LANDSCAPES AS AN EDUCATIONAL MEDIUM:

INTEGRATING EDUCATION INTO THE OUTDOOR BUILT ENVIRONMENTS OF ELEMENTARY SCHOOLS

by

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(Under the Direction of Alfred Vick)

ABSTRACT

In the American elementary school environment, the school yard, playground, and overall master plan of the facilities are a major part of each child's personal and educational experiences. Just as the interior environments are designed to be conducive to the educational arena, the exterior environments of these schools should also be designed to provide the same educational experiences. Although these elementary school landscapes should reflect the educational needs of the children, many schools' exterior spaces are not addressing what the quality of school landscape should address. The current state of design in the outdoor environments of public elementary schools does not focus on learning, but rather focuses on meeting codes and budget. Landscapes of public elementary schools should be designed to meet the demands and needs of all stakeholders with the primary focus of design remaining on the schoolchildren and their education and experience of the designed site.

INDEX WORDS: adolescence, built environment, education, elementary school, field, k12, landscape, playground, playscape, schoolchildren, sports field, and toddler.

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M.S., GEORGIA INSTITUTE OF TECHNOLOGY, 2013

A Thesis Submitted to the Graduate Faculty of the University of Georgia in Partial Fulfillment of the Requirements for the Degree

MASTER OF LANDSCAPE ARCHITECTURE

ATHENS, GEORGIA

2016

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May 2016

ACKNOWLEDGEMENTS

I would like to foremost thank my parents for their support and strength. Without their strength I would not be who I am today. By reciting God's name, "Om Namaha Shivaya." I am afforded the realization that we are soulless without faith in God and the acknowledgement of God. I cannot demonstrate how much I am grateful for Alfred Vick, Georgia Harrison, and Donna Gabriel for giving me a second chance. You are great teacher's both inside and outside of the classroom. Last but not least, my wife has given me the best advice, support, and strength through everything, thick and thin.

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CHAPTER 1

INTRODUCTION

Purpose

Currently, one of the problems that is challenging the education sector as well as the lives of countless parents and children is the lack of connection with the activities that occur in school and how they limit the benefits of outdoor learning by not integrating the surrounding environment into the school activities. Lack of activity outside goes hand in hand with the growing epidemic of obesity, decrease of physical activity, and increase of time spent on digital media for children. Here are some statistics from a recent issue of *Parks & Recreation* (2012) Magazine: (1) ”1 in 5: Children in the U.S. who live within walking distance of a park or playground,” (2) “31: Percent of U.S. children who played outside daily in 2004,” (3) “70: Percent of children who played outside daily one generation ago,” (4) “7.5: Hours a day the average child aged eight to 18 spends on entertainment media. Due to media multitasking and using multiple forms of media simultaneously, children actually pack in nearly 11 hours of media use daily,” and (5) “15: Minutes of recess time needed to cause children to behave better in class and learn more, according to a study of 11,000 third graders.”

In Richard Louv’s latest book on children and “nature-deficit disorder,” Louv states that:

> “The evidence indicates that experiences in the natural world may reduce the symptoms of Attention Deficit Hyperactivity Disorder, serve as a buffer to depression and anxiety, help prevent or reduce obesity and myopia, boost the immune system, and offer many other psychological and physical health benefits. Time spent in nature may also improve social bonding and reduce social violence, stimulate learning and creativity, strengthen the conservation ethic, and even help raise standardized test scores.” (Louv 2016b)

Concurrently, current research supports that exposure to nature and the outside elements will positively affect student performance, including both student academic achievement and behavior. (Kumar et al. 2008) Studies have also associated nature exposure to better attention levels, greater cognitive function, enhanced levels of self-discipline, and stress reduction, thus improving the overall health, cognitive development, and social values of schoolchildren in nature-exposed classrooms. (Blair and Sobal 2006) Studies of the effect of indoor classroom plants found reductions in misbehaviors, feelings of unfriendliness, and hours of sick leave among junior high students. There exists an obvious ratio between the amount of vegetation (exterior or interior) to various socio, behavioral, and physical behaviors among students. (Matsuoka 2010) A Cornell University study by Nancy Wells and Gary Evans reported that the benefit of conducting research on this topic lies in the potential to better develop the youth of today into the next generation of successful business and social leaders.

Other research in the area of landscape gardening and increasing the fruit & vegetable intake of children further analyzes the effect of school landscapes on children's health. "According to recent estimates, the total worldwide mortality currently attributable to inadequate intake of fruits and vegetables is up to 2.635 million deaths per year" (Bazzano 2006, 1366). That being said, only 6.2% of adolescents in the U.S. consume the recommended fruit and 5.8% consume the recommended daily servings of vegetables. (Evans et al. 2012, 608) There lies an opportunity to use landscape design to further mitigate obesity by introducing a food growing culture within the boundary of the school. "Mounting scientific evidence shows that garden-based nutrition education in schools can improve dietary behaviors and related psychosocial factors in young people"

(609). Studies show that school-based, after-school-based, and summer programs, all are significant in increasing fruit intake, vitamin A and vitamin C intake, and vegetable intake respectively. (608)

Children are sensitive to the environment around them and show keen observations of plant and animals when in their natural settings. The awakening of the senses that arise when in contact with nature seems to diminish in the dual-sensory learning experiences of the classroom. Robin Moore reports that the primary experiences of nature (i.e. sound, touch, smell, taste, visual, etc.) is being substituted by the indirect, one-sided learning experiences found in the classroom (visual and sound only) such as television and electronic media. (Moore 1997) According to Moore,

> "Children live through their senses. Sensory experiences link the child's exterior world with their interior, hidden, affective World. Since the natural environment is the principal source of sensory stimulation, freedom to explore and play with the outdoor environment through the senses in their own space and time is essential for healthy development of an interior life….This type of self-activated, autonomous interaction is what we call free play. Individual children test themselves by interacting with their environment, activating their potential and reconstructing human culture. The content of the environment is a critical factor in this process. A rich, open environment will continuously present Alternative choices for creative engagement. A rigid, bland environment will limit healthy growth and development of the individual or the group." (Moore 1997)

Exposure to natural settings are essential to whole child development and serve as a medium of inventiveness and creativity. These multi-sensory experiences in nature assist in the development of cognitive constructs that are essential to intellectual development. (Moore and Wong 1997) To add to Robin Moore's view on the degree of inventiveness and creativity that nature can offer to children, Simon Nicholson's "Loose-parts" theory

states that the degree of inventiveness and creativity found in any environment is directly proportional to the number and different types of variables within the environment. (Nicholson 1971) This aspect of research in k-12 landscape design is often overlooked or is addressed by field trips to zoos and other destinations that feature nature as the main attraction. Exposure to flora and fauna develops a sense of environmental stewardship within children. The development and understanding of the impact we have on the environment and animal kingdoms positively increases science process skills and improves understanding of design and technology-related issues within the context of natural processes and the animal kingdoms. In fact, Nancy Wells reported that a room with a view of nature potentially protects children against stress. The study found that stressful events in a child's life caused less psychological distress in children who lived in high-nature conditions compared to children who live in the low-nature conditions. (Wells and Evans 2003) There exists many barriers to achieving this type of improvement in schoolchildren via exposure to nature, including (a) health and safety concerns, (b) teacher's lack of confidence in teaching in outdoor settings, (c) school curriculum requirements that limit the opportunity for outdoor learning, (d) shortages of time, resources, and support, (e) broader changes within and beyond the education sector (National Foundation for Educational Research and King's College London 2004), (f) Electronic media, (g) longer school hours, (h) fear of strangers, (i) the worry that we do not know enough to share nature (Louv 2016b, 3), (j) availability of funding, (k) difficulty in maintenance, and (l) teacher involvement. (Dyment 2005, Page 39) The opportunities for this type of improvement in schoolchildren via exposure to nature lie in (a) new legislation & reform, (b) school board reform (National Foundation for

Educational Research and King's College London 2004), (c) teacher involvement, (d) availability of funding, (e) parental involvement, (f) principal involvement, and (g) student involvement (Dyment 2005, 39) as well as in non-profit organizational initiatives that aim to develop and establish this type of learning experience in public schools such as Denver's Learning Landscapes.

Research in this sector of k-12 educational school design needs to be undertaken to better improve the educational experience, behavior, health, and environmental stewardship of schoolchildren and all end-users of the school facilities. Although tremendous research points to a course of action that favors improvements in elementary school landscapes aiming to integrate children into the outdoor built environments, this form of elementary school landscape design is rarely implemented pragmatically. The research being conducted should solve the overall question of how to better integrate the existing curriculum into the exterior environments of the school property with proper consideration of the health, safety, and welfare of the students, teachers and users. Along with the efforts to improve current school landscapes into more educational landscapes, the research being conducted should also support the improvement of the social aspects of whole childhood development.

Methodology

The purpose of the research is to establish effective strategies and demonstrate, using landscape design, ways to overcome impediments to creating a landscape that is progressive towards the educational, social, and healthy experiences of elementary schoolchildren. What are the opportunities that progress the design of outdoor built

environments that improve the educational experience of elementary schoolchildren? Being that current research explores the positive and negative effects of nature and its function on schoolchildren, opportunity lies in utilizing current data on this topic towards a more rational solution for elementary school site design. The new school outdoor built environment design will provide a framework for educating elementary schoolchildren on various biological, ecological, and botanical subjects, while at the same time maintaining its original function of storm water management, circulation, and play areas for children. It will offer a new perspective on how children learn by offering more hands-on knowledge applications for various educational topics that are already covered in the school curriculum. An initial review will be conducted in order to further aid in the design decision-making of the final elementary school test site that will be used for redesign into a more efficient, hands-on learning-based landscape that enhances the school's current curriculum and teaching methods.

The research methodology of this thesis first consists of conducting a literature review on the current research and studies found in academia and in public press that support this view of enhancing the elementary school landscapes to better improve children's academic performance, physical health, creativity, and overall growth into adolescence and adulthood. Furthermore, multiple case studies will be conducted to research current exemplary examples of elementary school landscapes that excel in using the outdoor built environment to improve these qualities in the schoolchildren's education. By performing literature reviews and multiple case studies on these types of elementary school landscapes, some best practices can be established for creating and designing these nature-infused and nature-inducing landscapes within the k-5 schools

sector of the landscape architecture industry. Finally, projective design research methodology will allow the findings from the literature and case study to be applied into an existing elementary school landscape test site. The elementary school test site will function as the control and the redesign of this elementary school's landscape will function as the variable. The decisions made for the redesign process will take into account the findings from literature reviews and successful elementary school landscape case studies. The final output will be a redesigned elementary school landscape for an existing elementary school project that is currently underway.

Limitations

Throughout the course of making critical decisions about the thesis literary analyses, research questions, research strategies, and research methodologies many limitations can be identified. Because the research involves multiple age groups of people, a county facility for schoolchildren, and approval from the administrative figures within the school and school board, there are many barriers that are in place to complete this research. The main limitations that restrict the extent of the research topic proposed are:

1. *Obtaining as-built plans of the existing facility and site to conduct analytical research.* The design research portion of the thesis research will require the use of as-built plans of the existing school site and facilities. To obtain these classified documents, permission from the school board will be required. The strategy to obtain the as-built plans of the existing school facility will be to include the request to this information in an email

to a member of the Athens-Clarke County administration. Within the written email, the school board will be reassured that the use of the provided construction documents would be limited for the purposes of thesis research only and that any improper misuse, distribution, or representation of the contents of the documents will be avoided in any manner, thus outlining to the school board what purposes the research will commence and what restrictions will be placed on the use of the documents. Any representation used within the final thesis research that is derived from the construction documents will only be used with proper permissions granted by the issuing authority.

2. *The lack of present knowledge and current research on the research topic.* Currently, there is a lack of research on the topic of landscapes that induce both the educational and social experiences of elementary schoolchildren. The little knowledge that is available on this topic just scratches the surface of the largely uninvestigated topic of the elementary school landscape experience. The lack of knowledge on this topic is primarily due to the lack of monetary funds available to enhance the landscape as well as the lack of interest of the public school system. Most school boards are satisfied with the current level of designs that are provided with the final design of their elementary school sites, however they lack the knowledge of the potential that elementary school landscapes have to better the educational and social experiences of the schoolchildren, faculty, staff, and parents. Overcoming this limitation in the future would involve larger

efforts both legislatively and in the community to push local school boards and schools to deliver richer learning experience in the school ground by approving new laws, higher budgets for the exterior built environments, and reforming the government-mandated curriculum standards.

3. *The existing budget for landscaping set by the school board.* Typically, in public school construction projects, the budget for the projects landscaping is low and the landscaping team comes into the site after everyone else before occupancy. Also, the school board will define the scope of what the landscape budget can be used for on the school site. The justification for staying within the budget limitations set by the school board is to most accurately represent a real landscape design project for a new construction public elementary school. By staying within the limits of the budget, an effective design can be introduced to the school board that both meets their minimum requirements and better delivers a positive learning experience for the schoolchildren, thus proving that a school ground landscape that delivers a variety of learning experiences on-campus can be produced within a typical public school budget.

Delimitations

In the process of investigating the research questions and developing the research strategies & methodologies, much delimitation must be set. These delimitations are set to allow the researcher to see the full canvas of what is pertaining to the research topic and what is not pertaining to the research topic. Once these boundaries are set, the researcher

can better utilize the resources at hand for only the progression of the research at hand. There are many definitive boundaries of the study. The main delimitations that set the limits and boundaries of my research proposal are:

1. *The physical delimitation of the test elementary school site topography, site elements, and parcel boundary.* The test school site will have an existing topography by which the final design will be based on. Because the existing topography might be too steep or the soil might be too sandy, the researcher's final design will have to conform to the restrictions and needs of the existing landscape at hand. The property boundaries shall be set based on the school board's ownership of land. By staying within the context of the school site's parameter (i.e. topography, sun exposure, vegetative habitats, drainage patterns, and pedestrian/vehicular circulation, soil type, and slopes) the design of the school ground can deliver the best learning experience for children, while also utilizing what is existing on the site for cost-effectiveness.
2. *The physical delimitation of confining the final design to the exterior portions of the site and not architectural, structural, or interior portions of the test school site.* Because the topic of the research focuses on landscapes that are conducive to the educational and social experiences of schoolchildren, all portions of the research strategy and methodology will focus primarily on the redesign of the exterior portions of the test school site. Although any design of the exterior portions of a site will alter the experience of the site from the eyes of the structural, architectural, and

interior points of view, a physical boundary will be placed so that the interior portions of the school are not a part of the research and design. The reason behind studying the exterior portions of the school ground are to explore best approaches to expanding the learning abilities and environments within a close proximity to the schoolchildren's' classrooms. By providing learning opportunities on the school site, teachers and administration would be more likely to actually teach using nature and the built environment.

3. *The conceptual delimitation of what is age appropriate for schoolchildren.* Assuming that the test school site would be an elementary school, many design ideas must be adjusted or abandoned all together for the safety and usability of the schoolchildren. Children-proofing the design is a mandate from both the eyes of the school board and parents. The reason behind studying the design of elementary schools' exterior built environments was to address the how influential the exterior school environment can be on the schoolchildren at that age. In the third grade, children are exposed to standardized testing. Also around that age, children are intrigued by exploring their surrounding environment and sponge more information. Designing for that age category is something that must strongly influence the design decision-making.

Justification

The benefits of this study can contribute to real landscape projects for the elementary school education sector regardless if the projects are for new construction, renovations, or additions. The raw data and finalized design will provide a plethora of beneficial research for use in real elementary school projects. The research data gained from the literature review and case studies will allow future designers to see the landscape of elementary schools from the eyes of the stakeholders. The tangible data will be the evidence that will help progress the future of landscape design within the context of elementary schools. Research on this topic allows landscape designers in the elementary school education sector to realize flaws and impractical decisions in some aspect of their designs that can be improved into functional and useful elements of design that benefit not only schoolchildren, the primary users, but also teachers, parents, and staff, the secondary users as well. A few changes to an elementary school campus that allow the schoolchildren to feel comfortable, sociable, and intelligent can alter the overall student morale and mold children into practical adults with brighter futures.

CHAPTER 2

LITERATURE REVIEW

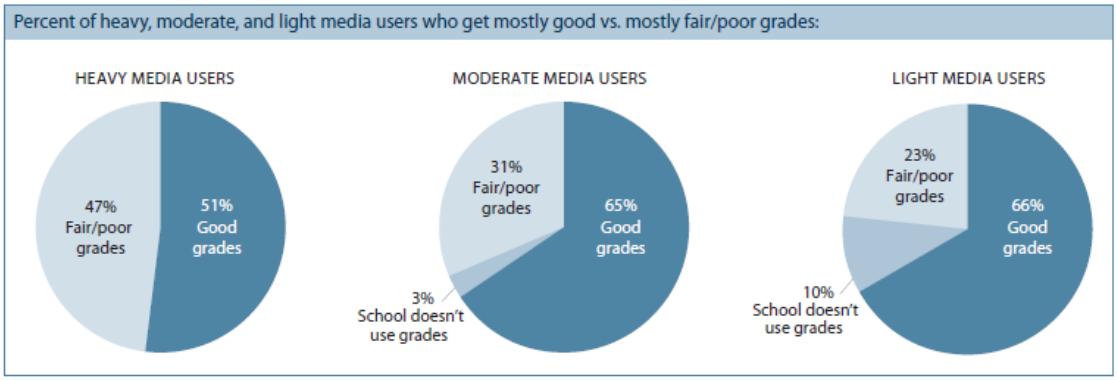
Student Performance

In a 2010 speech, U.S. Secretary of Education Arne Duncan stated that "A well-educated student is exposed to a well-rounded curriculum. It is the making of connections, conveyed by a rich core curriculum, which ultimately empowers students to develop convictions and reach their full academic and social potential." (Duncan 2010) Defining a well-educated student and high-performance learner is an essential step in establishing the grounds of what should be considered the best learning environments and methods for our children. In Coyle's words, it constitutes a child "who is motivated, curious, and even hungry for knowledge. A good learner is creative, a problem solver and has broad perspective, and every problem looks like an intriguing new puzzle to be solved." (Coyle 2010, 11) Academic research does support the idea that more inventiveness and creativity can be observed in children following larger numbers of environmental variables that we expose to them. (Ramey 1973) In fact, the outdoors offers a significant number learning variables and educational benefits that will help our children lead a fulfilled life with a broad future. Likewise, the outdoors can be an integral part of a child's education and curriculum, rather than just solely relying on the confinement of the indoor classroom. (Coyle 2010, 11)

Richard Louv states that "One might argue that the Internet has replaced the woods in terms of inventive space, but no electronic environment stimulated all the senses. So far Microsoft sells no match for nature's code." (Louv 2008, 87) A huge barrier to environmental exposure in schoolchildren can be seen in the advent use of

today's mobile media devices and electronic devices. The harsh reality of American children today consists of an average American child aged 8- to 18- years old will spend seven hours and 38 minutes per day (53 hours per week) indoors using some form of electronic media like television, computer, video games, iPads, etc. (4) The results of this study show that:

"Youth who spend more time with media report lower grades and lower levels of personal contentment." (4)



Source(s): Rideout et al. 2010, 13.

Figure 2.1. Pie Graph Comparing Schoolchildren's Media Use and Grades.

Overall, more negative trends are prevalent in heavy media users compared to light or moderate media users. Heavy media users also are more likely to say they get into trouble a lot, say they are often sad or unhappy, and say they are often bored. Media consumption overall can be managed and reduced by parents that limit media opportunities by (a) imposing some type of media related rules on their youth, (b) not putting a TV in youth's bedrooms, and (c) not leaving the TV on during meals or in the background when not in

use. The results of these media consumption statistics demonstrates to parents the effects of raising their offspring with media rather than traditional discipline, and virtues. Parents are very much so in control of media consumption in youth. (4)

Following legislation in The National No Child Left Behind Act of 2001 that concentrated on high stakes testing for children in school, cutbacks in many discretionary activities, physical education programs, and other expendable programs were inevitable. Only topics covered on these tests seemed relevant to the actual curriculum of these schools. In fact, very little actual environment or nature-based content was covered in these tests. At the time, knowledge of environmental and outdoor education programs was significant enough for environmental and outdoor educators to state that students performed at higher levels through exposure to these types of nature-based programs, however it was harder to state that these nature-based programs also improved performance for the children on statewide tests. When framing student academic performance in context to outdoor public school environments and learning programs, the question that followed was “Do environmental education programs support higher performance on standardized tests?” (Coyle 2010, 21-22)

Prior to this major legislation, research did point to increased levels of academic performance in children who are exposed to the outdoors and natural settings both while in-school or out-of-school. A 1998 breakthrough study of this exact notion led to many advances in the definition and implementation of proper outdoor learning approaches for American youth even before the passing of such legislation cutting these types nature-based programs. The State Education and Environmental Roundtable (SEER) along with the support of the Pew Charitable Trusts and twelve state Departments of Education[i]

made this effort to examine high quality environmental education programs across the country. The SEER study found that 92% of the students exposed to the Environment as an Integrating Context for learning (EIC) programs academically outperformed their peers in traditional programs. The SEER study also found that 100% of the students exposed to the EIC programs outperformed their peers in traditional programs in the comparative analyses of the behavioral data.

In a similar study comparing test scores for children taught in environment-based classrooms vs traditional classrooms, over a five-year period from 1997-2002 also demonstrated positive improvements in academics. The results showed that for the state-wide test, 65% of the Environmental Education (EE) schools did better in math, 66% of the EE schools did better in reading, 73% of the EE schools had better sores in writing, and 60% of the EE schools showed superior performance in listening. For another national exam, the results showed that 58% of the EE schools did better in math, 57% of the EE schools had higher scores in reading. Holistically, of the 77 pairs of schools studied, 73 of the EE schools, or 95%, did better on the tests with a significant margin. The study actually reaffirmed that EE programs not only proved to increase science scores, but also literacy and reading. (Bartosh 2003)

Often times nature is undefined both in the context of subjective and objective definitions of what nature actually is. A recent study reported that exposure to nature has a positive effect on student academic performance. Scientists used an algorithm, “Vegetation Index,” to quantify the concentrations of green leaf vegetation around multiple school environments. Test results from 905 public schools of third graders were measured in comparison to the vegetation index of the surrounding schools in the months

of March, July, and October between 2006 and 2012. In the end, the result demonstrated a positive significant association between the “greenness” of the school and standardized test scores and schoolwide performance in Math and English tests. These results are informed by the seasonal change that occurs between Spring and Summer to Fall and Winter. Many deciduous trees shed their leaves and become “browner.” The visible light spectrum of the color green decreases and less infrared light is reflected back to space during the latter seasons, thus showing the effect of this dramatic seasonal change on the schoolchildren. However, the conclusion was that “students with higher exposure to greenness for the balance of the year (even in summer) show better academic performance too. (Wu et al. 2014)

In support of the Attention Restoration Theory, Stephen Kaplan reports that directed attention has a significant role on information processing and can cause fatigue of the mind, therefore having impactful consequences. The Attention Restoration Theory suggests that experiences with natural environments lead to a form of recovery from directed attention fatigue. (Kaplan 1995, 169) The Psycho-evolutionary Theory actually proposes that having an encounter with most tranquil and calm natural environments will reduce stress and have a restorative influence on those experiencing stress due to our natural instinct to react to the environment around us, whereas the fast-moving, hectic, and demanding urban environments evoke stress and alertness, resultantly becoming a barrier towards recuperation. A similar study examining the effects of greener school grounds on the academic achievement of 101 high schools’ students found a similar outcome. The results indicated that larger window views of more natural landscapes from the cafeteria, outdoor eating areas, and classrooms are associated with improved student

academic achievement and behavior. (Matsuoka 2008, 68-69) The greatest positive effect was seen from the exposure to more natural surroundings during the lunch period. Particularly, students who experienced a view of nature with higher nature content during lunch significantly saw an increase in Merit Award recipients, more students with four-year college plans, and graduation rates. Also, allowing students to eat outside during the lunch break also led to more Merit Award recipients. Having a view of more natural landscapes in the classroom is correlated to having a higher percentage of students planning to attend a four-year college. (Matsuoka 2008, 66-68) To be considered a more effective natural environment in student academic achievement and behavior, the results of the study suggest the trees and shrubs need to be in close proximity to the viewer. Furthermore, allowing students to spend their lunch period in a place where they can actually experience nature forehand can prove exceptionally beneficial for the recovery from mental fatigue and stress. Another suggestion is that the vegetated landscapes lacking in natural features like athletic fields, lawns, and farmlands are also associated with poorer student performance. The report also suggested that more natural features made a difference on the campus only if visible from inside the classroom or lunchroom through the window, thus making the argument for landscape design decision-making that considers the view of the vegetated landscape from inside the building or structure. (76) The landscape design of the school landscape does have a significant impact on student academic achievement.

Furthermore, Ulrich's psycho-evolutionary theory proved beneficial in the context of hospitals and their main purpose, to heal patients. Ulrich's 1984 landmark study comparing gallbladder patients with a room facing a grove of trees or a room facing a

brick wall, he found that those patients with a view of nature left the hospital almost a full day sooner than those without. He also found that these same patients required a fewer dosage of strong and moderate pain medication. (Ulrich 1984) Similar to Matsuoka's findings that windows views with more diversity in nature lead to improved academic and behavioral performance in high school students (Matsuoka 2008) and Wu's study demonstrating that the higher exposure to greenness throughout the year leads to higher academic performance in students (Wu et al. 2014), Ulrich's findings also supported the design of the exterior built environment with the view from the interior perspective of the building occupants in mind. Architect Alvar Aalto actually designed a hospital in his native Paimio, Finland that actually emphasized the health benefits of well-designed architecture and the role of nature view in the healing process. The healthcare facility featured a patients' wing with south-facing rooms that allowed the sunlight to brighten the rooms and views of a pine forest. In fact, Aalto conditioned that the surrounding built environment be calm, soothing, and pleasant. Later this hospital served as a standard for all later hospitals. (Sternberg 2009, 5-6)

In the footsteps of Aalto's design, landscape design should allow for sunlight to light up the classrooms and rooms along the Southern exposure of the school building and provide a steady 'green' backdrop of evergreen foliage in the background for year-round and balanced exposure to more greenness. One study that involved examining the effects of colored light shined on mid-sized rooms' walls supported the idea that blue is calming, whereas red and yellow are more stimulating colors. Furthermore, feelings of hunger and thirst were more apparent in people in the red rooms, whereas food and beverage consumption was prevalent twice as much in the yellow room. In fact, the word that

people used to describe their emotion in the blue room was “calm,” comparatively more so than in the other two colored rooms. In conjunction with the psycho-evolutionary theory’s suggestion that unthreatening and tranquil, pleasant environments reduce stress in people, the design of the exterior views of the landscape from the classroom window should utilize the effect of the color blue on people, which also “calms” people immersed in a blue-colored environment. (Sternberg 2009, 41-42) To that effect, planting native vegetation with blue-foliage and/or blue fruits or flowers should also invoke similar feelings.

Benefits of School Gardening

School gardens were first introduced in the United States at the George Putnam School in Roxbury, Massachusetts in 1890 by Henry Lincoln Clapp. Along with European influence, the spread of school gardens was also indigenously influenced by a number of factors. During this time period, the concept of school gardening spread because of concern about rural out migration from declining farm communities, heightened attention to nature conservation and preservation, and due to fears about less education immigrants in major cities. By 1918, every state had at least one school gardening program. Furthermore, they served as war contributions by getting one million children to contribute to the U.S. food production during World Wars I and II. By applying the concept of Victory Gardens, the U.S. Army induced children to grow food for food production under the U.S. School Garden Army Program. (Koehlstedt 2008) In fact, 40% of all fruits & vegetables consumed in the U.S. during World War II were raised in Victory Gardens. (Bentley 1998) Recent applications of school-based gardening

learning approaches focus on appreciation of the environment & environmental stewardship as well as the integration of school-based gardens into learning approaches and curriculums. (Kane and Hayden Smith 2008)

Source(s): Kohlstedt 2008

Figure 2.2. Late Nineteenth Century School Gardens with Second-grade Students at Hyannis Normal School in Massachusetts.

Current research on the effects of gardening on schoolchildren point to many positive directions ranging from behavioral, academic, health, environmental stewardship development in children. The most transparent benefit of school gardening can be distinguished as the increasing knowledge, awareness, and exposure to healthier eating habits of eating fruits and vegetables. A time lapse study of children's nutrition conducted by Mathematica Policy Research, Inc. allowed researchers to assess the

adequacy of children's diets based on estimates of what children usually eat. The study found that in terms of fresh vegetables and fruit, all elementary schools offered some type fresh produce (fruits or vegetables) in their lunch menus at least once per school week. Elementary schools offered raw vegetables in their lunch menus on average three times per school week and offered fruits on average two times per school week. 20% of elementary schools did not offer fresh fruit on their lunch menus. Only 24% of elementary schools offered fresh fruit on their lunch menus every day and 39% offered fresh vegetables on their lunch menu every day. (U.S Department of Agriculture 2007b, 141) The application of school gardening will further expose different fruits and vegetables to the children thus encouraging greater consumption and knowledge about the nutritional benefits and requirements that fruits and vegetables fulfill.

