses for the interaction among people from different neighborhoods. With an identical frequency for both greenways, there was a high incidence of users who had interacted with people from other neighborhoods in the past 2 weeks (14 days) (BCGW: with 62.00%/29 and WOCGW: with 62.00%/28). Interestingly, this

response rate was similar to that found for users who had interacted with neighbors. On the other hand, with inferior moderate and scores, users from both greenways tended to not interact with people from other neighborhoods when they utilized the greenways (WOCGW: with 38.00%/18 and BCGW: with 38.00%/18) *(Question 14)*.

To better understand the interactions that took place among people from the different neighborhoods, it was necessary to obtain some additional information in terms of the frequency and quantity of those interactions, as well as the types, interaction levels and lengths of those interactions *(Question 14)*.

In terms of number of interactions there was a higher incidence of interaction with people from other neighborhoods than for interactions with neighbors for both of the greenways. The category of 1-3 times in the past 2 weeks received the highest response rate, with 76.00% (n=22) on the BCGW and 62.00% (n=16) in the WOCGW. The occurrence of 7-12 times interactions with people from other neighborhoods was only encountered in the WOCGW (with 15.00%/4). On the other hand, interacting more than 12 times presented the lowest frequency in both greenways with similar scores (WOCGW: with 8.00%/2 and BCGW: with 7.00%/2) *(Question 14)*.

In terms of the quantity of interactions with people from other neighborhoods, the results were similar when compared to the interactions with neighbors. In relation with the socialization with 2 persons from other neighborhoods, configuring a Triadic intra-interaction relationship, the BCGW response rate was 45.00% (n=13) and for the WOCGW it was 31.00% (n=8). The WOCGW presented a higher score (with 35.00%/9) in terms of interaction with more than four persons from other neighborhoods, composing the biggest the Group intra-interaction relationship, however the BCGW presented the lowest score in this category (with 10.00%/3). The WOCGW presented the lowest score in terms of interaction with 3-4 persons from the other neighborhoods (with 12.00%/3) *(Question 14)*.

In terms of the level of interaction with the people from other neighborhoods, the lowest level of interactions received the greatest response rate, followed by the moderate level of interactions. Smile/wave (low interaction level) to the people from the other neighborhoods presented the highest score in both greenways, but with superior frequency in the WOCGW (WOCGW: with 93.00%/25 and BCGW: with 76.00%/22). The BCGW users, followed by the WOCGW users, also tended to greet a stranger from the other neighborhoods without stopping their activities (low interaction level), with high-moderate frequency (BCGW with 69.00%/20 and WOCGW: with 67.00%/18). The users from both greenways presented equivalent and moderate results in both greenways for two categories: greet a friend from other neighborhoods without stopping the activity (WOCGW: with 48.00%/13 and BCGW: with 31.00%/9) and casual/informal meeting with strangers of other neighborhoods, also with more manifestation in the WOCGW than the BCGW (WOCGW: with 48.00%/13 and BCGW: with 28.00%/8). On the other hand, for the higher levels of interactions with the people form the other neighborhoods, the frequencies reduced considerably in both greenways, comparable to the previous analysis with the interactions with people from the same neighborhood, with lower frequencies for meet/do activities together with friends from other neighborhoods, with similar frequencies in both greenways (WOCGW: with 11.00%/3 and BCGW: with 7.00%/2), followed by the category of meeting/doing activities together with strangers with greater incidence in the BCGW than the WOCGW (BCGW: with 7.00%/2 and WOCGW: with 4.00%/1), and with the lowest score was the category of meeting/doing activities together with family, that only was presented in the WOCGW users (with 7.00%/2) *(Question 14)*.

In terms of the length of the interaction with people from other neighborhoods, very short interactions (less than 1 minute) were more prevalent for both greenways, with moderate frequencies in both greenways, but more prevalent in the BCGW (BCGW: with 65.00%/17 and WOCGW: with 56.00%/15). Short interactions (1-30 minutes) were more reportedfor the WOCGW than the BCGW with moderate frequencies (WOCGW: with 44%/12 and BCGW: with 35.00%/9). On the other hand, extended interactions (longer than 30 minutes) were absent in both greenways *(Question 14)*.

The overall combined results for interactions with the people from the other neighborhoods in the past 2 weeks presented greatest incidence for the categories ‘never’ and ‘1-3 times’. One similar trend was found between the results for this section of the survey and those from the previous analysis of the interactions with people from the same neighborhood: the greater the numbers of times, the less frequent the interaction in both greenways.

For the BCGW, there was a higher rate of people who had never had a long conversation with people from other neighborhoods (with 83.00%, n=24), followed of those that never met new people (62.00%, n=18). However, there was a high occurrence of those that had short conversations with people from other neighborhoods 1-3 times (62.00%, n=18), followed by those that greeted people form other neighborhoods (55.00%, n=16). On the other hand, the lowest occurrence was for: meet new people from other neighborhoods 4-6 times with 10.00% (n=3), followed by have short conversation with people from the other neighbors 4-6 times with 7.00% (n=2), and greet people from other neighborhoods 7-12 times with 7.00% (n=2). For the WOCGW, there was a higher incidence of interactions of those that had long conversation with people from the other neighborhoods and meeting new people from the other neighborhoods with 81.00% (n=22) and 56.00% (n=15), respectively. Both of these cases revealed higher scores if compared to the previous analysis of the relationship with people from the same neighborhood in the WOCGW. With moderate scores, greeting people and having short conversations 1-3 times with the people from other neighborhoods presented equivalent frequency with 37.00% each (n=10 each). The category for greeting people 7-12 times also presented moderate frequency, with 37.00% (n=10). However, the greeting people from the other neighborhoods 4-6 times presented the lowest frequency with 4.00% (n=1), followed by having short conversation more than 12 times with the people from the other neighborhoods with also 4.00% (n=1) *(Question 14)*.

7) greenway as an opportune environment for socialization, greenway benefits and greenway social benefits according to the chart results of the survey questionnaire, in Appendix R*:*

This set of topics were transcribed using the qualitative coding process, in which several main themes emerged in each question (15 to 22). The themes and their subthemes are presented based on some of the respondents' statements and with the charts results of the survey questionnaire, in Appendix R.

For social aspects that motivate people to use the greenway, a total of 12 main-axial themes emerged (*sociability/interaction; exercise/physical activity; people watching; nature/natural environment; comfort and image; none; access and connectivity; interaction with animals; others; don't socialize; health development, and seclusion/solitude experiences*) after the collapse of the axial sub-themes categories, and their total frequency results was presented in the charts comparing the categories in both greenways *(Question 15)*.

The *sociability/interaction* arisen from the collapse of these sub-themes: *friendliness/friendship ties; people togetherness/gathering/meeting; children development/interaction; neighborhood integration/neighborliness; welcoming; neighborhood identity; community building/integration; cultural diversity and meeting place/environment.* Several descriptions from the BCGW respondents can be utilized to characterize this category: *"place to do things with family", "spend time with family", "family togetherness", "place to walk and talk with friends", "meeting people I already know", "place to do things with friends", "socialize with friends", "interactions for my child with other kids", "kids wanting to see friends", "neighborhood proximity", "potential to see neighbors", "run into neighborhoods", "comradery", "friendly atmosphere", "welcome place", "see people from different cultures", "diversity of people and people from other cultures" and "potential to become acquainted with new people".* From the WOCGW respondents: *"seeing friends from other neighborhoods when walking similar trails", "enjoy nature with friends", "take time with friends to exercise and talk", "connecting with friends", "social environment for creating friendship linkages", "enjoy making friends", "spend quality time with loved ones", "seeing other people and greeting them with a smile", "exchange few words with people", "nice place to interact", "opportunity to meet new people", "walk my dogs and meet other dog lovers",* "connect with spouse", "*being with my family", "family moments", "family connection", "gets*

the family out, together and about, "social environment for family bonding", connecting with neighbors I don't know", "neutral territory to meet neighbors", "opportunity to meet new friends at playgrounds for children", "kids playing and adventuring together", "children play with others", "friendly people", "nice people", "belonging", "neighborhood identity", "build community and create positive sense of community and care (each other and nature)", "conversations with strangers and people from other countries." (Question 15).

The *exercise/physical activity* arose from the collapse of these sub-themes: *individual exercise/physical fitness; regular programs* and *activities and exercise/physical activity togetherness (gathering and* exercise with others*).* Some descriptions from the BCGW respondents can be used to characterize this category were: *"see and do activity with my friends (walking)", "walk with* friend and husband*", "relaxing walk with friends", "being and exercise with people that have same values", "exercise in motivations", "running and exercise" and "physical fitness"*, and for the WOCGW respondents were: *"fitness is # 1", "good physical activity", "outdoor physical activity" and "just exercise." (Question 15)*.

The *people watching* were created from the collapse of these sub-themes: *see/watch/observe people* and *see active and healthy people.* Some descriptions from the BCGW respondents can be utilized to characterize this category: *"seeing other families and kids in the area", "seeing people from the neighborhood", "seeing people outside", "seeing other people", "seeing other people performing similar activities" and "people watching"*, and for the WOCGW respondents were: *"seeing familiar faces", "nice to see people not in cars", "cute children", and "you see other people exercising too, helps with motivation." (Question 15)*.

The *nature/natural environment* was generated from the collapse of these sub-themes: *Environmental Awareness/Sensitivity*, *Naturalness and Outdoor and Leisure Recreation.* Some descriptions from the BCGW respondents can be used to characterize this category: *"spend* outdoor time" and "be outside*/fresh air"*, and for the WOCGW respondents*: "sense of nature and belonging", "create positive care (each other and nature)", "enjoy nature",*

"nature", "to see the plants, birds and animals", "just feel around nature" "exchange ideas with others" and "similarity of interests." (Question 15).

The *comfort and image* resulted from the collapse of these sub-themes: *quiet place/environment, safety* and *alternative transportation/mobility*. Several descriptions from the BCGW respondents can be utilized to characterize this category were: *"quietness", "quiet place", "quiet place to talk", "have quiet surrounding", "alone time", "safe place", "feel safe" and "safer than sidewalks and roadways"* and for the WOCGW respondents were: "safety" and "safer neighborhoods." *(Question 15)*.

The *access and connectivity* resulted from the merge of these sub-themes: *accessible, connection with parks* and *greenways (connectedness), connect people and places (connectedness), convenience/proximity* and *connection/destination/point of attraction (connectedness).* Some descriptions from the BCGW respondents can be used to characterize this category were: *"access to parks", "free for everyone", connection to parks" and "connecting people and places"* and from the WOCGW were: *"close to neighborhood", "convenient - in our backyard", "get from one place to another" and "going to school." (Question 15)*.

The *interaction with animals* resulted from the collapse of these sub-themes: *pets access.* Some descriptions from the BCGW respondents can be used to characterize this category were: "*I go mostly to be with my dog"* and for the WOCGW respondents were: *"to walk with dogs", "dog friendly", "be with animals" and "dogs". (Question 15)*.

The *don't socialize* category was generated from the collapse of these sub-themes: *not use for socialization.* Some descriptions from the BCGW respondents can be used to characterize this category: "t*hat's not why I use them"* and for the WOCGW respondents were: *"don't like to socialize much", "Getting away from my job and getting away from people" and "don't really want to socialize, just exercise and feel around nature." (Question 15)*.

The *health development* arose from the collapse of these sub-themes: *health/increase quality of life.* Descriptions from the WOCGW respondents only included: “livelihood”, “de-stress” and “getting away from my job.” The *seclusion/solitude experiences* resulted from the sub-theme: *uncrowded*. Descriptions from the WOCGW respondents included only: “not crowded.” The *none* and *others* categories remained the same. *(Question 15)*.

The chart in in Appendix R shows the results of the social aspects that motivate people to use the greenway of the 12 main-axial themes in both greenways. The category that presented the highest frequencies in both greenways was the *sociability/interactions* with 50.00% in the BCGW (n=60) and 37.64% in the WOCGW (n=35), followed by the exercise/physical activity with moderate frequencies, the BCGW with 24.73% (n=23) and the WOCGW with 18.34% (n=22). In contrast, the BCGW presented the lowest scores in the *nature/natural environment* with 2.15% (n=2) and the BCGW presented the lower scores for the *comfort and image* with 1.67% (n=2) and *seclusion/solitude experiences* with 0.83% (n=1) *(Question 15)*.

For the social benefits of greenways, a total of 12 main-axial themes emerged (*sociability/interaction; exercise/physical activity; nature/natural environment; health development; people watching; access and connectivity; comfort and image; other activities and programs; none; don’t socialize; others and the image and attractiveness,* after the collapse of the axial sub-themes categories, and their total frequency results are presented in the charts comparing the categories in both greenways *(Question 18)*.

The *exercise/physical activity* arose from the merge of these sub-themes in both greenways: exercise/physical activity togetherness (gathering and exercise with others) and individual exercise/physical activity. The *nature/natural environment* arose from the collapse of these sub-themes in the BCGW: naturalness and environmental awareness/sensitivity; and from the WOCGW: naturalness, being outdoors/open spaces and environmental awareness/sensitivity. The *health development theme* arose from the collapse of sub-themes in both greenways: public/individual health development and health/increase quality

of life. The *people watching theme* arose from the collapse of these sub-theme in both greenways: see/watch/observe people. The *access and connectivity theme* was generated from the collapse of these sub-themes: in the BCGW: connection/destination/point of attraction (connectedness); and in the WOCGW: connection/destination/point of attraction (connectedness) and convenience/proximity. The *comfort and image theme* was generated from the collapse of these sub-themes in both greenways: safety and alternative transportation/mobility. The *other activities and programs theme* arose from the collapse of these sub-themes in the BCGW: interact with pets, rarely socialize, and planning activities/programs. F*or the don't socialize theme and* sub-theme, it was stated by one of WOCGW users *"I don't believe people should actually use the greenways to socialize as they would probably block path standing around socializing."* The *image and attractiveness* arose from the collapse of these sub-themes in the WOCGW: greenness *(Question 18)*. The other theme and sub-theme remained with the same identification in both greenways.

In terms of the users' perspectives about the social benefits of greenways the *sociability/interactions* presented the highest frequencies in the BCGW and WOCGW (with moderate response rates of 50.40%/66 and 45.05%/50, respectively), followed in second place, for the BCGW and WOCGW, by the *exercise/physical activity* with equivalent low-moderate frequencies (with 16.03%/21 and 16.22%/18, respectively). In third place, the nature/natural environment presented low-moderate frequency in the BCGW (with 11.45%/15) and for the WOCGW in the health development with low-moderate frequency (with 15.32%/17). On the other hand, the BCGW presented the lowest frequencies for the *other activities and programs* and *other* categories (with 2.29%/3 and 1.52%/2). For the WOCGW the lowest frequencies were respectively encountered in the *none, don't socialize and image and attractiveness* categories (with 2.70%/3, 1.80%/2 and 0.90%/1) *(Question 18)*.

From the respondents perspective about the social benefits of greenways, the most mentioned ones for the BCGW were *sociability/interactions, exercise/physical activity* and *nature/natural environment* and included: *"meeting others in an open setting", "meeting*

people outside my neighborhood", "getting to know who is around you", "meet new people", "a free place to meet", "meeting people with similar interests", "connects people with common interests", "to meet and interact with new people", "feeling a common purpose with neighborhoods", "meeting neighborhoods", "feeling that the neighborhoods have similar values as I", "feeling a common purpose with neighborhoods", "spend time with people I know", "keeping connected to neighborhoods", "be together with the ones I love", "meet a friend and exercise", "friendship tie", " place to see my friends", "place for people to get together", "make new friends", "see new friends", "seeing people", "share ideas with friends", "easy gathering/meeting place", "hanging out with people", "attracts people", "beautiful scenery around you when you're with people", "more conducive to discussions", "it's a place to be active while hanging out with people", "socializing", "social environment", "spend time with people I know", "meet a friend and exercise", "great place to meet friends while enjoying nature", "meeting and running into friends", "share ideas with friends", "family bound and development", "increase appreciation of people", "family bonding", "family togetherness", "community building", "social environment, community identity and bonding", "bring my community together", "ties in different communities of the Town", "interact with new people", "to meet and interact with new people", "make new friends", "seeing and meeting people outside my neighborhood", "reduce social alienation and isolation", "cultural exchanges", "nurturing of others", "welcome - friendly environment" and "friendly atmosphere"; "encourages group physical activity", "exercise together", "exercising while socializing", "group exercise", "family physical exercise", "walking with family", "provides meeting/exercising with groups", "provide outdoor recreation for groups (exercise and nature observation)", "provides social activities (group exercise etc)", "provides meeting places for picnic of groups…", "allow people to walk and talk without traffic noise", "it's a place to be active while hanging out with people", "exercise", "run", "place to walk", "great place to walk/bike/run" and "run, walk, rollerblade, bike"; "well being" and "rest and relief from week work days" (Question 18).

The most mentioned ones for the WOCGW *sociability/interactions, nature/natural environment* and *health development* were: *"make new friends", "making/meeting new*

fiends", "friendship ties", "friendship linkage", "probably to see my friends", "friends connection", "being with friends", "friends gathering", "family bond", "family togetherness", "being with family", "family support", "just being in presence of other people who talking can be comforting", "talking with others–interacting", "easy to start conversation with strangers, if you want to", "see and meet new people", "meeting people and bringing people together", "develop relationships from seeing same people", "social environment", "use to improve current relationships (talk and spend time together)", "provide a communal place to do activities", "interaction can be spontaneous", "impromptu conversations", "allowing people to meet others", "meeting new people by chance, not planned", "build familiarness with a neighborhood or Town", "you might meet neighborhoods that otherwise you would never see", "neighbors connection", "sense of community", "community interaction", "kids togetherness", "children meeting other children and playing", "building social strengthen", "mutual learning", "confidence in myself and others", "nice to view wildlife together", "socio-cultural and nature enjoyment", "welcome environment", "neighborhood and community identity" and "interaction with exposure to various cultures is healthy for society, and greenways attract people of all backgrounds and ethnicities, which is wonderful!"; "appreciation of nature", "get clean oxygen", "a place to get some fresh air and interact with nature without driving out to the country", "fresh air" and "1 on 1 with nature"; "healthy living", "healthier people are happier", "de-stress", "health", "quality of life", "peace on mind", "peaceful", "relaxing", "well being", "happiness", "a place to get away for a while", "communal health", "increase social physical activity - healthier population" and "encourage healthy interaction in a neutral setting" (Question 18).

8) greenway attributes, greenway user attitudes related to the greenway characteristics, greenway user expectations, greenway success, greenway features and greenway places for socialization according to the chart results of the survey questionnaire, in Appendix R.

For the greenway characteristics that encourage people to socialize, a total of 14 main-axial themes emerged: *physical structural features; street furniture; access and connectivity;*

image and attractiveness; exercise/physical activity; greenway/trail characteristics; nature/natural environment; none; comfort and image; don't socialize; sociability/interactions; landscape features; wildlife and weather conditions, after the collapse of the axial sub-themes categories, and their total frequency results were presented in the charts comparing the categories in both greenways *(Question 16)*.

The *physical structural features* arose from the combination of these sub-themes in the BCGW: gazebo/Kiosk with benches, playgrounds, dog area, fitness area, observation stations, shelters, picnic areas, stretching areas, overlooks with benches, public restroom, amphitheater, meditation areas, fitness and sitting areas and walking board areas; and from the WOCGW: playgrounds, fitness areas, dog area, multi-use areas, observation stations, stretching areas, walking board areas, public restrooms, gazebo/kiosk with benches, shelters, picnic areas and community garden. The *street furniture* was generated from the combination of these sub-themes in the BCGW: benches/sitting areas, activity signs, drinking fountains, information panel and tables; and the WOCGW were: benches/sitting areas, lighting post, drinking fountains, information panel, activity signs, nature/wildlife signs and pet drinking fountains *(Question 16)*.

The *access and connectivity* was generated from the combination of sub-themes in both greenways: greenway connections/more trails (connectedness), accessible and accessibility. The *image and attractiveness* was generated from the combination of sub-themes in both greenways: aesthetics/scenery values and trail maintenance. The *exercise/physical activity* was generated from the combination of sub-themes in both greenways: activities and program. The *greenway/trail characteristics* was generated from the combination of these sub-themes in the BCGW: activity nodes, trail signs/markings, wider trails, woods and trees with benches; and the following sub-themes from the WOCGW: activity nodes, wider trails and trail surface. *The nature/natural environment* theme was created from the collapse of these sub-themes in both greenways: naturalness, share environmental interest and same points of environmental interest: places and/or actions. *The comfort and image* theme was generated from the combination of these sub-

themes in the BCGW: safe place; and from the WOCGW: safety and quiet place/environment. The *landscape features* were generated from the combination of these sub-themes in the WOCGW only: Water Resources: *"lake" and "ponds"*, and vegetation: *"More flowers and green plants."* The *wildlife* theme remained the same as the sub-theme *wildlife* and only was mentioned in the WOCGW. The *weather conditions* theme remained the same as the sub-theme *weather conditions* and only was mentioned in the WOCGW *(Question 16)*.

The *none* topic and *don't socialize* remained the same in their sub-topics in both greenways, in which some respondents provided important reports related to not using the greenways for socialization. In the BCGW: *"none", "I don't think people are necessarily looking to meet people on the greenway" and "for me don't really care, nothing would engourage me to socialize more or less"*, and in the WOCGW: *"none", "unsure", "sorry, I don't feel people use the greenway to socialize. It just happens - people will if they're comfortable doing so. Some will, some won't", "it's not a social motivation in my opinion", "the greenway allows people who live in the city the opportunity to feel, interact and enjoy the nature, away from people and away from the city", "I don't go to the greenway to meet people, I go to get away from people and be close to nature."* On the other hand, the *sociability/interactions* theme was generated from the combination of these sub-themes in both greenways: welcome: *"welcome environment" (BCGW)* and *"the greenway has no life on its own. It only reflects the condition of the people who go there and those who made it (WOCGW) (Question 16)*.

In terms of the greenway characteristics that might encourage more people to socialize, the *physical structural features* presented the highest score in the BCGW (with 35.54%/43), followed in second place by the *street furniture* with low-moderate frequency (with 18.18%/22). The WOCGW presented the highest moderate score for the street furniture (with 25.45%/28), followed by the physical structural features with the second place in terms of frequency (with 22.73%/25). On the other hand, the comfort and image and don't socialize presented the lowest scores in the BCGW (with 1.65% each/2 each) and the WOCGW presented unique categories with the lowest frequencies, respectively for the

landscape features (with 2.72%/3), than the *sociability/interactions* and *wildlife* that presented equivalent frequencies (with 1.81% each/2 each) and, finally, weather condition (with 0.91%/1) *(Question 16)*.

From the respondents perspective about the greenway characteristic that encourage people to socialize, the most mentioned characteristics for the BCGW *structural features* and *street furniture* were: *"gazebo/kiosk with benches", "provide shelters, wide wooden kiosks and walking board areas", "more relaxation/resting areas alongside (bench, gazebo)", "playgrounds", "dog area", "fitness area", "pets and kids areas", "put playground near Lake Crabtree", "educational bulletin board / kiosk", "More larger sitting areas, like the gazebo on Crabtree", "gazebo with view to Lake Crabtree", "playground equipment", "playgrounds", "dog areas (is necessary one)", "a dog park", "exercise stations", "outside gym equipment", "physical exercise stations", "scenic spots", "picnic/shelter areas", "picnic areas with covered tables and grills", "stretching area", "overlook", "places to get water and restrooms", "additional facilities noted above (amphitheater and playground)", "areas for meditate", "sitting and fitness areas", "more benches", "sitting areas", "provide benches and tables", "more benches and/or grassy areas along sides of trail", "educational bulletin board/kiosk" and "water fountain".* The most mentioned characteristics for the WOCGW were *structural features* and *street furniture*: *"more benches", "seats", "more benches or places together", "have multiple benches together", "lighting at nights", "lighting in tunnel", "drinking fountains", "information panel stations–maps", "more signage on where you are and what/where it goes", "put safety watch sign", "event boards", "info signs about flora, fauna and wildlife", "drinking fountain for pets", "playgrounds", "play areas", "have common facilities, e.g. play equipment", "fitness trail", "workout equipment (pull-up bars, etc)", "workout or exercise stations along greenway trails", "very open grass areas to play with dogs off-leash", "dog park", "exercising stations", "have common facilities", "open areas for socializing", "have wildlife observation stations or ponds", "stretching stations", "restrooms, kiosk with benches", "picnic areas", "community garden or public garden" (Question 16)*.

For the greenway characteristics that discourage people to socialize, a total of 19 main-axial themes emerged: *image and attractiveness problems; lack of physical structural features; lack of street furniture; greenway/trail characteristics problems; lack of access and unconnected; none; crowding; people's bad behaviors; not applicable; conflict with insects and plants; conflict with insects; greenway rules issues; exercise/physical activity conflicts; others; bad weather conditions; lack gathering/socialization areas and wilderness issues (Question 17)*.

The *image and attractiveness problems* theme was generated from the combination of these sub-themes in the BCGW: trash/pet waste, bad smell, weather damage, lack maintenance and bad facilities; and in the WOCGW: lack maintenance, vandalism/depredation, bad smell, trash/pet waste, noisy problems and weather damage. The *lack of physical structural features* theme was generated from the combination of these sub-themes in the BCGW: lack multi-use facilities/facilities, lack of shelters, lack of playgrounds, lack of gazebo/kiosk, lack of observation stations/belvederes, lack of fitness areas/exercise stations, lack stretching areas, lack resting areas and lack parking areas; and these sub-themes in the WOCGW: lack multi-use facilities/facilities, lack of shelters, lack of playgrounds, lack of gazebo/kiosk, lack of picnic areas, lack of fitness areas/exercise stations, lack stretching areas and lack of public restrooms. The *lack of street furniture* theme was created from the merge of these sub-themes in the BCGW: lack of benches, lack of lights, lack of tables and lack sitting areas for socialization; and these sub-themes in the WOCGW: lack of benches, lack of lights, lack of trash cans, lack sitting areas for socialization, lack of drinking fountains, lack of tables and lack of public emergency telephones *(Question 17)*.

The *greenway/trail characteristics problems* theme was generated from the combination of these sub-themes in the BCGW: lack activity node areas: *"don't provide areas on the trail-side", "lack of spaces for people to get together", "not enough equipment (playground, gym-stretch and benches)", "lack of places for socialization near the trail" and "Not improving areas for socialization (seating areas, gazebo-belvedere)", narrow trail/ greenway areas issues: "narrow areas", "narrow paths", "long narrow paths" and "trail path too narrow"*, trail

paved markings conflicts: *"barriers (designated, marked lanes)";* and these sub-themes in the WOCGW: narrow trail/ greenway areas issues: *"narrow parts", "short and narrow greenway", "greenway goes in little circle like a track, people don't stop", "lack of grassy open spaces", "long stretches with nothing but trees", "no cover from rain" and "having no shady areas"* and trail surface issues: *"poorly paved trails."* The *lack of access and unconnected* theme was generated from the grouping of these sub-themes in both greenways: lack of greenway/trail connection: *"lack of access" and "if its not easily accessible", and lack of trail connections "lack of trail connections" (BCGW)* and *"absence of parks", "going near highways/having to cross roads", "no connection to parks/schools/commercial areas", "not connected greenway", "no connection to other greenways", "lack of connection", "lack (missing) connection-same greenway" and "no connectivity", and lack of access: "the fact that part is closed and has been since May 2012" (WOCGW) (Question 17)*.

The *none* theme and sub-themes in both greenways remained the same. The *crowding* theme was created from the grouping of these sub-themes in the BCGW: extremely crowded*: "too much traffic on greenway", "too many people at times", "it is overgrown", "presence of lots of people", "crowding (overuse)" and "presence of lots of people (trail)";* and these sub-themes in the WOCGW: *"lots of people", "overuse", "lot's of people using at the same time", "presence of too many people", "crowded" and "you can't socialize if the greenway is too noisy/crowded."* The *people's bad behaviors* theme remained the same as the sub-theme in both greenways: *"bikes in way of walkers" and "unruly people" (BCGW)* and *"people that do not behave courteously to manage a polite hello or conversation", "people on greenway to cause trouble", "people don't pick up after pets" and "disrespectful kids / teens" (WOCGW)* The *not applicable* theme remained the same as the sub-theme in the BCGW that corresponds with the *"n/a" and "not sure"* answers and for the WOCG also remained the same, that correspond to *"the greenway only reflect the condition of the people who go there and those who made it"* and *"socialization It just happens - people will if they're comfortable doing so. Some will, some won't" (Question 17)*.

The *conflict with insects and plants* theme was created from the sub-theme only in the BCGW: presence bugs/poisonous plants. The *conflict with insects* theme was created from the sub-theme only in the WOCGW: presence of bugs. The *greenway rules issues* was generated from from a sub-theme in the BCGW only: too many rules. The *exercise/physical activity conflicts* theme was generated from the combination of these sub-themes in the BCGW: traffic barriers: *"presence of people on the trail standing and talking, blocking our passage"* and conflicting activities: "bikers x walkers"; and he sub-theme in the WOCGW: conflicting activities: "mixing uses, e.g. biking and horseback riding", "serious bike riders" and "people smoking (at least for non-smokers)." The *conflict with insects* theme and sub-theme remained the same and only was mentioned by the WOCGW respondents: presence of bugs. The *others* theme and sub-theme remained the same in both: additional comments. The *bad weather conditions* theme only was mentioned in the WOCGW and only presented one sub-theme, which was: inclement weather. The *lack gathering/socialization areas* theme and sub-themes remained the same and only were mentioned by the BCGW users: *"lack of gathering places" and "lack socialization areas near the trail."* The *wilderness issues* theme and sub-themes remained the same and only was mentioned by the WOCGW: fear of wilderness.

In terms of the greenway characteristics that might discourage more people to socialize, the image and attractiveness problems presented the superior, albeit low-moderate, frequency in the WOCGW (with 17.40%/20) and secondly with low-moderate response in the *lack of physical structure features* and *lack of street furniture* with equivalent frequencies (with 14.78% each/17 each), followed by *greenway/trail characteristic problems, unsafe/insecurity and lack of access and unconnected* with low frequency (with 7.83% each/9 each). On the other hand, the the lowest scores for the WOCGW were *conflict with insects and plants, wilderness issues and socializing* (with 1.74% each/2 each). The BCGW presented the superior, albeit moderate, frequency in the *lack of physical structure features* (with 16.33%/16), followed by low frequencies for the image and attractiveness problems, the greenway/trail characteristic problems and unsafe/insecurity (with 10.20% each/10 each). On the other hand, the BCGW presented the lowest scores for *people's bad behaviors,*

conflict with insects and plants, conflict with animals, greenway rules issues, bad weather conditions and lack/gathering socialization areas (with 2.04% each/2 each), followed by *others* (with 1.02%/1) *(Question 17)*.

From the respondents perspective about the greenway characteristic that discourage people from socializing, the most mentioned ones for the BCGW were: *lack of structural features*, *lack of street furniture, image and attractiveness problems, greenway trail characteristic problems* and *unsafe/insecurity* were: *"lack of multi-use facilities along the trail", "don't provide areas on the trail-side", "Nonexistence of places for socialization near the trail", "lack of facilities for socializing", "lack of spaces for people to get together", "absence of facilities (shelters, benches, tables, kiosk)", "lack of tables", "not improving areas for socialization (seating areas, gazebo-belvedere)", "absence of kiosks/gazebos", "lack of playgrounds", "not enough equipment playground", "lack of observation points", "lack of belvederes", "no resting spots", "lack of benches", "bad facilities", "debris on greenway", "no sitting areas", "dirty - negleted toilet facilities", "limited visibility", "trail path too narrow", "long narrow paths", "lack of access", "it is overgrown", "barriers (designated, marked lanes)", "not enough parking during events", "dark spaces", "crime on the trail (like the Tobacco Trail in Durham)", "crime on greenway" and "concerns about safety"*. For the WOCGW, the most mentioned characteristics were: *image and attractiveness problems*, *lack of structural features*, *lack of street furniture, greenway trail characteristic problems, unsafe/insecurity* and *lack of access and unconnected* were: *"more spots for water", "drinking fountains", "greenways need to connect destinations so people stop", "accessibility to parks", "access must be safe and easy", "connection to parks/playgrounds to make it a destination", "more trails (walking path)", "trail expansion", "more entrances from neighborhoods", "scenic views or Information", "need shelters", "more benches", "play areas", "playgrounds", "fitness trail, workout equipment (pull-up bars, etc)", "picnic areas", "no features that provide socialization", "have multiple benches together", "socializing away from the trail, to not block passage", "kiosk with benches", "community garden area or public garden", "have wildlife observation stations or ponds", "more benches or places together", "more walking boards –*

decks", "lighting at night", "put safety watch sign", "bike lanes, safety" and "safety partrol" (Question 17).

From the perspectives about the greenways' positive attributes, a total of 15 main-axial themes emerged: *comfort and image, image and attractiveness, nature/natural environment, exercise/physical activity, access and connectivity, greenway/trail characteristics, sociability/interactions, landscape features, health development, wildlife, physical structural features, street furniture, seclusion/solitude experiences, interaction with animals and others (Question 19)*.

The *comfort and image* was generated from these sub-themes in the BCGW: Safety, Away from Traffic, Alternative Transportation/Mobility, Shaded, Quiet Place/Environment and Spirituality/Meditation; and from the WOCGW: safety, quiet place and environment, away from traffic, spirituality/meditation, and alternative transportation/mobility. The *image and attractiveness* was generated from the combination of these sub-themes in the BCGW: cleanliness/well maintained, aesthetic/scenery values and greenness; and these sub-themes in the WOCGW: aesthetic/scenery values, cleanliness/well-maintained and dynamic/interesting Place. The *nature/natural environment* was generated from the combination of these sub-themes in the BCGW: naturalness, share environmental interests and being outdoors/open spaces; and these sub-themes in the WOCGW: naturalness, share environmental interests, being outdoors/open spaces and see/watch/observe nature. The *exercise/physical activity* was generated from the sub-theme in the BCGW: exercise/physical activity and the sub-theme in the WOCGW was: individual exercise/physical activity *(Question 19)*.

The *access and connectivity* was generated from the combination of these sub-themes in both greenways: greenway connections (connectedness): *"connection to parks", "connect neighborhoods", "connected to parks and other places of interest, "connection to other greenways", "access to park", "the access to Lake Crabtree Park", "connection points to nature zones", "neighborhoods and commercial areas" and "landscape connection"*,

convenience/proximity: *"close by", "proximity to home", "the proximity to where I live and the beauty of your surroundings", "close to home", "proximity to my house", "convenient" and "just a great place to take walk that's convenient to my home"* and accessible/accessibility: "access to park", "the access to Lake Crabtree Park" and "Easy to access throughout Cary, Apex, Morrisville"; and from the WOCGW: greenway connections (connectedness): *"few if any commercial buildings near or on", "connect with nature", "connects neighborhoods", "linkage to other parks and playgrounds", "connection to parks, playgrounds and YMCA", "provides neighborhoods connectivity and buffers", "they do connect in a lot of places" and "connection to schools"*, convenience/proximity: *"close proximity to home", "proximity to home", "convenient", "safe exercise close to home" and "convenient place"* and accessible/accessibility: "easy access", "open and accessible to everyone", "easy access to exercise", "provides access to other areas", "accessible - encourages easy outdoor activities" *(Question 19)*.

The *greenway/trail characteristics* theme remained the same in the sub-theme in both greenways: *"variety of surfaces (paved, natural, mulch) to suit many", "trails", "large trails", "many paths", "how long it is", "good length", "paved trail", "shaded", "a variety of trails", "paved", "Variety of paths", "well-maintained path" and "nice paths/trails" (BCGW)* and *"paved", "length", "good walking trail", "they are buffered in lots of places", "extensive layouts and wide paths", "wide enough for passing others", "optimized for watching nature and wildlife", "nice, wide and smooth", "good trails", "long", "protected areas" and "good use of urban space" (WOCGW) (Question 19)*.

The *sociability/interactions* theme was generated from the combination of these sub-themes in the BCGW: children development/interactions: *"great place for kids to play", "child friendly" and "great place for kids to play safe",* socialization: *"natural and social place" and "social environment"*, meet new people: *"opportunity to meet other people"*, diversity/social mix: *"diversity of people"* and meet neighborhoods: *"nice place to chat with neighborhoods";* and from these sub-themes in the WOCGW: welcome: *"friendly for walking or biking", "friendly people" and "welcome place (to see, contact and communicate with others)"*,

socialization: *"great social venue", "neutral" and "safe place to congregate"*, people togetherness/gathering/meeting (socializing): *"nice to see and talk", "great way to spend time in natural setting and with others" and "enables the exchange of ideas and values with others"*, diversity/social mix: *"open and accessible to everyone" and "suitable for all ages"*, public/democratic place: *"it is free"*, children development/interactions: *"kid-friendly"* and neighborhood integration/neighborliness: *"neighborhood feeling" (Question 19)*.

The *landscape features* theme remained the same in the sub-theme and only was mentioned in the BCGW: *"natural landscapes", "pretty landscapes", "woods, trees and creek", "natural landscapes", "variety of landscapes", "lake view" and "creek and lake."* The *physical structural features* theme remained the same in the sub-theme and only was mentioned in the BCGW: *"gazebo overlooking" and "trail."* The *street furniture* theme remained the same in the sub-theme and only was mentioned in the WCGW that were: *"benches are good to see and talk" and "some signs to give direction" (Question 19)*.

The *health development* theme remained the same in the sub-theme and only was mentioned in the WCGW: health/increase quality of life and public/individual health development. The *wildlife* theme remained the same in the sub-theme and was mentioned in both greenways. The *seclusion/solitude experiences* theme was generated from the combination of these sub-themes only in the BCGW: uncrowded and seclusion. The *interaction with animals* theme arose from the sub-theme in the WOCGW only: pet friendly. *The others* remained the same *as* the sub-theme and were mentioned in both greenways *(Question 19)*.

In terms of the user perspectives about the greenway positive attributes, the comfort and image presented the superior frequency in the BCGW and in the WOCGW (with 20.51%/40 and 17.34%/26). The second most mentioned topic, with low-moderate frequency, in the BCGW was image and attractiveness (with 18.98%/37). For the WOCGW, the second most mentioned was the exercise/physical activity with low-moderate frequency (with 16.00%/24). In third place was the nature/natural environment for both, the WOCGW and BCGW, with

low-moderate and similar frequencies (WOCGW: with 16.93%/33 and BCGW: with 15.33%/23). In contrast, the BCGW presented the lowest scores for the street furniture, interaction with animals and others (1.02% each/2 each) and the WOCGW presented comparable lower scores for the physical structure features, seclusion/solitude experiences and others (with 1.33% each/2 each) *(Question 19)*.

From the respondents' perspective about the social benefits of greenways, the most mentioned benefits for the BCGW were comfort and image, image and attractiveness and *nature/natural environment* : *"safety", "how safe it is", "safe", "great place for kids to play, safe", "no traffic", "able to exercise away from car traffic", "safe from traffic", "no cars", "great place to run, walk, bike away from traffic", "safer to run and ride on than roadways", "safe place to wokout (run, bike)", "Safer travel than roadside", "safe place to walk and run", "aids in "green" transportation", "alternate routes", "shaded", "quiet", "peaceful", "usually quiet", "quiet place", "relaxing", ""green" space to exercise, meditate and enjoy nature", "connect people with nature", "place to meditate", "peaceful place"; "nature", "nature closeness", "nature and beauty", "natural scenery", "opportunity to experience nature", "natural landscapes", "natural-beauty", "native", "pretty landscapes", "natural and social place", "woods, trees and creek"," "encourage more people to get outside in nature", "enjoy seeing nature while exercising", "connect to nature", "trees, shade, birds", "Variety of paths and landscapes", "Nature and wildlife observation", "connection points to nature zones, neighborhoods and commercial areas", "nature learning", "enjoy the nature instruction – informative", "opportunity to experience nature", "wooded", "nature and wildlife observation", "nature preservation", "nature learning", "open space", "appreciation of the outdoors" and "fresh air." (Question 19)*; and for the WOCGW: comfort and image, exercise/physical activity and nature/natural environment: *"safer exercise", "safe", "safety", "safe place", "safe walking trails", "safe place for recreation", "safe for biking", "safe place to walk and exercise", "safe environment", "safe recreation place", "calm environment", "quiet", "serene", "relaxing", "peaceful", "peaceful nature setting", "peace of mind", "safe - not near busy roads", "away from crowds" and "safe place to walk and bike with no cars"; "walking or biking", "exercise", "good place to exercise", "great way to get some exercise", "encourages exercise", biking",*

"good physical exercise and walking ", "good walkings", "focal point for activities", "can set your own pace at walking, running or using bike", "good place to take your dog", "place to walk pets", "place to walk dogs" and "encourages easy outdoor activities"; "nature", "beautiful woodlands", "Presence of natural areas", "great way to explore nature", "presence of nature", "Natural beauty", "peaceful natural setting", "beautiful nature", "you feel close to nature, even thought you are in the middle of the city", "quick escape to nature", "more nature", "great way to spend time in natural setting and with others", "enables the exchange of ideas and values with others", "help to preserve wilderness and to support environmental education and appreciation", "great place to observe nature", "optimized for watching nature" and "fresh air" (Question 19).

From the perspectives about the greenway negative attributes, a total of 12 main-axial themes emerged: *none; image and attractiveness; lack of access and connectivity; unsafe/insecurity; lack of street furniture; greenway/trail characteristic problems; lack of physical structural features; exercise/physical activity conflicts; crowding; others; conflict with animals and conflict with insects (Question 20)*.

The *lack of street furniture* was created from the grouping of these sub-themes in the BCGW: lack of benches, lack of drinking fountains, lack of trash cans, lack of lights and lack of tables; and these sub-themes in the WOCGW: lack of lights, lack of drinking fountains, lack of public emergency Telephone, lack of trash cans, lack of benches and lack of information panel. The *lack of physical structural features* was created from the grouping of these sub-themes in the BCGW: lack of public restrooms, lack of playgrounds, lack of activity node areas, lack of fitness areas/exercise stations and lack stretching areas; and these sub-themes in the WOCGW: lack of public restrooms, lack of fitness areas/exercise stations, lack stretching areas, lack of ramps, lack of skating areas, lack of educational areas, lack of public community garden areas and lack of socialization areas *(Question 20)*.

The *exercise/physical activity conflicts* theme was created from the grouping of these sub-themes in both greenways: conflicting activities and people bad behavior: *"path a bit too*

narrow for bikes and walkers", "sometimes crowded for walking my dog when lots of bike rides out", "trail conflicts (different activities)", people that block the trail talking and won't move", "narrow path results in the conflict of different activities", "skateboards and bikes don't always yield to pedestrians", unfriendly people, and selfish - careless patrons" (BCGW) and "Presence of people who don't control dogs "bicycling impacting other activities" and "congestion in places, blocking other activities" (WOCGW). The *crowding* theme arose from the sub-theme extremely crowded in both greenways: "only negative is sometimes crowded for walking my dog", "Sometimes too crowded", "sometimes get too crowded or too empty" and "too crowded at times*" (BCGW) and "some areas over used", "too many people", "sometimes get too crowded" and "overcrowding in places, blocking passage" (WOCGW).* The *conflict with animals and conflict with insects* themes remained the same in the sub-theme and only occurred in the BCGW. The *others theme* remained the same in the sub-category and only was mentioned in the WOCGW.

In terms of the users' perspectives about the greenway negative attributes, part of the users from both greenways not perceive any problem in the greenways. And some of the users of the WOCGW defined this no negative attributes perception as "*none if properly designed"*, *"none"* or *"neutral."* However, there was an equal response for the none category, and both problem categories of image and attractiveness problems and unsafe/unsecurity in the BCGW, with moderate frequencies (with 15.30% each/15 each). The users of the WOCGW were also divided between the none response and responses of lack of access and unconnected, both of which presented equal and moderate frequencies (with 14.13% each/13 each), followed by the greenway/trail characteristics problem with low-moderate percentage (13.04%/12) On the other hand, the BCGW presented lower frequencies in negative attributes such as crowding and others (with 4.35%;4) and the WOCGW presented lower frequencies for the conflict with animals and conflict with insects (with 3.06%;3 and 1.02%;1) *(Question 20)*.

In terms of the BCGW users' description about the greenway negative attributes, the most mentioned topics were image and attractivennes problems and unsafe/insecurity: *"poor*

maintenance", "need to be better maintained", "cut trees in areas and weeds grew in place", "sometimes the grass gets a little long along the trail", "sometimes the grass get over whelming in the summer", "a few "potholes" here and there on the trail", "sewer man hole stench", "occ. sewer smell", "sometimes there's a sewage smell", "dog poop", "dog mess on greenway", "run-off from development has eroded bridge and pavement", "debris", flooding" and "slippery and too muddy after rainstorm"; "sometimes somewhat isolated / safety concerns", "Safety concerns", "safety risk", "access to trespassers", "road crossings", "possibility of crime", "Isolated in spots", "might not be safe at night", "brings a lot of "foot traffic" near people's homes (affect privacy)", "In person back yard with no separation", "sometimes get too empty", "isolated (no people)", "isolated some places (no people)" and "road crossings" (Question 20).

In terms of the WOCGW users' descriptions about the greenway negative attributes, the most mentioned topics were lack of access and unconnected and greenway/trail characteristics problems: *"it isn't complete in either direction to connect to other greenways", "waiting for construction to be completed on 540 to fully access our greenway", "not enough of them", "not connected", "need more of them!", "not entirely and well connected", "some areas very isolated, don't feel safe alone", "sections closed for construction", "segments missing connections", "part is closed and has been for a long time", "not continuous - they are not all connected", "not connected through out counties" and "not connecting"; "flooding a residual mud", "some muddy/soggy areas don't dry well after rain", "some trail areas are very isolated", "sometimes with isolated and risky areas", "poor drainage (wet)", "tunnels that flood/and are muddy", "Sometimes, too narrow for bikers and walkers", "closes at dark", "some "blind curves" are dangerous when bikers fly around them", "some places flood during rain", "not enough pleasant sitting areas, picnic areas and green open space areas" and "lack of various trail facilities" (Question 20)*.

For the greenway locations where people meet new people, a total of 6 main-axial themes emerged: *physical structural features; other destination/point of attractions; landscape features; several greenway settings, street furniture and others (Question 22)*.

The *landscape features* was created from the grouping of these sub-themes in the BCGW that: lake, creek and grass area; and these sub-themes in the WOCGW: lake and marsh vegetation area. The *several greenway settings* was created from the sub-theme various/all greenway settings, in both greenways: "along greenway (various settings)" and "all over the greenway" (BCGW) and *"In brief passing, all over and parks" and "Open space areas" (WOCGW).* The *street furniture* theme was created from the grouping of these sub-themes in the BCGW: Drinking Fountains: *"stopping for water"* and Benches: *"at bench"*; and these sub-themes in the WOCGW: Benches: *"bench."* The *others* theme arose from one sub-theme in both greenways: additional comments: *"we bought our house specifically because it was connected to Black Creek trail and Umstead" and "how about cookouts, scavenger hunts, parent-child competitions?" (BCGW)* and "*but those relationships are irrelevant, they are not even acquaintances" (WOCGW) (Question 22)*.

Respondents also provided information of the greenway locations where they met new people, where the physical structural features received most mention for both greenways, but with greater prevalence in the WOCGW (WOCGW: with 72.54%/37 and BCGW: with 55.56%/30). The second greatest response in terms of locations to meet new people was the other destinations/point of attractions for the BCGW users, which received a low rate (with 18.52%/10) and the other destinations/points of attractions and others, with equivalent low frequencies (with 9.81%/5 each) for the WOCGW respondents. On other hand, the BCGW presented the lowest frequencies for street furniture and others (with 5.56%/3 and 3.70%/2) and the WOCGW presented the lowest frequencies for the landscape features and several greenway settings (with 3.92%/2 each) *(Question 22)*.

For the BCGW, the most mentioned locations where they meet new people were physical structural features and destinations/point of attractions: *"Just when walking on the trail", "just when waking on the greenway path", "on the Black Creek toward North Cary Park", "along the trail when walking/hiking", "walking on path", "walk/run ways", "just by constantly passing on same route and schedules while exercising", "on trail", "walking on trails", "Black Creek trail", "trail", "on a trail", "Black Creek while riding bikes", "mommy walks (military spouses)*

on the trail", "trail and lake", "along path (Black Creek)", "on the trail", "gazebo", "gazebo at the Lake Crabtree", "observation deck, Crabtree Lake - Black Creek Greenway", "at shelter/deck by Lake", "at the kiosk near the lake", "Smit's Gazebo" and "bridge"; "boat house (Bond Park)", "going to Bond Park", "at the boat house", "at Bond Park", "at a ball field", "an entrance to North Cary Park (many times)", "at North Cary Park", "park", "near our house, getting ready to walk to park" and "community events." Responses for thhe other category included: *"we bought our house specifically because it was connected to Black Creek trail and Umstead" and "how about cookouts, scavenger hunts, parent-child competitions?" (Question 22)*.

For the WOCGW the most mentioned locations where they meet new people were physical structural features and destinations/point of attractions: *"along trail", "during walk", "trail when walking", "when walking the trail", "just walking - only by chance on the trail. Not planned", "along paved greenway - usually because of pets", "Black Creek - viewing owls", "trail - when people are walking their dogs along with kids", "on the trail", "trail", "along the trail", "trail, when watching unusual bird", "pathway", "walking dog", "out on the path running", "trail when running", "when I am traveling at the same speed as someone else in the same place (trail)", "pets greeting each other - then talking with the other pet owner", "walking dog (greenway)", "trail when walking my dog", "by roads", "on trail", "playground", "at playground", "bridges", "at the bridge", "at the walking-boards" and "entrance"; "parks", "in parks" and "usually at park playground" (Question 22)*.

9) greenway attachment according to the chart for the survey questionnaire results, in Appendix R*:*

For the most memorable moments on the greenway, a total of 12 main-axial themes emerged: *sociability/interactions; wildlife experiences; landscape features and seasons; place attatchent (greenway); interaction with animals; exercise/physical activity; nature/natural environment; seclusion/solitude experiences; none; image and attractiveness; physical structural features and access and connectivity (Question 21)*.

The *sociability/interactions* theme was created from the grouping of these sub-themes in both greenways: family togetherness/bonding, children development/interactions, friendship ties/friendliness, neighborhood interaction/neighborliness and social capital development (bridge/ties). The *wildlife experiences* theme was created from the grouping of the sub-theme wildlife in both greenways. The *landscape features and seasons* theme was created from the grouping of these sub-themes in the BCGW: Landscape Changes Over Seasons and Landscape Features; and in the WOCGW: Landscape Features *(Question 21)*.

The *place attachment (greenway)* theme remained with the same name as the sub-theme in both greenways: *"pet memorial (cremated)", "got engaged!", "10K benchmark run through Black Creek Greenway", "Easter egg hunt (lake and woods)", "getting engaged while on a walk to my husband", "taking our daughter for her first walk after she was born" (BCGW)* and *"the first time that I ran for an hour straight" and "going exploring with my kids in their John Deere Gator" (WOCGW).* The *interaction with animals* theme was created from the grouping of these sub-themes in both greenways: interacting with pets and other animals experiences/interactions. The *exercise/physical activity* stayed with the same name as the sub-theme and was only mentioned in the WOCGW *(Question 21)*.

The *nature/natural environment* arose from the sub-theme in both greenways: naturalness: *"nature" and "totally interested in nature" (BCGW)* and "Enjoying nature", "observing plants", "seating near creek, forest and wetland areas contemplating landscapes", "presence of nature", "enjoy great weather", "getting caught in a storm" and "nature watching" (WOCGW). The *seclusion/solitude experiences* originated from the sub-theme seclusion in both greenways. The *none* aroaw from the sub-theme with the same name in both greenways. The *image and attractiveness* arose from the Aesthetic/Scenery Values sub-theme in both greenways. The *physical structural features* stemmed from the sub-theme with the same name in both greenways: *"kiosk" and "Lake Crabtree overlook" (BCGW)* and *"playing at playground" and "kids playing with neighborhoods on the playground" (WOCGW).* The *access and connectivity* was created from the sub-theme only in the BCGW:

Convenience/Proximity: *"becoming a runner at age 49 due to convenience of greenway" (Question 21)*.

The most memorable moment on the greenway with the greatest response rate for both greenways was sociability/interactions, mainly among the family kinship and friendship relationships. The BCGW presented a moderate frequency (50.00%/58) followed by the WOCGW with moderate frequency (39.63%/42). The second most prevalent topic in the BCGW was the landscape features and seasons, followed by wildlife experiences with low-moderate frequencies (12.94%/15 and 11.20%/13). The second most prevalent topic for the WOCGW was the wildlife experience with low-moderate frequency, followed by the exercise/physical activity with low frequency (15.10%/16 and 9.43%/10). In contrast, the BCGW presented respectively the lowest frequencies for the image and attractiveness and physical structure features (2.59%/3 and 1.72%/2), and the WOCGW presented the same topics as the BCGW with the lowest and equivalent frequencies for the image and attractiveness and physical structure features (1.89%/2 each), and also presented the lowest score for access and connectivity (0.86%/1) *(Question 21)*.

For BCGW users, the most memorable moments on the greenway presented the greatest incidence in the categories sociability/interactions, landscape features and seasons, and wildlife experiences: *"walking with my kids as they have grown", "seeing my kids enjoy nature", "spending time with family", "being with my family", "my husband and I love spent time at the Lake Crabtree Overlook", "time spent with kids", "walking my babies in strollers", "being around my family and friends", "walking with family", "walking with children", "family picnic", "getting engaged while on a walk to my husband", "interacting with kid", "talking with family on way to fish", "seeing my kids learn new skills", "walking dogs with family", "walking with my husband grandkids", "my boys swimming in it during the flood", "conversation with spouse", "teaching kids to ride bike", "taking our daughter for her first walk after she was born", "enjoying many special moments with my family and friends", "meeting kids and observe my toddlers growing interaction", "walking with my son and puppy", "seeing my kids play together and enjoy one another", "cycling with my son", "walking with my family when*

they visit", "taking my kids bike riding", "family time", "time spent with kids", "interacting with kids", "taking family photo" "paddle boating with my son", "kids riding bike", "enjoying being with my friends", "riding with friends", "be with friends and enjoy nature together", "running into my old next door neighbors", "group bike rides with friends", "talking with friends", "walking and talking with friends", "walking, talking and enjoying the company of my friends", "be with friends and enjoy nature together", "meet new neighbor" and "socializing place"; "Seeing deep snow", "change at seasons", "sledding on snow down some of the hills (when it snows)", "watching seasons change", "Observing landscape change – seasons", "walking greenway in the snow", "leaves change", "enjoy landscape beauty change over the different seasons along the year", "lake", "creek" and "woods"; "seeing deer and fox", "seeing 40 cormorants", "seeing cranes near the water", "copperhead crossing path in front of me", "seeing deer", "observing wildlife - deer, foxes, turtles, snakes and ducks", "saw an owl very close in day", "watching wildlife in the woods", "wildlife", "observing wildlife (snakes, herons and ducks)", "seeing a bald eagle", seeing a fox and "seeing deer on greenway" (Question 21).

For WOCGW users, the most memorable moments on the greenway that received the greatest prevalence were sociability/interactions, wildlife experience and exercise/physical activity: *"biking with my son", "riding bikes with family", "walking with the kids to Dunkin Donuts", "my husband helping me train for a 10K race", "walking with family", "walking the greenway trail and watching my son get on school bus for the first time", "walking with my friends", "spending time with spouse", "walking with wife", "early Saturday morning walks with my husband – peaceful", "playing with grandchildren on playground", "children having fun playing", "kids playing on the playground and in the creek", "teaching my kids to ride a bike", "watching my boys discover new things", "kids playing with neighborhoods (playground and creek)", "too many to list with family", "have a good time with family", "walking my dogs with my husband", "going exploring with my kids in their John Deer Gator", "playing with children", "walking and biking with family", "pushing my children in a stroller each day for many years", "talking with/and growing closer with my spouse", "taking children into the woods and stream", "taking child out with new toy car", "spending time with family",*

“walking while my child ride his bike”, “walking while my child ride his bike”, “bring my kids to the creek to play (water, rocks, trees)”, “walking with them now as they are older”, “building friendships by routinely walking and talking”, “running into an acquaintance I hadn't seen in a long time”, “walking with my friends”, “walking my dogs with my husband and meet other pet lovers”, “catching up with neighbors”, “meeting friendly strangers” and “chatting with people”; “seeing wildlife”, wildlife”, “seeing owls up close”, “seeing deer”, “unusual wildlife encounters”, “seeing rabbits”, “seeing blue herons”, “seeing a bald eagle eat a fish and finding snakes and turtles”, “Watching beavers at length”, “seeing owls”, “watching a turtle in the creek”, “seating near creek, forest and wetland areas contemplating landscapes and watching wildlife”, “seeing large snakes on it” and “see coyotes (briefly)”; “running on nice day”, “early morning walks or runs with sun rising”, “skating on ice”, “very pleasant feeling while walking”, “walking it during a storm”, “great runs at any time, even when it is raining “, “riding my bike”, “long walks for exercise”, “walking it on a summer night” and “riding bikes and walking” (Question 21).

5.4.2. Mapping Exercise Results with General Discussion with Comparisons Across Both Greenways

The mapping exercise survey results for each greenway and its segments are presented based on different topics: *start locations, end locations, destination places, meeting places and interaction places.* The total returned responses for the BCGW was 25.00% (n=50) and for the WOCGW was 37.00% (n=74). Table 73 illustrates the total frequency of the mapping exercise in each greenway type, its segments and surrounding areas according to each topic (*start, end, destination, meet and interact*). In all topics, the WOCGW surpassed the BCGW by almost two times, which may attributed to the higher number of returned responses. The global mapping exercise outcome for each greenway type, segments and surrounding areas was illustrated in Appendix T.

Table 73: Mapping Exercise Total Frequency Per Greenway Type.

Source: Pippi (2013)

Black Creek Greenway (n=50, 25%)		White Oak Creek Greenway (n=74, 37%)	
Legend Coding Stickers	**Total Stickers**	**Legend Coding Stickers**	**Total Stickers**
Start (S)	55	**Start (S)**	93
End (E)	62	**End (E)**	111
Destination (D)	106	**Destination (D)**	209
Meet (M)	52	**Meet (M)**	126
Interact (I)	69	**Interact (I)**	153

Tables 74 and 75 showed the total frequency of the global mapping exercise outcomes for both greenways in relation to their location in miles, according to each of the segment boundary areas. The “outsiders” locations of the BCGW segments (1, 2, 3 and 4) and the WOCGW (5, 6, 7 and 8) were represented mostly by schools, school parks, surrounding playgrounds, parks, parks facilities (playground, picnic shelter, restrooms, soccer field and basketball court), surrounding neighborhoods, other greenways and commercial areas. The information illustrated the possible flows of the greenway users related to specific locations within and outside of the greenway boundaries.

Table 74 shows the mapping exercise global outcome for the Black Creek Greenway, in terms of each category that fell within “X” mile(s) of the BCGW trail segment (1, 2, 3 and 4). A total majority of 322 places that fall within 0.25 miles from each of the greenway trail segments (1, 2, 3 and 4). The total minority of 22 places (Umstead State Park – S: 1; E: 2; D: 10, M: 0 and I:1; Lake Crabtree Park – S:1; E:1; D:4, M:1 and I:1) fall within 1 mile from the greenway trail segments; the Destination (D) followed by the Interaction (I) respectively presented the highest frequencies (D: 92 and I: 67). No place fell within 5 miles of the

greenway trail segments(1, 2, 3 and 4) or within more than 5 mile from the greenway trail segments (1, 2, 3 and 4). Apendix T shows a thematic map of the mentioned locations for each category in relation to the BCGW.

Table 74: BCGW Mapping Exercise Locations Total Frequency.
Source: Pippi (2013)

BCGW – Segments 1, 2, 3 and 4 – Locations				
Places	**0.25 miles**	**1 mile**	**5 miles**	**More than 5 miles**
Start (S)	53	2	0	0
End (E)	59	3	0	0
Destination (D)	92	14	0	0
Meet (M)	51	1	0	0
Interact (I)	67	2	0	0
Total Places	322	22	0	0

Table 75 shows the mapping exercise global outcome for the White Oak Creek Greenway, in terms of each category that fell within “X” mile(s) from the WOCGW trail segment (5, 6, 7 and 8). A total majority of 685 places fell within 0.25 miles from the greenway trail segments (5, 6, 7 and 8). The total minority of 07 places (American Tobacco Trail – S: 0; E: 1; D: 04, M: 01 and I:01) fell within 1 mile from the greenway trail segments; the Destination (D) followed by the Interaction (I) respectively presented the highest frequencies (D: 205 and I: 152). No place fell within 5 miles from the greenway trail segments (5, 6, 7 and 8); or more than 5 mile from the greenway trail segments (5, 6, 7 and 8). Appendix T shows a thematic map of the mentioned locations for each category in relation to the BCGW.

Table 75: WOCGW Mapping Exercise Locations Total Frequency.

Source: Pippi (2013)

WOCGW – Segments 1, 2, 3 and 4 – Locations				
Places	**0.25 miles**	**1 mile**	**5 miles**	**More than 5 miles**
Start (S)	93	0	0	0
End (E)	110	1	0	0
Destination (D)	205	4	0	0
Meet (M)	125	1	0	0
Interact (I)	152	1	0	0
Total Places	685	7	0	0

Table 76 shows the frequency results for each topic category, in relation with the BCGW and WOCGW boundary ("insiders") areas, that were extracted from the previous global outcome results ("insiders and outsiders") illustrated in the previous table 68, and shows a comparative of the two greenways in terms of the frequencies of the "insiders" locations only within each category. The BCGW presented greater frequency of "insiders" than "outsiders" in all the five topics Start, End, Destination, Meet and Interact (S, E, D, M and I); the Meet (M) category presented the highest frequency score for the "insiders" locations (with 98.05%/51) and the Destination (D) category presented the lowest frequency score for the "insiders" locations (with 73.57%/78). The BCGW "outsiders" location (situated outside of the greenway and segment boundaries) frequency results were – S: 14.57%; E: 16.15%; D: 26.43%; M: 1.95% and I: 13.07%. On the other hand, the WOCGW presented higher frequency only for the Start (S) category "insiders" locations (with 76.32%/71), moderate frequency scores for the Interact, Meet and End categories "insiders" locations (I: with 54.23%/83, 52.36%/66 and 49.53%/55) and the lowest frequency score for the Start (S) category for "insiders" locations (with 76.32%/71). The WOCGW "outsiders" location (situated outside the greenway and segment boundaries) frequency results were – S: 71/23.68%; E: 55/50.47%; D: 75/64.14%; M: 66/47.64% and I: 83/45.77%.

Table 76: Mapping Exercise Locations Total Frequency Per Greenway Type.
Source: Pippi (2013)

Black Creek Greenway (n=50, 25%)		White Oak Creek Greenway (n=74, 37%)	
Legend Coding Stickers	**Total Stickers Percentage/Number**	**Legend Coding Stickers**	**Total Stickers Percentage/Number**
Start (S)	85.43%/47	**Start (S)**	76.32%/71
End (E)	83.85%/52	**End (E)**	49.53%/55
Destination (D)	73.57%/78	**Destination (D)**	35.86%/ 75
Meet (M)	98.05%/51	**Meet (M)**	52.36%/66
Interact (I)	86.93%/60	**Interact (I)**	54.23%/83

Tables 77 and 78 show the results for each of the category's "insiders" locations within each greenway segment: BCGW in segments 1, 2, 3 and 4 and the WOCGW in segments 5, 6, 7 and 8.

As can be seen in Table 77, of all the BCGW segments, the segment 2 presented the highest frequency score for the Start (S) category and segment 1 the lowest frequency score (s2: with 29.09%/16 and s1: with 10.90%/6). For the End (E) category, the segment 1 presented the highest frequency score and segment 3 the lowest score (s1: with 37.09%/23 and s3: 11.29%/7). For the Destination (D) category, also the segment 1 presented the highest frequency score and segment 3 the lowest score (s1: with 34.90%/37 and s3: 6.60%/7). For the Meet (M) category, segment 2 presented the highest frequency score and segment 3 the lowest score (s2: with 40.38%/21 and s3: 5.76%/3). For the Interact (I) category, segment 1 presented the highest frequency score and segment 3 the lowest score (s1: with 33.33%/23 and s3: 7.24%/5). In summary, segment 1 presented the superior scores in the E, D and I categories and the segment 3 presented the inferior scores in the E, D, M and I categories.

Table 77: BCGW Exercise Locations Total Frequency Per Segment Type.

Source: Pippi (2013)

Black Creek Greenway (n=50, 25%)					
Legend Coding Stickers	**Segment 1 Perc./Numb.**	**Segment 2 Perc./Numb.**	**Segment 3 Perc./Numb.**	**Segment 4 Perc./Numb.**	**Total Sum Perc./Numb.**
Start (S)	10.90%/6	29.09%/16	13/23.63%	21.81%/12	85.43%/55
End (E)	37.09%/23	16.12%/10	11.29%/7	19.35%/12	83.85%/62
Destination (D)	34.90%/37	11.32%/12	6.60%/7	20.75%/22	73.57%/106
Meet (M)	28.84%/15	40.38%/21	5.76%/3	23.07%/12	98.05%/52
Interact (I)	33.33%/23	24.63%/17	7.24%/5	21.73%/15	86.93%/69

As can be seen in table 78, of all the WOCGW segments, the segment 5 presented the highest frequency score for the Start (S) category and segment 6 the lowest frequency score (s5: with 25.80%/24 and s6: with 12.90%/12). For the End (E) category, segment 8 presented the highest frequency score and segment 6 the lowest score (s8: with 15.31%/17 and s6: 7.20%/8). For the Destination (D) category, segment 7 presented the highest frequency score and segment 5 the lowest score (s7: with 16.74%/35 and s5: 4.78%/10). For the Meet (M) category, also the segment 7 presented the highest frequency score and segment 6 the lowest score (s7: with 26.98%/34 and s6: 5.55%/7). For the Interact (I) category, also segment 7 presented the highest frequency score and segment 8 the lowest score (s7: with 27.45%/42 and s8: 5.22%/8). In summary, segment 6 presented inferior scores in the S, E and M categories and the segment 7 presented the superior scores in the D, M and I categories.