The National Farm to School Network describes farm to school programs as "a program that connects schools (K-12) and local farms with the objectives of serving healthy meals in school cafeterias, improving student nutrition, providing agriculture, health, and nutrition education opportunities, and supporting local and regional farmers." Many school districts have implemented Farm-to-School programs. Farm-to-School programs enrich the connection communities have with local, healthy food and food producers by changing food purchasing and educational activities at schools. (Joshi et al. 2014) Through the Farm to School program, the local economy gains a boost as well as the local environment. By buying and delivering within local proximity, school districts reduce the carbon footprint and further create healthier ecosystems and environments around the school grounds and local communities. (National Farm to School Network)

Currently, the farm to school program is nationally implemented in 42% of school districts across the country, totaling 5,254 districts and 42,587 schools and more than 23.6 million schoolchildren. Nationally the farm to school programs account for 17,089 salad bar offerings in schools and 7,101 school gardens developing on campuses. (Farm to School Census, "Farm to School Works") For the 2013-2014 school year, approximately 21 schools within the Clarke County School District participated in farm to school activities. In addition to this greater benefit, the farm to school program also initiated the use of local foods in the (a) breakfast program, (b) lunch program, (c) snacks program, (d) fresh fruit and vegetable program, and (e) summer meals program. Overall the farm to school program has helped school districts invest over $1 billion dollars in local economic activity nationally. (Farm to School Census, "Georgia, Clarke County, 2015 Farm to School Census Responses")

There exists some form of improvement in the overall nutritional value offered to schoolchildren through the farm to school program through the administering of more salad bars in school cafeterias, reports of higher school meal participation, and improvements in student attitudes and behaviors towards new foods, and increased fruit and vegetable consumption. (Martin 2008) For Abernathy Elementary School, the introduction of the salad bar also saw an increase in the number of servings of fruits in vegetables per meal. Before the salad, bar, kids consume on average 1.24 servings of fruits and vegetables per lunch purchase, whereas the last three months of the salad bar recorded 2.26 servings per lunch purchase. (Silverman et al. 2006) Two Elementary schools in Olympia, OR, Lincoln Elementary School and Pioneer Elementary School, also saw a similar increase in the number of fruit and vegetable servings that children

intake during school lunches after the introduction of a salad bar during school lunches. The application of a farm to school program called the Juanamaria Healthy Schools Project actually saw students choosing the salad bar lunch over the hot lunch at a two to one ratio usually regardless of the type of hot lunch offered in Juanamaria Elementary School. (Christensen 2003, 12) From 2003 to 2004, Yolo County reported that after they introduced a salad bar to their elementary schools, their children's consumption of fruits and vegetables increased to more than 120% of the United States Department of Agriculture (USDA) requirement. (Feenstra and Ohmart 2005) In fact even among the low-income population, the introduction of a salad bar lead to an increase in fruit and vegetable consumption among 337 children ages 7-11 in a Los Angele School Unified School District. Fruit and Vegetable consumption increased from 2.97servings to 4.09 servings after the installation of the salad bar. In a comparison of the quality of nutrition that the children received, the children's mean energy, cholesterol, saturated fat, and total fat intakes were significantly lower in children after the salad bar was introduced. (Slusser et al. 2007) Even bilingual students, international students, and English-learning students can benefit from the application of a farm to school program. 5th and 6th graders from the Lozano Bilingual and International Center School actually increased their daily fruit and vegetable consumption by 53.6% after participation in the farm to school program. (Joshi and Azuma 2006) This program increases school lunch participation which leads to an increase in revenue for the school from students purchasing more lunches through the school lunch program.

Aside from the multiple cases that saw improvements in fruit and vegetable consumption with the application of the farm to school program and/or salad bar, more

children also chose healthier eating habits outside of the school as well. A similar farm to school program in Burlington, Vermont actually led to 60% of students claiming to eat new foods, 59% of students claiming to eat healthy snacks more often, 56% of students claiming to eat less healthy food choices less often, and 31% of students claiming to eat desserts and sweets less often. (University of Vermont 2006, 4) The Kindergarten Initiative, a farm to school program applied to Pennsylvania kindergartens, not only improved healthier eating habits, but actually proved beneficial to the overall healthy lifestyle of children in the program. 90% of the parents with children in the program reported that they had changed the way they shop, cook, and talk with their children about food, and the program also increased parental awareness around providing healthier snack options for their children by 80%. (The Food Trust 2007, 18)

The past couple of decades have seen school gardening turn into a national movement. 44% of school districts that were surveyed in the Farm to School Census indicated that they maintained and used a school garden to teach children about growing food, which represents an increase of 42% compared to school gardens in existence pre-2013. Gardens, in the context of schools, have been primarily used for experiential education. Quantitative studies show benefits of school-gardening in the areas of science achievement and food behavior. (Blair and Sobal 2006, 63 – 74) Children's attitudes towards school was more positive in schools that offered more intensive individualized gardening. (Waliczek et al. 2001)

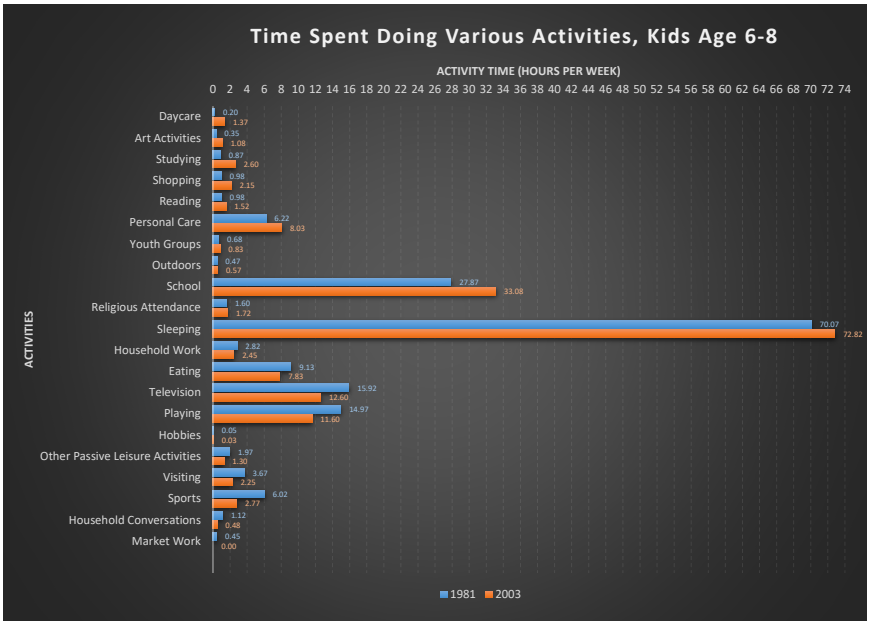
There is substantial evidence that children that participate in school gardens do in fact increase their fruits & vegetable consumption and improve their nutrition knowledge and vegetable preferences thus also encouraging children to select healthier snack

options. (Farm to School Census, “Farm to School Works to Make Gardens Grow”) Out of 11 studies examining the effect of school gardens on fruit and vegetable intake on children ages five to 12, nine studies found that the intervention group of students that participated in the school garden program saw a higher intake of fruits and vegetables compared to the non-participating groups of students with an increase ranging from +0.3 to +0.99 servings per day. (Knai et al. 2006) A gardening program implemented at two schools in the San Francisco Unified School District proved to improve knowledge about fruits and vegetables, the ability to identify different fruits and vegetables, the consumption of different varieties of fruit and vegetables. (Ratcliffe et al. 2011)

Outdoor Learning

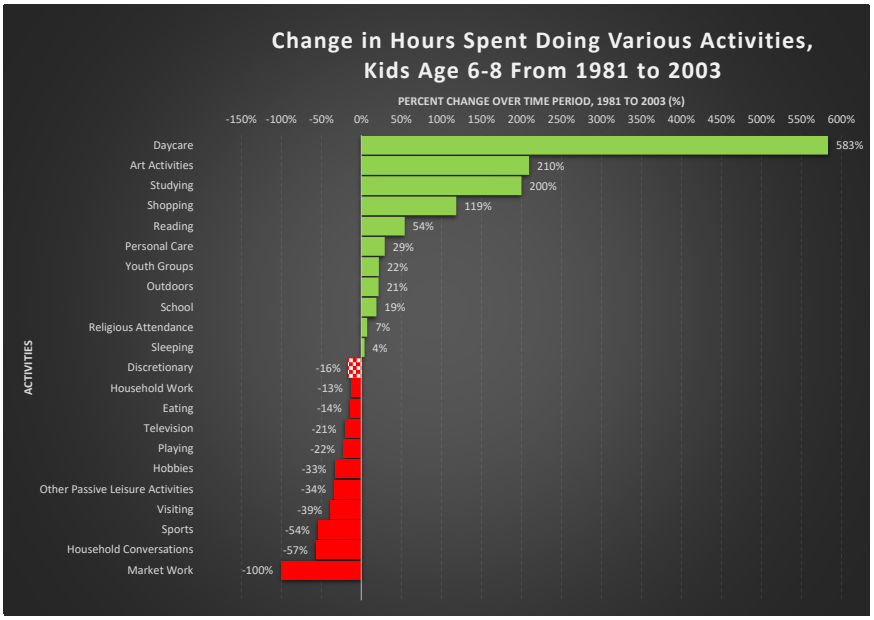
During the implementation of the Outdoor Challenge, an experiment initiated by Robert A. Hanson, in its last two years, 49 participants divided into eight groups were asked to go on a nine-day backpacking trip through a large wilderness area around the McCormick Experimental Forest in Upper Michigan. (Kaplan & Kaplan 1981) In reading the comments expressed by the participants’ post return from the backpacking trips, they were trying to understand and assimilate new perceptions gained from nature exposure to the current realities of their day to day lives. For many of the participants, reentry into their daily fast-paced lives in “civilization” requires readjustment. Many people noted that civilizations’ surroundings are ugly and artificial as well as they noted the civilization tends to unnecessarily impose urgency in daily activities and the expose superficiality of friendships. (143) There is much literature that does support the ability of outdoor visits to restore the attention and concentration levels of schoolchildren.

In 1981, children aged six to 12 spent approximately 111 hours (66% of their week) towards non-discretionary activities (eating, sleeping, personal care, school, and day care) compared to 121 hours (72% of their week) in 2003. An eight percent increase in non-discretionary time also means that children had approximately 10 hours less time per week (approximately 1.5 hours per day) for discretionary activities (i.e. studying, playing, outdoors, sports, television, shopping, hobbies, art, etc.). Sandra Hofferth accounts this decrease in discretionary time to children spending more time sleeping and in school. (Hofferth 2009, 37) Figure 2.8 and 2.9 shows the change in the amount of time children age six to eight spent doing various activities from 1997 to 2003 and the percent of increase or decrease of the amount of time spent for each activity respectively. Figure 2.10 and 2.11 shows the same data for kids age nine to 12 from the time period 1981 to 2003.



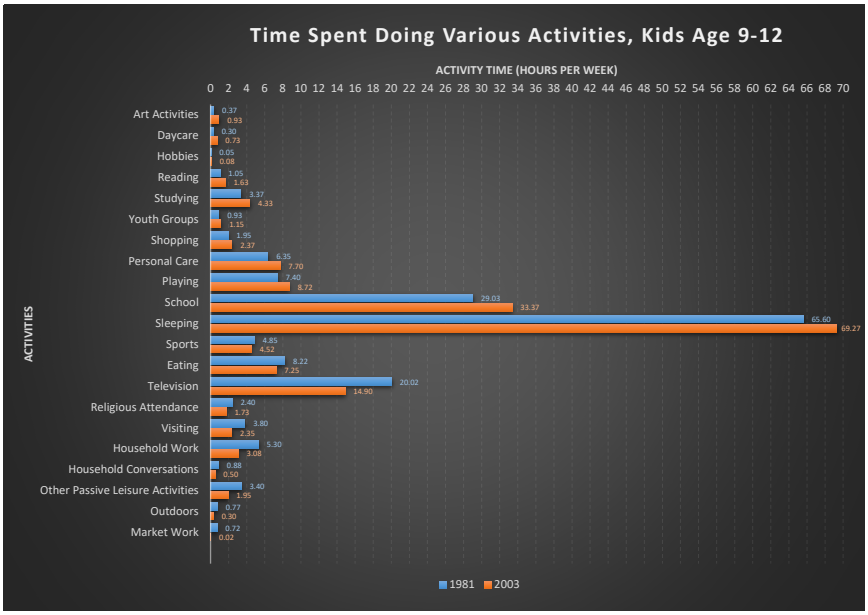
Source(s): Recreated from Hofferth and Sandberg 2000, 27; Hofferth 2009, 38.

Figure 2.3. Time Spent Doing Various Activities, Kids Age 6-8 (1981-2003).



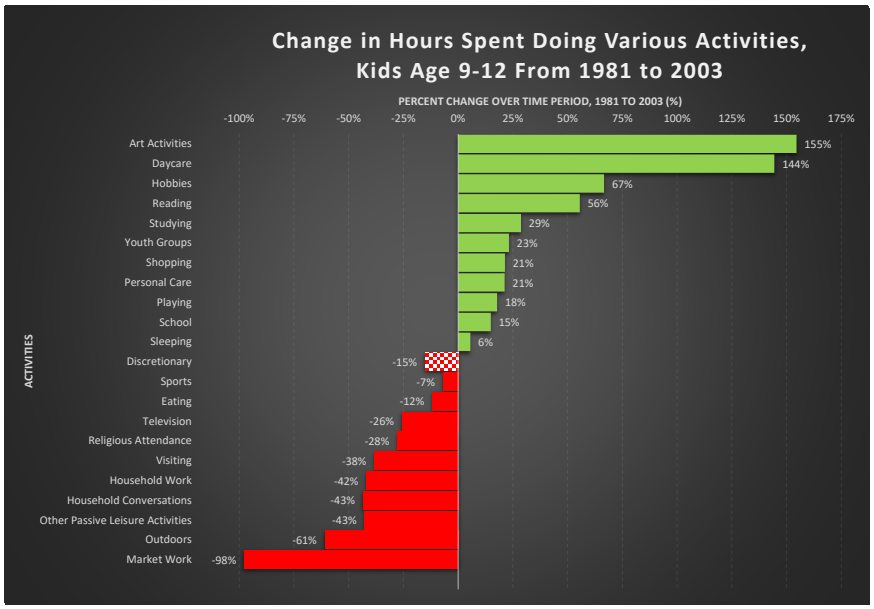
Source(s): Recreated from Hofferth and Sandberg 2000, 27; Hofferth 2009, 38.

Figure 2.4. Change in Hours Spent Doing Various Activities, Age 6-8 (1981-2003).



Source(s): Recreated from Hofferth and Sandberg 2000, 27; Hofferth 2009, 38.

Figure 2.5. Time Spent Doing Various Activities, Kids Age 9-12 (1981-2003).



Source(s): Recreated from Hofferth and Sandberg 2000, 27; Hofferth 2009, 38.

Figure 2.6. Change in Hours Spent Doing Various Activities, Age 9-12 (1981-2003).

Analyzing children's time management on a weekly basis concludes that children have about six-percent less discretionary time in 2003 as compared to children in 1981 amounting to 6.71 hours of discretionary time per day to spend on sports, play, play outside, studying, reading, and other activities. (Hofferth and Sandberg 2000, 27; Hofferth 2009, 38) Kids age eight to 10 spend about 5.48 hours daily on non-school-related media usage (television, computer, music, video games, movies, and print material) and children age 11-14 spend about 8.67 hours daily on non-school-related media usage. (Rideout et al. 2010, 42-43)

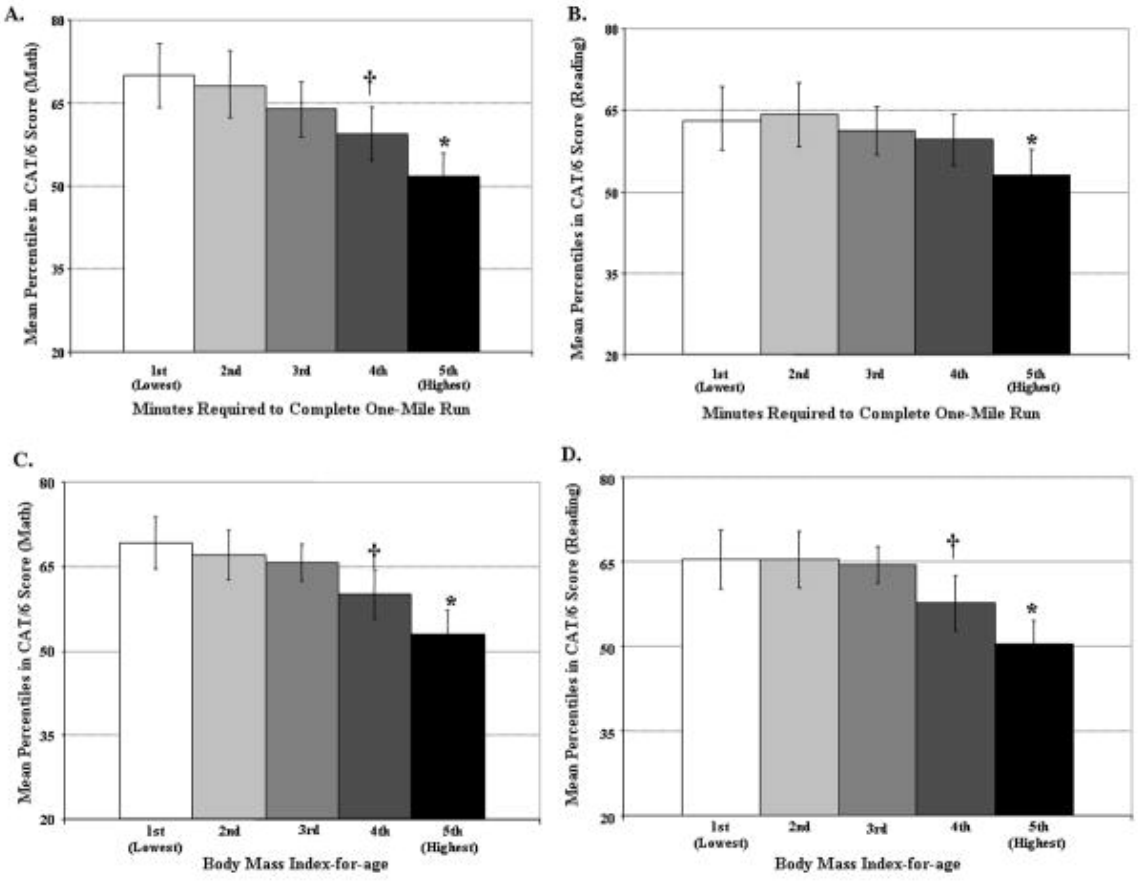
Research shows that when children play in natural spaces, they are more likely to stimulate their creativity and learning throughout life. In fact, a key factor in becoming self-directed and inventive as children [and later in life], occurs when children are allowed to invent their own games than in more structured settings. (Louv 2016) On the other hand researchers comparing natural and traditional play environments found that the more creative children emerged leaders in the natural and vegetated play environments. Children in the natural environments actually rely more on language arts skills, creativity, and inventiveness. (Kirkby 1989; Malone and Tranter 2003; Taylor et al. 1998; Herrington and Studtmann 1998) One Swedish study found that children's play on asphalt playgrounds was more interrupted and segmented than children's play in natural setting which actually demonstrated that children carried play from day to day, thus enjoying whole sagas of play uninterruptedly. (Louv 2008) Taylor and Kuo's research that allowed children to choose their preferred play environments proved that children are more able to concentrate in natural settings. (Taylor and Kuo 2006) Thus, from a design standpoint, less asphalt parking and more green lawns and natural elements account for more creativity, inventiveness, and varied interaction in schoolchildren which improves whole-child development.

Since this new push from the Federal and State governments and local school boards to push for higher test scores in the twenty-first century, almost 40% of elementary schools in the United States either removed or are preparing to remove recess from school schedules. (National PTA 2006) It has been proven that many of today's kids have a sedentary nature in lifestyle (Pelligrini and Smith 1998), however research has proven that physical activity is essential to whole child development. (Bredekamp &

Copple 1997). Learning for children occurs not only in structured and arranged settings, but also in unstructured, free-play settings. 59% of a series of Center for Disease Control & Prevention (CDC) studies, found one or more positive indicators that suggest the recess is associated with better attention, concentration, and/or on-task classroom behavior. (Centers for Disease Control and Prevention 2010, 29) Contrary to what many districts believe about the effects of recess on schoolchildren, multiple studies have shown that recess proves to improve student classroom behavior (Barros et al. 2009), focus/attentiveness (Jarrett et al. 1998; Peligrini et al.), and less fidgeting. (Jarrett et al. 1998)

Similar to the case of recess time, Physical Education (P.E.) attendance is also being targeted. P.E. class attendance has been steadily dropping from 42% to 28% from 1993 to 2003. (American Alliance for Health, Physical Education, Recreation and Dance 2012) Only 44 out of 51 (86.3%) of states require elementary schools to provide physical education. Collectively, the Institute of Medicines aims to suggest that increased aerobic fitness from physical activity strengthens the integrity of brain structure, that which is the foundation of strong academic performance. Out of 22 CDC studies, 12 (52%) found positive associations between extracurricular physical education and positive GPAs. (Centers for Disease Control and Prevention 2010, 29) Furthermore, unfit children demonstrated a reduced GPA, lesser degree of reading power based on national percentile ranks, more detentions for the school year, more absents for the school year, more suspensions for the school year, and more tardiness for the school year. (Shore et al. 2008, 1536) Another study classifying children based on the amount of time taken to run one mile and their Body Mass Index (BMI) compared this classification to the children's

California Achievement Tests Version 6 (CAT6) outcome. The research showed that on average, children that were classified ‘underweight’ or ‘desirable weight’ outperformed children that were classified as ‘at risk for overweight’ children. Children classified as ‘overweight,’ on average performed the worse of the set. In conjunction with these findings, children that completed the one-mile run the quickest also performed higher on the CAT6 exam on both the math and reading portions. (Roberts et al. 2010) Quite frankly, the additional time that is invested in physical education and physical activities before, during, and after school outweigh the benefits of solely investing in academic learning during school hours. (Institute of Medicine 2013, 187)



Source(s): Roberts et al. 2010.

Figure 2.7: Children's Body Mass Index (BMI) and Time (In Minutes) to Run One Mile Compared to California Achievement Tests Version 6 Scores.

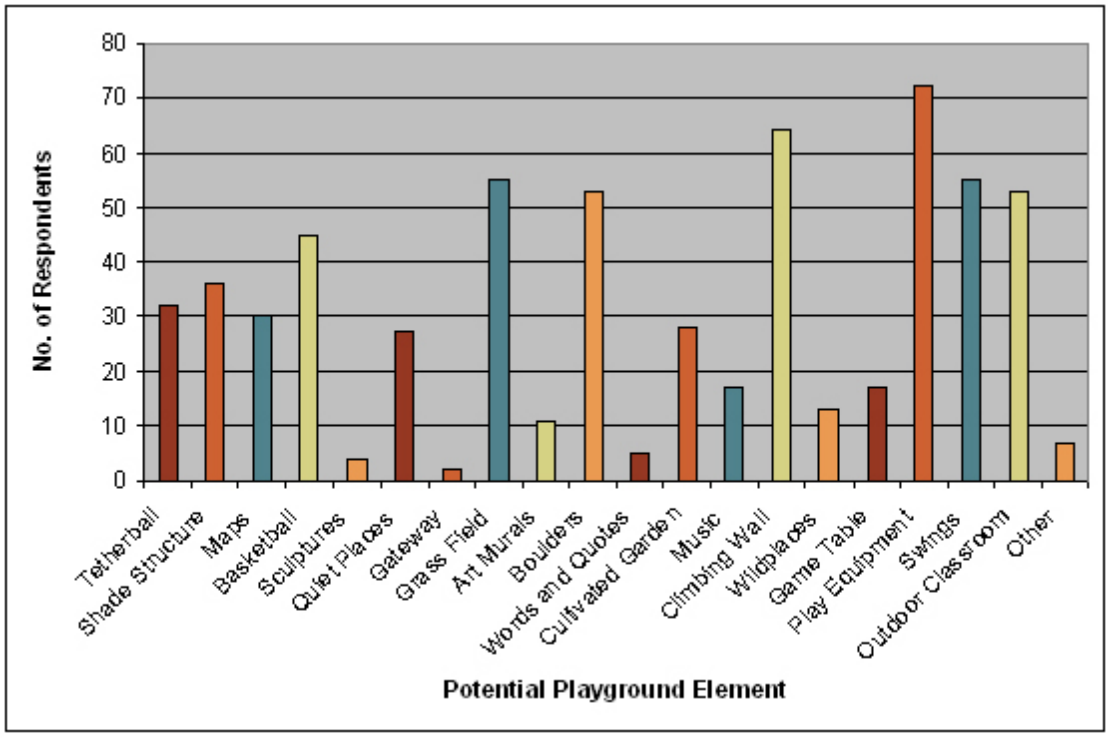
A study about children's play in rural environments provided a picture of the preferred play environments of children as claimed by children themselves. Roughly 66% of girls and 50% of boys claim that local playgrounds are the best places to play. (Akhurst and Wheway 2013, 8) In terms of designing the spaces, 48% of the girls and 57% of the boys talked about hiding in various places. Places that provide shelter, cover, and block the view from other children, should be considered in the design of the space. (11) 20% of girls and 34% of boys talked about tree climbing, making tree dens, and tree swings. Girls actually mention it as the most thrilling of activities. (12) 35% of girls and 71% of boys play in woods, fields, and on waste ground which are classified as natural play areas. (17) 65% of girls and 77% of boys play in their local parks or play areas. (19) 80% of girls would like a play area designed for lots of children (29) and 90% of boys would like the same. (26) The ideal play area that suits both sexes includes (a) trees, preferably atop a hill, (b) bushes and undergrowth, (c) long grass and corn and bales, (d) hilly or bumpy ground, (e) water, (f) flat grass, (g) traditional playground equipment, (h) rope swings from trees, and (i) adventurous playground equipment. (31-32) Some other basic trends noticed were that girls found traditional playground equipment to be more favorable than boy did. (36) The design should take into account the need for quiet corners away from the paths of energetic activities and also keeping in mind not to make these quiet areas too private which can be sources of unacceptable activities by older children. The design of the playground should take into consideration the most popular

manufactured play equipment (i.e. mainly swings and slides and highly mentioned climbing frames, seesaws, and roundabouts) as well as unmanufactured play equipment (i.e. Tarzan swings, tire swings, etc.). (32-37)

Wide-spreading play areas and social nodes allow and encourage the children to disperse, thus giving children their own space with fewer conflicts occurring. The example given from the Learning Landscapes model in Colorado establishes a groundwork for how to develop and implement landscapes that progress the quality of education from textbooks to physical hands-on activities as well as convert vast spaces of concrete and asphalt into effective play areas for the whole school population. Learning Landscapes increase the options offered for children's play and accommodate the entire school population at one time which is an important characteristic of Learning Landscapes that allows for the accommodation of the whole school before and after school as well as decrease conflicts among children. (Brink and Yost 2004) A photo survey in Denver revealed that playground equipment was the number one preferred playground element followed by a climbing wall at number two and swings and grass fields tied for the number three position for preferred playground elements. Additionally, the use of boulders in the playground and gardens has been a positive cost-effective solution. (Brink et al. 2004) Early childhood education (ECE) play equipment places an emphasis on fine- and gross- motor skill development and creates interactive play environments with water play and sand. Climbing structures like monkey bars and jungle gyms create a physical challenge for children and help develop the upper body. These climbing activities also provide opportunities to showcase progressed improvement and support responsible risk taking in children. Motor skills, strength coordination, and

balance are developed using overhead ladders, tall slides, large climbers, and spinning/rotating activities and equipment. (Brink and Yost 2004)

Aside from the use of traditional playground equipment, the topography, intimate spaces, and landmarks for group gathering provide essential development opportunities for young children. Subtle changes of scale and in elevation are all that are needed to create a dramatic effect on children. Spaces that are in scale to the size of children draw children into the spaces. In addition to spaces along high traffic areas visible to the playground, intimate spaces must also be created to allow child development away from the supervision of teachers, family members, and adults. Intimate gathering spaces with or near a landmark or two (boulder, log, other natural stagnant element, etc.) that are not visible or not fully visible to the rest of the playground and adults offers children opportunity to enjoy the surrounding natural landscape in solitude or semi-solitude. (Brink and Yost 2004) A photo survey in Denver revealed that boulders were one of the top five preferred playground elements chosen by parents, community members, and others. Additionally, the use of boulders in the playground and gardens has been a positive cost-effective solution. (Brink et al. 2004) The preferred size of boulders for children is five to seven tons which accommodates three full children while allowing one child to sit alone and read. (Brink and Yost 2004)



(*Source(s):* Brink et al. 2011, 17.

Figure 2.8: Photo Survey Ranking the Top Five Playground Elements as Chosen by Denver Public School Constituencies.