Table 78: WOCGW Exercise Locations Total Frequency Per Segment Type.
Source: Pippi (2013)

White Oak Creek Greenway (n=50, 25%)					
Legend Coding Stickers	**Segment 5 Perc./Numb.**	**Segment 6 Perc./Numb.**	**Segment 7 Perc./Numb.**	**Segment 8 Perc./Numb.**	**Total Sum Numb./Perc.**
Start (S)	25.80%/24	12.90%/12	19.35%/18	18.27%/17	76.32%/93
End (E)	12.61%/14	7.20%/8	14.41%/16	15.31%/17	49.53%/111
Destination (D)	4.78%/10	6.69%/14	16.74%/35	7.65%/16	35.86%/209
Meet (M)	11.90%/15	5.55%/7	26.98%/34	7.93%/10	52.36%/126
Interact (I)	11.11%/17	10.45%/16	27.45%/42	5.22%/8	54.23%/153

The Appendix T illustrates the “outsiders” locations of the mentioned and spatialized locations with stickers for each topic category according to the greenway types. JMP Pro 10 Statistic Program, was used to generate the frequency distribution of the values of each location in relation to each of the categories and within each greenway structural network system surrounding locations: greenway and/or park landscape features (e.g. lake and pound), schools, school parks, surrounding playgrounds, parks, parks facilities (playground, picnic shelter, restrooms, soccer field and basketball court), surrounding neighborhoods, other greenways and commercial areas. In general, the results showed that the conventional parks, followed by schools near greenway locations and playgrounds were more prevalent with superior frequency scores if compared to the other locations, reinforcing the finding that those locations are more prevalent as Destination (D), Meeting (M) and Interactions (I) and/or serve as the main point of attraction, proving the symbiosis phenomena between the greenways of this study with those locations, in which people use the greenways to reach those locations and/or vice-versa.

The Appendix T presented a set of tables that show the BCGW mapping exercise “outsiders” locations for each topic category. The first table, presented a total of 6 Start (S) locations (conventional parks, other greenways and surrounding neighborhood) in which all of them (Bond Park, Lake Crabtree, Oxford Hunt Greenway, Reedy Creek Greenway,

Surrounding Neighborhoods and Umstead Park) presented equivalent frequency (with 16.00%/1 each). As can be seen in the second table, there were a total of 11 End (E) locations (conventional parks, other greenways, other BCGW segment and lake) in which the Umstead Park presented the highest frequency (with 27.00%/3), followed by the other segments of the BCGW and the Bond Park (with 18.00%/2 each). The third table shows a total of 52 Destination (D) locations (conventional parks, other greenways and/or path, school, highways, sidewalk, surrounding commercial areas and lakes) in which the Umstead Park presented the highest frequency (with 19.00%/10), followed by the WOCGW (with 11.00%/6 each). The fourth table shows a total of 15 Meeting (M) locations (conventional parks, other greenways and/or path, playground, sidewalk, surrounding neighborhoods and lakes) in which the North Cary Park and the Bond Lake presented the highest frequency (with 20.00%/3 each), followed by the Bond Park (with 13.00%/2). The fifth table shows a total of 20 Interaction (I) locations (conventional parks, other greenways, playground, senior center, surrounding neighborhoods and lake) in which the Bond Park and the North Cary Park presented the highest frequency (with 25.00%/5 each), followed by the Playground and Surrounding Neighborhoods (with 10.00%/2 each).

The Appendix T presented a set of tables that show the WOCGW mapping exercise “outsiders” locations for each topic category. The sixth table shows a total of 16 Start (S) locations (conventional park, other greenways, sidewalks, highway and streets) in which only the Park Village Greenway presented a higher frequency (with 62.00%/10) and the others (Bowers lane, Davis Dr., Hwy 55, NC 55 sidewalk, Sherwood Greens Greenway and White Oak Park) presented equivalent low frequencies (with 6.00%/1 each). The seventh table shows a total of 36 End (E) locations (conventional parks, other greenways, schools, street side trail, playgrounds, tunnel, pound, highways and streets) in which the Park Village Greenway presented the highest frequency (with 16.00%/6), followed respectively by the BCGW and the Bond Park (with 13.00%/5 and 8.00%/3). The eight table shows a total of 88 Destination (D) locations (conventional parks, other greenways and/or street side trail, school, highways, sidewalk, playgrounds, basketball court, picnic shelter, exercise points, underpass, pounds, surrounding neighborhoods, neighborhood pool, surrounding

commercial areas, other town area, highways and streets) in which the Bond Park presented the superior frequency (with 13.00%/12), followed by the Park Village Greenway (with 9.00%/8), then by the Davis Drive Park and the Davis Drive Elementary School (with 6.00%/6 and 4.00%/4, respectively). The ninth table shows a total of 46 Meeting (M) locations (conventional parks, other segment of the WOCGW, other greenways and/or path, playgrounds, basketball court, picnic shelter, soccer field, sidewalk, schools, surrounding neighborhoods, surrounding neighborhood pounds, commercial area and other town area) in which the White Oak Park, the picnic shelter of the White Oak Park and the Crabtree Creek Greenway presented the highest, and equivalent, frequency (with 8.00%/4 each), followed by the Davis drive Middle School/Park, Davis Drive Park, Park Village Greenway and the playground of the White Oak Park (with 6.00%/3 each). The tenth table shows a total of 60 Interaction (I) locations (conventional parks, walking board in the other segment of the WOCGW, other greenways, playgrounds, picnic shelter, soccer field, sidewalk, schools, surrounding neighborhoods, surrounding neighborhood pounds, commercial areas, street intersections, highways and streets) in which the BCGW, the Bond Park, and the White Oak Park presented the superior, albeit low, frequencies (with 8.00%/5 each), followed by the playground of the White Oak Park, and with equivalent scores by the picnic shelter of the White Oak Park and the Davis Drive Park (with 6.00%/4 and 5.00%/3 each).

CHAPTER 6: CONCLUSION

This chapter describes the final discussion of the study with the triangulation of the results across the multi-methods and the implications of the findings for policy makers and designers as well as possible areas for future research.

The main objective of this study is to describe the social interaction and behaviors that were enabled by the greenway environment, with detailed analysis of the different types and levels of social ties/bridges interactions that take place on recreational greenways by understanding the relationships between greenway characteristics and social network characteristics.

It was challenging to define the greenway social roles that are associate to the greenway characteristics and/or social life, by exploring the relationship between greenway characteristics (structural network system and greenway features) and the social network (social interaction, behavior, ties/bridges and cohesion). The study analyzed data from two greenways using descriptive statistics and data mining analysis (decision tree, clustering and regression) for complex and large data sets, to present the quantitative data. Finally, the quantitative and qualitative data gathered from the multi-method study of two greenways, the BCGW and the WOCGW, were combined and analyzed to test the research hypotheses and assumptions.

The multi-method analysis was used to measure the relationship between the social interaction dependent variables—ties/bridges; user tie/bridge interactions by gender and age; actor tie/bridge interactions; patterns of interactions; level of interactions; catalyst of interactions and centralities—and the different predictor variables—greenway type variable, greenway segments variable, greenway characteristics variable, greenway temporal variables, people variables and behavior variables.

6.1. Triangulation Across the Multi-Methods

The study was created based in *seven hypotheses and six assumptions.* The *first positive hypothesis (H1)* stated that all recreational greenways provide a positive impact on social factors, such as interaction, behavior, tie/bridge and cohesion, because they catalyze interactions within the community. To examine the *first hypothesis, two complementary hypothesis (H6 and H7)* were generated: recreational greenways can impact the social factors to a greater and different extent, depending on the greenway type *(H4)*, and different interactional styles (user type by gender and age, and different types of actor types: pure and transformative) can influence the social factors *(H5)*. To support this first set of hypotheses, one assumption was created: greenways have an impact on social networks *(A1)*. These hypotheses were confirmed by the descriptive statistics and data mining analysis (decision tree, clustering and regression). In addition, the protocol utilized in this study for behavior mapping was found to be effective in terms of observing the social network features, patterns and intensity. The GIS database was a powerful tool for the spatialization of the mapping exercise observations (especially the social network interaction and behavior features) and greenway characteristics (structural network system and features) and made possible the transferal of complex data sets to the statistical programs such as SAS and JMP.

The results of the 10,205 observations (BCGW with 5,512 observations and WOCGW with 4,693) showed that both greenways presented relative few occurrences of social tie/bridge interactions and connections, when compared to the non-occurrences. The BCGW presented a majority of 79.40% of *no occurrence of ties/bridges* (4,377 observations) and minority of 20.60% of *occurrences of ties/bridges* (1,135 observations) and the WOCGW presented a majority of 73.28% of *no occurrence of ties/bridges* (3,439 observations) and a minority of 26.72% of *occurrences of ties/bridges* (1,254 observations). The WOCGW presented slightly higher number of interactions than the BCGW. The study found by the descriptive statistics and data mining statistical analysis (decision tree, clustering and regression) that most of the independent variables (*greenway types, greenway segments*

type, greenway temporal variables, people variables and behavior variables), except the *greenway characteristics variables,* were consistent predictors of the phenomenon of social ties/bridges among the different users, actors, patterns of use/types of activities and levels of activities. Regression analysis showed significance in predicting *people variables* association with the *ties/bridges interactions*: in terms of actor and use type, the adult individuals (i.e. individual actor type) tended to interact more, followed by dyadic adult users. The dyadic child users tended to interact moderately and the dyadic adolescent and senior users tended to interact less. Groups and triadic relations presented a higher incidence of adolescent actors, followed by children with moderate incidence. The bigger the actor size (e.g. triads and groups), the lower the frequency of interaction. Of all the user age categories, the Senior users presented the lowest frequency but the highest tendency to interact more; males tended to interact more than females especially in the adult, children and adolescents categories, however in the senior category females tended to interact more. Regression analysis showed significance in predicting the association of *temporal variables* with tie/bridge interactions: in terms of periods of day, users/actors tended to interact more during the morning periods, followed by the evenings; they also tended to interact more during the weekends than the weekdays, and in terms of weather conditions, users interacted more during winds of WNW at 5 to 10 mph.

In terms of the relationship between the ties/bridges interactions with the *behavior variables and people variables*, decision tree analysis revealed association of the social ties/bridges interactions with the "old" patterns of use/types of activities (*behavior variable*) and actor type (*people variable*). Clustering and regression did not uncover an association between the social ties/bridges interactions and the "old" and "new" patterns of use/type of activities and the different complementary activities, because of the large data set of variables. To mitigate this problem, it was necessary to reduce the set of variables categories in order to provide more reliable frequency results. On the other hand, the findings of the descriptive statistics for the survey and mapping exercise approaches provided elucidative and complementary information for some of the independent variable sub-sets and mitigated the

lack of information related to some of the independent variables, such as the *greenway characteristics variables* and/or some *behavior variables*.

The *second hypothesis (H2)* stated that the greenways characteristics have the potential to catalyze interactions within the community. However, patterns of use and interaction might be affected by three different categories of greenway characteristics: type of structural network connection (destination/point of attraction), type of features (landscape and physical structure features) and street furniture components. To sustain the *second hypothesis, three complementary hypotheses (H3, H4 and H5)* were generated: different types of recreational greenways can impact social factors differently, depending on their intrinsic structural network characteristics: neighborhood connection and connection to a park, and connection to both: neighborhoods and parks as a destination/point of attraction *(H3)*; different styles of recreational greenways can influence social factors, differently, depending on their type of features. The physical structure features and street furniture components encourages greater social interactions than the landscape features *(H4)* and finally, the greenway that presents a connection with a park and with a park and neighborhoods, as a destination/point of attraction, presents more and specific interactions than does a greenway that only connects neighborhoods *(H5)*. These hypotheses were confirmed by the descriptive statistics (for the behavior mapping, survey and mapping exercise), but were not confirmed by the data mining: decision tree, cluster and regression analysis. Hypothesis 4 (H4) was confirmed through GIS spacialization of the attribute table information, where each of the greenway features (vegetation type, physical structural type, street furniture components and trail circulation layout type) was selected by location in relation to the social tie/bridge occurrence (target), confirming that the physical structural features and the street furniture presented more social interactions than the landscape features in both greenway types. The triangulation results of methods 2 and 3 provided important information regarding the relationship between social interaction and greenway physical environment characteristics. Results for each greenway type are presented below.

Of all of the occurrences of ties/bridges (observations) on the BCGW, the majority occurred on the trail and within 10 feet of the trail (937 occurrences). The number of occurrences of ties/bridges recorded for the physical structural features was 116 observations of which the physical structural type presented 112 occurrences of ties/bridges (bridges: with 60 ties/bridges, kiosk/gazebo: with 34 ties/bridges, exercise stations: with 8 ties/bridges and picnic tables: with 6 ties/bridges); while the street furniture components presented 4 occurrences of ties/bridges (drinking fountains and pet drinking fountain: with 4 ties/bridges). In the landscape features within each of the vegetation types, the BCGW presented a total of 82 (observations) occurrences of ties/bridges (maintained grassy open field: with 28 ties/bridges, riparian vegetation: with 25 ties/bridges, open meadow: with 19 ties/bridges, lightly wooded forest: with 7 ties/bridges and heavily wooded forest: with 3 ties/bridges).

Of all of the occurrences of ties/bridges (observations) on the WOCGW, the majority occurred on the trail and within 10 feet of the trail (1,052 occurrences). The number of occurrences of ties/bridges in the physical structural features was 176 (observations) of which the physical structural type presented 133 (observations) occurrence of ties/bridges (bridges: with 61 ties/bridges, playground: with 56 ties/bridges, tunnel/underpass: with 12 ties/bridges, walls: with 2 ties/bridges and fences: with 2 ties/bridges); while the street furniture components presented 43 (observations) occurrence of ties/bridges (pedestrian/bike cross walk post: with 25 ties/bridges and benches: with 18 ties/bridges). In the landscape features within each of the vegetation types, the WOCGW presented a total of 26 (observations) occurrence of ties/bridges (riparian vegetation: with 11 ties/bridges, maintained grassy open field: with 9 ties/bridges and freshwater forested shrub wetland: with 6 ties/bridges).

Correlation of the results for both greenways demonstrated that the WOCGW presented greater occurrences of ties/bridges in the structural network connection with a total of 1,052 ties/bridges occurrences (trail circulation layout type) and physical structural features with a total of 176 observations: (physical structural type: with 133 observations and street furniture type: with 43 observations). On the other hand, the BCGW presented a total of 937

ties/bridges occurrences related to the structural network connection (trail circulation layout type) and 116 observations for physical structural features (physical structural type: with 112 observations and street furniture type: with 4 observations). However, the BCGW presented greater occurrences of ties/bridges in the the vegetation features with a total of 82 ties/bridges occurrences, as compared to the WOCGW that presented a total of 26 ties/bridges in the vegetation features. In summary, it was more evident the occurrence of tie/bridge interactions along both of the greenway trails, rather than at greenway features, and this may be because of the lack of designed greenway features, or lack of designed activity node areas, or because the interactions arose spontaneously.

Since most of the ties/bridges interactions occurred on the greenway trails, with few cases located at greenway features, the GIS database provided the information of the social role for the greenway type and its segments, based on the vegetation type, physical structure configuration, street furniture components, types of connection and trail characteristics, but did not provide information related to socialization for each of the greenway topography features and water features. As a consequence, in future studies it will be important to verify whether certain trail circulation layout types (10 feet wide, sinuosity/organic and bifurcate) impact social aspects more than the greenway features (landscape features and physical structural features).

The descriptive statistics provided valuable complementary information for the social network characteristics in the behavior mapping and the greenway characteristics spatialization in GIS. However, the GIS database did not presented quantitative results for each of the spatialized greenway features (vegetation features and/or physical structural features, and/or street furniture components) and structural network system in terms of which of the greenway characteristics presented more or less social tie/bridge interactions. It only provided the thematic map spatialization and the analysis and evaluation with descriptive statistics separately for the greenway characteristics and the greenway social role. On the other hand, the GIS database was able to correlate the *social dependent variables* with the *greenway types variables* and *greenway segment variables* and also

facilitated the data feature categorization and description of the *greenway characteristics variables* (independent variable), which were compiled and analyzed successfully using descriptive statistics, providing a connection between the social aspects and the greenway characteristics.

Decision tree, clustering and regression analysis did not showed significant association with the *greenway characteristics variables* and because of this condition it was generated the second *negative hypothesis* for this study. Of all the *greenway characteristics variables*, only *connectivity to conventional parks* showed significance in predicting or associating the greenway characteristics with the social ties/bridges interactions. The Metro Park presented less probability of interaction than the Special Use Park and the School Park also presented less probability of interactions than the Special Use Park. However, there was no correlation between the Neighborhood Parks and Community Parks.

The descriptive statistics showed that the independent variables (*greenway types, greenway segments type, greenway temporal variables, people variables and behavior variables* and the *greenway characteristics variables)* were consistent prognosticators of the relationship between the social ties/bridges and the greenway features (behavior mapping, survey and mapping exercise).

The protocol, utilized in method 3 (Appendix O), demonstrated with effectiveness that the public recreational greenways can provide ideal physical environments for social interactions. For the pure actors' ties/bridges interactions, users come and perform activities together, and maintain interactions within their group only, without interacting with other actors. For the transformative actors' ties/bridges interactions, users may meet and interact at the greenway environment as casual, occasional, unexpected, planned or unplanned occasions, so their original pure actor tie/bridge pattern becomes a transformative actor tie/bridge pattern, as they interact with other pure actor categories, changing the patterns, promoting a more dynamic interaction. The definition and measurements of the three different levels of interactions (lower, medium and high level) effectively provided an

understanding of the social interaction level ritual and/or choreography: in the lower interaction level, the two actor categories interacted rapidly and without stopping their activity (smiling only; greeting and smiling). Upon interaction, each pure actor category transformed into a new pattern, generating a transformative actor tie/bridge category; in the medium level of interaction, two actor categories stopped their activity and interacted for a short time, also transforming from their original pure actor categories into a transformative actor tie/bridge type of interaction, and when they finished interacting then returning to their original activity and original pure actors category. At the high level of interaction, the two categories of actors, stopped their activity and interacted together by merging into a new actor group and going on to perform an activity together. They also changed the pattern of interaction and become a transformative actor tie/bridge type of interaction.

In terms of the characterization of the type of user by age in the people variables for the observational methods, it will be useful to break down the children category into more specific ages according to each stage of the childhood development, which may reveal differences in their behaviors and interactions: Ch under 2 years old, Ch with 2-5 years old and children with 6-12 years old. The Senior category could also be broken into the age-interval of 65-75 years old with the addition of an Elderly category for users over 75 years old. However, it would be hard to precisely differentiate these categories by observation techniques.

In terms of the spatialization and data compilation of information of the actors categories (pure and transformative) it was challenging to spatialize them by each category type, because each “point” spatialized in GIS for the behavior mapping, represented one person or individual unit or cell, and its characteristics (different variables), thus it was impossible to spatialize a Dyad (2 persons or individuals), a Triad (3 persons or individuals), or a a Group of persons or individuals (up to 25 persons or individuals) with only one dot. In terms of mapping the density of interactions based on their actor category type (pure and/or transformative), it would be helpful to have an hierarchical diameter scale classification (lower point for individuals - bigger points for bigger groups size).

One alternative for classifying ties and bridge (social network interactions) between different pure actor categories is to consider and count them as one tie/bridge relation, so instead of 4 interactions, there will be only one (for example, between IT or between DD). However, because a GIS attribute table was utilized and then imported to excel (rows: behavior mapping observed information of each user/actor and columns: variables observation content) However, because a GIS attribute table was utilized and then imported to excel (rows: behavior mapping observed information of each user/actor and columns: variables observation content) with the identification and information of each person or individual. Another alternative could be to recognize each type of network both within each inner-category and across other categories. In this case, 9 possible interactions could be counted (ITa, ITb, ITc, TaTb, TaTc, TbTa, TbTc, TcTa, TcTb). In both of these alternatives for handling the social interaction information and mapping in GIS, the identification and information of each person or individual would be lost (characteristics such as gender, age, type of activity, level of physical activity and complementary activity type).

The protocol utilized in method 2 (Appendix T) for analyzing the greenway characteristics was also effective. It can be used to describe greenway physical environments at different planning stages: inventory, planning and design process, management and post-occupation evaluation.

In terms of GIS mapping analysis (observations and mapping exercise) to achieve a better understanding about the greenway environment movement and physical interactions, spider diagrams, centroids, modeling path over a network and flow mapping can be useful in the spatialization of the social network interactions and also their interaction with the greenway and/or surrounding area destinations. For example, 1) distance of one actor type from other actors, 2) one destination distance from other destinations or distance between meeting and/or interactional places; 3) preferable or not preferable demand destinations allocations, 4) showing the flow of usage of the behavior tracking with direction of the movement along the greenways, 5) showing the distance among each of the greenway physical structural

features and street furniture allocations, 6) the presence of centroid spots of interactions, all of which can be mapped in GIS with the use of the network spatial analyst tool.

The multi-methods findings of this study with quantitative and qualitative data analysis were triangulated to enable a comparison of the overlapping multi-method approaches.

In the Triangulation of the Method 2: Greenway Characteristics Audit with the Method 3: Social Characteristic Audit Behavior Mapping, it was clearly shown which of the components of the greenway physical environments (*greenway characteristics variables: structural network connection, greenway features and street furniture components*) may or may not enhance or facilitate social interaction and behavior.

The findings showed that the greenway segments that are connected to parks and neighborhoods (BCGW segments 2 and 3) and the segments that are connected to neighborhoods only (WOCGW: segments 5 and 8) have the potential to impact social aspects more than the other segments with connection to only parks. It was found that the bigger the conventional park (e.g. Bond Metro Park, in the segment 4 of the BCGW), the more volume of people tended to use the greenway segment and the less interaction tended to occur. Segments 2 and 3 of the BCGW presented the greatest occurrence of social tie/bridge interactions compared to the other segments, and this may be attributed to their structural network connection (connected to a community park and neighborhoods) and features (vegetation features: presented moderate amount of riparian vegetation, low-moderate portions of heavily wood forest and lightly wood forest, and low amount of open meadow in both segments; physical structure features: moderate amount of bridges and sanitary sewer lines in both segments, and high-moderate amount of trail gates and moderate amount of fences in the segment 3; street furniture: presented in segment 2 moderate amount of benches and low amount of benches in segment 3, low-moderate volume of trash cans in segment 3 and low amount in segment 2, moderate amount of trail traffic signs in segment 3 and low signage system in segment 3). In contrast, in the WOCGW it was found that the greater volume of social tie/bridge interactions occurred in

segments 8 and 5, which are only connected to neighborhoods. The structural network connections provided a more significant association than the greenway landscape features and physical structural features, also the street furniture provided more significant association than the landscape and physical structural features. The segment 6 that was connected to neighborhoods, school and school/park (Davis Drive Middle School Park) and segment 5 that also was connected by neighborhoods and neighborhood conventional park (White Oak Park) presented the lowest volume of social tie/bridge interactions. (In terms of the greenway features, the segments 8 and 5 presented following vegetation features: the segment 8 presented high amount of heavily wooded forest, open meadow and freshwater forested/shrub wetland and moderate amount of lightly wooded forest and riparian vegetation and low-moderate maintained grassy open field and, in contrast, the segment 5 presented low-moderate amount of lightly wooded forest and maintained grassy open field, and low amount of riparian vegetation; physical structure features: segment 5 presented the high-moderate amount of bridges, and the unique presence and high amount of playground, moderate amount of tunnel and walls and low-moderate amount of sanitary sewer lines, and the segment 8 presented the unique presence with high amount of walking board, moderate amount of tunnel, walls and sanitary sewer lines; street furniture: segment 5 presented moderate amount of benches and signage system and moderate–low amount of bollard posts, information signs and trash cans, and the segment 8 presented the moderate amount of information signs, trash cans, trail traffic signs, signage system and temporary physical barrier, and low-moderate amount of benches and low amount of bollard posts).

In the Triangulation of the Method 2: Greenway Characteristics Audit, with the Method 3: Social Characteristic Audit Behavior Mapping and the Method 4: Standardized Survey Questionnaire and Mapping Exercise, the method 2 provided with GIS database the spatialization and descriptive information of the greenway features and structural network system types within the greenway types and segments boundaries. The method 3 provided the spatialization, analytical and descriptive information of the greenway social role within the greenway types and segments. Method 4 provided complemented the observational methods with descriptive and analytical information of the greenway adult and senior users

about how people perceive the socialization role, their behaviors and the greenway characteristics in terms of their impacts on greenway usage and socialization (positive impact and/or negative impact) and their preferences and meanings. The survey provided important and complementary information about what type of greenway characteristics impacted the social aspects (positively and/or negatively) and also provided information about what aspects and conditions motivated people to use and interact when they come to a greenway. The mapping exercise supplemented with a better understanding of the relation of the greenway structural network system and features with the social role components, with the spatialization and analysis of the locations in which users commonly go, including starting and ending places, destination places, meeting places and interaction places.

Greenways do appear to provide a positive physical environment for the social network, providing the important elements for the social utilization and well-being, because they directly influence the way that people perceive, experience, use, interact and behave. The positive perception of safety, comfort, image, attractiveness, nature/natural environment, access/connectivity, greenway/trail characteristics provide users with a feeling of comfort and security in the greenway physical environments, which were perceived as a peaceful, welcome, natural and calm place with various types of natural landscapes and wildlife, and these conditions are crucial components for interaction to arise. If the greenway physical environments did not provide those components, especially in terms of safety and comfortable scenery, it can negatively affect the users' behaviors and impair socialization and usage. Other factors, such as user age and gender, actor type and pattern of use/type of activity also influenced the greenway social interactions. This type of information is fundamental for understanding how to create quality recreational greenway physical environments and encouraging the socialization (individuals, community, society and tourists), the social-nature integration, environmental conservation and socio-environmental education, thus making greenways more successful and more interesting places for the community.

Recreational greenways provide a powerful environment that allows the ties/bridges connections for the social role interactions and behavior occurrence (user's and actor's inner and intra relations).

6.2. Strengths of the Study:

The utilized multi-method approach of this study (different phases of the study and with different populations: greenway expert and greenway users and actors) successfully showed the advantage in combining different methods: interview, observations, survey and mapping exercise in terms of its ability to compare people's perceptions and preferences with their actions, behaviors and interactions. The triangulation of the results provided positive insights in terms of correlation of different greenway characteristics (structural network and features) and different social network features (social interaction, behavior, tie/bridge and cohesion).

Method 2, focusing on the greenway characteristics and method 3, on the behavior mapping approach, together with the supplemented information from the method 4 approach, provided important information about the BCGW and WOCGW in terms of physical environmental characteristics (structural network system and features) and attempted to outline which characteristics impact place attachment, feeling, preference, value, social interaction among users of different ages and gender as well as among the different actors (pure and transformative). The study discovered and provided vital information in terms of the greenway social network components: interaction, behaviors, ties/bridges and cohesion occurrence and types. It was possible to recognize affordances, information about the behavior dimensions (pattern of use/types of activities, complementary behaviors and physical activity levels) and more specifically the greenway social dimension occurrence and its dynamics (ties/bridges relations, patterns and levels of interactions, catalyst of interactions and presence and types of centralities) on the different BCGW and WOCGW segments, generating new and valuable knowledge regarding the recreational greenway

physical environments and social usage. However, even though the presence of social network components—interaction, behaviors, ties/bridges and cohesion occurrence and types was documented for the BCGW and WOCGW, this social activity mostly occurred in a spontaneous fashion among the greenway users and actors, with few cases of socialization related to the greenway features. It was clear that the greenway environment as a whole creates and provides opportunity for recreation and alternative transportation, but its physical environments are still underdeveloped in terms of accommodating and affording socialization.

Methods 2 and 3 could be replicated not only for the other segments of the BCGW and WOCGW, but also to other urban and suburban public spaces (conventional parks, plazas and waterfront) and other greenways (urban, suburban and rural areas).

Another strength of this study was the large, rigorous and complex data set for the Method 3: Social Characteristic Audit Behavior Mapping, which provided extensive and detailed information about the recreational greenway social dimensions, mitigating the gap of knowledge in terms of understanding greenway social aspects and dimensions. The study provided a better understanding of the greenway's social role and indicated some guidelines for how the greenway physical environments could be used and designed to enhance socialization and social interaction with the greenway features.

The multi-methods approach provided exhaustive information and both quantitative and qualitative findings. The interview with the greenway expert in Method 1 and the survey and mapping exercise in Method 4 complemented the observational approaches in methods 2 and 3.

Finally, the mapping exercise generated elucidative qualitative information on how the greenway users (a portion of the surrounding neighborhoods residents) utilize the greenway for recreational and alternative transportation pursuits in different the greenway segments, not only the four utilized in this study, but also the other segments of the BCGW and

WOCGW. Also they indicated information of usage in other areas, such as other other segments of the BCGW and WOCGW, other greenways, conventional parks, neighborhoods, schools, playgrounds and commercial areas. This provided an understanding about the greenway flow and destinations/points of attractions areas and socialization areas as well.

6.3. Limitations of the Study:

One limitation of the method 2: behavior mapping and stationary observation was that the observations were conducted only during the Fall of 2012. Additional research on these greenways and their segments would provide deeper understanding related to other seasons: winter, spring and summer and fall. In terms of external validity, the results cannot be applied to other times, periods of days and days of the week during the other seasons, due to differing weather conditions and changes in landscape features. Additionally, because data was only collected for two recreational greenways, the results for user and actor usage, interaction and behaviors cannot be extrapolated for other greenways. In future research, comparison with other segments of the BCGW or the WOCGW, or comparison to other greenway types and across different seasons of the years or hours and days could enhance the external validity of the research.

Another limitation due to the small number of cases is that the findings do not represent the diversity of greenway physical environment types as a structural network system. However, because for the study I selected different greenway segments in the BCGW and WOCGW, as a fragment with the representation of the most prevalent greenway characteristics types, I was able to contribute with the knowledge of the greenway social ties/bridges interactions and behaviors. The methods 2, 3 and 4 approaches did not incorporated the entire greenway segments of the BCGW and WOCGW, only 4 segments for each greenway type.

The behavior mapping and stationary observations were affected in 3 of the WOCGW segments, due to trail closings, stream restoration and trail resurfacing, which probably affected original usage, interactions and behavior in the WOCGW segments 2, 3 and 4 during the behavior mapping and stationary observation data collection. On the other hand this phenomenon also generated spontaneous and temporary interactions in terms of discussion, complaints, appreciation and information searches by users/actors.

The study provided observational information only by the behavior mapping (entire greenway segment boundaries) and it was lacking in terms of the data collection for the stationary observation which could not provide very deep information related to how user/actors used the greenway physical structural features and landscape features. The stationary observation stations were elected at important activity node areas with different types of greenway features, and involved one observation station per segment, in a total of 8 stations, 4 for each greenway type, one for each of the segments. However the lack of this information in this study (data spatialization and analysis of it results) may have affected the understanding in how they use, interact and behave in those areas. It could provide more detail information in how the greenway characteristics are used. Figure 129 illustrates the main difference between both observational approaches, in which the behavior mapping facilitated the scanning of all the interactions and behaviors along the entire trail, but may not contribute greatly with information on how users/actors used specific features. The stationary observation may provide more intensive information of which type of greenway features stimulated or not the social ties/bridges interactions, that could be atrelated because the lack of planning and design or because they are not significant; it also can prove that the amount and type of interactions and/or the patterns of use/types of activities are the same or not as the behavior mapping results, in this case when compared to the behavior mapping results it can provide more detail information about which of the greenway characteristics makes or does not make a difference in terms of successful features socialization and usage. If those aspects presented different information when compiled and combined both observational approaches, then the greenways make a difference in terms of impacting the interaction and behaviors.

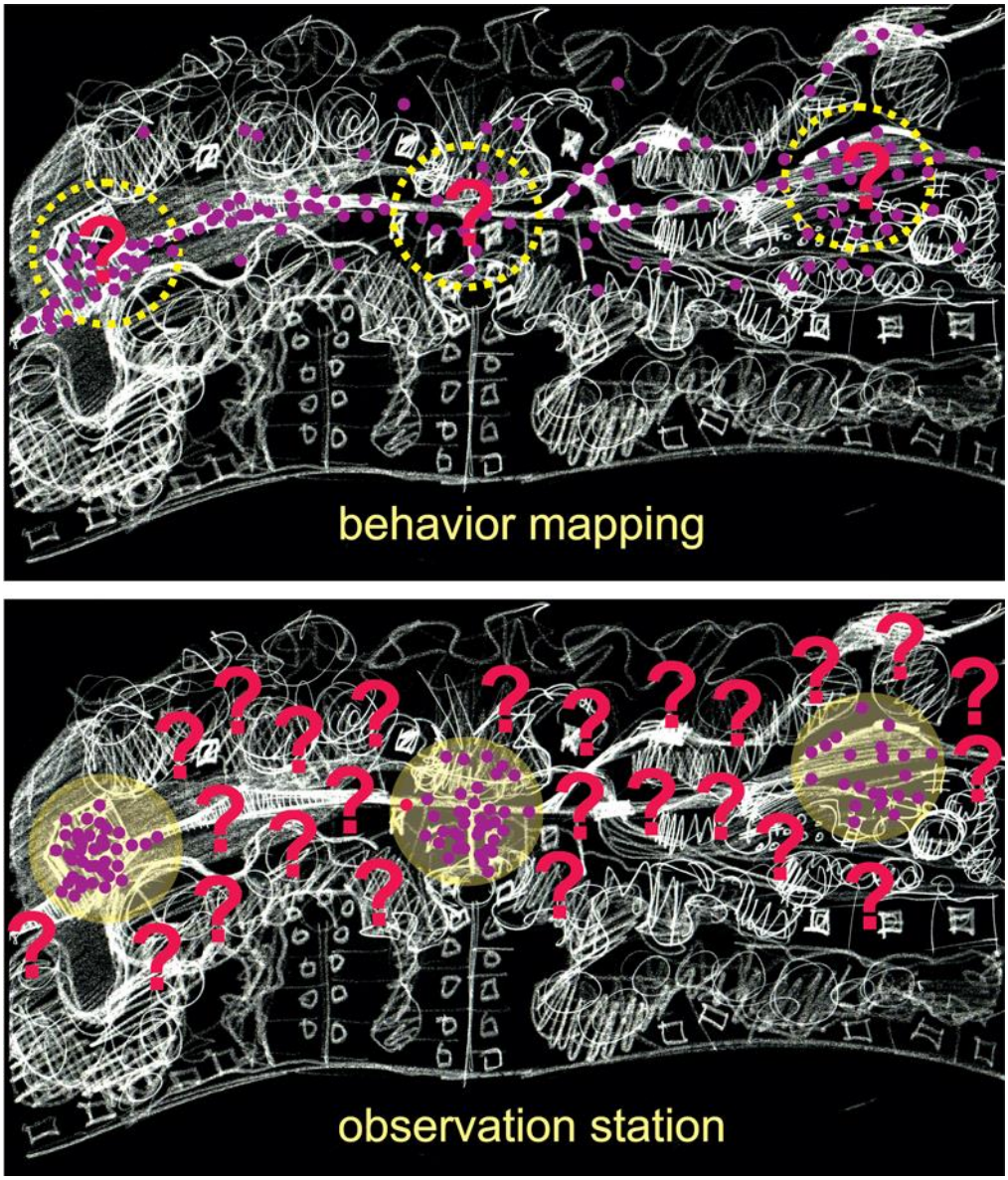


Figure 129: Schematic Drawing Comparing Both Observational Approaches – Behavior Mapping and Stationary Observation.

Source: Pippi (2013)

Due to a lack of time, it was not possible to present the entire data collection, with the addition of the stationary observation results, thematic maps and statistical analysis. It was not possible to compile the data in GIS and make a statistical comparison among the two different observational approaches: behavior mapping and stationary observation. The study did not provide the information about the stationary observation data, especially in terms of adding to the study more detailed information of the levels of interaction and its 21 categories with the information of the users/actors frequency. This material was recorded in the stationary observations but not yet analyzed and presented.

The Results in the behavior mapping analysis with the categorization of the new patterns of uses/types of activities and the complementary behavior categorization were only presented in this study as the combined data for the BCGW and WOCGW. However, the study lacks in terms of providing information and comparisons of the categorization of the new patterns of uses/types of activities and the complementary behavior categorization in each greenway separately and also in each of their segments. Such an analysis would allow a verification of which types of patterns of uses/types of activities and complementary behavior are more or less prevalent in each of the greenway types and their physical environments.

Each of the people, behavior and social variables spatialized in GIS was identified only within the greenway type and its segments, providing spatialization and quantification (percentage and number of observations) in each vegetation features, physical structural features, street furniture components and structural network system. However, the study did not provide more detailed information about their quantification (percentage and number of observations) in each topographic features and each water resource features.

The study lacked in terms of a characterization of activity nodes for each greenway and its segments in terms of spatialization and quantification and also a correlation with the different variables of this study, mainly the social interaction variables. It also lacked in statistical results in terms of providing information of each of the user gender categories related to the actor type and the occurrence or not of ties/bridges.

Survey respondents did not represent the entire greenway population (users and actors). Future studies should apply the survey to the entire population of Cary to achieve more information about the greenway characteristics and the greenway social network: interaction and behaviors.

Mapping exercise problem, about using the greenway stickers to other areas, extrapolating the greenways.

Behavior tracking (see blue) achieved a greater understanding about flow, direction and preferred destinations/points of attractions areas, socialization areas as well.
Focus group, record direction, time, points of interest etc.

6.4. Potential and Utility to Policy Makers and Designers

The greenway has the potential to bring people together as it provides a matrix of inner and intra interactions relations of users and actors. By investigating the relationships between the social network and greenway characteristics: greenway network structural system (type of connections and trail characteristics) and the greenway features (landscape features and physical structure features), policy makers, designers and planners can find alternatives that encourage social integration and have an impact on social networks and connections. The design of greenways must be re-thought to take advantage of the greenway's potential in terms of supporting social interaction, promoting the essential conditions for the establishment of social capital, gathering, lingering and social tie/bridge interactions. The results of this study provided some useful directions for the development of design guidelines for greenways with more functional and efficient characteristics specifically designed for socialization. Some guidelines that can be derived from the findings are the following:

- 1) improve the entrances and access areas for socialization (with stretching, exercise stretching and exercise stations, public restrooms, information panel, communal seating areas, drinking fountains and bicycle racks) *(Supported by the findings from the behavior mapping showed that the locations that are directly connected to conventional parks with the BCGW and WOCGW presented higher density of usage and/or interactions, mainly by different subgroups and groups types);*
- 2) make the recreational greenways attractive, functional, inclusive and accessible to all users (age, gender) and actors (individuals, sub-groups of dyads and/or triads, and groups), designing necessary social gathering places, providing the enhancement of conviviality for people to spend time together, do activities together, see others, exchange ideas, interact and bond, enhancing the greenway utilization with their families, friends and with strangers and then promoting inner and intra interaction relations and then creating a community bond, integration, identity and meaning *(Supported by the findings from the behavior mapping showed that the greenway trail and features presented higher usage and/or interactions by individuals, dyads and triads, adults and males. Such information was also supported by the statistical comparative tables of the ties/bridges occurrence related to gender, age and actor type. Other user/actor categories must be also considered in the greenway design);*
- 3) provide multi-functional activity pockets and/or passive social tie/bridge communal “islands” for socialization along the trail by attracting and meeting the needs of different users and actors (communal seating areas, picnic tables or green and permeable tatames, exercise and stretch stations, yoga practices, environmental education areas, information panel/signs, and/or adventure circuit nodes). They must be planned and designed to accommodate more areas for gathering and socialization, and also in secluded areas, in a way to improve circulation (flow and passage) and avoid activity conflicts (see the types of activity node possibilities in Appendix N). Use vegetation with color, texture and perfume to enhance the human senses. The activity nodes configured by the physical structural features and street furniture must be designed in harmony and with respect of the landscape features

and wildlife (findings from the behavior mapping showed that the high intensity of usage and also interactions occurred along the greenway trail. Off-trail place and features must be designed to accommodate usage and/or interactions) *(Supported by the findings from the behavior mapping showing that the highest volume of usage and the highest occurrence of interactions occurred along the entire trail and independent of the different circulation layout types in all the segments of both greenways, rather than specifically at greenway features and/or other types of trail characteristics);*

- 4) provide more gathering places with more benches or bench re-arrangements to promote more interaction among sub-groups and groups, promoting communal seating areas that accommodate larger numbers of people that are using the greenway together or to propitiate socialization, when resting and/or observing the landscape. New design that allows socialization, grouping and/or different seating styles or configurations with more ergonomic and functional design and with unique identity; incorporate public art in the design of functional-sculptural benches and seating areas *(Supported by the findings from the behavior mapping showed that the greenway benches presented low usage and very low interactions. Also the mappings with the density island information of the pure and transformative actors showed in all segments of both greenways, pointed the greenway features and locations along the trail that presented high and moderate density of different types of subgroups and groups);*
- 5) design different physical structure features that facilitate socialization, mainly for sub-groups (dyads and triads) and groups, especially at overlooks, gazebo/kiosks and information panel areas. Afford greater number of overlooks and/or gazebo/kiosks, to avoid overcrowding or activity conflicts in those areas *(Supported by the findings from the behavior mapping showed that these features presented high incidence of usage, interactions and high density island of the pure and transformative actors);*
- 6) design new bridge layouts, that also incorporate interesting and symbolic structures and forms and can accommodate socialization, without interfering in the

trail activity and flow *(Supported by the findings from the behavior mapping showed that the bridges, were one of the physical structural features that presented high occurrence of ties/bridges and usage in both greenways);*

- 7) use vegetation with perfume, such as jasmine, magnolias, honeysuckle and lavender, to mitigate the bad smell from sanitary sewer lines *(Supported by the findings from the survey indicated that the bad smell of this feature can impact negatively the greenway usage and interaction);*
- 8) Improve the greenway physical environments to accommodate the needs of the other categories of users, such as Children, Adolescents and Seniors, by facilitating their interaction and behaviors *(Supported by the findings from the behavior mapping showed that the greenway trail and features presented more usage and/or interactions by adults. Such information was also supported by the statistical comparative tables for the tie/bridge occurrence related to gender, age and actor type. Other users by age categories must also be considered in the greenway design);*
- 9) plan, design and maintain the open meadow areas and maintained grassy open fields to provide features for exercise and stretching stations, practicing yoga, information panel, communal benches, small pockets for skating, pockets of playgrounds, overlooks of the landscape features and public restrooms, facilitating socialization and usage in those areas *(Supported by the findings from the behavior mapping showed that the greenway landscape features with those types of vegetation presented a considerable volume of usage and also social ties/bridges interactions);*
- 10) improve the greenways' light forest, open meadow areas, riparian vegetation and wetland areas to provide some adventure activities, and/or places for interaction and/or education, in respect with the natural environments, for the children and adolescents, such as adventure circuits, hanging walkways, climbing and jumping rocks, water playscapes, and environmental education, enhancing their contact with the greenway features, providing their development and providing memorable and fun experiences *(Supported by the findings from the behavior mapping showed that*

the greenway landscape features with those types of vegetation presented a considerable volume of usage and also social ties/bridges interactions, especially for children and adolescents, a group that presented tie/bridge interactions more often with each other or within the same actor category type, rather than interacting with other actor categories, as pointed by the behavior mapping and the statistical comparative tables of the ties/bridges occurrence related to gender, age and actor type);

- 11) Design and improve the greenway features for the older greenway populations, to accommodate the senior and elderly people usage, by providing accessible, legible, restful, comfortable, ergonomic, informative and sociable environments (communal seating areas, benches, drinking water fountain, public restrooms, information panel and signage) *(Supported by the findings from the behavior mapping and the statistical comparative tables of the tie/bridge occurrence related to gender, age and actor type and the regression showed that while the volume of use of this user age category was lower, this category presented greater interaction, and especially across different actor/user types);*

The results of this study also provided some useful recommendations for the greenway management:

- 1) provide necessary attention to the greenway re-design, continuous environmental monitoring and maintenance to keep the greenway vitality, and its dynamics in terms of image, attractiveness, comfort, image and sociability *(Supported by the findings from the survey pointed those aspects as positively or negatively impacting people's socialization and usage),*
- 2) promoting additional community programs, social activities for families, friends and strangers (e.g. environmental education, adventure in nature, physical activities, adopting a greenway, organizational volunteer activities, and neighbor day with fun activities/programs, greenway day and green market day) building a sustainable

social capital and democratic network *(Supported by the findings from the survey indicated user preference and suggestions to enhance greenway socialization).*

6.5. Further Research Recommendations and Goals

The method 1 provided valuable and specific information based on the perspective of the Senior of Greenway of Cary but only related to Cary's greenways, which may not be generalized to other surrounding locations of the Triangle Area (Raleigh, Durham and Chapel Hill). It is necessary the application of the same questions with other greenway experts of the Triangle area: Raleigh, Durham and Chapel Hill, to reach a more detailed understanding in how the greenways are being planned, designed and managed. Such information and comparisons of those results can provide new insights about the perspectives of greenway master-planners.

The multi-method approaches (method 2, 3 and 4) and their protocols could also be applied to the entire greenway segments of the BCGW and WOCGW. In addition, the same protocol used for methods 2 and 3 can be applied to the other segments of the BCGW and WOCGW, as well as to other urban and suburban public spaces (conventional parks, plazas and waterfront) and other greenways (urban, suburban and rural areas) to see the possibility of similar or different patterns of socialization and behavior.

The same protocol used for methods 2 and 3 can be applied to the other greenways of Cary, to achieve a complete spatialization (GIS and statistics) and better report of the characteristics of the entire Greenway System of Cary, as a whole, and to be able to comprehend with more detail information possible potentialities, issues (causes and consequences) of the social network aspects: interaction and behaviors, and then be able to plan and design the expansion of this structural network system.

Furthermore, it would be valuable to spatialize and analyze how the structural network system has expanded in Cary over the years, with a temporal analysis at different periods, with their characterization and also correlation with the social aspects to comprehend the greenway impacts over the social aspects (positively and/or negatively) in the greenway physical environments, and surrounding neighborhoods and community.

The stationary observation data collected in this study could be fully compiled and spatialized in order to compare with the behavior mapping data and results to see the presence of similar or unique patterns of socialization and behavior and also to compare the strengths and limitations of each observational approach. This comparison could aid in improving even more those approaches as a method for understanding social interaction within greenway physical environments.

The method 4 protocol with the same questions and mapping exercise can be applied to a more extensive population of greenway users and/or the entire population of Cary, to strengthen the reliability of the study. In the case of the mapping exercise, it would be necessary to maintain the same legend for the greenways and add new legends for the surrounding areas, indicating the name of those destinations, points of attraction, meeting, interacting, starting, ending places. A second map and stickers could also be introduced to the same respondents, in a second moment, to provide information about the greenway features preference. In this case, respondents would provide a list with the names and brief description of those locations. Users and residents may also be asked to provide information about their perception of the greenway structural network system in terms of direction, expansion, attendance and social-environmental impacts.

Other methods, such as cognitive mapping, could be employed to achieve more information about the greenway characteristics and dynamics in terms of its image and user values. Photography sorting task analysis using pictures of the greenway characteristics and social characteristics (different behaviors and densities) could be used to achieve more information about the potential of specific characteristics to impact social interaction and behaviors.

GIS spatialization of additional greenway features, such as topographic and water resources features, could be further interpreted and correlated with the social dimensions to achieve a more complete understanding of how those features affect the social interaction and behaviors. GIS spatialization of the surrounding neighborhoods information (census data) and density information could be applied to the analysis to better understand the information of the method 3: behavior mapping, stationary observation and method 4: survey and mapping exercise information as well. GIS spatialization with information of the greenway social Density and the ArcGIS Network Analyst are important techniques to understand the social network incidence, impact, connections and routing, and also to achieve information about the greenway characteristics with the surrounding neighborhoods in terms of access, attendance and distance to other locations. Neighborhood zip code areas and demographic information of the Census data could be used in the GIS spatialization to generate an analysis of the density of the greenway surrounding neighborhoods and associate their relation with the greenway features. The destination areas are especially important elements to be spatialized and analyzed in terms of providing information and understanding how the greenway structural network system direction and expansion attends and impacts the different neighborhoods' needs for leisure, recreation, socialization and transportation at different points in time.

Behavior tracking is another method that could be used to understand the greenway usage flow and verify settings and features that enhance social interactions. It is an efficient method that could enhance the understanding about the greenway features, because in this approach it is possible to obtain information about the subject's location, destination, travel direction, location of points of interest/areas for socialization, where all the social behaviors and interactions could be recorded on the base-map, with a key-code to identify the areas in which users and actors stop and interact, and their travel routes. If analyzed with the same variables used in the *behavior mapping and stationary observations,* this method could enhance the comparison of the methods used in this study and provide more data regarding social interaction and behaviors. The only issue with behavior thracking is difficulties with respect to users/actors privacy. To mitigate this issue, focus group behavior tracking

observation could be done, but users/actors may change their behavior, since they know that they will be observed and recorded. Time-lapse and normal video also could be utilized in those observational methods to capture the greenway essence of the social role.

In summary, the present method provided a novel approach to understanding the relationship between greenway physical environments and features and the social interactions that occur on them. There is still very little knowledge about this relationship, highlighting the value of creating a robust protocol for documenting and analyzing it. This protocol should be applied in other greenways (urban, suburban and rural areas) and also in other countries with different cultural, physcial environment features and structural network system contexts.

A modified protocol should be applied in other types of public spaces, such as conventional parks, to gather more data related to this relationship, however future studies would do well to limit the number of variables. In addition, a cross-verification of the data gathered using behavior mapping and surveys with the data collected through stationary observation would provide a broader base from which to confirm the impact of greenway physical environemt characteristics and social behavior and interactions.

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APPENDICES

Appendix A: Tables of Greenways Characteristics and Social Benefits

Table A1. Greenway Characteristics Framework: Associated/Synonymous Names Objectives, Benefits, Functions, Potential Uses and Users.

Source: Pippi (2013), base on Evans (1969); Flounoy (1969); McHarg (1969); Zube et. al. (1975); Little (1990); Taylor et. al. (1990); Flink et.al. (1993); Smith and Hellmund (1993); Lyle (1994); International Greenway Resource Collection (1995); Fabos and Ahern (1995); Gobster (1995); Forman and Dramstad (1996); International Greenway Resource Collection (1998); Marcus and Francis (1998); Lyle (1999); Flink et. al. (2001); Boullón (2002); Lusk (2002a); Lusk (2002b); Forman (2004); Ahern (2004); Jongman and Pungetti (2004); Hoctor et. al. (2004); Moore and Driver (2005); Hellmund and Smith (2006); Erickson (2006); GEOPLAN Center (2006); Magnoli (2006); Twaites and Simkins (2007); Macedo (2008); Macedo et. al. (2008); Pippi et. al. (2009b);Tângari et.al. (2009), Manning (2011).

Greenways Framework	
Major Types of Greenways	Urban Riverside Greenways Recreational Greenways Ecological Significant Natural Corridors Scenic and Historic Routes Comprehensive Greenway Systems or Networks

Table A1 Continued

Associated/ Synonymous Names Related to the Types of Connectivity	Landscape Linkages Biological Corridor Conservation Corridor Ecological Corridor Environmental Corridor Ecological Networks Green-Infrastructure Green Fingers Green Frame Green Links Green Veins Greenbelts Gateway Green-Infrastructure Nature`s Superstructure Geneways Open Space Protect Area Natural Corridor of Open Space Natural/Landscape Route (People and Bicycle) Linear Open Space Corridor Linear Recreation Resources Connector Open Spaces (Parks, Nature, Reserves, Cultural Features and Historical Sites) Scenic Corridors Scenic Trail Scenic Road Riparian Buffers River Front Stream Valley Canal Pathways Recreational Corridors (Natural Corridor with Trails) Multiple-Use/Multi-Use Trail Trail Corridors Parkway Greenbelt Ridge Line Rail Road Utilitarian Corridors Wildlife Corridors Dispersal Corridors Linear Parks

Table A1 Continued

Objectives	Promote Landscape Integrity Protect Geological Features Protect Streams, Corridors, Wetlands and Riparian Vegetation Offer Alternative Route(Connect Places and People) Offer Aesthetic Route Present a Safe Walkway Promote a Continuous and Non-Motorized Trail-Path Encourage Social Development Promotes Social Health and Well-Being Provide Community Safety and Security Promote Social Integration Encourage Tourist Development Provide a Recreational Use (Active, Passive or Both) Provide a Wildlife/Species a Resource Corridor Preservation (Habitat, Food and Reproduction) Protect/Conserve Open Space Protect Ecological Resources Promote Habitats for Wildlife Provide Natural Migration Route Retain Natural Ecological Functions (Within the Natural/Urban Environments) Provide Regional and Local Connections Establish a Linear Parks Network System (With Public Recreation) Provide Structural System Network with Urban Amenities (Public Use) Promote a System of Trail Connections Compatible with Urban Uses Provides the Interconnection of Urban Environments (Commercial Areas/Services, Work Places, Schools, Parks and Colleges) Link People and Places Provide an Effective/Sustainable Planning for Future Urban Growth Stimulate More Advantageous Costs of Public Funds through the Multi-Use of Public Property Mitigate Conflicting Urban Land Uses Mitigate Flooding Problems (Open Space Corridor System/Green-Infrastructure) Greater Awareness of the Environmental Surroundings Elevate the Livability of the Urban Environment Increase Properties Values Provides Different Types of Access Encourage Outdoors Physically Activities Promotes a Multi-Use Trail (by Their Attractions) Provide Alternative and Safe Transportation (Pedestrians and Bicycles) Provides Cultural Manifestation Provides Musical and Acting Events Improve Air Quality Minimize Sound Pollution Reduce Urban Pollution Specially at the Local Water Sources (Channel, Streams and Wetlands) Restore the Natural Environments Conserve and Valorize Scenic Views of the Landscape (Historic, Natural and Cultural Values) Valorize Significant Historically Sites Promotes the Conservation of Archeological Sites Promotes the Conservation of Paleontological Sites Rehabilitate Abandoned Industrial Areas Revitalize and Renew Abandoned Rail-Road Inform Data-Resource

Table A1 Continued

Benefits	Economic Development Social Development and Relationship Maintenance Enhance Community Identity and Pride Ecological Open Space and Ecological Protection/Conservation Pollution Mitigation (air, soil, water and noisy) Environmental Institutional Educational (Environmental, Social and Patrimonial) Cultural Tourism Value Nearby Properties Personal Psychological Psychophysiological Kinesthetic Improved Public Health and Fitness (Users and Actors)
Benefits	Outdoor Recreation Opportunities Historic Preservation Opportunities Aesthetic/ Beauty Sustainable Transportation Alternatives Location for Utility Easements
Functions	Ecological Integrity Environment Health Biotic Movement (Fauna and Flora) Natural Preservation Natural Conservation Natural Restoration Landscape Integrity Connection (Nature/Landscape, Urban Open Spaces, People) Recreational Leisure Educational (Environmental, Social and Patrimonial) Multi-functional Social Cultural Historical Aesthetic Scenic Sports Transportation (Alternative Mobility) Economic Development Natural Tourism or Ecotourism Natural Resources Resources

Table A1 Continued

	Nature Studies and Researches Camping Hunting Landscape Observation and Contemplation Land Art Contemplation Hiking Canoeing kayaking Skiing Pedal-Boating Snow Mobiling Swimming Fishing Picnicking Eating/Drinking Cycling – Bicycling Mountain Biking Unicycling Skating/ In-Line Skating (Rollerblading) Roller-Skating Walking
Potential Uses/ Type of Activities	Walking Animals (Pets, Dogs) Walking Stroller Nature Walk Running / Jogging Cross-Country Snow Mobility Stretching and other Physical Exercises Playing with Natural Elements Playing with Instruments (Playgrounds) Playing Self-Organizing Social Interaction Social Integration Watching/Observing People Meeting People Equestrian Use (Horse-Back Riding) Birds and other Animals Observation Wilderness Observation Wildlife Photography Sunbathing Sledding Playing Freebie Playing Bad Mutton Playing Fly Kite Rocketing Sliding Sailing
Potential Uses/ Type of Activities	Modeling Airplane Balloonists Environmental Education Environmental Conservation Tubing Active Transportation Passive Transportation Nautical (Water) Transportation

Table A1 Continued

Type of Users	Children Teenagers Adults Seniors Elderly

Table A2: Greenway Social Benefits Attributed to Outdoor Recreation.

Source: Pippi (2013), base on Whyte (1980); Little (1990); Driver (1990a); Driver (1990b); Driver et.al. (1991); Flink, and Searns (1993); Gobster (1995); Moore et. al. (1998); Lee et. al. (2002); Lusk (2002a); Lusk (2002b); Moore and Scott (2003); Moore and Driver (2005); Hellmund and Smith (2006); Thwaites and Simkins (2007); Driver (2008); Jeannotte (2008); Secco and Zulian (2008); Baris et. al. (2010); Peters et. al. (2010); Dempsey et. al. (2011); Manning (2011).

Greenway Social Benefits	
Community Satisfaction and Morale	Family Bounding
Community Identity	Ethnic and Social Integration
Community Involvement	Enhance World View
Community Integration	Reciprocity and Sharing
Community Opportunity: Knowledge/Activities	Opportunities for Social Strengths/Skills
Neighborhood Satisfaction and Morale	Social Development
Neighborhood Identity	Social Networking
Neighborhood Involvement	Social Mobility
Neighborhoods Integration	Social Cohesion
Social Inclusion	Reduce Loneliness
Friendship Ties	Racial Integration
Children Development	Cultural Integration
Youth Development	Bring People Together
Adult Development	Build Communities
Senior Development	Sense of Community
Social Capital Development (Bridge and Ties)	Public Health Development Opportunity
Social Support	Nurture New Community Leaders
Support for Democratic Freedom	Nurturing of Others
Build Organized Programs/Activities	Trust and Reciprocity
Increase Trust in Others	Understand and Tolerance of Others
Increase Compassion for Others	Promoting Voluntary Community Efforts
Cultural/Historical Awareness Appreciation	Environmental Awareness/Sensitivity
Cultural Identity	Reduced Social Alienation
Cultural Continuity	Reduced Crimes and Drug Traffic
Prevention of Social Problems	Mitigate Social Exclusion
Increase Quality of Life	Reduced Illness and Social Impacts
Teamwork Improvement	Strengthen Ties Among Community Residents

Table A3: Greenway Characteristics: Landscape Features and Physical Structure Features.

Source: Pippi (2013), base on Evans (1969); Flounoy (1969); McHarg (1969); Zube et. al. (1975); Little (1990); Taylor et. al. (1990); Flink et.al. (1993); Smith and Hellmund (1993); Lyle (1994); Fabos and Ahern (1995); Gobster (1995); International Greenway Resource Collection (1995); Forman and Dramstad (1996); International Greenway Resource Collection (1998); Marcus and Francis (1998); Lyle (1999); Flink et. al. (2001); Boullón (2002); Lusk (2002a); Lusk (2002b); Carmona et. al. (2003); Forman (2004); Ahern (2004); Jongman and Pungetti (2004); Hoctor et. al. (2004); Moore and driver (2005); Hellmund and Smith (2006); Erickson (2006); GEOPLAN Center (2006); Magnoli (2006); Twaites and Simkins (2007); Carmona et. al. (2008); Macedo (2008); Macedo et. al. (2008); Schaftoe (2008); Pippi et. al. (2009b); Tângari et.al. (2009); Carmona et. al. (2010); Gehl (2010), Manning (2011).

Greenways Framework		
Landscape Features	**Water resources**	Rivers Valleys (Shaped Valley, Broad Floodplain), Rivers Channels (Clams, Borrowing Mayfly Mymphs, Midge) Drainage Patterns (Streams, Dendritic Pattern, Trellised Pattern), Channel Shapes (Meandering Chanel, Braided Chanel), Adjacent Landform (Floodplains, Oxbow Lakes, Gorges, Cascade), Wetlands (Mangrove Swamps, Bogs, Salt Marshes), Salt Marshes, Lagoons, Ocean, Spring Waters, Springs, Waterfalls, Aquifer, Watersheds, Mangroves, Marshes, Wetlands, Tributary Streams, Dams, Man-Made Lakes, Lakes, Hydromorphic Soils, Geyser
	Vegetation	Forest (Native and Exotic), Rainforest (Tropical andTemperate); Tropical Dry Forests; Sub-Tropical Forests; Temperate Hardwood Forest; Boreau Forest, Atlantic Rainforest, Ciliar forest, Riparian Vegetation, Gallery Vegetation, Transitional Rainforest, Horticulture, Sustenance Pasture and Extensive Pasture, Savannah Forest, Lagunar Vegetation, Mangrove Forest, Agricultural Areas)
	Topographic features	Hills, Low Rolling Hills Plains, Depression)
	Geological features	—
	Geotechnical features	—
	Urban areas	Surroundings Greenway Areas: Dense, Sparse, Homogeneous, and Heterogeneous. Density: High, Medium, Low-Medium, Low

Table A3 Continued

	Green -Infrastructure	**Dry Swale / Wet Swale, Bioretention, Permeable Pavement, Rain Garden, Stream Buffer,** Biowales, Green Gardens, Rain Gardens
	Infrastructure	Water sewer, Sanitary Sewer Lines, Eletrical Lines, Cable TV/Internet, Telephone, Oil and Natural Gas, Storm Sewers
Physical Structure Features	**Facilities and Urban Furniture**	Decks Overlook (Natural or Artificial) Viewing Tower Harbor Information Panel Souvenirs Shop Information Kiosk Universal Design Facilities Greenhouse Playground Rustic Picnic Sites Picnic Shelters Barbecue Places Picnic Tables Park Bench, Benches Shelters Adventure Circuit Porch Pergola Signage Systems Bower Drinking Fountain Gateway Bollards Fence Passageways Stretching Areas Fitness Courses Camping Facilities Parking Area Visitors Center Restrooms Facilities Parking Areas Museum Library Natural Resources Lab Amphitheater Lunch Area Bicycle Shop Emergency Telephones Board Stairs Ramp Trail (Unpaved and Paved) Old Train Railroad Trash Receptacles Signage System Dikes areas Exercise and Physical Station Areas Mountain Bike Off-Road Trails Bike Racks Walking Boards Bridges, Overpasses, and Underpasses

Table A4: Greenway Characteristics: Potential Successful Features and Potential Unsuccessful Features.

Source: Pippi (2013), base on Evans (1969); Flounoy (1969); McHarg (1969); Zube et. al. (1975); Whyte (1980); Little (1990); Taylor et. al. (1990); Flink et.al. (1993); Smith and Hellmund (1993); Lyle (1994); Fabos and Ahern (1995); Gobster (1995); International Greenway Resource Collection (1995), Forman and Dramstad (1996); Forman (1996); International Greenway Resource Collection (1998); Marcus and Francis (1998); Lyle (1999); Flink et. al. (2001); Boullón (2002); Lusk (2002a); Lusk (2002b); Carmona et. al. (2003); Forman (2004); Ahern (2004); Jongman and Pungetti (2004); Hoctor et. al. (2004); Moore and Driver (2005); Hellmund and Smith (2006); Erickson (2006); GEOPLAN Center (2006); Magnoli (2006); Twaites and Simkins (2007); Carmona et. al. (2008); Macedo (2008); Macedo et. al. (2008); Schaftoe (2008); Pippi et. al. (2009b); Tângari et.al. (2009); Carmona et. al. (2010); Gehl (2010), Manning (2011).

Greenways Framework			
Landscape Features		**Physical Structure Features**	
Potential Successful Features	**Potential Unsuccessful Features**	**Potential Successful Features**	**Potential Unsuccessful Features**
Natural Quality	Lack of Nature	Enough Settings in Different Locations	Not Enough Settings in Different Locations
Create Visual of Interesting Landscapes	None Visual of Interesting Landscape	Enough Settings for All Users	Not Enough Settings for All Users
Presence Areas for the Landscape Observation and Contemplation	Lack of Areas for the Landscape Observation and Contemplation	Enough Seating for All Users	Not Enough Seating for All Users
Threes Block Partially the Landscape View	Threes Block Total the Landscape View	Seating Designed for Groups	Seating Not Designed for Groups
Good Disposition of the Shade and Sun Areas	Bad Disposition of the Shade and Sun Areas	Variety of Activities	Absence of Activities
Soil Permeability	Soil Impermeability	Variety of Settings Areas for Socialization	Few Settings Areas for Socialization
Good Disposition of the Open and Close Areas	Bad Disposition of the Open and Close Areas	Variety of Attractions	Designed Few Attractions
Good Vegetation Composition	Bad Vegetation Composition	Enough Equipment	Not Enough Equipment
Good Topographical Composition	Bad Topographical Composition	Enough Equipment Infrastructure	Not Enough Infrastructure
Presence of Native Vegetation	Presence of Exotic Vegetation	Enough Furniture	Not Enough Furniture
Good Polychromy	Bad Polychromy	Safe Parts	Unsafe parts

Table A4 Continued

Scenic Qualities	No Scenic Qualities	Multiple Users/Uses	Few Users/Uses
Functional Environment	Non-Functional Environment	Bridge and Walking Boards are Used	Bridge and Walking Boards are Not Used
No Natural Trails Conflicts	Natural Trails Conflicts	Bridge and Walking Boards with Good Maintenance	Bridge and Walking Boards with Bad Maintenance
Easy Circulation on the Natural Trails	Difficult Circulation on the Natural Trails	Presence of Green-Infrastructures	Lack of Green-Infrastructures
No Visual Pollution	Visual Pollution	Enough Picnic Facilities	Not Enough Picnic Facilities
No Noisy	Noisy	Height Level of Maintenance	Low Maintenance
Environmental Conservation	No Environmental Conservation	Good Management	Lack of Management
Wind Protection by the Vegetation	No Wind Protection by the Vegetation	Serves for Education Programs	Lack of Educational Programs
Heterogeneous Composition of the Vegetation	Homogeneous Composition of the Vegetation	Server for Neighborhood Integration	Lack of Neighborhood Integration
Variety of Color of the Vegetation	Lack of Color of the Vegetation	Accessibility for Everyone	Lack of Accessibility for Everyone
Dynamic Place	Monotonous Place	With Environmental Educations Programs	No Environmental Education Programs
Greenery	Lack of Greenery	No Trails Conflicts	Trails Conflicts
Potential Successful Features	**Potential Unsuccessful Features**	**Potential Successful Features**	**Potential Unsuccessful Features**
Visible Areas for Variety of Users	Invisible Areas for Variety of Users	Easy Circulation on the Built Trails	Difficult Circulation on the Built Trails
Accessible Areas for Variety of Users	Inaccessible Areas for Variety of Users	Enough Public Restrooms	Lack of Public Restrooms
Authentic, Rich and Varied Aesthetic Environment	Without Authentic and Monotonous Aesthetic Environment	Public Restroom with a Good Maintenance	Lack of Maintenance of the Public Restrooms
Presence of Different Environments	Presence of Same Environment	Serve with Program, Activities, or Events	Lack of Program, Activities, or Events
Presence of Wildlife	Lack of Wildlife	Adequate Lighting	Inadequate Lighting
Presence of People	Lack of People	Presence of People	Lack of People
Provide Plants with Variety of Colors, Textures and Shapes	Non Provide Plants with Variety of Colors, Textures and Shapes	Sufficient Numbers of Trash Cans	Insufficient Numbers of Trash Cans
Provide Meandering Pathways Through or Along Side Natural Settings	No Provides Meandering Pathways Through or Along Side Natural Settings	Disposition of Trash Cans in Different Areas	Lack of Trash Cans in Different Areas
Provides Microclimate	No Provides Microclimate	Presence of Interpretative Signs	Lack of Interpretative Signs
Conservation of Nature	No Conservation of Nature	Provides Access for Disabled Users	No Provides Access for Disabled Users
No Pollution	Pollution	Provides Water Fountain	Lack of Water Fountain
Presence of Wildlife Corridor Connection	Lack of Wildlife Corridor Connection	Presence of Gathering Features	Lack of Gathering Features
Protection of Ecological Sensitive Areas	No Protection of Ecological Sensitive Areas	Presence of Activity Node Areas	Lack of Activity Node Areas
Provide Ecological Connection/Linkage	Not Provide Ecological Connection/Linkage	Presence of Physical Connection Areas	Lack of Physical Connection Areas

Appendix B: Table Integration 19 Annotated Bibliographies

Legend: ○ present

— absent

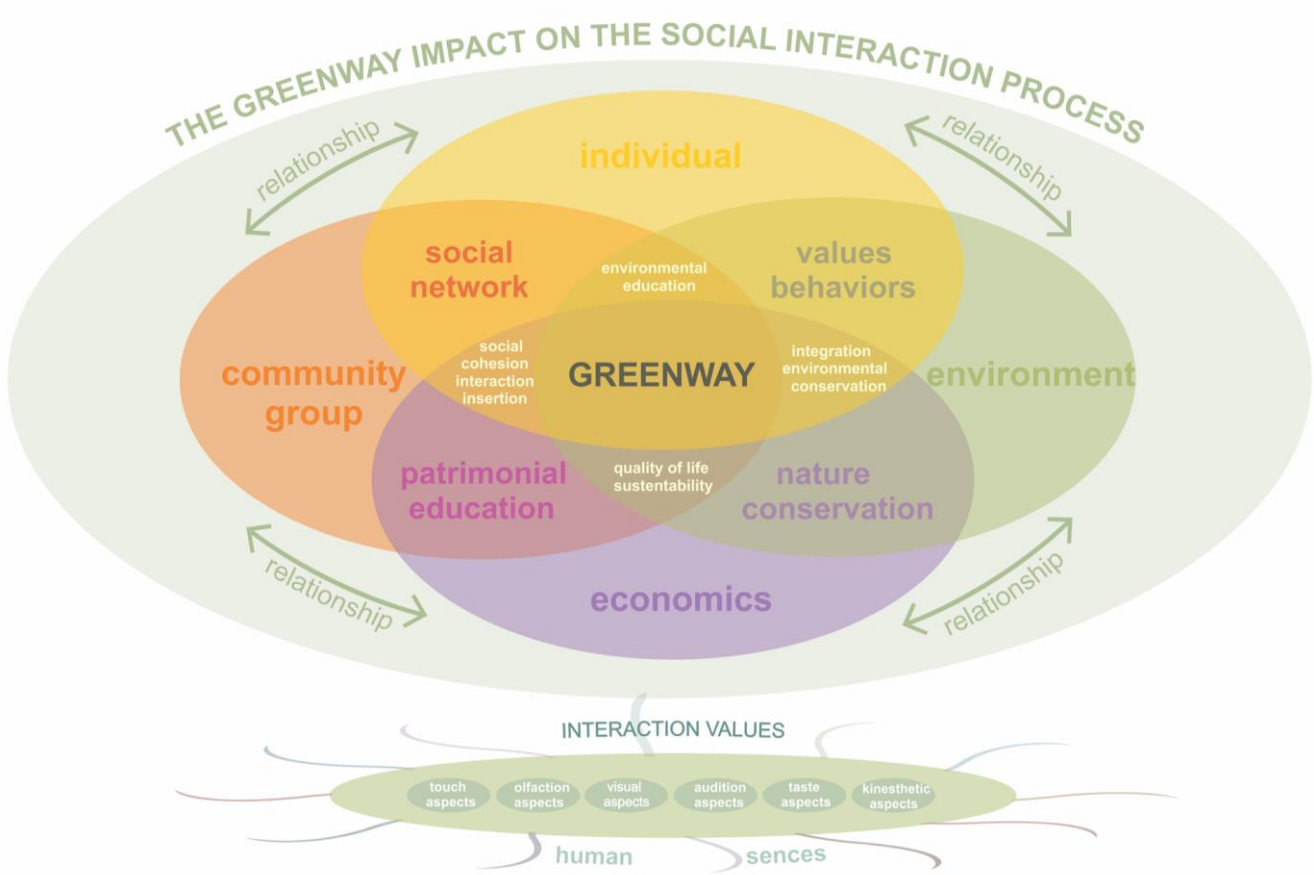
	Main-Aspects Secondary - Aspects	Integration 19 Annotated Bibliographies									
		Gobster (1995)	Moore et al. (1998)	Lee et al. (2002)	Gobster (2002)	Moore and Scott (2003)	Kyle et al. (2005)	Asakawa et al. (2004)	Gobster (2005)	Lindsey et al. (2008)	Chon and Schafer (2009)
Theoretical Framework	Connection, destination types and/or transportation	o	—	—	—	o	o	o	o	o	—
	place dependence	—	—	—	—	o	o	—	—	—	—
	place attachment	—	—	—	—	o	o	—	—	—	—
	place identity	—	—	—	—	o	o	—	—	—	—
	sense of place	—	—	—	—	o	o	o	—	—	—
	individual/community attachment	o	—	—	—	—	o	—	—	—	—
	setting interaction	o	o	o	o	o	o	—	o	—	—
	behavior setting	o	o	o	—	o	—	—	o	—	—
	territoriality or territorial range development	—	—	—	—	—	—	—	—	—	—
	setting affordance or segment affordance	o	—	—	—	o	—	—	—	o	—
	social aspects of outdoor recreation	o	o	o	o	o	o	o	o	—	—
	motivation/benefits of outdoor recreation	—	o	o	—	o	—	—	—	—	—
	active living	—	—	—	—	—	—	—	o	—	—
	standard quality of the outdoor environments	o	o	o	—	—	o	—	o	o	o
	Outdoor recreation conflicts/problems	o	o	o	o	o	—	—	o	—	o
	type of experiences	—	o	o	o	o	o	—	o	—	o
	attitudes, preferences, perception and meanings	o	o	o	o	o	—	o	o	—	o
	frequency, distribution and density of uses	—	o	o	o	o	o	—	o	o	—
	crowding in outdoor recreation	o	o	o	—	o	o	—	o	—	—
	features and amenities/facilities	o	—	o	o	o	—	o	o	o	o
	Planning, design and management implications	o	o	—	o	o	—	o	o	o	O
	greenways and trails	o	o	o	—	o	o	o	o	o	o
	parks	—	o	—	o	—	o	—	—	—	—

	Main-Aspects Secondary - Aspects	Integration 19 Annotated Bibliographies								
		Lusk (2002a)	Cromley et al. (2008)	Shahani (2013)	Gobster and Westphal (2004)	Bush (2010)	Bush (2011)	Golicnic and Thomson (2010)	Reynolds et al. (2007)	Moore and Cosco (2007)
Theoretical Framework	Connection, destination types and/or transportation	o	o	—	o	o	o	o	o	—
	place dependence	—	—	—	—	—	—	—	—	—
	place attachment	—	—	—	o	—	—	—	—	—
	place identity	—	—	—	—	—	—	—	—	—
	sense of place	—	—	—	—	—	—	o	—	—
	individual/community attachment	—	—	o	o	—	—	—	—	—
	setting interaction	—	—	o	o	—	—	o	—	—
	behavior setting	—	—	—	—	—	—	o	—	o
	territoriality or territorial range development	—	—	—	—	—	—	—	—	o
	setting affordance or segment affordance	—	—	—	—	o	o	o	o	o
	social aspects of outdoor recreation	o	o	o	o	o	o	o	o	o
	motivation/benefits of outdoor recreation	—	—	o	—	—	—	—	—	—
	active living	—	—	—	—	o	o	—	—	—
	standard quality of the outdoor environments	—	—	o	o	—	o	—	—	—
	Outdoor recreation conflicts/problems	—	—	o	o	—	—	—	o	—
	type of experiences	o	o	—	o	—	—	—	—	o
	attitudes, preferences, perception and meanings	o	o	o	o	o	—	o	—	—
	frequency, distribution and density of uses	o	o	o	—	o	o	o	o	o
	crowding in outdoor recreation	o	—	o	—	o	o	o	o	—
	features and amenities/facilities	o	o	—	o	o	o	o	o	o
	Planning, design and management implications	o	—	o	o	o	o	o	—	o
	greenways and trails	o	o	o	o	o	o	—	o	—
	parks	—	—	—	—	—	—	o	—	o

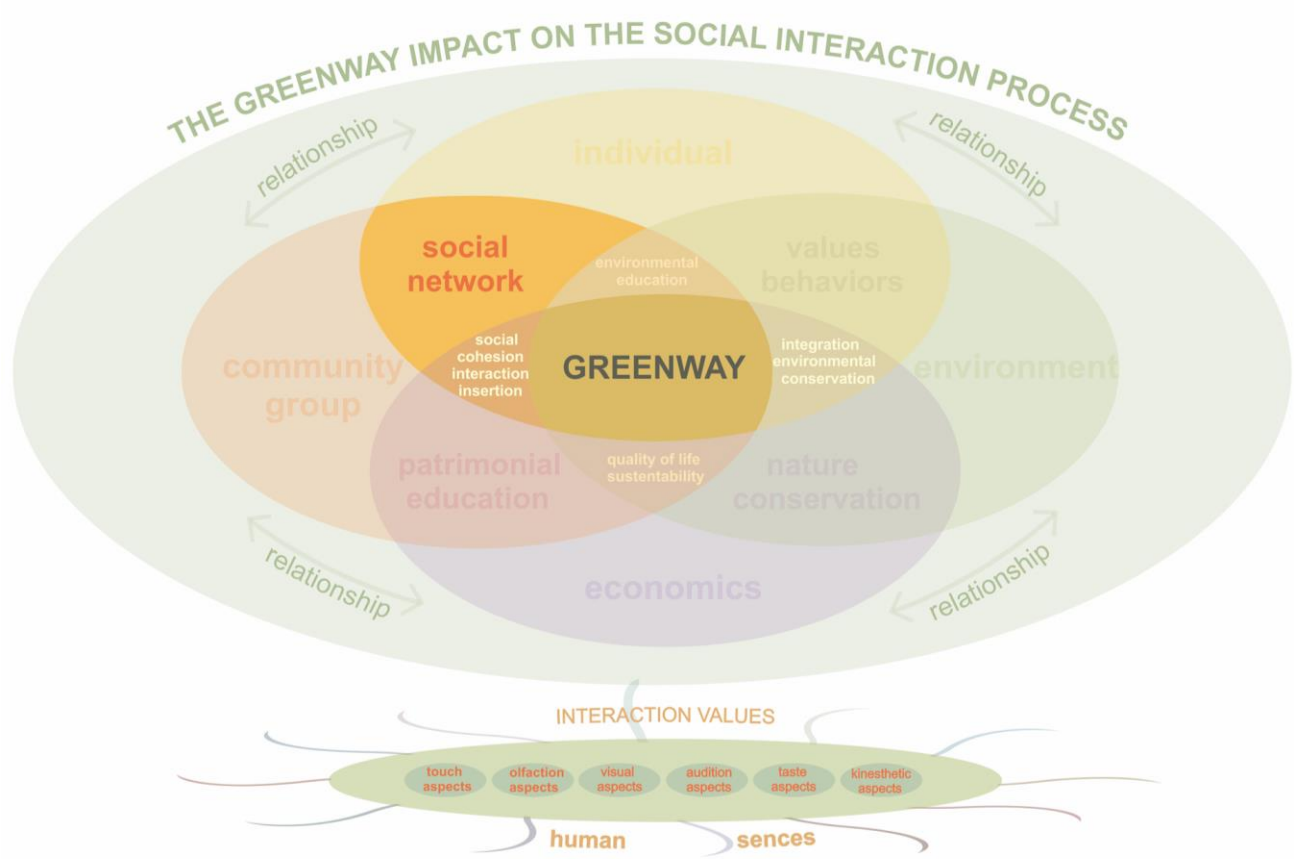
Figure B1. Common and Unique Elements Investigated in Theoretical Perspective.

Source: Pippi (2013).

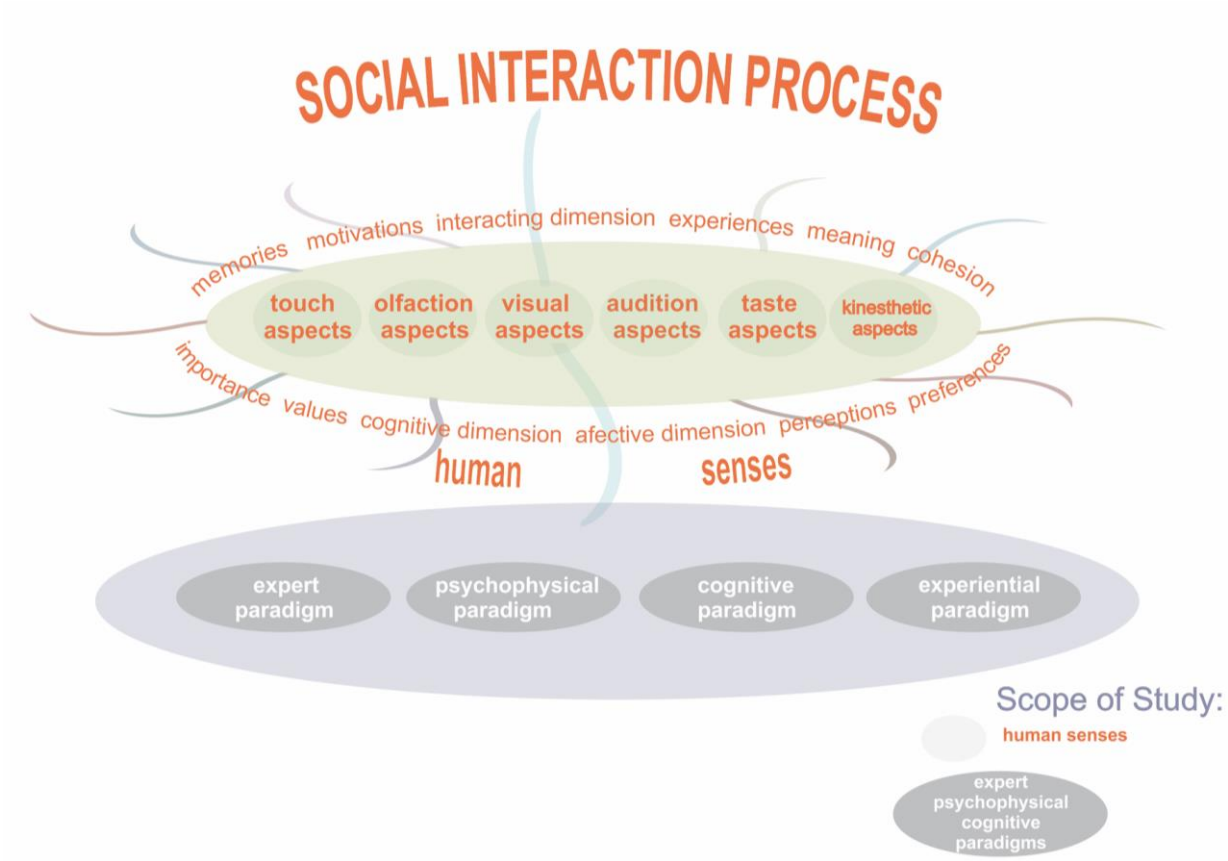
Appendix C: General Conceptual Framework of the Study



SOURCE: PIPPI (2013), based on ZUBE (1975); TAYLOR & ZUBE & SELL (1987); SCHAFER & TURNER (2000) and CHON & SCHAFER (2009).

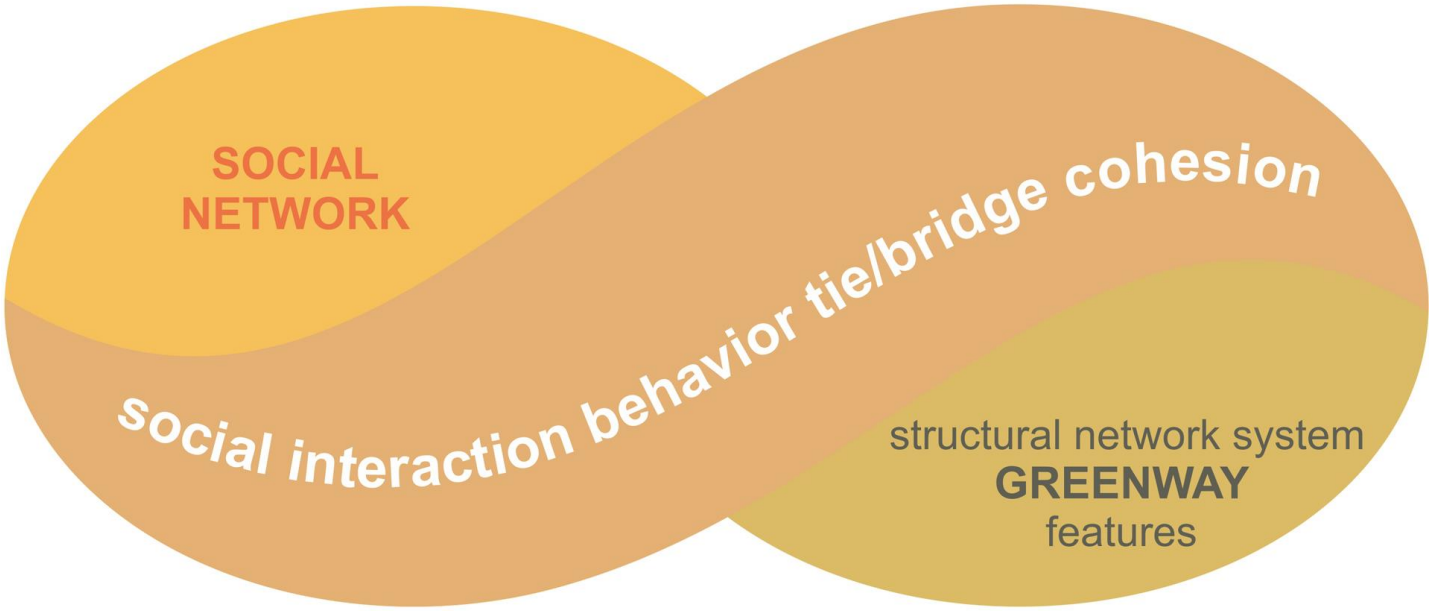


SOURCE: PIPPI (2013), based on ZUBE (1975); TAYLOR & ZUBE & SELL (1987); SCHAFER & TURNER (2000) and CHON & SCHAFER (2009).



SOURCE: PIPPI (2013), based on ZUBE (1975); TAYLOR & ZUBE & SELL (1987); SCHAFER & TURNER (2000) and CHON & SCHAFER (2009).

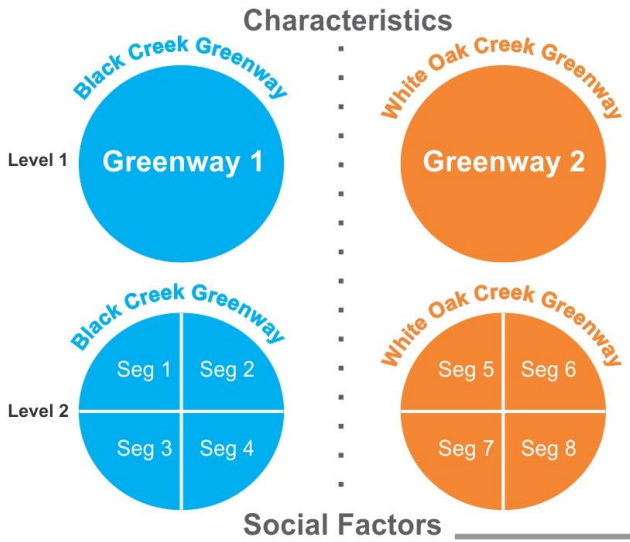
Appendix D: Simple Conceptual Framework of the Study



Source: PIPPI (2013)

Appendix E: Structure of the Study Variables

TOWN OF CARY GREENWAYS - NORTH CAROLINA



OBSERVATION METHODS
Behavior Mapping and Stationary Observation
Survey and Mapping Exercise

EXPLORATORY FACTORS
Independent Variables

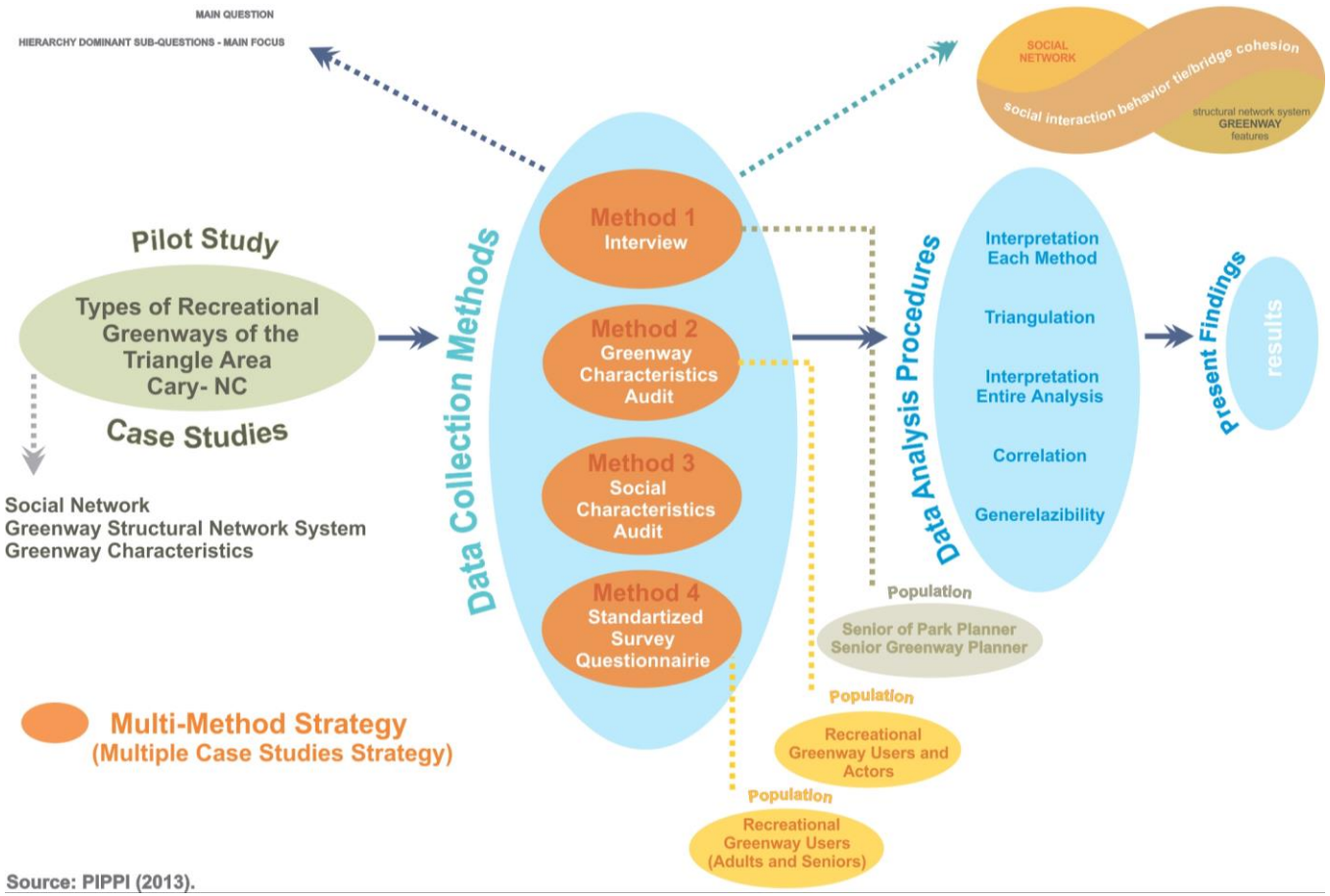
Greenway Type Variable	Greenway 1 and Greenway 2
Greenway Characteristics Variable	Greenway Structural Network System Greenway Features (Landscape and Physical Structural) Street Furniture Components
Greenway Temporal Variables	Week (Weekdays and Weekends) Period of Day (Mornings, Afternoons and Evenings) Weather Condition
People Variables	Type of User (Age) Type of Actor (Pure and Transformative) Gender
Behavior Variables	Patterns of Use / Type of Activities Complementary Behavior Physical Activity Level
Greenway Segments Variable	Segments 1, 2, 3 and 4/5, 6, 7 and 8
Greenway Characteristics Variable	Greenway Structural Network System Greenway Features (Landscape and Physical Structural) Street Furniture Components
Greenway Temporal Variables	Week (Weekdays and Weekends) Period of Day (Mornings, Afternoons and Evenings) Weather Condition
People Variables	Type of User (Age) Type of Actor (Pure and Transformative) Gender
Behavior Variables	Patterns of Use / Type of Activities Complementary Behavior Physical Activity Level

Dependent Variable Social Interaction Variables

total number, proportion and types
(ties/bridges, user/actor interactions, patterns of interactions, level of interactions, catalyst of interactions and centralities)

Main Questions	Sub-Questions
Do recreational greenways impact social factors such as interaction, behavior, ties, bridges and cohesion? (Q1)	What are the characteristics of recretional greenways? (Q2) How do the types of greenway characteristic impact social factors? (Q1 and Q2) How do greenway characteristic impact social factors? (Q1 and Q2)
Do recreational greenways impact social factors in ways that are different depending upon the characteristics of the greenways? (Q2)	Do recreational greenway characteristics provide a catalyst for social interaction? (Q2) What is the nature of social interaction on greenways? (Q1, Q2 and Q3) Do the greenway characteristics impact social aspects and play a role in creating social ties and bridges? (Q2) Do greenways promote social interaction in a various type and degree? (Q2 and Q3)
What is an effective protocol for analyzing interaction, behavior, ties and bridges on recreational greenways?(Q3)	What are the type of users, actors, ties/bridges and centralities of recreational greenways? (Q1 and Q3) What type of social interaction and behaviors can be found on recreational greenways? (Q1 and Q3) What are the catalysts for greenway social network behavior and interactions? (Q1 and Q3)

Appendix F: Diagram of the Research Methodology



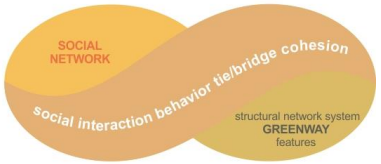
Source: PIPPI (2013).

Research Main Questions

Do recreational greenways impact social factors such as interaction, behavior, ties, bridges and cohesion? (Q1)

Do recreational greenways impact social factors in ways that are different depending upon the characteristics of the greenways? (Q2)

What is an effective protocol for analyzing interaction, behavior, ties and bridges on recreational greenways?(Q3)



Research Dominant Sub-Questions (main focus)

Which are the most used greenways of the entire structural network of Raleigh and Cary?

Does the greenway structural network type impact the social aspects?

How does the greenway structural network type impact the social aspects?

What are the characteristics of recretional greenways? (Q2)

How do the types of greenway characteristic impact social factors? (Q1 and Q2)

How do greenway characteristic impact social factors? (Q1 and Q2)

Do recreational greenway characteristics provide a catalyst for social interaction? (Q2)

What is the nature of social interaction on greenways? (Q1, Q2 and Q3)

Do the greenway characteristics impact social aspects and play a role in creating social ties and bridges? (Q2)

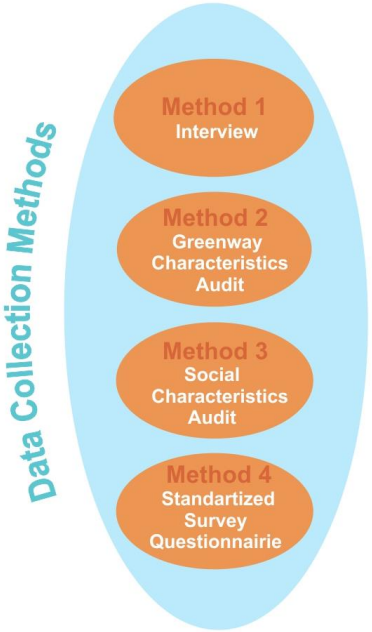
Do greenways promote social interaction in a various type and degree? (Q2 and Q3)

What are the type of users, actors, ties/bridges and centralities of recreational greenways? (Q1 and Q3)

What type of social interaction and behaviors can be found on recreational greenways? (Q1 and Q3)

What are the catalysts for greenway social network behavior and interactions? (Q1 and Q3)

Source: PIPPI (2013).



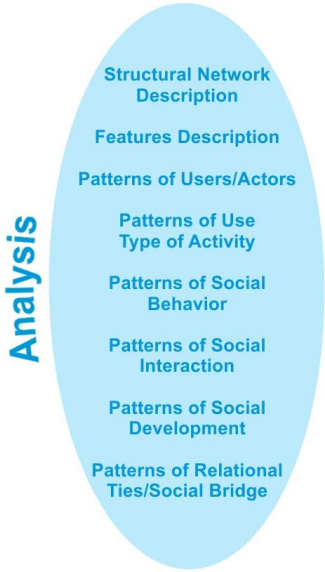
Phases

Phase 1

Phase 2 and 3

Phase 3

Phase 2 and 4



Outcomes

Protocol
Administration
Site Selection

Social Observation/Check
Behavior Mapping
Stationary Observation

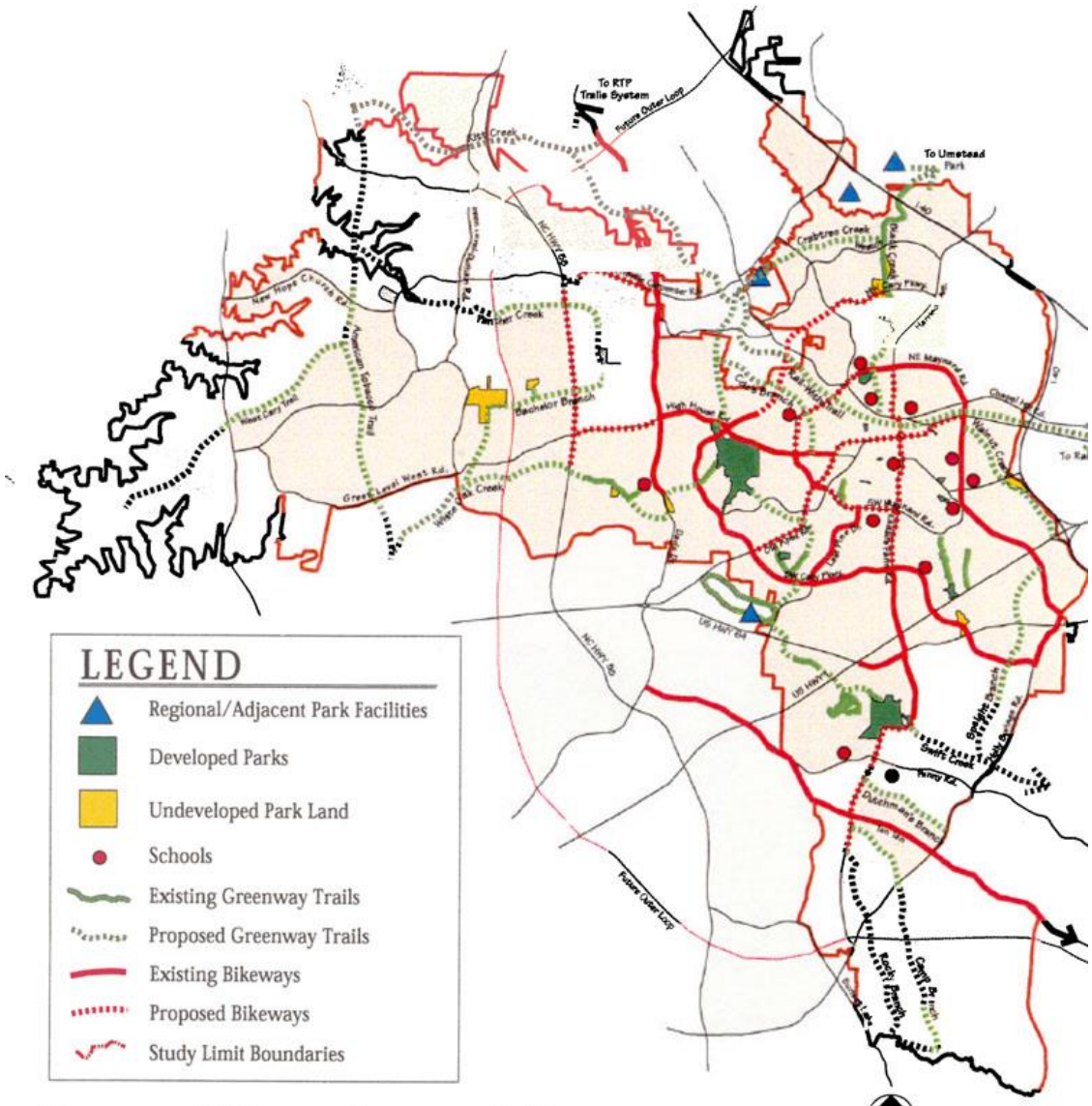
Structural Network
System Observation
Features Observation

Survey
Mapping Exercise

Appendix G. 1998 Parks, Greenways and Bikeways Master Plan

Town of Cary

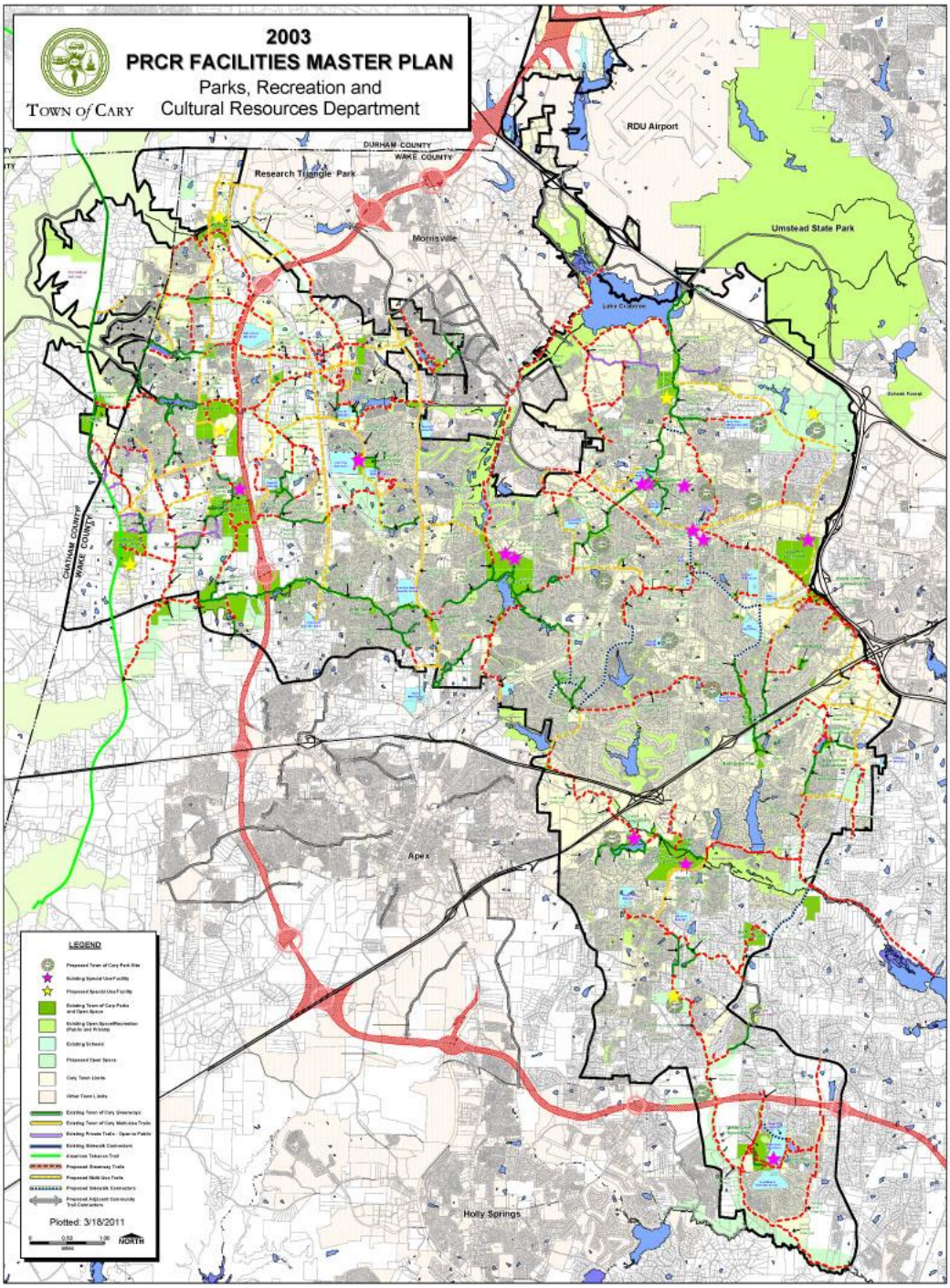
Parks, Greenways & Bikeways Master Plan



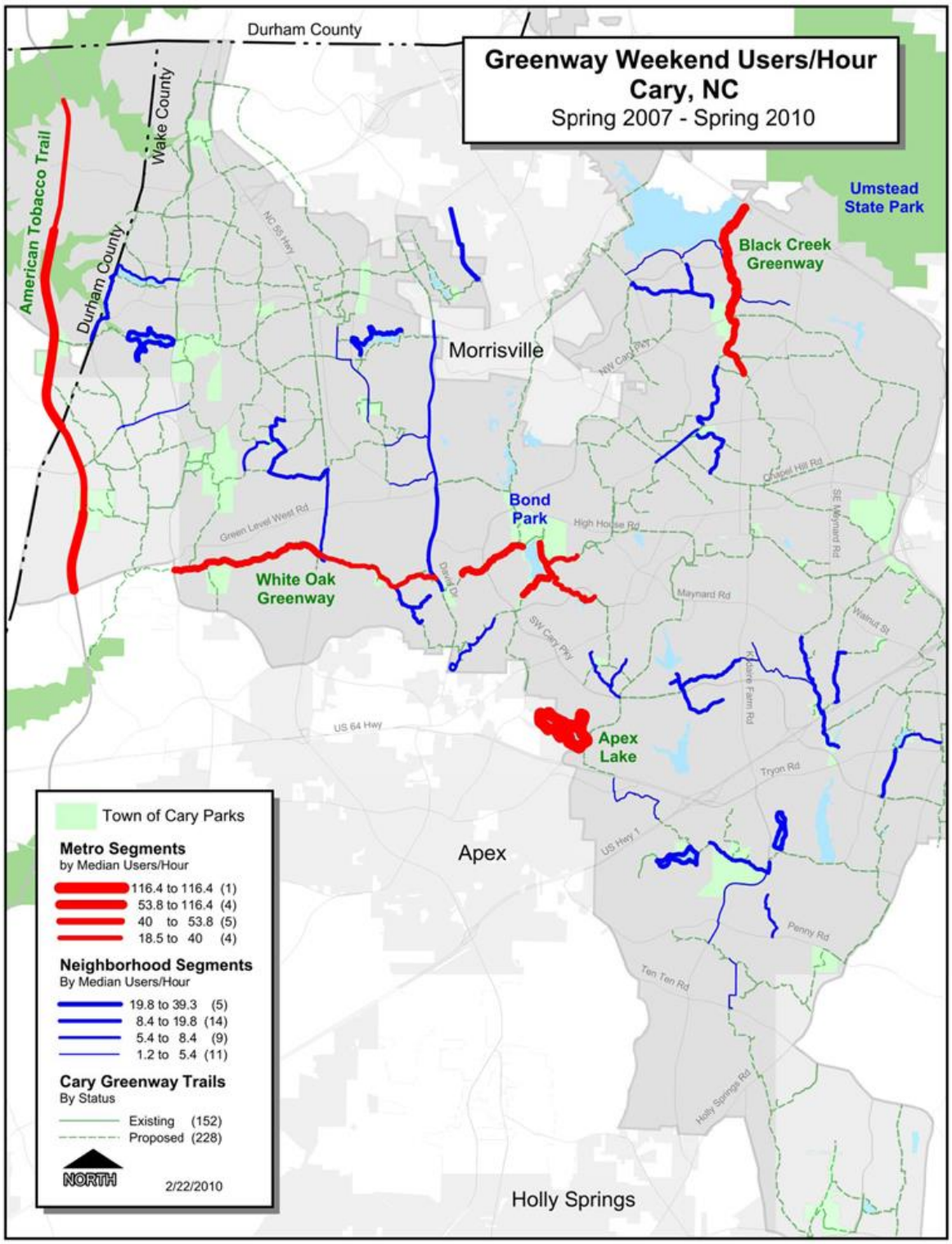
Greenways & Bikeways Recommended Routes

NORTH SCALE: None

Appendix H. Parks, Recreation and Cultural Resources Facilities Master Plan – 2003

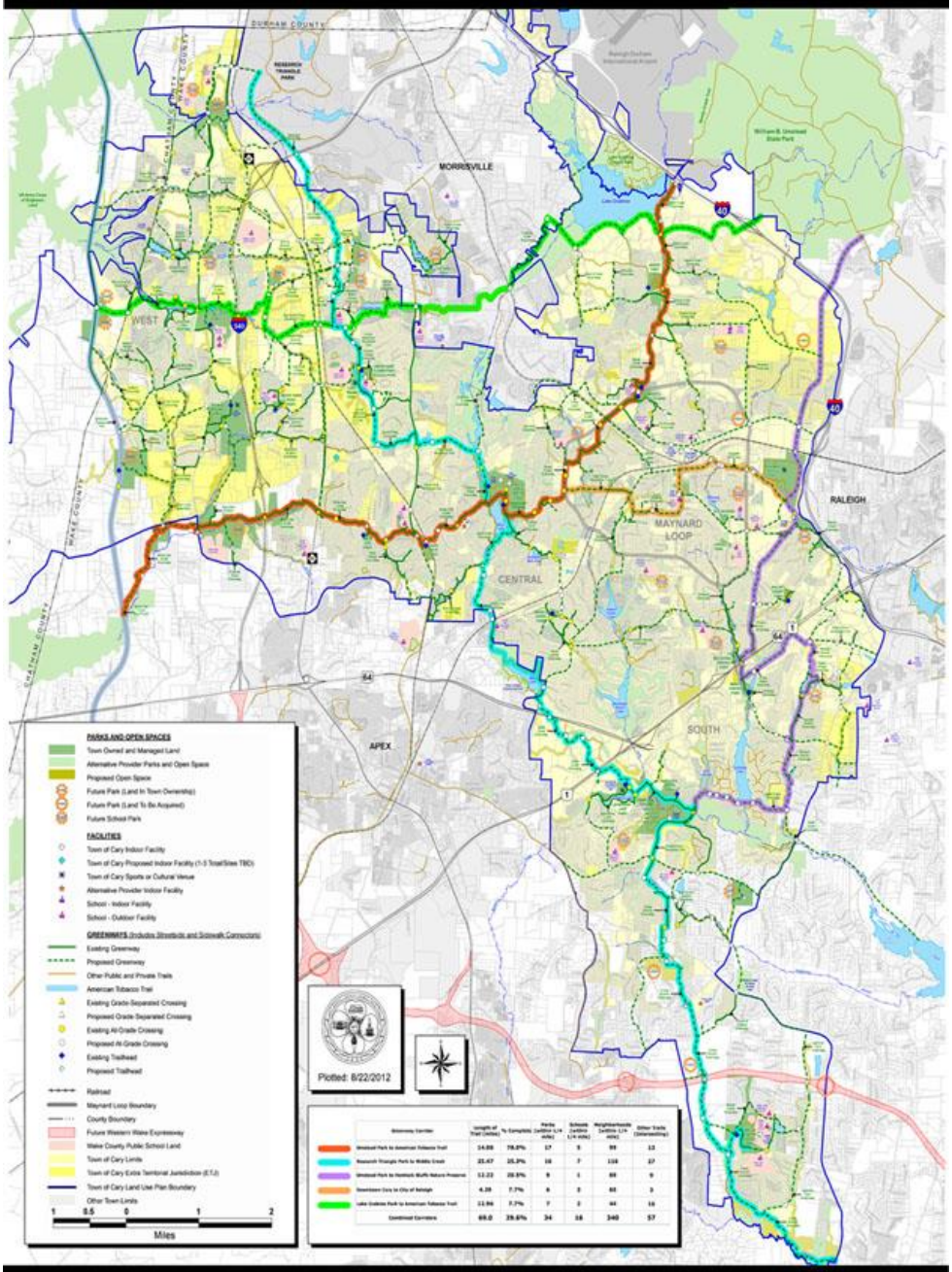

2003
PRCR FACILITIES MASTER PLAN
Parks, Recreation and
Cultural Resources Department
TOWN of CARY
DURHAM COUNTY
WAKE COUNTY
Research Triangle Park
RDU Airport
Morrisville
Umstead State Park
Lake Crabtree
CHATHAM COUNTY
WAKE COUNTY
Apex
Holly Springs
LEGEND
Plotted: 3/18/2011
NORTH

Appendix I. Greenway Weekend Users/Hour Cary, NC Spring 2007-Spring 2010


Greenway Weekend Users/Hour
Cary, NC
Spring 2007 - Spring 2010
Durham County
Wake County
Durham County
American Tobacco Trail
Umstead State Park
Black Creek Greenway
Morrisville
Bond Park
White Oak Greenway
Apex Lake
Apex
Holly Springs
NC 55 Hwy
NW Cary Pkwy
Chapel Hill Rd
SE Maynard Rd
High House Rd
Green Level West Rd
Maynard Rd
Walnut St
SW Cary Pkwy
Kildaire Farm Rd
US 64 Hwy
Tryon Rd
US Hwy 1
Penny Rd
Ten Ten Rd
Holly Springs Rd
Town of Cary Parks
Metro Segments
by Median Users/Hour
116.4 to 116.4 (1)
53.8 to 116.4 (4)
40 to 53.8 (5)
18.5 to 40 (4)
Neighborhood Segments
By Median Users/Hour
19.8 to 39.3 (5)
8.4 to 19.8 (14)
5.4 to 8.4 (9)
1.2 to 5.4 (11)
Cary Greenway Trails
By Status
Existing (152)
Proposed (228)
NORTH
2/22/2010

Appendix J. Parks, Recreation & Cultural Resources Master Plan – 2012

TOWN OF CARY, NORTH CAROLINA
PARKS, RECREATION & CULTURAL RESOURCES
MASTER PLAN



2012 GREENWAYS MASTER PLAN MAP

Appendix K. Greenway Expert Interview Questions

Conversation-Interview with "James": Senior Park Planner – Town of Cary

Place: Department of Parks, Recreation & Cultural Resources – Town of Cary
Date: Thursday, 30th June, 2011
Time: 10:00 – 11:00 am
Duration Tape-Record Interview: 1 hour
Interviewer: Luis Guilherme Aita Pippi

Our aim of the communication interview is to investigate the greenway structure and it relation with social aspects. The provided information will guide then next steps of our doctoral study: the Greenway Social Network.

Topics -Questions:

1. **What do you see as the main functions of the greenways?**
2. **What are the contexts of the Greenways in the Cary Structural Network System and Green Infrastructure System?**
3. **How is the existing Greenway Network being improved at this moment as a part of the Parks and Recreation Master Plan?**
4. **How does the Department of Parks, Recreation and Cultural Resources of Cary plan, implement and manage the connections between Greenways and between Greenways and Parks?**
5. **What are the goals and the future plans to improve the greenway network? Why is this important for citizens and tourists?**
6. **Of all the Cary Greenways, which one is the most representational and most intensively used by people? Why?**
7. **Do you think it is important to study the level of social interaction that takes place on the recreational greenway? Why?**
8. **Do you think that the greenway structural network and greenway features can influence the level of social interaction?**
9. **Do you have any analysis with the quantification of users and type of users of the Cary greenways? What are the high use periods?**
10. **Which is the most used greenway? Have you counted the users and type of users on the paved and unpaved trail?**
11. **Of all the trails of Cary, where are the greenways with the highest volume of use? If you pick one of these trails (paved and unpaved) what are the significant segments and locations that are more heavily used by people? Can you point this out to me on the map? I need you to circle for me 3 points on the unpaved and 3 points on the paved trails that in your expert opinion have the greatest volume of use.**
12. **Can you provide some materials about the greenways such as recent aerial photos, maps, information of the quantification of users and uses? May we scan or copy these materials?**

Provided materials by Joe Godfrey: two printed maps: 2003 PRCR facilities Master Plan, and Town of Cary Greenway Map: Current Projects and Gap; pdf file: greenway weekend users-hour Cary-NC: Spring 2007-Spring 2010; article: The Value of Greenways in Children's Play and Education, a contact with Robert Bush, and an invitation to attend the greenway committee meetings (at the PKCR Department – Cary; third Thursday of the month, once a month, at 6:00 pm).

Appendix L. Transcription Interview Greenway Expert

Legend:

James (J)

Luis (L)

Introduction Conversation during the Interview Method

L Hello J, how are you doing today and thanks for having me here today.

J Fine thank you L. First, in the study of greenways with Robin Moore and I wrote an article on greenways in how they can help to expand children environments (hum-hum), and Robin got this published in this global magazine, is the Children Rights to Play, so you can take that, is OK (handle to L a copy of the article)

L Thank you.

J It was basically, it is interesting that when you came with the same type, when you are looking to the characteristics on the Cary Greenways, because when I was a student I did the same thing, and this articles, I focused basically my study on the Black Creek Greenway, so if you read through you will get an idea of my observations, back when I was on school, 15 years ago, and I wrote this article on Cary Greenways, so here I am now as a greenway planner. You can have that.

L Thank you, J.

L I want to find out not only the levels but also what catalysts, in other words, what aspects that brings people together, is because greenways uniqueness? Or another factors? , like linking neighborhoods, linking parks and linking to both, and how this may affect usage and socialization.

J Let's put this on the table, you can have that and take it with you (opening Cary's Greenway Master Plan Maps on the table: 2003 PRCR facilities Master Plan). This is Town of Cary's Parks and Recreation and Greenways Master Plan, so you can see this dark black line here, this is the line of our Town limits. And everything you see in dark green, these are built greenways. And the red-dash line, like right here, is like a long greenish planning. Like, this is designed for the next 20 years, 25 years of greenway building, so the reason that we will have a Master Plan like this, let's say

per example this undeveloped part, is a red-dash line, and you are a developer and come into our Town and want to build a sub-division, when we have this dash line, it means that the developer is required to work with us in giving a greenway easement. This is the master Plan that was adopted by the Town Council.

L That was the 2003 Master Plan, right?

J Yes, and right now we are updating it.

L So it will be the 2011 Master Plan. I remember that P mentioned, when we were dealing with the Walnut Street Park conversation.

J Oh, Ok, Yes, so right now we are in a process of updating our Master Plan, and so it's been 7 to 8 years since we've going through this process…(2:55-3:01) and so, that will go for the council to be kind of law essentially? The adopted, the agreed to the Master Plan. So, any of new trails we add on into it, that will be, that will give us like a jurisdiction in control when new development occurrence. So the developers will be required to give us greenway easements. Because a big part of building these trails, is getting the land to build them on. That is the most difficult part, especially if you are in an urban setting.

L I know, I know.

J Take years to take it the land.

L Yes, I imagine, acquiring the land and making possible all the connections.

J Let me grab one of the maps, I will be right back. I want to show you the projects that we have going on (Town of Cary Greenway Map: Current Projects and Gap).

L Ok.

J This is basically the same writing this map. I want to show and share with you, a kind of projects that we are working on, like I said, is a long, long process, a lot of this as I said… getting land, etc. So we lay out (J means: mapping all the projects) and here it is a wide range of 24 different projects in some stage of either we are looking at it, we are getting Land Park and Greenways, we are getting easements or permitting it, we are doing the structure drainage all over and/or we are building them. (5:52-6:21)

L So one of your main goals latter is connect by the greenways all the parks.

J Yes, in part you are right. Our main goal is to develop a Greenway System through the whole Town, to connect to schools, commercial/shopping centers, businesses, neighborhoods and parks… and for people be able to access the trails easily from their neighborhoods, when possible. They don`t have to drive to go somewhere, they don`t have to agree. (6:45 - 6:48). So, trail-heads, a lot of times we will use the existing parks, because is already packing for the vehicles at those locations. So, for example like Bond Park.

L Your Metro Park.

J Yeah, this is like our main park in Town (talking about Bond Park), size-wise (7:10), is has the Community center there, Senior Center, there is a Boat House, lots of Ball Fields and all sort of things. Anyways, this is more or less like the hub of our greenway system. So if you are down there, a lot of our trails start on that location, so the Black Creek Greenway, which is this trail right here (J showing in the map) runs approximately 7 miles Bond Park North up to Lake Crabtree and then into Olmstead State Park. So this is Raleigh access to Cary essentially on this greenway trail (J showing in the map).

L And you also pass in this circuit by the North Cary Park, right.

J Yes, which is right here (J showing in the map). So, that's a good example, if you go down by the Black Creek Greenway, for example, you will be connected to the North Cary Park, this park on that location, you go down here to the Robert Godbold Park, is another main park in that location, across the street we have a parking lot (J showing in the map).

L That's the "skate park" and dog park".

J Yes, the skate part and dog area is also part of that facility. So this section of trail we just completed (J showing in the map) it's 1.03 miles, you will see right out here that we had put in a (8:30) 200 foot-bridge over the rail road line. So those are … I've been working in that section of trail for the last 5 years, 6 years, as far I was getting approval for the rail road, usually when you approach an agency like that, and they will tell you: we are not interest. So, it takes you a lot of effort and time to meet the expenses. Like this section of trail it cost $ 2,000,000.00 dollars (two million dollars)

and is only 1.03 miles, but we have, as I said, is a 203 footbridge over the rail road line, so lot of coordination, a lot of long schedules by the time you get all the approvals and the agencies, to get the land that you need to build it, and everything else. And actually this was funded by stimulus grant, a good part of it, so we have a lot of Federal money towards the construction of that project. So that's another whole level of bureaucracy to deal with, and getting the money and things like that. So anyways this continuous down, and this down yellow section as can you see it (J showing in the map), these are areas that haven't been built yet.

L The future greenway projects.

J Right, the future projects. These were all designed and ready to go, and will be pick up when you stop this project (9:48) and hopefully we will have this under construction by the Fall (2012) up and down, and connected and then this whole thing, this whole 7 mile level will be completed, except for this one section right here (J showing in the map), and we have those pink areas, that we called greenway-gaps (J showing in the map), so we are identifying gaps that you want to build in the future.

L And manage too.

J Yeah, well, here at this particular gap (J showing in the map), is only a small length, is only a quarter of mile, but it will be a difficult build because is probably a 35 foot gray change from where we need to go, like down in a hole. So for right now, for people that want to continue on the Black Creek Greenway they will take this section of sidewalk, is like a sidewalk link, up to (10:35-37), so if you go to the Black Creek, you can see that.

L Is like a link short-cut.

J Right. So anyways, we will get this section of section and then will complete with this other missing piece that we will start the construction on the Fall (2012) and that will complete the 7 miles of the Black Creek Greenway. And so, it is a mission that we will connect to several schools, and is also we connect with this elementary school (10:50-57), so we brought the trail right by the elementary school here (J showing in the map).

L So the children can be able to use the greenway.

J Right. Bike to school, walk to school (J meaning about alternative, health and secure transportation).

L Also it can be used for the environment education, as an outside classroom.

J Right. If you look at the article that I just gave you (J showing L the article), actually here in this picture are my kids when they were small when I was writing this article.

L That's good.

J Anyway, here is when I went to a school that was right on a the greenway, one of my sons went to a pre-school there, and they were bringing the kids out to the greenway and talk about nature, just to get them out, into the woods, you know and observe squirrels and the leaves changing colors and things like that. And so definitively I documented that area and you can see that there is a really good educational environment.

L Yes, I can see the high potential of the greenway for this purpose.

J And unfortunately, a lot of people not get out into these environments if they didn't have this type of back of access. because if you go through with building some of this trails is a very rough terrain, just places that you wouldn't go if there isn't a trail to walk on, like when you build walk-boards in a mash areas and things like that you know.

L Yeah, I do believe that the greenways have a high potential to environmental education, is not only for the physical activity purpose.

J Yeah, this is the focus. You will see this, a lot when you read this article.

J Anyways this is our main trail, that's the Black Creek Greenway (J showing in the map) and in the Bond Park we have this is the hub of our system, than we will change to the White Oak Creek Greenway so is like another 7.5 miles.

L Where is that (…) you have a big marsh area on the White Oak Creek Greenway, right.

J Yes, is right here (J showing in the map). So you've been to that area?

L Yes, I've been on, and for me is a very unique greenway section with gorgeous landscapes.

J So, that's the White Oak Creek Greenway. You can see it starts, right, this is our jurisdiction, our playing jurisdiction, and this other piece is on Apex, and then it will take you to the American Tobacco Trail. Have you been out there?

L Yes.

J So, we constructed this section of the American Tobacco Trail in Chatham County (J showing in the map).

L So you want to expand this from...

J So, we want to extend this down to connect even though in Apex, like it's gonna serve a lot of Cary's residents. So, we got the design for this trail, but we are waiting to find some grant funding to build it. Because is not in our jurisdiction. And that's probably a couple of million bucks to do that. So, politically is pretty hard to go and ask for money and build something in someone else community. And especially in this economic time. That probably it will be some type of partnership between Counties: Apex and Cary to get that last section built to the American Tobacco Trail. And then when you reach the American Tobacco Trail, that is another 23 miles corridor, eventually to go all the way down to Durham Ball Stadium and Downtown area. It's just one segment left to build, that they are working on that right know. So, they are working in finishing the design, is not under construction right know.

L So, are both Departments of Parks and Recreation of Cary and Durham are talking and interacting together to pursue all of those connections and then propose in a bigger scale, a regional greenway?

J Yes, a regional scale. Yes.

L Like a regional connection: mobility and ecotourism? In another level, you know

J Yes, if you look at, right here (J showing in the map), in this gray colored line, this is the other neighborhoods and communities greenways system, so this are the greenway trails on Apex, Morrisville, Raleigh, so we tried to… so here it is the main one in Raleigh coming to Olmstead State Park and then connect to our Black Creek Greenway, that's why this length is really important to Raleigh, so they will be able to get out to the American Tobacco Trail. So by completing the Black Creek and the White Oak Creek Greenways, it will be provided a Raleigh access and Cary. Just

going through Cary is only 14 miles, so is really will beginning to be a regional connection, and then to reach the ATT (American Tobacco Trail) that's like a 22 miles trail, you know and you can get to the Downtown Durham.

L Awesome.

J Yeah, we definitively look in linking other communities, learn about big challenges. The 2 I say, when you want to ask me specific questions, I just given you here some broad impression overview. Our biggest challenge is getting the land, especially in a urban setting, like if you look in an area like this for example (J showing in the map), let's say, just to get it build this little piece of stretching greenway, just probably a quarter of mile, with all that little lots that you need to go through and you need to get easements from those people, and it can be very time consuming and difficult, like people might be not interested.

L Yeah, some people value the greenways, while other ones no.

J Like this particular trail right here (J showing in the map), it goes through a really high neighborhood, in West NC 55, and we had to get from them between 28 to 30 easements, so you can imagine the time involved and… the properties on this In buying easements after them.That is the big challenge and the other big challenge is crossing over main roads safely.

L Yes, by providing overpasses and underpasses.

J There are 3 ways that you can do it: you can go cross at street-…, heavy bridge over, or a tunnel underneath. So for example, on the trail that we just finished, up here at this section of the Black Creek (J showing in the map), we put a 203 foot bridge over a rail road and that really doubled the cost. That will be really interesting to look at this one right here.

L Yes, I do remember that bridge, on the Black Creek section next to the Robert Godbold Park. I also remember another huge footbridge at the Hinshaw Greenway that connects two of Cary's Parks: MacDonald Park and Kids Together Park.

J Yeah, the one that cross the 164. But this is an old connection. This one that I mentioned is new. We just finished this project and recently have been opened to the public. Is right around the corner.

J So a big challenge is crossing main roads safely. If we prepared go over and under, but it is expensive.

L Is more expensive, but less risky.

L Do people accept more overpass or underpass? You have 3 underpasses, two on the Black Creek and the other one at the White Oak.

J The White Oak is on 55. I can show to you where our tunnels are: on is here on the NC 55, (J showing in the map), we have the other one right here, there some good things to look at and there is another one right here, there is two right there, and actually if you are, this is a good example, you said that you know where the Robert Godbold Park is, right. There is a Lowe's right here, a Lowe's shopping center, so when they built that Lowe's, there is a road that comes in, called Evans Road and they were required to build us as a tunnel, like if you walk down there from the Godbold Park you will go through to a tunnel, right here, have you walked out there? …

L No.

J You will see a Lowes shopping center. And when they came to build this shopping center.

L Is a very little tunnel right?

J Is probably about 60 to 70 feet. Because is a two lane way traffic to get over, is about the access to get to the shopping center on Evens Road.

L Oh I saw that tunnel, but never walk this part.

J So, when they were building that Lowe's, we required them to build us that tunnel. So is was just kind of like leverage that we had when they came in and want to build the shopping center, because there was a re-zone in the land, the original zone was residential, so we had leverage if they want to change to commercial, so one of the requirements is going to be if they build that safe separate crossing area for our greenway, so they will not conflict with that future greenway trail. So they built that tunnel and they built that section of greenway that connects the Godbold Park to the intersection of the main Chapel Hill road.

L And there is a bridge on the other side.

J On the other side is where we put the 203 bridge over the rail road line. If you cross the street and go down. So there is different ways to get this built. So that was one of the big challenges. This red line right here (J showing in the map) this is the I-540, so this is a new expressway going through, and as you can see, this will be like a wall for our greenway system.

L And so, you will need to have a lot of safe connections.

J For example, this is our Bachelor Bridge Greenway, they came to the Town and want to get land to build this highway, and so, essentially they are buying easements off us and we also requiring them to build on these locations a great separate crossings, so for example, look at those two different crossings: this is the Bachelor Bridge future trail that is going to go through, that going to baseball…. They are putting a tunnel, that I think is a 200 feet. So as you can see, a pretty extensive, is going to be under a pretty long and wide highway. And then here, because the grey, and because the highway goes up, and they will have to build us a board walk, because they actually, we had to stop our trail, that is temporary closed at this point, but they will build us a board walk underneath the trail and the highway is going to be high in this location, so there is a wetland here, so they will build a continuous the board walk around, and we worked with them about the design scene, what we want to build, how is going to be constructed, and as part of that highway project, I think is 5 different crossings. So the highway will go in, but is not going to disturb our system. So if you do not plan that, like a long-range planning, you will have that like a wall and you not going to cross very easily.

L But are you also providing ecological crossing for the wildlife?

J Wildlife, yes, this one here (J showing in the map), as I said where the highway is flying over, so and the trail are down, and we have continuous walking boards, yes all the wildlife can go through safely.

L Oh, that’s good. That’s good.

J Those are the two biggest obstacles, I can say that actually to build the trail we budget around 700 thousand dollars per mile with this construction, nothing with… no land acquisition, no design, no construction, no administration, just pure cost of

700 thousand dollars. I think if you talk with people in Raleigh. Have you talked with them, with “Victor”?

L No, not yet. I’m pretending to interview soon, “Victor”, the Senior of Greenways of Raleigh.

J He will be a good person to talk too. They have a really extensive greenway system, you know we work well with them, in different aspects, like in terms of regulation issues, so we definitively are trying to merge our systems to….

L That’s good. It will complete more the idea of the greenway structural network system in a bigger scale.

J One other thinks that I was mentioned early, like if someone comes in, like a developer and want to develop a piece of land, for example, this is the South Bridge Greenway (J showing in the map), so when the developer of this sub-division came in, they had to pay a certain amount of money to into the Parks and Recreation fund, depending in how many houses they were building, we performed a formula and then we charged them a certain amount to get build some extra parks and greenways, to serve the extra citizens they are bringing to the Town, and sometimes we calculate will be the cost of building out the trail and let them build the trail, instead of paying to the fund, so in that way we were able to really add a lot of miles. Is a win-win to both of us. Could provide really good roads, they brought the equipment out there and they can build the trail at the same time. So that was the situation right here (J showing in the map), but as you can see, this is about a half mile trail, a real nice trail, really close to all these people, in which they can get out really easily, but it has a couple of missing links, for example, is just like this, require to half mile segment to the trail and is very close to link to this trail that goes around this lake about for 2 miles.