Native wildlife habitats can also be formed along with raising your own livestock within the school campus. Rotting logs provide habitats for insects, mammals, and amphibians if partially submerged in wetlands or ponds. Snags, or standing dead trees provide nesting habitats for many birds and are a source of food for these birds who feed on the insects living inside the snags. Brush piles along woodland or forest edges provide cover for rabbits, chipmunks, skunks, birds, and insects. Nesting boxes for pollinators, birds, and butterflies are artificial structures that provide a variety of animal species with habitat. (Kolstad et al. 2011, 21) The most commonly replicated habitat types for

schoolyards are woodlands, meadows, and wetlands. (19) In replicating wetlands, a maintenance consideration to take is to plant the correct type of vegetation that can thrive in the amount of water present within the soil. (xiv)

Outdoor classrooms can serve both the educational needs of children as well as their spiritual need to disconnect with the man-made and reconnect with nature. Outdoor classrooms ranked in the top five of preferred playground elements as chosen by parents, teachers, community member, and other. (Brink et al. 2004) The National Wildlife Foundation published a design guide for designing natural play and learning areas called *Nature Play & Learning Places*. Many suggestions are put in place for common activity settings and are divided into (a) plants, (b) natural play surfacing, loose parts structures, and construction, (c) habitat types, (d) animals, (e) signage, and (f) boundaries. The design guidelines provided by the National Wildlife Foundation provide information on how to design for children, faculty, and other users of the elementary schoolyard with health, safety, and welfare in mind. (Moore and Cooper 2014)

Barriers and Opportunities to Implementation

Implementation of such nature-based learning programs into public elementary school landscapes comes with many challenges, whether at the school, district, or state level. Crucial to the success of these programs is the communication that must be maintained among the stakeholders, as well as involving all decision makers in the process. From a legal standpoint, permission and approval from different levels of government is required, either from the local school board, district, municipality, county, or state levels of government, from an instructional standpoint, support is needed to

supplement the big change, from an administrative standpoint, stakeholders need to achieve clarity about the educational purposes of the nature-based learning program, and from a community standpoint, input from the locals and parents is a must for the continuation and maintenance of the learning programs. (Lieberman 2013, 81-88) The most basic step in the implementation of these learning programs is getting the required authority to agree and getting direct support from local administrators & school boards. (83)

Health and safety are a threat to achieving this type of improvement in schoolchildren via exposure to nature. (National Foundation for Education Research and King's College London 2004) In present a risk is defined as the probability of the occurrence of harm and the severity of that harm. In the current play environment, both natural and traditional play areas, risk is present in every situation. A very crucial goal for the design of nature play and natural learning spaces is to create challenging and interesting conditions of manageable risk and minor injuries and to decrease the presence of avoidable bad risk conditions such as sharp objects than have the potential to cause serious injury. (Moore and Cooper 2014, 100-106)

Another barrier to the implementation of play and learning environment based on nature is the lack of confidence of teachers in using and teaching in these natural environments. (National Foundation for Education Research and King's College London 2004; Dyment 2005, 43) Some commonly cited concerns presented by teachers in using and teaching in these spaces included student health and safety, class management, and extra time needed for the preparation of curriculum lessons tamed to work with the newly designed environment-based learning landscape. The lack of knowledge of nature and the

natural settings also serves as a barrier for the use of outdoor learning and play arenas for teachers. (Louv 2016b, 3) Some opportunities for improvement lie in professional development opportunities that could be offered to teachers to improve their understanding of natural learning environments and apply curriculum to support the application of natural learning environments. These types of supportive programs and certificate programs provide unconfident teachers with the confidence and abilities to use the outdoor classroom. These types of training programs also address other barriers to implementation such as fundraising, time management, and maintenance. (Dyment 2005, 43)

Current school curriculum requirements limit the opportunity for outdoor learning. (National Foundation for Education Research and King's College London 2004; Dyment 2005, 43) Due to the busy nature of teachers' schedules, the burden of matching mandated curriculum standards to that of curriculums for nature-based learning using the schools landscape exists. Many school boards do not allow flexibility in their approach for matching mandated school curricula to that of nature-based learning curricula. Institutional support is needed to drive the connections needed for linking curriculum standards and nature-based curriculum. The lack of flexibility in mandated curriculum inhibits teachers from choosing the content that they are allowed to teach. Therefore, teachers are not allowed to direct their own lessons. (Kim and Fortner 2006) Due to the accountability issues, environmental education is limited in its application in the learning environment. Gruenewald looks towards place-based education to tackle the accountability issue that is seen with changing mandating curriculum. Place-based education methods utilize the children immediate environment (e.g. the local community,

the schoolyard, or the school building) as a learning tool. (Gruenewald 2005) Additionally, the rise in standardized testing decreases the need for nature-based learning methods. Standardized testing is already unsupportive of nature-based learning methods. (Dyment 2005, 43) To address this issue directly, many certificate programs exist that both provide training for teachers to teach in these new environments and already link new nature-based curriculum to the state and national curriculum requirements. Project Wet and Project Wild are both proven and state-of-the-art curricula that teach ecology, wildlife, and water resource principles that are correlated to both state and national curriculum standards. Other programs like Growing up Wild, Project Wild Aquatic, Wonders of Wetland, and Project Learning Tree are also worth mentioning as viable training and curriculum programs to better utilize nature-based learning environments. (Projectwet.org 2016; Projectwild.org)

Outside of the classroom, and during children's time spent at home, children are drastically more attentive to media-based activities such as the computer, television, the internet, music players, tablets, and cellular devices which is a barrier to the implementation of nature-based learning programs. (Louv 2016b) These media devices are now a primary form of entertainment and activity among today's youth. Kids ages eight to 18 on average spend seven hours and 38 minutes using some type of media medium per day. (Rideout et al. 2010) Because children spend a large portion of their day on school grounds, the school curriculum, learning environment, and learning method all play an evident role in the influence of children's activities at home. (Hofferth and Sandberg 2000; Hofferth 2009) School provides the perfect backdrop for teachers to utilize the benefits of the natural environment. Both Kaplan's and Ulrich's theories on

nature and its impact on the mentality of people are effective in training schoolchildren to appreciate and enjoy nature for what it is rather than what is only seen and heard seen on media. (Kaplan 1989; Ulrich et al. 1991) In fact, school curriculums enhance and stimulate only the sense of vision by focusing mainly on textbooks and chalkboard content and sometimes the sense of hearing with videos rather than hands-on activities that allow the children to both learn within nature using all five sense. (Louv 2016b) An opportunity for reducing the use of media and electronics during school hours is to mandate recess periods, utilize outdoor classroom space for weekly/daily use, and utilize natural learning spaces in the schoolyard.

Another barrier is the lack of funding that is readily available to implement these nature-based learning strategies. (Dyment 2005, Page 39) This lack of funding extends beyond the realm of the designing landscape architect that is responsible for the design of the exterior built environment of the school and extends well into countless school years that lack funding for the implementation of new nature-based activities and curriculum. Many teachers claimed that the lengthy application process was time-consuming and that the amount of the funds requested did not justify the amount of effort and time required to actually get the funds. Furthermore, many of these fundraising sources only provided funds aimed at a specific type of project (e.g. composting stations or an outdoor classroom) and they were rarely on-going, thus fundraising would become a yearly task for the fund seekers. Although many forms of fundraising are available in the form of grants and aids, from all levels of government and organizations, to better adjust for the quality of funds versus time spent getting funds, parental- and faculty- led fundraising initiatives are proven methods to raise funding and for the purpose that the school and

stakeholders want. The results of a fundraising initiative might vary with results using this method, however the funds that are collected are free for the school to use for any nature-based learning improvement project. A prime example of collecting local funds for nature-based learning improvements is exemplified by the parent group G.R.O.W. at Barnett Shoals Elementary School. The parent group was formed more than 25 years ago, and since then has improved the school grounds of the old Barnett Shoals Elementary School by adding to the landscape an outdoor classroom structure, a butterfly garden, meadows, a wetland habitat, an upland habitat, a native garden, a greenhouse, and a tire exhibit in the forest. The butterfly garden was actually used within the Kindergarten curriculum to teach children about the process from caterpillar to cocoon, and then finally butterfly. The butterflies were then released during the school year. The funding source came from various fundraising activities held by the parent group in conjunction with their own internal fundraising donations. Their purpose was to invigorate the quality of the school ground landscape to promote learning using place- and environment- based methods with hands-on learning. They successfully provided the school students with a high quality of outdoor environments and activities that promoted the use of all senses. The parent group even managed to install a barn for livestock grazing and storage and a chicken coup on the school property. Additionally, they worked with Project Lunch Box to provide an afterschool program for the schoolchildren. They also worked in conjunction with Georgia Power to provide solar panels for a solar display on the school grounds. The students were even able to view electricity generation data and electricity consumption data online. The involvement and dedication of the parents dramatically

improved the quality of the learning potential in the schoolyard outside of the classroom setting. (G.R.O.W. Parent's Committee to Barnett Shoals Elementary School 2016)

Maintenance plays a huge roll in the landscape of the schoolyard. It is a barrier to nature-based learning and play due to the need for professional management. (Dyment 2005) Untrained landscape maintenance workers do not understand the requirements and needs of outdoor learning environments that are atypical like non-turf areas, non-pavement areas, and mulched areas). By collecting funds through means other than grants and aids, the funding can then be directed towards something other than capital costs like the operating costs involved in the maintenance of these learning landscapes. (41) A Toronto study noted that many respondents reported the projects required to much maintenance for their successful outcome. Maintenance is a time-consuming, daunting and expensive task especially if the design professional does not take these maintenance issues in consideration. (44) As a design recommendation, irrigation and other daily maintenance requirements are usually higher for annual plants than perennial plants. (Rideout et al. 2010, 67) The use of invasive plants used in schoolyards can dominate the local ecosystems to the point or breaking down the natural equilibrium of the environment or even destroying it completely. (94) Low-maintenance and drought-tolerant native plants are the best choice for schoolyard landscapes that have low funds and manpower for the maintenance of the school grounds.

Through the understanding of these barriers to integrating education into the landscape of public elementary schools, one can better design for the stakeholders involved, for the circumstances provided, and for budget allocated. Further analysis of these barriers through both literature review and case studies can provide insight into how

to manage and overcome these barriers. A look into how other successful elementary school projects have overcome these barriers can lead to better decision-making in the design of future elementary school projects. Only through proper research of existing studies and successful project can one make just decisions to create better exterior learning environments for our elementary schoolchildren.

CHAPTER 3

CASE STUDIES

The following chapter will discuss various case studies that were influential and helpful in the design decision-making of the landscape design of Barnett Shoals Elementary School. Through the literature review research process, multiple projects were highlighted and further investigated to determine the similarity in their design intent to the current landscape design being undertaken for the Barnett Shoals Elementary School. Overall the design organization of each case study follows the Landscape Architecture Foundation ‘s Case Study Model for a Project Abstract. (Francis 1999, 20) The case studies that were chosen are displayed in the following sections by first introducing the background information of the successful elementary school projects (i.e. project name, project locations, date designed, management details, construction completion date, construction costs, landscape designer, client, and architects). Then each cases study will include (a) Photos and describe the (b) Project Background, (c) Project Significance and Impact, (d) Lessons Learned, (e) Contacts, and (f) Keyboards. (20) The Project Background section will provide insight into the history of the site and project and further describe the project design details. The Project Significance and Impact section will describe the key design elements that were significant enough to mention for the purpose of the landscape design of the Barnett Shoals Elementary School. The Lessons Learned section correlates the barriers to the integration of education into the elementary school landscape with the design-decisions made for the case study. The Contacts section provides a point of contact for the case study project and the Keywords section provides terms used to reference and research the case study.

Barnett Shoals School: G.R.O.W. Program

PROJECT NAME	Barnett Shoals Elementary School G.R.O.W Team Enhancements
LOCATION	3220 Barnett Shoals Rd, Athens, GA 30605
DATE DESIGNED/PLANNED	Over 25+ Years
MANAGED BY	Parents and Local Community Members

Project Background - The old Barnett Shoals Elementary School was located at the current site where the new Barnett Shoals Elementary School is scheduled to reopen after construction of a new building. In the past 25 years, a parent/teacher group called G.R.O.W. has established a new landscape for the children to play and learn in. It can be heralded as a trendsetter in elementary school landscape design that advocates taking learning outside of the classroom. Unlike other exemplary examples of elementary school exterior built environments that push for environment- and place-based learning, they do not have the full financial support and resources needed that are usually provided by the school board and government. Rather, the G.R.O.W. team is similar to a Parent Teacher Association (PTA) based on teaching about ecology, plants, & biology with an emphasis on the stewardship of the environment through exterior learning environments, natural play areas, and school gardens. Historically, the G.R.O.W. team has a track record for successfully implemented initiatives involving the school campus and the children. (G.R.O.W. Parent's Committee to Barnett Shoals Elementary School 2016; Zeichner 2016)

Source(s): Taken by Arpan Patel with the Permission of Chris, Piedmont Construction.

Figure 3.1: The Various Habitats Replicated on the Schoolyard with the Support of G.R.O.W.

Project Significance and Impact - G.R.O.W has independently funded, planned for, and implemented multiple features to the school campus that serve as a teaching ground and innovative play area in the daytime, and a public park during non-school hours. Some of the projects developed by the G.R.O.W. team for the old Barnett Shoals Elementary School includes the following:

- Constructed Outdoor Shelter as an Outdoor Classroom
- Butterfly Garden
- Herb Garden
- Native Plants Garden
- Arboretum
- Wetland Habitat
- Grassland Meadows
- Upland Forest
- Rock Geology Wall

- Livestock Area for Animal Grazing (Including Accommodations for Chickens, a Goat, and a Sheep)
- Barn

The impact is seen with both the children during school hours as well as with the parents and children who use the spaces after-school for recreational purposes. The key features of the G.R.O.W. design include ample programming for the student population, proper maintenance of the livestock animals, gardens, and habitat types, and hands-on learning through the use of school gardens and the geology wall. (G.R.O.W. Parent's Committee to Barnett Shoals Elementary School 2016; Zeichner 2016)

Source(s): Taken by Arpan Patel with the Permission of Chris, Piedmont Construction.

Figure 3.2: Left. Entrance to the Arboretum from the West. Center. Tire Playground Element Installed by the Children. Right. Outdoor Classroom with Benches in the Arboretum.

Lessons Learned - The G.R.O.W. team did establish the setting for which children can further learn from, however a major limitation was the lack of teacher involvement to utilize these outdoor learning spaces. (Zeichner 2016) The teachers were hesitant on working outdoors and therefore prevented the children from utilizing the full potential of the landscape offered. Research needs to be established to offer the teachers support for

taking their classes outside more often, to teach a specific lesson from the curriculum, offer sporadic outdoor breaks, and read a book. Programs like Project Wild, Project Wet, and Project Learning Tree that are a wildlife-, aquatic-, forest-based respectively can be sources of certification to train teachers how to teach outside. These programs also offer correlations to various national- and common core state-based standards for teaching various curricula like science, math, and social sciences. (Bonus Energy Resources 2016; Common Core and Next Generation Science Standards 2016, Correlations 2016) The programs can offer to both children and teachers the opportunity to fulfill government standards as well as enjoy the spiritual, health, mental, and learning benefits offered by exposure to the sun, nature, and hands-on learning.

Another limitation is the need for maintenance and upkeep for the school ground. Due to budget restraints, hiring a highly qualified landscaping contractor for maintenance is not the most likely solution. An important consideration in the design should be the ease of maintenance Many teachers were hesitant to use the arboretum due to the fact that it was not neatly trimmed and up kept. Teachers were scared to use the space because of the lack of maintenance in the area. (Moore 1997) Teacher involvement was ranked fourth in leading barriers that influenced the success of their nature-based green initiatives. 12% of respondents claimed that teachers were a major barrier in the implementation of green, nature programs for the Toronto School Board. (Dyment 2005, 40) Teacher are less likely to teach in outside settings with less properly maintained & clean access routes and seating areas.

The G.R.O.W. team's model for the elementary school can offer many lessons to the design of future elementary school exterior built environments. The parental and

community involvement on the school campus can be seen through the works and project established by the G.R.O.W. team as well as the programs that they were involved in like Project Lunchbox, funding received by grants, and working with Georgia Power to establish a measure of study for the student by displaying power data from a solar panel on campus through a website. The model goes to show the need to work with third-party sources of learning and environmental involvement within the campus. A class was also taught at the University of Georgia that coincided with the design and construction of different aspects of the campus landscape. The landscape architecture college students did establish signage for the schoolyard, plant trees, and establish a meadow. (G.R.O.W. Parent's Committee to Barnett Shoals Elementary School 2016; Zeichner 2016)

Source(s): Taken by Arpan Patel with the Permission of Chris, Piedmont Construction.

Figure 3.3: Left. Geology Wall Exhibit Signage with Appropriate Diagrams. Right Geology Wall with Various Rock Formations That Correspond to the Geology Wall Signage.

Contact – Lauren Zeichner – lauren.zeichner@gmail.com

Keywords – Academic achievement, afterschool programming, children's sensory development, community involvement, environmental education, hands-on learning, physical activity, physical fitness, place-based learning, school-based gardening, whole-child development

Fairmount Elementary School

PROJECT NAME	Fairmount Elementary School Learning Landscape Master Plan Improvements
LOCATION	Golden, Colorado
CONSTRUCTION COMPLETED	2011
CONSTRUCTION COST	$322,951.83

Project Background - Fairmount Elementary School is located in unincorporated Jefferson County of Colorado. The building has a net square footage of 65,000 sq. ft. and is set on a 12-acre parcel. (See Appendix A) Similar to Barnett Shoals Elementary School, it is only accessible from one road on one side of the site and is surrounded by low density to medium density residential areas. Since its opening in 1961, it has undergone numerous renovations with the most recent happening in 2006 with classroom additions, a new gymnasium, and music rooms. The enrollment count for 2010 was 625 children with 332 males (55.5%) and 266 females (44.5%).

The existing site contained 21,000 sq. ft. of asphalt hardscapes (not including parking) and 13,100 square feet of play pits and playground equipment. In terms of drainage, the site falls in elevation from the northeastern high point to the low point located in a centrally located swale along the southern property line. A central drainage swale running north to south is located on the western side of the school building. Some safety issues of circulation did exist, first between vehicular traffic leaving and entering the parking lot in the morning and afternoon and the high amount of pedestrian volume conflicting with each other, and second, children traversing through the swings area to reach one of the most popular areas, the soccer field. There also existed inadequate drainage of the baseball field and hardscape areas. The school did not serve children in wheelchairs nor did they have sidewalks along the main access road, 50th Ave. The

existing playground showed little to no vegetation and the site contained only one main circulatory sidewalk leading from the vehicular roundabout to the rear hardscapes; no connections existed between playground features on the site. (Brink et al. 2011)

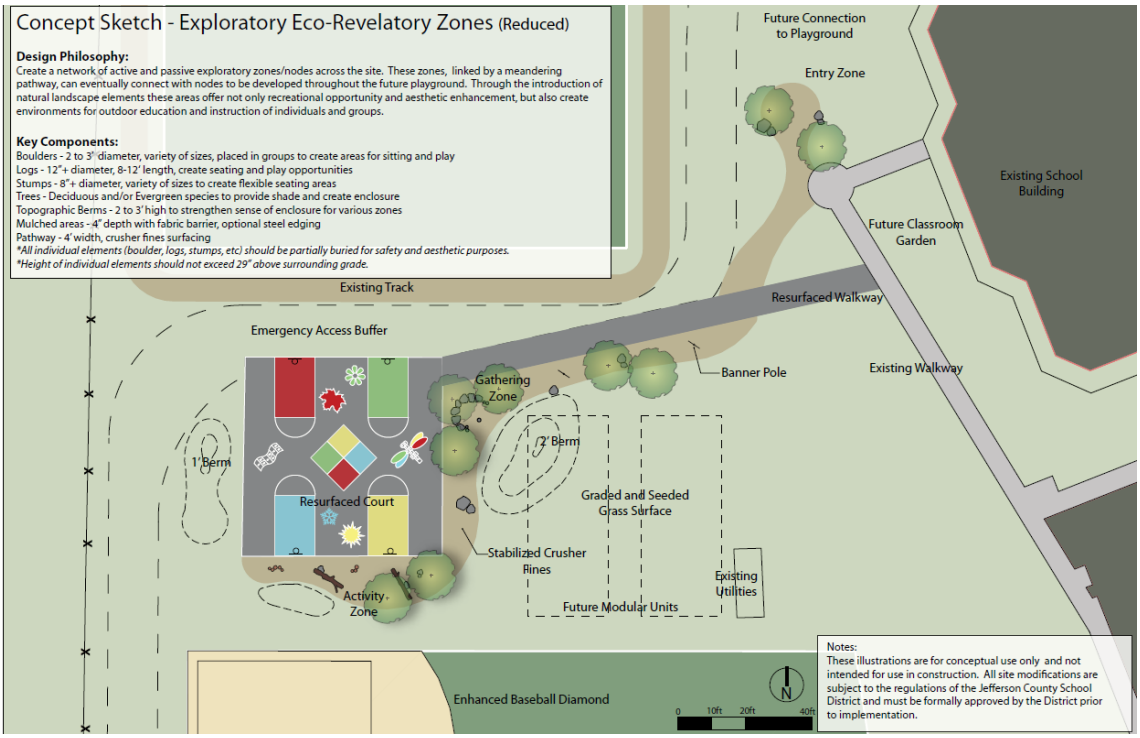
Source(s): Brink et al. 2011.

Figure 3.4: Fairmount Elementary School Swings Play Area with Minimal Vegetation, Complexity, and Texture.

Project Significance and Impact – The final master plan (See Appendix B) includes natural play areas blended into the overall landscape enhancements of the site. Similar to Barnett Shoals Elementary School, Fairmount Elementary School also included plans to relocate and maintain existing, acceptable playground equipment to safer and more appropriate parts of the schoolyard. A well-known aspect of Denver Learning Landscapes is the inclusion of decorative educational and recreational paintings

and games (e.g. maps, star constellations, paintings, etc.) Fairmount Elementary School stakeholders were polled to find the preferred ordering systems they'd like to see incorporated as improvements on the site. The poll showed that more than two-thirds of the respondents wanted to incorporate knowledge about the history of Colorado and the ecosystems of Colorado into the concept of the landscape. (Brink et al. 2011, 30)

Some other well-known aspects of the Denver Learning Landscapes include outdoor classrooms to facilitate learning amongst nature and shade structures to accommodate for the average 320 sunny days of a typical year in Colorado. (Brink et al. 2011) The average number of sunny days in Athens, GA is 218 days in a typical year. (Days of Sunshine Per Year 2016) Furthermore, to inhibit the use of the school walls as play spaces, a planting buffer will be added to the sidewalk running along the walls and add texture to the monotonous, non-vegetated schoolyard. General vegetative transitory zones planted with native plants will break up large open space to minimize maintenance, water needs, and increase the endurance of materials. School gardening will be imposed in an unused area of the site. The existing swale will be planted with a learning garden that will also serve the water quality of the school site. Some areas of the site are being reserved for future expansion, either for gardens or future parking spaces, based on the needs of the school at that point in time. A parking and drop-off improvement will also be implemented to better facilitate the conflict between before- and after- school pedestrian and vehicular traffic. (Brink et al. 2011)



Source(s): Brink et al. 2011.

Figure 3.5: Phase One of the Fairmount Elementary School Learning Landscape Renovation Showing the Decorated Basketball Play Area and Transitory Passive and Active Natural Play Areas.

Lessons Learned – Natural play areas served as aesthetic enhancements, while at the same time offered non-traditional, creative play opportunities in both active and passive forms. Some of the most cost-effective playground features - boulders, logs, and earth berms - dominated these zones and added to the complexity of the site as well as the sensory experience of the children at minimal cost. The simple relocation of the swings suppressed a safety issue and allowed for the land area where the swings were located to be repurposed. Another important lesson provided by the Denver Learning Landscape program deals with the decorative educational and recreation paintings that are painted on

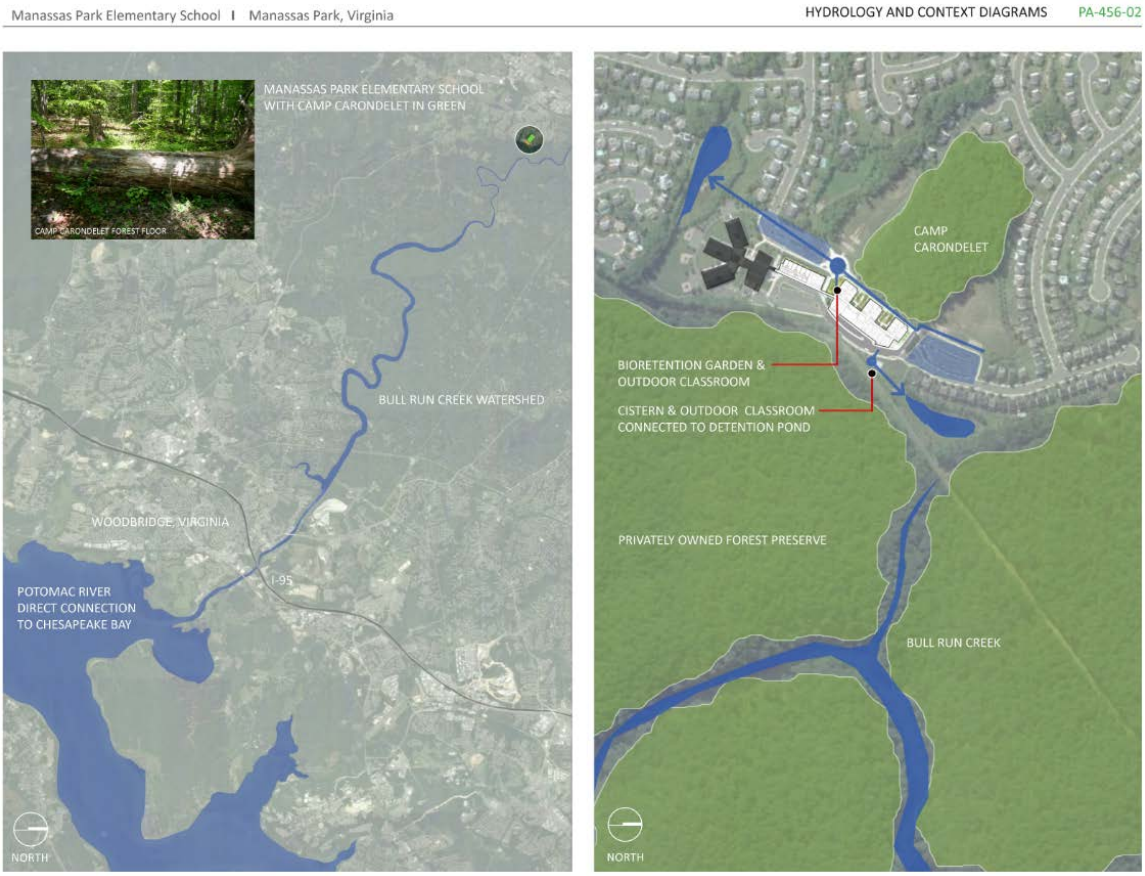
asphalt and/or concrete hardscapes, thus providing multiple purposes for their usage. The design of the outdoor classroom accommodates a whole grade-level of students, thus providing a new setting for teachers to communicate with students. The amphitheater like space has adequate buffer from public spaces and creates a natural enclosure similar to that of a theater enclosed in a building. Vegetative planting is used innovatively on-site as an indicator of off-limits areas and boundary dividers. It naturally acts as a natural form of water management on site. The designed water management system has also been repurposed to also act as a learning habitat for how the ecosystem works, water traverses, and benefits that plants offer to water quality. (Brink et al. 2011)

Contact – Lois Brink, Executive Director, Learning Landscapes

Keywords – Academic achievement, afterschool programming, children's sensory development, community involvement, environmental education, hands-on learning, Learning Landscapes, natural playscapes, outdoor classroom, school gardening, place-based learning, physical activity, physical fitness, school-based gardening, whole-child development

Manassas Park Elementary School

PROJECT NAME	Manassas Park Elementary School
LOCATION	Manassas Park, VA
CONSTRUCTION COMPLETED	Built in phases from 1991 to 1995
CONSTRUCTION COST	Park Rehabilitation = $5.9 million
SIZE	4.6 Acres
LANDSCAPE ARCHITECT(S)	Siteworks
CLIENT/DEVELOPER	Manassas Park School Districts
CONSULTANTS/ARCHITECTS	VMDO Architects
MANAGED BY	Hess Construction + Engineering Services



Source(s): American Society of Landscape Architects 2011.

Figure 3.6: Hydrology and Context Diagram of the Manassas Park Elementary School Site.

Project Background – The Manassas Park Elementary School is located in a tract of land that is surrounded by housing, private forests, and a camp. (See Appendix C) In 2009, the population consists of 68% non-white students, with 26% English-learning students. 44% of the students receive free or reduced-lunch. Historically, the camp served as the forested winter quarters of the Confederacy's Louisiana Brigade. The three-story school was built close to the camp forest for the purpose of open space conservation and to utilize the camp grounds to create a learning experience using the forests. The project is a LEED Gold certified project designed with fresh air circulation, natural daylight, and a connection to the outdoors. Today, the city of Manassas Park is surrounded by the affluent Virginia suburb communities of Washington D.C. and directly connects to the regional park system. The existing site was chosen because of infrastructure and transportation efficiencies it has to offer to the school grounds. Camp Carondet serves as a direct source for children as a suburban "school in the woods," as a place for physical activity & exercise, and as a place for recreation. (American Society of Landscape Architects 2011)

Source(s): American Society of Landscape Architects 2011.

Figure 3.7: Manassas Park Elementary School Storm Water Garden with Amphitheater Stage and Terrace Seating.