L Cary Parkway?

J Yes, Cary Parkway. Those is like, if people say why did you… build at in the whole way, but this was the … for that development to add to work with it. These were the requirements, so we will come back and fill that gap, we will take advantage and get this build when we can and then come back and fill these gaps.

L So this Master Plan that will be done by the end of 2011, you are counting a lifetime of 15 years, 20 years?

J Ideally every 5 years, we have to get our plan updated and the Town limits is always been changing, like this line it could change (J showing in the map).

L Like expand more.

J Expand, like if people that live down here and come to the Town and say that they want to be in to the Town and usually people do that because they want to hook-up their water, their sewer and things like that on Town. These lines can change in those new areas. For most parts they are pretty well, like I said we had a greenway committee that meets monthly and those are the things that we talk about it. The Master Plan, the trails and it's been pretty well… on the Master Plan, we have a consultancy, and one of the consultancy, what they think about it, …. Look what they think for the greenway system, where the things could be improved. I will let you know some of the dates of those meetings if you want to attend and if you find interesting.

L OK, thank you, I will love to attend some of the meetings.

L So, J, can I ask you some questions? I will be applying the same questions for both greenway planners: Cary and Raleigh. As a part of the interview method of my study.

J OK. Right.

L I also brought with me one base-map for you to indicate latter some greenways and specific points for my future observational methods. Primarily, I was intending to do the entire greenways of Cary and Raleigh and then compare, but it was impossible to pursue that ideal, because of the lack of money and time. So I decided to come and ask you to point specific locations, and that will be on the last question, for you to point me the 3 paved and 3 unpaved greenway trails that you know that is heavily used. And then latter I'm intending to compare and correlate them, and them the intention is to pick only one trail each and compare. But first I'm intending to do some studies in one level and then go in a more detail in another level, when dealing with the social variables, specific social variables. I'm using also some social network references to add in knowledge as a landscape architecture and see what is going to

emerge with the results, and maybe trying to bring something knew for you as a greenway planner and designer, and also for the greenway researchers, the goal is to improve the greenway system and it potential.

J It sounds good.

L And so J, as the first question…

1. What do you see as the main functions of the greenways?

J OK, we look at the: are the trails basically to their recreation purposes and… the recreation and attention to corridors. I say that the main function is a dual function: one is for people to be able to go out and get exercise, recreate, get out in nature and observe nature. And the second will be to, is a mode of transportation. So all of our trail system right now, we are trying to connect to the old trail system into a large network in which people can get to a bike and go to schools, go to groceries stores, to shopping centers, to church, etc.

L In this case, as an alternative transportation.

J Yes, as an alternative transportation. Those are our two main goals to get people out recreating and into those transportation corridors.

L OK, the second question is…

2. What are the contexts of the Greenways in the Cary green infrastructure system?

J What do you mean by context?

L Like… as a system, how this planning, how you can visualize the landscape functioning in that system and as a network.

J The landscape?

L Yes, the landscape, as a context, as a green infrastructure.

J Our trails for the most parts follow stream corridors and sewer lines. Sewer lines a lot of times it will be previously clear through the woods and we are trying to collocate the greenways with the sewer lines when possible, so you clearly less vegetation and a lot of times you will have easements from the … that own those locations and

a lot of sewer lines will follow the streams corridors as lower points on the drainage. There are all a different list, depending on their locations and we tried to keep as wide as possible the corridor as we can to have more natural areas and we tried to service as many residences as we can, we are going to these urban areas that already developed, so we have very little room to work with, so the landscape corridor it will be much narrow in those situations, like when you talk about the White Oak Creek Greenway, like right down in this location (J showing in the map) in some we will have the corridor of 300 feet wide is like an open space, large natural open space, so if you go up here in this area (J showing in the map), where I mentioned to you early at the Bachelor Branch Greenway, we could have a little 25 to 35 wide easement, when we built the trail, because we will have easement from each individual property.

L OK, the next question is…

3. **How is the existing Greenway Network being improved at this moment as a part of the Parks and Recreation Master Plan?**

L You already explained that before that you are in this process.

J Right. We are now updating the Master Plan and getting some fresh advise, and take the look of the work that we have been done, and that we propose to do in the future, as I said we have a greenway committee meeting once a month composed by us and 10 citizens that are greenway activists, with different levels of experience and they continuously give input to our main goal in improving the network is to connect isolated links and different trails links, that we have, a network that is fully connected.

L the next one is…

4. **How does the Department of Parks, Recreation and Cultural Resources of Cary plan, implement and manage the connections between Greenways and between Greenways and Parks?**

L You also already explained this one in advance.

J Yes, we see the parks and the greenways as going hand and hand, let's say: right now our main parking trail is to have different park locations, different park facilities, and there are already infrastructure in those facilities, like restrooms and parking lots, so we utilize a lot of our parks as a trail heads for the greenway system.

L OK, the next question is…

5. What are the goals and the future plans to improve the greenway network? Why is this important for citizens and tourists?

L In other words, so one of the goals for your future greenway plan is to connect the Black Creek Greenway with the White Oak Creek Greenway, right?

J Yes, we look at those two greenways, as our two main trails. One of the main reasons is because is connecting to Olmstead State Park, Lake Crabtree, is giving Raleigh access into our facility and eventually get to the American Tobacco Trail. In this green line here (J showing in the map).

L Hum, hum, and also connect to the US Army Corps?

J Well…

L This is a closed area? Or is this not related, only like a historical instance?

J That's a cool land, the same as the one right here (J showing in the map), this is just management cool land, it's just like a green area as you can see. Actually, you have to get the Army permission to enter this corridor when you pass., when you went through this area. So, like this area is open for hunting (J showing in the map), so there was a lot of concerns about the trail going through hunting areas. So we have between putting those sites, we do have those very small fences to keep people that wants to go through to those locations on the trail and then also access points to the hunters to be able to get through cross the trail and go inside, so that's the only location where we have that situation. Have you been up at the American Tobacco Trail?

L Just a part of the American Tobacco Trail, but not in this area.

J That's the trail that has equestrian use in our system.

L OK, and so, all these future goals are planned for Cary's citizens and tourists in mind, right? The main focus is the citizens of Cary, right?

J We get a lot of people from other communities, I think that come to Cary to use our facilities. So, obviously, you know, when the Cary citizens are funding the trails, so they get to taxes and so… you know and we try to definitely serve what is going to benefit our citizens but we also acknowledge the neighboring communities and try to connect to their trail system too, we know that we have a lot of people that want to reach and just come to Cary and use our facilities.

L I guess, that when you are able to connect the Cary's Greenway System, Raleigh and Durham, into a regional and connected greenway network you then will be able to achieve a very touristic moment, not just regional, and why not national and international? Like tourists that come to visit and able to visit and travel to different places, landscapes and facilities.

J I think for that to be successful, you have to have long trails for those corridors, so that's also one of the reasons that I said about the White Oak and Black Creek, because that will give us 14 miles of trails that will get all connect to the American Tobacco Trail with another 23 miles, then you really beginning to build a system that facility that propitiates for a person that comes out of our state to get out there and use the trail system. You know and you can generate, extra taxes form hotels and restaurants and things like that.

6. Of all the Cary Greenways, which one is the most representational and most intensively used by people? Why?

J I will say the White Oak and the Black Creek. And I can get you and I will put you in contact with Robert Bush who did the exact statistics on: when people used, what time of day, who's used and the numbers. So definitively the White Oak and Black Creek you will find the most intensive use.

L And you know why they receive more people usage?

J I can say that a lot of this, is because of the distance. Like this is more like the original trail. And the American Tobacco Trail is probably the mostly heavily used,

because that it goes through 3 different counties and you can go off a quite of a distance and you notice that most people use the American Tobacco Trail around bicycle.

L Because is very linear.

J Yeah, is very linear, is an old rail corridor, and is a different experience. And also is a Nationally Trail that has an equestrian use. But you will see the numbers of highest usage on trails that have longer distances and if they go by water features.

L Like lakes.

J Yeah, like Lake Crabtree. And a lot of people like to be able to do a loop, as opposed to starting in one point, going down and coming back, so loop trails are really popular, so let me see, I will show you a project that I'm working on, like right here (J showing in the map), this is another project that we've been working with, the Space Branch Greenway, this is going to be the very dense, there is a very complex and dense apartments around this development, so this will be like a 3 corridor miles around this lake, so I think when this goes in, this will be really significant and heavily used.

L What is the name of this lake?

J Macedonia Lake. Is a small lake, is not a lineage lake, but just the density around it. And when this road was wide on Tryon Road, we had an industrial tunnel put in that locations, so if you get a chance to look at, is interesting

L So, in one side you do have the existed greenway and on the other side the planned greenway?

J Yes, but the greenway stops before it gets down to the tunnel. There is a dam at this side of the lake, so it took quite a bit of engineering to be able to get this trail down into the tunnel that we're want to get it, because we had to dig in inside of the dam, and when you do that you will get people nervous. You understand, so we have to get a lot of permitting have to occur for that.

7. **Do you think it is important to study the level of social interaction that takes place on the recreational greenway? Why?**

J Yes, you know… in one thing that I've observe is, a lot of times when you go through a neighborhood and people put a private post on the greenway, because they are worry about crime and different things.

L Right safety and privacy issues, and they put also fences, walls.

J Right, and once the trail is in, a lot of that goes away and they realize that is like a false fear and the social interaction that they have with their neighbors and other neighborhoods I think that really increases and improves, because it will be a walking and running into people that they haven't seen for a while and things like that. So I definitively think that greenways really do enhance the sociability and interaction. People that live really close together, they may not interact that much, because they drive home, and they go inside to a box and then they drive back out to their vehicle, so you know what I mean

L And could be more strong and different the interactions than the conventional parks.

J Oh, it is, we considered them as linear parks, like greenways, we consider them as a linear parks.

L Yeah, I know, but linear parks, are different than other types of parks.

J Then go to a children's park or other parks.

L Yeah, or Community or neighborhood parks and so on. Is different, because that linearity permeate and connects different neighborhoods, so people can go more easily to the nature or to interact with others than if they have to conventionally travel to another park to have that, by driving.

J Right, exactly. That's very true.

L So there is a strong potential on the greenways in promoting the socialization arena. It sounds simple, but is not, it is very complex. For example, it could be improved or not the greenways facilities to receive more or less number of people.

J Right.

L So, for the quantitative and statistical analysis of the Cary's greenways I must talk with Robert Bush, right?

J Yes, Robert Bush. We have extensive studies.

L Like he may provide information of his study and I will mention in my study.

J Yeah, he will be happy to do that. It's all broken down by graphs by years, seasons, temperatures, what trail was the most heavily used… exactly the information that you are looking for. You will find that information very useful.

J Do you intend to observe also in your study the trail frequency of use?

L Yes, so here is the map, so I can show you some trails that I'm doing a pilot test of my observation methods, like those points here, so I started doing the observation on the weekends for one hour (L showing in the map), but at the beginning I was intending to do the observations everywhere.

J So, when you do an observation, you do it for how long, how many hours you do

L 1 hour.

J That's how long Robert has the people for do the observations for him also.

L For latter, the idea is to do that 1 hour observations, in different periods of the day, you know, like morning, afternoon and evening, in some week days and weekend days.

J OK, the data that you will get form Robert is all weekends. Because everyone in our committee, except for one women that maybe retired and don't have a job full time, we did the counts on Saturdays and Sundays.

L The same time?

J Different times, on weekends, is very organized, you will see when you get this information.

J I will send him an email and copy to you and ask him to send you the most current data.

L Thanks, it will be very useful to compare our methods and results of our findings on the weekends. The idea is to do a more detail analysis, on weekdays and weekends, at the end in some specific greenway segments, and maybe provide you some information about the greenway usage on week days also.

J Right, that will be good and we will be interesting on that.

L The idea is to start the analysis, by picking the heavily used greenways, after your and his information. And then select specific segments for my analysis.

J He has that.

J So, when you do your survey and observations, you will be looking at how many people are using the trail, what is the things that you intend to study?

L I have here the protocol with the topics that I'm intend to use, to show to you, let's see where it is. Here (L showing the observation protocol). This is my idea, first studying the greenway characteristics by their structural network and features (landscape features and physical structure features), as descriptive variables. But the real focus is those topics here, as descriptive and analytical variables: type of users by age and gender; type of actors, like individual, dyads, triads, sub-groups and groups, like 4 people, 10 people, more than 16 people;

J You're not going to find many of this.

L Well, maybe some cases.

J You will find more of this (J meaning about the bigger groups) around the American Tobacco Trail. You will have, let's say, like groups of bike riders.

L Also, patterns of use, type of activities, type of activity levels, types and levels of social interactions, type of catalyst for those interactions.

L Like for example, for the type of activity, I was observing during 2 years, in different greenways, the most prevalent patterns, so I can be able to create a huge-list, to use in the future as a check-list, when I start the really observations. Bill Flournoy and Charles Flink already mentioned some patterns in their greenway studies.

J Have you talked with them?

L Yes, briefly with Flournoy at the last Growing in Place and I interviewed and had a conversation with Flink about the greenways.

L So, here are the list of the activities (L showing the activities check-list ready for the observation pilot test) that I observe in my general observations of greenways. So I'm really want to quantify them, for now, is just a qualitative list. I want to be able to point and quantify them in each greenway and/or specific segment. And then recognize them by type of users and actors.

J Right.

L The idea for the social interaction variables, as a network analysis, is to achieve information and map, in terms of identification of greenway places, like: where they

meet, where they go, where they interact. To be able to understand how and why they prefer to use those places.

J OK, I see. So you also will have to do a lot of interviews.

L Yes, I want to do observations, survey and mapping exercise to collect this information. The main goal, after achieving that information is to test each method, and to come up with some recommendations for the greenway design and planning, especially the greenway facilities.

J Right. I`m will tell you one of the things that we are doing right know that I think that is really improved the system that I hadn't mentioned. We are rolling out a sign package because we were so busy in building all this trails, and we weren't identifying them as well. As far I like, where the trails are, having maps on the trails. But it's like I said, it takes a few years, by the time, to get the whole system done. But if you go on the trails, especially if you go, the good places to go today it will be right here (J showing in the map) at the Bond Park, and you can get a good idea, on the maps and things that we are putting out and the trail markers and things like that. So, when we complete that, we will start to put mile markers on the trails, which are another whole challenge of itself, like where you begin and where you end. And then you will have the network working.

L Another thing, are you thinking about working with the node of activities, along and next to the trails? So people do not blow the passage and flow of the trail. Like, suppose that a big group of people that are using the trail and want to stop and/or observe something or do some type of activity, so, like a places that can provide them to pull-over and do such actions without blocking the trail usage, like for example, stretching areas, it could be, why not.

J Right. Like exercise areas along the trail.

L Yes, exercise areas and other types of activity node facilities. You know, without intergroup the alternative traffic flow and activities of the trail.

J Yes, you're right. I think, you know, if you look at, let`s say for example (J showing in the map), if you run and go back to where we were, if you were, like I said in the Black Creek Greenway and you have a dog and want to go to the Dog Park (J mean

about of the facilities of the Robert Godbold Park), is like right off to the trail, you know what I mean.

L Yes, exactly.

J And that`s the way we want to connect all of our work, like greenways and parks.

L Yes, then many people is going to come here, because of that facility, in this case, specific for dogs.

J Right, exactly.

J If you stop, let`s see, right here (J showing in the map) on Chapel Hill Road with the trail intersects… where the Lowe`s is, if you park at the Starbucks and go up to the corner, you will see this public add in that corner of the greenway now so we are beginning to incorporate this and some statues like benches with people sitting on them. Is like one guy that wants to play a drum like a congo and there is a guy playing the violin and another ones sitting and watching (J meaning about the public art), so we incorporate that into the trails. We are trying to add art work to make some of this trails more interesting, like really visible trails. So, the trail goes up and this is a seating area off to the side, with sculptures, so this is a kind of integrated to the trail work.

L So the greenway trail users can use this as a point of reference.

J Yes, they do. I see people there, using and taking their photos and that kind of things. Now, if you continue down, so that is right here (J showing in the map) and if you continuing down to where put the 200 foot-bridge over the rail road, we commission the same artist who did that to do some pieces at the end of each side of the bridge, go take and look at it, I think you will find very interesting. We are begging to incorporate some art into the trails, so we are thinking, let’s say on the Black Creek Greenway is to have the same artist to set several pieces along the whole 7 miles, in a kind of link and kind of identity of the Black Creek.

L That’s wonderful, and actually is going to enhance people’s perception of these uniqueness art pieces and also motivates them to go and use the entire trail.

J Yes, exactly.

L Thant’s good.

J You will find interesting, when you see it.

8. **Do you think that the greenway structural network and greenway features can influence the level of social interaction? How?**

J

L Already Answered in the Introduction.

9. **Do you have any analysis with the quantification of users and type of users of the Cary greenways? What are the high use periods?**

J I suggest you to contact Robert Bush, and when you talk with him and see the current data of the greenway usage quantification, you will see this information, but as I said, only on the weekends.

L It will be wonderful to have your information and also to exchange information with you and him later, when I finished, as a feedback.

J That will be great, it will be good to have some week counts. Because most of our information is on weekends.

10. **Which is the most used greenway? Have you counted the users and type of users on the paved and unpaved trail?**

J As I mentioned before: White Oak, Black Creek and American Tobacco Trail are the most used greenways. You will see this information about the user frequency and quantity on Robert's Bush study.

J Ok, he has that (J mean about Cary's greenways study of Robert Bush).

11. **Of all the trails of Cary, where are the greenways with the highest volume of use? If you pick one of these trails (paved and unpaved) what are the significant segments and locations that are more heavily used by people? Can you point this out to me on the map? I need you to circle for me 3 points on the**

unpaved and 3 points on the paved trails that in your expert opinion have the greatest volume of use.

L I decided together with my advisor, professor Arthur Rice, this strategy to simplify and determine the selection of my study cases.

J Oh, Arthur Rice was part of my committee members of my master's at NCSU.

L So, for you J to be able to answer this question, I brought some color pens, so you can identify on this map, according to this specific legend, the most heavily used greenway trails (paved and unpaved), like their significant or locations that are heavily used, from all of your knowledge of those years, in working with Cary's greenways. Please, pick 3 points (L meaning about the greenway trail segments) for the paved trails and 3 points for the unpaved trails.

J Three points of paved and three points of what?

L Unpaved trails. You can use for the paved green and for the unpaved orange. Just the heavily ones.

J Do you want me to include the American Tobacco Trail or excluded?

L Included. Just the heavily used ones, pick 3 that you know.

J Well, from this section to here (J showing and marking in the map, the American Tobacco Trail), this Cary's takes care of this, so I just marking here Cary area, OK.

L OK.

J I will say that Cary's maintain between these two points. So, I will circle this whole thing, because this is also pretty busy, that is a heavily used, I can say that that is definitively one (J showing and marking in the map). The next one, let's say, how many areas do you want?

L Well, you can pick 3, 4 or more and then I will go and talk with, what is his name?

J Robert Bush.

Yes, Robert Bush, and then decide which trails I will work with.

J And you will notice that this links, the longer pieces get more heavily use. I will go ahead and do the Bond, like this in all Bond is heavily used. I said that this the four most heavily used right here (J showing and marking in the map).

J And for the natural, hiking trail, we have.

L Some trails have both paved and unpaved right?

J Oh, our standard is for the trails with 10 foot wide asphalt (J meaning about the 4 paved trails). And then when we have natural trails, they will be walking trails within a park. You know what I mean, they are not going to be, we are not making them as part of the network. You know, like separate, like for example.

L Like inside of the park boundary. Like here as an example (L showing in the map, some natural trails at the Bond Park).

J Right. So, I will have to circle all the Bond Park for the natural trails.

L And which trail has the adventure circuit, over the soil, on the top of trees? It is also inside of the Bond Park, right.

J That's our… ropes-course. Have you been over there?

L Yes.

J How many times have you been over there at the Bond Park?

L last year I went 5 times and this year 3 times. I've been all over the parks and the greenways.

J So, what are you think about Cary's greenways, as far, and how do they look if compared to other communities that you been? I'm just curious, like maintenance-wise.

L I like the part of the Black Creek Greenway trail next to North Cary's Park that present lots of heavily wood forest and also the part by the Lake Crabtree view, the kiosk area, the natural overlook at the end. I love the last part of the White Oak, that has a marshland area and a continuous wood walking board areas with some expansions, I love that design and the unique landscape, and for my perspective they are well maintained. What I like about those greenways, is the landscape changing. Huge footbridge at the Hinshaw Greenway that connects two of Cary's Parks: MacDonald Park and Kids Together Park.

J That's Hinshaw Greenway is an old trail, and is pretty hilly when you go to the back of that trail.

L Yes, on that one I think needs a little bit more attention, you can see the difference if compared with the trails of the Black and White Oak greenways, the newest ones.

J The difference between the old and the new ones. Right. That's a good point.

L there is a part of the Black creek that has a water fountain, without water, is next to a school, right there on the sport fields.

J That is right here (J showing in the map).

L Yes, right here that I observed.

J So, that's part of Black Creek, but that little trail that brings you to the school, with that water fountain, that's part of the schools. That's Wake County schools.

L Oh, Ok. Because was a little bit confusing the recognition of this facility on the trails.

L I still think that need more kiosks, more information panel with maps and other types of facilities. In comparing with other greenways from other communities, I love the lake Johnson greenways in Raleigh, they are next to my house, and we can directly interact with woods, lake and creeks. I also love the NC Museum of Art greenways, because of the unique landscape, and the presence of the public art sculptures off-trail areas, the 3 giant rings sculpture, you have a nice sensation when you pass by them when using the trail, I like the little grassy-hills, the structure for viewing the landscape and picnic, and also the paintings in the paved surface and green-infrastructure along the trail, plus the beautiful overpass. I've been at the Lake Lynn trail and walking board area, but in some parts it need maintenance, it is nice too, but for me the end of the White Oak, with all of those walking board and marsh landscapes parts is much more nicer. Oh, the American Tobacco Trail, is nice because of the linearity of the trail, you can see and interact with horses along the trail, and also because of the different trail surfaces, paved and unpaved. I also saw one specific greenway on Chapel Hill that is well maintained and connects to ne school, playground and sports field, that present a little amphitheater at the side of the trail and also that brings you to a natural pound with vegetation and lots of frogs, which function as a green infrastructure, and that attracted lots of kids that where interacting and playing with nature, but cannot remember the name. I loved the greenway at the Greenville, South Carolina, that you can see and interact with the river, the rocks, see the new development, it brings you to downtown, and there is a specific part, under the bridge, that presents a very unique and interesting children

play and educational area, and also the greenway trail pavement is this area is with colorful and porous tiled turf, a soft surface. One very urban greenway in Chicago that has lot of usage and benches so you stop and see the lake view and the city skyline.

J These were the two of our walking trails that are the most heavily used. And these ones that I circle for the greenways, And with Robert, when you see his data, you will get the exact counts.

L When did Robert start? Is he still doing it?

J Yes, he's still doing it. Is been about 3 years.

L So, 2009?

J I think he has enough data to be statistically viable.

L OK, and do you have his email?

J I will send him an email and I will copy you on it, and I will ask him to contact you, and will tell what you are doing. I will ask him to send you the most current survey data and charts that he has. And then get in touch with him directly.

L Oh, thank you J.

J So, let him know what you are doing and he will be very interested, because he put a lot of time and a lot of effort in getting all this surveys, like hundreds, and hundreds, and hundreds of counts.

L Wow, I imagine.

J Yeah, with all those people going out. So, they sent him the data and he controls and keeps records and things like that.

L So after you indication and after talk with Robert, I can define the greenways for the analysis and really start my study, probably I will have the data collection on the 2012, and I need to finish the results analysis by 2013. I'm a CAPES/Fulbright student, and I must finish the study od my PhD in 4 years, by the end of 2014, and then come back to my country and work in the Santa Maria Federal University in teaching and research.

J Right. So they are paying you to be here?

L Yes, they are paying me, and I have to pay them back with 4 years of knowledge and production.

J How are you enjoying here?

L I'm really like Raleigh, Cary and Durham. I live right there on Lake Johnson in Raleigh. But I always come with my 3 kids and wife to Cary to use your parks and greenways. That's one of the reasons that I want to study Cary's, because for me is special. I really got attached, also attached to the Lake Johnson, because I live there and use almost every day.

J Right.

L So we use a lot of Cary's parks, greenways and facilities, and my kids love it. Like Black Creek and North Cary Park.

J That's a nice park and greenway.

L It's funny that now my big ones just want to bike the greenways, because they got tired of walk with me all the way. So is not just the trail, the woods, creek and lake, there is the climbing rock, soccer fields.

J Yeah, Cary has lots of nice facilities. Actually when I moved here from Honolulu-Hawaii, my wife is from Hawaii, I just want to go for NCSU for 2 years and we will come back to Hawaii, but we end up here, like 16 to 17 years, it's a good place to raise your family.

L Yes, I agree with you.

J Good schools, good places to raise your family, lots of parks and greenways and the cost of living is much more affordable.

L Yes, you have everything, plus are a very cosmopolitan place, because of the Universities of the triangle area, very international, you can see different people from different cultures. And you have all of those different parks and greenways. The entire structure of greenways that are expanding. Everything are close, you do not have to spend a half of your day in traffic, like you know what I mean, if you compare to Chicago, Atlanta, it is completely different., a nice place to raise your kids and live. All of this that makes special this place, plus it quality of life.

J Yes, it is. That's why we end up staying here. Probably when we retired we will go back to Hawaii. It's funny because I came here to go to State, and my sons were 2 and 5 years. My son just graduate from State in May, my oldest sun and my youngest is going to his Junior's State. So is kind of we are going to a full circle.

L Yes, I understand. I will be very sad when I come back with my wife and kids to my country and will miss here a lot. I'm form the very southern part of Brazil, the state, next to Argentina, Uruguay and Paraguay. And now in our city I've tried to talk with the city planners and convince them to build a greenway and park system, like what you have here, but is so hard, to implement this.

J To get them to buy into this concept?

L Yes, the concept, and also to visualize the importance of such integrated system: greenway and parks. I was as a teacher and a researcher at the university trying to open their minds, how important to have this and improve the city and it livability. And Santa Maria it is a medium size city, like Raleigh, with 300.000 people.

J Right.

L They are not interested and prepared, they just want to build more roads, highways, more buildings, without paying attention and value our interesting sub-tropical landscapes: lake, dam, wetland areas, riparian areas, Biosphere Reserve Forest, mountains. But they don't care. Our landscapes are being fragmented and reduced every year, and the population does not use and value them. And probably will disappear in the future. And we also lack on public parks like parks, especially ones integrated with nature, like the ones that you have up here. So that's why I become interested about the greenways. I always used in my landscape architecture classes some examples of greenways since 2004, but wasn't able to really experience them and to have more details information about them. That's why I became interested about this topic and come here to study and to understand its complexity and dynamics.

J Right. I think you end up living in a really good place, especially for studying the greenways, because the Raleigh and Cary area is probably more progressive than most places. You know, that there are certain places in this Country, like Seattle,

Boulder, Portland, you know they are very greenway friendly. But I think this area is also it becoming more and more about greenway all the time.

L Of course, some years ago, 30 in Raleigh and 20 in Cary started to plant the first "seeds" of greenways, and now you have all of this, and the most incredible is the fact that this system still growing, and are receiving by the your community high priority and attention, and also increasing their satisfaction and quality of life.

J And you clearly can see how our community seen what happen in Raleigh and Cary, and they begin to do their own. I receive calls from different and small communities, and I send them the information, because they beginning and just starting like their greenway system. Smithfield for example, we send them our sign package and they liked. They want to use that similar type of thing, you know.

L And J are you going to talk with Paul Kuhn today?

J Yes, he is here.

L I promised to him that I will bring with me a copy of our analysis and results of the Walnut Street Park. I put the panels, the final report, and the presentation that we did on the Design Studio, and he was there attending our presentations, and I told him by email that I will bring with me a copy when I talk with you. Can you handle this to him for me?

J Yes, I can give this to him if you want, sure.

L OK, it is everything here, and in case he have some questions and want more information, he can contact us. He knows how to find us.

J Who did you work with on this project, it was your project?

L No, it's our group project for Robin Moore class: Human Use of the Urban Landscape, one of our graduation courses. So lots of public spaces methods and analysis.

J Oh, I can imagine, I took a class with Robin, so this is like… probably he did a lot of the…, he is really good and big into behavior mapping with dots, compiling also quantitative and qualitative data.

L Yes, we did that analysis.

J Yes, they are very simple but very time consuming.

L Yes, it is not easy to analyze later, but provide you strong information about how people use the public spaces.

J Right. It is easy to look at it and analyze it.

L We also interviewed Paul Kuhn by that time, and he suggested me to talk with you in the future about your greenway system.

12. Can you provide some materials about the greenways such as recent aerial photos, maps, information of the quantification of users and uses*?* May we scan or copy these materials?

J Sure, I will introduce you to Robert Bush so you can get information about his greenways quantification and statistics, so you may contact and talk with him, and also, you can have those maps.

L Thank you J for all your time, help, attention and information. I'm really appreciated. And I hope I can contribute with my study to improve even more the greenways.

J Sure, you're welcome. In some point I will like you to come in one of our greenways meetings, so you can present us your study.

L Sure, I will come, it will be a pleasure.

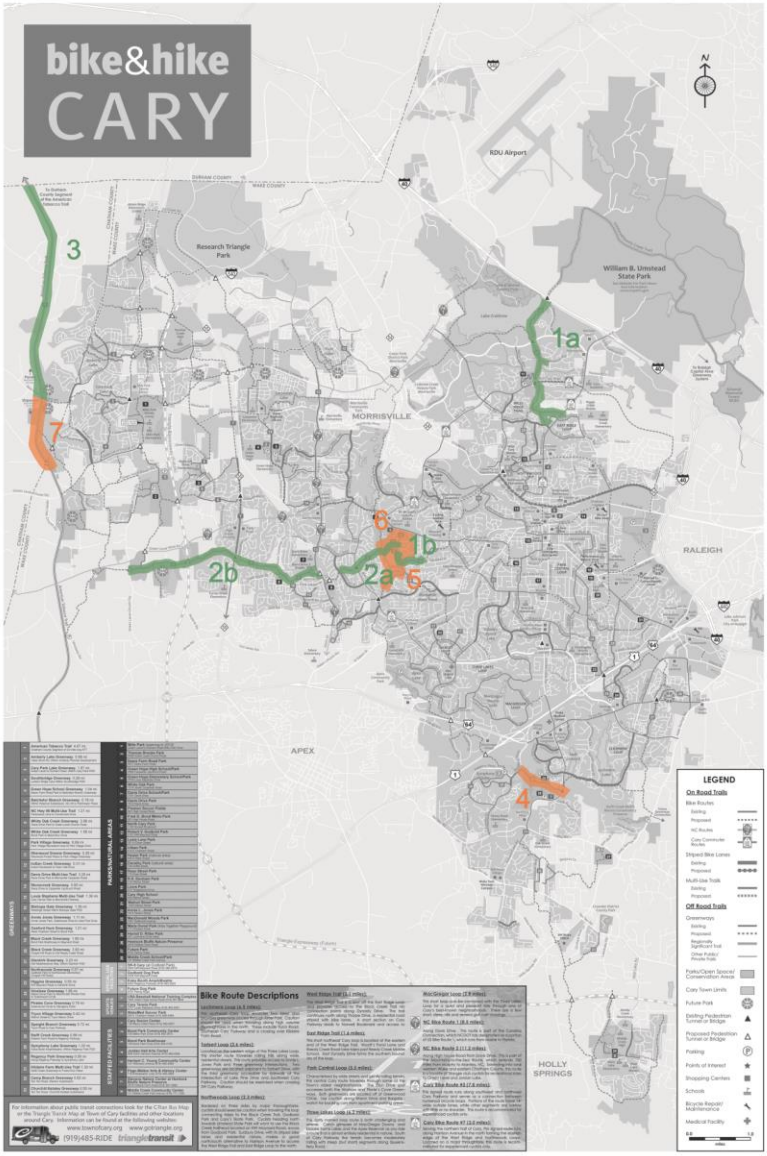
J I will let you know when you can come, a little further. I will let you know about the schedule of our meetings that happens once a month in the evening.

L Sure, just let me know the day and time, OK. Thank you and have a nice day, and see you soon.

J Have a nice day L, see you.

Appendix M. Cary Greenways Selection: Highest Volume of Use

Cary Greenways Selection: Highest Volume of Use



Source: Town of Cary Parks, Recreation and Cultural Resources Department (2012). Bike & Hike 2012 Cary - Cary Bicycle/ Greenway Map - Town of Cary

Legend:

greenway paved trails

1a, 1b. Black Creek Greenway
2a, 2b. Whyte Oak Creek Greenway
3. American Tobacco Trail

greenway unpaved trails

4. Swift Creek Greenway
5. Black Creek Greenway
6. Whyte Oak Creek Greenway
7. American Tobacco Trail

Elaborated by PIPPI (2013).

Appendix N. Protocol Method 2: Greenway Characteristics Audit: Structural Analysis of the Greenway Characteristics

Method 2: Greenway Characteristics Audit

Greenways Characteristics

Greenway Name: Black Creek Greenway (BCGW)

- [ ] Segment BCGW 1 / 5
- [ ] Segment BCGW 2 / 6
- [ ] Segment BCGW 3 / 7
- [ ] Segment BCGW 4 / 8

Features

Type of Landscape Features

Topography Features Configuration

Topography Slope Degree/Slope Terrain Rating Configuration

- [ ] Very Steep (45% - more than 45%)
- [ ] Steep (35 - 45%)
- [ ] Moderate (25 - 35 %)
- [ ] Gentle (15 - 25%)
- [ ] Very Gentle (0 - 15%)

Cross-Sectional (Greenway Boundary)

- [ ] 0-5%
- [ ] 5-12%
- [ ] 12-20%
- [ ] 20-30%
- [ ] More then 30%

Profile (Trail)

- [ ] 0-5%
- [ ] 5-12%
- [ ] 12-20%
- [ ] 20-30%
- [ ] More then 30%

Altimetry(Elevation Contour Lines)

Topography Elevation (High and Low Values)

Water Resources Features Configuration

Natural Water Resources Configuration

- [ ] Lake
- [ ] Creek
- [ ] Streams
- [ ] River
- [ ] Lagoon
- [ ] Wetlands
- [ ] Pound
- [ ] Bio Retention Lagoon
- [ ] Wetlands

Man-Dade Water Resources Configuration

- [ ] Canal
- [ ] Dam
- [ ] Dike/weir
- [ ] Reflecting Pool
- [ ] Fountains

Vegetation Features Configuration

Vegetation Configuration

- [ ] Softly Homogeneous
- [ ] Soft Heterogeneous
- [ ] Moderate Homogeneous
- [ ] Moderate Heterogeneous
- [ ] Totally Homogeneous
- [ ] Totally Heterogeneous

Vegetation Type (Area %)

- [ ] Heavily Wood Forest
- [ ] Lightly Wood Forest
- [ ] Open Meadow
- [ ] Maintained Grassy Open Field
- [ ] Freshwater Forested/Shrub Wetland
- [ ] Lake Wetland
- [ ] Fresh Pond Wetland
- [ ] Riparian Vegetation (30feet, 80 feet, 320 feet)
- [ ] Swamp (Shrub/Wooded)
- [ ] Savanna

Vegetation Components Type

- [ ] Trees
- [ ] Shrubs
- [ ] Hedges
- [ ] Climbing Shrubs
- [ ] Ornamental Plant
- [ ] Grass
- [ ] Vine
- [ ] Marshes
- [ ] Aquatic Vegetation
- [ ] Palm Tree
- [ ] Aquatic Vegetation

Type of Physical Structural Features

Physical Structural Features Configuration

Physical Structure Configuration

- [ ] Parking Area
- [ ] Equestrian Trailer Parking
- [ ] Public Restroom
- [ ] Decks
- [ ] Walking Board
- [ ] Information Kiosk
- [ ] Picnic Shelter
- [ ] Picnic Table
- [ ] Barbeque Place
- [ ] Pergola
- [ ] Bower
- [ ] Water Sewer
- [ ] Amphitheater
- [ ] Trail Head
- [ ] Trail
- [ ] Bicycle Trail
- [ ] Kiosk/Gazebo
- [ ] Overlook/Scenic View Area
- [ ] Playground
- [ ] Entryways
- [ ] Multi-Use Areas
- [ ] Educational Areas
- [ ] Exercise Station
- [ ] Stretching Area
- [ ] Athletic/Sport Field
- [ ] Community Garden
- [ ] Skate Areas
- [ ] Socialization Areas
- [ ] Bridge
- [ ] Suspension Bridge
- [ ] Foot Bridge
- [ ] Canal
- [ ] Adventure Circuit
- [ ] Porch
- [ ] Shed
- [ ] Tunnel/Underpass
- [ ] Fence
- [ ] Stairs
- [ ] Ramps
- [ ] Wall
- [ ] Sanitary Sewer-Line
- [ ] Docks Firewood/Harbor
- [ ] Canoe/Trailer Parking
- [ ] Dike Areas

Street Furniture Components

Street Furniture Components Configuration

- [ ] Benches
- [ ] Swing
- [ ] Tables
- [ ] Trash Cans
- [ ] Signage Systems
- [ ] Information Panel
- [ ] Bicycle Racks (Rail, Ribbon)
- [ ] Bollard/Post
- [ ] Trail Gate
- [ ] Public Art/Sculpture
- [ ] Monument
- [ ] Pedestrian/Biker Cross-Walk Post
- [ ] Public Emergency Telephones
- [ ] Dog Waste Bag Dispenser Post
- [ ] Lighting Post
- [ ] Drinking Fountains
- [ ] Pet Drinking Fountain
- [ ] Information Sign
- [ ] Mile Marker Sign
- [ ] Pictograph Sign
- [ ] Directional Sign
- [ ] Warning Sign
- [ ] Canoe/Boat/Kaiak Racks
- [ ] Trail Traffic Sign (Regulatory)

Method 2: Greenway Characteristics Audit

Greenways Characteristics

Greenway Name: Black Creek Greenway (BCGW)

- [ ] Segment BCGW 1 / 5
- [ ] Segment BCGW 2 / 6
- [ ] Segment BCGW 3 / 7
- [ ] Segment BCGW 4 / 8

Structural Network System

Type of Connection

Network Type

Configuration on a Macro/Meso Scale

- [ ] Traditional/Single
- [ ] Hierarchical
- [ ] Minimalist/Least Cost to Builder
- [ ] Single Back Route
- [ ] Economical/Least Cost to User
- [ ] Single Back Route and Economical
- [ ] Major Loops
- [ ] Minor Loops
- [ ] Major Polylines/Lines
- [ ] Minor Polilynes/Lines
- [ ] Penetrators
- [ ] Permeators

Trail Type of Connection by Barrier

Physical Barrier with Connection

- [ ] Connection by Overpasses
- [ ] Connection by Underpasses/Tunnel
- [ ] Connection by Bridge
- [ ] Connection by Walking-Board Areas
- [ ] Connection by Canals
- [ ] Connection by Trail
- [ ] Cross Walk Pedestrians/Bikers
- [ ] Railroad Crossing

Physical Barrier with Fragmentation

- [ ] No Connection

Trail Characteristic

Destination/Point of Attraction

Configuration on a Meso/Micro Scale

- [ ] Neighborhood Only
- [ ] Conventional Park Only
- [ ] Neighborhoods and Conventional Parks

Connection Related/Associated with Conventional Parks

- [ ] Mini-Parks
- [ ] School Parks
- [ ] Neighborhood Park
- [ ] Community Park
- [ ] Metro Park
- [ ] State Park
- [ ] Special Use Park/Facilities

Connection Related/Associated with Type of Neighborhoods

- [ ] Proximity (1/4 mile From the Greenway Trail)

Density Population:

- [ ] Lowest
- [ ] Medium
- [ ] Highest

Connection Related/Associated with Other Areas

- [ ] Other Greenways
- [ ] Other Trails
- [ ] Schools (Elementary/Middle/High)
- [ ] Museums
- [ ] Commercial/Shopping Areas
- [ ] Historical Areas/Places
- [ ] Touristic Areas
- [ ] Farmers Market
- [ ] Community Center
- [ ] Senior Center
- [ ] Downtown Area
- [ ] University/College
- [ ] Playgrounds
- [ ] Bus Stops

Trail Characteristic

Trail Circulation Layout Type

Physical Barrier with Connection

- [ ] Linear
- [ ] Looping
- [ ] Maze
- [ ] Sinuous/Organic
- [ ] Multi-Looping
- [ ] Satellite-Loop
- [ ] Bifurcate
- [ ] Intersection
- [ ] Branched/Diverging
- [ ] Cul-de-Sac
- [ ] Converging/Dispersing
- [ ] Zigzagging/Erratic

Type of Trail

Surface Type

- [ ] Natural (Scattered Railroad)
- [ ] Gravel Surface Basalt
- [ ] Compacted Surface
- [ ] Asphalt (Paved Surface)
- [ ] Rubber (Paved Surface)
- [ ] Brick (Paved Surface)
- [ ] Concrete (Paved Surface)

Trail AccessType

- [ ] Public
- [ ] Private
- [ ] Public and Private

Trail Lenght

- [ ] Partial Segment (miles)
- [ ] Whole Segment (miles)

Trail Pavement Markings

Pavement Markings Components

- [ ] Greenway Name
- [ ] Stop Ahead
- [ ] Crossing Areas
- [ ] Trail Lanes
- [ ] Trail Direction (Arrow Markings)
- [ ] Trail Mile Marker Sign
- [ ] Trail Material Type Information
- [ ] Trail Route Information
- [ ] Public Art (Drawing/Painting)
- [ ] Off-Trail Interactional Stations

Method 2: Greenway Characteristics Audit

Greenways Characteristics

Greenway Name: Black Creek Greenway (BCGW)

☐ Segment BCGW 1 / 5 ☐ Segment BCGW 2 / 6 ☐ Segment BCGW 3 / 7 ☐ Segment BCGW 4 / 8

Structural Network System

Trail Characteristic

Type of Activity Node

Use Related/Associated to Activity Node Configuration

- ☐ Exercise Station
- ☐ Stretching Area
- ☐ Playground
- ☐ Yoga
- ☐ Seating Area
- ☐ Environmental Education Area
- ☐ Skate Park Area
- ☐ Multi-Use (Multi-Function)
- ☐ Social/Interactional Area
- ☐ Amphitheater
- ☐ Contemplation/Observation
- ☐ Water Fountain
- ☐ Bicycle Rack
- ☐ Information Area
- ☐ Kiosk/Gazebo
- ☐ Picnic Shelter
- ☐ Picnic Grass Area
- ☐ Picnic Table
- ☐ Deck
- ☐ Public Restroom
- ☐ Trash Cans
- ☐ Adventure Circuit
- ☐ Mini-Dog Area (Fenced)
- ☐ Maintenance
- ☐ Shed
- ☐ Connector Node (Transportation)
- ☐ Buffer for Wildlife
- ☐ Overlook/Scenic View Area
- ☐ Athletic/Sport-Field

Activity Node Form

Activity Node Configuration

- ☐ Major Node
- ☐ Minor Node
- ☐ Single Pocket Node
- ☐ Multi-Pocket Node
- ☐ Expanded Trail Area
- ☐ Alternate Pocket Node
- ☐ Sequential Pocket Node
- ☐ Intersection Pocket Node
- ☐ Bifurcate Pocket Node
- ☐ Mirror Pocket Node
- ☐ Axial/Central Pocket Node
- ☐ Disjointed/Offset Pocket Node

Surface Type

- ☐ Natural (Grass)
- ☐ Gravel Surface Basalt
- ☐ Compacted Surface
- ☐ Wood
- ☐ Asphalt (Paved Surface)
- ☐ Concrete (Paved Surface)
- ☐ Brick (Paved Surface)

Length (Miles)

Area (Square Feet)

Activity Node Usage Type

- ☐ Simple (One Use)
- ☐ Complex (Multi-Use)
- ☐ Absent (No Activity Node Use)

Trail Characteristic

Type of Bridge

Material Type

- ☐ Wood
- ☐ Metallic
- ☐ Wood and Metallic
- ☐ Concrete
- ☐ Wood and Concrete
- ☐ Wood, Metallic and Concrete

Trail Characteristic

Type of Walking-Board

Material Type

- ☐ Wood
- ☐ Metallic
- ☐ Wood and Metallic
- ☐ Concrete
- ☐ Asphalt
- ☐ Wood and Concrete
- ☐ Wood, Metallic and Concrete
- ☐ Wood, Metallic and Asphalt

Walking-Board Form

Walking-Board Configuration

- ☐ Linear
- ☐ Curvilinear
- ☐ Sinuous/Organic
- ☐ Interrupted
- ☐ Branched
- ☐ Intercalary
- ☐ Zigzagging/Erratic
- ☐ Bifurcate

Length (Miles)

Area (Square Feet)

Walking-Board Components

Presence of Walking-Board Components

- ☐ Signs
- ☐ Information Panel
- ☐ Benches
- ☐ Seating Areas
- ☐ Pocket Areas ("Ears")
- ☐ Binoculars
- ☐ Kiosk/Gazebo
- ☐ Trash Cans
- ☐ Lighting Post
- ☐ Bollard/Post
- ☐ Exercise Station
- ☐ Stretching Area
- ☐ Arbor

Method 2: Greenway Characteristics Audit

Greenways Characteristics

Greenway Name: White Oak Creek Greenway (WOCGW)

- [ ] Segment WOCGW 1 / 5 / 9
- [ ] Segment WOCGW 2 / 6
- [ ] Segment WOCGW 3 / 7
- [ ] Segment WOCGW 4 /8

Features

Type of Landscape Features

Topography Features Configuration

Topography Slope Degree/Slope Terrain Rating Configuration

- [ ] Very Steep (45% - more than 45%)
- [ ] Steep (35 - 45%)
- [ ] Moderate (25 - 35 %)
- [ ] Gentle (15 - 25%)
- [ ] Very Gentle (0 - 15%)

Cross-Sectional (Greenway Boundary)

- [ ] 0-5%
- [ ] 5-12%
- [ ] 12-20%
- [ ] 20-30%
- [ ] More then 30%

Profile (Trail)

- [ ] 0-5%
- [ ] 5-12%
- [ ] 12-20%
- [ ] 20-30%
- [ ] More then 30%

Altimetry(Elevation Contour Lines)

Topography Elevation (High and Low Values)

Water Resources Features Configuration

Natural Water Resources Configuration

- [ ] Lake
- [ ] Creek
- [ ] Streams
- [ ] River
- [ ] Lagoon
- [ ] Wetlands
- [ ] Pound
- [ ] Bio Retention Lagoon
- [ ] Wetlands

Man-Dade Water Resources Configuration

- [ ] Canal
- [ ] Dam
- [ ] Dike/weir
- [ ] Reflecting Pool
- [ ] Fountains

Vegetation Features Configuration

Vegetation Configuration

- [ ] Softly Homogeneous
- [ ] Soft Heterogeneous
- [ ] Moderate Homogeneous
- [ ] Moderate Heterogeneous
- [ ] Totally Homogeneous
- [ ] Totally Heterogeneous

Vegetation Type (Area %)

- [ ] Heavily Wood Forest
- [ ] Lightly Wood Forest
- [ ] Open Meadow
- [ ] Maintained Grassy Open Field
- [ ] Freshwater Forested/Shrub Wetland
- [ ] Lake Wetland
- [ ] Fresh Pond Wetland
- [ ] Riparian Vegetation (30feet, 80 feet, 320 feet)
- [ ] Swamp (Shrub/Wooded)
- [ ] Savanna

Vegetation Components Type

- [ ] Trees
- [ ] Shrubs
- [ ] Hedges
- [ ] Climbing Shrubs
- [ ] Ornamental Plant
- [ ] Grass
- [ ] Vine
- [ ] Marshes
- [ ] Aquatic Vegetation
- [ ] Palm Tree
- [ ] Aquatic Vegetation

Type of Physical Structural Features

Physical Structural Features Configuration

Physical Structure Configuration

- [ ] Parking Area
- [ ] Equestrian Trailer Parking
- [ ] Public Restroom
- [ ] Decks
- [ ] Walking Board
- [ ] Information Kiosk
- [ ] Picnic Shelter
- [ ] Picnic Table
- [ ] Barbeque Place
- [ ] Pergola
- [ ] Bower
- [ ] Water Sewer
- [ ] Amphitheater
- [ ] Trail Head
- [ ] Trail
- [ ] Bicycle Trail
- [ ] Kiosk/Gazebo
- [ ] Overlook/Scenic View Area
- [ ] Playground
- [ ] Entryways
- [ ] Multi-Use Areas
- [ ] Educational Areas
- [ ] Exercise Station
- [ ] Stretching Area
- [ ] Athletic/Sport Field
- [ ] Community Garden
- [ ] Skate Areas
- [ ] Socialization Areas
- [ ] Bridge
- [ ] Suspension Bridge
- [ ] Foot Bridge
- [ ] Canal
- [ ] Adventure Circuit
- [ ] Porch
- [ ] Shed
- [ ] Tunnel/Underpass
- [ ] Fence
- [ ] Stairs
- [ ] Ramps
- [ ] Wall
- [ ] Sanitary Sewer-Line
- [ ] Docks Firewood/Harbor
- [ ] Canoe/Trailer Parking
- [ ] Dike Areas

Street Furniture Components

Street Furniture Components Configuration

- [ ] Benches
- [ ] Swing
- [ ] Tables
- [ ] Trash Cans
- [ ] Signage Systems
- [ ] Information Panel
- [ ] Bicycle Racks (Rail, Ribbon)
- [ ] Bollard/Post
- [ ] Trail Gate
- [ ] Public Art/Sculpture
- [ ] Monument
- [ ] Pedestrian/Biker Cross-Walk Post
- [ ] Public Emergency Telephones
- [ ] Dog Waste Bag Dispenser Post
- [ ] Lighting Post
- [ ] Drinking Fountains
- [ ] Pet Drinking Fountain
- [ ] Information Sign
- [ ] Mile Marker Sign
- [ ] Pictograph Sign
- [ ] Directional Sign
- [ ] Warning Sign
- [ ] Canoe/Boat/Kaiak Racks
- [ ] Trail Traffic Sign (Regulatory)

Method 2: Greenway Characteristics Audit

Greenways Characteristics

Greenway Name: White Oak Creek Greenway (WOCGW)

☐ Segment WOCGW 1 / 5 / 9 ☐ Segment WOCGW 2 / 6 ☐ Segment WOCGW 3 / 7 ☐ Segment WOCGW 4 /8

Structural Network System

Type of Connection

Network Type

Configuration on a Macro/Meso Scale

- ☐ Traditional/Single
- ☐ Hierarchical
- ☐ Minimalist/Least Cost to Builder
- ☐ Single Back Route
- ☐ Economical/Least Cost to User
- ☐ Single Back Route and Economical
- ☐ Major Loops
- ☐ Minor Loops
- ☐ Major Polylines/Lines
- ☐ Minor Polilynes/Lines
- ☐ Penetrators
- ☐ Permeators

Trail Type of Connection by Barrier

Physical Barrier with Connection

- ☐ Connection by Overpasses
- ☐ Connection by Underpasses/Tunnel
- ☐ Connection by Bridge
- ☐ Connection by Walking-Board Areas
- ☐ Connection by Canals
- ☐ Connection by Trail
- ☐ Cross Walk Pedestrians/Bikers
- ☐ Railroad Crossing

Physical Barrier with Fragmentation

- ☐ No Connection

Trail Characteristic

Destination/Point of Attraction

Configuration on a Meso/Micro Scale

- ☐ Neighborhood Only
- ☐ Conventional Park Only
- ☐ Neighborhoods and Conventional Parks

Connection Related/Associated with Conventional Parks

- ☐ Mini-Parks
- ☐ School Parks
- ☐ Neighborhood Park
- ☐ Community Park
- ☐ Metro Park
- ☐ State Park
- ☐ Special Use Park/Facilities

Connection Related/Associated with Type of Neighborhoods

- ☐ Proximity (1/4 mile From the Greenway Trail)
- ☐ Density Population:
  - ☐ Lowest
  - ☐ Medium
  - ☐ Highest

Connection Related/Associated with Other Areas

- ☐ Other Greenways
- ☐ Other Trails
- ☐ Schools (Elementary/Middle/High)
- ☐ Museums
- ☐ Commercial/Shopping Areas
- ☐ Historical Areas/Places
- ☐ Touristic Areas
- ☐ Farmers Market
- ☐ Community Center
- ☐ Senior Center
- ☐ Downtown Area
- ☐ University/College
- ☐ Playgrounds
- ☐ Bus Stops

Trail Characteristic

Trail Circulation Layout Type

Physical Barrier with Connection

- ☐ Linear
- ☐ Looping
- ☐ Maze
- ☐ Sinuous/Organic
- ☐ Multi-Looping
- ☐ Satellite-Loop
- ☐ Bifurcate
- ☐ Intersection
- ☐ Branched/Diverging
- ☐ Cul-de-Sac
- ☐ Converging/Dispersing
- ☐ Zigzagging/Erratic

Type of Trail

Surface Type

- ☐ Natural (Scattered Railroad)
- ☐ Gravel Surface Basalt
- ☐ Compacted Surface
- ☐ Asphalt (Paved Surface)
- ☐ Rubber (Paved Surface)
- ☐ Brick (Paved Surface)
- ☐ Concrete (Paved Surface)

Trail AccessType

- ☐ Public
- ☐ Private
- ☐ Public and Private

Trail Lenght

- ☐ Partial Segment (miles)
- ☐ Whole Segment (miles)

Trail Pavement Markings

Pavement Markings Components

- ☐ Greenway Name
- ☐ Stop Ahead
- ☐ Crossing Areas
- ☐ Trail Lanes
- ☐ Trail Direction (Arrow Markings)
- ☐ Trail Mile Marker Sign
- ☐ Trail Material Type Information
- ☐ Trail Route Information
- ☐ Public Art (Drawing/Painting)
- ☐ Off-Trail Interactional Stations

Method 2: Greenway Characteristics Audit

Greenways Characteristics

Greenway Name: White Oak Creek Greenway (WOCGW)

☐ Segment WOCGW 1 / 5 / 9 ☐ Segment WOCGW 2 / 6 ☐ Segment WOCGW 3 / 7 ☐ Segment WOCGW 4 /8

Structural Network System

Trail Characteristic

Trail Characteristic

Trail Characteristic

Type of Activity Node

Use Related/Associated to Activity Node Configuration

- ☐ Exercise Station
- ☐ Stretching Area
- ☐ Playground
- ☐ Yoga
- ☐ Seating Area
- ☐ Environmental Education Area
- ☐ Skate Park Area
- ☐ Multi-Use (Multi-Function)
- ☐ Social/Interactional Area
- ☐ Amphitheater
- ☐ Contemplation/Observation
- ☐ Water Fountain
- ☐ Bicycle Rack
- ☐ Information Area
- ☐ Kiosk/Gazebo
- ☐ Picnic Shelter
- ☐ Picnic Grass Area
- ☐ Picnic Table
- ☐ Deck
- ☐ Public Restroom
- ☐ Trash Cans
- ☐ Adventure Circuit
- ☐ Mini-Dog Area (Fenced)
- ☐ Maintenance
- ☐ Shed
- ☐ Connector Node (Transportation)
- ☐ Buffer for Wildlife
- ☐ Overlook/Scenic View Area
- ☐ Athletic/Sport-Field

Type of Walking-Board

Material Type

- ☐ Wood
- ☐ Metallic
- ☐ Wood and Metallic
- ☐ Concrete
- ☐ Asphalt
- ☐ Wood and Concrete
- ☐ Wood, Metallic and Concrete
- ☐ Wood, Metallic and Asphalt

Activity Node Form

Activity Node Configuration

- ☐ Major Node
- ☐ Minor Node
- ☐ Single Pocket Node
- ☐ Multi-Pocket Node
- ☐ Expanded Trail Area
- ☐ Alternate Pocket Node
- ☐ Sequential Pocket Node
- ☐ Intersection Pocket Node
- ☐ Bifurcate Pocket Node
- ☐ Mirror Pocket Node
- ☐ Axial/Central Pocket Node
- ☐ Disjointed/Offset Pocket Node

Surface Type

- ☐ Natural (Grass)
- ☐ Gravel Surface Basalt
- ☐ Compacted Surface
- ☐ Wood
- ☐ Asphalt (Paved Surface)
- ☐ Concrete (Paved Surface)
- ☐ Brick (Paved Surface)

Length (Miles)

Area (Square Feet)

Activity Node Usage Type

- ☐ Simple (One Use)
- ☐ Complex (Multi-Use)
- ☐ Absent (No Activity Node Use)

Type of Bridge

Material Type

- ☐ Wood
- ☐ Metallic
- ☐ Wood and Metallic
- ☐ Concrete
- ☐ Wood and Concrete
- ☐ Wood, Metallic and Concrete

Walking-Board Form

Walking-Board Configuration

- ☐ Linear
- ☐ Curvilinear
- ☐ Sinuous/Organic
- ☐ Interrupted
- ☐ Branched
- ☐ Intercalary
- ☐ Zigzagging/Erratic
- ☐ Bifurcate

Length (Miles)

Area (Square Feet)

Walking-Board Components

Presence of Walking-Board Components

- ☐ Signs
- ☐ Information Panel
- ☐ Benches
- ☐ Seating Areas
- ☐ Pocket Areas ("Ears")
- ☐ Binoculars
- ☐ Kiosk/Gazebo
- ☐ Trash Cans
- ☐ Lighting Post
- ☐ Bollard/Post
- ☐ Exercise Station
- ☐ Stretching Area
- ☐ Arbor

Appendix O. Protocol Method 3: Social Characteristics Audit: Behavior Mapping

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION — Source: Elaborated by Pippi, 2012

Name of the Greenway: White Oak Creek Greenway
City: Cary State: NC

Name Observer: Luis Guilherme Aita Pippi
Photo Source: Pippi Perssonel File, 2012

SOCIAL OBSERVATON CHECK

Date:
Day of Week: Sunday Monday Tuesday Wednesday Thursday Friday Saturday
Time Started: AM or PM Time Ended: AM or PM
Direction: North South East West Clockwise C-C-Wise

Weather: Sunny Partly Sunny Cloudy Partly Cloudy Rainy Snowy
Approximately Temperature:
Weather Conditions: forecast condition, low, high, precipitation chance, wind, humidity

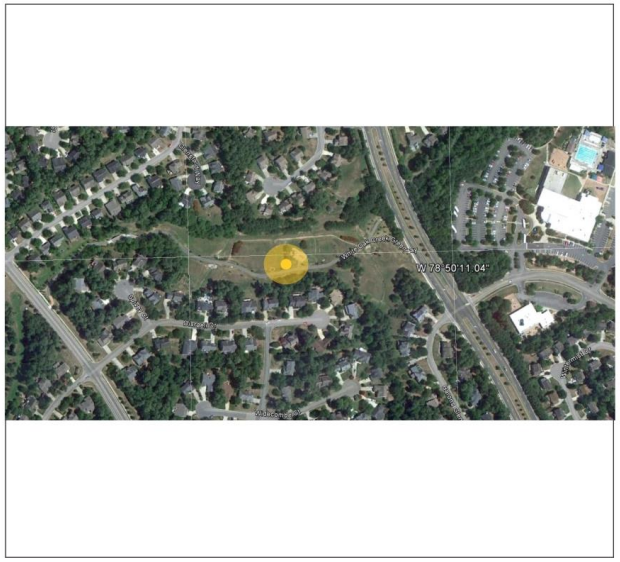
http://weather.gov/ (NOAA Website)
http://www.weather.com/weather/tenday/27601
http://www.wral.com/weather/

White Oak Creek Greenway

2 segments

Connection with Neighborhoods Only

Number Neighborhoods:
Segment: Mac Arthur Dr. - SW Cary Pkwy



observation station

radius of visibility 10 feet

2 greenway segments
2 types of structural network connection:
- park only
- neighborhood only

N

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION — Source: Elaborated by Pippi, 2012

Name of the Greenway: White Oak Creek Greenway
City: Cary State: NC

Name Observer: Luis Guilherme Aita Pippi
Photo Source: Pippi Perssonel File, 2012

SOCIAL OBSERVATON CHECK

Type of Users

children users (00 - 12 ys)	# girls #	adolescents users (13 - 17 ys)	# girls #	adult users (18-65 ys)	# women #	senior users (over 65 ys)	# women #	total users by gender ♀#
	# boys #		# boys #		# men #		# men #	total users by gender ♂#
Total Users/ Day - 1 hr	#	Total Users/ Day - 1 hr	#	Total Users/ Day - 1 hr	#	Total Users/ Day - 1 hr	#	Total Users/ Day - 1 hr ♀♂#

Legend:

♀ females

♂ males

Type of Users

- Children (Ch) users (00 - 12ys)
- Adolescent (As) users (13 - 17ys)
- Adult users (Ad) (18 - 65ys)
- Senior users (Sn) (over 65ys)

Type of Actors

- Individual (I)
- Dyad (D)
- Triad (T)
- Groups (G)
- Sub Groups (SB)

Type of Actors social network categories type relational size

Individual (I)	# females # / # males #	Sub Groups (SB)	# females # / # males #	Dyad (D)	# females # / # males #	Triad (T)	# females # / # males #	Groups (G)	# females # / # males #	4-5 people	# females # / # males #	6-7 people	# females # / # males #	8-10 people	# females # / # males #	11-15 people	# females # / # males #	more than 15 people	# females # / # males #	total actors by gender ♀# / total actors by gender ♂#
Total Actors/ Day - 1 hr	#	Total Actors/ Day - 1 hr	#	Total Actors/ Day - 1 hr	#	Total Actors/ Day - 1 hr	#	Total Actors/ Day - 1 hr	#	Total Actors/ Day - 1 hr	#	Total Actors/ Day - 1 hr	#	Total Actors/ Day - 1 hr	#	Total Actors/ Day - 1 hr	#	Total Actors/ Day - 1 hr	#	Total Actors/ Day - 1 hr ♀♂#

Observations:

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION — Source: Elaborated by Pippi, 2012

Name of the Greenway: White Oak Creek Greenway
City: Cary State: NC

Name Observer: Luis Guilherme Aita Pippi
Photo Source: Pippi Perssonel File, 2012

SOCIAL OBSERVATON CHECK

Type of Relational Ties and Social Bridges Matrices

occurrence social network ties/bridges among users type	(Ch) (As)	#	(As) (As)	#	(As) (Sn)	#	(Ch) (Ch)	#
	(Ch) (Ad)	#	(As) (Ad)	#	(Ad) (Sn)	#		
	(Ch) (Sn)	#	(Ad) (Ad)	#	(Sn) (Sn)	#		

occurrence social network ties/bridges among actors type	(I) (D)	#	(D) (D)	#	(D) (G)	#	(I) (I)	#
	(I) (T)	#	(D) (T)	#	(T) (G)	#		
	(I) (G)	#	(T) (T)	#	(G) (G)	#		

(SB)

occurrence social network categories relation users type/ each type actors	Individual (I)	Sub Groups (SB)	Dyad (D)	Triad (T)	Groups (G)		#
							#
							#
	# # # #	# # # #	# # # #	# # # #	# # # #		#

Legend:

Type of Users

- Children (Ch) users (00 - 12ys)
- Adolescent (As) users (13 - 17ys)
- Adult users (Ad) (18 - 65ys)
- Senior users (Sn) (over 65ys)

ties/bridges

Type of Actors

- Individual (I)
- Dyad (D)
- Triad (T)
- Groups (G)
- Sub Groups (SB)

Observations:

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION

Source: Elaborated by Pippi, 2012

Patterns of Use/Type of Activities

total diversity of activities / type of user	●	#
	●	#
	●	#
	●	#

Legend:

Type of Users

🟧 ● children users (00 - 12ys)

🟪 ● adolescent users (13 - 17ys)

🟦 ● adult users (18 - 65ys)

🟩 ● senior users (over 65ys)

Type Activities

* pattern of use/type of activities

🟨 diversity of activity - qualitative analysis

*** pattern of use/type of activities**

complementary behavior

🟧

w	wttp	wtstpstoltp	wlm	wstrtstpstol	wtstppexse	sitt	sittpodpol	stcw	s	rdt	rstpexse	bd	btstpstlip	btpso	sktstpst	p	y
wt	wtstpsttp	wstpsttol	wslm	wstrtstpstcw	wstppexse	sitwt	sitol	sttop	st	rdd	rwstps	bdt	bstpstlis	bstpsitst	skb	pne	ys
wtsit	wtstptp	wstpsittol	whhet	wtpcw	ex	sitre	sittol	stol	ssitol	rstr	rwpne	blm	btstpsttp	bstpsittol	skbt	pnet	yt
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wstpst	wtstpstcwtp	wtstpsitop	wtcia	wr	pexset	sitreol	sitreldsb	sttol	srt	rslm	rstpsitol	btllm	btstpstop	btstpdrkwat	sktstpst	pnetpdd	ga
wtstpst	wstpcw	wtstpoltp	wcia wstrlm	wrt	exexse	sitop	sitoddsp	sttoltp	ststol	rllm	rtstpexexse	bstpst	btstpstolop	btstpdrk	rstb	olpnet	gt
wstps	wstpstcwtp	wstpstoltp	wstrdt	wrd	exse	sittop	sittpol	sttcpol	stpktstol	rdlm	rstpolu	bctr	btstpsitolop	btstpsttp	sct	pso	gstpst
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wdrk	wstpstolop	wdstpstlip	wstrdstpst	wrtstps	exdt	sitoplol	sts	sttop	rt	rstpstst	b	btstpst	btstppso	iskd	scttstppspl	psplt	
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wstpsttp	wtstpstol	wstpstlis	wstrtstpsitol	wbtstpst	sit	sittoploltp	stttp	stoddsp	rd	rwext	btstpwb	btstps	btstpstpspl	skt	ft	watb	

Pets:
- a. dog on leash
- b. dog without leash
- c. dog held in arms
- d. cat without leash
- e. cat held in arms
- f. other pet
- g. dog in stroller
- h. dog swimming
- i. dog playing
- j. cat on leash