Project Significance and Impact – The Manassas Park Elementary School Final Plan shows plantings of native vegetation which serves the children with a space for teaching children about plants and photosynthesis. (See Appendix D) Aside from the preservation of the vegetation near the camp, the school actually replanted the larger disturbed areas with warm season grasses and wildflowers similar to the savannah landscapes of the eastern woodland Native Americans. The school building and the surrounding landscape is designed to be an extension of the forest landscape surrounding the school site. Two outdoor forest classrooms are framed within the courtyards that are

created from the building envelope. These courtyards are planted to emulate the mixed deciduous woodland forests that is contiguous to the school site. Between the school's northern façade and the camp lies a fire lane that contains a planted median in the middle, thus allowing fire trucks to pass without difficulty. The fire lane transforms into an outdoor hallway for changing classes that is framed at one end by a storm water classroom and at the other end by a pick-up/drop-off location. The dense canopy of the camp forest consists of mixed oak species, poplars, and maples. The understory has a thick network of underbrush vegetation, including ample supply of decaying logs. In fact, the logs and the white oak planks in the forest courtyards was salvaged from a nearby construction site. Hydric plant species highlight the storm water garden, fit with a black locust wood theater stage and benches utilizing regionally harvest black locust wood and recycled steel. The storm water garden has a stage overlooking the hydric grass or rush species and terraces leveled using grass encircling the storm water garden. These gardens serve as an outdoor laboratory of native species meant for the purpose of exploring the local flora, fauna, and ecosystems created. Animal species like toad, skinks, and turtles can easily inhabit gardens like the storm water garden at Manassas Park Elementary School. A key feature that is notable of this school is the emphasis on the intimate interior views of the surrounding mixed oak and maple forest made for the extended learning spaces. The elementary classrooms are designed with a view facing the shady moss- and fern-covered learning courtyards stocked with "fallen" trees and other characteristics that mimic an eastern deciduous forest. Children are encouraged to use the exterior break-out spaces like the bio-retention area, which also is designed to serve as an outdoor classroom, performance stage, and point of parental pick-up. Unsurprisingly, the

children consider this area a common informal gathering space. One of the most successful features that makes this a notable example of outdoor learning and place-based learning is the emphasis on quality signage. Figure 3.8 shows how the designers provided large, professional quality maps and diagrams to relay information about storm water management to children. These “green” signs display pertinent information highlighting the green building design, exposing sustainable building systems, and explain facts about flora, fauna, and the local ecosystems that exist in the nearby forest. (American Society of Landscape Architects 2011)

Source(s): American Society of Landscape Architects 2011.

Figure 3.8: Manassas Park Elementary School Cistern Diagram for Teaching Children About Water Processes.

Lessons Learned – The Manassas Park Elementary School exemplifies how the landscape designer and contractor can get the children involved in the design, construction, and learning processes provided by the local ecosystems and habitats highlighted throughout the campus. Following the completion of this project, the design team committed to hosting a service learning day along with a yearly lecture on environmental issues. The lead Landscape Architect even delivered a speech to the fifth-grade level children on the importance of forests to the planet, and followed up with a day planting over 2,000 plants by the fifth-grade class, teachers, and the design & construction teams. First-hand community service involvement by the professional designers similar to the Manassas Park example is a leading, exemplary example of how to teach children about the local environment, utilize the site to enforce the teachings, and further invoke environmental stewardship within the children by direct involvement in the construction process on-site. The replication of the original native ecosystem by replanting savannah-like grasses in the highly disturbed portions of the site brings learning opportunities to teach about both the local history and local ecosystems. The metaphor of the adjacent mixed oak and maple forest habitat implied in the design of the outdoor forest courtyards connects the school space to the pristine, natural forest in Camp Carondelet without much disruption. The requirement of the fire lane in all school sites, is an inhibiting force for the aesthetic fluidity of the campus. A bare asphalt road can break and divide the program and aesthetic connectivity of the schoolyard. The designer's decision to add a planting median in the middle of the fire lane allowed the fire lane to serve as a frequented outdoor hallway for the elementary schoolchildren. The path directly connected the pick-up, drop-off location for the parents to the facilities on the

north side of the campus. The hydric flora and fauna species that thrived in the storm water garden provided an avenue for the children to gather, perform, & learn, the teachers to teach, and the garden to serve the water quality of the site runoff. The "green" signage that was used to relay information about the site brought a little bit of the zoo, the botanical garden, the science center, and the nature center to the campus. Similar signage makes going to outside like going on a field trip every day before-, during-, and after-school. (American Society of Landscape Architects 2011)

Contact – Pete O'Shea, ASLA, Principal, Siteworks

Keywords – Academic achievement, afterschool programming, children's sensory development, cistern, community involvement, environment stewardship, environmental education, hands-on learning, interior views of nature, LEED, nature-based design, outdoor classroom, outdoor theater, physical activity, physical fitness, place-based learning, professional signage, terrace seating, whole-child development

Nueva School

PROJECT NAME	Nueva School
LOCATION	Hillsborough, CA
CONSTRUCTION COMPLETED	2007
LANDSCAPE ARCHITECT(S)	Andrea Cochran Landscape Architecture
CLIENT/DEVELOPER	Nueva School
CONSULTANTS/ARCHITECTS	Leddy Maytum Stacy Architects
MANAGED BY	Charles Salter Associates, Inc.

Project Background – The Nueva School is located in the hills southwest of San Francisco. The Nueva School is a pre-kindergarten to eighth grade school that focuses on creativity via arts, integrated studies, and social-emotional learning. The addition to the school transformed an existing parking lot into additional school facilities including classrooms, a library, cafeteria, and administrative offices. It also boasts a hands-on learning research and development lab. The new additions are arranged around a central plaza. In 2008, the American Institute of Architects (AIA) named the school a 'Top Ten Green Project.' And the project also earned LEED Gold certification. The 33-acre campus serves about 400 students and mature woodlands with trails and opportunities for extended learning are located adjacent to the site. (The Nueva School, Hillsborough, CA 2016; American Society of Landscape Architects 2010; American Society of Landscape Architects 2016)

Source(s): American Society of Landscape Architects 2010.

Figure 3.9: Left. Nueva School Dining Terrace and Outdoor Amphitheater. Right. Open Lawn with Native California Grasses in the Background.

Project Significance and Impact – The design of the school focuses around a central courtyard that serves as a dividing space, a play space, and a central gathering space. The designer decided to reference local flora and materials from the adjacency as well as preserve a majestic, heritage oak as an anchor point for the campus center. Shifts in the design of the grade, paving materials, and planting, shape the outdoor space into a series of outdoors rooms that seem to function both independently or cohesively, depending on the needs of the situation. A visible storm water runnel down the center of the open plaza further divides the larger scale of the plaza. The old heritage oak stands as a symbol and a landmark that is unique to the project. Furthermore, the change in grade is reinforced by the subtle smaller changes in elevation emphasized by the amphitheater and dining terrace. The landscape designer enhanced the library's thermal performance by designing berms on the library's eastern elevation with native grasses. 10,000 square feet

of green roof replicate native California grassland habitats which serves as shelter for a host of indigenous species like native bee and bird species and even the endangered Myrtle's Silverspot Butterfly. The majority of the plant species used in the design of the site are mostly native species to the area including native rushes, oaks, grasses, and groundcovers. These species link the site to the local ecosystems that are present. A simple use of drought-tolerant species and water conserving systems reduce landscape water usage by 53%. (American Society of Landscape Architects 2010)

Source(s): American Society of Landscape Architects 2010.

Figure 3.10: Earth Berm on the Eastern Elevation of the Library Provides Thermal Insulation to the Library to Reduce Energy Usage.

Lessons Learned - The use of landscape vegetation and paving materials as well as the grade change for the separation of space is a very advanced way of dividing large open spaces like the plaza at Nueva School. For architects, mortar, blocks, bricks, glass, and concrete walls are the usual dividers of space. Landscape designers also have a professional duty to divide spaces based on the health, safety, and welfare needs of the public, the users of the spaces, and the local ecosystems of the space. (American Society of Landscape Architects 2010) The decision to use mostly native plant species, reinforces the value of preserving native habitats, flora, fauna, and ecosystems. Native plant species also use less water and less fertilizer than non-native plants, plus perennial natives require less maintenance and replanting each year. The influx of insects and wildlife also can serve as a native pest control and a source for pollination of vegetables and fruit trees. (Kohler 2013) The runoff from the library roof drains into a bio swale full of *Juncus* species that border the eastern edge of the building. Material selection for the project exemplifies and draws memory of the adjacent ecosystems and materials naturally available. The need to remove ailing and diseased Monterey Cypress Trees gave rise to the opportunity of landscape designers to reuse them for site screens, furniture, and decking. Tree leaves from local flora were used to imprint certain concrete slabs, both as a symbol of place and divider of space. (American Society of Landscape Architects 2010)

Contact – Andrea Cochran, Andrea Cochran Landscape Architecture.

Keywords - Academic achievement, afterschool programming, children's sensory development, cistern, community gathering tree, community involvement, environment

stewardship, environmental education, green roofs, hands-on learning, interior views of nature, LEED, material reuse, native habitats, native plants, nature-based design, outdoor amphitheater, outdoor classroom, outdoor rooms, physical activity, physical fitness, place-based learning, professional signage, supporting endangered wildlife, terrace seating, whole-child development

CHAPTER 4

TEST SITE: BARNETT SHOALS ELEMENTARY SCHOOL

Site Context

The geographical location of the elementary school test site is 3220 Barnett Shoals Rd, Athens, GA 30605. The new Barnett Shoals Elementary School site is expected to be constructed and approved for occupancy within this summer, and ready for the 2016 – 2017 school year. The newly rebuilt structure will replace the existing school structure. The new structure will include a two-story building and a connected one-story building. The existing storm water management pond will remain with a few adjustments and will handle the onset of the storm water that is collected on-site. In addition to this storm water management feature, the site will also boast two bio retention ponds (large and small) as well as a bio swale to exceed the requirement for the storm water quality event. A new outdoor basketball/four square court will be added to the site in addition to a jogging/running track. The existing barn that served as the storage unit for the livestock held on-site will be preserved and moved to a different location. Some of the playground equipment and seating features will be preserved and/or relocated. (See Appendix E)

The new building is location on a site measuring 15.03 acres. Approximately 11 acres of the site is disturbed for construction purposes. Of the approximately four acres that are leftover, the design and construction team preserved about 0.8 acres of land that was used as the arboretum, 0.5 acres of land that served as the livestock grazing area, a small playground area, as well as an existing geology wall. The 92,123 square feet building includes 26 classrooms and 105 parking spaces.

The original plan for this school was to renovate its existing structure with a $9.6-million-dollar budget. However, after several meetings with stakeholders, architects declared that the $9.6-million-dollar budget was sufficient enough to rebuild a new school including everything that the school officials and parents wanted. (Shearer 2014) The actual budget set aside for the landscaping portion of the project stands as $100,000 reserved for the landscaping (including vegetation, fine grading, mulching, hardscapes, a fire route access road, etc.) Fencing will not be covered in this $100,000 landscaping budget. Another $60,000 will be reserved for the playground equipment. (Gilbert 2016)

Design Introduction

The design approach for the new Barnett Shoals Elementary school is to best utilize the given elements and conditions within the school ground to better provide an educational medium for teachers and children to use outside of the classroom. In aiming for this approach, the health, safety, and welfare of the students and users of the grounds should be a foremost consideration, whilst the physical and social development of the schoolchildren should simultaneously be improved to benefit whole-child development. The main limitation would be the set budget by the school board.

To achieve the design goal through this approach, many aspects of schoolyard design must be researched before beginning the design process. As a precursor to the design process, literature reviews and multiple case studies of schools that successfully implemented a learning environment into the exterior built environment of a public elementary school building were used to help inform the design decision-making for the new Barnett Shoals Elementary School project. The findings from the literature reviews

and case studies then led to the creation of design goals and objectives which culminated into a well-defined Program of Elements desired on the school yard. Seeing that the parent group, G.R.O.W. had the most insight as to what they wanted to see implemented, their input was very influential in creating the list of programming elements desired for the school ground.

The design of the school does put into effect the methods and strategies learned to be effective from literature review studies and successful elementary school precedents. In doing so, the landscape budget was not drastically overlapped and the campus provides variety and more options for learning, play, and letting nature do its course. The overall goal for the project is to design an exterior built environment that is beneficial to the learning experiences of children, that is beneficial to the social and physical development of schoolchildren, that is within the scope of the school board, that is within the limits of the budget, that is diversified in wildlife quality and type, and that is safe for year-round use for the schoolchildren, teachers, and the community. The list of strategies and objectives utilized in the design include:

- The use boulders and logs to provide a dynamic to the site and naturalize the site. It also provides habitat for certain wildlife. (Brink et al. 2011; Moore and Cooper 2014)
- The use of boulders and logs to divide space and programming. (Brink et al. 2011; American Society of Landscape Architects 2010)
- The use of vegetation to divide space and programming. (American Society of Landscape Architects 2010; Brink et al. 2011)

- Using natural landforms and land formations for different programmatic uses. (American Society of Landscape Architects 2010)
- Restoring the arboretum habitat using low-cost, locally sourced native plants. (G.R.O.W 2016; Zeichner 2016)
- Finding a low-cost, locally source native plant provider. (State Botanical Garden of Georgia 2016)
- Using native, drought-resistant, low-maintenance plants. (American Society of Landscape Architects 2010; American Society of Landscape Architects 2011)
- Using plants with a high wildlife value (e.g. *Quercus alba, Prunus serotina*, *Betula nigra*, etc.) to attract pollinators, birds, humming birds, butterflies, moths, mammals, insects, and amphibians. (Georgia Wildlife Federation 2006; "10 Ways to Add Biodiversity to Your Garden" 2016)
- Find low-cost alternative materials for paths and hardscapes (i.e. compacted crushed stone base trails, colored concrete hardscapes, engineered wood fiber playground surfacing, pine straw mulching). (RS Means Site Work & Landscape Cost Data 2014)
- Set a reasonable vegetable gardening schedule and plant herbs nearby as natural pest control. ("Container Vegetable Gardening" 2016)
- Use interesting tree foliage, structure, and form to create a landmark or gathering point. (American Society of Landscape Architects 2010)
- Design to stimulate all five senses. (Louv 2016b)

- Provide interesting landforms for nature play for children to use. (Moore and Cooper 2014)
- Create areas for “Loose Parts” play and “Loose Construction” play. (Moore and Cooper 2014)
- Provide ample signage for wayfinding and providing educational facts. (Moore and Cooper 2014; American Society of Landscape Architects 2010; American Society of Landscape Architects 2011)
- Providing energy savings using landscaping (i.e. windscreens, shade from the summer sun, letting in winter sun, shading northern property of the building). (North Carolina Department of Commerce Energy Division 2000; South Carolina Energy Office 2016; American Society of Landscape Architects 2010)
- Use edible shrubs for screens. (Moore and Cooper 2014)
- Create an Outdoor Classroom that offers support and a sense of safety to teachers to induce more frequent usage of the classroom. (Zeichner 2016)
- Provide ample shade for the Outdoor Classroom. (Brink et al. 2011)
- Ample programming for learning should be planned for the students to provide a variety of experiences and opportunities. (G.R.O.W. Parent’s Committee to Barnett Shoals Elementary School 2016; Zeichner 2016)
- The design of the various learning environments should require minimal maintenance to provide clean access to the program elements and so that the teachers and students have a safe place to teach and learn. (Zeichner 2016)

- The organization of program elements and points of entry and gathering should be design with the safety in mind and ample room for circulation without interruptions. (Brink et al. 2011)
- Relocate existing playgrounds and design new playgrounds to safer and more appropriate areas on the site. (Brink et al. 2011)
- Include educational decorations, signs, and maps throughout the site
- Design to accommodate for a whole grade-level and/or the whole school population. (Brink et al. 2011)
- Use a variety of gardens to serve as outdoor laboratories for the purpose of exploring different flora and fauna. (American Society of Landscape Architects 2011)
- Design the school ground to preserve the views of nature. (American Society of Landscape Architects 2011)

The design goals and objectives helped to establish a list of programming elements on the school ground based on the literature reviews and case studies The list of the site program elements was compiled to better establish a list of requirements for the design of the school ground. The list was developed using the G.R.O.W. team's list of requirements as described in a G.R.O.W team meeting held in February. Additional items were added to the list based on the literature review & case studies and findings based on the site analysis.

Table 4.1. List of Barnett Shoals Elementary School Landscape Design Program of Requirements.

Barnett Shoals Elementary School Program of Requirements	
• Raised Garden Beds (G.R.O.W. 2016; Moore and Cooper 2014)	• Butterfly Garden (G.R.O.W. 2016; Moore and Cooper 2014; Brink et al. 2011)
• Wildlife Habitats - Wetland, Mesic Forest, Native Grassland Meadows, and Native Wildflower Meadows (G.R.O.W. 2016; Georgia Wildlife Federation 2006; Coyle 2010; Moore and Cooper 2014)	• Pollinator Garden (G.R.O.W. 2016; Moore and Cooper 2014; Brink et al. 2011)
• Arboretum (G.R.O.W. 2016)	• Native Garden (G.R.O.W. 2016; Brink et al. 2011; American Society of Landscape Architects 2010)
• Jogging Track (School Board Requirement)	• Nature Playground (Malone and Tranter 2003; Moore and Cooper 2014)
• Natural “Loose Parts” Play (Moore and Cooper 2014)	• Natural “Loose Construction” Play (Moore and Cooper 2014)
• Outdoor Classroom (G.R.O.W. 2016; Coyle 2010; Moore and Cooper 2014; Brink et al. 2011; American Society of Landscape Architects 2011)	• Livestock Area (G.R.O.W. 2016)
• Fitness Playground (Centers for Disease Control and Prevention 2010)	• Amphitheater (American Society of Landscape Architects 2010;

	American Society of Landscape Architects 2011)
• Compost Area (Moore and Cooper 2014)	• Outside Eating Area (Matsuoka 2010; American Society of Landscape Architects 2010)
• Pond Area (Georgia Wildlife Federation 2006)	• Outdoor Media Library Area (American Society of Landscape Architects 2010)
• Edible Garden (Moore and Cooper 2014)	• Playground (School Board Requirement; Brink et al. 2011)
• Native Meadows/Grasslands (American Society of Landscape Architects 2011; American Society of Landscape Architects 2010; G.R.O.W 2016)	• Signage (American Society of Landscape Architects 2011)
• Geology Wall (G.R.O.W 2016)	• Barn (G.R.O.W 2016)
• Herb Garden (G.R.O.W 2016)	

Source(s): (G.R.O.W. Parent's Committee to Barnett Shoals Elementary School 2016; Moore and Cooper 2014)

Site Analysis

The first step of the site analysis consisted of collecting a site inventory (See Appendices G-K). A visit to the school site was scheduled with a member of the G.R.O.W. team. I was allowed to visit and walk the site with Lauren Zeichner and get a detailed explanation of the school ground improvements that G.R.O.W. was responsible for (e.g. Outdoor classroom structure, native garden, butterfly garden, upland forest habitat, wetland habitat, meadows, signage, an arboretum, memorial bench and trellis, livestock grazing, chicken coup, barn structure, etc.) Furthermore, I was allowed to take

pictures and document the undisturbed portions of the site that will remain for the actual opening of the school. A 20-foot wide portion of the thick row of bushes and tall screens that screened the adjacent northwest property, had to remove from Barnett Shoals Road halfway into the school parcel. The purpose of removing this large portion of the screening area was to provide access for a new electrical line as well as provide a fire access road. Certain existing trees were protected with a tree fence from construction activity in efforts to maintain its integrity and function well after occupancy. A small, manufactured traditional playground structure was also protected from construction activity in hopes of having it relocated and reused after occupancy. Along with certain protected trees and the playground structure, the design & construction team decided that the protection of the arboretum was also a priority. The existing livestock fence and storm water detention pond fence were demolished. Appendix F shows these protected areas, the demolished fences, the planned drainage inlets & culverts on the school site, and the existing trees that are to remain in context to the building and asphalt footprint. The site inventory provided an inventory of existing site elements and vegetation that should be considered in the design process as these elements would remain after occupancy. The existing plants that were undisturbed did effect the local microclimates of the site in terms of wind patterns, sunlight catchment, and placement of hardscapes, thus affecting the plant selection and circulation during the concept development into the final design phase.

The site analysis process continued with a separate set of analyses for winter sunlight hours (See Appendix G), summer sunlight hours (See Appendix H), warm prevailing winds (See Appendix I), cold prevailing winds (See Appendix J), and slope

analysis (See Appendix K). The conditions found to dominate the site informed many of the decisions made in the final design of the school ground. These individual analyses were compiled into a composite site inventory (See Appendix L) to be used as the base under layer for the purpose of developing the concept. The combined results in addition to the findings from the case studies and literature review justify the final decisions made in the design of the school landscape.

Appendixes G and H shows the results from the shadow study of the site for both the Summer Equinox and Winter Equinox respectively. The existing grade design and undisturbed area were modeled in Revit with context to the building footprint and height to create the various shadow outlines that are developed throughout the course of the year. The Summer Equinox shadows were recorded for each hour in between the hours of 7:00 A.M. and 7:00 P.M., accounting for each hour that the sun produced applicable sunlight onto the site. Similarly, the Winter Equinox shadows were also recorded for each hour in between 9:00 A.M. to 4:00 P.M. The obvious conditions that would be noted are that the portions of the site that are exposed to the southern sun have the most year-round sunlight exposure. The summer sun produces the most sunlight for the portions of the site that are exposed to the southern, western, and eastern sun. The amount of exposure to the hot summer sun corresponds to the amount of energy that is wasted during the summer months when the mechanical system is working overdrive to offset the heat gained from the day-long hot sun exposure on the building's envelope. A standard good practice is to place deciduous trees near the building's western-, eastern-, and southern- exposed envelope where the sun is hot to shade the building from the hot sun and decrease the energy costs associated with cooling down a hot building. Even planting trees on the

north side of a building reduces the overall temperature of the area surrounding the building. (North Carolina Department of Commerce Energy Division 2000) Another energy-saving solution to reduce the cost of energy is to shade the air conditioning unit from hot summer sun. Shade keeps the temperature of the air conditioning unit down, so the unit does not have to work as hard to cool the building down. ("Tips for Landscaping Around Your Air Conditioning Unit" 2014) Shading the air conditioning unit can increase its efficiency by as much as 10%. (South Carolina Energy Office 2016) Vice versa, the northern portions of the site have the least year-round sunlight exposure. In fact, the winter sun produces zero direct sunlight exposure for a large portion of the Medial Library Courtyard. The sets of analyses performed for sunlight exposure will also direct some of the design decision-making for circulation, hardscape placement, and plant selection. A majority of plant species ability to survive depends on the amount of sunlight hours that they are exposed to. Based on energy-conserving landscape design principles, deciduous trees with high spreading crowns should be planted along the southern facades of the building at a set distance based on the height of the windows to block sunlight in the summer and let in the winter sun to aid the building when the heater is used to heat the building. Trees with lower crowns can line the western and eastern facades where shade is needed from lower afternoon sun angles. (South Carolina Energy Office 2016)

Another site analysis recorded the prevailing winds of the site showing where there is opportunity to block harsh cold winter winds and where there is opportunity to channel warmer winds into the site during the hotter months (See Appendix I and J) Prevailing winds speed and directions data was collected from weatherspark.com for the city of Athens, GA. The website took into account wind and weather data from 2012 to

2015 to provide a more accurate window into the most recent weather patterns of the region. Athens, GA is recorded as a warm humid temperate climate with hot summers and no dry season. The year-round prevailing wind direct came either from the eastern direction (15% of all winds) or the wester direction (14% of all winds). The next largest prevailing winds came from the northwestern direction (10% of all winds), and the northeastern direction (9% of all winds). In summary, the eastern and northeastern direction combined for a total of 24% of all winds and the western and northwestern directions also accounted for a total of 24% of all winds. ("Average Weather for Athens, Georgia, USA" 2016) The daily mean wind speed was recorded as a peak seven miles per hour daily mean wind speed during the beginning of March and a low three miles per hour daily mean wind speed in September. For the course of most of the winter and half of the spring season, mid-December to the end of April, the daily mean wind speed reached approximately six miles per hour. For the course of half of the spring season through the fall season, mid-May to the end of November, the daily mean wind speed reached approximately three miles per hour. The colder winds in November have an average daily wind speed of 4.5 miles per hours which slowly pick up to an average daily wind speed of five to six miles per hour from December through April with a high daily mean of seven miles per hour at the beginning of March. At the same time, from the months December through March, about 35% of all winds come from the western or northwestern direction and another 20% of the winds come from the eastern and northeastern directions. The warmer winds in August have an average daily wind speed of 3.5 miles per hours which slowly pick up to an average daily wind speed of four miles per hour through September. At the same time, from the months August through

September, about 38% of all winds come from the eastern and northeastern direction and another 15-18% of the winds come from the western and northwestern directions. Energy efficient landscape design states that properly placed landscaping can provide wind protection and resultantly reduce heating costs considerably. The best wind breaking solutions to block wind currents are trees and shrubs with a low crown that effectively block wind close to the ground. Planting the windbreak at a distance of two to five times the mature height of the trees away from the building produce the best results. Conjunctively, planting shrubs, bushes, and vines close to the building structure creates a dead air space that acts as an insulator for the building in winter and summer. Planting this insulating layer of vegetation produces the best results with at least one foot of space in between full grown plants and the building's exterior wall. (South Carolina Energy Office 2016) For the spring and summer heat, wind currents should be channeled into the space, especially where activity will occur for children during warmer periods. (North Carolina Department of Commerce Energy Division 2000) Because the building footprint is not arranged along one long axis, there exists multiple channels for the wind currents to travel through as well as two courtyard pockets for the wind currents to gather in. The site is surrounded by tall vegetation on three side of the parcel and on the fourth side of the parcel runs Barnett Shoals Rd. Due to the vegetation planted around the perimeter of the property, most of the wind currents are sourced from the northeastern side from Barnett Shoals Road. Some prevailing western and northwestern winds that are dominant during the winter months are sourced in the western and northwestern portions of the site however due to the building footprint being located closer to the western and northwestern portions of the site, there is less wind activity deriving from that portion of

the site. The wind activity that does reach the openings of the two courtyards does create an issue for the users of the courtyards. Appendix I and J shows the effects of both the prevailing cold and warm wind currents on the elementary school design. To protect the Media Library Courtyard in the northern wing and the Cafeteria Courtyard in the southern portion of the building, energy efficient landscape design calls for blocking all cold wind current with evergreen shrubs that are low to the ground. The Cafeteria Courtyard will be protected with a non-porous screen of different varieties of Feijoa sellowiana. These shrubs are evergreen, with a low crown, 15-foot canopy coverage, and also serves as an edible landscape. The pineapple guava fruit is a treat especially for children who eat outside in the cafeteria patio for lunch and/or breakfast. The Media Library Courtyard in the Kindergarten wing also will be protected with a screen of *Juniperus virginiana* trees, Eastern Red Cedars. Eastern Red Cedar are great wind screens as they are evergreen, have a low crown, and a 20-foot canopy. They are also very important for wildlife because the provide year-round shelter and cover for various animals, especially birds. ("10 Ways to Add Biodiversity to Your Garden." 2016) Another location where a wind screen is needed is between the basketball court and the loading docks/teacher parking. The area is widely exposed in all directions from wind currents. An effective wind screen placed here will guard the basketball court and jogging track from the harsh winter air elements. The wind screen planted here will consist of *Ilex crenata* 'Hetzii,' Feijoa sellowiana, and Magnolia grandiflora 'Coco.' The wind screen will have a large opening near building to allow access to the storm water easement that leads to the detention pond in the western portion of the site. As well as provide access for Physical Education (P.E.) students traveling from the gym to the jogging track,

exercise equipment, and the basketball court. Warmer wind currents during warmer months coming from the east and northeast will be effective in cooling the site and building by passing through the street tree plantings and the vegetated areas to the north of the building. Vegetation shades the ground around the building reducing heat radiation and also cools the air before the wind currents reach the building, thus adding a cooling effect. (South Carolina Energy Office 2016) Furthermore, an area near the wind screen placed for the Media Library Courtyard has a channeled opening that leads to the traditional playground for the children. The cooled warm wind currents are channeled through this opening to effectively help cool children off from their play activities and the spring and summer heat. Warm wind currents will also effectively reach the area between the arboretum and the building.

The slope analysis of the site showed opportunities for the design of natural play areas based on the undulating topography, as well as opportunities to use heavy sloping hill banks for other purposes without the need to move too much earthwork. Appendix K shows the slope of the graded site. In the analysis two average sloping hills can be noted in the western and southern corners of the site. In fact, these two portions of the site have the largest open area surface on the whole parcel of land with a manageable slope percentage. The large open space on the southern portion of the site has an average slope of zero to five percent with a few spots of 12 to 15% slope. At its widest it has a width of 204 feet and length of 255 feet, thus making it the largest open space available on the site. The other large open space with a manageable slope has an average slope of five to twelve present with a few spots of 12 to 18% slope. The space also has a strip of land with a slope exceeding 25%. This open space was previously used as the livestock (e.g.

sheep and goat) grazing area and a chicken coup. It measures approximately 189 feet long and 164 feet wide and is the second largest available open space on the site. Aside from these areas, the only other notable heavy sloped area on the map includes the hill leading from the Cafeteria Courtyard to the jogging track and the hill leading from the basketball court to the jogging track. Both of these hills have slopes exceeding 25% and provide opportunity for repurposing and/or regrading for use. Landforms with undulating sloping patterns can be fun for children in that they provide increased visual complexity and screen from undesirable views. Steep slopes can be too challenging to develop and make accessible. (Moore and Cooper 2014)

All of these analyses were then combined into a composite site inventory to be used as the under layer to develop the concept design of the new Barnett Shoals Elementary School landscape. (See Appendix L) The composite site inventory only included important aspects of the individual analyses that would affect the decision making for the development of the design. Only the summer sunlight hours were included in the site inventory. Areas of the site that only allowed five to seven hours of sunlight per day and eight to ten hours of sunlight per day were mapped on the site inventory map. Because, most vegetables prefer about eight to ten hours of sunlight per day for growth and vegetable production, these two areas on the map seemed like appropriately divided portions of the site that needed to be inventoried. (University of Georgia 2009a, 1) Furthermore, the portions of the building that received the hottest summer sun exposure was noted. The wind currents, both warm and cold, were also noted on the composite site inventory map. Referencing the original prevailing wind analyses, the location of planned windbreaks could be noted in context to the rest of the site analysis. Water drainage inlets

and culverts were also included in the composite site inventory to better visualize the network of storm water management in context to the site. The grass swale locate on the northwestern portion of the site was mapped as a reference to the location and route of the swale. The storm water features and swale will help the decision-making of where to place circulation, programming, vegetation, and other landscape elements. From the slope analysis, the only information that placed importance in the composite site inventory were slopes that exceed 25% and the large open space in the southern corner of the site. These would serve as area of opportunity for the purpose of programming, repurposing, and grading. To designate areas with good views versus bad views, the windows and doorways of the building were also mapped. Individual areas with good views versus bad views were also noted individually on the composite site inventory map. Existing vegetation and existing site elements that were to remain undisturbed after occupancy were also noted on the composite inventory map for the purpose of designing programming, circulation, and vegetation. The asphalt driveway and parking areas maintained the same boundaries without any change. The fencing around the detention pond also maintained the same boundary without any change. The mandatory 20-foot wide fire lane boundary also remained unchanged. The resultant composite site inventory map provided a canvas for the design concept to develop on.