Stretching:
- a. in picnic shelter
- b. on bench
- c. on bridge
- d. on table
- e. on walking-board
- f. on the ground/grass
- g. in the parking lot area
- h. on bike racks
- i. on wood-fence
- j. on tree
- l. on information panel
- m. on dog waste bag post
- n. on dispenser post
- o. on kiosk
- p. on picnic table
- q. on exercise station
- r. on bollard/post

Exercising / Yoga:
- a. by kiosk
- b. in exercise station
- c. on grass
- d. on bench

Picnicking:
- a. in picnic shelter
- b. on table
- c. on bench
- d. on grass
- e. on the walking-board
- f. in the lake/pond area
- g. in activity node area

Drinking:
- a. drinking fountain
- b. pet drinking fountain
- c. bottle

Sitting:
- a. on the ground/grass
- b. on the bench
- c. on the rock
- d. on bicycle
- e. on stroller
- f. on baby seat
- g. on child trailer
- h. in adult's arms
- i. in kangaroo carrier
- j. on picnic table
- k. in car/truck/tractor
- l. in wagon
- m. in chair
- n. on bridge
- o. by kiosk
- p. on wood-fence
- q. on wall

🟪

w	wttp	wtstpstoltp	wlm	wstrtstpstol	wtstppexse	sitt	sittpodpol	stcw	s	rdt	rstpexse	bd	btstpstlip	btpso	sktstpst	p	y
wt	wtstpsttp	wstpsttol	wslm	wstrtstpstcw	wstppexse	sitwt	sitol	sttop	st	rdd	rwstps	bdt	bstpstlis	bstpsitst	skb	pne	ys
wtsit	wtstptp	wstpsittol	whhet	wtpcw	ex	sitre	sittol	stol	ssitol	rstr	rwpne	blm	btstpsttp	bstpsittol	skbt	pnet	yt
wtstpsit	wtstpstcw	wstpsttop	wthhet	wre	pexse	sitreop	sitthheol	stoltp	sr	rlm	rstpstlis	btcp	btstpstol	btstpstdrkwat	skblm	pnepd	g
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wtstpdrkwat	wstpolop	wstpstlis	wstrdtsit	wrstpst	exsettp	sitptp	sitpspl	sttcpol	r	rstrdt	tt	bstpst	btstppne	iskt	scttstpst	pspl	ot
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wstpsttp	wtstpstol	wstpstlis	wstrtstpsitol	wbtstpst	sit	sittoploltp	stttp	stoddsp	rd	rwext	btstpwb	btstps	btstpstpspl	skt	ft	watb	

Pets:
- a. dog on leash
- b. dog without leash
- c. dog held in arms
- d. cat without leash
- e. cat held in arms
- f. other pet
- g. dog in stroller
- h. dog swimming
- i. dog playing
- j. cat on leash

Stretching:
- a. in picnic shelter
- b. on bench
- c. on bridge
- d. on table
- e. on walking-board
- f. on the ground/grass
- g. in the parking lot area
- h. on bike racks
- i. on wood-fence
- j. on tree
- l. on information panel
- m. on dog waste bag post
- n. on dispenser post
- o. on kiosk
- p. on picnic table
- q. on exercise station
- r. on bollard/post

Exercising / Yoga:
- a. by kiosk
- b. in exercise station
- c. on grass
- d. on bench

Picnicking:
- a. in picnic shelter
- b. on table
- c. on bench
- d. on grass
- e. on the walking-board
- f. in the lake/pond area
- g. in activity node area

Drinking:
- a. drinking fountain
- b. pet drinking fountain
- c. bottle

Sitting:
- a. on the ground/grass
- b. on the bench
- c. on the rock
- d. on bicycle
- e. on stroller
- f. on baby seat
- g. on child trailer
- h. in adult's arms
- i. in kangaroo carrier
- j. on picnic table
- k. in car/truck/tractor
- l. in wagon
- m. in chair
- n. on bridge
- o. by kiosk
- p. on wood-fence
- q. on wall

🟦

w	wttp	wtstpstoltp	wlm	wstrtstpstol	wtstppexse	sitt	sittpodpol	stcw	s	rdt	rstpexse	bd	btstpstlip	btpso	sktstpst	p	y
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wstpst	wtstpstcwtp	wtstpsitop	wtcia	wr	pexset	sitreol	sitreldsb	sttol	srt	rslm	rstpsitol	btllm	btstpstop	btstpdrkwat	sktstpst	pnetpdd	ga
wtstpst	wstpcw	wtstpoltp	wcia wstrlm	wrt	exexse	sitop	sitoddsp	sttoltp	ststol	rllm	rtstpexexse	bstpst	btstpstolop	btstpdrk	rstb	olpnet	gt
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wtstps	wtstpcw	wtstpsitoltp	wstrd	wrlm	exset	sitoptp	sittpopol	sttop	tpsit	rstrt	u	btstppne	btstpsitol	isk	sctt	psot	twtstptp
wtstpdrkwat	wstpolop	wstpstlis	wstrdtsit	wrstpst	exsettp	sitptp	sitpspl	sttcpol	r	rstrdt	tt	bstpst	btstppne	iskt	scttstpst	pspl	ot
wdrk	wstpstolop	wdstpstlip	wstrdstpst	wrtstps	exdt	sitoplol	sts	sttop	rt	rstpstst	b	btstpst	btstppso	iskd	scttstppspl	psplt	
wtdrk	wstpsolop	wtstpstlis	wstrstpstlip	wbt	exst	sittoplol	sttp	stllmopol	rwt	rstpex	bt	btstpstw	btstppspl	iskskga	f	pdt	
wstpsttp	wtstpstol	wstpstlis	wstrtstpsitol	wbtstpst	sit	sittoploltp	stttp	stoddsp	rd	rwext	btstpwb	btstps	btstpstpspl	skt	ft	watb	

Pets:
- a. dog on leash
- b. dog without leash
- c. dog held in arms
- d. cat without leash
- e. cat held in arms
- f. other pet
- g. dog in stroller
- h. dog swimming
- i. dog playing
- j. cat on leash

Stretching:
- a. in picnic shelter
- b. on bench
- c. on bridge
- d. on table
- e. on walking-board
- f. on the ground/grass
- g. in the parking lot area
- h. on bike racks
- i. on wood-fence
- j. on tree
- l. on information panel
- m. on dog waste bag post
- n. on dispenser post
- o. on kiosk
- p. on picnic table
- q. on exercise station
- r. on bollard/post

Exercising / Yoga:
- a. by kiosk
- b. in exercise station
- c. on grass
- d. on bench

Picnicking:
- a. in picnic shelter
- b. on table
- c. on bench
- d. on grass
- e. on the walking-board
- f. in the lake/pond area
- g. in activity node area

Drinking:
- a. drinking fountain
- b. pet drinking fountain
- c. bottle

Sitting:
- a. on the ground/grass
- b. on the bench
- c. on the rock
- d. on bicycle
- e. on stroller
- f. on baby seat
- g. on child trailer
- h. in adult's arms
- i. in kangaroo carrier
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- p. on wood-fence
- q. on wall

🟩

w	wttp	wtstpstoltp	wlm	wstrtstpstol	wtstppexse	sitt	sittpodpol	stcw	s	rdt	rstpexse	bd	btstpstlip	btpso	sktstpst	p	y
wt	wtstpsttp	wstpsttol	wslm	wstrtstpstcw	wstppexse	sitwt	sitol	sttop	st	rdd	rwstps	bdt	bstpstlis	bstpsitst	skb	pne	ys
wtsit	wtstptp	wstpsittol	whhet	wtpcw	ex	sitre	sittol	stol	ssitol	rstr	rwpne	blm	btstpsttp	bstpsittol	skbt	pnet	yt
wtstpsit	wtstpstcw	wstpsttop	wthhet	wre	pexse	sitreop	sitthheol	stoltp	sr	rlm	rstpstlis	btcp	btstpstol	btstpstdrkwat	skblm	pnepd	g
wstpst	wtstpstcwtp	wtstpsitop	wtcia	wr	pexset	sitreol	sitreldsb	sttol	srt	rslm	rstpsitol	btllm	btstpstop	btstpdrkwat	sktstpst	pnetpdd	ga
wtstpst	wstpcw	wtstpoltp	wcia wstrlm	wrt	exexse	sitop	sitoddsp	sttoltp	ststol	rllm	rtstpexexse	bstpst	btstpstolop	btstpdrk	rstb	olpnet	gt
wstps	wstpstcwtp	wstpstoltp	wstrdt	wrd	exse	sittop	sittpol	sttcpol	stpktstol	rdlm	rstpolu	bctr	btstpsitolop	btstpsttp	sct	pso	gstpst
wtstps	wtstpcw	wtstpsitoltp	wstrd	wrlm	exset	sitoptp	sittpopol	sttop	tpsit	rstrt	u	btstppne	btstpsitol	isk	sctt	psot	twtstptp
wtstpdrkwat	wstpolop	wstpstlis	wstrdtsit	wrstpst	exsettp	sitptp	sitpspl	sttcpol	r	rstrdt	tt	bstpst	btstppne	iskt	scttstpst	pspl	ot
wdrk	wstpstolop	wdstpstlip	wstrdstpst	wrtstps	exdt	sitoplol	sts	sttop	rt	rstpstst	b	btstpst	btstppso	iskd	scttstppspl	psplt	
wtdrk	wstpsolop	wtstpstlis	wstrstpstlip	wbt	exst	sittoplol	sttp	stllmopol	rwt	rstpex	bt	btstpstw	btstppspl	iskskga	f	pdt	
wstpsttp	wtstpstol	wstpstlis	wstrtstpsitol	wbtstpst	sit	sittoploltp	stttp	stoddsp	rd	rwext	btstpwb	btstps	btstpstpspl	skt	ft	watb	

Pets:
- a. dog on leash
- b. dog without leash
- c. dog held in arms
- d. cat without leash
- e. cat held in arms
- f. other pet
- g. dog in stroller
- h. dog swimming
- i. dog playing
- j. cat on leash

Stretching:
- a. in picnic shelter
- b. on bench
- c. on bridge
- d. on table
- e. on walking-board
- f. on the ground/grass
- g. in the parking lot area
- h. on bike racks
- i. on wood-fence
- j. on tree
- l. on information panel
- m. on dog waste bag post
- n. on dispenser post
- o. on kiosk
- p. on picnic table
- q. on exercise station
- r. on bollard/post

Exercising / Yoga:
- a. by kiosk
- b. in exercise station
- c. on grass
- d. on bench

Picnicking:
- a. in picnic shelter
- b. on table
- c. on bench
- d. on grass
- e. on the walking-board
- f. in the lake/pond area
- g. in activity node area

Drinking:
- a. drinking fountain
- b. pet drinking fountain
- c. bottle

Sitting:
- a. on the ground/grass
- b. on the bench
- c. on the rock
- d. on bicycle
- e. on stroller
- f. on baby seat
- g. on child trailer
- h. in adult's arms
- i. in kangaroo carrier
- j. on picnic table
- k. in car/truck/tractor
- l. in wagon
- m. in chair
- n. on bridge
- o. by kiosk
- p. on wood-fence
- q. on wall

Observations:

Legend:

Type of Activity Level

S = Sedentary - engaged in stationary activity (lying down, sitting, standing, sun-bathing, socializing, others)

M= Moderate - engaged in more passive activity: different types of walking (walking stroller, walking fast, carrying baby, walking dog, others)

V = Vigorous - engaged in more energetic/active/forceful/strong activity (biking, jogging/running, in-line skating, cross-country, others)

***SM, *SV, *MV**= alternate activity level during the observation

SS*, *MM*, *VV* *SMV= alternate the pattern of activity/type of use within the same activity level during the observation

Type of Activities Level

(S)	(M)	(V)	(*SM)	(*SV)	(*MV)	(*SS*)	(*MM*)	(*VV*)	(*SMV*)
● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●
# # # #	# # # #	# # # #	# # # #	# # # #	# # # #	# # # #	# # # #	# # # #	# # # #

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION

Source: Elaborated by Pippi, 2012

Patterns of Use/Type of Activities

total diversity of activities / type of actor	●	#
	●	#
	●	#
	●	#

Legend:

Type of Actors

🟪 ● Individual (I)

🟨 ● Dyad (D)

🟩 ● Triad (T)

🟦 ● Groups (G)

● Sub Groups (SB)

Type Activities

* pattern of use/type of activities

▬ diversity of activity - qualitative analysis

*** pattern of use/type of activities**

complementary behavior

🟪	w	wttp	wtstpstoltp	wlm	wstrtstpstol	wtstppexse	sitt	sittpodpol	stcw	s	rdt	rstpexse	bd	btstpstlip	btpso	sktstpst	p	y
	wt	wtstpsttp	wstpsttol	wslm	wstrtstpstcw	wstppexse	sitwt	sitol	sttop	st	rdd	rwstps	bdt	bstpstlis	bstpsitst	skb	pne	ys
	wtsit	wtstptp	wstpsittol	whhet	wtpcw	ex	sitre	sittol	stol	ssitol	rstr	rwpne	blm	btstpsttp	bstpsittol	skbt	pnet	yt
	wtstpsit	wtstpstcw	wstpsttop	wthhet	wre	pexse	sitreop	sitthheol	stoltp	sr	rlm	rstpstlis	btcp	btstpstol	btstpstdrkwat	skblm	pnepd	g
	wstpst	wtstpstcwtp	wtstpsitop	wtcia	wr	pexset	sitreol	sitreldsb	sttol	srt	rslm	rstpsitol	btllm	btstpstop	btstpdrkwat	sktstpst	pnetpdd	ga
	wtstpst	wstpcw	wtstpoltp	wcia wstrlm	wrt	exexse	sitop	sitoddsp	sttoltp	ststol	rllm	rtstpexexse	bstpst	btstpstolop	btstpdrk	rstb	olpnet	gt
	wstps	wstpstcwtp	wstpstoltp	wstrdt	wrd	exse	sittop	sittpol	sttcpol	stpktstol	rdlm	rstpolu	bctr	btstpsitolop	btstpsttp	sct	pso	gstpst
	wtstps	wtstpcw	wtstpsitoltp	wstrd	wrlm	exset	sitoptp	sittpopol	sttop	tpsit	rstrt	u	btstppne	btstpsitol	isk	sctt	psot	twtstptp
	wtstpdrkwat	wstpolop	wstpstlis	wstrdtsit	wrstpst	exsettp	sitptp	sitpspl	sttcpol	r	rstrdt	tt	bstpst	btstppne	iskt	scttstpst	pspl	ot
	wdrk	wstpstolop	wdstpstlip	wstrdstpst	wrtstps	exdt	sitoplol	sts	sttop	rt	rstpstst	b	btstpst	btstppso	iskd	scttstppspl	psplt	
	wtdrk	wstpsolop	wtstpstlis	wstrstpstlip	wbt	exst	sittoplol	sttp	stllmopol	rwt	rstpex	bt	btstpstw	btstppspl	iskskga	f	pdt	
	wstpsttp	wtstpstol	wstpstlis	wstrtstpsitol	wbtstpst	sit	sittoploltp	stttp	stoddsp	rd	rwext	btstpwb	btstps	btstpstpspl	skt	ft	watb	

Pets:
a. dog on leash
b. dog without leash
c. dog held in arms
d. cat without leash
e. cat held in arms
f. other pet
g. dog in stroller
h. dog swimming
i. dog playing
j. cat on leash

Stretching:
a. in picnic shelter
b. on bench
c. on bridge
d. on table
e. on walking-board
f. on the ground/grass
g. in the parking lot area
h. on bike racks
i. on wood-fence
j. on tree
l. on information panel
m. on dog waste bag post
n. on dispenser post
o. on kiosk
p. on picnic table
q. on exercise station
r. on bollard/post

Exercising / Yoga:
a. by kiosk
b. in exercise station
c. on grass
d. on bench

Picnicking:
a. in picnic shelter
b. on table
c. on bench
d. on grass
e. on the walking-board
f. in the lake/pond area
g. in activity node area

Drinking:
a. drinking fountain
b. pet drinking fountain
c. bottle

Sitting:
a. on the ground/grass
b. on the bench
c. on the rock
d. on bicycle
e. on stroller
f. on baby seat
g. on child trailer
h. in adult's arms
i. in kangaroo carrier
j. on picnic table
k. in car/truck/tractor
l. in wagon
m. in chair
n. on bridge
o. by kiosk
p. on wood-fence
q. on wall

🟨	w	wttp	wtstpstoltp	wlm	wstrtstpstol	wtstppexse	sitt	sittpodpol	stcw	s	rdt	rstpexse	bd	btstpstlip	btpso	sktstpst	p	y
	wt	wtstpsttp	wstpsttol	wslm	wstrtstpstcw	wstppexse	sitwt	sitol	sttop	st	rdd	rwstps	bdt	bstpstlis	bstpsitst	skb	pne	ys
	wtsit	wtstptp	wstpsittol	whhet	wtpcw	ex	sitre	sittol	stol	ssitol	rstr	rwpne	blm	btstpsttp	bstpsittol	skbt	pnet	yt
	wtstpsit	wtstpstcw	wstpsttop	wthhet	wre	pexse	sitreop	sitthheol	stoltp	sr	rlm	rstpstlis	btcp	btstpstol	btstpstdrkwat	skblm	pnepd	g
	wstpst	wtstpstcwtp	wtstpsitop	wtcia	wr	pexset	sitreol	sitreldsb	sttol	srt	rslm	rstpsitol	btllm	btstpstop	btstpdrkwat	sktstpst	pnetpdd	ga
	wtstpst	wstpcw	wtstpoltp	wcia wstrlm	wrt	exexse	sitop	sitoddsp	sttoltp	ststol	rllm	rtstpexexse	bstpst	btstpstolop	btstpdrk	rstb	olpnet	gt
	wstps	wstpstcwtp	wstpstoltp	wstrdt	wrd	exse	sittop	sittpol	sttcpol	stpktstol	rdlm	rstpolu	bctr	btstpsitolop	btstpsttp	sct	pso	gstpst
	wtstps	wtstpcw	wtstpsitoltp	wstrd	wrlm	exset	sitoptp	sittpopol	sttop	tpsit	rstrt	u	btstppne	btstpsitol	isk	sctt	psot	twtstptp
	wtstpdrkwat	wstpolop	wstpstlis	wstrdtsit	wrstpst	exsettp	sitptp	sitpspl	sttcpol	r	rstrdt	tt	bstpst	btstppne	iskt	scttstpst	pspl	ot
	wdrk	wstpstolop	wdstpstlip	wstrdstpst	wrtstps	exdt	sitoplol	sts	sttop	rt	rstpstst	b	btstpst	btstppso	iskd	scttstppspl	psplt	
	wtdrk	wstpsolop	wtstpstlis	wstrstpstlip	wbt	exst	sittoplol	sttp	stllmopol	rwt	rstpex	bt	btstpstw	btstppspl	iskskga	f	pdt	
	wstpsttp	wtstpstol	wstpstlis	wstrtstpsitol	wbtstpst	sit	sittoploltp	stttp	stoddsp	rd	rwext	btstpwb	btstps	btstpstpspl	skt	ft	watb	

Pets:
a. dog on leash
b. dog without leash
c. dog held in arms
d. cat without leash
e. cat held in arms
f. other pet
g. dog in stroller
h. dog swimming
i. dog playing
j. cat on leash

Stretching:
a. in picnic shelter
b. on bench
c. on bridge
d. on table
e. on walking-board
f. on the ground/grass
g. in the parking lot area
h. on bike racks
i. on wood-fence
j. on tree
l. on information panel
m. on dog waste bag post
n. on dispenser post
o. on kiosk
p. on picnic table
q. on exercise station
r. on bollard/post

Exercising / Yoga:
a. by kiosk
b. in exercise station
c. on grass
d. on bench

Picnicking:
a. in picnic shelter
b. on table
c. on bench
d. on grass
e. on the walking-board
f. in the lake/pond area
g. in activity node area

Drinking:
a. drinking fountain
b. pet drinking fountain
c. bottle

Sitting:
a. on the ground/grass
b. on the bench
c. on the rock
d. on bicycle
e. on stroller
f. on baby seat
g. on child trailer
h. in adult's arms
i. in kangaroo carrier
j. on picnic table
k. in car/truck/tractor
l. in wagon
m. in chair
n. on bridge
o. by kiosk
p. on wood-fence
q. on wall

🟩	w	wttp	wtstpstoltp	wlm	wstrtstpstol	wtstppexse	sitt	sittpodpol	stcw	s	rdt	rstpexse	bd	btstpstlip	btpso	sktstpst	p	y
	wt	wtstpsttp	wstpsttol	wslm	wstrtstpstcw	wstppexse	sitwt	sitol	sttop	st	rdd	rwstps	bdt	bstpstlis	bstpsitst	skb	pne	ys
	wtsit	wtstptp	wstpsittol	whhet	wtpcw	ex	sitre	sittol	stol	ssitol	rstr	rwpne	blm	btstpsttp	bstpsittol	skbt	pnet	yt
	wtstpsit	wtstpstcw	wstpsttop	wthhet	wre	pexse	sitreop	sitthheol	stoltp	sr	rlm	rstpstlis	btcp	btstpstol	btstpstdrkwat	skblm	pnepd	g
	wstpst	wtstpstcwtp	wtstpsitop	wtcia	wr	pexset	sitreol	sitreldsb	sttol	srt	rslm	rstpsitol	btllm	btstpstop	btstpdrkwat	sktstpst	pnetpdd	ga
	wtstpst	wstpcw	wtstpoltp	wcia wstrlm	wrt	exexse	sitop	sitoddsp	sttoltp	ststol	rllm	rtstpexexse	bstpst	btstpstolop	btstpdrk	rstb	olpnet	gt
	wstps	wstpstcwtp	wstpstoltp	wstrdt	wrd	exse	sittop	sittpol	sttcpol	stpktstol	rdlm	rstpolu	bctr	btstpsitolop	btstpsttp	sct	pso	gstpst
	wtstps	wtstpcw	wtstpsitoltp	wstrd	wrlm	exset	sitoptp	sittpopol	sttop	tpsit	rstrt	u	btstppne	btstpsitol	isk	sctt	psot	twtstptp
	wtstpdrkwat	wstpolop	wstpstlis	wstrdtsit	wrstpst	exsettp	sitptp	sitpspl	sttcpol	r	rstrdt	tt	bstpst	btstppne	iskt	scttstpst	pspl	ot
	wdrk	wstpstolop	wdstpstlip	wstrdstpst	wrtstps	exdt	sitoplol	sts	sttop	rt	rstpstst	b	btstpst	btstppso	iskd	scttstppspl	psplt	
	wtdrk	wstpsolop	wtstpstlis	wstrstpstlip	wbt	exst	sittoplol	sttp	stllmopol	rwt	rstpex	bt	btstpstw	btstppspl	iskskga	f	pdt	
	wstpsttp	wtstpstol	wstpstlis	wstrtstpsitol	wbtstpst	sit	sittoploltp	stttp	stoddsp	rd	rwext	btstpwb	btstps	btstpstpspl	skt	ft	watb	

Pets:
a. dog on leash
b. dog without leash
c. dog held in arms
d. cat without leash
e. cat held in arms
f. other pet
g. dog in stroller
h. dog swimming
i. dog playing
j. cat on leash

Stretching:
a. in picnic shelter
b. on bench
c. on bridge
d. on table
e. on walking-board
f. on the ground/grass
g. in the parking lot area
h. on bike racks
i. on wood-fence
j. on tree
l. on information panel
m. on dog waste bag post
n. on dispenser post
o. on kiosk
p. on picnic table
q. on exercise station
r. on bollard/post

Exercising / Yoga:
a. by kiosk
b. in exercise station
c. on grass
d. on bench

Picnicking:
a. in picnic shelter
b. on table
c. on bench
d. on grass
e. on the walking-board
f. in the lake/pond area
g. in activity node area

Drinking:
a. drinking fountain
b. pet drinking fountain
c. bottle

Sitting:
a. on the ground/grass
b. on the bench
c. on the rock
d. on bicycle
e. on stroller
f. on baby seat
g. on child trailer
h. in adult's arms
i. in kangaroo carrier
j. on picnic table
k. in car/truck/tractor
l. in wagon
m. in chair
n. on bridge
o. by kiosk
p. on wood-fence
q. on wall

🟦	w	wttp	wtstpstoltp	wlm	wstrtstpstol	wtstppexse	sitt	sittpodpol	stcw	s	rdt	rstpexse	bd	btstpstlip	btpso	sktstpst	p	y
	wt	wtstpsttp	wstpsttol	wslm	wstrtstpstcw	wstppexse	sitwt	sitol	sttop	st	rdd	rwstps	bdt	bstpstlis	bstpsitst	skb	pne	ys
	wtsit	wtstptp	wstpsittol	whhet	wtpcw	ex	sitre	sittol	stol	ssitol	rstr	rwpne	blm	btstpsttp	bstpsittol	skbt	pnet	yt
	wtstpsit	wtstpstcw	wstpsttop	wthhet	wre	pexse	sitreop	sitthheol	stoltp	sr	rlm	rstpstlis	btcp	btstpstol	btstpstdrkwat	skblm	pnepd	g
	wstpst	wtstpstcwtp	wtstpsitop	wtcia	wr	pexset	sitreol	sitreldsb	sttol	srt	rslm	rstpsitol	btllm	btstpstop	btstpdrkwat	sktstpst	pnetpdd	ga
	wtstpst	wstpcw	wtstpoltp	wcia wstrlm	wrt	exexse	sitop	sitoddsp	sttoltp	ststol	rllm	rtstpexexse	bstpst	btstpstolop	btstpdrk	rstb	olpnet	gt
	wstps	wstpstcwtp	wstpstoltp	wstrdt	wrd	exse	sittop	sittpol	sttcpol	stpktstol	rdlm	rstpolu	bctr	btstpsitolop	btstpsttp	sct	pso	gstpst
	wtstps	wtstpcw	wtstpsitoltp	wstrd	wrlm	exset	sitoptp	sittpopol	sttop	tpsit	rstrt	u	btstppne	btstpsitol	isk	sctt	psot	twtstptp
	wtstpdrkwat	wstpolop	wstpstlis	wstrdtsit	wrstpst	exsettp	sitptp	sitpspl	sttcpol	r	rstrdt	tt	bstpst	btstppne	iskt	scttstpst	pspl	ot
	wdrk	wstpstolop	wdstpstlip	wstrdstpst	wrtstps	exdt	sitoplol	sts	sttop	rt	rstpstst	b	btstpst	btstppso	iskd	scttstppspl	psplt	
	wtdrk	wstpsolop	wtstpstlis	wstrstpstlip	wbt	exst	sittoplol	sttp	stllmopol	rwt	rstpex	bt	btstpstw	btstppspl	iskskga	f	pdt	
	wstpsttp	wtstpstol	wstpstlis	wstrtstpsitol	wbtstpst	sit	sittoploltp	stttp	stoddsp	rd	rwext	btstpwb	btstps	btstpstpspl	skt	ft	watb	

Pets:
a. dog on leash
b. dog without leash
c. dog held in arms
d. cat without leash
e. cat held in arms
f. other pet
g. dog in stroller
h. dog swimming
i. dog playing
j. cat on leash

Stretching:
a. in picnic shelter
b. on bench
c. on bridge
d. on table
e. on walking-board
f. on the ground/grass
g. in the parking lot area
h. on bike racks
i. on wood-fence
j. on tree
l. on information panel
m. on dog waste bag post
n. on dispenser post
o. on kiosk
p. on picnic table
q. on exercise station
r. on bollard/post

Exercising / Yoga:
a. by kiosk
b. in exercise station
c. on grass
d. on bench

Picnicking:
a. in picnic shelter
b. on table
c. on bench
d. on grass
e. on the walking-board
f. in the lake/pond area
g. in activity node area

Drinking:
a. drinking fountain
b. pet drinking fountain
c. bottle

Sitting:
a. on the ground/grass
b. on the bench
c. on the rock
d. on bicycle
e. on stroller
f. on baby seat
g. on child trailer
h. in adult's arms
i. in kangaroo carrier
j. on picnic table
k. in car/truck/tractor
l. in wagon
m. in chair
n. on bridge
o. by kiosk
p. on wood-fence
q. on wall

Observations:

Legend:

Type of Activity Level

S = Sedentary - engaged in stationary activity
(lying down, sitting, standing, sun-bathing, socializing, others)
M= Moderate - engaged in more passive activity: different types of walking
(walking stroller, walking fast, carrying baby, walking dog, others)
V = Vigorous - engaged in more energetic/active/forceful/strong activity
(biking, jogging/running, in-line skating, cross-country, others)
***SM, *SV, *MV**= alternate activity level during the observation
SS*, *MM*, *VV* *SMV= alternate the pattern of activity/type of use within the same activity level during the observation

Type of Activities Level

(S)	(M)	(V)	(*SM)	(*SV)	(*MV)	(*SS*)	(*MM*)	(*VV*)	(*SMV*)
● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●
# # # #	# # # #	# # # #	# # # #	# # # #	# # # #	# # # #	# # # #	# # # #	# # # #

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION — Source: Elaborated by Pippi, 2012

Patterns of Interaction / Social Network Ties/Bridges

total diversity of interactions in the user category	(Ch) (As)	#	(As) (As)	#	(As) (Sn)	#	(Ch) (Ch)	#	
	(Ch) (Ad)	#	(As) (Ad)	#	(Ad) (Sn)	#			
	(Ch) (Sn)	#	(Ad) (Ad)	#	(Sn) (Sn)	#			

Legend:

Type of Users

- Children (Ch)
- Adolescent (As)
- Adult (Ad)
- Senior (Sn)

Type of Interactions

- * pattern of interaction
- diversity of activity - qualitative analysis

* pattern of interaction		
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)

Observations:

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION

Source: Elaborated by Pippi, 2012

Patterns of Interaction / Social Network Ties/Bridges

total diversity of interactions in the user category	(Ch) (As)	#	(As) (As)	#	(As) (Sn)	#	(Ch) (Ch)	#	
	(Ch) (Ad)	#	(As) (Ad)	#	(Ad) (Sn)	#			
	(Ch) (Sn)	#	(Ad) (Ad)	#	(Sn) (Sn)	#			

Legend:

Type of Users

- Children (Ch)
- Adolescent (As)
- Adult (Ad)
- Senior (Sn)

Type of Interactions

- * pattern of interaction
- diversity of activity - qualitative analysis

* pattern of interaction		
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)

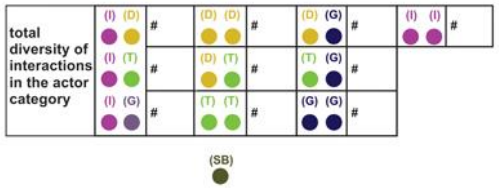
Observations:

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION

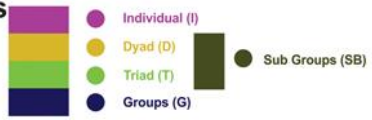
Source: Elaborated by Pippi, 2012

Patterns of Interaction / Social Network Ties/Bridges



Legend:

Type of Actors



Type of Interactions

* pattern of interaction		
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)

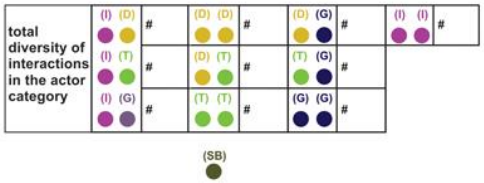
Observations:

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION

Source: Elaborated by Pippi, 2012

Patterns of Interaction / Social Network Ties/Bridges



Legend:

Type of Actors

- Individual (I)
- Dyad (D)
- Triad (T)
- Groups (G)
- Sub Groups (SB)

Type of Interactions

- * pattern of interaction
- diversity of activity - qualitative analysis

* pattern of interaction		
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)
socializing (soc)	kinship patterns of socialization (kps)	cultural customs sharing (ccs)

Observations:

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION — Source: Elaborated by Pippi, 2012

Type of Activities Level

Legend:

Type of Users

- Children (Ch)
- Adolescent (As)
- Adult (Ad)
- Senior (Sn)

Type Activities

level of activity - qualitative analysis

total level of activities / in the user category social network ties/bridges	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(Ch) (As)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(As) (As)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(As) (Sn)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(Ch) (Ch)	#
	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(Ch) (Ad)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(As) (Ad)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(Ad) (Sn)	#			
	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(Ch) (Sn)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(Ad) (Ad)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(Sn) (Sn)	#			

OBSERVATIONS:

Legend:

Type of Activity Level

S = Sedentary - engaged in stationary activity (lying down, sitting, standing, sun-bathing, socializing, others)
M= Moderate - engaged in more passive activity: different types of walking (walking stroller, walking fast, carrying baby, walking dog, others)
V = Vigorous - engaged in more energetic/active/forceful/strong activity (biking, jogging/running, in-line skating, cross-country, others)
***SM, *SV, *MV**= alternate activity level during the observation
SS*, *MM*, *VV* *SMV= alternate the pattern of activity/type of use within the same activity level during the observation

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION

Source: Elaborated by Pippi, 2012

Type of Activities Level

Legend:

Type of Actors

- Individual (I)
- Dyad (D)
- Triad (T)
- Groups (G)
- Sub Groups (SB)

Type Activities

- level of activity - qualitative analysis

total level of activities / in the actor category social network ties/bridges	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(I) (D)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(D) (D)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(D) (G)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(I) (I)	#
	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(I) (T)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(D) (T)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(T) (G)	#			
	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(I) (G)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(T) (T)	#	(S) (*SM) (V) (*SV) (M)(*MV) (*SS*) (*MM*) (*VV*) (*SMV*)	(G) (G)	#			

OBSERVATIONS:

Legend:

Type of Activity Level

S = Sedentary - engaged in stationary activity (lying down, sitting, standing, sun-bathing, socializing, others)
M= Moderate - engaged in more passive activity: different types of walking (walking stroller, walking fast, carrying baby, walking dog, others)
V = Vigorous - engaged in more energetic/active/forceful/strong activity (biking, jogging/running, in-line skating, cross-country, others)
***SM, *SV, *MV**= alternate activity level during the observation
SS*, *MM*, *VV* *SMV= alternate the pattern of activity/type of use within the same activity level during the observation

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING — Source: Elaborated by Pippi, 2012

Type of Interactions Level

Legend:

Level of Interactions

- Level 1 (L1) - low level of interactions
- Level 2 (L2) - moderate level of interactions
- Level 3 (L3) - high level of interactions

Type of Users

- Children (Ch)
- Adolescent (As)
- Adult (Ad)
- Senior (Sn)

total level of interactions in the user category social network ties/bridges

L1	L2	L3	(Ch) (As)	#	L1	L2	L3	(As) (As)	#	L1	L2	L3	(As) (Sn)	#	L1	L2	L3	(Ch) (Ch)	#
1x	2x	3x			1x	2x	3x			1x	2x	3x			1x	2x	3x		
1y	2y	3y			1y	2y	3y			1y	2y	3y			1y	2y	3y		
1z	2z	3z			1z	2z	3z			1z	2z	3z			1z	2z	3z		
L1	L2	L3	(Ch) (Ad)	#	L1	L2	L3	(As) (Ad)	#	L1	L2	L3	(Ad) (Sn)	#					
1x	2x	3x			1x	2x	3x			1x	2x	3x							
1y	2y	3y			1y	2y	3y			1y	2y	3y							
1z	2z	3z			1z	2z	3z			1z	2z	3z							
L1	L2	L3	(Ch) (Sn)	#	L1	L2	L3	(Ad) (Ad)	#	L1	L2	L3	(Sn) (Sn)	#					
1x	2x	3x			1x	2x	3x			1x	2x	3x							
1y	2y	3y			1y	2y	3y			1y	2y	3y							
1z	2z	3z			1z	2z	3z			1z	2z	3z							

OBSERVATIONS:

Legend:

Type of Interaction Level

- 1x Smile / Wave
- 1y Greeting a friend only, without stopping the activity
- 1z Greeting a stranger only, without stopping the activity
- 2x Casual/Informal meeting, stopping activity and engage in a conversation between family members
- 2y Casual/Informal meeting, stopping activity and engage in a conversation between friends
- 2z Casual/Informal meeting, stopping activity and engage in a conversation between strangers
- 3x Meeting, engage in a conversation and start doing activities together between family members
- 3y Meeting, engage in a conversation and start doing activities together between friends
- 3z Meeting, engage in a conversation and start doing activities together between strangers

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING — Source: Elaborated by Pippi, 2012

Type of Interactions Level

Legend:

Level of Interactions

- Level 1 (L1) - low level of interactions
- Level 2 (L2) - moderate level of interactions
- Level 3 (L3) - high level of interactions

Type of Actors

- Individual (I)
- Dyad (D)
- Triad (T)
- Groups (G)
- Sub Groups (SB)

total level of interactions in the actor category social network ties/bridges	L1	L2	L3	(I) (D)	#	L1	L2	L3	(D) (D)	#	L1	L2	L3	(D) (G)	#	L1	L2	L3	(I) (I)	#
	1x	2x	3x			1x	2x	3x			1x	2x	3x			1x	2x	3x		
	1y	2y	3y			1y	2y	3y			1y	2y	3y			1y	2y	3y		
	1z	2z	3z			1z	2z	3z			1z	2z	3z			1z	2z	3z		
	L1	L2	L3	(I) (T)	#	L1	L2	L3	(D) (T)	#	L1	L2	L3	(T) (G)	#					
	1x	2x	3x			1x	2x	3x			1x	2x	3x							
	1y	2y	3y			1y	2y	3y			1y	2y	3y							
	1z	2z	3z			1z	2z	3z			1z	2z	3z							
	L1	L2	L3	(I) (G)	#	L1	L2	L3	(T) (T)	#	L1	L2	L3	(G) (G)	#					
	1x	2x	3x			1x	2x	3x			1x	2x	3x							
	1y	2y	3y			1y	2y	3y			1y	2y	3y							
	1z	2z	3z			1z	2z	3z			1z	2z	3z							

OBSERVATIONS:

Legend:

Type of Interaction Level

- 1x Smile / Wave
- 1y Greeting a friend only, without stopping the activity
- 1z Greeting a stranger only, without stopping the activity
- 2x Casual/Informal meeting, stopping activity and engage in a conversation between family members
- 2y Casual/Informal meeting, stopping activity and engage in a conversation between friends
- 2z Casual/Informal meeting, stopping activity and engage in a conversation between strangers
- 3x Meeting, engage in a conversation and start doing activities together between family members
- 3y Meeting, engage in a conversation and start doing activities together between friends
- 3z Meeting, engage in a conversation and start doing activities together between strangers

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

STATIONARY OBSERVATION

Source: Elaborated by Pippi, 2012

Type of Interactions Level

Legend:

Level of Interactions

- Level 1 (L1) - low level of interactions
- Level 2 (L2) - moderate level of interactions
- Level 3 (L3) - high level of interactions

Type of Users

- ● Children (Ch)
- ● Adolescent (As)
- ● Adult (Ad)
- ● Senior (Sn)

total level of interactions in the user category social network ties/bridges	L1 L2 L3 1a 2a 2d 2g 3a 3d 3g 1b 2b 2e 2h 3b 3e 3h 1c 2c 2f 2i 3c 3f 3i	(Ch) (As) ● ●	#	L1 L2 L3 1a 2a 2d 2g 3a 3d 3g 1b 2b 2e 2h 3b 3e 3h 1c 2c 2f 2i 3c 3f 3i	(As) (As) ● ●	#	L1 L2 L3 1a 2a 2d 2g 3a 3d 3g 1b 2b 2e 2h 3b 3e 3h 1c 2c 2f 2i 3c 3f 3i	(As) (Sn) ● ●	#	L1 L2 L3 1a 2a 2d 2g 3a 3d 3g 1b 2b 2e 2h 3b 3e 3h 1c 2c 2f 2i 3c 3f 3i	(Ch) (Ch) ● ●	#
	L1 L2 L3 1a 2a 2d 2g 3a 3d 3g 1b 2b 2e 2h 3b 3e 3h 1c 2c 2f 2i 3c 3f 3i	(Ch) (Ad) ● ●	#	L1 L2 L3 1a 2a 2d 2g 3a 3d 3g 1b 2b 2e 2h 3b 3e 3h 1c 2c 2f 2i 3c 3f 3i	(As) (Ad) ● ●	#	L1 L2 L3 1a 2a 2d 2g 3a 3d 3g 1b 2b 2e 2h 3b 3e 3h 1c 2c 2f 2i 3c 3f 3i	(Ad) (Sn) ● ●	#	**OBSERVATIONS:**		
	L1 L2 L3 1a 2a 2d 2g 3a 3d 3g 1b 2b 2e 2h 3b 3e 3h 1c 2c 2f 2i 3c 3f 3i	(Ch) (Sn) ● ●	#	L1 L2 L3 1a 2a 2d 2g 3a 3d 3g 1b 2b 2e 2h 3b 3e 3h 1c 2c 2f 2i 3c 3f 3i	(Ad) (Ad) ● ●	#	L1 L2 L3 1a 2a 2d 2g 3a 3d 3g 1b 2b 2e 2h 3b 3e 3h 1c 2c 2f 2i 3c 3f 3i	(Sn) (Sn) ● ●	#			

Legend:

Type of Interaction Level

1a	**Smile / Wave** (less than 1 minute)
1b	**Greeting a friend only, without stopping the activity** (less than 1 minute)
1c	**Greeting a stranger only, without stopping the activity** (less than 1 minute)
2a	**Casual/Informal meeting, stopping activity and engage in a conversation between family members** (1minute - 5 minutes)
2b	**Casual/Informal meeting, stopping activity and engage in a conversation between family members** (6 minutes - 9 minutes)
2c	**Casual/Informal meeting, stopping activity and engage in a conversation between family members** (10 minutes - 15 minutes)
2d	**Casual/Informal meeting, stopping activity and engage in a conversation between friends** (1 minute - 5 minutes)
2e	**Casual/Informal meeting, stopping activity and engage in a conversation between friends** (6 minutes - 9 minutes)
2f	**Casual/Informal meeting, stopping activity and engage in a conversation between friends** (10 minutes - 15 minutes)
2g	**Casual/Informal meeting, stopping activity and engage in a conversation between strangers** (1 minute - 5 minutes)
2h	**Casual/Informal meeting, stopping activity and engage in a conversation between strangers** (6 minutes - 9 minutes)
2i	**Casual/Informal meeting, stopping activity and engage in a conversation between strangers** (10 minutes - 15 minutes)
3a	**Meeting, engage in a conversation and start doing activities together between family members** (1 minute - 15 minutes)
3b	**Meeting, engage in a conversation and start doing activities together between friends** (1 minute - 15 minutes)
3c	**Meeting, engage in a conversation and start doing activities together between strangers** (1 minute - 15 minutes)
3d	**Meeting, engage in a conversation and start doing activities together between family members** (16 minutes - 30 minutes)
3e	**Meeting, engage in a conversation and start doing activities together between friends** (16 minutes - 30 minutes)
3f	**Meeting, engage in a conversation and start doing activities together between strangers** (16 minutes - 30 minutes)
3g	**Meeting, engage in a conversation and start doing activities together between family members** (more than 30 minutes)
3h	**Meeting, engage in a conversation and start doing activities together between friends** (more than 30 minutes)
3i	**Meeting, engage in a conversation and start doing activities together between strangers** (more than 30 minutes)

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

STATIONARY OBSERVATION

Source: Elaborated by Pippi, 2012

Type of Interactions Level

Legend:

Level of Interactions

- Level 1 (L1) - low level of interactions
- Level 2 (L2) - moderate level of interactions
- Level 3 (L3) - high level of interactions

Type of Actors

- ● Individual (I)
- ● Dyad (D)
- ● Triad (T)
- ● Groups (G)
- ● Sub Groups (SB)

total level of interactions in the actor category social network ties/bridges	L1	L2	L3	(I) (D)	#	L1	L2	L3	(D) (D)	#	L1	L2	L3	(D) (G)	#	L1	L2	L3	(I) (I)	#
	1a	2a 2d 2g	3a 3d 3g	● ●		1a	2a 2d 2g	3a 3d 3g	● ●		1a	2a 2d 2g	3a 3d 3g	● ●		1a	2a 2d 2g	3a 3d 3g	● ●	
	1b	2b 2e 2h	3b 3e 3h			1b	2b 2e 2h	3b 3e 3h			1b	2b 2e 2h	3b 3e 3h			1b	2b 2e 2h	3b 3e 3h		
	1c	2c 2f 2i	3c 3f 3i			1c	2c 2f 2i	3c 3f 3i			1c	2c 2f 2i	3c 3f 3i			1c	2c 2f 2i	3c 3f 3i		
	L1	L2	L3	(I) (T)	#	L1	L2	L3	(D) (T)	#	L1	L2	L3	(T) (G)	#	**OBSERVATIONS:**				
	1a	2a 2d 2g	3a 3d 3g	● ●		1a	2a 2d 2g	3a 3d 3g	● ●		1a	2a 2d 2g	3a 3d 3g	● ●						
	1b	2b 2e 2h	3b 3e 3h			1b	2b 2e 2h	3b 3e 3h			1b	2b 2e 2h	3b 3e 3h							
	1c	2c 2f 2i	3c 3f 3i			1c	2c 2f 2i	3c 3f 3i			1c	2c 2f 2i	3c 3f 3i							
	L1	L2	L3	(I) (G)	#	L1	L2	L3	(T) (T)	#	L1	L2	L3	(G) (G)	#					
	1a	2a 2d 2g	3a 3d 3g	● ●		1a	2a 2d 2g	3a 3d 3g	● ●		1a	2a 2d 2g	3a 3d 3g	● ●						
	1b	2b 2e 2h	3b 3e 3h			1b	2b 2e 2h	3b 3e 3h			1b	2b 2e 2h	3b 3e 3h							
	1c	2c 2f 2i	3c 3f 3i			1c	2c 2f 2i	3c 3f 3i			1c	2c 2f 2i	3c 3f 3i							

Legend:

Type of Interaction Level

1a	**Smile / Wave** (less than 1 minute)
1b	**Greeting a friend only, without stopping the activity** (less than 1 minute)
1c	**Greeting a stranger only, without stopping the activity** (less than 1 minute)
2a	**Casual/Informal meeting, stopping activity and engage in a conversation between family members** (1minute - 5 minutes)
2b	**Casual/Informal meeting, stopping activity and engage in a conversation between family members** (6 minutes - 9 minutes)
2c	**Casual/Informal meeting, stopping activity and engage in a conversation between family members** (10 minutes - 15 minutes)
2d	**Casual/Informal meeting, stopping activity and engage in a conversation between friends** (1 minute - 5 minutes)
2e	**Casual/Informal meeting, stopping activity and engage in a conversation between friends** (6 minutes - 9 minutes)
2f	**Casual/Informal meeting, stopping activity and engage in a conversation between friends** (10 minutes - 15 minutes)
2g	**Casual/Informal meeting, stopping activity and engage in a conversation between strangers** (1 minute - 5 minutes)
2h	**Casual/Informal meeting, stopping activity and engage in a conversation between strangers** (6 minutes - 9 minutes)
2i	**Casual/Informal meeting, stopping activity and engage in a conversation between strangers** (10 minutes - 15 minutes)
3a	**Meeting, engage in a conversation and start doing activities together between family members** (1 minute - 15 minutes)
3b	**Meeting, engage in a conversation and start doing activities together between friends** (1 minute - 15 minutes)
3c	**Meeting, engage in a conversation and start doing activities together between strangers** (1 minute - 15 minutes)
3d	**Meeting, engage in a conversation and start doing activities together between family members** (16 minutes - 30 minutes)
3e	**Meeting, engage in a conversation and start doing activities together between friends** (16 minutes - 30 minutes)
3f	**Meeting, engage in a conversation and start doing activities together between strangers** (16 minutes - 30 minutes)
3g	**Meeting, engage in a conversation and start doing activities together between family members** (more than 30 minutes)
3h	**Meeting, engage in a conversation and start doing activities together between friends** (more than 30 minutes)
3i	**Meeting, engage in a conversation and start doing activities together between strangers** (more than 30 minutes)

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION — Source: Elaborated by Pippi, 2012

Interaction Motivations

Legend:

Catalyst of Interactions

Catalyst Type

Type of Users

- Children (Ch)
- Adolescent (As)
- Adult (Ad)
- Senior (Sn)

total catalyst of interactions / in the user category social network ties/bridges	DA, GWF, W, GWSNS, CH, TA, CSC, B, I, UE	(Ch) (As)	#	DA, GWF, W, GWSNS, CH, TA, CSC, B, I, UE	(As) (As)	#	DA, GWF, W, GWSNS, CH, TA, CSC, B, I, UE	(As) (Sn)	#	DA, GWF, W, GWSNS, CH, TA, CSC, B, I, UE	(Ch) (Ch)	#			
	DA, GWF, W, GWSNS, CH, TA, CSC, B, I, UE	(Ch) (Ad)	#	DA, GWF, W, GWSNS, CH, TA, CSC, B, I, UE	(As) (Ad)	#	DA, GWF, W, GWSNS, CH, TA, CSC, B, I, UE	(Ad) (Sn)	#	**OBSERVATIONS:**					
	DA, GWF, W, GWSNS, CH, TA, CSC, B, I, UE	(Ch) (Sn)	#	DA, GWF, W, GWSNS, CH, TA, CSC, B, I, UE	(Ad) (Ad)	#	DA, GWF, W, GWSNS, CH, TA, CSC, B, I, UE	(Sn) (Sn)	#						

Legend:

Type of Catalyst

DA	**Domestic Animals** (dogs, cats, horses and others)
W	**Wildlife** (deers, foxes, racoons, squirrels, rabbits, turtles, snakes, birds, coyotes and others)
CH	**Children** (00 - 12 years)
CSC	**Cultural Sharing Customs** (gathering, celebrating, eating, drinking, behaving and others)
GWF	**Greenway Features** (landscape and physical structure)
GWSNS	**Greenway Structural Network System** (type of connection and type of trail)
TA	**Type of Activity** (patterns of use)
B	**Behavior** (conduct: acceptable and unacceptable; positive and negative manners)
I	**Information** (directions, location specific features and others)
UE	**Unexpected Experience** (accident, action/reaction of a natural phenomena and others)

METHOD 3: SOCIAL CHARACTERISTICS AUDIT

BEHAVIOR MAPPING / STATIONARY OBSERVATION — Source: Elaborated by Pippi, 2012

Interaction Motivations

Legend:

Catalyst of Interactions

Catalyst Type

Type of Actors

Individual (I)
Dyad (D)
Triad (T)
Groups (G)
Sub Groups (SB)

total catalyst of interactions / in the actor category social network ties/bridges	DA GWF W GWSNS CH TA CSC B I UE	(I) (D)	#	DA GWF W GWSNS CH TA CSC B I UE	(D) (D)	#	DA GWF W GWSNS CH TA CSC B I UE	(D) (G)	#	DA GWF W GWSNS CH TA CSC B I UE	(I) (I)	#
	DA GWF W GWSNS CH TA CSC B I UE	(I) (T)	#	DA GWF W GWSNS CH TA CSC B I UE	(D) (T)	#	DA GWF W GWSNS CH TA CSC B I UE	(T) (G)	#			
	DA GWF W GWSNS CH TA CSC B I UE	(I) (G)	#	DA GWF W GWSNS CH TA CSC B I UE	(T) (T)	#	DA GWF W GWSNS CH TA CSC B I UE	(G) (G)	#			

OBSERVATIONS:

Legend:

Type of Catalyst

DA	**Domestic Animals** (dogs, cats, horses and others)
W	**Wildlife** (deers, foxes, racoons, squirrels, rabbits, turtles, snakes, birds, coyotes and others)
CH	**Children** (00 - 12 years)
CSC	**Cultural Sharing Customs** (gathering, celebrating, eating, drinking, behaving and others)
GWF	**Greenway Features** (landscape and physical structure)
GWSNS	**Greenway Structural Network System** (type of connection and type of trail)
TA	**Type of Activity** (patterns of use)
B	**Behavior** (conduct: acceptable and unacceptable; positive and negative manners)
I	**Information** (directions, location specific features and others)
UE	**Unexpected Experience** (accident, action/reaction of a natural phenomena and others)

The detailed list of patterns of use/types of activity, utilized in the behavior variables, was generated from observations during the pilot test study (2010 and 2011 years). New activities that were observed during that time were added to this list. Patterns of activity that have emerged during the observation checks have been added to the patterns of use/types of activity protocol. A final list was elaborated, defined and used in a quantitative analysis of Method 3 in both observational approaches: behavior mapping and stationary observation. In the *behavior mapping* observational approach, the patterns of use/types of activity and the complementary behaviors were recorded following a protocol list of activities to observe (Appendix O). However, if the users and actors changed their type of activity and behavior during the data collection, by adding extra activities to the first activity pattern, the entire sequence of activities and behaviors was registered. New and unique patterns of activity and behaviors were classified in the “others” set (Appendix O).

The two observational approaches differ in one aspect, which is the *interaction types (level of interactions)* variable, where the *behavior mapping* consisted of 9 different types of interactions distributed over 3 different levels and because a movable scan record was conducted along the entire trail, but it was not possible to record the time-frame intervals of those interactions. The levels of interactions of t*he stationary observation* consisted of 21 types of interactions, distributed over 3 interaction levels. It was possible to verify everything that happened inside of that stationary boundary area during 1 hour, not only to characterize the types of interaction level but also to record the time of those interactions (less than one minute to more than 30 minutes), as illustrated in Appendix O. The *stationary observation* may present different results if compared to the behavior mapping approach, in terms of behavior and interactions, principally in the *pattern of use/type of activities* and

complementary behavior variables and in the *interaction types (level of interactions)* variable.

In the behavior mapping technique, one of the social interaction variables is the *interaction types (level of interactions)* which consisted of 9 different types of interactions distributed across 3 different levels: level 1 (3 types of interaction level: 1x, 1y and 1z), level 2 (3 types of interaction level: 2x, 2y and 2z) and level 3 (3 types of interaction level: 3x, 3y, 3z). However, in the behavior mapping approach it was impossible to record the time-frame of the types of interaction levels because I was conducting a movable scan record along the entire trail (Appendix O).

The occurrence of these interactional types was identified in relation with other social variables, such as, user tie/bridge (combined pattern of intra-relationship among users' categories), actor tie/bridge (combined pattern of intra-relationship among actors' categories), transformative actor type (with new combined pattern of inter-relationship), transformative actor size (with new combined pattern of inter-relationship), tie/bridge gender types (combined pattern of intra-relationship among gender type) and interaction catalysts.

Appendix P. Fragment of the Behavior Mapping GIS Attribute Table/Excel

	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1	Gender	User_Type	Actor_Type	Actor_Size	P_UseActiv	Compl_Beha	P_ActLevel	Tie_Bridge	User_TieBr	Actor_TieB	TranActTyp	TranActSiz	Gender_Ti	P_Interact	Int_ActLev	Int_Type	Int_Catalg	Centrality	CNetworkVi
2	Male	Adult (Ad)	Individual (I)	1	rdd	Pets a	V	no	no	no	no	0	no	no	no	no	no	no	no
3	Female	Adult (Ad)	Individual (I)	1	rlm	none	V	no	no	no	no	0	no	no	no	no	no	no	no
4	Male	Adult (Ad)	Individual (I)	1	wstpsitol	Sitting b	SM	no	no	no	no	0	no	no	no	no	no	no	no
5	Female	Adult (Ad)	Individual (I)	1	rlm	none	V	no	no	no	no	0	no	no	no	no	no	no	no
6	Male	Adult (Ad)	Individual (I)	1	b	none	V	no	no	no	no	0	no	no	no	no	no	no	no
7	Female	Adult (Ad)	Individual (I)	1	b	none	V	no	no	no	no	0	no	no	no	no	no	no	no
8	Male	Adult (Ad)	Dyad (D)	2	rdd	Pets a	V	yes	AdAd	DD	Group (G)	4	MM	soc	V	tz	B	no	no
9	Male	Adult (Ad)	Dyad (D)	2	r	none	V	yes	AdAd	DD	Group (G)	4	MM	soc	V	tz	B	no	no
10	Male	Adult (Ad)	Dyad (D)	2	r	none	V	yes	AdAd	DD	Group (G)	4	MM	soc	V	tz	B	no	no
11	Male	Adult (Ad)	Dyad (D)	2	r	none	V	yes	AdAd	DD	Group (G)	4	MM	soc	V	tz	B	no	no
12	Male	Adult (Ad)	Individual (I)	1	w	none	M	no	no	no	no	0	no	no	no	no	no	no	no
13	Female	Adult (Ad)	Individual (I)	1	w	none	M	no	no	no	no	0	no	no	no	no	no	no	no
14	Male	Adult (Ad)	Individual (I)	1	w	none	M	no	no	no	no	0	no	no	no	no	no	no	no
15	Male	Adult (Ad)	Individual (I)	1	b	none	V	no	no	no	no	0	no	no	no	no	no	no	no
16	Male	Adult (Ad)	Individual (I)	1	b	none	V	no	no	no	no	0	no	no	no	no	no	no	no
17	Male	Adult (Ad)	Individual (I)	1	ot	none	M	no	no	no	no	0	no	no	no	no	no	no	no
18	Male	Adult (Ad)	Individual (I)	1	wstpstlis	none	SM	no	no	no	no	0	no	no	no	no	no	no	no
19	Female	Adult (Ad)	Dyad (D)	2	wdt	Pets a	M	no	no	no	no	0	no	no	no	no	no	no	no
20	Male	Adult (Ad)	Dyad (D)	2	wt	none	M	no	no	no	no	0	no	no	no	no	no	no	no
21	Female	Adult (Ad)	Dyad (D)	2	w	none	M	yes	AdAd	DD	Group (G)	4	MF	soc	M	tz	B	no	no
22	Male	Adult (Ad)	Dyad (D)	2	w	none	M	yes	AdAd	DD	Group (G)	4	MF	soc	M	tz	B	no	no
23	Female	Adult (Ad)	Dyad (D)	2	w	none	M	yes	AdAd	DD	Group (G)	4	MF	soc	M	tz	B	no	no
24	Male	Adult (Ad)	Dyad (D)	2	w	none	M	yes	AdAd	DD	Group (G)	4	MF	soc	M	tz	B	no	no
25	Male	Adult (Ad)	Individual (I)	1	wstpstol	none	SM	no	no	no	no	0	no	no	no	no	no	no	no
26	Male	Adult (Ad)	Individual (I)	1	wlm	none	M	no	no	no	no	0	no	no	no	no	no	no	no
27	Female	Adult (Ad)	Individual (I)	1	w	none	M	no	no	no	no	0	no	no	no	no	no	no	no
28	Female	Adult (Ad)	Individual (I)	1	w	none	M	no	no	no	no	0	no	no	no	no	no	no	no
29	Female	Adult (Ad)	Individual (I)	1	w	none	M	no	no	no	no	0	no	no	no	no	no	no	no
30	Female	Adult (Ad)	Individual (I)	1	w	none	M	no	no	no	no	0	no	no	no	no	no	no	no
31	Male	Adult (Ad)	Dyad (D)	2	rt	none	V	no	no	no	no	0	no	no	no	no	no	no	no
32	Female	Adult (Ad)	Dyad (D)	2	rt	none	V	no	no	no	no	0	no	no	no	no	no	no	no
33	Male	Adult (Ad)	Dyad (D)	2	wt	none	M	no	no	no	no	0	no	no	no	no	no	no	no
34	Female	Adult (Ad)	Dyad (D)	2	wdt	Pets a	M	no	no	no	no	0	no	no	no	no	no	no	no
35	Male	Adult (Ad)	Individual (I)	1	b	none	V	no	no	no	no	0	no	no	no	no	no	no	no
1972	Adult (Ad)	Dyad (D)	2	wt	none	M	yes	AdAd	ID	Triad (T)	3	MF and MM	soc	M	tz	B	no	no
1973	Adult (Ad)	Dyad (D)	2	wt	none	M	yes	AdAd	ID	Triad (T)	3	MF and MM	soc	M	tz	B	no	no
1974	Adult (Ad)	Individual (I)	1	w	none	M	yes	AdAd	ID	Triad (T)	3	MF and MM	soc	M	tz	B	no	no
1975	Adolescent (As	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	DG	Group (G)	8	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1976	Children (Ch)	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	DG	Group (G)	8	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1977	Adolescent (As	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	DG	Group (G)	8	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1978	Children (Ch)	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	DG	Group (G)	8	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1979	Children (Ch)	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	DG	Group (G)	8	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1980	Children (Ch)	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	DG	Group (G)	8	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1981	Children (Ch)	Dyad (D)	2	pnet	none	M	yes	ChCh and ChAs	DG	Group (G)	8	MF, FF and MM	soc	M	3g	G/VF and TA	no	no
1982	Children (Ch)	Dyad (D)	2	pnet	none	M	yes	ChCh and ChAs	DG	Group (G)	8	MF, FF and MM	soc	M	3g	G/VF and TA	no	no
1983	Adolescent (As	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	TG	Group (G)	9	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1984	Children (Ch)	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	TG	Group (G)	9	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1985	Adolescent (As	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	TG	Group (G)	9	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1986	Children (Ch)	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	TG	Group (G)	9	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1987	Children (Ch)	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	TG	Group (G)	9	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1988	Children (Ch)	Group (G)	6	pnet	none	M	yes	ChCh and ChAs	TG	Group (G)	9	MF, FF and MM	soc	M	3g	G/VF and TA	yes	G with D and T
1989	Children (Ch)	Triad (T)	3	pnet	none	M	yes	ChCh and ChAs	TG	Group (G)	9	MF, FF and MM	soc	M	3g	G/VF and TA	no	no
1990	Children (Ch)	Triad (T)	3	pnet	none	M	yes	ChCh and ChAs	TG	Group (G)	9	MF, FF and MM	soc	M	3g	G/VF and TA	no	no
1991	Children (Ch)	Triad (T)	3	pnet	none	M	yes	ChCh and ChAs	TG	Group (G)	9	MF, FF and MM	soc	M	3g	G/VF and TA	no	no
1992	Adult (Ad)	Dyad (D)	2	rdt	Pets a	V	yes	AdAd	ID	Triad (T)	3	MF and FF	soc	V	tz	B	no	no
1993	Adult (Ad)	Dyad (D)	2	rt	none	V	yes	AdAd	ID	Triad (T)	3	MF and FF	soc	V	tz	B	no	no
1994	Adult (Ad)	Individual (I)	1	r	none	V	yes	AdAd	ID	Triad (T)	3	MF and FF	soc	V	tz	B	no	no
1995	Adult (Ad)	Triad (T)	3	pne	none	M	no	no	no	no	0	no	no	no	no	no	no	no
1996	Adult (Ad)	Individual (I)	1	w	none	M	no	no	no	no	0	no	no	no	no	no	no	no
1997	Adult (Ad)	Dyad (D)	2	b	none	V	no	no	no	no	0	no	no	no	no	no	no	no
1998	Adult (Ad)	Dyad (D)	2	b	none	V	no	no	no	no	0	no	no	no	no	no	no	no
1999	Adult (Ad)	Individual (I)	1	wd	Pets a	M	no	no	no	no	0	no	no	no	no	no	no	no
2000	Children (Ch)	Triad (T)	3	pnetpdd	Pets b	M	no	no	no	no	0	no	no	no	no	no	no	no
2001	Adult (Ad)	Triad (T)	3	pnetpdd	Pets b	M	no	no	no	no	0	no	no	no	no	no	no	no
2002	Adult (Ad)	Triad (T)	3	pnetpdd	Pets b	M	no	no	no	no	0	no	no	no	no	no	no	no
2003	Adult (Ad)	Individual (I)	1	w	none	M	yes	AdAd	ID	Triad (T)	3	MF and MM	soc	M	2z	DA	no	no

In terms of the spatialization and data compilation information of the people variables (type of user by age; gender; type of actor or pure actor; user tie/bridge, actor tie/bridge and transformative actor type) for the observational method, I proceeded as follows: one person or individual and his/her variables was spatialized in the GIS for the behavior mapping as *one point*, that can characterizes a myriad of variables in accordance to the spatialization of the thematic map and the attribute table. For example in (Appendix P) row number 2, highlighted in yellow, that represented all the characteristics of one person or individual: an adult male that was running with two dogs on leash, in a vigorous physical activity, without interacting with others.

However, in the case of a dyad, as can be seen in Appendix P, highlighted in yellow, rows 19 and 20 consist of a pair of people that were utilizing the trail and interacting with each other. Since their unique characteristics must be identified with a row for each one, each individual of the pair of greenway users must be spatiallized in the GIS map with a separate point on the map. Thus in the attribute table, point 1/identity 1, represents a female adult as one of the dyadic actors (Dyad 19), and because she was utilizing the greenway trail with her husband, an adult male, in this case represented by the point 2/identity 2 in the GIS map, as another of the dyadic actors relation (Dyad 20) in the attribute table/excel row. Each of them has their unique behaviors and inner (inter-relation) interaction event within the Dyad (D) pure actor type interaction category (interacting with each other) and other variable characteristics. In this case they did not interact with other users and actors, so they did not make up a tie/bridge relation (intra-relation). However, this was one of the challenging aspects of this methodology: to spatialize both of them in the same category type, in this case a Dyad, as one point and identity in the *behavior mapping* on the GIS, because each person or individual information and characteristics (are represented in their unique row and the description of their different variables along each columns), could be lost when merged together, or could be very complex to code.

This challenge is even more complex, when spatializing and compiling other actor categories, such as a Triad (T) made up of 3 people. For example, a family made up of 2

adults, one female and one male, and 1 child female, composing the Triad actor type, can be seen in rows 2000, 2001 and 2002. The triad was playing with natural elements, talking and playing with two dogs without leash. Rows 9 through 12 (highlighted in orange in Appendix V) display two sets of Dyads (D) that interacted with each other. All of them were adult males. Three were running and 1 was running with two dogs on leash. They were doing vigorous physical activity and presented a tie/bridge (yes) with a new classification of the user tie/bridge by age: adult with adult (AdAd) and new classification of the Actor tie/bridge relation between two Dyads (D + D = DD), that when merged during their interactions became a new and transformative pattern of actors, in this case a Group (G), because the sum of two Dyads (DD, conformed by 4 persons or individuals; D + D = G) resulted in a Group (G) of four people and a 4 events of interaction. They had a brief interaction, with low level: just greeting each other without stopping their activity and the catalyst for those interactions were just the behavior (greeting each other).