Concept Design

The development of the concept design was initialized with the findings from the existing school site, the new building, parking lots, and sidewalks drawings, site analyses, literature reviews, and case studies. Combining these dataset using visual drawing

methods allowed for different concepts to be developed into final drawings. Items such as circulation, programming elements, site conditions, and sun exposure played a part in the organization of the school site programming and its circulation. Preservation of the arboretum, herb garden, rock geology wall, and other features of the site, were also major factors in laying out the different program elements on the site. The different relationships that were created during the concept design phase were then refined and synthesized into the final design.

First, access between the building and major points on the site (e.g. bus/parent pick-up and drop-off, loading docks, teacher parking, and street pedestrian access) was mapped to determine mandatory circulation routes to and from these areas. The Kindergarten wing was designed with the use and application of the five senses in mind. Children between the ages of three to seven years old (i.e. Pre-Kindergarten and Kindergartens students) show an increase in rapid brain development and sensory stimulation through play can progress neurological development. (Moore and Cooper 2014, 21) This is the only region on the site that contains an open grass swale that is not piped underground into a storm water junction box for further relay. To take advantage of this, a 1500 gallon above-ground rainwater cistern will be installed near the Kindergarten wing door to collect rainwater for reuse (i.e. watering plants and other water-related learning activities). For visual and hearing purposes a rock runnel for the guidance of storm water is planned to convey rainwater from the rain cistern through the grass swale into the storm water culvert. A “Learning” Pond will also be constructed in this area for children to learn about aquatic fauna and flora. A small wooden dock will also hover over the pond for the children to observe and learn about aquatic habitats. A sand pit will be

linked to the pond for the young children to play and learning. Children at this age like to knead, shape, sculpt, dig, sift, burrow, and experiment. (22) The Outdoor Library Courtyard area will have a small fence in-between the library patio and the Kindergarten play area. To further the sensory development of the children, fragrant *Osmanthus fragrans* (Tea Olive) will be planted in the courtyard along with edible *Vitis rotundifolia* (Muscadine Grapes) on the fence in between the Library Courtyard and the Kindergarten Wing for the children to taste and learn. A circulation path between the Kindergarten area will be needed to run to both the front and back of the building.

Multiple habitat environments were planned to be included in the design of the schoolyard including the fore mentioned aquatic habitat, a wetland habitat, a native Piedmont Grassland habitat, a native wildflower meadow, and restoration of the Mesic Mid-Slope Forest habitat arboretum. To take advantage of the floodplain environment that is developed by the planned grass swale in the northern portion of the site near the storm water culvert, a wetland habitat will be formed to teach children about biology, hydrology, botany, science, ecology and ecosystems. In the rear of the building, along the site perimeter where the livestock area is set to remain, the design of a nature playground was set to be place in between the Outdoor Classroom and livestock grazing area. Due to the sloping nature of the hill, placement of the grassland habitat, wildflower habitat, and the nature playground prove effective because it provides well-drained soil for the meadow and grassland development, and for the nature playground, it provides visual interest and opportunity to utilize the natural slop for play opportunities. The Mesic Mid-Slope Forest habitat located in the arboretum is set to be preserved and restored for the purpose of adding wildlife and visual appeal. Various vegetation will be planted to

restore the forest. To make the arboretum forest more useable for the teachers, an informal wooden fence will be installed along the exterior perimeter of the arboretum and along the interior trail paths. These paths will have an edge guard to aesthetically please the users as well as provide a safe, visible, and non-eroding route in and out of the arboretum for daily classroom usage. Teachers are less likely to use natural area of the site if they are not well-maintained and presented. The existing benches in the arboretum will remain along with a few new benches.

To respond to the need to bring gardening into the school environment for teaching core curriculum, knowledge awareness, increasing fruit & vegetable consumption, and physical fitness, two school gardens and four different fruit patches/orchards were integrated into the site. The Cafeteria Courtyard and an area of the rear of the building will serve as the two school garden locations for teachers to teach children about gardening and food production. Both vegetable garden locations are located near the garden stations. These areas have good sun exposure and are readily accessible for handicap children. The G.R.O.W. team had requested four feet wide and 12 to 16 feet long planting beds. (G.R.O.W. Parent's Committee to Barnett Shoals Elementary School 2016) Handicap beds should be raised 24 inches for children in wheelchairs to be able to reach and should have ample space for a wheelchair to enter and exit. (Romeo 2013) The spacing of planting beds should have a minimum of five feet in-between each planting bed. Using the recommended vegetable planting chart published by the University of Georgia Extension, a vegetable planting schedule was created in an effort to bring year-round harvest and learning opportunities for all children (See Table 4.2).

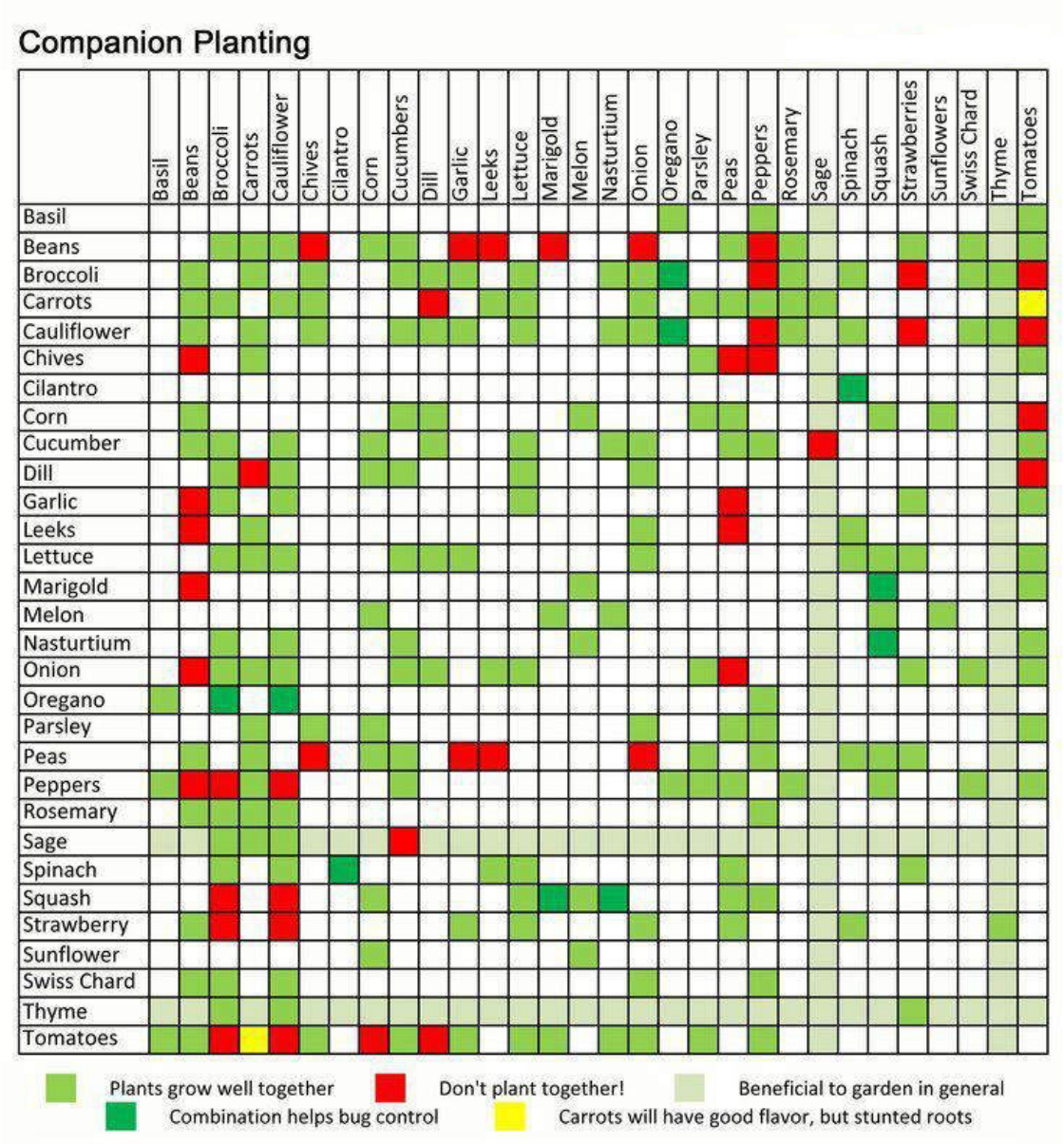
Table 4.2. Vegetable Garden Planting Schedule.

SCHOOL GARDEN 1 – CAFETERIA COURTYARD LOCATION			
Vegetable	**Seed Rate**	**Scheduled Planting Dates**	**Spacing Rows per Plant**
Beets	1 oz. seeds / 100 sq. ft.	Aug 10 – Oct 15	18” x 2”
Radish	1 oz. seeds / 100 sq. ft.	Oct 15 – Nov 15	24”x1”
Green Onion	300 Plants / 100 sq. ft.	Nov 15 – Feb 15	18” x 3”
Spinach	1 oz. seeds / 100 sq. ft.	Feb 15 – Apr 15	18” x 2”
Watermelon	1 oz. seeds / 100 sq. ft.	May 8 – Aug 8	72” x 36”
SCHOOL GARDEN 2 – BUILDING REAR LOCATION			
Vegetable	**Seed Rate**	**Scheduled Planting Dates**	**Spacing Rows per Plant**
Kale	0.5 oz. seeds / 100 sq. ft.	Aug 10 – Oct 10	26” x 16”
Spinach	1 oz. seeds / 100 sq. ft.	Oct 12 – Nov 27	18” x 2”
Green Onion	300 Plants / 100 sq. ft.	Nov 27 – Feb 27	18” x 3”
Collard Greens	0.5 oz. seeds / 100 sq. ft.	Feb 27 – Apr 27	36” x 16”
Cantaloupe	1 oz. seeds / 100 sq. ft.	May 8 – Aug 8	60” x 36”

Source(s): University of Georgia 2009b.

Herbs such as *Thymus vulgaris* (Thyme), *Salvia officinalis* (Sage), and *Rosmarinus officinalis* (Rosemary) will also be planted near the vegetable garden to help in pest

control and serve as companion plants that help the vegetables grow more efficiently. These plants will also serve to help develop the children's sense of smelling, as they are very pungent. ("Container Vegetable Gardening" 2016) Figure 4.1 shows a chart of appropriate companion plants that will serve as appropriate plant combinations with various vegetable types.



Source(s): "Container Vegetable Gardening" 2016.

Figure 4.1. Successful Companion Planting Combinations for Vegetable and Herbs.

For the edible garden, fruit choices are limited, especially due to the school year schedule and summer vacation. Fruit plants that produce fruit during the school year are preferred. Fruits that grow well in this region, produce perennial fruit, and are most likely to be successful in a school garden during the traditional school year include strawberries, figs, and muscadine grapes. Strawberries can be harvested in the spring and muscadine grapes and figs in the fall. Blueberries are also a great choice due to their longevity, high yields, and ease of growth, regardless of their usual summer harvest. (University of Georgia 2013) In fact the blueberries and figs can provide decades of fruit yields. Blueberries, strawberries, and figs all require full sun for peak production. (Sorrow 2011) Due to their growing condition requirements. Large open spaces with full year-round sun were preferred. The best places to place these edible landscapes were in the front of the building due to the availability of large open spaces and full sun. Placement of the edible landscapes in these areas also reinforced healthier eating habits by constantly reminding passer-byers of the importance of fruits in daily diets. A blueberry patch is planned to be planted in the soil north of the bus pick-up/drop-off area. A strawberry patch is planned to be planted next to the loading docks so that teachers and visitors alike can appreciate the value of eating fruits in their diet on a daily basis going in and out of the building to the teacher parking lot. A fig orchard is planned to be planted next to the strawberry patch. Muscadine grapes should be planted along the perimeter fence of the detention pond.

The Cafeteria Courtyard will be enclosed from the rest of the site using edible evergreen *Feijoa sellowiana* as a screening plant, making it inaccessible from the school grounds. The only access points to and from the Cafeteria Courtyard are to remain at the access points between the Cafeteria Courtyard and building. To best control children in efforts to naturalize and bring outdoors the breakfast and lunch eating experiences for the schoolchildren, access to the courtyard remains blocked from the rest of the school grounds, thus ensuring a defensible landscape that uses the site, building, and vegetation to ensure security and supervision of children (Louv 2016b) Furthermore it is connected to one of the school gardens to reinforce knowledge awareness and consumption of fruits and vegetables, The Cafeteria Courtyard will also be home to one of the more interesting gathering spaces on the school ground. The concrete sidewalk that connects the two-story classroom building to the one-story general building will also be planted with vegetation that brings and demands attention. Children will be able to distinguish this gathering area from the rest of the school grounds just by the plant selection of interesting structure and foliage that will be chosen. Two *Ilex vomitoria* 'pendula' trees will be selected to serve as the landmark tree for students to gather at in the Cafeteria Courtyard. It will serve as a landmark around school for children to reference and gather at. Additionally, a hardscape will be constructed leading from the cafeteria to serve as the eating area for children that prefer to enjoy their lunches and breakfast outside. A small lawn will be designed for informal seating and gathering in this space as well. Vegetation that brings a sweet fragrance to this courtyard will also be used to enhance the smell sensory experience of the space while children are eating and learning about gardens. A flowering tree that frames the space will also be planted to add aesthetic value to the outdoor eating area.

A steep hill and flatland grace the area between the planned jogging track and the Cafeteria Courtyard. In an effort to reduce the cost of grading, cutting, and filling earthwork, the steep hill and the adjacent flatland serve as a perfect opportunity to repurpose the land for a school amphitheater with seating for over 650 students. The school's 25-year high for student population was reached in 2008 with a population of 632 students. ("Barnett Shoals Elementary School" 2016) For the purpose of avoiding the cost of using cast-in-place concrete and the labor associated with pouring and letting the concrete structure's set, the design solution calls for the use of larger flat boulders and stones that are too heave to move by humans. These large stones will be arranged along a terrace for every one foot of topography decrease until the bottom of the steep slope is reached. The material cost of boulders and stones and labor costs of installing these features along the hill with minimal earthwork movement are less compared to using cast-in-place concrete. Shade trees with high crowns will be planted at the bottom of the steep hill to provide shade for the onlookers paying attention to the amphitheater stage ahead. The stage will be made of bare dirt at a zero to two percent slope and framed by a retaining wall in the background in front of existing trees. The western edge of the amphitheater stage will be outlined by the start of the arboretum and other various boulder will be place along the hill leading up to the jogging track both to serve as props for stage and informal seating.

The area designated for Physical Education classes will be located behind the amphitheater stage and to the southwest of the teacher parking lot. A wind screen of Southern magnolias, Pineapple Guava shrubs and Japanese Holly will screen the Physical Education Area from the loading docks and teacher parking lots. The location of the

basketball court will remain in its original intended design location. A path leading from the entrance of the amphitheater will curve up the hill past the basketball court into the jogging track area. Originally, the jogging track was designed to be built along the contours of the hill, however for the purposes of flattening the area and building athletic fields for the children to play organized sports on, the land contained in the southwestern corner of this hill will be held back with the installation of retaining walls. Once the retaining wall retains the land from the hill, the jogging track can be built around the newly graded flat athletic fields. The newly created flatland will be designed to have two athletic fields. The first athletic field will be designed for smaller children (i.e. Pre-Kindergarteners to second-graders) with a width of 60 feet and length of 90 feet. The second field will be designed for older children (i.e. third-graders to fifth-graders) with a width of 120 feet and length of 210 feet. ("Soccer Field Dimensions" 2016) As an added feature to this Physical Education Area, various manufactured outdoor exercise equipment (e.g. parallel bars, rope climb, monkey bars, balance beam, agility bars, etc.) will be installed where the path leading to the jogging track meets with the jogging track.

The location of the outdoor classroom was designed to be placed near all other school ground zones that would impact the quality of learning for the children (i.e. butterfly garden, herb garden, geology wall, detention pond, meadows, wildflower meadows, livestock area, arboretum) A central location such as this would host more opportunities for teacher involvement in bringing classrooms outside. The livestock area will consist of a large open forage area for sheep and goat to graze on with an attached barn facing the detention pond. The barn will be constructed with a chicken coup attached to the barn.

A successful butterfly garden should include nectar-producing flowers, single flowers rather than double flowers, various colors, larval host plants for various species of butterflies, include damp areas or shallow puddles, and flat stones for sun bathing. (Georgia Wildlife Federation 2006, 17) Certain trees such as *Betula nigra* (River Birch) and *Quercus alba* (White Oak) can be larval hosts for a specific butterfly species or thousands of caterpillars respectively. ("10 Ways to Add Biodiversity to Your Garden" 2016) These companion trees should be used to the advantage of the school ground for shade or rain garden use as well as for butterfly habitats. The Bioswale Area and the smaller bio retention system in the eastern corner of the site contain River Birch trees and the front main entrance contain a couple of White Oaks. The butterfly garden planned will contain both nectar plants and larval host plants. Additionally, butterfly gardens prosper with the help of pollinators for proper and further growth of plants. The success of flowering plants is a result of their ability to form a mutually beneficial relationship with insects, pollen, nectar, and cross-pollination. (Missouri Botanical Garden 2016) A pollinator garden is to be planned for the main entrance of the building near the administrative offices. The garden would help pollinate many of the plant species around the school ground. A Native Garden was also planned between the amphitheater seating area and the detention pond near the planned location of the outdoor classroom to facilitate a nearby learning outlet for the outdoor classroom users.

The design of the bioretention system and bioswale system planting took into consideration native species, the limiting budget, increasing wildlife value (e.g. increase pollinators, butterflies, birds, hummingbirds, amphibians, insects, etc.), sunlight exposure, and drought-resistance. The typical list of Georgia rain garden plants was

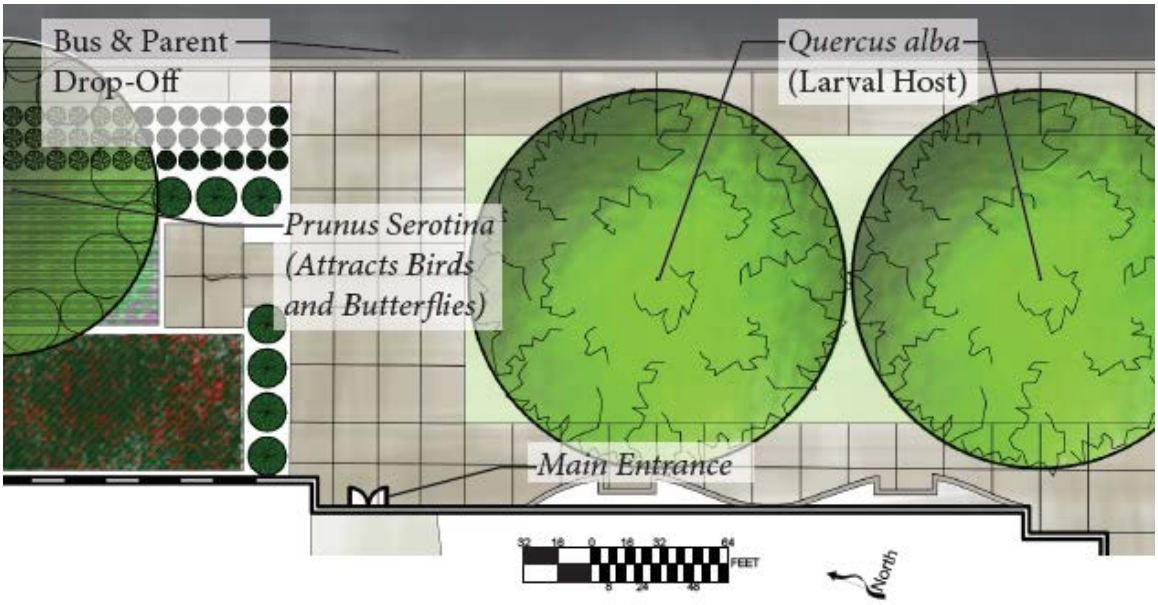
considered in the selection of plants for these areas of the school ground. (Georgia Wildlife Federation 2006, 27) The concept plan was created taking all of these elements into consideration. (See Appendix M) For the most part, the relationship between the circulation of the site, the programming of the site, slope of the site, the sunlight exposure of the site, and the prevailing winds controlling the site were all studied in the development of the design concept.

Final Design

The final design of the school ground further developed relationships between the site, programming needs, and the natural elements affecting the site (i.e. slope, topography, wind elements, sunlight exposure, soil drainage, etc.). (See Appendix N) Plant selection of the individual zones of the site was established, detailed landscape features (i.e. logs, boulders, benches, branches, stumps, etc.) were placed, and materials were selected. The final design also contains a few area of grade change and one area of flattening a hill with a retaining wall for the design of an athletic field. (See Appendix O) The code-required fire lane access specified a 20-foot road access route for a fire truck to enter the premises of the school ground in case there is a fire. It runs along the northern perimeter of the site between the school property and the adjacent residential property. The size of the specified fire lane is approximately 8,384 square feet (779 square meters). Unfortunately, due to the size and costs associated with the fire lane, a cheaper and appropriate material was chosen. Compacted crushed stone base will serve as the material for the fire lane access route. The original road and parking layout was unaltered. The asphalt footprint originally designed has remained untouched as is the footprint of the

basketball courts and the concrete pads for the mechanical systems. The original footprint of the jogging track was also unchanged from the original design. The original perimeter fence of the storm water detention pond was also left unchanged.

The main entrance of the building contains two *Quercus alba* (White Oak) trees and a *Prunus serotina* (Black Cherry). Both of these trees add to the wildlife value of the school grounds. The Black Cherry tree is said to be a host plant for over 450 species of butterflies and moths. Over 53 different species of birds eat the fruits that are produced from the Black Cherry tree. ("A Perfect Plant for Birds in Georgia" 2015) Similarly, the White Oak can be a larval host for over 1000 caterpillars. ("10 Ways to Add Biodiversity to Your Garden" 2016) Other shrubs (*Callicarpa americana* and *Baptisia australis*) and groundcovers (*Echinacea purpurea* and *Mitchella reptans*) that birds and butterflies are attracted to are also planted around the Black Cherry to promote biodiversity outside the main front windows of the Administrative Offices. The raised planting beds along the main entrance wall will be planted with *Salvia azurrea* for its shade-tolerance and its wildlife value.



Source(s): Designed by Arpan Patel.

Figure 4.2. View of Barnett Shoals Elementary School Main Entrance.

Further along the main entrance of the building towards the loading docks lies the *Fragaria x ananassa* 'Delmarva' (Strawberry) patch and the *Ficus carica* 'Brown Turkey' (Fig Tree) orchard, both of which should be integrated into the gardening curriculum. The recommendation for Strawberry patches in the northern part of the state are to plant two rows of 15 plants each that are four feet apart with a two-foot space in-between each plant leaving a total of 30 plants per eight foot by 30-foot bed. (Krewer et al. 2004) A total of 450 plants will be planted in the Strawberry patch. A fig patch grown in tree form should be spaced 15 feet apart within each row and 20 feet apart from each row in the spring. (Krewer and Hendrix 1999) *Vaccinum ashei* (Rabbiteye Blueberry) varieties are best grown in the northern part of the state. It is recommended to plant more than one variety of Blueberries to get the best yields. The best late season-yielding varieties are Baldwin, Centurion, and Ochlockonee. The standard spacing is five to six feet in between

plants in a row and 11 to 12 feet between rows. (Krewer and NeSmith 1999)

Approximately 150 Blueberry bushes will be planted in the lawn between Barnett Shoals Road and the bus drop-off area. Furthermore, *Vitis rotundifolia* (Muscadine Grapes) will be planted along the perimeter fence of the detention pond and along the fence of the Media Library Courtyard. Muscadine is a dioecious plant and will require both male and female plants to fruit. The varieties Summit (female) and Magnolia (male) demonstrate good winter hardiness. The recommendation is to plant one Muscadine plant per 20 feet of fence. (Krewer and Myers 2001)

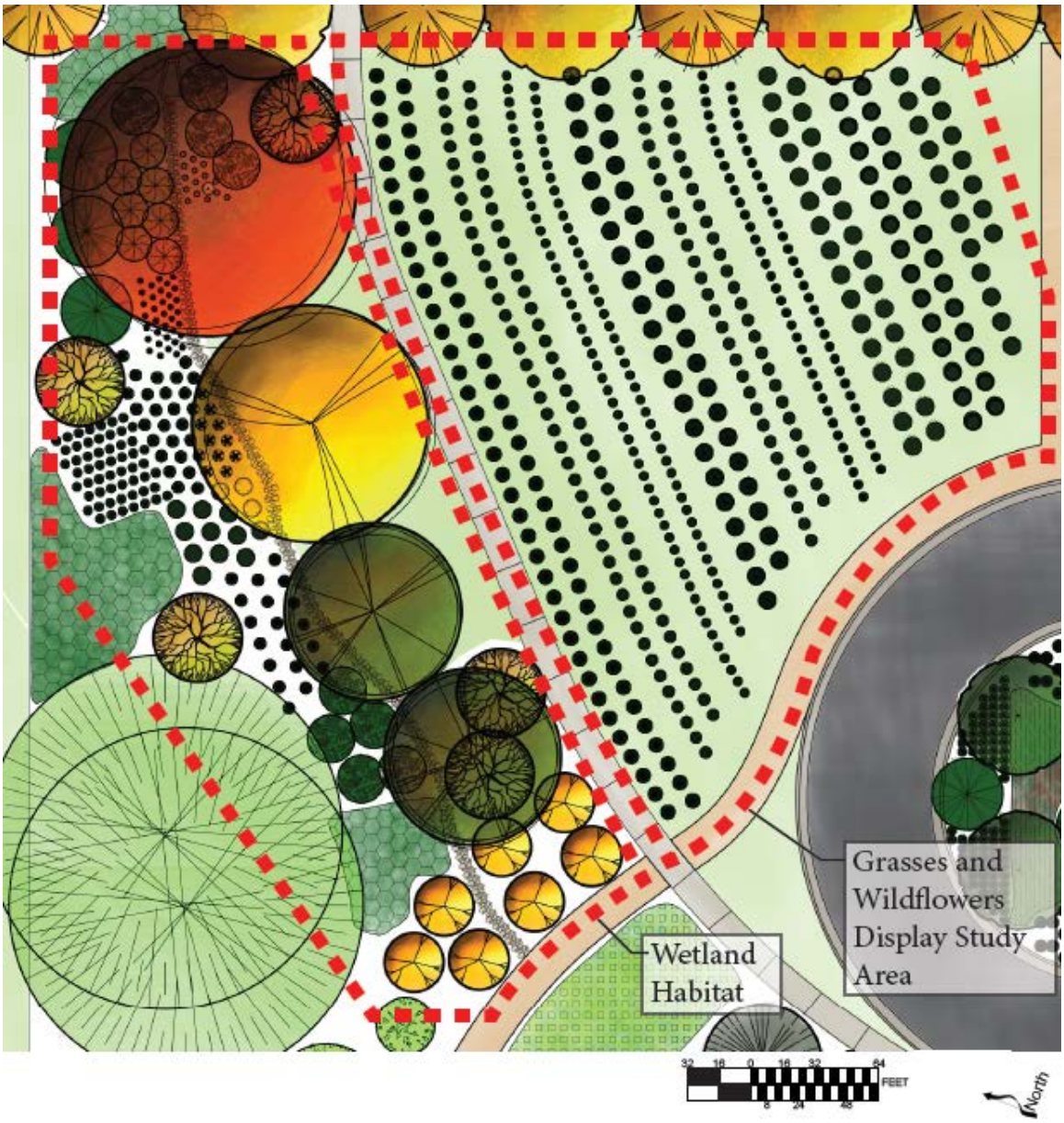
Source(s): Designed by Arpan Patel.

Figure 4.3. View of the Blueberry Patch, Strawberry Patch, and Fig Orchard Near the Front of the Building.