Another complex example consists of a group of 4 or more persons, such as the Group (G) of 6 persons or individuals, decomposed by users gender (3 males and 3 females); and user type (2 adolescents and 4 children), that were playing with the natural elements of the greenways and talking in a moderate activity level. They interacted with other two other male children, in this case a Dyad (D) actor type that were also playing with the natural elements of the greenways and talking in a moderate activity level. When they started their tie/bridge relation (yes), the user category of the interaction changed to Children with Children and Children with Adolescent relation (ChCh and ChAs), represented by the actor tie/bridge of DG (D with G, D+G = DG) and then transformed into a new actor pattern type (a G of 8 persons or individuals) and 8 interaction events, composed by a gender relation between males, females and male-females (MF, FF and MM) that were socializing with each other in a moderate way; they presented a high level of interaction, because they met and engaged in a conversation and did activities together. This Group (G) of 6 were counted twice, because they are central persons (more open to socialize with others) that interacted first with the mentioned Dyad (D) constituted in one relational pattern, and then later interacted with new users and actors, organized in another relational pattern, with a Triad

(T) composed of 3 children, 2 females and 1 male that presented the same patterns of use/type of activity, level of activity, interaction type and level of interaction. In that case they became a new transformative actor type of a Group (G) of 9 persons or individuals and 9 interaction events. All of them are highlighted in orange, in rows 1975 to 1991, in Appendix P. In such complex cases, each row in the GIS attribute table represents one person. Each row has several columns with the different variables to characterize that person.

Appendix Q. Consent Form and Survey Questionnaire

My name is Luis Pippi. I am a Ph.D Candidate at the College of Design, at North Carolina State University. I am doing a case study on two Cary greenways: **Black Creek Greenway and White Oak Creek Greenway**. This study involves understanding social networks, social interactions and behaviors that occur on recreational greenways and is funded by Fulbright/Capes-Brazil.

I am requesting you to participate in **this voluntary survey, should only take around 10-15 minutes of your time.** The information collected will provide valuable guidelines and recommendations for policy makers and designers in terms of greenway development parameters. I'm willing to share the results of this research study with all interested residents and the community upon request.

This survey contains quick fill-in type questions and you may also add any comments. All the questions are either multiple choice or short answers. All responses are anonymous and confidential, and after the compilation of the data will then be erased. There are no risks in participating in this study.
Before I begin the survey consent process, can you confirm that you are 18 years or older?
( ) Yes ( ) No

Please complete only one questionnaire per household. If you would like your name to be included in the **lottery for an iPod touch 8GB**, please **include your name and address in the detachable area at the bottom of this page.** The lottery applications will be separated from the questionnaires and a winner will be chosen (your information will be erased after the lottery prize).

If you have any questions, information or the procedures about the study, feel free to call or e-mail me, or to my advisor:

Luis Guilherme Aita Pippi (PhD Candidate) College of Design, Department of Landscape Architecture 919-521-6132 lgpippi@ncsu.edu guiamy@hotmail.com	Arthur Rice (Mentor/Advisor) Professor of Landscape Architecture, Director of the PhD Design Program and Associate Dean for Graduate Studies and International Studies North Carolina State University, Raleigh, NC 27695 College of Design, Department of Landscape Architecture North Carolina State University, Raleigh, NC 27695 919-515-8347 art_rice@ncsu.edu

If you feel you have not been treated justly or have any concerns about your participation, you may contact:
Deb Paxton or Carol Mickelson
Regulatory Compliance Administrator, Box 7514
North Carolina State University, Raleigh, NC 27695
919-515-4514
debra_paxton@ncsu.edu
carol_mickelson@ncsu.edu

By completing the survey questionnaire, I am confirming that I agree to participate in the study as described above in the informed consent form. ( ) Yes ( ) No

If you agree to participate in the study, please fill out this questionnaire and kindly return back to:
(Luis Pippi at 1012 Hawser Court, 27606, Raleigh, NC).

Thank you so much for your help and participation in this research.
Sincerely,
Luis Guilherme Aita Pippi
Raleigh, 09/07/2012.

_ _

Name:

Address:

GREENWAY USERS SURVEY

Date of Survey: Week Day: Time of Survey:

Your Neighborhood Name: _____
Zip Code: _____
Name and Address (optional)
Your Gender
( ) male ( ) female
Your Age:
( ) 18 – 65 ( ) above 65
Your level of education:
( ) didn't graduate from high school
( ) completed high school or equivalent
( ) completed undergraduate school
( ) completed some college or vocational school
( ) completed graduate school
( ) completed professional degree

Please list 3 Greenway names nearest to your house that you utilized during the last 12 months:
1-_____
2-_____
3-_____

1a. Are you born in United States? ( ) Yes ( ) No
If no, what Country do you originally come from? _____
1b. Where do you currently live?
( ) Raleigh
( ) Cary
( ) others US cities
( ) other countries

2. For what reason do you utilize the mentioned greenway(s)? (You may choose more than one)

( ) physical activity/fitness
( ) social interaction
( ) family togetherness
( ) friendship ties
( ) join my neighborhoods
( ) join people from other neighborhoods
( ) meeting new people
( ) connection with parks
( ) connection with other neighborhoods
( ) connection with playgrounds
( ) connection with commercial areas
( ) connection with historical areas/places
( ) enjoyment
( ) creativity
( ) relax/meditate
( ) tourism
( ) social events
( ) learning
( ) solitude
( ) wildlife observation
( ) watch/observe people
( ) introspection/spiritual
( ) educational programs
( ) others _____
( ) appreciation/interaction with nature
( ) community programs
( ) neighborhood activities
( ) alternative transportation/mobility
( ) proximity to my residence
( ) presence of good facilities/services
( ) landscape observation/contemplation
( ) escaping social/personal pressures
( ) achievement/stimulation
( ) walking/playing with pets

3. How often do you use the greenway?
( ) everyday
( ) 1-3 times a week
( ) 1-3 times a month
( ) more than 3 times a month
( ) 1 time a year
( ) others _____

4. When do you most often use the greenway?
( ) weekday
( ) holiday
( ) weekend
( ) vacation
( ) special events
( ) others _____

5. What time of the day do you usually go to a greenway?
( ) 6 - 11 a.m (Morning) ( ) 12 - 4 p.m (Afternoon) ( ) 5 - 8 p.m (Evening) ( ) after 9 p.m (Night)

6. How long do you usually stay on a greenway?
( ) 10-30 minutes ( ) 31 minutes-1 hour ( ) 2-3 hours ( ) more than 3 hours

7. What type of activities do you normally do at the greenway? (Please list 3 things)
1-_____
2-_____
3-_____

8. Who do you use the greenway with? (You may choose more than one)
( ) alone ( ) with family ( ) with friend ( ) with religious groups
( ) with conjugate/mate ( ) with parents ( ) with group of friends ( ) with club members/association
( ) with pets ( ) with children ( ) with strangers ( ) with classmates
( ) others _____

9a. How many people do you usually go with to the greenway?
( ) no one ( ) 1 person ( ) 2 persons ( ) 3-4 persons ( ) more than 4 persons

9b. If you answered one or more (9a), how long do you interact with the people that you go with to the greenway?
( ) do not interact ( ) less than 1 minute ( ) 1-5 minutes ( ) 6-9 minutes
( ) 10-30 minutes ( ) 31 minutes-1 hour ( ) 2-3 hours ( ) more than 3 hours

10a. Do you arrange to meet people at the greenway? ( ) Yes ( ) No (People you already know)
If, yes, usually how many people have you normally met? (People you already know)
( ) no one ( ) 1 person ( ) 2 persons ( ) 3-4 persons ( ) more than 4 persons

10b. If you answered one or more (10a), how long do you interact with the people that you normally meet at the greenway? (People you already know)
( ) do not interact ( ) less than 1 minute ( ) 1-5 minutes ( ) 6-9 minutes
( ) 10-30 minutes ( ) 31 minutes-1 hour ( ) 2-3 hours ( ) more than 3 hours

10c. How often do you have unplanned meetings with people that you know at the greenway?
( ) never ( ) rarely ( ) occasionally ( ) frequently

11a. On the greenway, how often do you interact with new people? (People you don't know / Strangers)
( ) never ( ) rarely ( ) occasionally ( ) frequently

11b. With how many new people do you normally interact? (People you don't know / Strangers: per greenway visit)
( ) no one ( ) 1 person ( ) 2 persons ( ) 3-4 persons ( ) more than 4 persons

11c. If you answered one or more (11b), how long do you normally interact with the new people at the greenway? (People you don't know / Strangers)
( ) do not interact ( ) less than 1 minute ( ) 1-5 minutes ( ) 6-9 minutes
( ) 10-30 minutes ( ) 31 minutes-1 hour ( ) 2-3 hours ( ) more than 3 hours

12a. How important is it for you to use the greenway to meet and socialize with people you already know? (Not including people you go with)
( ) not all important ( ) unimportant ( ) neither important nor unimportant ( ) important ( ) very important

12b. How important is it for you to use the greenway to meet and socialize with new people?
(People you don't know / Strangers)
( ) not all important ( ) unimportant ( ) neither important nor unimportant ( ) important ( ) very important

13. Have you interacted with people from your neighborhood on the greenway in the past 2 weeks (14 days)? ( ) Yes ( ) No
If yes, how many times?
( ) 1-3 ( ) 4-6 ( ) 7-12 ( ) more than 12
If yes, with how many people?
( ) no one ( ) 1 person ( ) 2 persons ( ) 3-4 persons ( ) more than 4 persons
If yes, what type of interaction? (You may choose more than one)
( ) smile/wave
( ) greeting a friend without stopping the activity
( ) greeting a stranger without stopping the activity
( ) casual/informal meeting with friends
( ) casual/informal meeting with strangers
( ) meeting/doing activities together with friends
( ) meeting/doing activities together with strangers
( ) meeting/doing activities together with family members

If yes, what is the typical duration of interactions?
( ) quick (less than 1 minute) ( ) short (1-30 minutes) ( ) expanded (longer than 30 minutes)

If, yes, how many times did you_____ from/with people from your neighborhood on the greenway in the past 2 weeks (14 days)?

	never	1-3 times	4-6 times	7-12 times	more than 12 times
greet people					
have short conversation					
have long conversation					
meet new people					

14. Have you interacted with people from other neighborhoods on the greenway in the past 2 weeks (14 days)? ( ) Yes ( ) No
If yes, how many times?
( ) 1-3 ( ) 4-6 ( ) 7-12 ( ) more than 12
If yes, with how many people?
( ) no one ( ) 1 person ( ) 2 persons ( ) 3-4 persons ( ) more than 4 persons
If yes, what type of interaction? (You may choose more than one)
( ) smile
( ) greeting a friend without stopping the activity
( ) greeting a stranger without stopping the activity
( ) casual/informal meeting with friends
( ) casual/informal meeting with strangers
( ) meeting/doing activities together with friends
( ) meeting/doing activities together with strangers
( ) meeting/doing activities together with family members

If yes, what is the typical duration of interactions?
( ) quick (less than 1 minute) ( ) short (1-30 minutes) ( ) expanded (longer than 30 minutes)
If, yes, how many times did you_____ from/with people from other neighborhoods on the greenway in the past 2 weeks (14 days)?

	never	1-3 times	4-6 times	7-12 times	more than 12 times
greet people					
have short conversation					
have long conversation					
meet new people					

15. In your opinion what are the social aspects that motivate you to use the greenway? (Please list 3 things)
1-_____
2-_____
3-_____

16. In your opinion what greenway characteristics might encourage more people to socialize? (Please list 3 things)
1-_____
2-_____
3-_____

17. In your opinion what greenway characteristics might discourage more people to socialize? (Please list 3 things)
1-_____
2-_____
3-_____

18. From your perspective what are the social benefits of greenways? (Please list 3 things)
1-_____
2-_____
3-_____

19. In your point of view what are the greenways positive attributes? (Please list 3 things)
1-_____
2-_____
3-_____

20. In your point of view what are the greenways negative attributes? (Please list 3 things)
1-_____
2-_____
3-_____

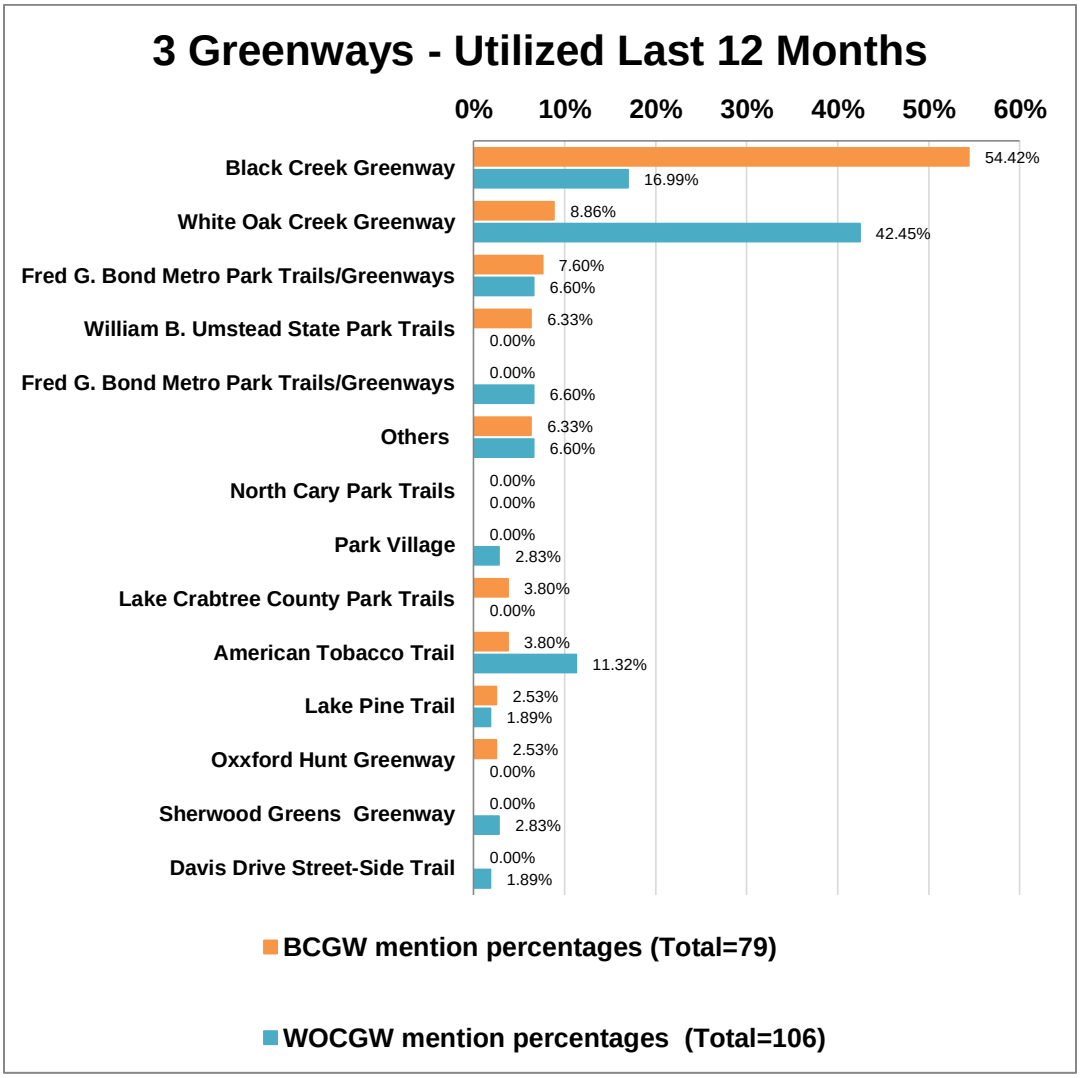
21. What are your most memorable moments on the greenways? (Please list 3 things)
1-_____
2-_____
3-_____

22. Have you ever meet new people at the greenways? ( ) Yes ( ) No
If yes, in which area/setting location? (Please list 3 things)
1-_____
2-_____
3-_____

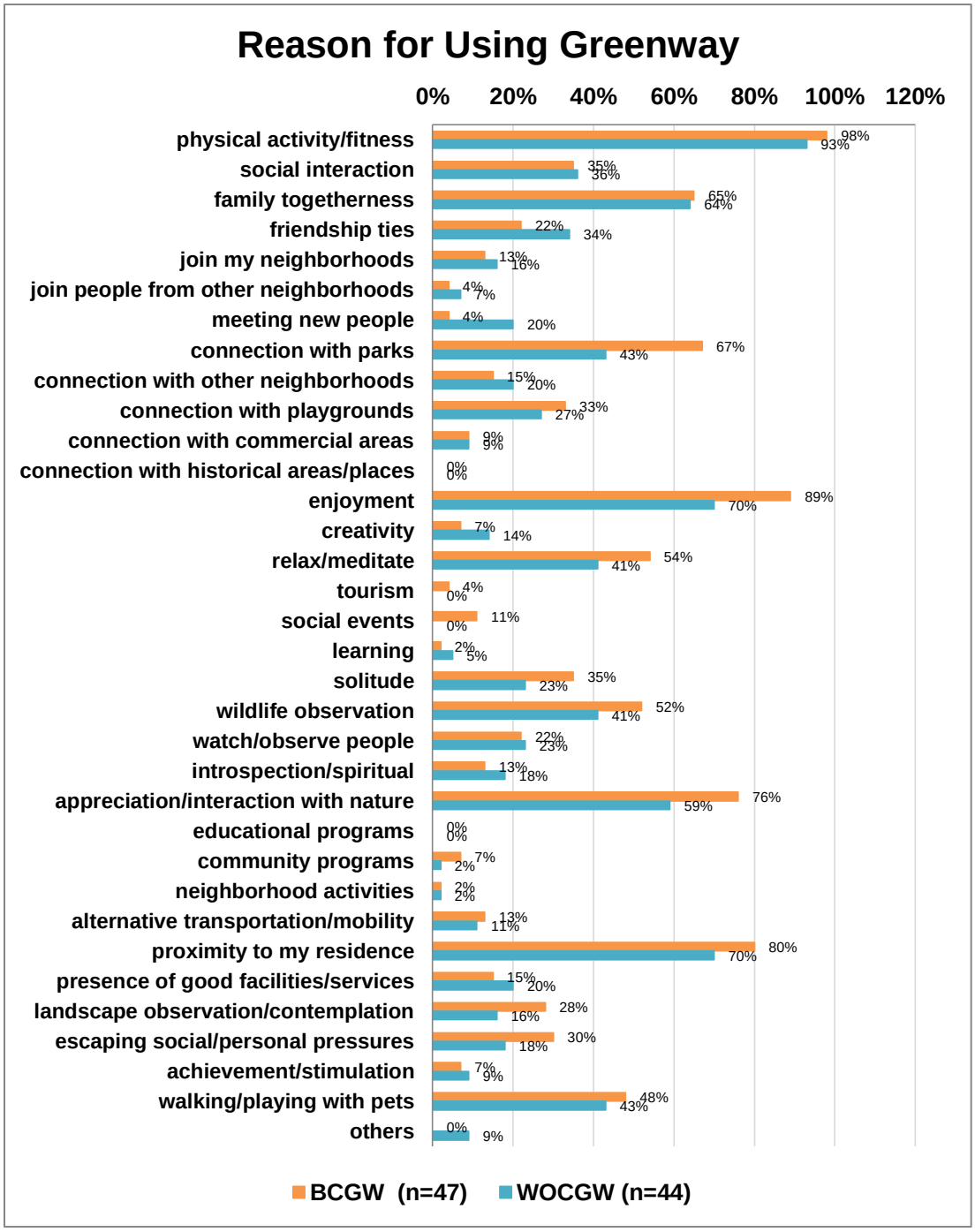
I`m appreciate you taking your time to fill out and return this questionnaire.
Thank you so much!

Sincerely,
Luis Pippi.

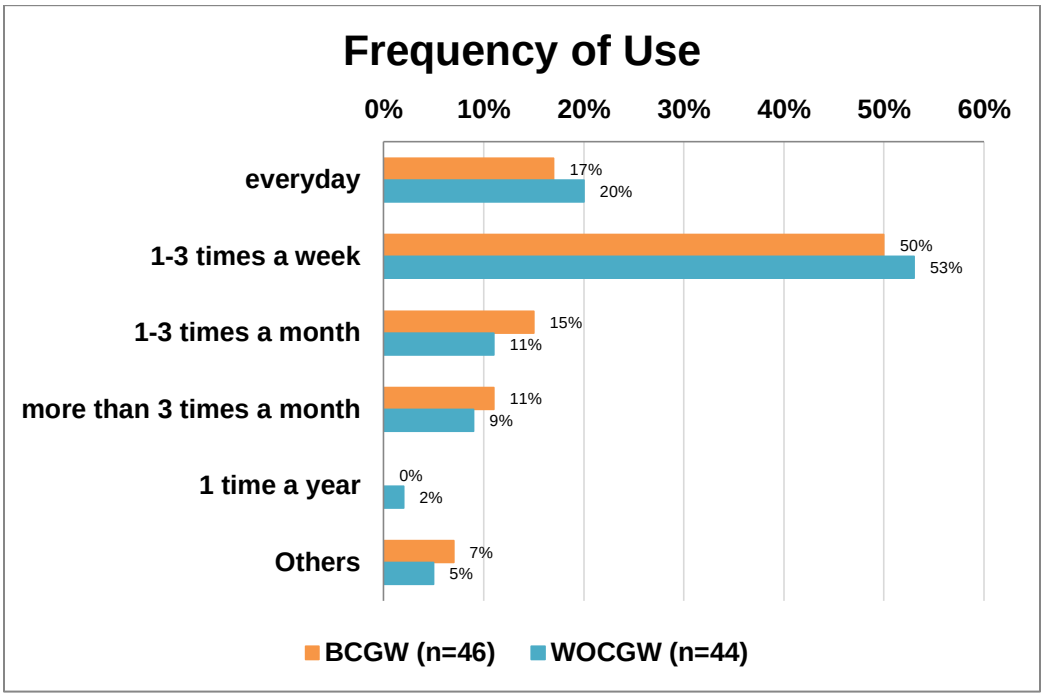
Appendix R. Survey Results Charts


3 Greenways - Utilized Last 12 Months
0%
10%
20%
30%
40%
50%
60%
Black Creek Greenway
54.42%
16.99%
White Oak Creek Greenway
8.86%
42.45%
Fred G. Bond Metro Park Trails/Greenways
7.60%
6.60%
William B. Umstead State Park Trails
6.33%
0.00%
Fred G. Bond Metro Park Trails/Greenways
0.00%
6.60%
Others
6.33%
6.60%
North Cary Park Trails
0.00%
0.00%
Park Village
0.00%
2.83%
Lake Crabtree County Park Trails
3.80%
0.00%
American Tobacco Trail
3.80%
11.32%
Lake Pine Trail
2.53%
1.89%
Oxxford Hunt Greenway
2.53%
0.00%
Sherwood Greens Greenway
0.00%
2.83%
Davis Drive Street-Side Trail
0.00%
1.89%
BCGW mention percentages (Total=79)
WOCGW mention percentages (Total=106)

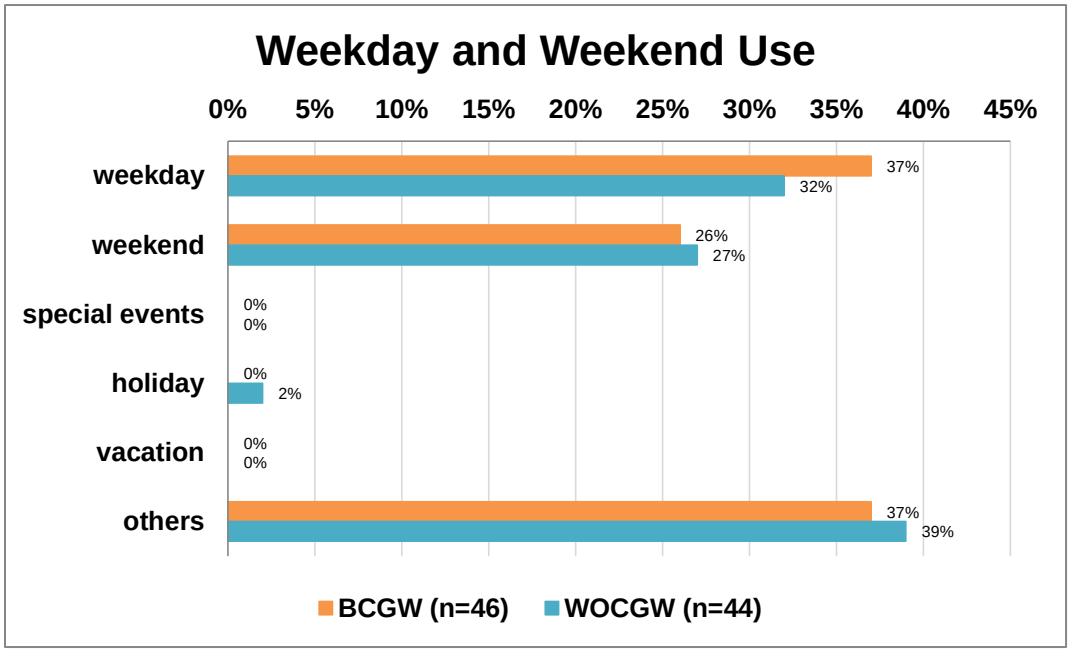
2. For what reason do you utilize the mentioned greenway(s)? (You may choose more than one)



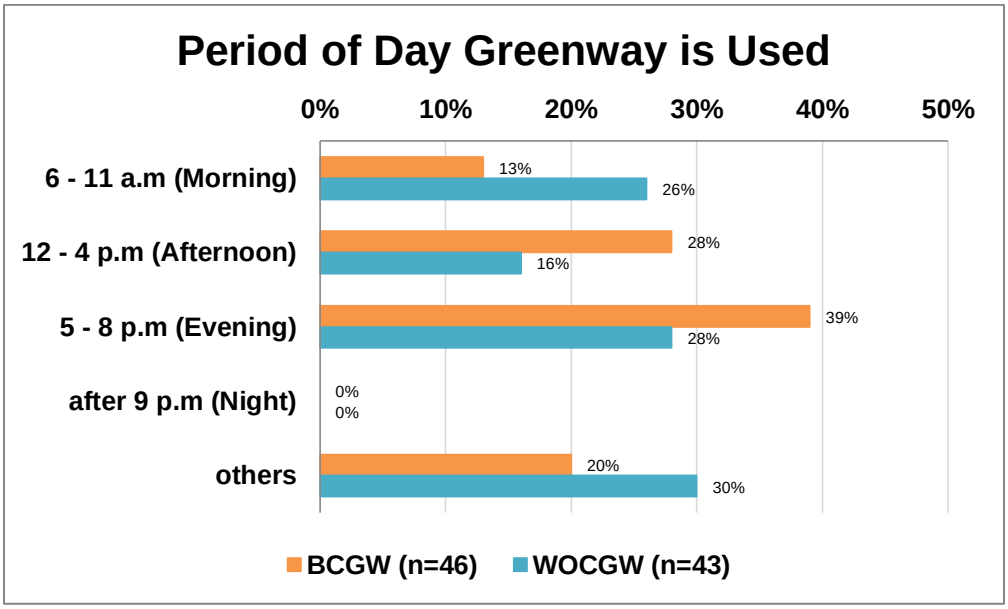
3. How often do you use the greenway?



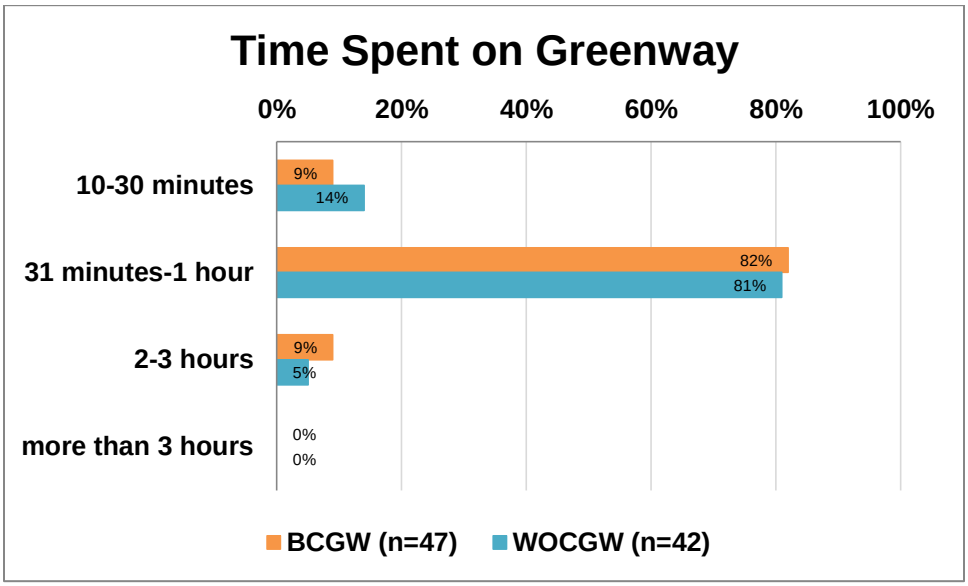
4. When do you most often use the greenway?



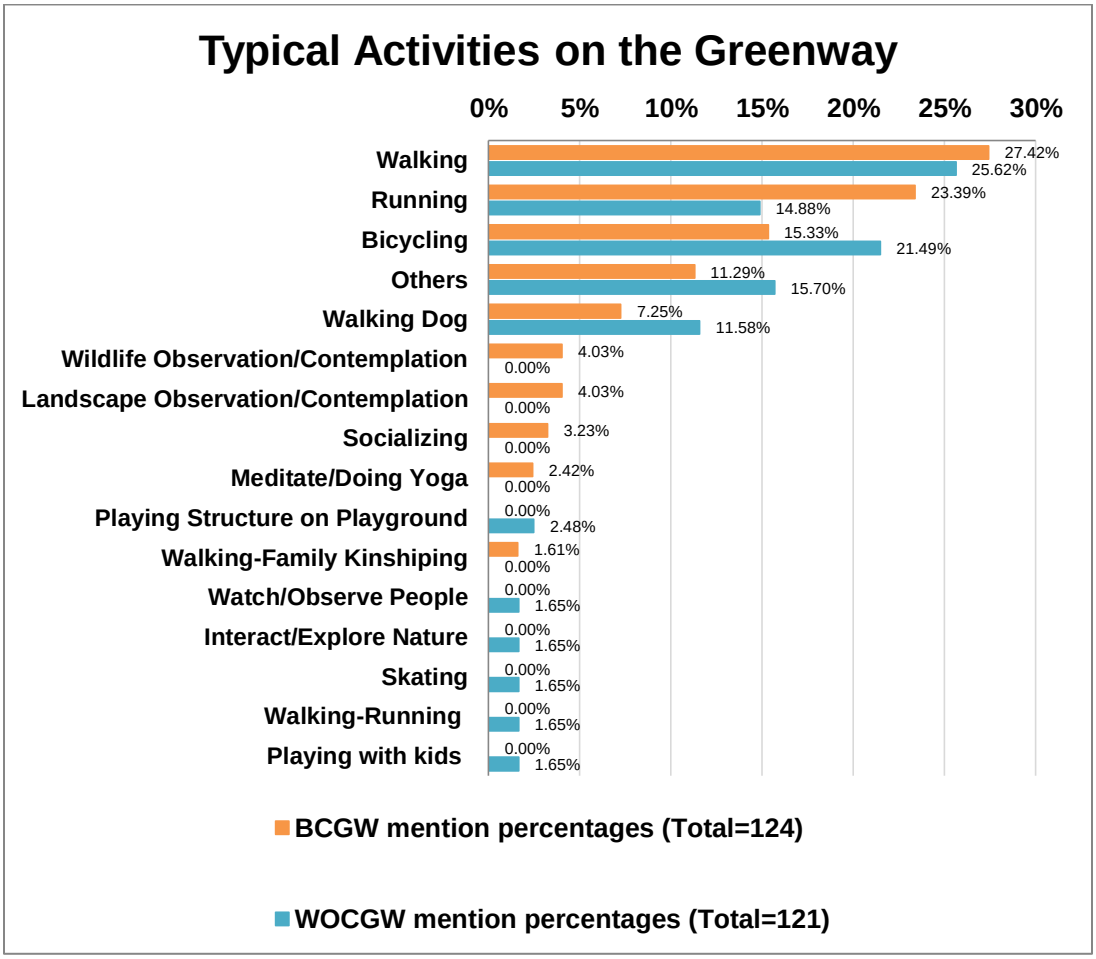
5. What time of the day do you usually go to a greenway?



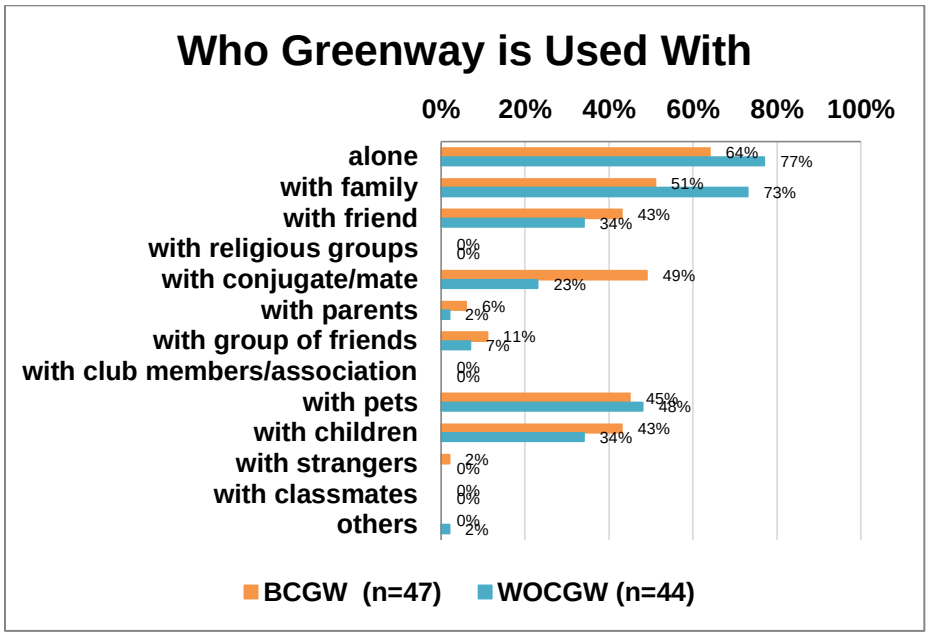
6. How long do you usually stay on a greenway?



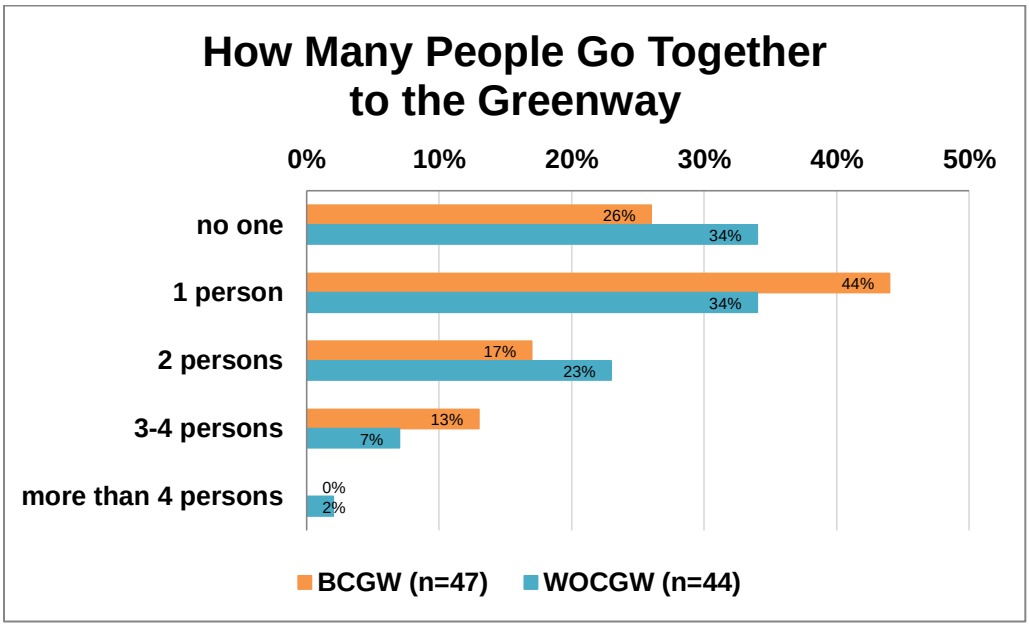
7. What type of activities do you normally do at the greenway? (Please list 3 things)



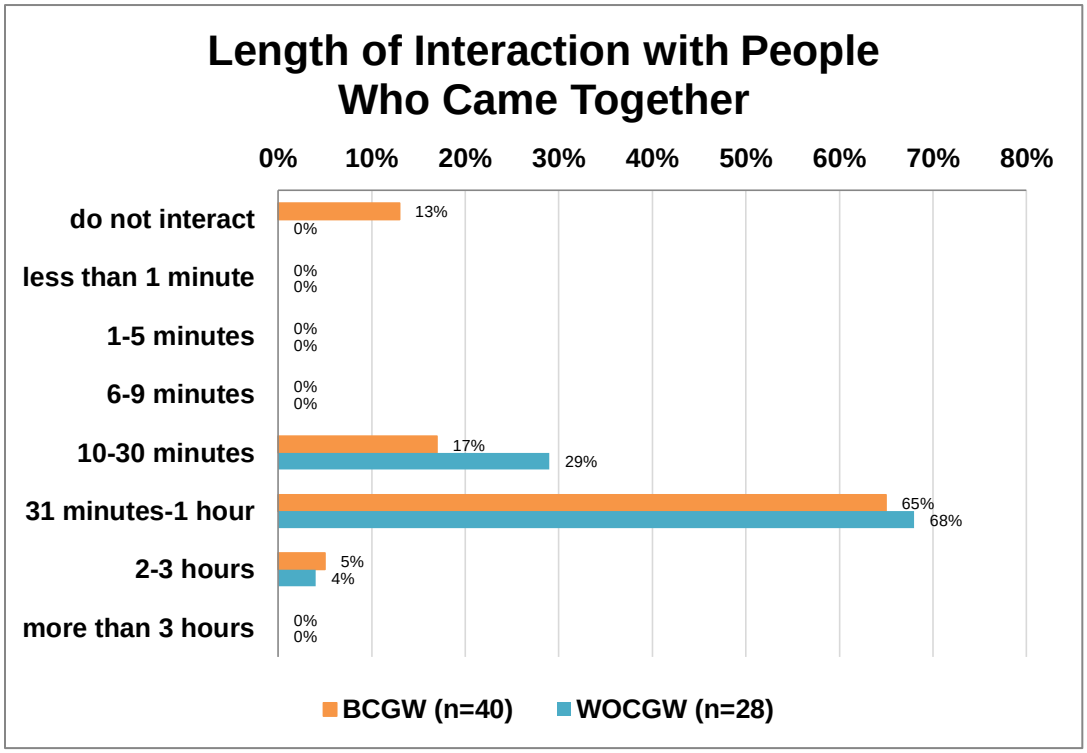
8. Who do you use the greenway with? (You may choose more than one)



9a. How many people do you usually go with to the greenway?

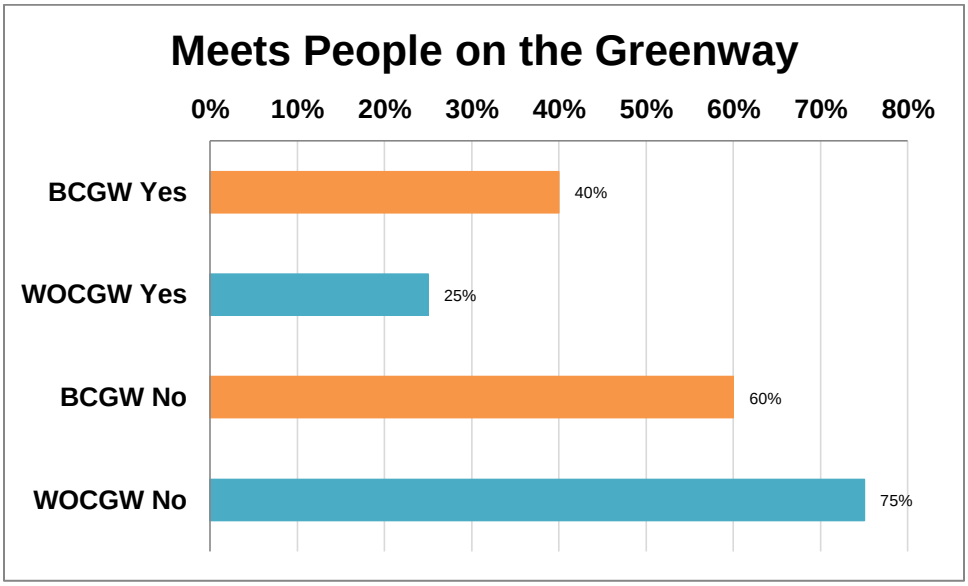


9b. If you answered one or more (9a), how long do you interact with the people that you go with to the greenway?

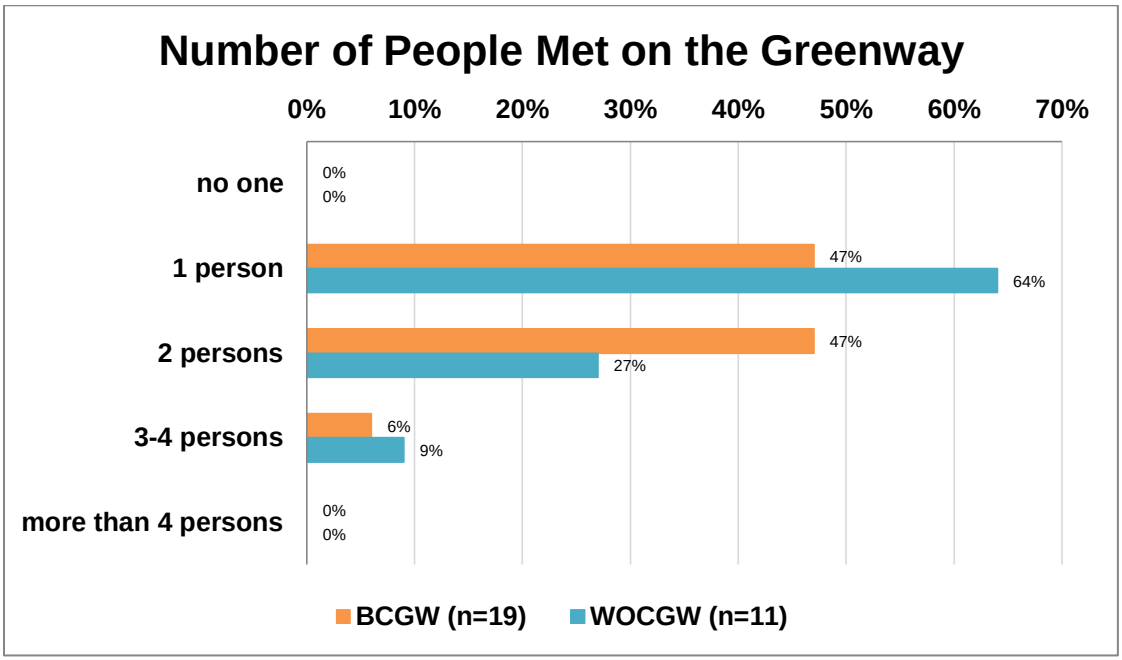


10a. Do you arrange to meet people at the greenway?

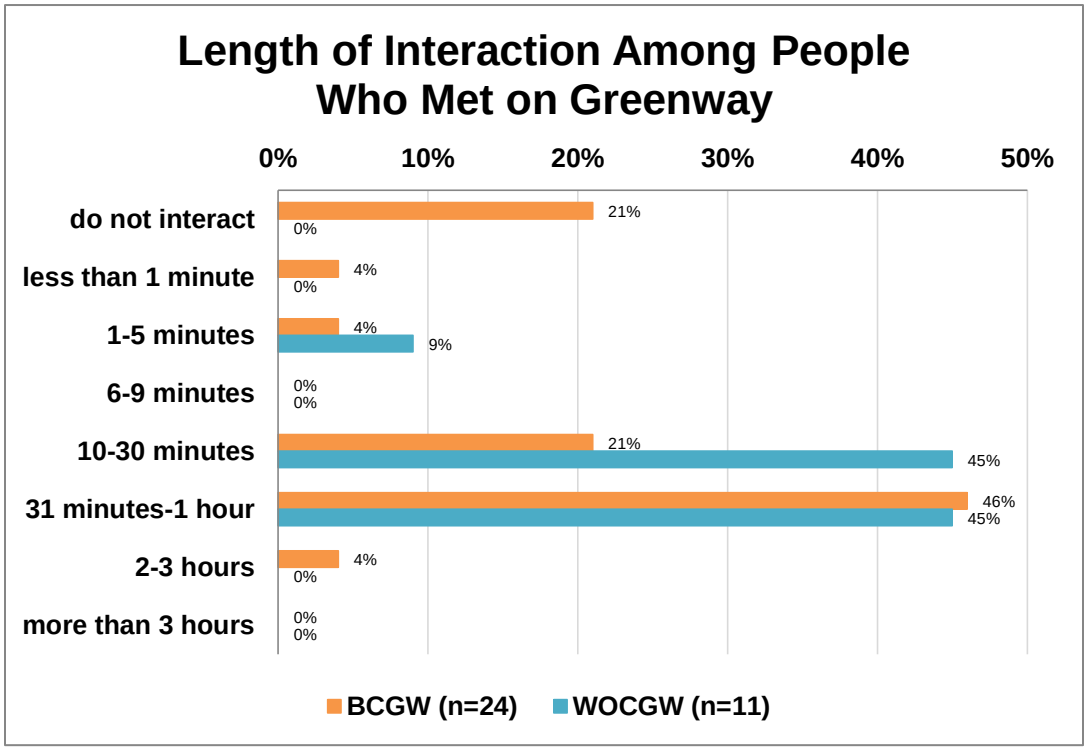
( ) Yes ( ) No (People you already know)



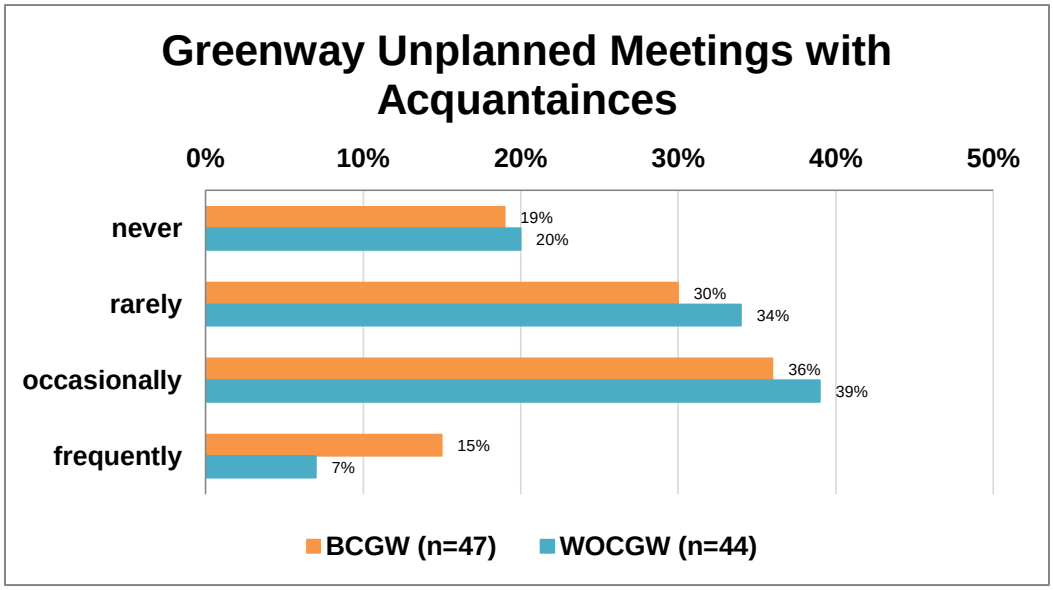
If, yes, usually how many people have you normally met? (People you already know)



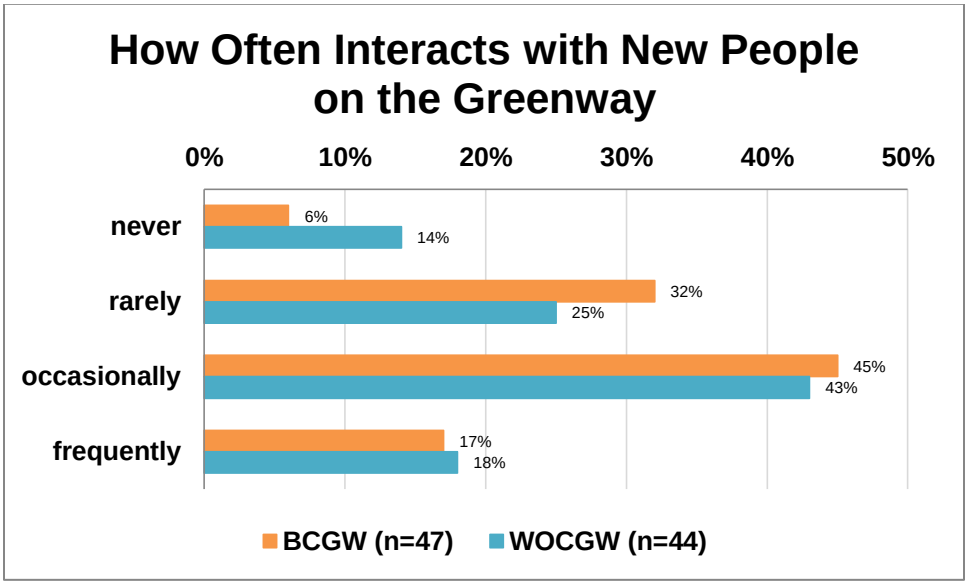
10b. If you answered one or more (10a), how long do you interact with the people that you normally meet at the greenway? (People you already know)



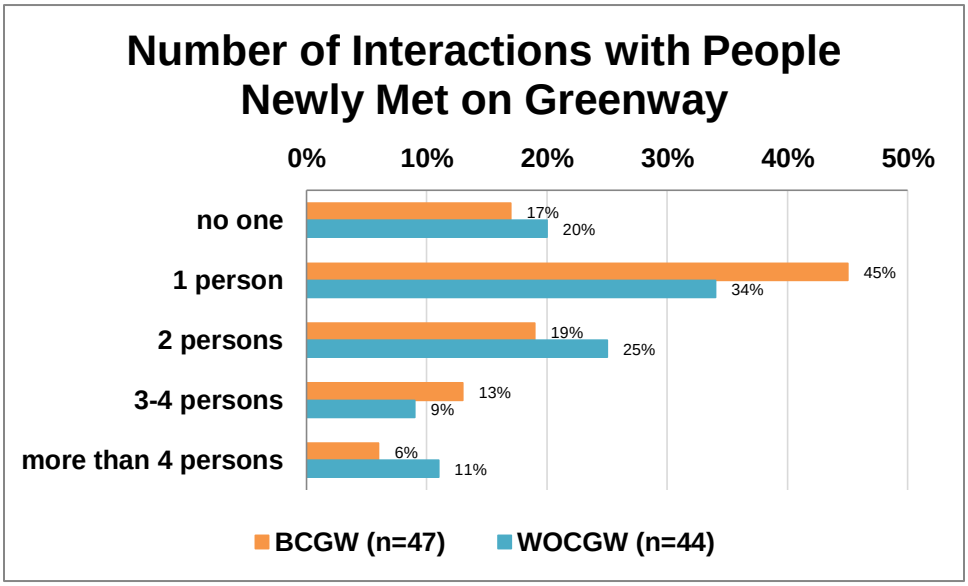
10c. How often do you have unplanned meetings with people that you know at the greenway?



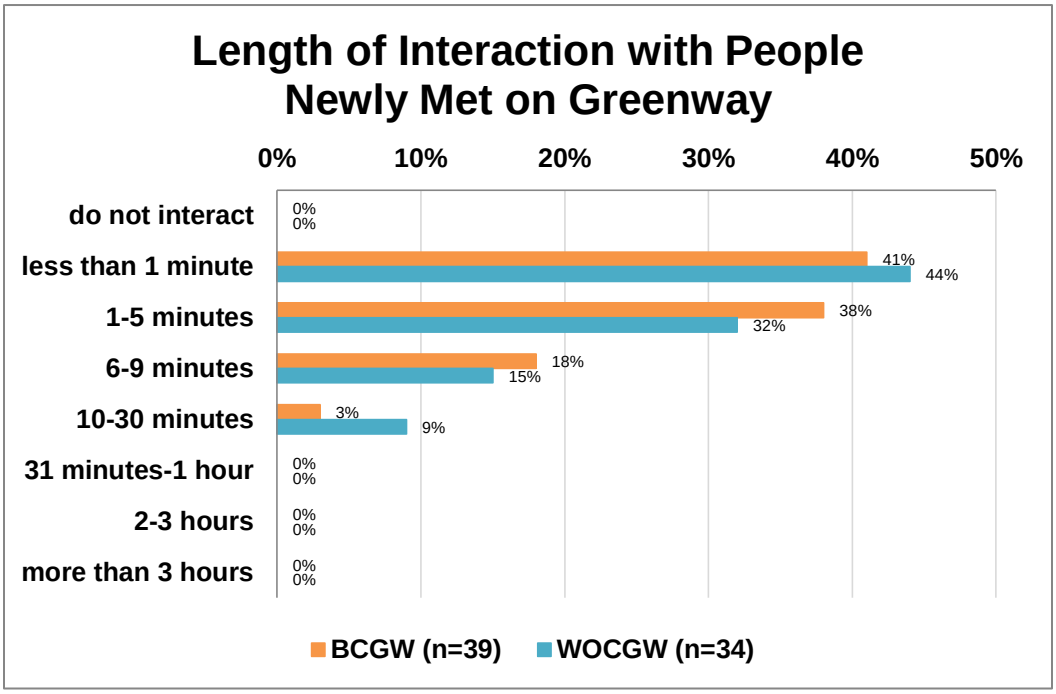
11a. On the greenway, how often do you interact with new people?
(People you don't know / Strangers)



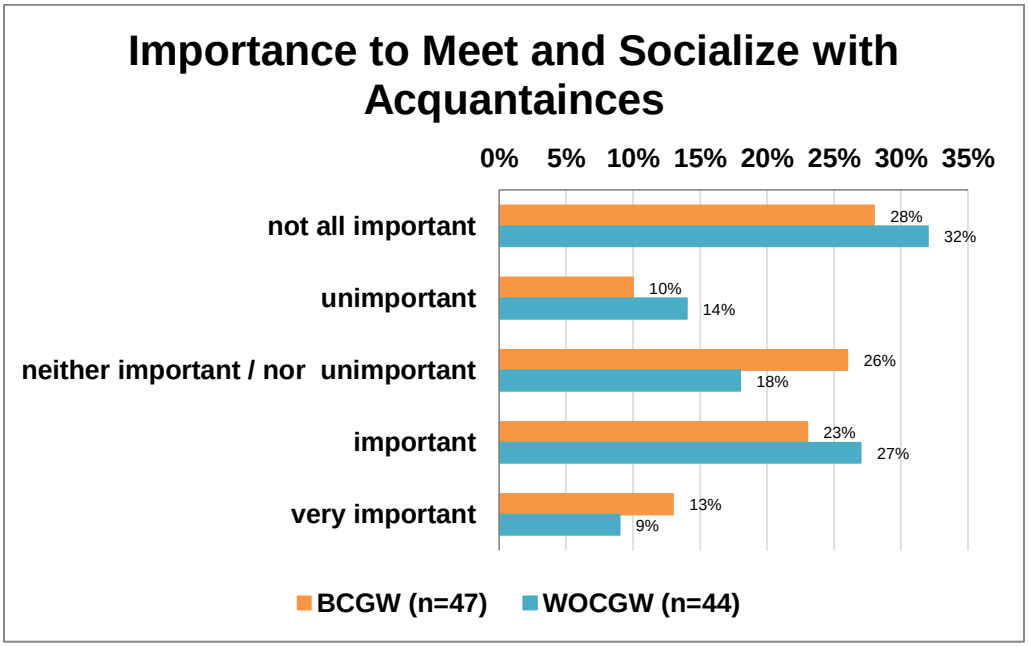
11b. With how many new people do you normally interact?
(People you don't know / Strangers: per greenway visit)



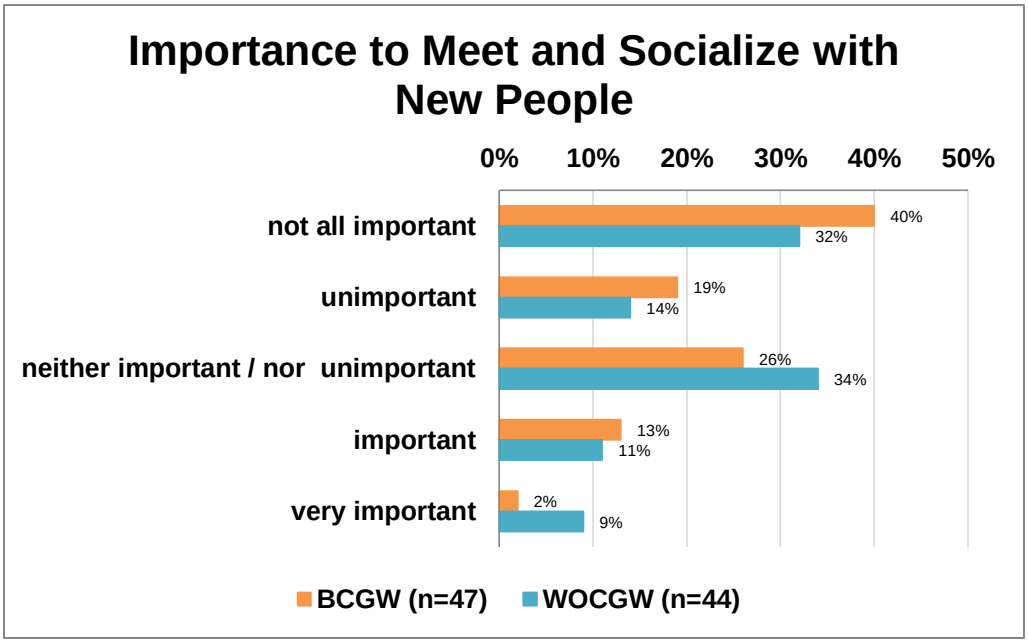
11c. If you answered one or more (11b), how long do you normally interact with the new people at the greenway? (People you don't know / Strangers)



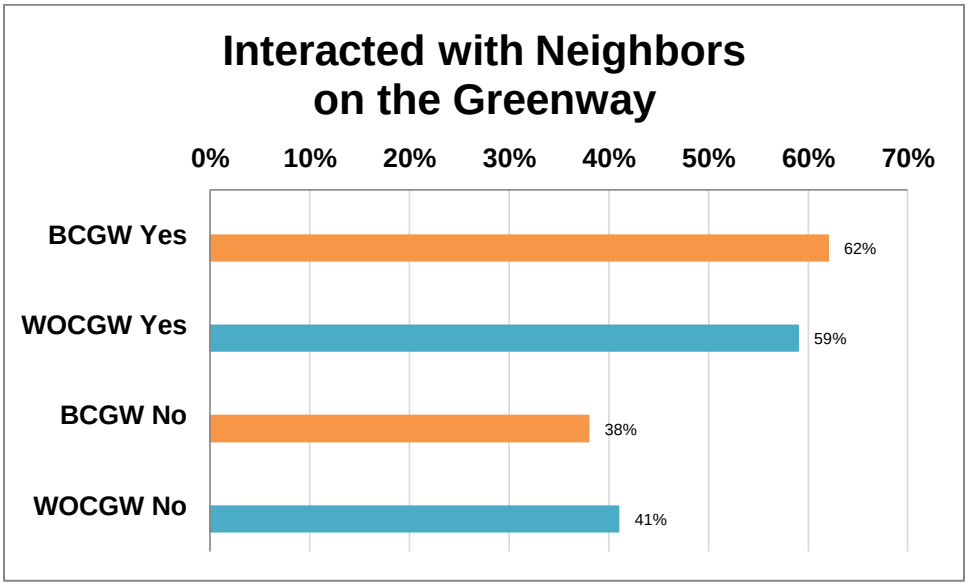
12a. How important is it for you to use the greenway to meet and socialize with people you already know? (Not including people you go with)



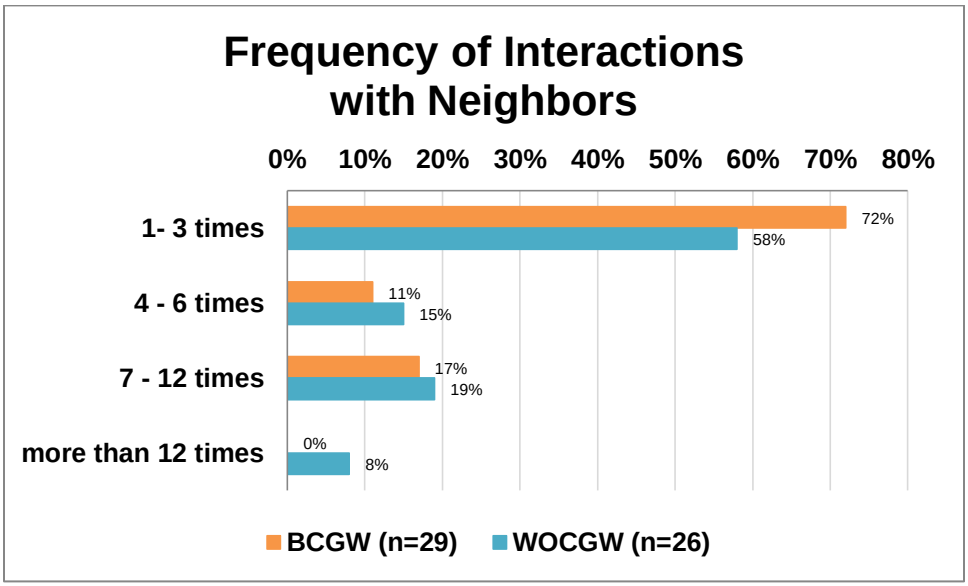
12b. How important is it for you to use the greenway to meet and socialize with new people? (People you don't know / Strangers)



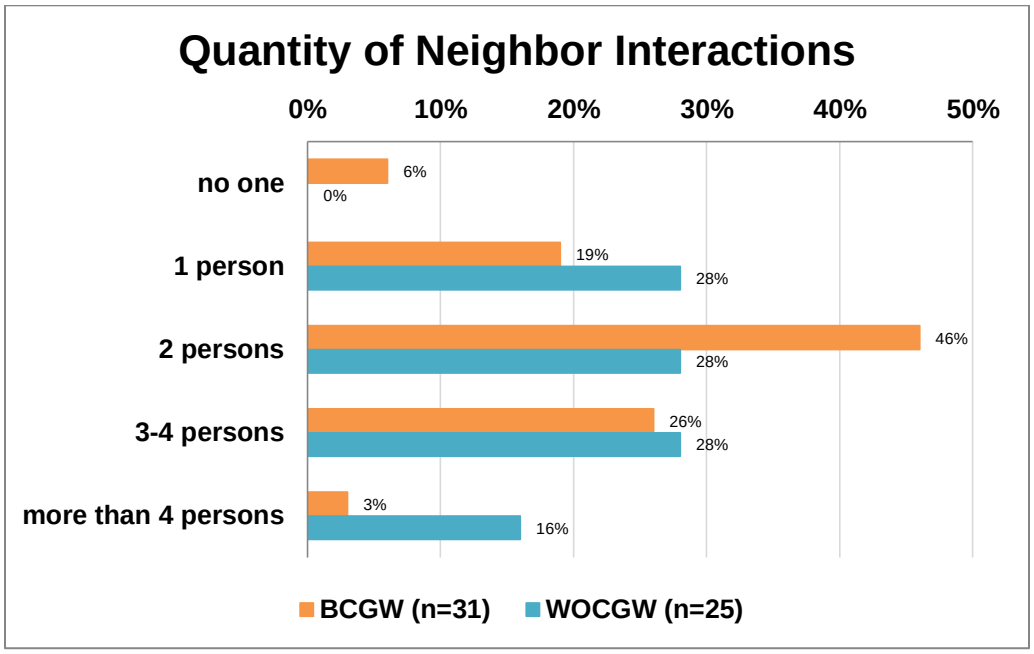
13. Have you interacted with people from your neighborhood on the greenway in the past 2 weeks (14 days)?
( ) Yes ( ) No



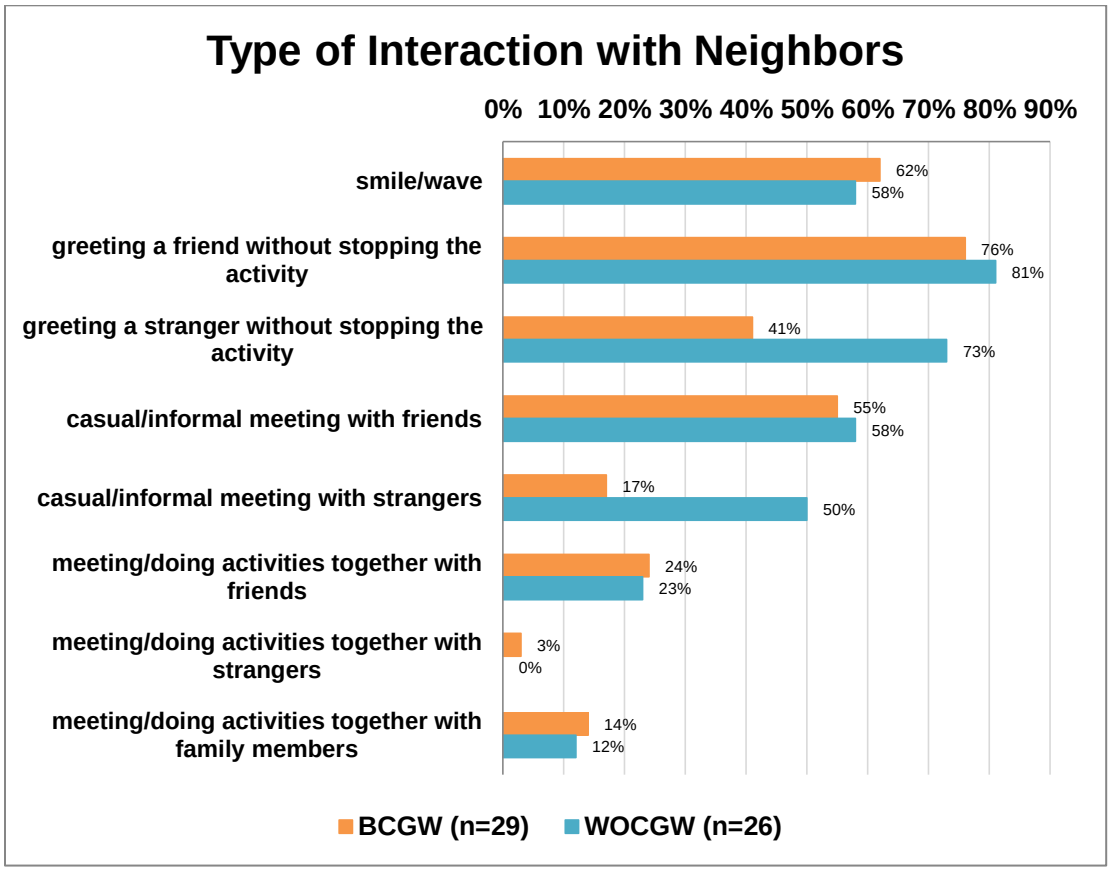
If yes, how many times?