Beside the Blueberry patch is a field planted with rows of wildflowers and grasses. The rows are wide enough for classes to travel through and closely observe and learn about the different grasses and wildflowers used in the native Piedmont Grassland

habitat and native wildflower habitat replicated in the rear of the building. Additionally, the field does radiate some cold air for the warm spring and summer winds to carry and channel into the playground area and the amphitheater. The species planted for display are *Muhlenbergia capillaris, Andropogon gyrans, Andropogon gerardii, Andropogon glameratus, Sorghastrum elliottii, Eragrostis spectabilis, Panicum virgatum, Rudbeckia hirta,* and *Solidago nemeralis.*

To the west of the native grasses and wildflowers display, a wetland/floodplain habitat will be replicated along the grass swale that carries storm water runoff into a storm water culvert located near Barnett Shoals Road. Multiple native trees (e.g. *Hamamelis virginiana, Nyssa sylvatica, Liquidambar styraciflua, Quercus nigra, Quercus phellos,* and *Ilex verticallata*), native shrubs (e.g. *Lindera benzoin, Cephalanthus occidentalis*, and *Hibiscus grandiflorus*) native wildflowers (e.g. *Eupatorium fistulosum, Asclepias incarnata, Solidago rugose, Aquilegia canadensis,* and *Tiarella cordifolia),* a native groundcover *(*e.g. *Oenothera fruticosa),* and a native grass *(*e.g. *Chasmanthium latifolium)* were planted in the replicated floodplain/wetland habitat.



Source(s): Designed by Arpan Patel.

Figure 4.4. View of Wetland Habitat and Adjacent Native Grasses & Wildflower Study Display Area.

As one enters the rear of the building behind the Eastern Red Cedar tree windscreen near the northern portion of the building the Kindergarten Wing play area is

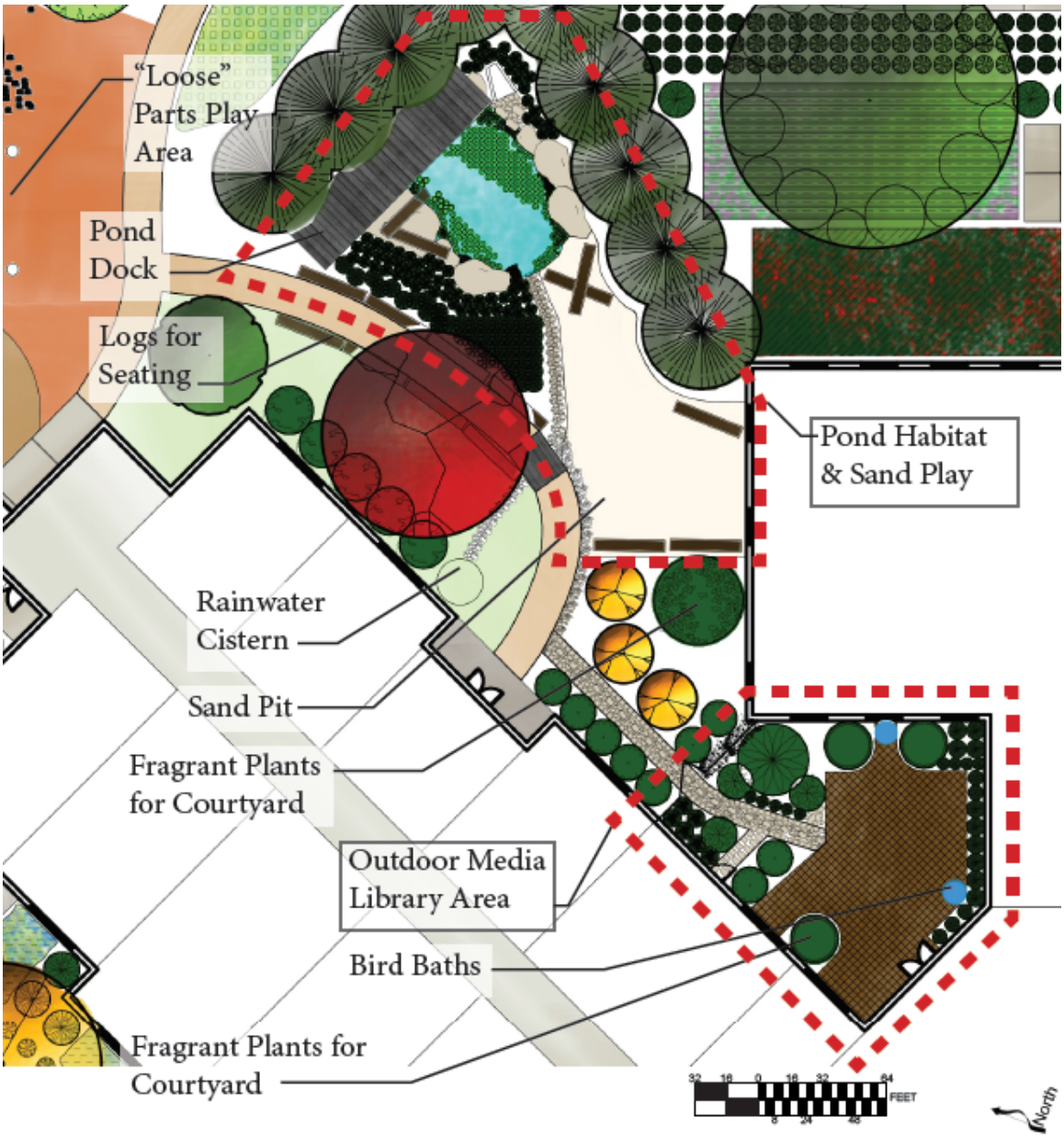
exposed. Walking from the concrete sidewalk path onto the compacted crush stone base side trail leading to the rear of the building, one notices there is a bare dirt play area with various tree stumps, boulders, branches, brush, grasses, logs, and hay bales where the "Loose Parts" play area, is located. In this area, children can transform and manipulate almost any natural, small loose object into a prop for creative and/or constructive play. Playing in this setting provides children the opportunity to manipulate the environment and create new environments based on their creative imaginations. (Moore and Cooper 2014, 69) Structured next to the "Loose Parts" play area is a small, manufactured playground area for younger children (e.g. Pre-Kindergarteners, Kindergarteners, and first-graders) surfaced with ADA-accessible engineered wood fiber which is affordable, ADA-accessible, and biodegradable. ("Playground Safety Surfacing - Rubber Mulch & Surface" 2016) Some fragrant *Calycanthus floridus* (Sweetshrub) is planted at the edge of the building near the younger children's traditional playgrounds and in-between the younger children's playground and the 20-foot fire lane.

Before entering the rear of the building through this compacted crush stone base side trail, the trail turns into the Media Library Courtyard. There the "Learning" Pond is exposed tucked behind the Eastern Red Cedar windscreen, planted with lush native aquatic and hydric vegetation. For a successful pond habitat to exist, different types of plants such as submerged oxygenators (*Elodea canadensis* and *Ceratophyllum demersum*), floater plants (*Lemna minor, Azolla caroliniana, nymphea pygmaea 'Alba,'* and *Pistia stratiodes*), marginal/emergent plants (*Typha latifolia, Sagittaria latifolia, Juncus effusus '*spiralis,*' Saururus cernuus,* and *Asclepias incarnata*), and other hydric plants (*Eupatorium fistulosum, Morella cerifera,* and *Ilex verticallata*) are necessary to

provide both flora and fauna a place to survive. Submerged oxygenators are plants that are rooted to the bottom of the pond that purify the water by absorbing mineral salts and carbon dioxide produce by animal waste and decaying plant material. Floater plants can be rooted to the bottom of the pond; however, leaves are free to float on the surface. These types of plant purify the water by filtering waste, absorbing nutrients, and adding oxygen to the habitat. As another benefit for aquatic life, the floater plants also shade the water and prevent algae from getting the ample sunlight needed for growth. Other marginal plants that live near the edges and margins of the water grow well in soil three inches to six inches under water so that their leaves and flowers can grow high above water. They offer colorful flowers, interesting foliage, and cover for many amphibians and insects. 50 to 75% of the pond's surface should be covered with plant foliage. (Reeves, Walter. 2011; Georgia Wildlife Federation 2006, 29)

A 1500-gallon rainwater cistern sits by the Kindergarten wing's courtyard entrance where rainwater from rain events is collected and overflows into the "Learning" Pond. The overflow of the storm water runoff that the rainwater cistern cannot collect will be redirected to a newly design "Learning" pond that sits near the row of Eastern Red Cedar windscreen that protects the Kindergarten wing courtyard from cold winds. A pre-designed drainage culvert near the Kindergarten wing was already planned for this wing to direct storm water runoff flow into the city storm water pipes. To account for this pre-planned storm water management system, the overflow of the "Learning" Pond will flow through a small rock swale and then into the culvert Near the sidewalk. To add to the learning experience of the younger children, logs will be installed along the compacted crush stone base trail for outdoor learning opportunity. A stone path will lead

the children from the Learning" Pond through the shade garden and into the Media Library Courtyard, where children can read and enjoy literature by sitting outside of the indoor library. Because this northern part of the building creates a deep pocket, some areas only receive five to seven hours of sunlight in the during the Summer equinox and zero hours of sunlight during the Winter Equinox. An effective shade garden that also stimulated the five senses was the only solution for this. Because the space is enclosed, opportunity to fill the outdoor "room" with a sweet fragrance arose. To address this *Osmanthus fragrans* (Tea Olive) was planted near the sand pit and *Clethra alnifolia* 'Rosea' (Sweet Pepperbush) was planted along the path leading to the Media Library Courtyard. The shade garden consists of *Viburnum acerifolium, Aspidistra elatior, Polygonatum odoratum* 'Variegatum,' *Begonia grandis* 'Heron's Pirouette,' *Hydrangea quercifolia, Osmunda cinnamomea, Hosta* 'Abiqua Moonbeam,' and *Hosta* 'Gentle Giant.' The Media Library patio extends to the distance of where the winter sun does not provide sunlight exposure during the Winter Equinox. Furthermore, to add to the sensory experience, a couple bird baths will also be installed outside for the children to observe and enjoy.



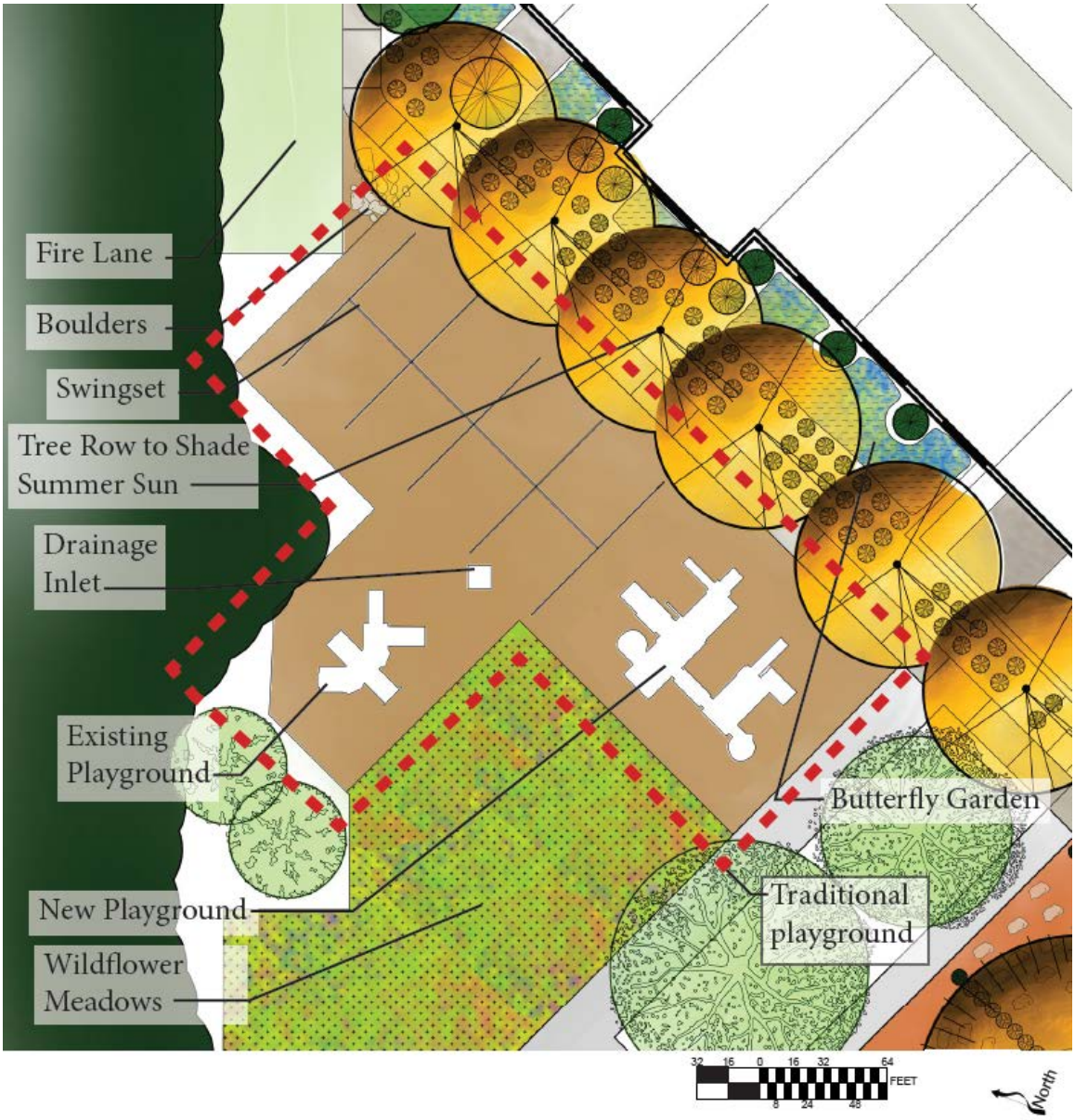
Source(s): Designed by Arpan Patel.

Figure 4.5. View of Outdoor Media Library Area, "Learning" Pond Area, and Kindergarten Playground Area Outside of the Kindergarten Wing

Continuing past the Kindergarten Wing's play area, the traditional playground can be seen around the corner of the classroom building. The school building's compacted

crushed stone base sidewalk also starts at this point and continues around the rear of the building into the other end of the classroom building near the Cafeteria Courtyard. The existing playground structure that was preserved for relocation sits along with a new playground structure. In addition to these larger play structures, an eight seat swing set will also be installed. The surfacing of the playground arena will extend to more than the safety-mandated six-feet from the edge of the equipment. The surfacing material will be made of engineered wood fiber with a nine-inch depth.

Next to the Traditional Playground area, a native Wildflower Meadow and native Piedmont Grassland will be planted. A compacted crushed stone base path will provide access to this part of the site. Due to the well-drained soil along the hill, this location is ideal. Both of the meadows also sit near the edge of the forest and serve as a buffer to the adjacent property. The traditional native Piedmont Grassland is made up of *Andropogon Gerardii* (Big Bluestem), *Sorghastrum nutans* (Indiangrass), *Schizachyrium scoparium* (Little Bluestem), *Panicum virgatum* (Switchgrass), and *Tripsacum dactyloides* (Eastern Gamagrass), of which only Switchgrass and Big Bluestem were available within the budget's reach. (U.S. Department of Agriculture 2007a) Other native grasses within the budgets reach that made the native list of grasses to be planted for the school's native meadows were *Sorghastrum elliottii, Andropogon glameratus,* and *Andropogon gyrans*. (State Botanical Garden of Georgia 2016; Wade et al. 2013) The native wildflowers that were attainable within the budget's reach and applicable for the school grounds were *Phlox paniculata, Liatris spicata, Asclepias tuberosa, Monarda punctata, Rudbeckia laciniata, Solidago nemeralis, Asclepias syriaca, Aquilegia canadensis, and Salvia azurrea.* (State Botanical Garden of Georgia 2016; Wade et al. 2011)



Source(s): Designed by Arpan Patel.

Figure 4.6. View of the Traditional Playground and Wildflower Meadows Behind the School.

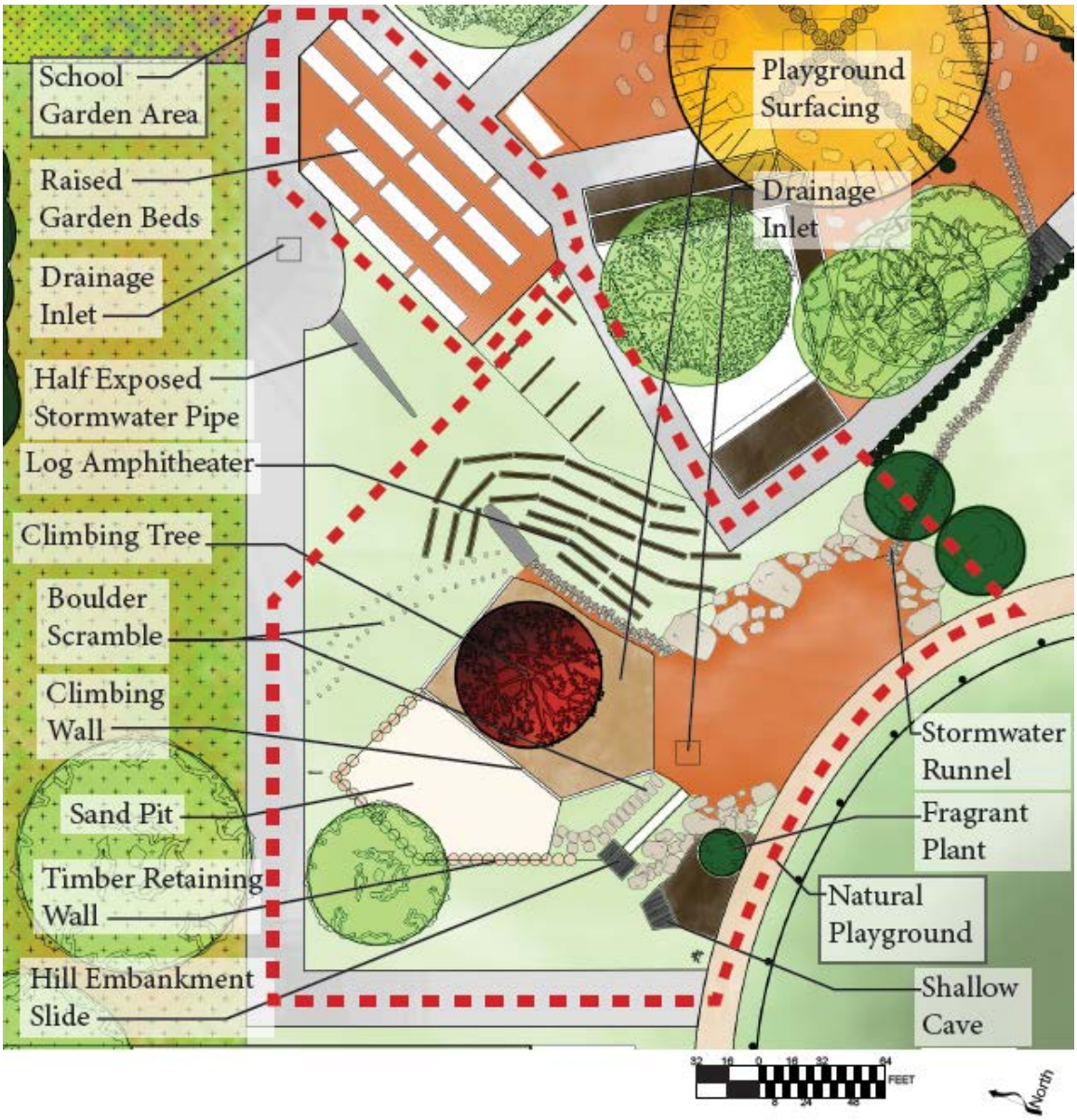
Furthermore, next to the native Piedmont Grasslands, the Livestock Area was kept in its original location at the top of the hill landform. The total area of the livestock

fence is 15,754.61 square feet and it will be enclosed with a fence. The barn will be located at the eastern corner of the Livestock area connected to the compacted crushed stone base path coming from the classroom building. The barn should also house chickens via the construction of a chicken coup. The area will provide shelter and food for a sheep, a goat, and chickens.

Along the bottom of the hill, next to the crushed stone path serving the Livestock Area, the Nature Playground provides play using the natural topography and landforms of the area. A sand pit area at the top of the Nature Play area is created by forming a retaining wall made of stumps. The sand pit is directly linked to a six-foot climbing wall that meets the bottom of the Nature Play area. It will be surrounded by engineered wood fiber mulch surfacing for its high impact attenuation. (U.S. Consumer Product Safety Commission 2015, 11) As an additional climbing feature, a low-branching, multi-trunk mid-sized tree was use for children to informally climb to the sand pit. The climbing tree species will be *Acer griseum* and will be installed with climbing aids. At the bottom of the Nature Play area, bare dirt will separate the lawn from the Nature Play area. Boulders will surround the bottom pit and the hill surrounding the bottom pit will be constructed with log timber along the hill topography to serve as informal seating. Climbing boulders and stone will be structured along the hill next to the climbing wall to provide informal climbing to the sand pit. Next to the sand pit, a seven-foot hill embankment slide will slide children to the bottom pit. Located further along the top of the hill embankment will be a timber-constructed shallow cave for children to hide in and climb. Storm water runnels with pea rock will run from the higher points near the classroom building exit and the storm water inlet near the native Piedmont Grasslands to the bottom pit storm water

inlet. A 12” wide concrete storm water pipe will be used as a nature play feature and storm water runnel by embedding half of the pipe in the hill leading from one storm water inlet to the next.

The first of two school garden plots will sit at the junction of the herb gardens and the native Piedmont Grassland meadows. The garden plots will conform to the G.R.O.W. requirements at four feet wide by 12 feet long and will be spaced with five feet of room for handicap accessibility. Placement near the herb garden will add a layer of natural pest protection. The crushed stone path leading from the classroom building leads to the school garden. At a point, the path turns and leads to the preserved herb garden, then the preserved rock geology wall, and finally back to the classroom building gravel rock sidewalk. These low maintenance and clean access routes to the geology wall and herb garden will aid teacher involvement and confidence, so that more teachers are likely to use the learning tools to their advantage.



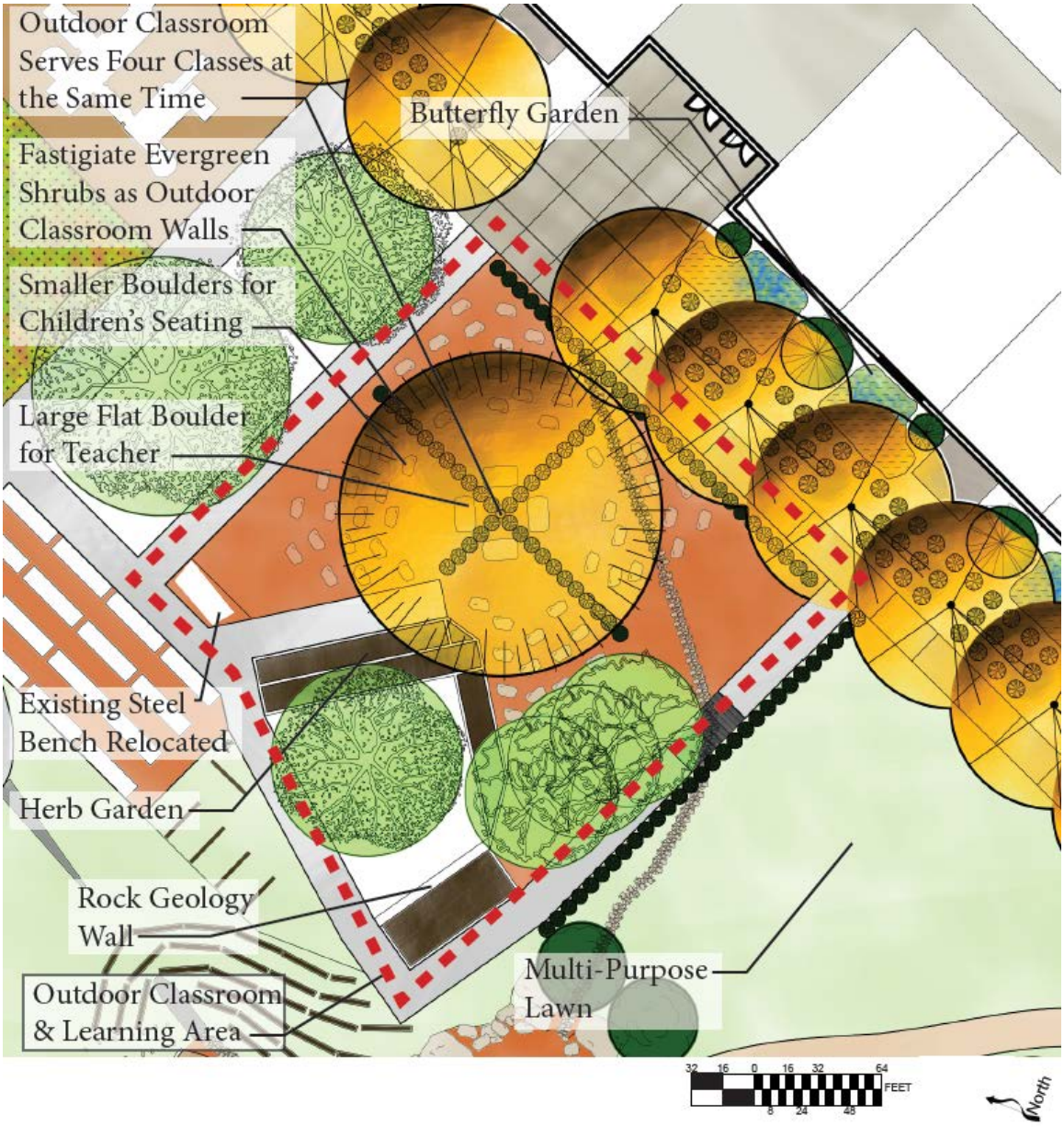
Source(s): Designed by Arpan Patel.

Figure 4.7. View of the Natural Playground Area and School Garden Behind the School.

At the center of all of these learning tools (i.e. school garden, herb garden, rock geology wall, native wildflower meadows, native grasslands, and the classroom building) lies the Outdoor Classroom. The design of the classroom was structured around a central open-round form tree (*Ulmus parvifolia* 'Allee'). From the central tree, four rooms will

be created using evergreen shrubbery (*Cephalotaxus harringtonia* 'Fastigiata') as the walls, thus framing exterior rooms to be used for learning and mental restoration. Near the central trunk of the Elm tree, a large, flat, and elevated stone will serve as the seat for the teacher with smaller flat boulders for student seating. An exterior chalk board will also be provided for the outdoor classrooms. The Outdoor Classroom is located nearest the classroom building exit to promote its use, foster knowledge about the space, and boost the confidence of teachers using the space. The space between the Nature Play area and the classroom building provides a nice location for a multi-purpose lawn. The multi-purpose lawn could be used as an informal classroom, a quick recess break, or for small gatherings.

The exterior classroom building wall will receive heat from the hot summer sun from the west and to offset the heat gain during the time when the air conditioning system is constantly running, efficient landscape design principles proposes to place high canopy deciduous trees near the building and roof to block summer heat. These design principles also suggest to shade the mechanical system so that the mechanical system runs more efficiently. Large *Liriodendron tulipifera* trees line the façade of the classroom building to make the building more efficient. A shade-tolerant butterfly garden is also planted along the western classroom building wall to serve wildlife and as insulation from the heat. The butterfly garden will consist of *Baptisia australis, Salvia azurrea, Lindera benzoin,* and *Callicarpa Americana*. These species provide food and cover for many butterflies and birds.



Source(s): Designed by Arpan Patel.

Figure 4.8. View of the Outdoor Classroom & Learning Area Behind the School.

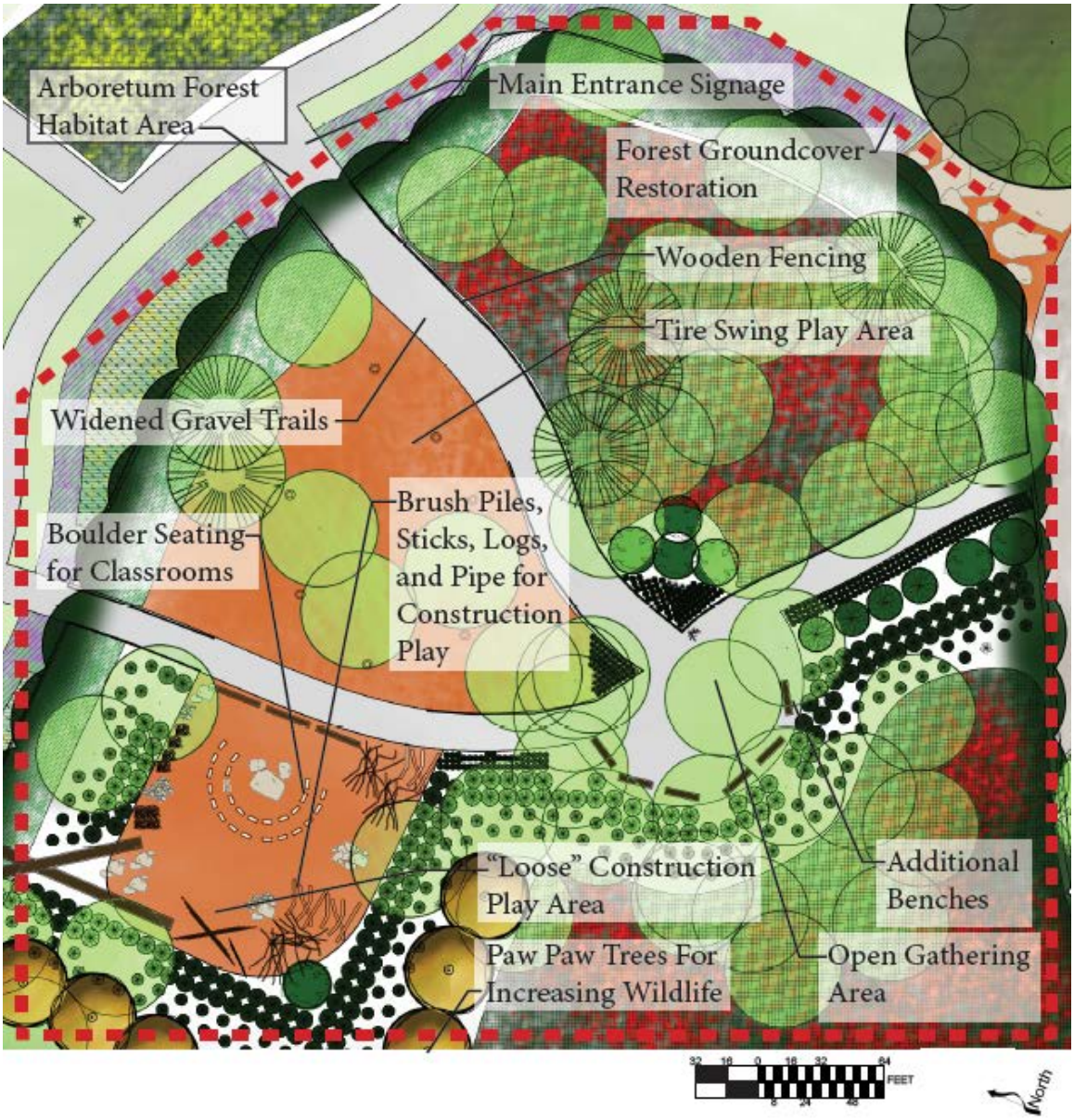
A compacted crushed stone base sidewalk provides circulation to the classroom building continuing around the classroom building to also provide circulation at the top of the boulder rock amphitheater. From the top of the amphitheater, children can walk

down the steps to find seating for events held or continue down the stairs to a compacted crush stone base trail that leads to the Physical Education Area, the Arboretum Forest, or to the Nature Play Area. The amphitheater itself is constructed along the natural steep hill that runs near the Cafeteria Courtyard. Converting the hill into an amphitheater affords saving in time, construction costs, and grading efforts. The boulders that will line the amphitheater seating area should be long, flat boulders that allow seating for multiple students. The amphitheater has two sections of ten rows each. Each row has a length of approximately 63 feet. Three stairways lead students to the different rows of seating. Two stairways are placed on either end and one central stairways runs central to the seating area. A row of taller *Lagerstroemia* x 'Natchez' trees line the bottom of the amphitheater seating area to provide shade for users in the hotter months and to allow in the low winter sun during the colder months. *Clethra alnifolia* 'Rosea' lines the compacted crush stone base trail along the bottom of the amphitheater to provide a sweet fragrance for passer-byers and amphitheater users. Across the open lawn and open bare dirt area that lines the front of the amphitheater stage are two *Prunus serotina* trees that provide a backdrop for the amphitheater stage. The concrete retaining wall that frames the amphitheater stage also provides a backdrop for the stage and shapes the jogging track route behind it. The hills that are located besides the amphitheater seating will be planted with *Trachelospermum jasminoides* and *Jasminum nudiflorum.* As a definitive, non-porous buffer, varieties of Feijoa sellowiana will screen the Cafeteria Courtyard from the boulder amphitheater seating area. Figure 4.11 shows the Amphitheater Seating and Stage Area.

Directly besides the amphitheater stage lies the restored Arboretum Forest. The natural habitat of the arboretum is a mesic mid-slope forest consisting of *Pinus spp.,*

Betula spp., *Prunus spp.*, *Populus spp.*, *Liquidambar spp.*, and *Quercus spp.* trees. The original arboretum did provide some bench seating for children and teachers to use, however it was not well-maintained and did not provide a proper comfort-level for teachers and children to take advantage of. The plan for the restoration of the forest consists of providing ample groundcover (*Smilax pumila*) for untraveled portions of the forest, and restoring the woodland edges with proper groundcover/herbaceous perennial (*Antennaria plantaginifolia, Chrysogonum virginianum,* and *Prunella vulgaris*). At the same time, restoring these conditions of the forest will afford more pollinating species on the school ground and will help define off-limits areas of the arboretum. The open, bare dirt areas of the arboretum will serve as the areas that children and teachers can use for learning and play. The trails of the forest will be six feet six inches wide and the main trail leading from the main entrance of the arboretum will be 10 feet wide. Compacted crush stone base will be used for the trails on the school ground and will be edged with logs. Multiple tire swings will be installed in the arboretum forest in front of the "Natural Construction" play area. The "Natural Construction" play area provides children opportunity to shape their own environment and provides opportunity for adventure play using loose parts to encourage hands-on, open-ended play using natural materials. By allowing children to use natural loose materials (i.e. tree stumps, tree logs, tree branches, bamboo poles, PVC pipe, brush, grasses, hay bales, boulders, etc.) one afford children the chance to learn properties of natural materials, build self-esteem and improve mental health, and develop communication, negotiation, and cooperation skills. Activities in this portions of the arboretum can allow children to use and apply knowledge learned in school, knowledge learn by application, and observe the limits of human and natural

capabilities. (Moore and Cooper 2014, 70). To help restore the mesic forest habitat and provide a boundary for usability along the provided trails, multiple mid-slop forest grasses (*Chasmanthium sessiflorum* and *Saccharum alopecuroides*) and herbaceous perennials (*Heuchera americana* and *Phlox paniculata*) will be planted along the boundary of the trails. To attract birds and improve the smell of the area, *Callicarpa Americana* and *Calycanthus floridus* will be planted along the trail. The area around the benches will be defined by the same gravel rocks used to define the trail boundary and the number of benches will also increase. As an area of interpretation and mental peace, the area around the benches in the arboretum will display handmade birdhouses made in the children's classrooms. To add wildlife value, native *Asimina triloba* trees (Paw Paw trees) will be planted near the "Natural Construction" play area.

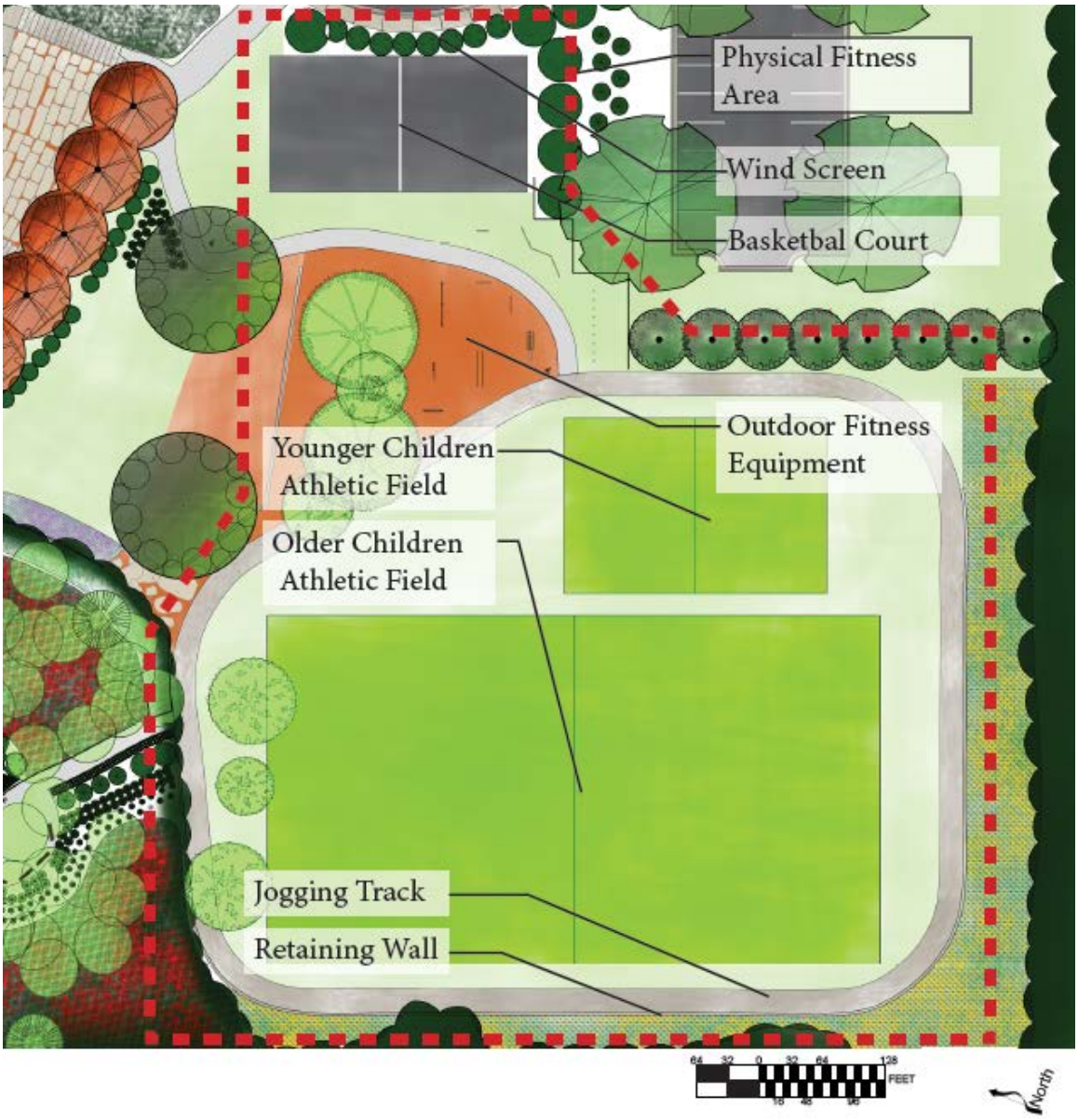


Source(s): Designed by Arpan Patel.

Figure 4.9. View of the Arboretum Forest Habitat Area Behind the School.

From the boulder amphitheater area, the compacted crush stone base trail goes up a small hill past the screened basketball courts and into the Physical Education area, consisting of independent outdoor fitness equipment, two athletic fields, and a basketball court. Going up the hill past the basketball court allows one to see the fitness area

consisting of various independent fitness equipment (e.g. vault bar, parallel bar, stall bar fence, parallel climber, triple horizontal bar, balance beam, and agility poles). A jogging track measuring roughly one-sixth of a mile long will encircle two athletic fields that serve both younger children (Pre-Kindergarteners through second-graders) and older children (third-graders through fifth-graders). To make the fields for the athletic fields flat, a retaining wall surrounding the jogging track will hold back the sloping land. These pieces of equipment can be used in conjunction with the jogging track and the athletic fields to teach effective physical education and demonstrate to the children how to maintain physical health.

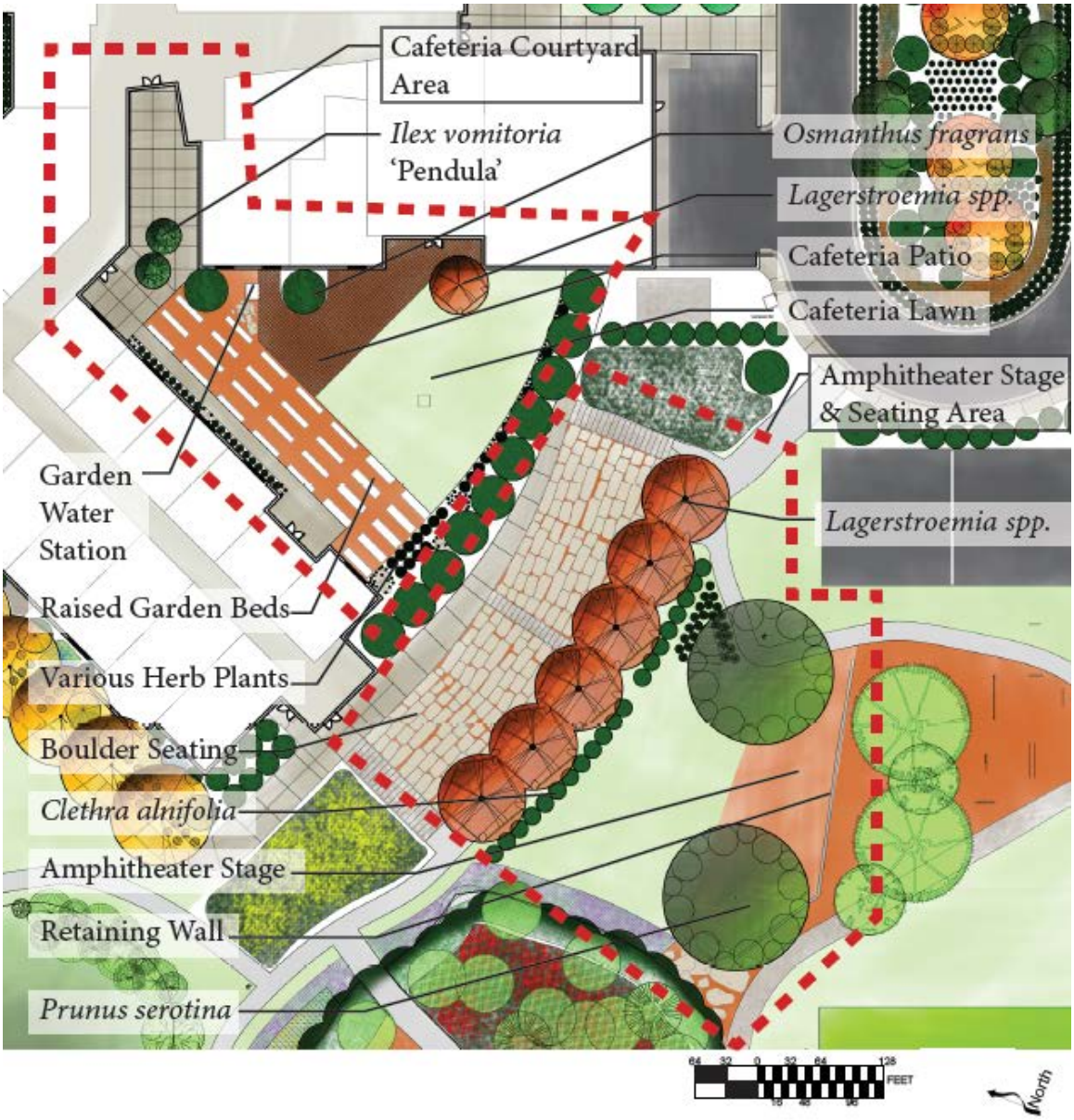


Source(s): Designed by Arpan Patel.

Figure 4.10. View of the Physical Fitness Area Near the Jogging Track.

The Cafeteria Courtyard will be screened from incoming cold winds by evergreen shrubbery. By enclosing the space, the school is afforded the opportunity to allow children to enjoy lunch outside on the cafeteria patio with minimal supervision. A secondary option for enjoying lunch is on the open lawn in the courtyard. Adjacent to the

open lawn is the second school garden area, containing raised planting beds that are four feet wide and 12 feet long. The garden station is located nearby to provide water for the vegetable garden. Classes are provided easy access to the gardens because is right outside of the classroom building's courtyard access points. The Cafeteria Courtyard is planted with herbs that aid in pest control as well as *Osmanthus fragrans* to fill the courtyard with a sweet smell. Furthermore, as a major landmark for student, *Ilex vomitoria* 'pendula' with interesting foliage and structure are planted in the concrete walkway as a gathering point. The tree's interesting structure and foliage leads to a topic of interest and notability among students, thus giving the students an identity to gather around.



Source(s): Designed by Arpan Patel.

Figure 4.11. View of the Cafeteria Courtyard & Amphitheater Area.

The bioswale around the bus drop-off area was planted with vegetation that was rain garden-appropriate, budget-friendly, and wildlife-friendly. (Georgia Wildlife Federation 2006; State Botanical Garden of Georgia 2016) *Betula nigra* and *Morella cerifera* were effective trees used in the bioswale system. *Mitchella reptans* was used as

an effective groundcover in the bioswale system. *Lindera benzoin, Hydrangea quercifolia, and Cephalanthus occidentalis,* and *Xanthorhiza simplicissima* were used as effective bushes in the bioswale system. *Hibiscus grandiflorus* and *Aquilegia canadensis* were effective herbaceous perennials used in the bioswale system. *Solidago* rugosa and *Asclepias incarnata* were effective wildflowers used in the bioswale system. *Chasmanthium latifolium* was an effective grass used in the bioswale system. All of the plants selected were both drought-tolerant and tolerant of wet feet.

The bioretention system around the loading docks was also planted with vegetation that was rain garden-appropriate, budget-friendly, and wildlife-friendly. (Georgia Wildlife Federation 2006; State Botanical Garden of Georgia 2016) *Nyssa sylvatica* and *Morella cerifera* were effective trees used in the bioretention system. *Lindera benzoin, Hydrangea quercifolia, Cephalanthus occidentalis,* and *Xanthorhiza simplicissima* were used as effective bushes in the bioretention system. *Hibiscus grandifloras* and *Asclepias tuberosa* were effective herbaceous perennials used in the bioretention system. *Solidago* rugosa and *Asclepias incarnata* were effective wildflowers used in the bioretention system. All of the plants selected were both drought-tolerant and wet feet-tolerant.

To meet the street tree requirement of one tree per 30 feet of street frontage, 15 *Amelanchier arborea* trees and 12 *Cercis canadensis* 'Forest Pansy' trees will be planted along Barnett Shoals Road. To meet the parking lot tree requirement of one tree per every seven parking spaces, 16 *Quercus shumardii* trees and two *Betula nigra* trees will be planted along the teacher parking lots. Appendix P has a listing of the plant species used in the project along with their landscape symbol.

Cost Estimation

The cost estimate of the project reveals more insight on the reasoning for material choices, plant selection, and layout of the site. Appendix Q shows the total landscaping budget for the landscaping of the school grounds. Mr. Ted Gilbert of the Athens-Clarke County School District provided me with an accurate budget limit for the landscaping portion of construction. The budget amount allocated to the landscaping portion of the Barnett Shoals Elementary School's landscaping was $100,000. Additionally, another $60,000 was set aside for the playground equipment. Within the scope of these two amounts, the project's costs to purchase and construct the hardscapes, gardens, planting beds, circulation paths, the playground equipment, necessary safety needs, and a 20-foot wide road-accessible fire lane coming from Barnett Shoals Road into the site was to be included. The costs associated with the construction of fences, parking lots, major circulation paths (i.e. main entrance sidewalks) were not to be included within this $160,000 total budget framework.

Due to the limits associate with the budget of this project, as is the limits associated with typical public k-12 construction projects across the country, some aspects of the designed project will be phased for later years of the school's growth. The costs associate with constructing these later phases will be assigned to the parent-led nature-enthusiast group, G.R.O.W. In fact, they have been responsible for most of the upgrades that were visible on the previous Barnett Shoals Elementary School campus. They managed to start the livestock program, lead an afterschool program called Project Lunchbox, build an outdoor classroom structure, construct multiple gardens (i.e. butterfly garden, native garden, and herb garden) and habitats (i.e. wetland habitat, meadows, and

upland forest) on-campus, and develop the arboretum. As-designed, the “Learning” Pond that was to be constructed in the Kindergarten wing and the barn for the livestock area were both out of the budget’s reach. Both of these two aspects of the design will be placed on G.R.O.W.’s agenda and will require the support of both the school administrative staff and the local community for it to be constructed for use by the children. Considering their experience and successful history in working with Barnett Shoals, these two project will not be as difficult to get started for the ambitious parent group.

The total construction costs calculated for constructing the project as designed is $161,638.12. The estimate takes into consideration both material and labor costs and was calculated using a 2014 copy of a RS Means Site Work & Landscape Cost Data book as well as internet sources of suppliers and nurseries. As in any project, original choices of material, placement, and complexity had to be changed or reduced to meet the project construction budget throughout the design process. Many adjustments were made and limitations were set based on cost-effective vegetation more readily available within the city limits.

The original intended material for the fire lane was to install a geo-grid system with grass in between the pores. The geo-grid paver system would cost upwards of $20,000 to install. The cheapest option was to choose a compacted 3-inch thick crushed stone road base. Also, the original design included a 4-inch thick, unreinforced cast-in-place concrete sidewalk spanning the rear classroom building to circulate students and teacher to and from classrooms and other areas of the school ground. Some of the side trails (e.g. the arboretum trails, Physical Education Area trail, Kindergarten Wing trail,

and Blueberry Patch trail) were also originally designed as wood chip trails with severe pressure treated wood edging. Both the concrete sidewalk in the rear of the building and the wood chip trails were converted into the same crushed stone road used for the fire lane to account for the low budget. Concrete pads were left for the access points of the building. The sizes of the playground areas, as well as some of the manufactured playground equipment originally included in the final design had to be reduced in size and cut out of the budget. The reduction in size area demonstrated savings for the cost of playground surfacing and reduced the direct cost of purchasing larger playground equipment and some independent playground equipment. Less equipment cuts were seen in the fitness playground equipment to reinforce the need to develop healthier children ad resultantly healthier minds. Only the large fitness course was removed from the budget. These reductions in playground equipment and fitness equipment demonstrated saving of over $34,000.

Another catalysts for the design of this school ground was the improvement of the quality of natural areas, as well as the improvement of the ability to learn within these natural areas using vegetation, replicating habitats, increasing the wildlife value, and serving other functions beneficial to the school in the long run (i.e. landscaping energy cost saving associated with shading the building and air conditioning unit during hotter months, and using drought-tolerant and native species of plants that both reduce the storm water runoff and did not require too much maintenance). To adjust for these demands and needs to improve the quality of education around the school campus based on the landscaping improvements led to the need to find a good source of native vegetation that was nearby and had a low impact on the ecosystem by reducing the costs associated with

the delivery of the plant material. Luckily, the State Botanical Garden of Georgia in Athens, GA has a program where they provide schools with packages of native plants ready for installation. The list of plants that they provide includes many native species that are adaptable to multiple habitat types (e.g. floodplains, wetlands, aquatic ponds, mesic forests, rain gardens, wildflower meadows, and native grasslands) and provide high wildlife value for the school campus by increasing the number of birds, hummingbirds, mammals, butterflies, moths, pollinators, and insects. Because these plants were native, they also had less maintenance issues and water demands, plus they were adaptable for rain garden use. These plants were also sold by the plug at $1.10 per plug or five to seven dollars per plant. These plants were locally sourced and were within the budget's reach. Many of the plant selection decision were based on this list as well as other lists of native plants based on their water needs, sunlight needs, wildlife value, and toughness. For special cases where a specific tree was preferred based on a highly specialized function (e.g. *Cephalotaxus harringtonia* 'Fastigiata' for outdoor walls, *Prunus serotina* for its wildlife value, or *Ilex vomitoria* 'pendula' for its interesting growth pattern, form, and structure) exception were made to purchase the plants regardless of costs. The cost of the edible landscape plant species (i.e. Fig tree, Strawberry plants, Blueberry bushes, and Muscadine Grape vines) were also considerably manageable especially considering the number of years of use gained out of each plant. The restoration of the arboretum forest was also affordable due the list of native plants provided to schools by the State Botanical Garden of Georgia.

To save on the costs of constructing the outdoor classrooms, the use of a large crowning, open-round form, shade tree was preferred, hence the decision to use *Ulmus*

parvifolia ‘Allee’ as the shading structure of the classroom. Instead of constructing physical walls and pillars that hold a roof structure, an evergreen, upright shrub, *Cephalotaxus Harringtonia* ‘Fastigiata,’ was used as the walls of the classrooms. By developing the outdoor classroom centered around this large tree, one also affords the opportunity to divide the space around the tree into multiple parts as individual classrooms. Four classrooms were created from these two plant species. To serve as the student’s desks and chairs, small boulders can be provided. The teacher’s area can be served by a larger flat boulder where the teacher can sit and teach as well as place items as if the boulder was an outdoor desk.

The construction of the amphitheater stage and seating area was also affordable by reducing the costs associate with heavy grading, earthwork moving, and cast-n-place concrete. The amphitheater seating area was built along a sloping hill with greater than 25% slope and instead of cast-in-place concrete, large flat fieldstones can be purchased at a fraction of the cost and placed along the hill for seating. Similarly, the cost of grading and earthwork moving was reduced for the Nature Play area by designing around the natural slope of the hill and using the interesting undulating topography to the advantage of play, adventure, and exploration, thus utilizing and developing the children’s creative play skill. The natural sloping hill afforded the opportunity to install a hill slide, a climbing wall, a shallow cave, and a sand pit at the top of the climbing wall. Another effective but cost-affordable method to increase the quality of learning in the exterior built environment is the use of signage to both guide children to the different areas of the site and provide background information such as energy savings statistics, flora and fauna

facts, and applications of core curriculum principles (e.g. science, math, social studies, language arts, etc.) on-site.

Overcoming Barriers Through the Final Design

The health and safety of the children is of important concern both from the standpoint of risk management for the school system and from the standpoint of protecting schoolchildren from harm and providing a safe environment for learning. The final design maintains proper management of risk in the event of an occurrence of harm. The risk is assessed based on its effective prevention of harm to the health and safety of children. Playground surfacing is provided in each area of the property where children have a chance of falling over 24 inches in height. Each of the boulders used throughout the site will be less than 24 inches tall. No areas of play contain rocks smaller than boulders that can be picked up and thrown by schoolchildren. Furthermore, the climbing tree that is stationed near the climbing wall will have climbing aides installed so that it functions more like manufactured climbing structure. Additional wood fiber will also be installed around the climbing tree and climbing wall to prevent the ground from compacting. Additionally, head entrapment will be avoided by installing modifiers to playground equipment with openings that measure between 3.5 and nine inches. Protrusion will be avoided on the site by avoiding vegetation with rigid, horizontal branches. Stumps with protrusions and trees with protruding roots will be avoided altogether on the site. Any items that children will use to balance on or stand on will be heavy enough so that children cannot move them. (Moore and Cooper 2014, 102-106)

Health and safety are a threat to achieving this type of improvement in schoolchildren via exposure to nature. (National Foundation for Education Research and King's College London 2004) In present a risk is defined as the probability of the occurrence of harm and the severity of that harm. In the current play environment, both natural and traditional play areas, risk is present in every situation. A very crucial goal for the design of nature play and natural learning spaces is to create challenging and interesting conditions of manageable risk and minor injuries and to decrease the presence of avoidable bad risk conditions such as sharp objects than have the potential to cause serious injury. (Moore and Cooper 2014, 100-106)

Furthermore, supervision is a primary method used to reducing the risk of injury and to manage risk with children. Architect and city planner, Oscar Newman introduced the concept of defensible space. Defensible spaces used the building and site plan to let the users of the space serve as the key agents in ensuring the security of the space. The design of the site should accommodate for the teacher's supervision of the children, either from within the classroom, or preferably from the edge of the site and/or the edge of the building. (Louv 2016b)

The greatest cause of injury on standardized playgrounds is falls. Placement of natural objects such as logs and boulders for climbing should consider what type of material a child might land on if he or she were to fall from the object. Furthermore, logs and stones that are low to the ground with no moving parts and minimal fall heights of less than 24 inches reduce the need for safety surfacing installment. Table 2.2. shows the safety surfacing requirements for different height levels of play structures, play logs,

boulders, or other play features. (Moore and Cooper 2014, 100-106)

Table 4.3. Playground Surfacing Requirements at Different Height Levels.

PLAYGROUND SURFACING REQUIREMENTS	
Play Feature (Equipment, Log, Boulder, etc.) Height from the Ground Level	**Playground Safety Surfacing (Wood Chips, Sand, Rubber Mulch, Safety Mats, etc.) Needed?**
>24” From the Ground Level	Yes
<24” From the Ground Level	No

Source(s): Moore and Cooper 2014, 100-106.

Safety surfacing, when installed, should also consider handicap access to the playground equipment. For trees that are meant for climbing, the fall prevention methods and standards should only be applied if the tree has been modified by adding climbing aids. Additional wood fiber should be placed around the tree if the tree is meant for climbing. Protrusions located at the end of pruned tree branches and shrubs at the eye level of children should be minimized. In fact, plants with rigid, horizontal branches are the riskiest plant choices for use on playground and school sites. Heavy stones used for climbing, should weigh enough not to move under the weight of multiple children or if the stone weighs less, it should be anchored.

To persuade teachers to use and teach in these newly designed learning areas around the school ground, many effective design elements were implemented on the site. Because teachers are hesitant to enter spaces that are overrun with untrimmed vegetation, unclear circulation paths, and thick weeds and brush, maintenance of the site is a huge

factor on the usage of the site program. Furthermore, because maintenance is not cheap, low maintenance plants without the need for trimming, cutting, clipping, or managing are the best choices for landscape design around the learning areas of the site. Teachers and some children are hesitant to use areas of the site if they seem threatened by the safety and usability of the area. Many of the site areas are designed with evergreen trees that do not shed leaves in the fall, thus making a cleaner and safer surrounding for the children and teachers to use.

The Outdoor Classroom, is situated underneath an *Ulmus parvifolia* and placed right next to the rear exit of the school building, so that children and teachers can feel safe using the outdoor classroom, knowing that other people are nearby in close proximity just in case something unexpected occurs. The Outdoor Classroom also hosts four different classrooms by dividing the space using Cephalotaxus Harringtonia 'Fastigiata.' Each grade level can use the outdoor classroom at least once a week. Like an indoor classroom with walls, the outdoor classroom allows the teacher to manage the classroom with easy visibility of all student, central focal point on the teacher, and a wall of vegetation to keep the children attentive on the instruction at-hand. The only non-design-related activity that should be implemented is to fund training for teachers on nature-based education teaching lessons and methods. Training programs like Project WET and Project WILD would train teachers on proper ways to administer lessons to children in natural settings on the schoolyard whilst also meeting the curriculum requirements mandated by the school board and government.