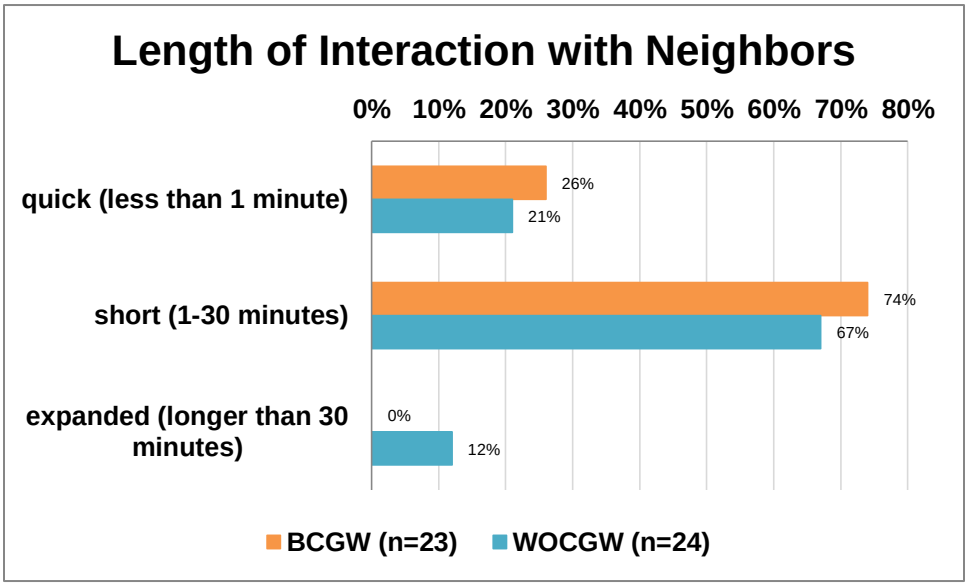
If yes, with how many people?



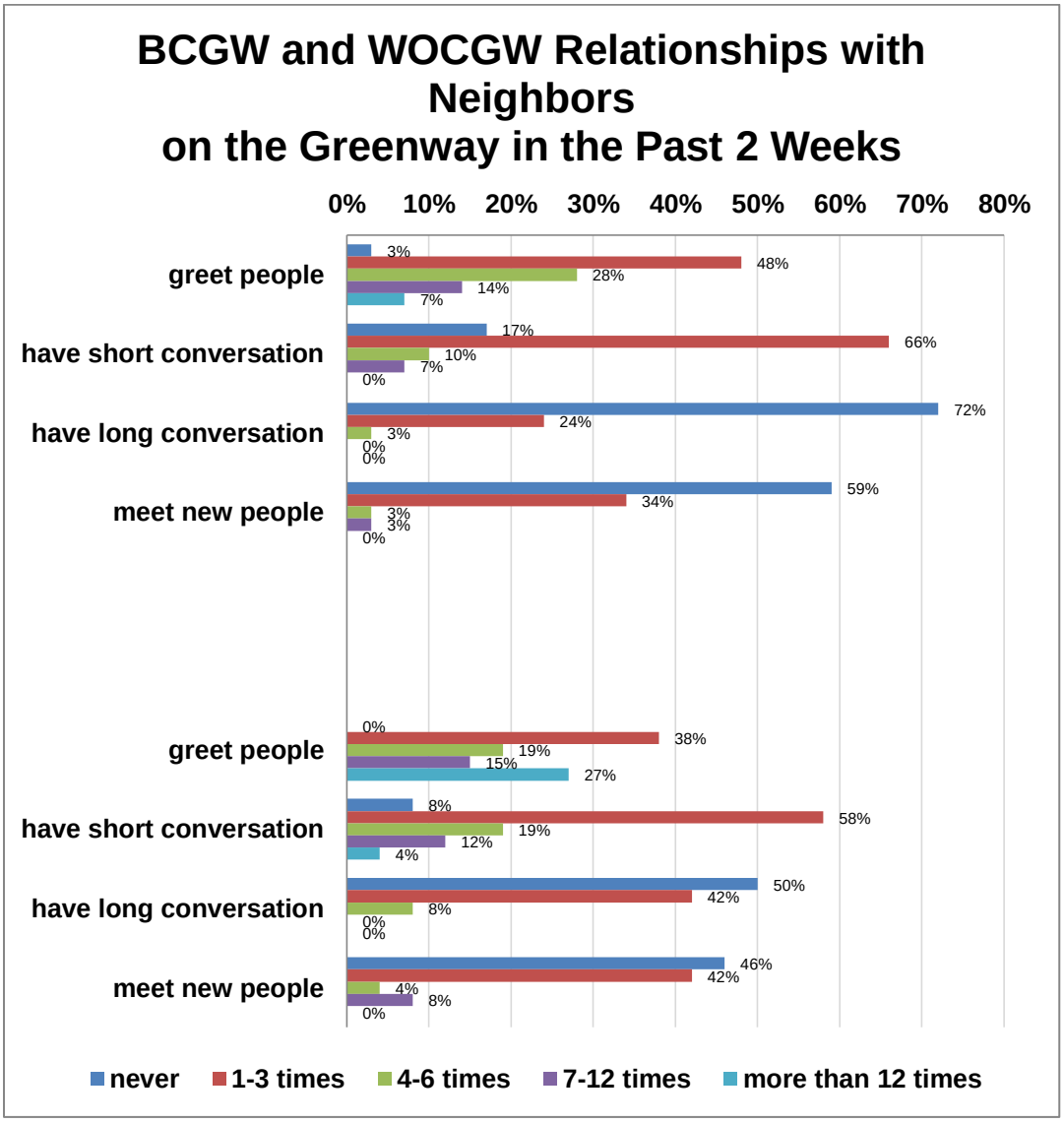
If yes, what type of interaction? (You may choose more than one)



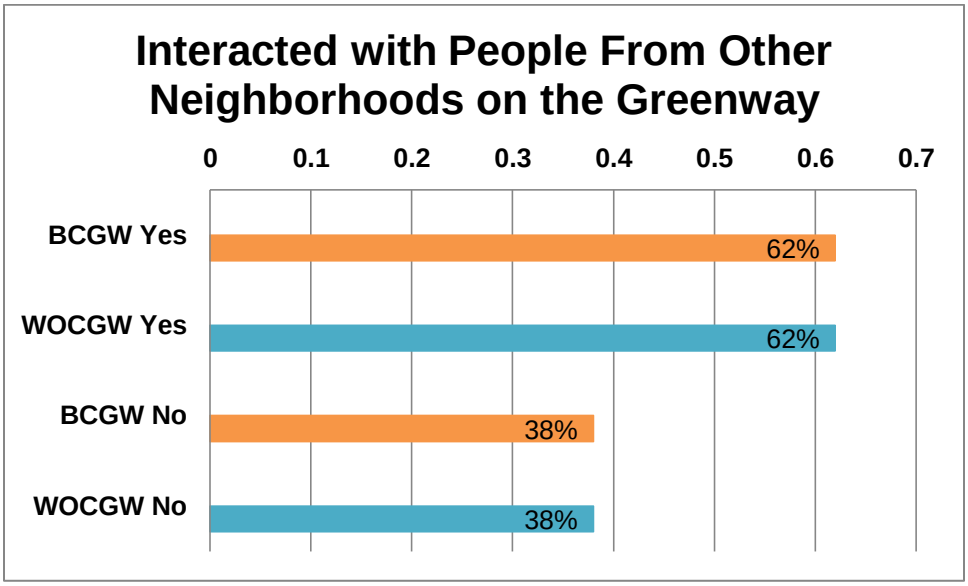
If yes, what is the typical duration of interactions?



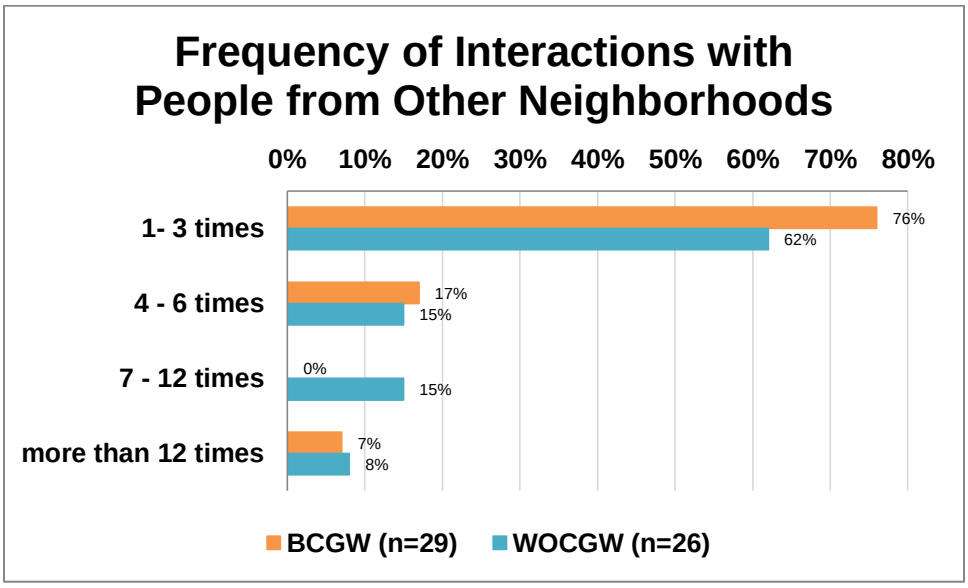
If, yes, how many times did you_____ from/with people from your neighborhood on the greenway in the past 2 weeks (14 days)?



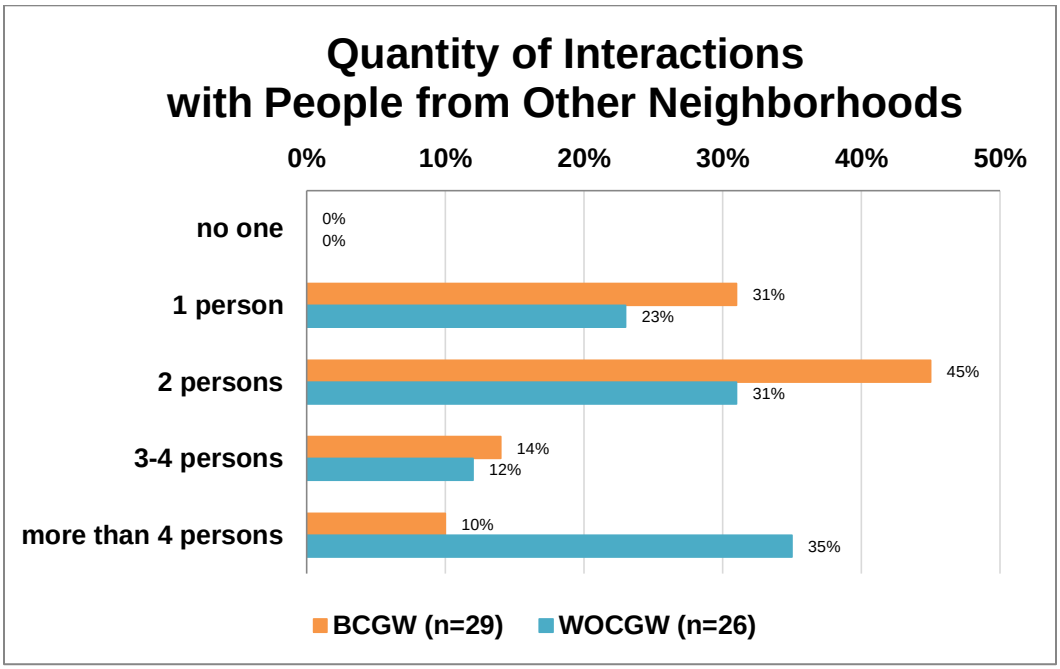
14. Have you interacted with people from other neighborhoods on the greenway in the past 2 weeks (14 days)?
( ) Yes ( ) No



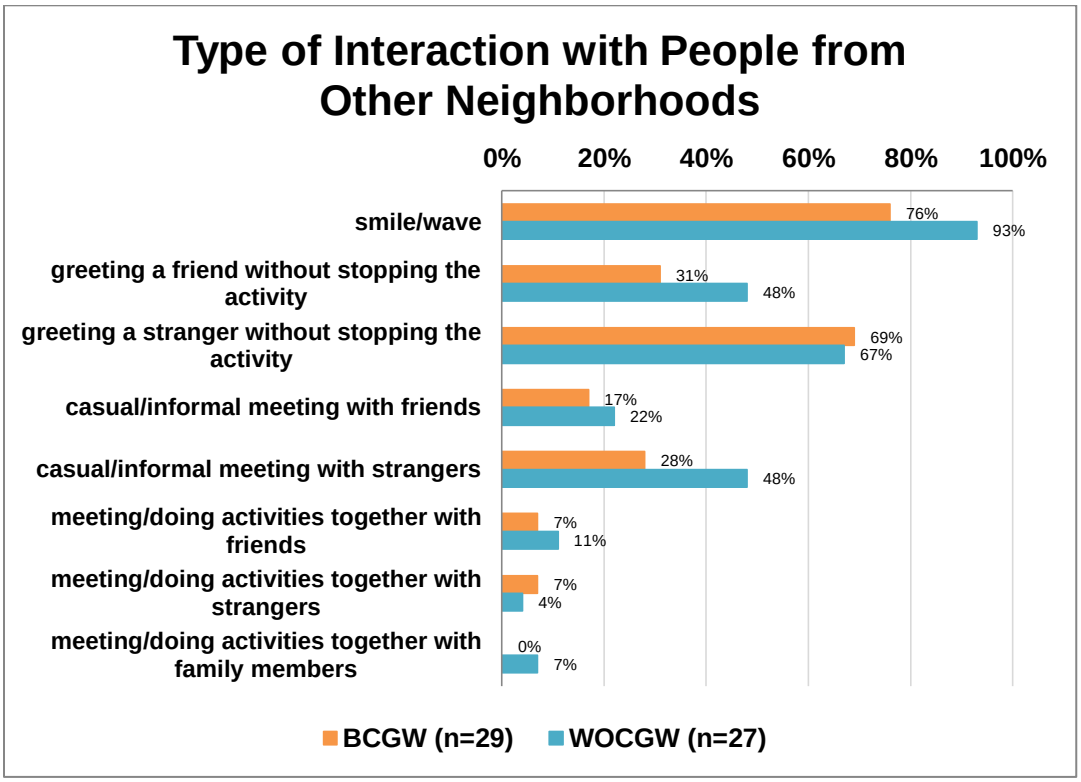
If yes, how many times?



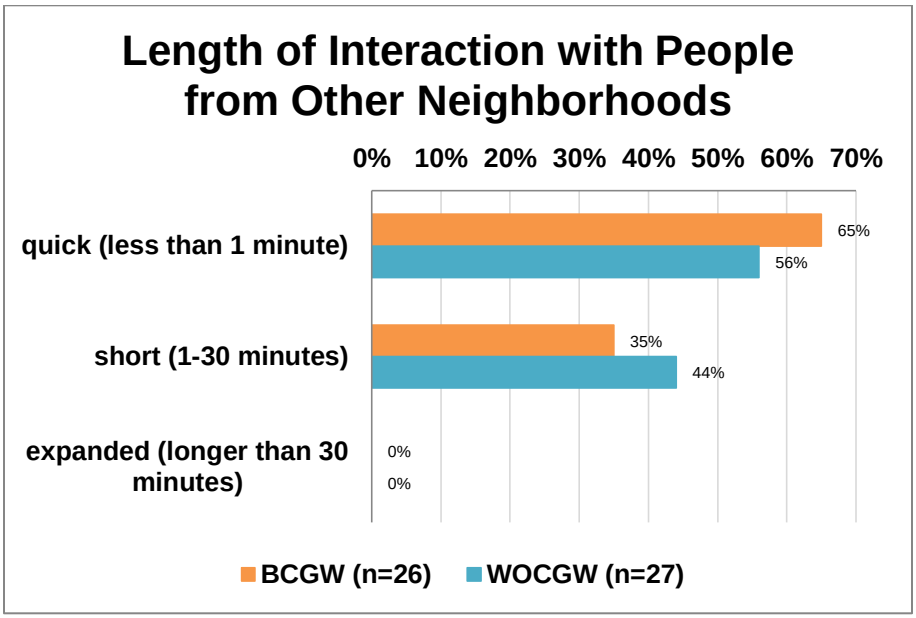
If yes, with how many people?



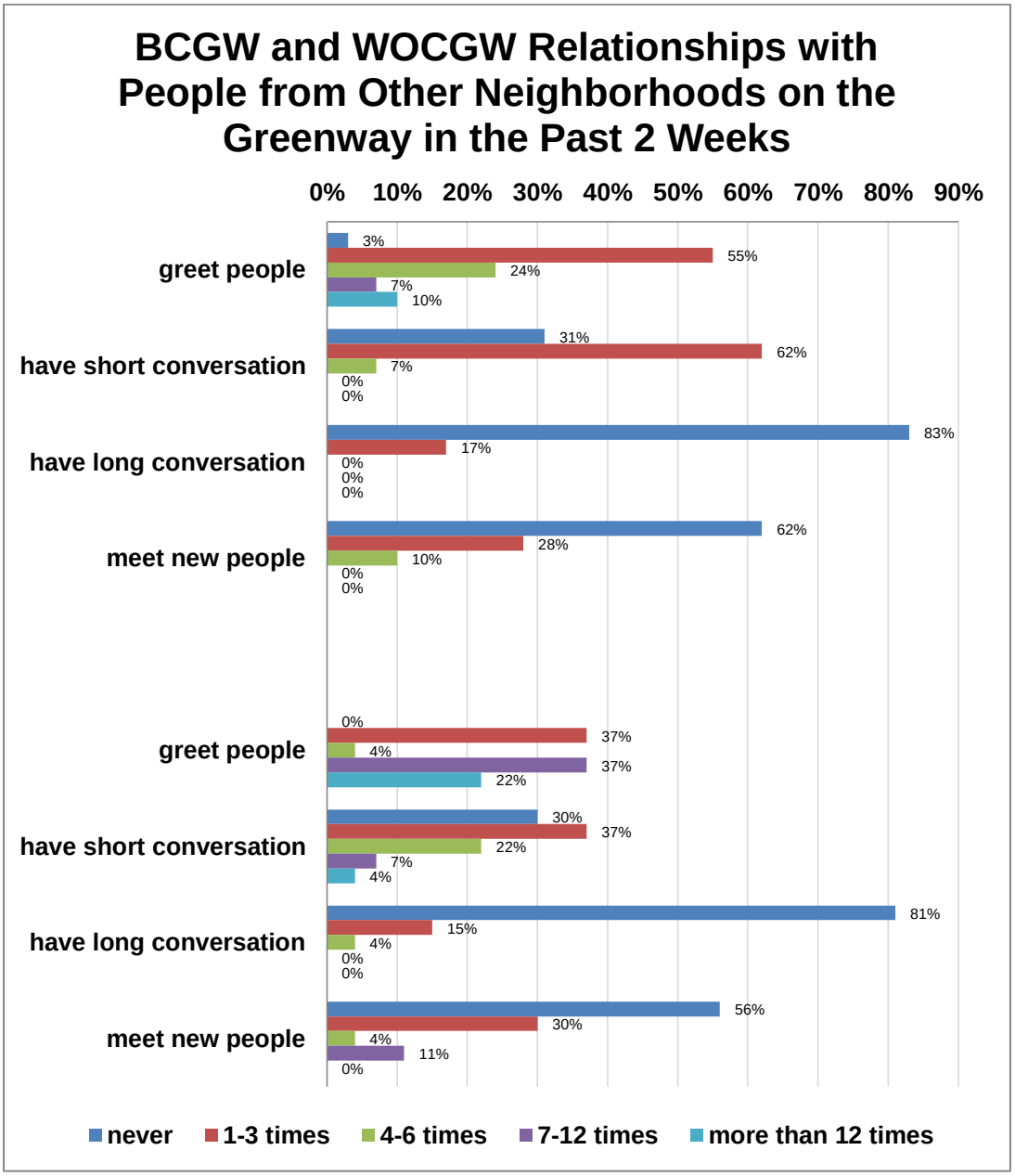
If yes, what type of interaction? (You may choose more than one)



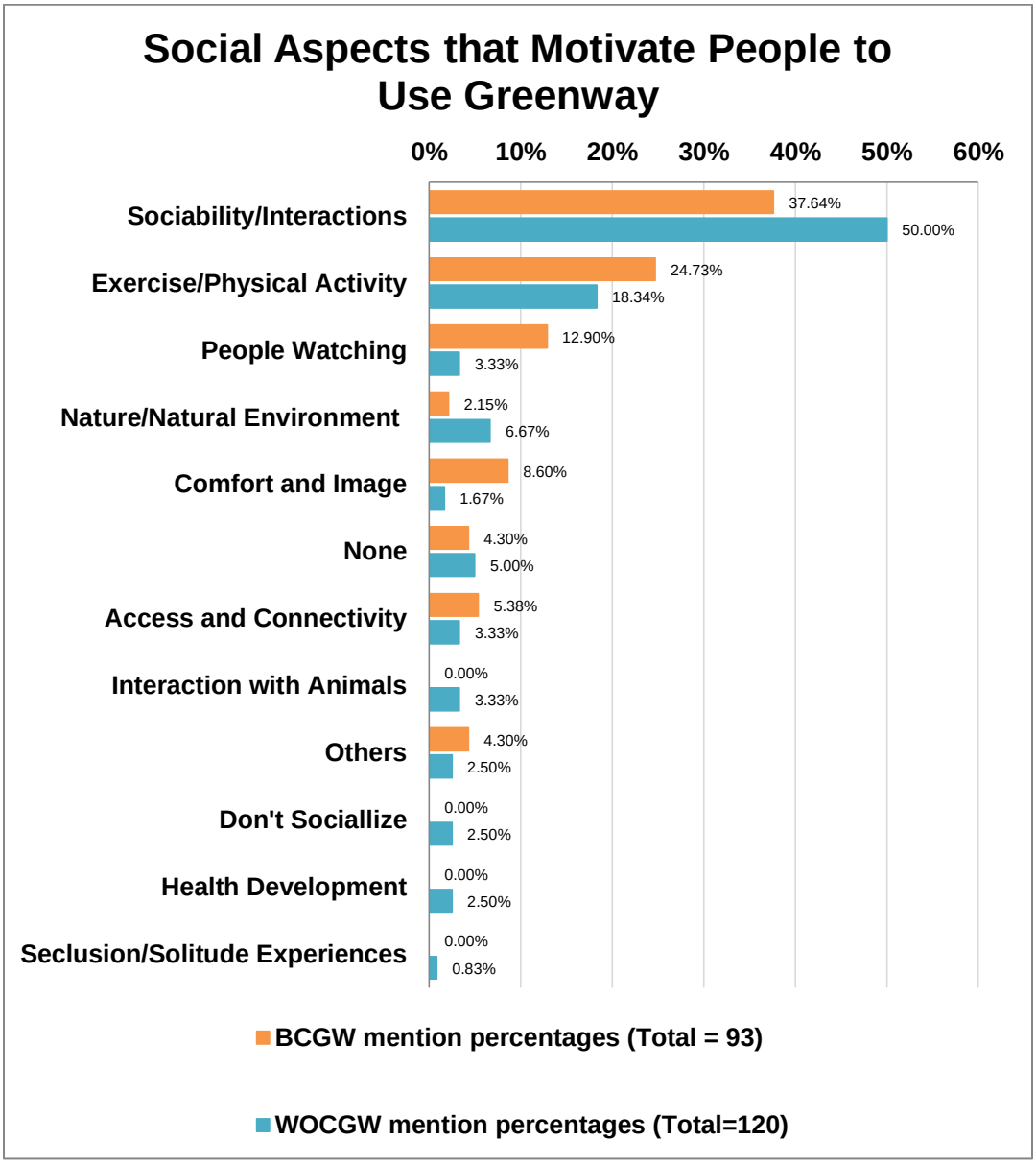
If yes, what is the typical duration of interactions?



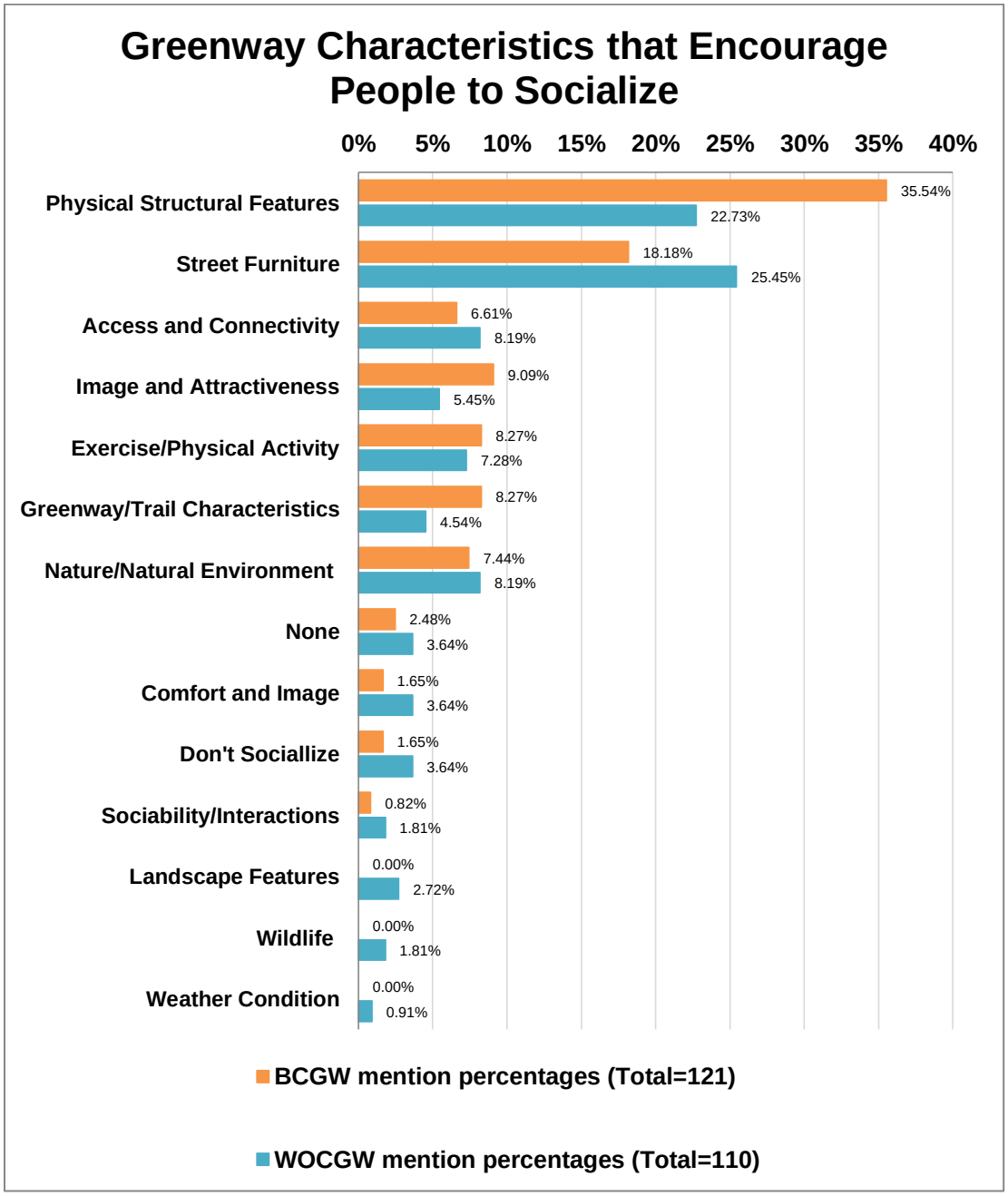
If, yes, how many times did you_____ from/with people from other neighborhoods on the greenway in the past 2 weeks (14 days)?



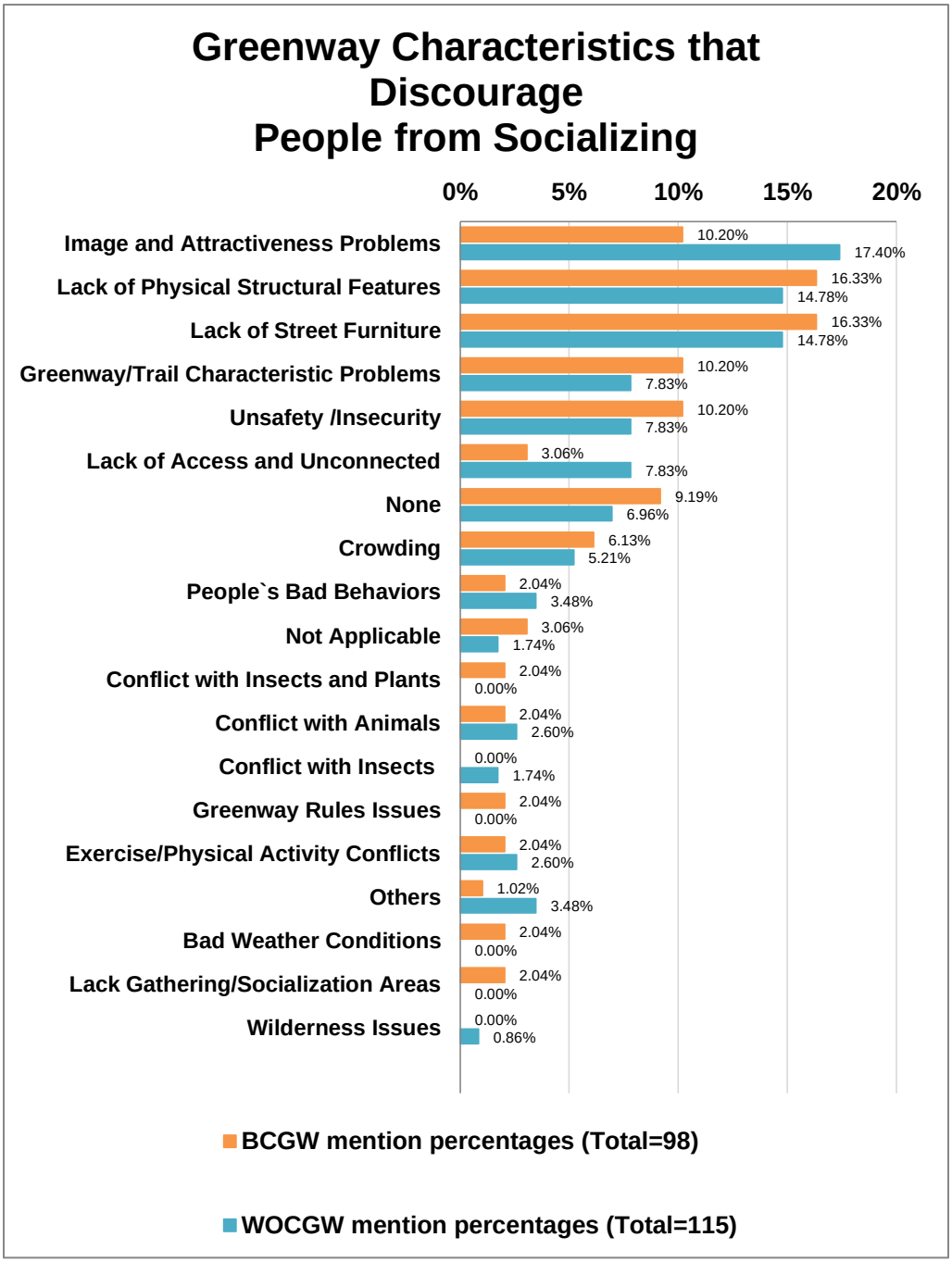
15. In your opinion what are the social aspects that motivate you to use the greenway? (Please list 3 things)



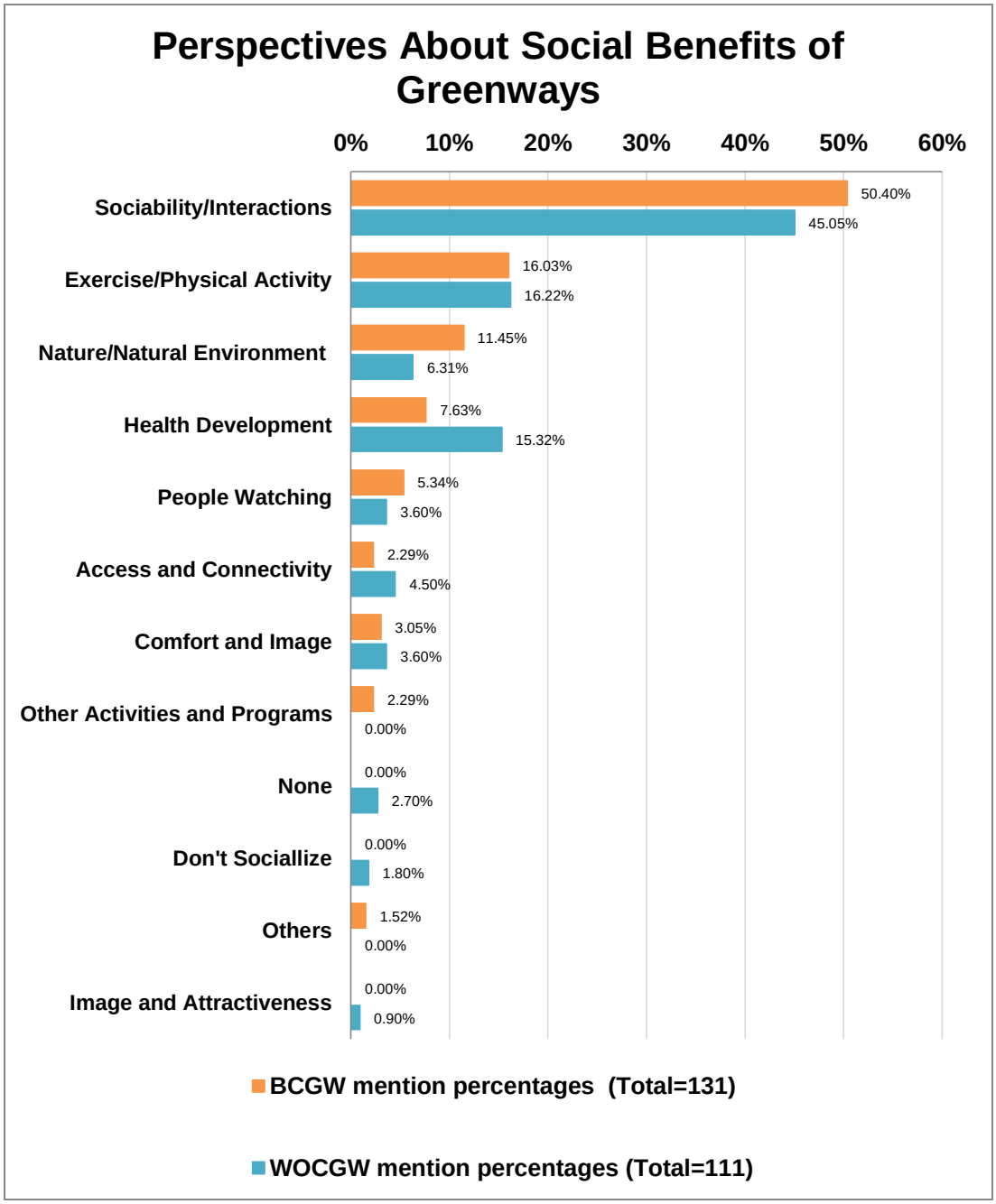
16. In your opinion what greenway characteristics might encourage more people to socialize? (Please list 3 things)



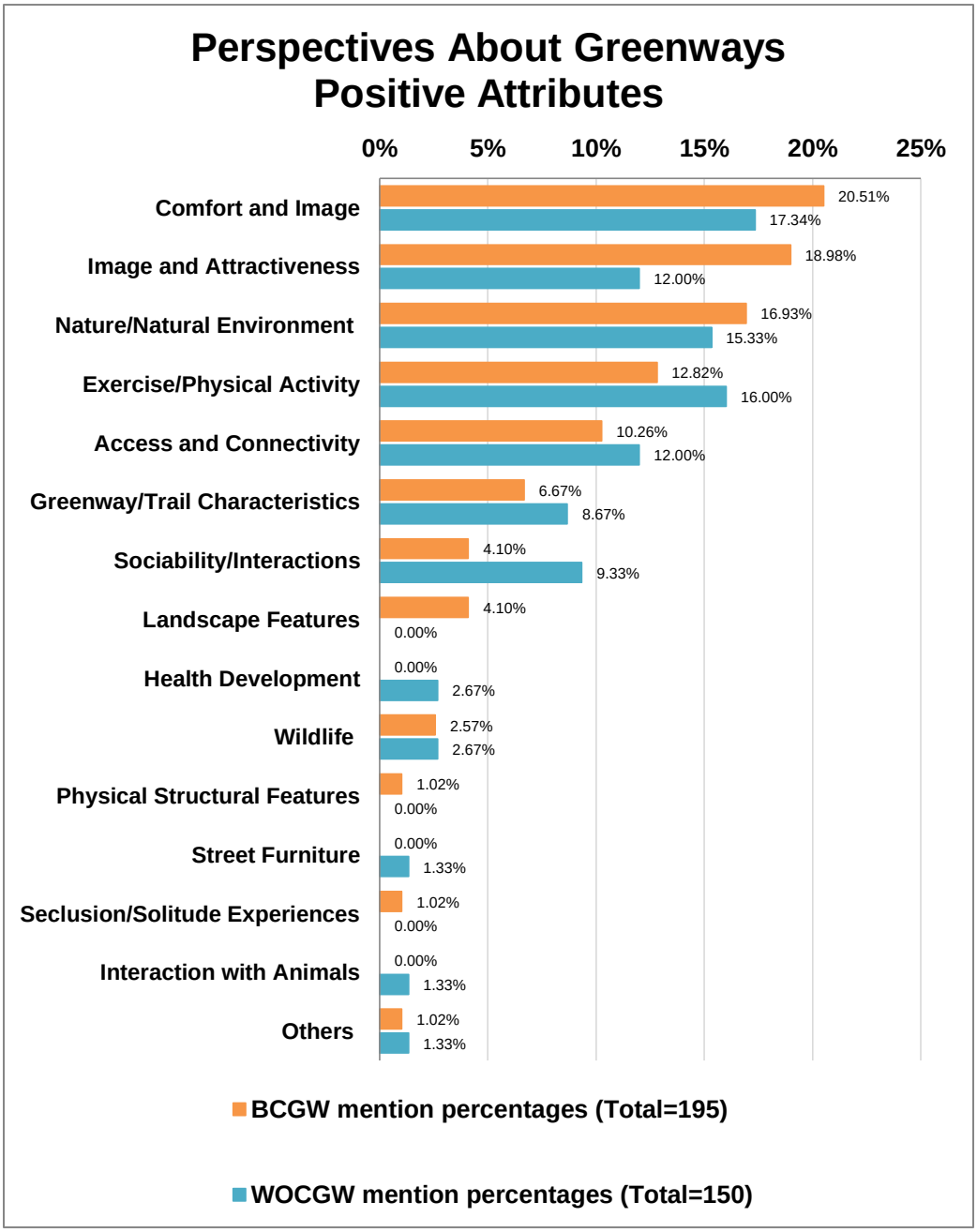
17. In your opinion what greenway characteristics might discourage more people to socialize? (Please list 3 things)



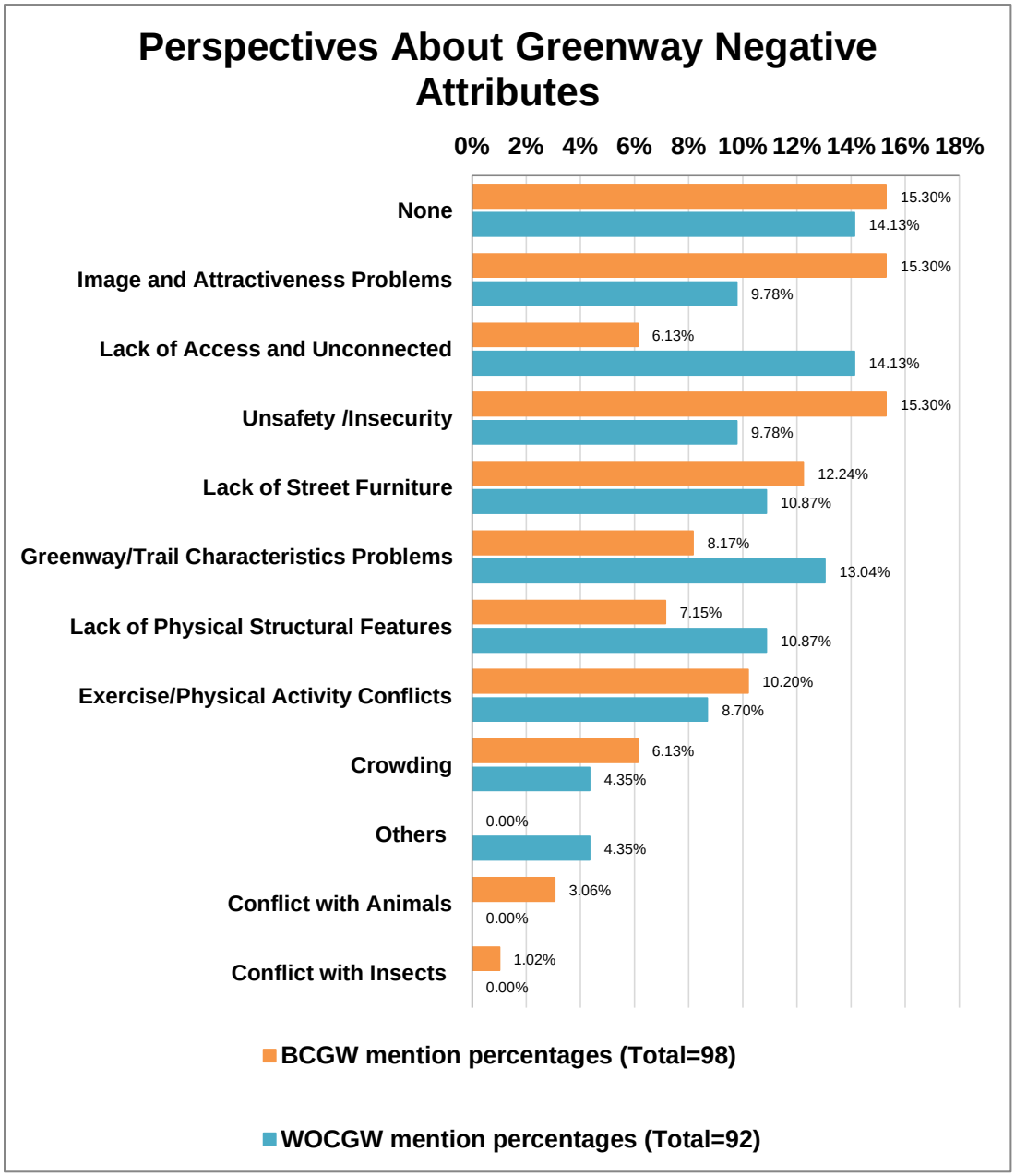
18. From your perspective what are the social benefits of greenways? (Please list 3 things)



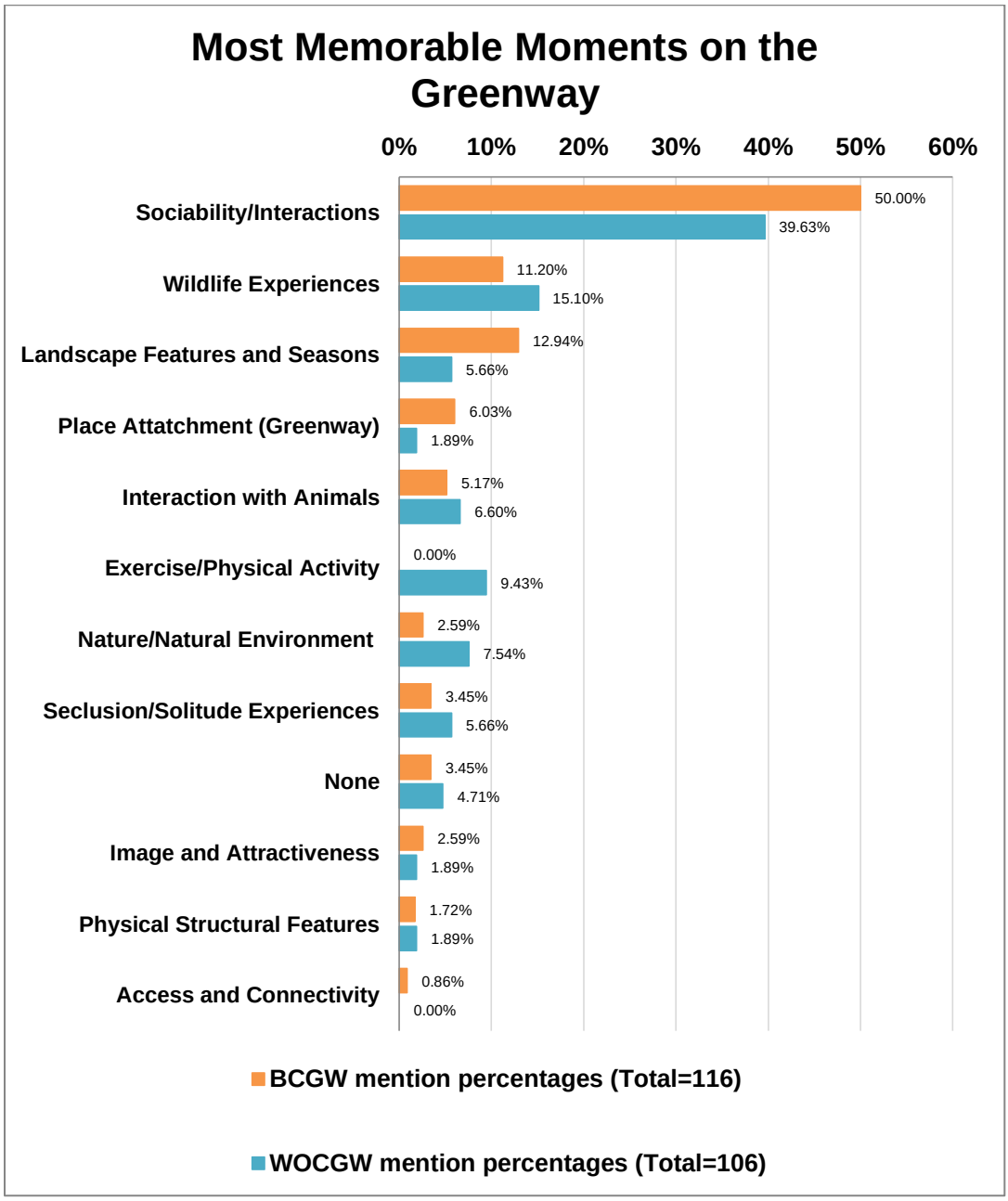
19. In your point of view what are the greenways positive attributes? (Please list 3 things)



20. In your point of view what are the greenways negative attributes? (Please list 3 things)

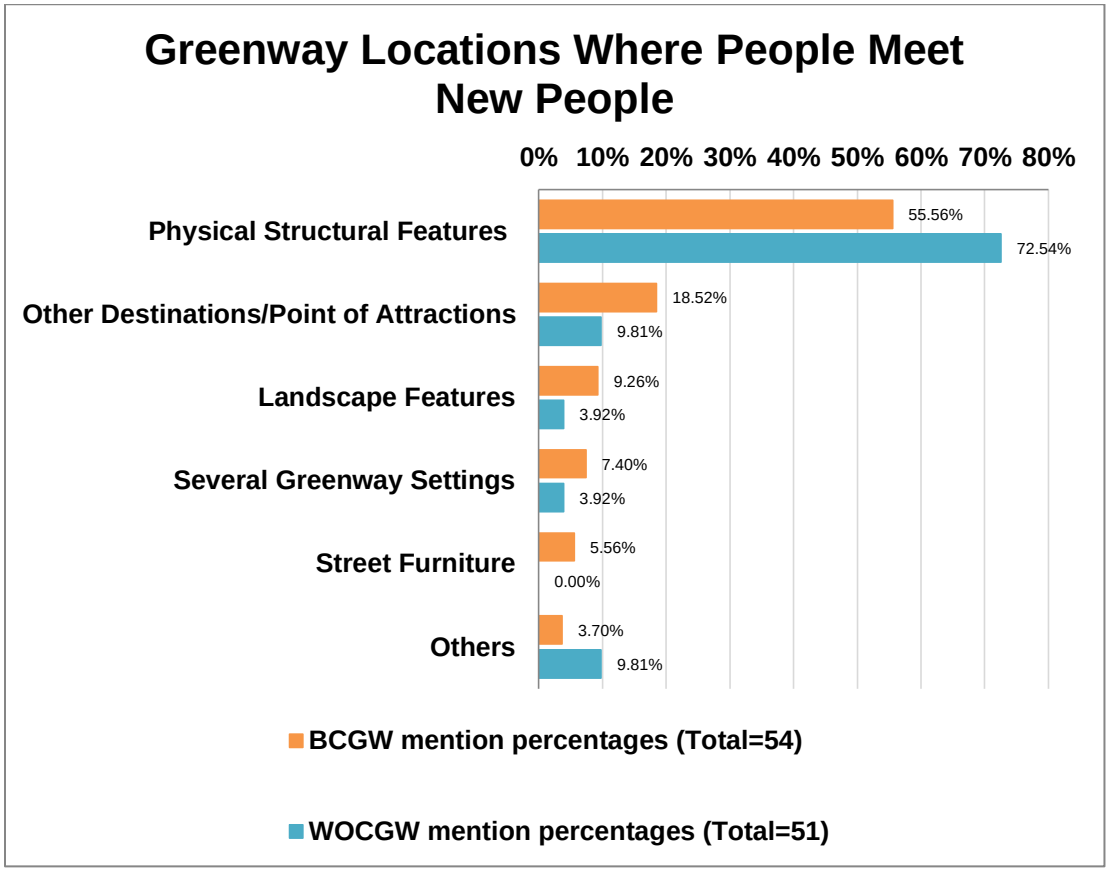


21. What are your most memorable moments on the greenways? (Please list 3 things)



22. Have you ever meet new people at the greenways?
( ) Yes ( ) No

If yes, in which area/setting location? (Please list 3 things)



Appendix S. Consent Form and Mapping Exercise BCGW and WOCGW

My name is Luis Pippi. I am a Ph.D Candidate at the College of Design, at North Carolina State University. I am doing a case study on two Cary greenways: **Black Creek Greenway and White Oak Creek Greenway**. This study involves understanding social networks, social interactions and behaviors that occur on recreational greenways and is funded by Fulbright/Capes-Brazil.

I am requesting your participation in **this voluntary mapping exercise, which should take around 01-02 minutes of your time.** The information collected will provide valuable guidelines and recommendations for policy makers and designers of greenways. If you are interested in learning the results of the study, you may request to be provided with a report upon its completion. All responses are anonymous and confidential and will be erased after the compilation of the data. There are no risks involved in participating in this study. **Before I begin the mapping exercise consent process, can you confirm that you are 18 years or older?**
( ) Yes ( ) No

In this **mapping exercise,** you should use the color-coded stickers (with the respective color-coded legend) and place them on the greenway map to indicate greenway destinations where you normally like to go, places where you usually meet other people, places where you normally interact with others and start and end points where you normally access the greenway trail. On the **side of the map, please write: the name of your neighborhood and the zip code area.**
Please complete only one questionnaire per household. If you would like your name to be included in the **lottery for an iPod touch 8GB**, please **include your name and address in the detachable area at the bottom of this page.** The lottery applications will be separated from the questionnaires and a winner will be chosen (your information will be erased after the lottery prize).

If you have any questions, information or the procedures about the study, feel free to call or e-mail me, or to my advisor:

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919-521-6132
lgpippi@ncsu.edu
guiamy@hotmail.com

Arthur Rice (Mentor/Advisor)
Professor of Landscape Architecture, Director of the PhD Design Program and Associate Dean for Graduate Studies and International Studies North Carolina State University, Raleigh, NC 27695
College of Design, Department of Landscape Architecture
North Carolina State University, Raleigh, NC 27695
919-515-8347
art_rice@ncsu.edu

If you feel you have not been treated justly or have any concerns about your participation, you may contact:
Deb Paxton or Carol Mickelson
Regulatory Compliance Administrator, Box 7514
North Carolina State University, Raleigh, NC 27695
919-515-4514
debra_paxton@ncsu.edu
carol_mickelson@ncsu.edu

By completing the survey questionnaire, I am confirming that I agree to participate in the study as described above in the informed consent form. ( ) Yes ( ) No

If you agree to participate in the study, please fill out this questionnaire and kindly return back to: (Luis Pippi at 1012 Hawser Court, 27606, Raleigh, NC).

Thank you so much for your help and participation in this research.
Sincerely,
Luis Guilherme Aita Pippi Raleigh, 09/07/2012.

Name:
Address:

Black Creek Greenway

Using the Following codes (legend) with stickers, place them as appropriate on the map (other page), and/or check those boxes when applicable:

S **Start(s)**
Within the area on the map, where is/are the most frequent location you most often start on the greenway trail?
If your greenway trail start point(s) is/are outside of the map area, please check the box. ☐

E **End(s)**
Within the area on the map, where is/are the most frequent location you most often end on the greenway trail?
If your greenway trail end point(s) is/are outside of the map area, please check the box. ☐

Destination(s)
Within the area on the map, where is/are the greenway place(s) that you consider as a destination(s)?
If your greenway destination(s) is/are outside of the map area, please check the box, and write the name of your destination(s): ☐

_____

Meeting(s)
Within the area on the map, where is/are the greenway place(s) that you most often meet people that you know and/or don`t know?
If the greenway place(s) where you meet people is/are outside of the map area, please check the box. ☐

Interaction(s)
Within the area on the map, where is/are the greenway place(s) that you most often interact with people that you already know and/or don`t know?
If the greenway place(s) where you interact with people is/are outside of the map area, please check the box. ☐

Black Creek Greenway

Neighborhood Name:

Zip Code:

Legend
Coding Stickers

- S Start on the Greenway Trail
- E End on the Greenway Trail
- Greenway Destination Point(s)
- Greenway Meeting Point(s)
- Greenway Interaction Point(s)

Map Legend

- Greenway Trail
- Parks and Greenways Boundary
- Open Space
- Major Lakes
- Creeks and Streams
- Streets
- Highway

0 0.15 0.3 0.6 0.9 1.2 Miles

Print Scale: 1/17.500
Source of Data:
Wake County GIS, Raleigh, NC, 2012
Town of Cary, Cary, NC, 2012

Elaborated by Luis Pippi, September, 24, 2012
College of Design - Landscape Architecture - NCSU

Black Creek Greenway

0 0.15 0.3 0.6 0.9 1.2 Miles

Neighborhood Name:

Zip Code:

Legend Coding Stickers

- S Start on the Greenway Trail
- E End on the Greenway Trail
- Greenway Destination Point(s)
- Greenway Meeting Point(s)
- Greenway Interaction Point(s)

Map Legend

- Greenway Trail
- Parks and Greenways Boundary
- Open Space
- Major Lakes
- Creeks and Streams
- Streets
- Highway

Print Scale: 1/17.500
Source of Data:
Wake County GIS, Raleigh, NC, 2012
Town of Cary, Cary, NC, 2012

Elaborated by Luis Pippi, October, 12, 2012
College of Design - Landscape Architecture - NCSU

White Oak Creek Greenway

Using the Following codes (legend) with stickers, place them as appropriate on the map (other page), and/or check those boxes when applicable:

S **Start(s)**
Within the area on the map, where is/are the most frequent location you most often start on the greenway trail?
If your greenway trail start point(s) is/are outside of the map area, please check the box. ☐

E **End(s)**
Within the area on the map, where is/are the most frequent location you most often end on the greenway trail?
If your greenway trail end point(s) is/are outside of the map area, please check the box. ☐

Destination(s)
Within the area on the map, where is/are the greenway place(s) that you consider as a destination(s)?
If your greenway destination(s) is/are outside of the map area, please check the box, and write the name of your destination(s): ☐

_____

Meeting(s)
Within the area on the map, where is/are the greenway place(s) that you most often meet people that you know and/or don`t know?
If the greenway place(s) where you meet people is/are outside of the map area, please check the box. ☐

Interaction(s)
Within the area on the map, where is/are the greenway place(s) that you most often interact with people that you already know and/or don`t know?
If the greenway place(s) where you interact with people is/are outside of the map area, please check the box. ☐

White Oak Creek Greenway

0 0.15 0.3 0.6 0.9 1.2 Miles

Neighborhood Name:

Zip Code:

Legend
Coding Stickers

- S Start on the Greenway Trail
- E End on the Greenway Trail
- Greenway Destination Point(s)
- Greenway Meeting Point(s)
- Greenway Interaction Point(s)

Map Legend

- Greenway Trail
- Parks and Greenways Boundary
- Open Space
- Major Lakes
- Creeks and Streams
- Streets
- Highway

Print Scale: 1/17.500
Source of Data:
Wake County GIS, Raleigh, NC, 2012
Town of Cary, Cary, NC, 2012

Elaborated by Luis Pippi, October, 12, 2012
College of Design - Landscape Architecture - NCSU

White Oak Creek Greenway

Neighborhood Name:

Zip Code:

Legend
Coding Stickers

- S Start on the Greenway Trail
- E End on the Greenway Trail
- Greenway Destination Point(s)
- Greenway Meeting Point(s)
- Greenway Interaction Point(s)

Map Legend

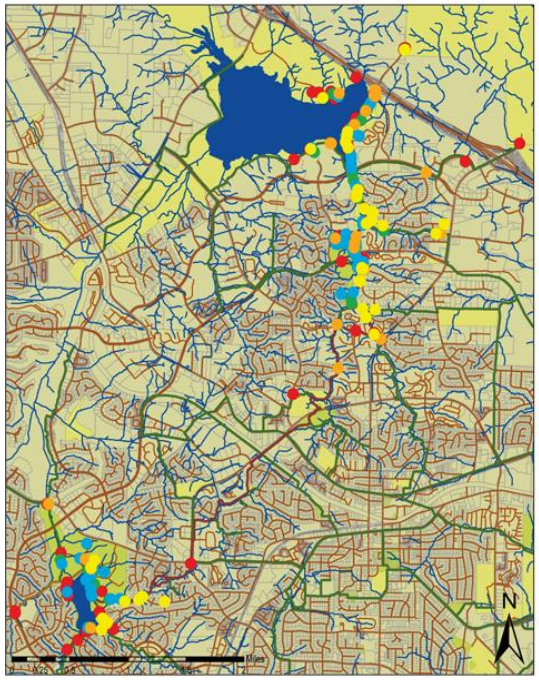
- Greenway Trail
- Parks and Greenways Boundary
- Open Space
- Major Lakes
- Creeks and Streams
- Streets
- Highway

Print Scale: 1/17.500
Source of Data:
Wake County GIS, Raleigh, NC, 2012
Town of Cary, Cary, NC, 2012

Elaborated by Luis Pippi, October, 12, 2012
College of Design - Landscape Architecture - NCSU

Appendix T. Mapping Exercise Results

Black Creew Greenway/Segments Mapping Exercise



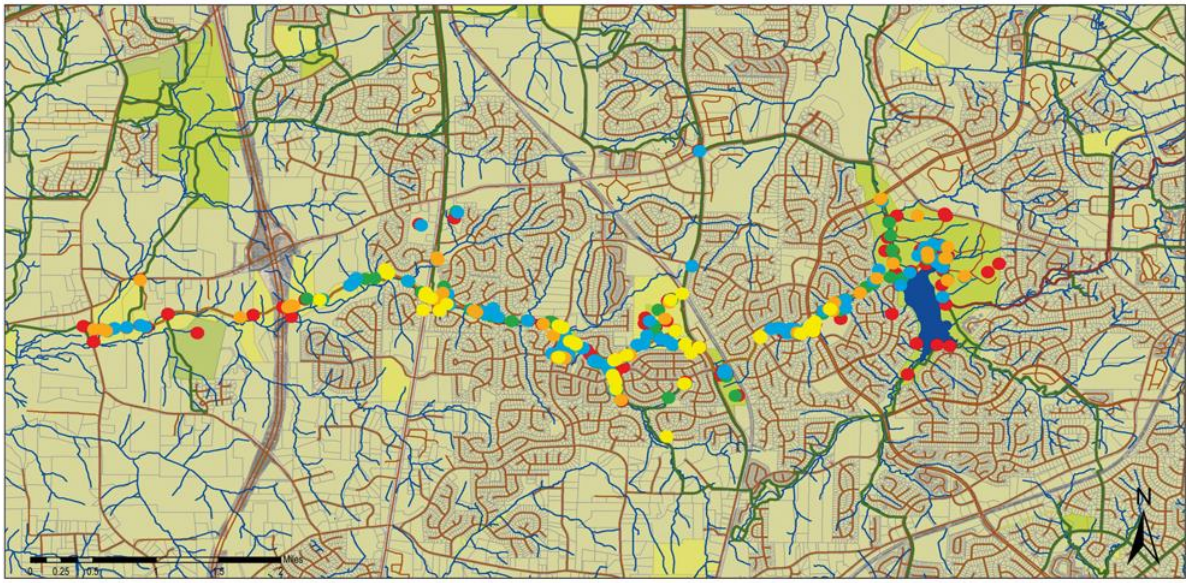
Legend

- Start on the BCGW Trail (S)
- BCGW Destination Points
- BCGW Meeting Points
- BCGW Interaction Points
- End on the BCGW Trail (E)
- Black Creek Greenway
- White Oak Creek Greenway
- GreenwayTrails
- Creeks and Streams
- Streets
- Major Lakes
- Cary Parks and Greenways
- Open Spaces
- CaryProperty
- Highway

Print Scale: 1/25.000
Source of Data:
Wake County GIS, Raleigh, NC, 2012
Town of Cary, Cary, NC, 2012

Elaborated by Luis Pippi,Septemberr, 24, 2012
College of Design - Landscape Architecture - NCSU

White Oak Creew Greenway/Segments Mapping Exercise



Legend

- Start on the WOCGW Trail (S)
- End on the WOCGW Trail (E)
- WOCGW Interaction Points
- WOCGW Meeting Points
- WOCGW Destination Points
- Black Creek Greenway
- White Oak Creek Greenway
- GreenwayTrails
- Creeks and Streams
- Streets
- Major Lakes
- Cary Parks and Greenways
- Open Spaces
- CaryProperty
- Highway

Print Scale: 1/25.000
Source of Data:
Wake County GIS, Raleigh, NC, 2012
Town of Cary, Cary, NC, 2012

Elaborated by Luis Pippi,Septemberr, 24, 2012
College of Design - Landscape Architecture - NCSU

Black Creek Greenway (BCGW) Mapping Exercise "Outsiders" Total Frequency

BCGW – Start Locations			
Level	**Count**	**Prob.**	**St. Err. Prob.**
Bond Park	1	0.16667	0.15215
Lake Crabtree	1	0.16667	0.15215
Oxxford Hunt Greenway	1	0.16667	0.15215
Reedy Creek Greenway	1	0.16667	0.15215
Surrounding Neighborhoods	1	0.16667	0.15215
Umstead Park	1	0.16667	0.15215
Total	6	1.00000	0.00000

BCGW – End Locations			
Level	**Count**	**Prob.**	**St. Err. Prob.**
BCGW_Other Segment	2	0.18182	0.11629
Bond Park	2	0.18182	0.11629
Bond Park and Bond Lake	1	0.09091	0.08668
Lake Crabtree	1	0.09091	0.08668
Oxxford Hunt Greenway	1	0.09091	0.08668
Swift Creek Greenway	1	0.09091	0.08668
Umstead Park	3	0.27273	0.13428
Total	11	1.00000	0.00000

BCGW – Destination Locations			
Level	**Count**	**Prob.**	**St. Err. Prob.**
Bond Park	4	0.07692	0.03695
Bond Park and Bond Lake	1	0.01923	0.01904
Elementary School	1	0.01923	0.01904
Hwy 40 to "Airport Look-Out"	1	0.01923	0.01904
Hwy 40 to Umstead	1	0.01923	0.01904
Lake Crabtree	2	0.03846	0.02667
Lake Crabtree Park	5	0.09615	0.04088
Natural Path (W Dynasty Dr.)	4	0.07692	0.03695
North Cary Park	7	0.13462	0.04733
Oxxford Hunt Greenway	4	0.07692	0.03695
Sidewalk (W Dynasty Dr. - BCGW)	1	0.01923	0.01904
Surrounding Commercial Areas	1	0.01923	0.01904
Swift Creek Greenway	4	0.07692	0.03695
Umstead State Park	10	0.19231	0.05465
White Oak Creek Greenway	6	0.11538	0.04430
Total	52	1.00000	0.00000

BCGW – Meeting Locations			
Level	**Count**	**Prob.**	**St. Err. Prob.**
Bond Lake	3	0.20000	0.10328
Bond Park	2	0.13333	0.08777
Crabtree Creek Greenway	1	0.06667	0.06441
Lake Crabtree	1	0.06667	0.06441
Natural Path (W Dynasty Dr.)	1	0.06667	0.06441
North Cary Park	3	0.20000	0.10328
Oxxford Hunt Greenway	1	0.06667	0.06441
Playground	1	0.06667	0.06441
Sidewalk (W Dynasty Dr. - BCGW)	1	0.06667	0.06441
Surrounding Neighborhoods	1	0.06667	0.06441
Total	15	1.00000	0.00000

BCGW – Interacting Locations			
Level	**Count**	**Prob.**	**St. Err. Prob.**
Bond Park	5	0.25000	0.09682
Crabtree Creek Greenway	1	0.05000	0.04873
Lake Crabtree	1	0.05000	0.04873
Natural Path (W Dynasty Dr.)	1	0.05000	0.04873
North Cary Park	5	0.25000	0.09682
Playground	2	0.10000	0.06708
Senior Center	1	0.05000	0.04873
Surrounding Neighborhoods	2	0.10000	0.06708
Swift Creek Greenway	1	0.05000	0.04873
Umstead Park	1	0.05000	0.04873
Total	20	1.00000	0.00000

White Oak Creek Greenway (WOCGW) Mapping Exercise "Outsiders" Total Frequency

WOCGW – Start Locations			
Level	**Count**	**Prob.**	**St. Err. Prob.**
Bowers Lane	1	0.06250	0.06052
Davis Dr.	1	0.06250	0.06052
Hwy 55	1	0.06250	0.06052
NC 55 Sidewalk	1	0.06250	0.06052
Park Village Greenway	10	0.62500	0.12103
Sherwood Greens Greenway	1	0.06250	0.06052
White Oak Park	1	0.06250	0.06052
Total	16	1.00000	0.00000

WOCGW – End Locations			
Level	**Count**	**Prob.**	**St. Err. Prob.**
American Tobacco Trail	1	0.02778	0.02739
Batchelor Branch Greenway	1	0.02778	0.02739
Black Creek Greenway	5	0.13889	0.05764
Bond Park	3	0.08333	0.04606
Bond Park (Playground)	1	0.02778	0.02739
Crabtree Creek Greenway	2	0.05556	0.03818
Davis Drive Elementary School	1	0.02778	0.02739
Davis Drive Middle School	1	0.02778	0.02739
Davis Drive Park	1	0.02778	0.02739
High House Rd.	1	0.02778	0.02739
Highway 55 Tunnel	1	0.02778	0.02739
NC 55 Street Side Trail	3	0.08333	0.04606
Park Village Greenway	6	0.16667	0.06211
Pound	1	0.02778	0.02739
SW Cary Pkwy	2	0.05556	0.03818
Walking Board Area – WOCGW	1	0.02778	0.02739
West Park (playground)	1	0.02778	0.02739
White Oak Park	2	0.05556	0.03818
White Oak Park (Playground)	2	0.05556	0.03818
Total	36	1.00000	0.00000

WOCGW – Destination Locations			
Level	**Count**	**Prob.**	**St. Err. Prob.**
American Tobacco Trail	3	0.03409	0.01934
Bank	1	0.01136	0.01130
Batchelor Branch Greenway	1	0.01136	0.01130
Black Creek Greenway	7	0.07955	0.02884
Black Creek Greenway (Exercise Points)	1	0.01136	0.01130
Bond Park	12	0.13636	0.03658
Bond Park (Playground)	2	0.02273	0.01589
Commercial Areas	2	0.02273	0.01589
Crabtree Creek Greenway	3	0.03409	0.01934
Davis Drive Elementary School	4	0.04545	0.02220
Davis Drive Middle School	2	0.02273	0.01589
Davis Drive Middle School/Park	3	0.03409	0.01934
Davis Drive Park	6	0.06818	0.02687
Davis Drive Park (Playground)	1	0.01136	0.01130
Durham	1	0.01136	0.01130
Future Park	1	0.01136	0.01130
Green Level Church Rd.	1	0.01136	0.01130
High House Rd.	1	0.01136	0.01130
Highway 55 Tunnel	1	0.01136	0.01130
NC 55 Street Side Trail (East)	1	0.01136	0.01130
Oxxford Hunt Greenway	1	0.01136	0.01130
Park Village Greenway	8	0.09091	0.03065
Park Village Playground	1	0.01136	0.01130
Park Village Pool	1	0.01136	0.01130
Playground – WOCGW	1	0.01136	0.01130
Surrounding Neighborhoods	1	0.01136	0.01130
Surrounding Neighborhoods – Pound WOCGW	5	0.05682	0.02468
Swift Creek Greenway	2	0.02273	0.01589
The 540 Underpass	1	0.01136	0.01130
Walking Board Area – WOCGW	1	0.01136	0.01130
West Park (Playground)	1	0.01136	0.01130
White Oak Park (Basketball Court)	1	0.01136	0.01130
White Oak Park (Picnic Shelter)	3	0.03409	0.01934
White Oak Park (Playground)	6	0.06818	0.02687
YMCA	1	0.01136	0.01130
Total	88	1.00000	0.00000

WOCGW – Meeting Locations			
Level	**Count**	**Prob.**	**St. Err. Prob.**
American Tobacco Trail	2	0.04348	0.03007
Black Creek Greenway	1	0.02174	0.02150
Bond Park	5	0.10870	0.04589
Bond Park (Playground)	1	0.02174	0.02150
Commercial Areas	1	0.02174	0.02150
Crabtree Creek Greenway	4	0.08696	0.04154
Davis Drive Elementary School	1	0.02174	0.02150
Davis Drive Middle School/Park	3	0.06522	0.03640
Davis Drive Park	3	0.06522	0.03640
Durham	1	0.02174	0.02150
NC 55 Sidewalk	1	0.02174	0.02150
Park Village Greenway	3	0.06522	0.03640
Park Village Greenway (Pond)	1	0.02174	0.02150
Surrounding Neighborhoods – Parking Area	1	0.02174	0.02150
Surrounding Neighborhoods – Pound	1	0.02174	0.02150
West Park (Playground)	1	0.02174	0.02150
White Oak Creek Greenway (Segment 2)	1	0.02174	0.02150
White Oak Park	4	0.08696	0.04154
White Oak Park (Basketball Court)	1	0.02174	0.02150
White Oak Park (Picnic Shelter)	4	0.08696	0.04154
White Oak Park (Playground)	3	0.06522	0.03640
White Oak Park (Soccer Field)	2	0.04348	0.03007
YMCA	1	0.02174	0.02150
Total	46	1.00000	0.00000

WOCGW – Interaction Locations			
Level	**Count**	**Prob.**	**St. Err. Prob.**
American Tobacco Trail	1	0.01667	0.01653
Bank	1	0.01667	0.01653
Black Creek Greenway	5	0.08333	0.03568
Bond Park	5	0.08333	0.03568
Bond Park (Ball Fields)	1	0.01667	0.01653
Bond Park (Bond Park Trail)	1	0.01667	0.01653
Bond Park (Pine Cone Trail)	1	0.01667	0.01653
Bond Park (Paw Paw Trail)	2	0.03333	0.02317
Bond Park (Playground)	1	0.01667	0.01653
Collins Rd. intersection with Davis Dr.	1	0.01667	0.01653
Commercial Areas	2	0.03333	0.02317
Crabtree Creek Greenway	1	0.01667	0.01653
Davis Drive Elementary School	1	0.01667	0.01653
Davis Drive Middle School/Park	2	0.03333	0.02317
Davis Drive Park	3	0.05000	0.02814
Davis Drive Park (Playground)	1	0.01667	0.01653
Durham	1	0.01667	0.01653
High House Rd.	1	0.01667	0.01653
NC 55 Sidewalk (Surrounding Neighborhoods)	1	0.01667	0.01653
Park Village Greenway	4	0.06667	0.03220
Surrounding Neighborhoods	4	0.06667	0.03220
Surrounding Neighborhoods – Pound – WOCGW	3	0.05000	0.02814
Walking Board Area – WOCGW	1	0.01667	0.01653
West Park (Playground)	1	0.01667	0.01653
White Oak Park	5	0.08333	0.03568
White Oak Park (Picnic Shelter)	3	0.05000	0.02814
White Oak Park (Playground)	4	0.06667	0.03220
White Oak Park (Soccer Field)	2	0.03333	0.02317
YMCA	1	0.01667	0.01653
Total	60	1.00000	0.00000

Appendix U. “Old” X “New” Patterns of Use/Types of Activities

New Pattern of Use /Type of Activities	Old Pattern of Use /Type of Activities	Frequency	Percent	Cumulative Frequency	Cumulative Percent
B_alone	b	1504	14.74	1504	14.74
B_alone	blm	18	0.18	1522	14.91
B_children	bctr	1	0.01	1523	14.92
B_dog_interacting	bdt	5	0.05	1528	14.97
B_interacting	bt	528	5.17	2056	20.15
B_interacting	btcp	2	0.02	2058	20.17
B_interacting	btllm	3	0.03	2061	20.2
B_interacting	btpso	3	0.03	2064	20.23
B_interacting	btstpdrk	2	0.02	2066	20.24
B_interacting	btstppne	5	0.05	2071	20.29
B_interacting	btstppso	1	0.01	2072	20.3
B_interacting	btstppspl	6	0.06	2078	20.36
B_interacting	btstps	3	0.03	2081	20.39
B_interacting	btstpsit	2	0.02	2083	20.41
B_interacting	btstpsitol	2	0.02	2085	20.43
B_interacting	btstpsitolop	2	0.02	2087	20.45
B_interacting	btstpsitopol	2	0.02	2089	20.47
B_interacting	btstpst	99	0.97	2188	21.44
B_interacting	btstpstdrkwat	2	0.02	2190	21.46
B_interacting	btstpstlip	4	0.04	2194	21.5
B_interacting	btstpstol	18	0.18	2212	21.68
B_interacting	btstpstop	1	0.01	2213	21.69
B_interacting	btstpstpspl	2	0.02	2215	21.71
B_interacting	btstpsttp	3	0.03	2218	21.73
B_interacting	btstpstwd	1	0.01	2219	21.74
B_interacting	btstpwb	2	0.02	2221	21.76
B_other	bstpsit	5	0.05	2226	21.81
B_other	bstpsitol	5	0.05	2231	21.86
B_other	bstpsitst	1	0.01	2232	21.87
B_other	bstpst	20	0.2	2252	22.07
B_other	bstpstlis	5	0.05	2257	22.12
B_other	bstpstolop	1	0.01	2258	22.13
Bike_dog	bd	16	0.16	2274	22.28
Bike_dog	bdstpst	1	0.01	2275	22.29
ex_interact_other	exdt	2	0.02	2277	22.31
ex_interact_other	exsettp	4	0.04	2281	22.35
ex_interact_other	exst	5	0.05	2286	22.4
ex_struct_interact	exset	3	0.03	2289	22.43
exercise_alone	ex	2	0.02	2291	22.45
exercise_structure	exexse	3	0.03	2294	22.48
exercise_structure	exs	1	0.01	2295	22.49
exercise_structure	exse	3	0.03	2298	22.52
fishing_alone	f	11	0.11	2309	22.63
fishing_interacting	ft	15	0.15	2324	22.77
gardening_alone	g	4	0.04	2328	22.81
gardening_alone	ga	2	0.02	2330	22.83
gardening_interacting	gstpst	2	0.02	2332	22.85
gardening_interacting	gt	2	0.02	2334	22.87
inline_skating_alone	isk	12	0.12	2346	22.99
inline_skating_alone	iskkga	2	0.02	2348	23.01
inline_skating_dog	iskd	1	0.01	2349	23.02
inline_skating_interact	iskt	8	0.08	2357	23.1
other	ot	73	0.72	2430	23.81
play_dog_interact	pdt	6	0.06	2436	23.87
play_structure_alone	pexse	6	0.06	2442	23.93
play_structure_alone	pspl	21	0.21	2463	24.14
play_structure_interact	pexset	4	0.04	2467	24.17
play_structure_interact	psplt	90	0.88	2557	25.06

Table Continued

pne_alone	pne	47	0.46	2604	25.52
pne_dog	pnepd	1	0.01	2605	25.53
pne_dog_interact	pnetpdd	3	0.03	2608	25.56
pne_interact	olpnet	3	0.03	2611	25.59
pne_interact	pnet	132	1.29	2743	26.88
pso_alone	pso	7	0.07	2750	26.95
pso_interacting	psot	14	0.14	2764	27.08
r_alone	r	1117	10.95	3881	38.03
r_alone	rllm	5	0.05	3886	38.08
r_alone	rlm	143	1.4	4029	39.48
r_alone	rslm	5	0.05	4034	39.53
r_alone	rwstpst	2	0.02	4036	39.55
r_children	rstr	13	0.13	4049	39.68
r_children_dog_interact	rstrdt	1	0.01	4050	39.69
r_children_interacting	rstrt	4	0.04	4054	39.73
r_children_other	rstrtstpst	1	0.01	4055	39.74
r_dog	rd	48	0.47	4103	40.21
r_dog	rdd	7	0.07	4110	40.27
r_dog	rdlm	2	0.02	4112	40.29
r_dog_interacting	rdt	5	0.05	4117	40.34
r_dog_other	rdstpst	4	0.04	4121	40.38
r_interacting	rstbtstp	2	0.02	4123	40.4
r_interacting	rt	268	2.63	4391	43.03
r_interacting	rtstpexexse	3	0.03	4394	43.06
r_interacting	rtstpexse	4	0.04	4398	43.1
r_interacting	rtstpst	1	0.01	4399	43.11
r_interacting	rwext	6	0.06	4405	43.17
r_interacting	rwt	2	0.02	4407	43.18
r_interacting	rwtpne	2	0.02	4409	43.2
r_other	rexst	3	0.03	4412	43.23
r_other	rstb	4	0.04	4416	43.27
r_other	rstpex	1	0.01	4417	43.28
r_other	rstpolu	1	0.01	4418	43.29
r_other	rstpsit	1	0.01	4419	43.3
r_other	rstpst	6	0.06	4425	43.36
r_other	rstpstlis	1	0.01	4426	43.37
r_other	rstpstst	7	0.07	4433	43.44
r_other	rw	2	0.02	4435	43.46
r_other	rwstps	1	0.01	4436	43.47
scootering_interact_other	scttstppspl	3	0.03	4439	43.5
scootering_interact_other	scttstpst	5	0.05	4444	43.55
scootering_interacting	sct	15	0.15	4459	43.69
scootering_interacting	sctt	30	0.29	4489	43.99
sit_alone	sit	155	1.52	4644	45.51
sit_interact_other	sittopoltp	1	0.01	4645	45.52
sit_interact_other	sitwt	1	0.01	4646	45.53
sit_interact_other	ssittol	2	0.02	4648	45.55
sit_interacting	p	4	0.04	4652	45.59
sit_interacting	sitodsp	3	0.03	4655	45.61
sit_interacting	sitol	9	0.09	4664	45.7
sit_interacting	sitop	5	0.05	4669	45.75
sit_interacting	sitosp	2	0.02	4671	45.77
sit_interacting	sitt	40	0.39	4711	46.16
sit_interacting	sitthheol	4	0.04	4715	46.2
sit_interacting	sittol	26	0.25	4741	46.46
sit_interacting	sittop	24	0.24	4765	46.69
sit_interacting	sittopol	16	0.16	4781	46.85
sit_other	sitopol	2	0.02	4783	46.87
sit_other	sitoptp	1	0.01	4784	46.88

Table Continued

sit_other	sitre	5	0.05	4789	46.93
sit_other	sitreldsb	1	0.01	4790	46.94
sit_other	sitreol	1	0.01	4791	46.95
sit_other	sitreop	1	0.01	4792	46.96
sit_other	sittpodpol	5	0.05	4797	47.01
sit_other	sittpol	5	0.05	4802	47.06
sit_other	sittpopol	5	0.05	4807	47.1
sit_other	sittpspl	1	0.01	4808	47.11
sit_other	sittptp	6	0.06	4814	47.17
sit_other	ssttol	1	0.01	4815	47.18
sit_other	tpsit	4	0.04	4819	47.22
skating_alone	sk	2	0.02	4821	47.24
skating_alone	skb	12	0.12	4833	47.36
skating_alone	skblm	1	0.01	4834	47.37
skating_interacting	skbt	19	0.19	4853	47.56
skating_interacting	skt	7	0.07	4860	47.62
skating_other	skstpst	2	0.02	4862	47.64
skating_other	sktstpst	4	0.04	4866	47.68
stand_interact_other	stlm	1	0.01	4867	47.69
stand_interact_other	stol	3	0.03	4870	47.72
stand_interact_other	stoltp	4	0.04	4874	47.76
stand_interact_other	sts	1	0.01	4875	47.77
stand_interact_other	ststol	1	0.01	4876	47.78
stand_interact_other	sttp	4	0.04	4880	47.82
stand_other	stoddsp	1	0.01	4881	47.83
stand_other	stpktstol	2	0.02	4883	47.85
stand_other	sttcpol	1	0.01	4884	47.86
stand_other	sttcw	2	0.02	4886	47.88
stand_other	sttol	26	0.25	4912	48.13
stand_other	sttoltp	2	0.02	4914	48.15
stand_other	sttop	17	0.17	4931	48.32
stand_other	stttp	6	0.06	4937	48.38
strecht_alone	s	3	0.03	4940	48.41
stretch_interacting	st	4	0.04	4944	48.45
stretch_interacting_other	srt	4	0.04	4948	48.49
stretch_other	sr	1	0.01	4949	48.5
tour_interact_other_activ	tourwtstptp	5	0.05	4954	48.54
tricycling	tt	1	0.01	4955	48.55
unicycling	u	1	0.01	4956	48.56
walk_alone	w	1324	12.97	6280	61.54
walk_alone	wb	1	0.01	6281	61.55
walk_alone	wllm	7	0.07	6288	61.62
walk_alone	wlm	76	0.74	6364	62.36
walk_children	wcia	1	0.01	6365	62.37
walk_children	wstr	36	0.35	6401	62.72
walk_children	wstrlm	1	0.01	6402	62.73
walk_children	wstrtcp	1	0.01	6403	62.74
walk_children_dog	wstrd	2	0.02	6405	62.76
walk_children_dog_intera c	wstrdt	2	0.02	6407	62.78
walk_children_dog_other	wcstpst	1	0.01	6408	62.79
walk_children_dog_other	wstrdstpst	1	0.01	6409	62.8
walk_children_dog_other	wstrdtsit	1	0.01	6410	62.81
walk_children_interact	wct	1	0.01	6411	62.82
walk_children_interact	wstrt	59	0.58	6470	63.4
walk_children_interact	wtcia	6	0.06	6476	63.46
walk_children_interact	wtpcw	8	0.08	6484	63.54
walk_children_interact_ot	wstrtstpsitol	2	0.02	6486	63.56
walk_children_interact_ot	wstrtstpst	7	0.07	6493	63.63

Table Continued

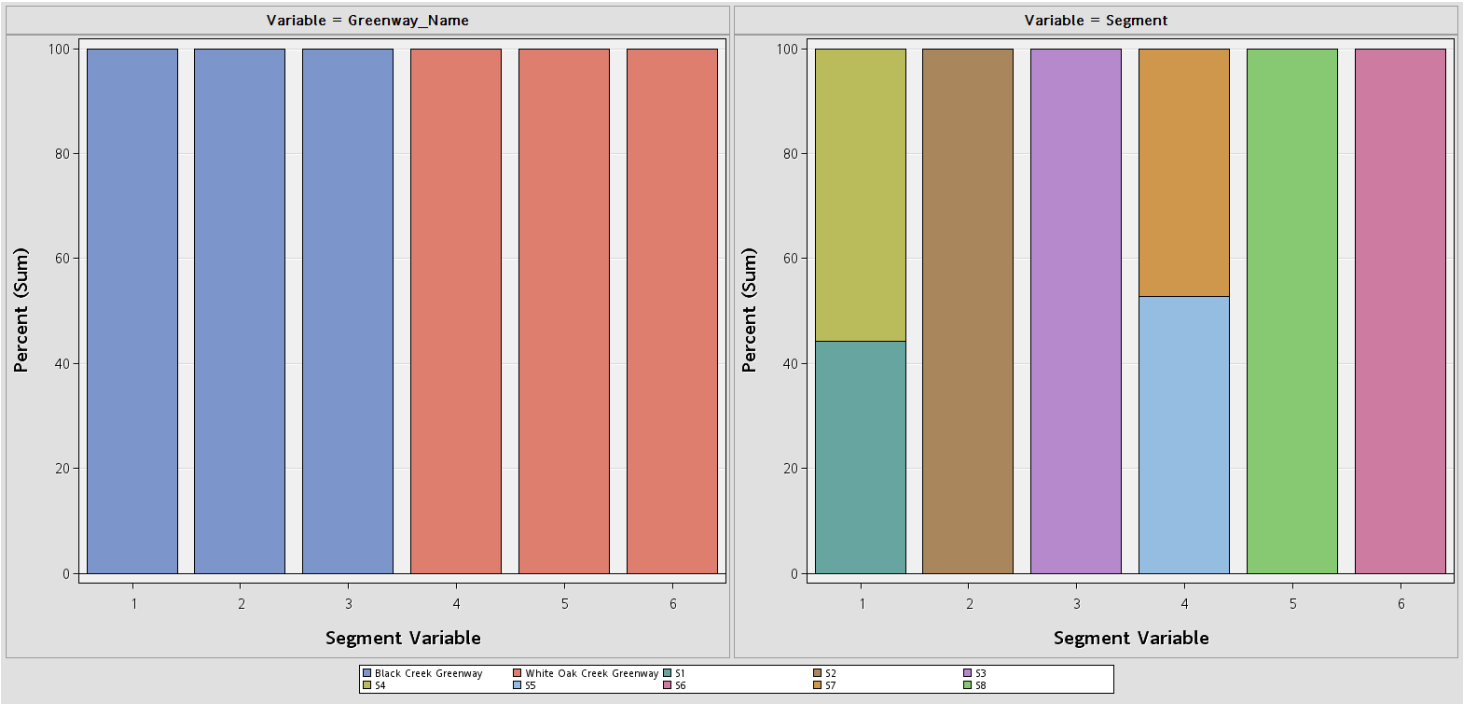
walk_children_interact_ot	wstrtstpstcw	1	0.01	6494	63.64
walk_children_interact_ot	wstrtstpstol	1	0.01	6495	63.65
walk_children_other	wstrstpst	1	0.01	6496	63.66
walk_children_other	wstrstpstlip	1	0.01	6497	63.66
walk_dog	wd	345	3.38	6842	67.05
walk_dog	wdd	105	1.03	6947	68.07
walk_dog	wddd	1	0.01	6948	68.08
walk_dog	wdllm	2	0.02	6950	68.1
walk_dog	wdlm	6	0.06	6956	68.16
walk_dog	wdtcp	5	0.05	6961	68.21
walk_dog_interact	wdT	1	0.01	6962	68.22
walk_dog_interact	wddt	34	0.33	6996	68.55
walk_dog_interact	wdt	340	3.33	7336	71.89
walk_dog_interact	wdtllm	1	0.01	7337	71.9
walk_dog_interact_other	wddtstpsit	2	0.02	7339	71.92
walk_dog_interact_other	wddtstpst	15	0.15	7354	72.06
walk_dog_interact_other	wdstpst	108	1.06	7462	73.12
walk_dog_interact_other	wdstpstol	2	0.02	7464	73.14
walk_dog_interact_other	wdtstpdrkwat	1	0.01	7465	73.15
walk_dog_interact_other	wdtstpol	3	0.03	7468	73.18
walk_dog_interact_other	wdtstpstlis	2	0.02	7470	73.2
walk_dog_interact_other	wdtstpstod	1	0.01	7471	73.21
walk_dog_other	wddstpst	20	0.2	7491	73.41
walk_dog_other	wddstst	1	0.01	7492	73.41
walk_dog_other	wdsm	1	0.01	7493	73.42
walk_dog_other	wdstpsit	1	0.01	7494	73.43
walk_dog_other	wdstpsttp	1	0.01	7495	73.44
walk_dog_other	wdstpstutc	3	0.03	7498	73.47
walk_dog_other	wdtstpst	107	1.05	7605	74.52
walk_dog_other	wdtstpstol	2	0.02	7607	74.54
walk_dog_other	wrd	2	0.02	7609	74.56
walk_interacting	whhet	2	0.02	7611	74.58
walk_interacting	wrt	3	0.03	7614	74.61
walk_interacting	wrtstps	2	0.02	7616	74.63
walk_interacting	wstpsittcp	1	0.01	7617	74.64
walk_interacting	wstpsolop	1	0.01	7618	74.65
walk_interacting	wstpsttop	1	0.01	7619	74.66
walk_interacting	wt	1973	19.33	9592	93.99
walk_interacting	wtdrk	2	0.02	9594	94.01
walk_interacting	wthhe	34	0.33	9628	94.35
walk_interacting	wtpbl	12	0.12	9640	94.46
walk_interacting	wtpne	5	0.05	9645	94.51
walk_interacting	wtpso	7	0.07	9652	94.58
walk_interacting	wtsit	1	0.01	9653	94.59
walk_interacting	wtsmk	3	0.03	9656	94.62
walk_interacting	wtsptst	2	0.02	9658	94.64
walk_interacting	wtsstpst	1	0.01	9659	94.65
walk_interacting	wtstpdrkwat	4	0.04	9663	94.69
walk_interacting	wtstpexse	3	0.03	9666	94.72
walk_interacting	wtstplis	2	0.02	9668	94.74
walk_interacting	wtstpoltp	3	0.03	9671	94.77
walk_interacting	wtstppspl	2	0.02	9673	94.79
walk_interacting	wtstps	4	0.04	9677	94.83
walk_interacting	wtstpsit	11	0.11	9688	94.93
walk_interacting	wtstpsitol	7	0.07	9695	95
walk_interacting	wtstpsitoltp	5	0.05	9700	95.05
walk_interacting	wtstpsitop	4	0.04	9704	95.09
walk_interacting	wtstpst	155	1.52	9859	96.61
walk_interacting	wtstpstcw	6	0.06	9865	96.67
walk_interacting	wtstpstcwtp	3	0.03	9868	96.7

Table Continued

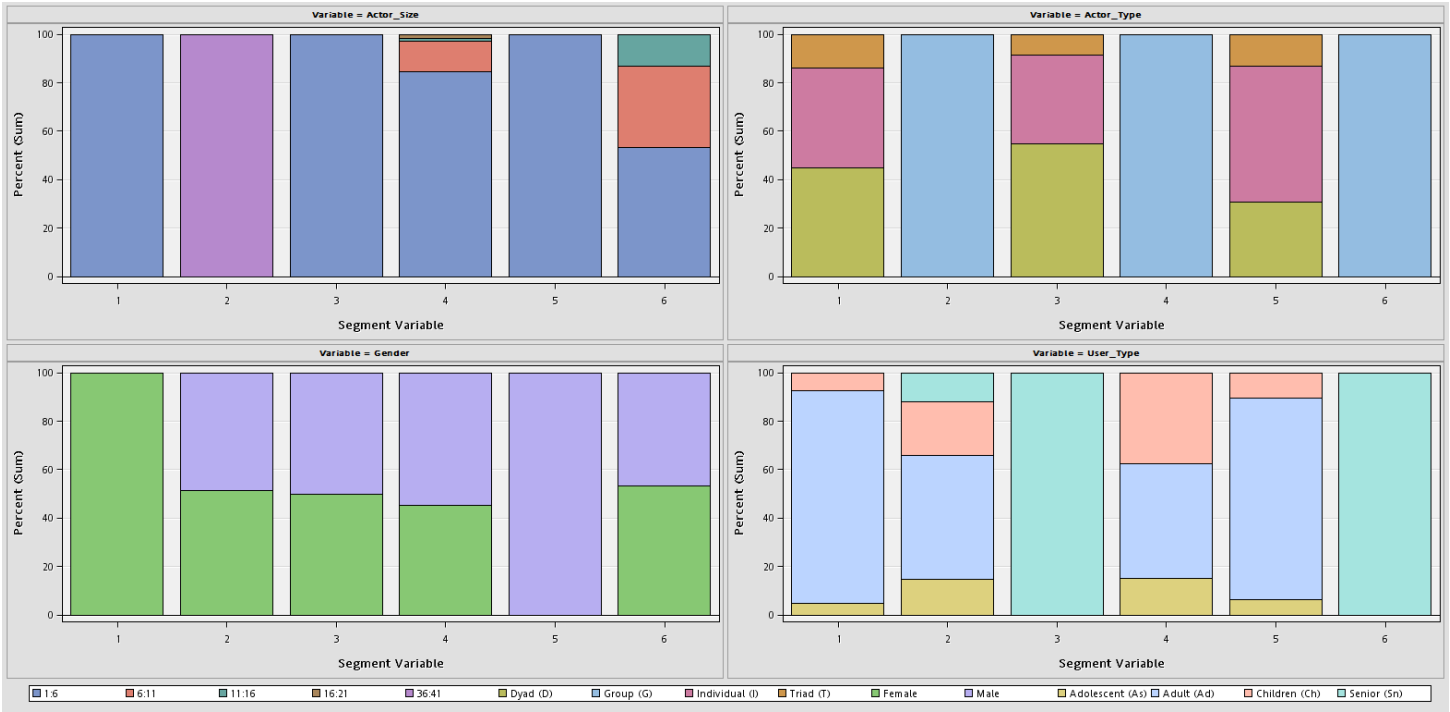
walk_interacting	wtstpstlip	6	0.06	9874	96.76
walk_interacting	wtstpstlis	9	0.09	9883	96.84
walk_interacting	wtstpstod	1	0.01	9884	96.85
walk_interacting	wtstpstol	27	0.26	9911	97.12
walk_interacting	wtstpstoltp	43	0.42	9954	97.54
walk_interacting	wtstpsttp	14	0.14	9968	97.68
walk_interacting	wtstptp	5	0.05	9973	97.73
walk_interacting	wttp	1	0.01	9974	97.74
walk_interacting	wumt	2	0.02	9976	97.76
walk_other	watb	2	0.02	9978	97.78
walk_other	wbtstpst	2	0.02	9980	97.8
walk_other	wdrk	1	0.01	9981	97.8
walk_other	wpbl	14	0.14	9995	97.94
walk_other	wr	31	0.3	10026	98.25
walk_other	wre	4	0.04	10030	98.29
walk_other	wrlm	2	0.02	10032	98.3
walk_other	wrstpst	2	0.02	10034	98.32
walk_other	wslm	3	0.03	10037	98.35
walk_other	wsmk	1	0.01	10038	98.36
walk_other	wstopst	2	0.02	10040	98.38
walk_other	wstpcw	9	0.09	10049	98.47
walk_other	wstpexexse	1	0.01	10050	98.48
walk_other	wstplip	2	0.02	10052	98.5
walk_other	wstpol	1	0.01	10053	98.51
walk_other	wstps	2	0.02	10055	98.53
walk_other	wstpsitol	1	0.01	10056	98.54
walk_other	wstpsitop	1	0.01	10057	98.55
walk_other	wstpst	77	0.75	10134	99.3
walk_other	wstpstcw	1	0.01	10135	99.31
walk_other	wstpstcwtp	1	0.01	10136	99.32
walk_other	wstpstlip	4	0.04	10140	99.36
walk_other	wstpstlis	5	0.05	10145	99.41
walk_other	wstpstol	12	0.12	10157	99.53
walk_other	wstpstolop	1	0.01	10158	99.54
walk_other	wstpstoltp	1	0.01	10159	99.55
walk_other	wstpstpspl	1	0.01	10160	99.56
walk_other	wstpsttp	4	0.04	10164	99.6
walk_other	wstst	2	0.02	10166	99.62
walk_other	wtcp	30	0.29	10196	99.91
walk_other	wtstpcw	2	0.02	10198	99.93
yoga_alone	y	2	0.02	10200	99.95
yoga_interact	yt	4	0.04	10204	99.99
yoga_other	ys	1	0.01	10205	100

Appendix V. Cluster Segment Plots

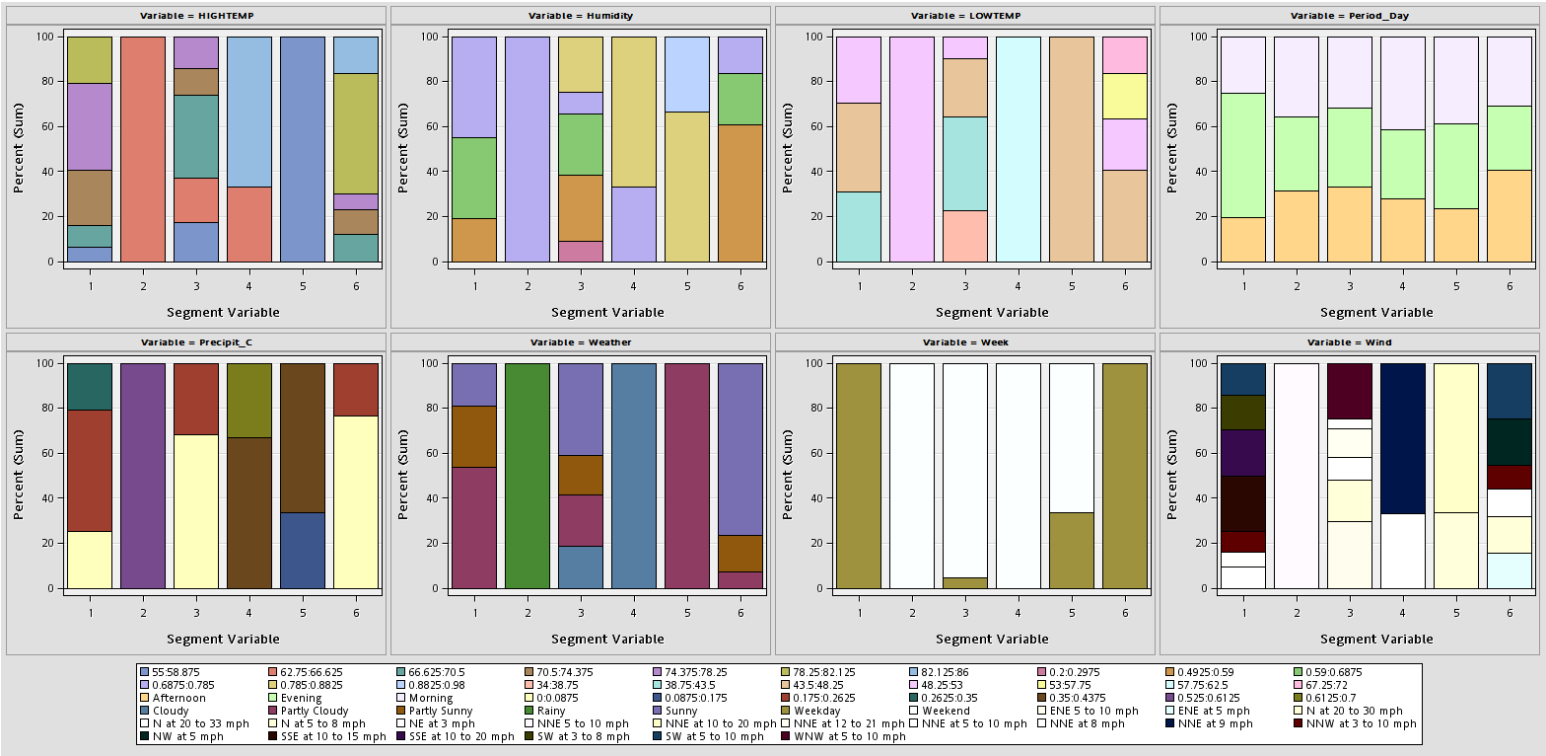
Segment Plot First Cluster (input-independent variables: greenway types and segment types, and target-dependent variable: social ties/bridges)



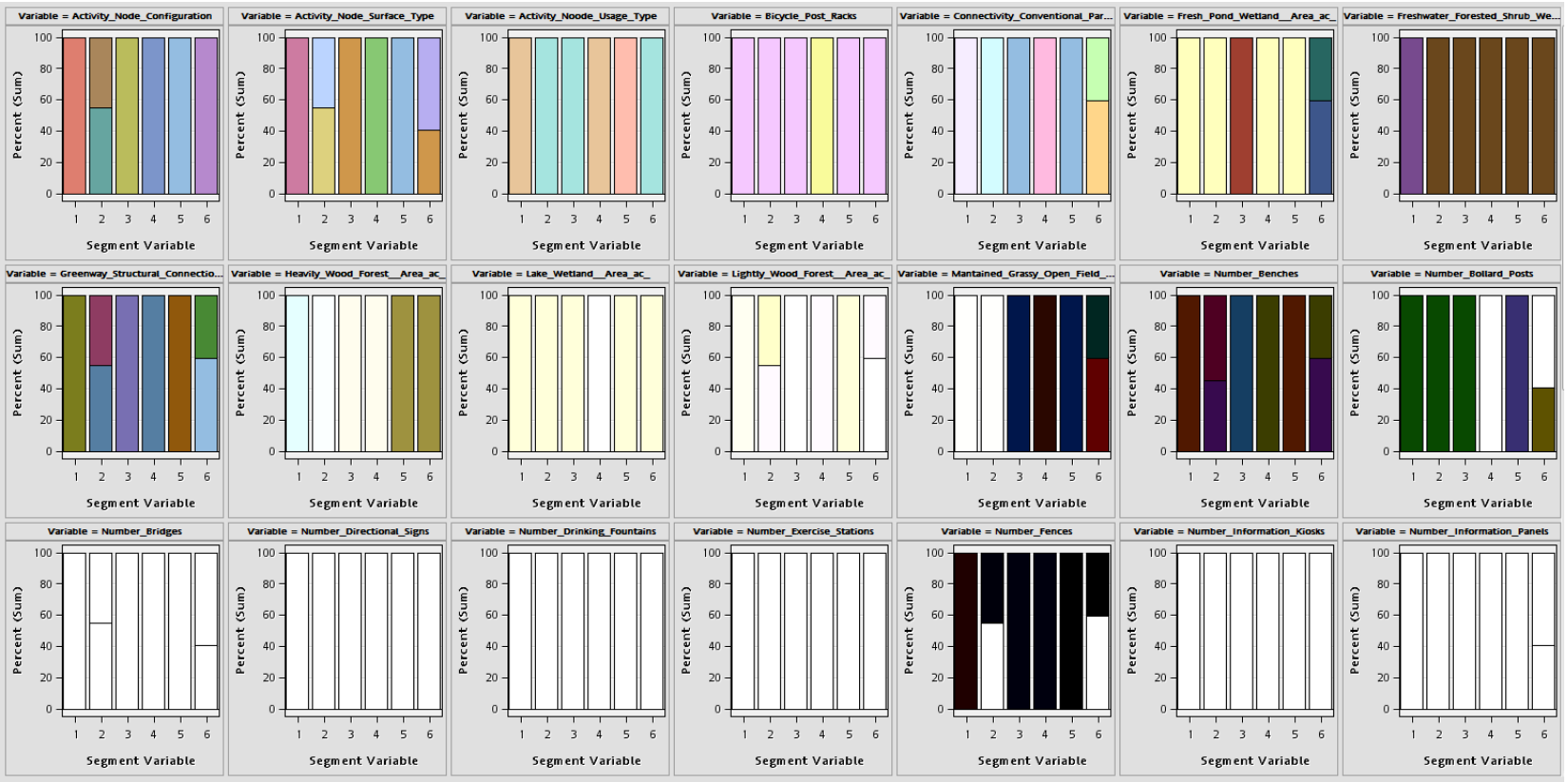
Segment Plot Second Cluster (input-independent people variables: gender type, actor size, actor type and user type, and target-dependent variable: social ties/bridges)

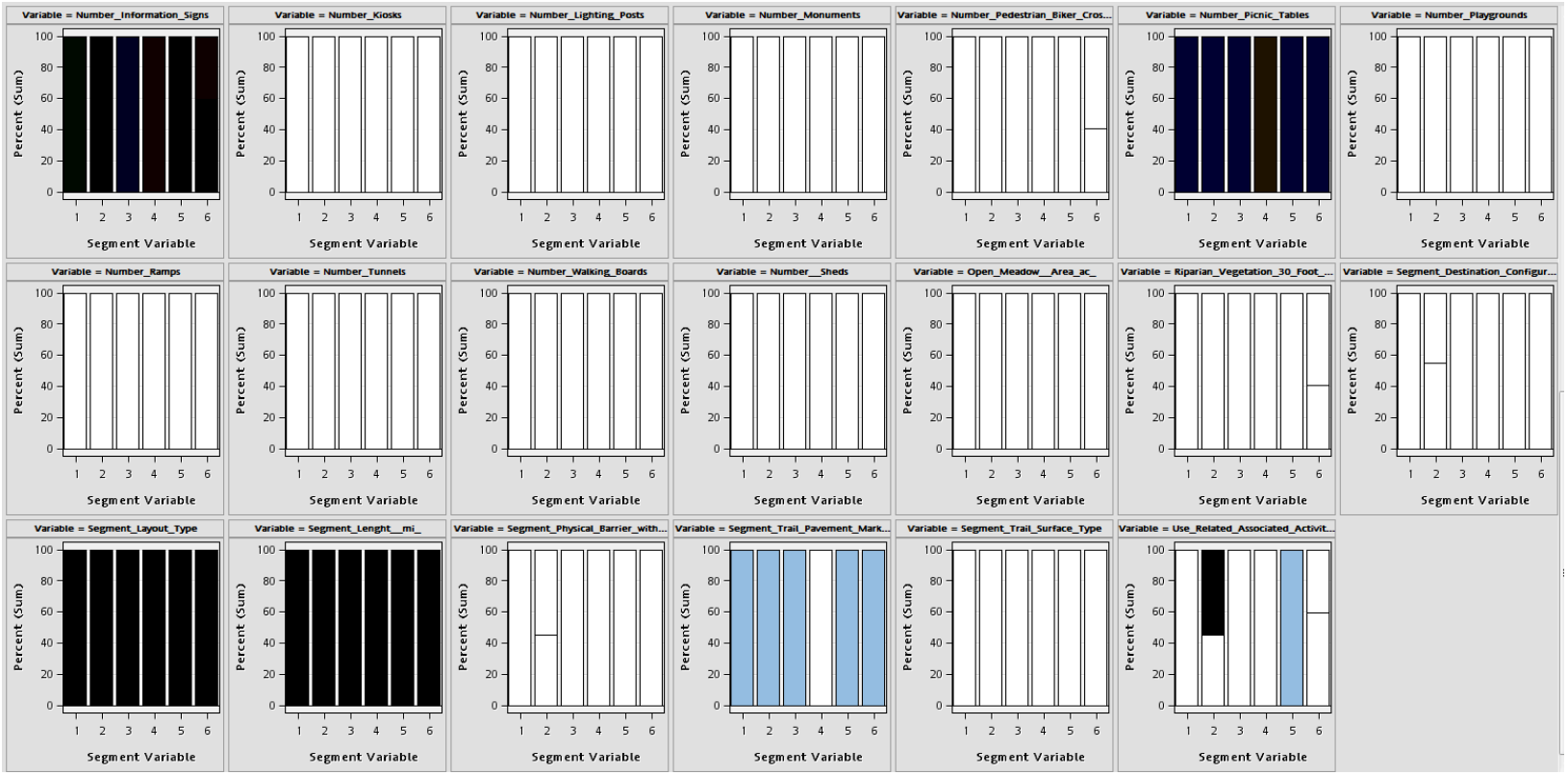


Segment Plot Third Cluster (input-independent temporal variables: week, period of day, and weather condition, and target-dependent variable: social ties/bridges)

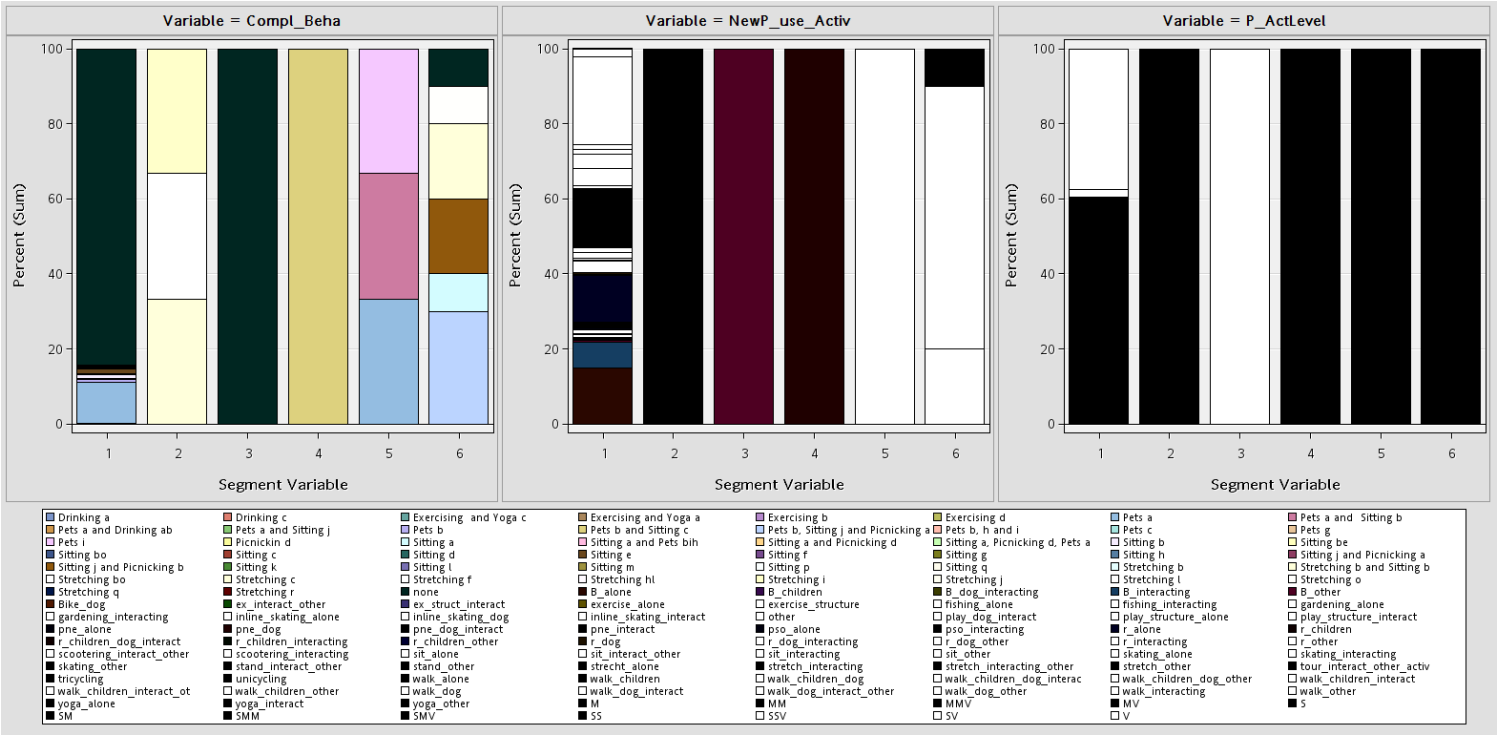


Segment Plot Fourth Cluster (input-independent greenway characteristics variables: activity node configuration, activity node surface type, activity node usage type, bycicle post racks, connectivity to conventional parks, fresh pond wetland area ac, freshwater forest shrub wetland, greenway structural connection with, heavily wood forest area ac, lake wetland area ac, lightly wood forest area ac, maintained grassy open field area ac, number sheds, number benches, number of bollard posts, number of bridges, number of directional signs, number of drinking fountains, number of exercise stations, number of fences, number of information kiosks, number of information panels, number of information signs, number of kiosks, number of lighting posts, number of monuments, number of pedestrian and biker cross walk, number of picnic tables, number of playgrounds, number of ramps, number of tunnels, number of walking boards, open meadow area ac, riparian vegetation 30 foot wide, segment destination configuration, segment layout type, segment length mile, segment physical barrier with connection, segment trail pavement markings, segment trail surface type and use related and associated with activity node type, and target-dependent variable: social ties/bridges)


Variable = Activity_Node_Configuration
Variable = Activity_Node_Surface_Type
Variable = Activity_Noode_Usage_Type
Variable = Bicycle_Post_Racks
Variable = Connectivity_Conventional_Par...
Variable = Fresh_Pond_Wetland__Area_ac_
Variable = Freshwater_Forested_Shrub_We...
Variable = Greenway_Structural_Connectio...
Variable = Heavily_Wood_Forest__Area_ac_
Variable = Lake_Wetland__Area_ac_
Variable = Lightly_Wood_Forest__Area_ac_
Variable = Mantained_Grassy_Open_Field_...
Variable = Number_Benches
Variable = Number_Bollard_Posts
Variable = Number_Bridges
Variable = Number_Directional_Signs
Variable = Number_Drinking_Fountains
Variable = Number_Exercise_Stations
Variable = Number_Fences
Variable = Number_Information_Kiosks
Variable = Number_Information_Panels
Percent (Sum)
0 20 40 60 80 100
Segment Variable
1 2 3 4 5 6


Variable = Number_Information_Signs
Variable = Number_Kiosks
Variable = Number_Lighting_Posts
Variable = Number_Monuments
Variable = Number_Pedestrian_Biker_Cros...
Variable = Number_Picnic_Tables
Variable = Number_Playgrounds
Variable = Number_Ramps
Variable = Number_Tunnels
Variable = Number_Walking_Boards
Variable = Number__Sheds
Variable = Open_Meadow__Area_ac_
Variable = Riparian_Vegetation_30_Foot_...
Variable = Segment_Destination_Configur...
Variable = Segment_Layout_Type
Variable = Segment_Lenght__mi_
Variable = Segment_Physical_Barrier_with...
Variable = Segment_Trail_Pavement_Mark...
Variable = Segment_Trail_Surface_Type
Variable = Use_Related_Associated_Activit...
Percent (Sum)
0
20
40
60
80
100
Segment Variable
1
2
3
4
5
6

Segment Plot Fifth Cluster (input-independent behavior variables: new pattern of use/type of activity, complementary behavior and pattern of activity levels, and target-dependent variable: social ties/bridges)

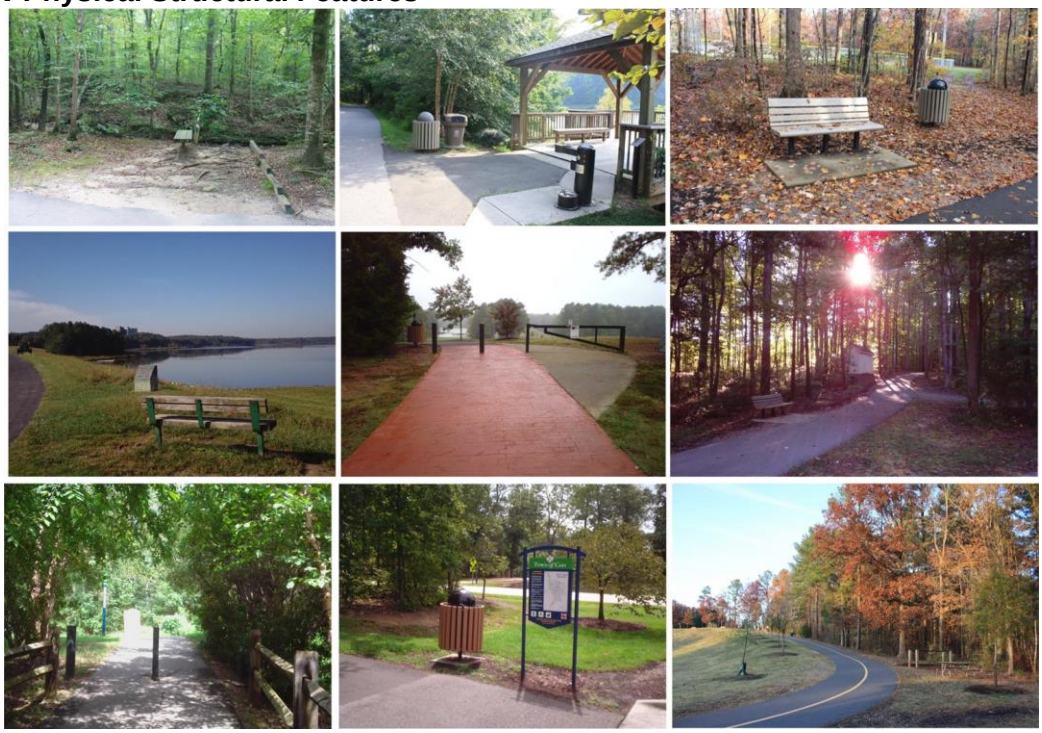


Appendix X. BCGW and WOCGW Pictures: Features, Behaviors and Interactions

BCGW Landscape Features

BCGW Landscape Features

BCGW Physical Structural Features



BCGW Physical Structural Features

BCGW Behaviors and Inner-Interactions

BCGW Behaviors and Inner-Interactions

BCGW Behaviors and Inner-Interactions

BCGW Behaviors and Inner-Interactions

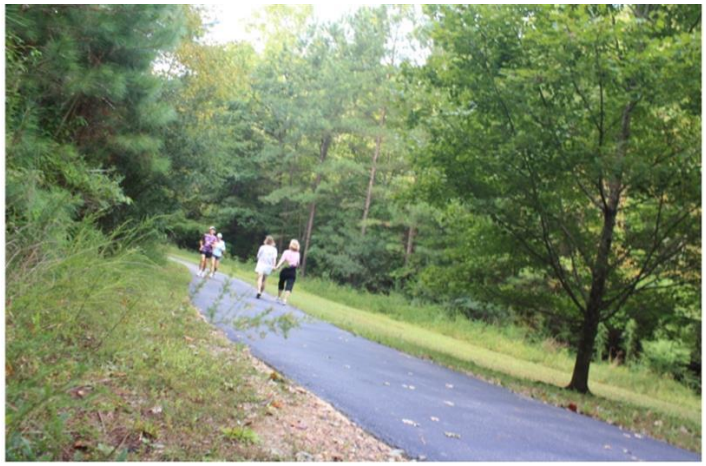
BCGW Behaviors and Inner-Interactions

BCGW Inner and Intra-Interactions

BCGW Behaviors and Inner-Interactions

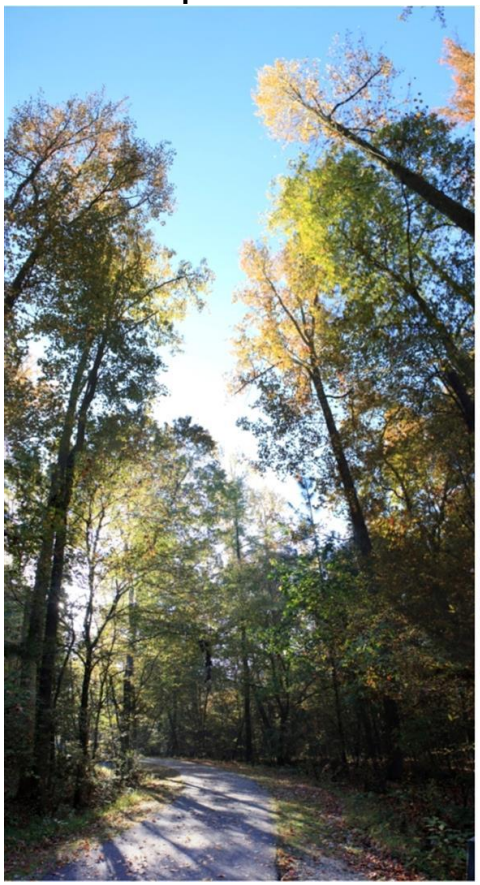
BCGW Intra-Interactions

BCGW Intra-Interactions



WOCGW Landscape Features

WOCGW Landscape Features



WOCGW Landscape Features

]

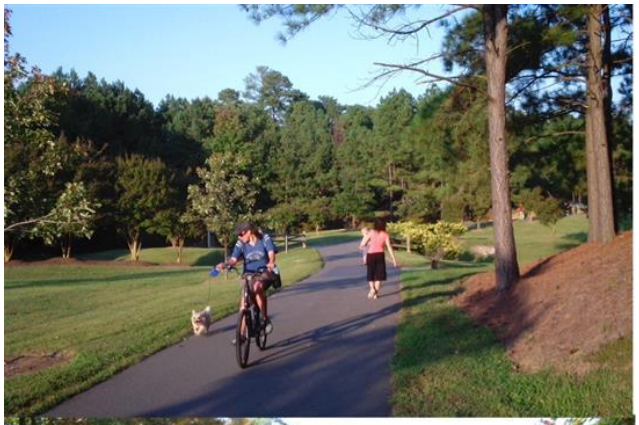
WOCGW Landscape Features

WOCGW Physical Structural Features

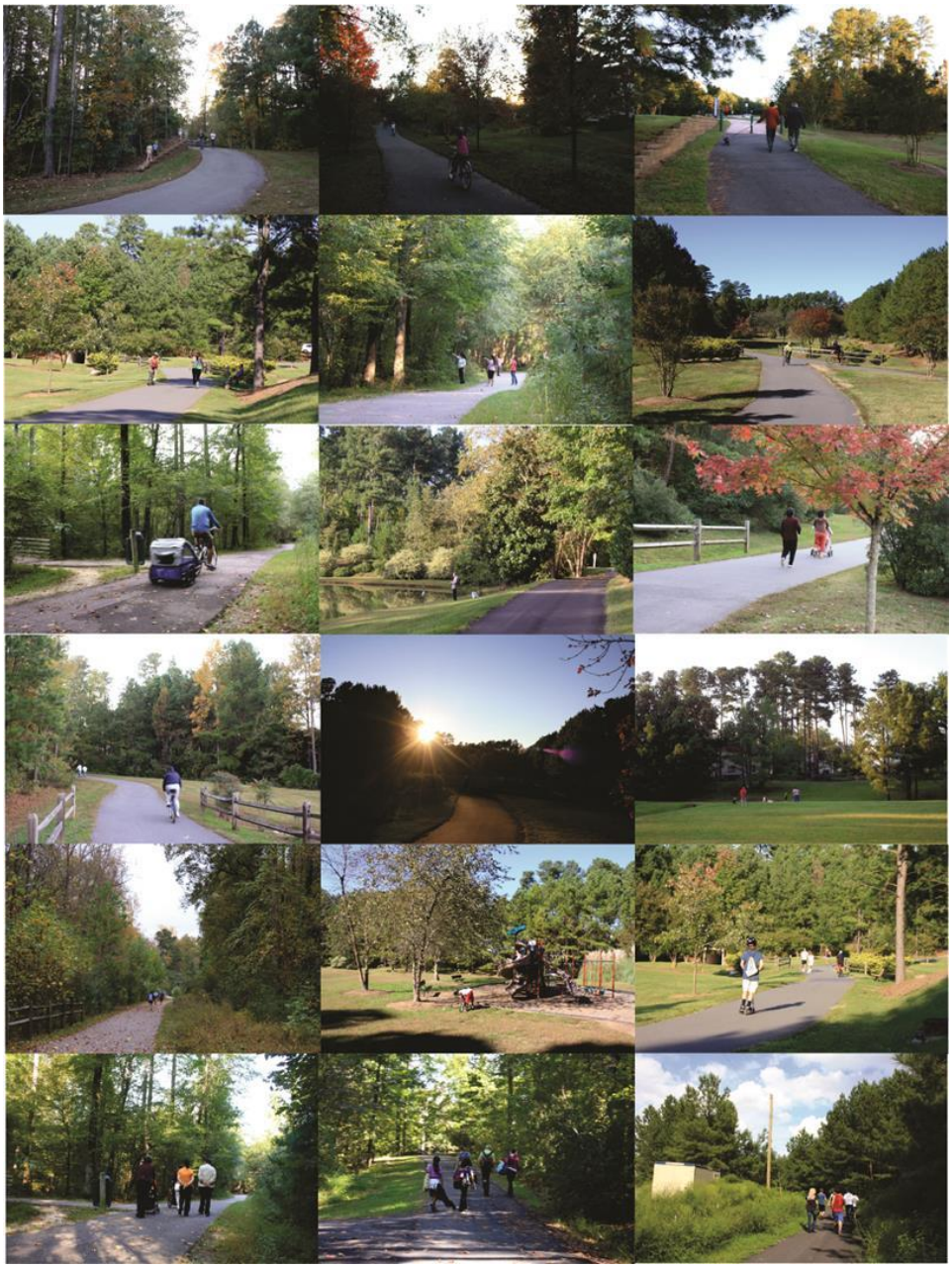
WOCGW Physical Structural Features

WOCGW Physical Structural Features

WOCGW Behaviors and Inner-Interactions

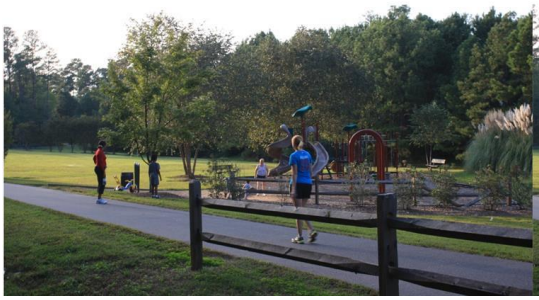


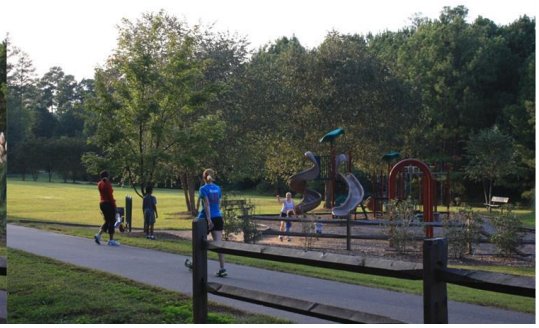
WOCGW Behaviors and Inner-Interactions



WOCGW Intra-Interactions

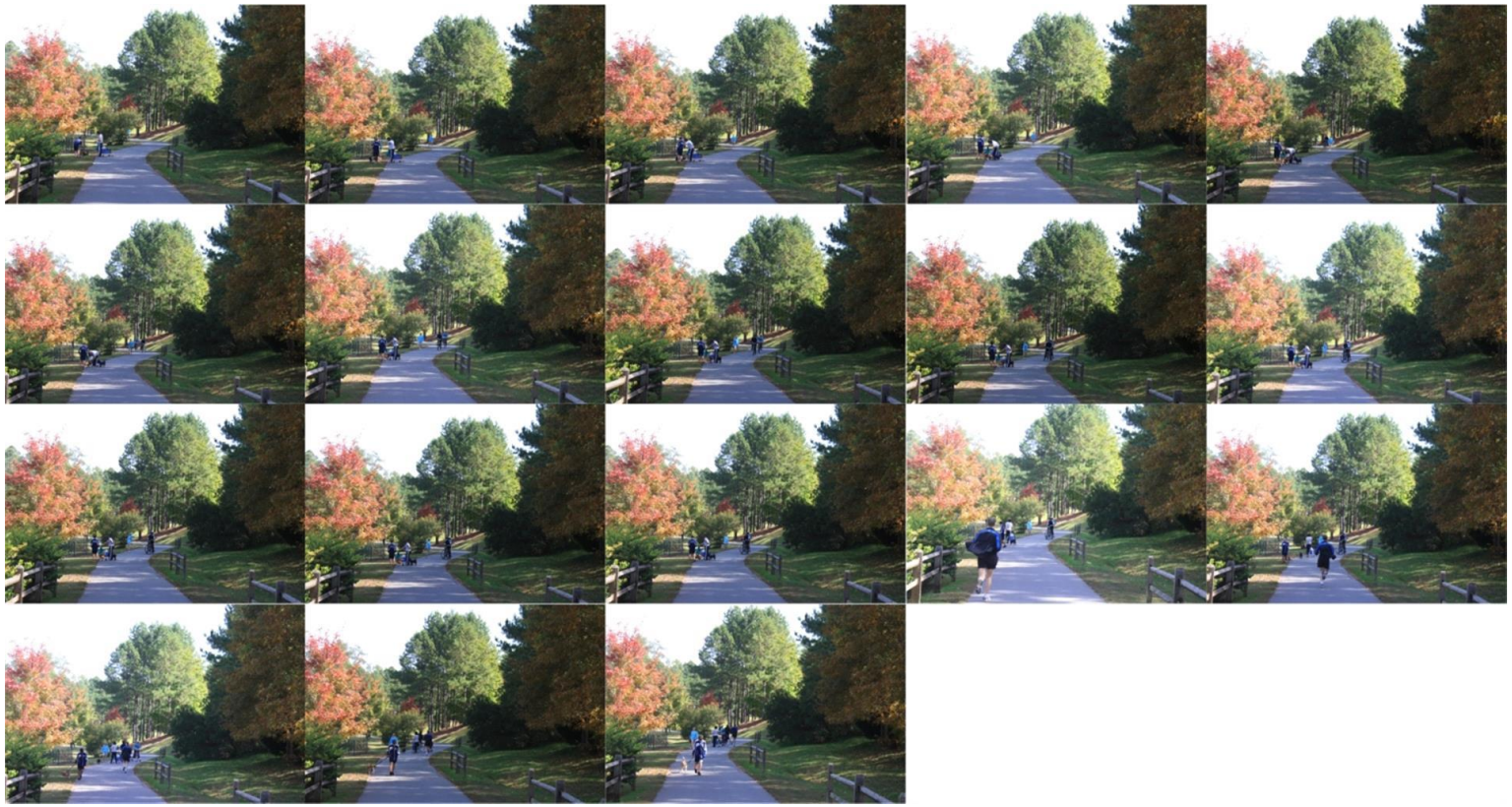
WOCGW Intra-Interactions





WOCGW Intra-Interactions

WOCGW Intra-Interactions



WOCGW Intra-Interactions

WOCGW Intra-Interactions and Centralities