To help tie the curriculum with the new learning areas offered on-campus, the ease of use and access is heavily emphasized in the design with the most emphasis on

health and safety. Also, signage plays a key role in tying the whole campus together. Throughout the site, signage has been placed to inform people of the locations of different areas on-site. The access trails are made of compacted crush stone base. The trails offering access to the different areas of the site are edged with a boundary to help contain the material and keep the trails mess-free. The material used for these trails are the most cost-effective, low maintenance materials available on the market. The Outdoor Classroom is centrally located in the rear of the school building for security and privacy from the main road access. Surrounding the Outdoor Classroom are a variety of areas that offer learning opportunity to the children, so that teachers can quickly and easily teach using and referencing the appropriate, nearby learning areas. The close proximity to the school building and the learning areas offer a sense of security, safety, ease of management, minimal need for maintenance, and ease of mind for the teachers. Therefore, teachers have less excuses to avoid using the provided facilities, thus facilitating the teachers' use and comfort.

Other design strategies used to help divide the outdoor areas and the non-accessible area are planting beds, fencing, and walking trails. Additionally, many of the learning features offered around the campus are aimed to meet the needs of either a whole grade level (i.e. Outdoor Classroom, "Natural" Play area, "Natural Construction" Play area, Playground, Physical Fitness area, and the Natural Playground or meet the needs of the whole school population through the Amphitheater. Through tying the classrooms together at different size levels (i.e. single classroom-level, whole grade-level, or school-wide-level), multiple levels of curriculum engagement and programming can be achieved whilst also facilitating teachers' use and comfort.

To better help the teacher's during the lunch hour, the exterior lunch area is enclosed by vegetation thus restricting the children to stay within the lunchroom courtyard limits. This makes supervision of the children is more manageable for the teachers in the Cafeteria Courtyard. The only exit and entrance points for the lunchroom courtyard are through the building. To facilitate the use and comfort of the kindergarten teachers, the Exterior Kindergarten Wing is smaller and more easily manageable with supervision points from any point in the exterior wing. The supervision of the children can be maintained at all times whenever using the "Learning" Pond or exterior courtyard. Another space that can informally be used as a private exterior classroom for teaching or breaks is the exterior media library courtyard. It can facilitate the needs of teachers who want to teach outdoors, but who are also scared or hesitant to use the more natural outdoors areas. The comfort level is great for any teacher regardless of the level of comfort they have working outside because the media library is only a few steps away.

Media content usage has drastically increased over the course of the past 15 to 20 years. More children are using computers, televisions, videogames, iPads, listening to music, and surfing the internet than ever before. Children spend a large quantity of their weekly time in the classroom. The classroom serves as the perfect backdrop for exposure to the outside elements rather than media based activities. Media usage, is also linked to lower grades, obesity, and low attention spans. By exposing children to the outdoors through the usage of the designed learning areas on the school ground, teachers are provided with another outlet for proper whole-child development. The Physical Fitness area, "Natural" Play area, "Natural Construction" Area, Arboretum, Amphitheater, and other learning areas are all effective ways to teach, rejuvenate, and restore children.

Lack of funding is another barrier to the implementation nature-based and place-based learning activities in the public school system. The landscape design team is the last to be considered when budgeting for new school projects. In fact, there are no requirements that mandate any level of outdoor activity from government. Some states don't even require recess or physical education. Although, the design itself does not account for fundraising, fundraising possibilities can be offered through the selling of strawberries, blueberries, and figs from areas that produce fruit on the school site. The promotion of more active parent groups like G.R.O.W. can also be very helpful to fundraising. In fact, G.R.O.W. raised enough money to develop a meadow, upland forest, wetland forest, outdoor classroom structure, livestock barn and grazing area, greenhouse, and the arboretum for the old Barnett Shoals Elementary School campus. Active parent groups can play a huge difference on the learning experience opportunities offered on the school site.

To overcome the lack of funding available for exterior improvements and landscaping in public school projects, simple design strategies such as minimizing cost and maximizing durability can be implemented. For the Barnett Shoals Elementary School project, cost is minimized by using less finished material (i.e. compacted crushed stone base) for the connecting trails in the rear of the building, as well as using (1) locally sourced, (2) low cost, (3) low maintenance, (4) drought-tolerant, and (5) perennial vegetation that has a high wildlife value. Additionally, edible vegetation (i.e. *Feijoa sellowiana*) is used as wind screens and privacy barriers. Another simple measure to minimize the cost is to procure lower cost plant plugs from the State Botanical Gardens of Georgia. Instead of using a built structure for an Outdoor Classroom, the simple use of

a large shade tree with fastigiated evergreen shrubs serving as walls to divide the space underneath the shade tree into rooms was used instead. Simple flat boulders will serve as the students' chairs and a larger flat boulder can serve as the teacher's desk. All of the vegetation and material used for the Outdoor Classroom is durable. The vegetation lasts for generations and the boulders are nearly indestructible from natural wear and tear. The durability of the compact crushed stone base is good as other materials like concrete, gravel, and rubber mulch and is also cleaner and more easily managed than wood chips, rubber mulch, and bark nuggets. The choice to plant more perennial, drought-tolerant plants makes the planting selection last longer than if annuals were selected.

Through the use of simple design principles such as (1) the use of cost-effective, low maintenance, and drought-tolerant plants, (2) proper community involvement, (3) health and safety measures to mitigate injury, (4) facilitating teacher use and comfort, (5) appropriate teacher training for nature-oriented curricula, and (6) fundraising using resources created on the school ground, a safe and effective learning experience can be provided to teachers, children, and community members. Furthermore, support from parents and the administrative staff of the School Board is a key factor in accomplishing this type of learning environment. Another major factor that helps overcome the barriers to the transition to an exterior learning environment on the school ground is the legislative branch of government. The "law-makers" do have the power to change laws and requirements for public schools to mandate certain curricula, environments, and higher budgets for the landscaping portion of public school building projects. In conjunction, both design related and non-design related strategies are essential to

successfully design, build, implement, and improve our children's learning opportunities, both inside and outside of the classroom walls.

CHAPTER 5

CONCLUSION

Summary

The Barnett Shoals Elementary School landscape design project provided a solid backdrop for the implementation and demonstration of current methods to improve the quality of education provided to children within the school ground boundary using landscaping design as a catalyst for such achievement. The definition of "Integrating Education into The Outdoor Built Environments of Elementary Schools" in the thesis title can be better clarified using the research from the cases studies and literature review as well as the design of the project. The definition of education in the context of integrating it into the school outdoor built environment encompasses all types of learning including curriculum subjects, physical education and health wellness, and the education associated with building better behavioral, interpersonal, social, physical development, and creative skills which are byproducts of the learning experience received in elementary school. The age for learning and development is best during these formative years. Due to lack of support, enthusiasm, confidence of educators, and primarily landscape budget limitations, neither the resources or precedents are utilized in common public elementary school design. Only some school district like the Denver Public School System have put in place efforts to implement such resources and precedents into their children's learning environments. The Barnett Shoals Elementary School landscape design set forth in this thesis aims to break down the barriers to nature- and environment- based learning in the public school system, by finding effective materials, plant material, and utilizing the

existing condition of site to make better design decisions that are pragmatic, that provide effective learning strategies, and withstand the test of time and nature.

The opportunities that promote the design of outdoor built environments and improve the educational experience of elementary schoolchildren lie in cost-effective and low maintenance plant and material selection and proper utilization of existing site conditions and site analyses. Teachers are less hesitant to use a learning area or teaching space if it is clean, trim, organized, near the building, and holds minimal risk for injury. The design of a learning area is of no use if the teachers are hesitant or scared to use the space. It should be designed with ease of use and access in mind. Plant selection should include perennial, low maintenance, drought-tolerant plants. If plants also produce edible fruits, their lies opportunity in incorporating a farming program or fundraising for future campus development. Materials should be low maintenance and have the minimal need for replacement. Compacted crushed stone base is the cheapest, low maintenance option for trails and non-hardscaped sidewalks. The site topography should be used to the advantage of schoolchildren and end-users of the site to form terrace seating, natural slides, informal seating, and interesting formations for kids to play and explore.

Designing for a wide variety of group sizes is also a great design consideration so that individual classes can use the exterior learning facilities as well as whole grade-levels. Even design for the whole school to hold functions, plays and fundraising events. Instead of designing and building a structure for the Outdoor Classroom that can decay and wear over time, using vegetation as outdoor walls and ceilings can create an enclosed classroom space outside that mimics an interior classroom. Different-sized flat boulders can serve as the desks, tables, and seats for the teacher and children. Furthermore,

treating the school ground like a science and learning center with educational signage, maps, and wayfinding tools adds an element of discovery and excitement for the children when learning outside, similar to the feeling of going on a field trip to a museum or science center. Opportunity also lies in utilizing empty grass lawn areas as garden areas, edible garden areas, or habitat zones for teaching schoolchildren. Any views facing nature during class and lunch should not be impeded or blocked. In fact, eating outside in a supervised area or courtyard should be encouraged.

There should also be different designed areas for usage by different age levels. The Kindergarten wing should have their own smaller exterior learning zone. Multiple play options aside from the typical playground with manufacture equipment should be considered, including creative play strategies and natural play strategies. Both older children and younger children should be accommodated during recess, physical education, and class time with appropriately sized areas to use. Any space that offers or mimics a forest should be preserved and converted into an arboretum or school forest for the community and children to use annually before or after class. Also the administration and school teachers should plan for programs and functions at the school-wide level, whole grade level, and the individual class level. Only with institutional support and planning can the success of a school ground with areas for learning opportunities be fully utilized.

Design Evaluation

The final design of the new Barnett Shoals Elementary School is effective in creating a school ground that employs learning areas and opportunities for schoolchildren

of all ages to better absorb curriculum lessons using provided natural avenues of learning outside of the classroom on the school ground. The design evaluation will serve as an analyses of the final design. When viewing the design through an objective lens, one can see the successes and fails in the overall design and how effectively the design addresses the design goals and objectives.

The division of space and the programming elements is successfully implemented on the school site using vegetation, material changes, changes in elevation, and smaller landscape features like boulders and logs. The areas are well organized and effectively located based on the existing site conditions provided and the Program of Elements required. The Natural Playground and Amphitheater area do make use of the natural slope of the topography, as well as integrate the surrounding areas into the space. To aid in the organization of the site, quality wayfinding signs are placed throughout the site for children and teachers to find their ways around the classroom.

The location of each program element does facilitate comfort and use for all of the users including the teachers and children. The vegetation used is low maintenance, and mostly drought-tolerant, thus keeping the spaces clean throughout the year without the need for constant maintenance and irrigation. Most of the vegetation is perennial making the planting selection long-lasting and durable for annual growth. Many of the choices for plant selection were based on the edibility of the plant for the children. The fruit created from hosting these edible plants (i.e. fig trees, strawberry and blueberry bushes, and muscadine vines) also served as a reminder to children to eat vegetable and fruits and can serve as a source of fundraising for the school community for improvement on the school campus. As another benefactor in the health levels of children, emphasis was placed on

larger fitness facilities including fields for both younger and older children, a jogging track, and various fitness equipment. Both the edible gardens and the natural Physical Fitness Areas can play a role on the health levels of children and reducing obesity rates.

The health, safety, and welfare of the school ground users are well maintained throughout each design element. The safety standards for the playground area and learning area have been ensured by following the guidelines set in the Consumer Product Safety Commission's Handbook for Public Playground Safety and in the national guidelines document, "Nature Play & Learning Places." Interesting play and learning environments were created using the existing site conditions and well-rounded plant selection that also has a high wildlife value. Additionally, new areas of creative play were integrated into the site to invoke the creativity of children in a different way as compared to the average recess held in playground with just manufactured equipment.

Energy saving landscaping techniques were effectively used throughout the site. The hot western sun is blocked by a series of large deciduous trees that also let in sunlight during the colder months. The mechanical equipment is also shaded by larger trees from the hot summer sun. perennial plants are planted near to the building to cool the land immediately near the building. The northern portion of the site is also left open to allow daylight into the building to reduce the need for electrical lighting. Wind screens and channels are created around the site using shrubs and evergreen trees to block cold winter winds and channel warm spring/summer breezes into the areas of activity.

A variety of learning opportunities are provided throughout the site for children of all ages. Creative can be developed by allowing the children to freely play in the natural play areas. Science can be taught in the livestock area, arboretum, various gardens,

meadows, and edible gardens. Business and mathematics can be taught using the edible gardens as business models and through the vegetable gardening program. Construction and engineering can be introduced to the kids by introducing them the “Natural Construction” play area. Art and literature can be exposed to the children by hosting plays and programs in the amphitheater area. Physical education and health studies can be taught using the Physical Fitness Area. Every subject can be taught in the Outdoor Classroom. All curricula are supported by the Program of Elements provided.

Although the successes in the design does tell a story of accomplishing the goal of providing learning opportunities to children in the exterior built environment of public schools. The budget of the School Board is exceeded. The preliminary budget created for the current final design of the Barnett Shoals Elementary School does not include the cost of turf grass sod installment, irrigation, and maintenance. The following list of strategies and objectives were not met or overlooked in the design:

- Although the design does incorporate low maintenance strategies, that does not mean there is no need for maintenance. The lunchroom courtyard in fact does not provide access for transporting gardening soil, equipment, fertilizer, and other basic maintenance needs to the vegetable garden plots.
- To better meet the budget, the expensive retaining wall designed near the jogging track can be avoided altogether by replacing the retaining wall with simple grading.
- Some of the learning areas are not designed with defensible design in mind. Supervision from the teacher’s point of view is overlooked. In fact,

many of the learning areas and play spaces do not provide bench seating for the teachers.

- The lunchroom courtyard design does not include the cost for tables and seating for the schoolchildren in the budget.
- Educational signage is mentioned as an objective, however it is not accounted for in the design and the budget. Signs explaining science concepts like the hydrologic cycle, photosynthesis, etc. need to be displayed strategically throughout the school ground. Fauna and flora should be highlighted in each area that demonstrates a high level of each. Different habitats should also have some educational signage explaining how they work. In fact, with this design, adding cost-effective educational signage would transfer the exterior space into a science and learning center of sorts.

Some limitations remained even after the final design was created. The main limitation that will be the most inhibiting is the school board's budget for landscaping. School boards do not place adequate importance on what influence the landscaping has on the child and the child's ability to learn. In fact, providing just a little bit of an increase in the landscaping budget can be justified by the increase in the attentiveness and interest of children on school topics. Healthier and higher academic performing student should also follow. Another limitation that will remain is the need for community involvement. The design might invite the community and have space for the community to integrate into the school activities, however the end result is in the hands of the community members and teachers. However much involved they want to be is up to them. Barnett

Shoals Elementary School is an exception to this limitation and does not have this problem of lack of community and parent involvement, however the average public school does have this problem. The last limitation to remain, regardless of the success of the design, is the lack of support provided to teachers and administration to implement nature-based learning and start correctly using the learning space provided. Neither is there a mandate from government or the school board to require any level of learning outside of the classroom. The design attempts to open the eyes of government officials, teachers, public school administration, community members, and parents to allow them to see the potential of children being allowed to learn outside of the classroom within the school ground.

Use in Industry

In industry, pragmatic application of the methods learned to be effective through conducting the literature review research and the case studies research is not always easy. Many factors are always working against the landscape designer (i.e. weather, administrative support, budget restrictions, site conditions, plant material availability, government curriculum standards, etc.). Using the methods applied in the design of this elementary school landscape, outlets for overcoming the various barriers can be found and used. Local organizations and nurseries that provide schools with cheap landscaping supplies and plant materials should first be sought and researched. Lists of cheap plants and supplies should be created and compared to determine the best cost-effective options available to be used in the design. Also, a list of landscape supplies and plant materials and their benefits, as they relate to integrating education into the school landscape, should

be rehearsed and researched to determine pockets of overlapping benefit (i.e. lists of native butterfly-friendly plant material, pollinator-friendly plant material, rain garden-friendly plant material, hummingbird-friendly plant material, habitat-based plant material, shade-tolerant plant material, and budget-friendly plants) Also, attachment to using certain materials and plants should be placed secondary to the list of cost-effective options. A proper site analysis of sunlight exposure and prevailing winds should be conducted to find areas of energy cost saving associated with shading the building and air condition, blocking winds, and allowing sunlight to enter the building. Furthermore, an analysis of existing site conditions should be performed to analyze opportunities of cost savings. Outdoor classrooms do not necessarily have to be expensive structures, however they can replicate structures for a lower cost using solely plant material and landscape features. A balanced emphasis on the both manufactured playground equipment and site-responding natural play opportunities should be considered in the site layout and design, thus intriguing more aspects of the child's mind. Cost-effective options for hardscapes should be considered such as crusher run paths, colored concrete hardscapes, and compacted bare dirt areas where water, wind, and erosion are not land-altering. High wildlife value trees should be used such as *Quercus alba, Prunus serotina,* and *Betula nigra.* The heavier costs associated with some tree species can be justified by the extra wildlife value and educational opportunities that it brings to the school ground. Using open land for non-conventional activities and purposes can add to the learning value of the site (e.g. fruit patches, vegetable patches, and grassland and wildflower showcases). Cheaper landscaping site elements such as tree stumps, branches, logs, and boulders should be considered for both its wildlife value, cost-effectiveness, and interesting visual

dynamic added to the landscape for children to enjoy and interact with. In the context of elementary school landscape design, cost-effectiveness should be a foremost concern in material selection and plant selection. By placing the emphasis on “cost-effectiveness” and not on “cheap” materials, the designer can appreciate the true value of plant materials, landscape supplies, and design decisions in context to integrating education into the landscape and improving its effectiveness on the learning experience for elementary schoolchildren. In the selection process, “cost-effective” material selection means that the material or plant should also be durable, inexpensive, low maintenance, and natural.

Self-Assessment

The purpose of the research was to integrate education into the landscape to enhance the learning experience that children gain in the exterior built environment of elementary schools. In doing so, noting the existing barriers and methods of overcoming the barriers should be performed. The final design of the elementary school is successful in increasing the amount of nature-accessibility on-campus, natural environments, bringing flora and fauna variety into the school, and demonstrating how landscape design effects energy, environment, and daily activities. The quality of education gained from the exterior built environment will be an improvement for the schoolchildren. The accuracy of the budget and costs associate with the various materials used and the labor associated with construction is not accurate enough to use on a real project. The budget and cost estimate created does however provide the opportunity for a landscape designer to evaluate the cost effectiveness of different options on the school site. The construction

method used for some aspect of the site might be underjudged and under evaluated in respect to the actual costs of the design and the ability to construct the feature or area. An example of underestimating the cost-effectiveness of the construction method in the final design can be found in the Physical Fitness Area where a retaining wall is designed near the jogging track. In retrospect, the expensive retaining wall can be replaced cost-effectively by simply grading that area instead of building the unnecessary retaining wall. Further research on the different habitats aimed to be replicated on the site should have been done to ensure the successful replication of the intended habitat.

Because the design of the storm water system was already created by the civil engineer according to the state's storm water manual, opportunity to design the full aspects of the site including parking, driveways, main entrance sidewalks, storm water management features, bioretention systems, and water quality management was not provided. Fully investigating the storm water code and trying to manage the storm water using alternative methods was not given to the designer. Additionally, the cost associated with seeding the site's grass lawns was not included in the budget of landscape. The methods and designer decisions used in this projective design project are effective in answering the thesis question and proving that landscape design can integrate education and learning into the exterior built environment of public elementary schools. More research on actual standards & codes and construction cost data could have made the design project more pragmatic and applicable for real public elementary school projects.

REFERENCES

References

"10 Ways to Add Biodiversity to Your Garden." 2016. *Missouribotanicalgarden.org.* Accessed June 29, 2016. http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/help-for-the-home-gardener/advice-tips-resources/visual-guides/adding-biodiversity-to-your-garden.aspx.

"A Perfect Plant for Birds in Georgia." 2015. *Usinggeorgianativeplants.blogspot.com*. Modified March 1, 2015. Accessed June 14, 2016. http://usinggeorgianativeplants.blogspot.com/.

"About Farm to School." 2016. *Farmtoschool.org.* Accessed April 2, 2016. http://www.farmtoschool.org/about/what-is-farm-to-school.

Akehurst, Alice and Rob Wheway. 2013. "Talking About Play: A Study of Children's Play in Rural Environments." Coventry, United Kingdom: Children's Play Advisory Service, September 2013.

Alvar Aalto Foundation. 2016. "Alvar Aalto: Paimio Sanitorium 1928 – 1933." *Alvaraalto.fi.* Accessed May 20, 2016. http://www.alvaraalto.fi/net//paimio/paimio.html.

American Alliance for Health, Physical Education, Recreation and Dance, National Association for Sport and Physical Education. 2012. "2012 Shape of the Nation Report: Status of Physical Education in the USA." Reston. Virginia: American Alliance for Health, Physical Education, Recreation and Dance, 2012.

American Society of Landscape Architects. 2010. “Honor Award: Nueva School.” *ASLA.org.* Accessed June 5, 2016. https://www.asla.org/2010awards/050.html.

American Society of Landscape Architects. 2011. “Honor Award: Manassas Park Elementary School Landscape.” *ASLA.org.* Accessed June 5, 2016. https://www.asla.org/2011awards/456.html.

American Society of Landscape Architects. 2016. “Designing our Future: Sustainable Landscapes – Nueva School.” *ASLA.org.* Accessed June 6, 2016. https://www.asla.org/sustainablelandscapes/nuevaschool.html.

Association for Supervision and Curriculum Development. 2012. “Making the Case for Educating the Whole Child.” Alexandria, Virginia: Association for Supervision and Curriculum Development, 2012. Accessed May 29, 2016. http://www.wholechildeducation.org/assets/content/mx-resources/WholeChild-MakingTheCase.pdf.

“Average Weather for Athens, Georgia, USA.” 2016. *Weatherspark.com.* Accessed June 14, 2016. https://weatherspark.com/averages/29595/Athens-Georgia-United-States.

“Barnett Shoals Elementary School.” 2016. *Schooldigger.com*. Accessed June 14, 2016. http://www.schooldigger.com/go/GA/schools/0117000446/school.aspx.

Barros, Romina M., Ellen J. Silver, and Ruth E. K. Stein. 2009. “School Recess and Group Classroom Behavior.” *Pediatrics* 123, No. 2: 431-436.

Bartosh, Oksana. 2003. “Environmental Education: Improving Student Achievement.” Master’s Thesis, Evergreen State College, 2003.

Bazzano, Lydia A. 2006. "The High Cost of Not Consuming Fruits and Vegetables." *Journal of the American Dietetic Association* 106, No. 9: 1364-1366.

Bell, Anne and Janet Dyment. 2006. “Grounds for Action: Promoting Physical Activity through School Ground Greening in Canada.” Toronto, Canada: Evergreen, 2006.

Bentley, Amy. 1998. *Eating for Victory: Food Rationing and the Politics of Domesticity*. Champaign, Illinois: University of Illinois Press, 1998.

Bjorklund, David F. and Katherine K. Harnishfeger. 1987. “Developmental Differences in the Mental Effort Requirements for the Use of an Organizational Strategy in Free Recall.” *Journal of Experimental Child Psychology* 44, No. 1:109–125.

Blair, Dorothy. 2009. “The Child in the Garden: An Evaluative review of the Benefits of School Gardens.” *Journal of Environmental Education* 40, No. 2: 15–38.

Blair, Dorothy and J. Sobal. 2006. "Luxus Consumption: Wasting Food Resources Through Overeating." *Agriculture and Human Values* 23, No. 1: 63–74.

“Bonus Energy Resources.” 2016. *Plt.org*. Accessed June 6, 2016. https://www.plt.org/bonus-energy-resources.

Boulton, Michael J. 1999. "Concurrent and Longitudinal Relations between Children's Playground Behavior and Social Preference, Victimization, and Bullying." *Child Development* 70, No. 40: 944-954.

Bredekamp, Sue and Carol Copple. 1997. *Developmentally Appropriate Practice in Early Childhood Programs*. Washington, D.C.: National Association for the Education of Young Children, 1997.

Brink, Lois and Bambi Yost. 2004. “Transforming Inner-City School Grounds: Lessons from Learning Landscapes.” *Children, Youth and Environments* 12, No. 1: 208-232.

Brink, Lois, Cate Townley, Christopher Schooler, and Bryon Weber. 2011. “Fairmount Elementary School - Jefferson County: Learning Landscapes Master Plan Spring 2011.” Denver, Colorado: University of Colorado at Denver, 2011.

Brink, Lois, Willem Van Vliet, Bambi Yost, and Jon Webb. 2004. “Learning Landscape Photo Surveys- Initial Composite Study Spring 2004.” Denver, Colorado: The University of Colorado at Denver and the University of Colorado at Boulder, Architecture and Planning, 2004.

“California Agricultural Production Statistics.” 2016. *cdfa.ca.gov*. Accessed April 8, 2016, https://www.cdfa.ca.gov/statistics/.

Centers for Disease Control and Prevention. 2010. *The Association Between School-Based Physical Activity, Including Physical Education, and Academic Performance*. Atlanta, Georgia: Centers for Disease Control and Prevention, 2010.

Center of Research Strategies. 2003. “Evaluation of the Learning Landscape Project.” Denver, Colorado: The Learning Landscape Alliance and The Gates Family Foundation, 2003.

Christensen, Heidi. 2003. “Juanamaria Healthy Schools Project Final Evaluation Report.” Ventura, California: Ventura County Superintendents’ Office, February 2003.

Clements, Rhonda. 2004. “An Investigation of the Status of Outdoor Play.” *Contemporary Issues in Early Childhood* 5, No. 1: 68-80.

"Common Core and Next Generation Science Standards." 2016. *Projectwet.org*. Accessed June 6, 2016. http://www.projectwet.org/what-we-do/publications/standards.

"Container Vegetable Gardening." 2016. *Scottsdalefarms.com*. Accessed June 14, 2016. http://www.scottsdalefarms.com/container-vegetable-gardening/.

Contento, Isobel R., Jill Randell, and Charles Basch. 2002. "Review and Analysis of Evaluation Measures Used in Nutrition Education Intervention Research." *Journal of Nutrition Education* 34, No. 1: 2-25.

"Correlations." 2016. *Projectwild.org*. Accessed June 6, 2016. http://www.projectwild.org/Correlations.htm.

Coyle, Kevin. 2010. *Back to School: Back Outside*. Reston, Virginia: National Wildlife Federation, 2010.

Cummings, Scott and Chris Boleman. 2002. "Executive Summary of the: Junior Master Gardener Program Coordinator Implementation Evaluation." Lubbock, Texas: The Department of Agricultural Education-Extension Education Unit, University of Texas, 2002.

"Days of Sunshine Per Year in Georgia." 2016. *Currentresults.com.* Accessed June 5, 2016. https://www.currentresults.com/Weather/Georgia/annual-days-of-sunshine.php.

Dirks, Amy and Kathryn Orvis. 2005. "An Evaluation of the Junior Master Gardener Program in Third Grade Classrooms." *Horttechnology* 15, No. 3: 443-447.

Duncan, Arne. April 9 2010. Speech to Arts Education Partnership National Forum.

Dyment, Janet. 2005. “Gaining Ground: The Power and Potential of School Ground Greening in the Toronto District School Board.” Toronto, Canada: Evergreen, 2005.

Emekauwa, Emeka. 2004. “They Remember What They Touch: The Impact of Place-based Learning in East Feliciana Parish.” Washington, D.C.: The Rural School and Community Trust, 2004.

Evans, A., Ranjit N., Rutledge R., Medina J., Jennings R., Smiley A., Stigler M., and Hoelscher D. "Exposure to Multiple Components of a Garden-Based Intervention for Middle School Students Increases Fruit and Vegetable Consumption." *Health Promotion Practice* 13, No. 5: 608-616.

“Farm to School Works.” 2015. *Farmtoschoolcensus.fns.usda.gov.* Last accessed April 5, 2016. https://farmtoschoolcensus.fns.usda.gov/.

“Farm to School Works to Make Gardens Grow.” 2015. *Farmtoschoolcensus.fns.usda.gov.* Accessed April 5, 2016. https://farmtoschoolcensus.fns.usda.gov/farm-school-works-make-gardens-grow.

Feenstra, Gail and Jeri Ohmart. 2005. “Yolo County Farm-To-School Project Evaluation Year Two Annual Report, 2004-2005.” Los Angeles, California: Center for Food and Justice Occidental College, October 2005.

Flock, Paul, Cheryl Petra, Vanessa Ruddy, and Joseph Peterangelo. 2003. “A Salad Bar Featuring Organic Choices: Revitalizing the School Lunch Program.” Olympia. Washington: Olympia School District, April 2003.

Francis, Mark. 1999. “A Case Study Method for Landscape Architecture.” Washington D.C.: Landscape Architecture Foundation, 1999.

Geier, Andrew B., Gary D. Foster, Leslie G. Womble, Jackie McLaughlin, Kelley E. Borradaile, Joan Nachmani, Sandy Sherman, Shiriki Kumanyika, and Justine Shults. 2007. "The Relationship Between Relative Weight and School Attendance Among Elementary Schoolchildren." *Obesity* 15, No. 8: 2157-2161.

"Georgia, Clarke County, 2015 Farm to School Census Responses." 2015. *Farmtoschoolcensus.fns.usda.gov.* Accessed April 5, 2016. https://farmtoschoolcensus.fns.usda.gov/find-your-school-district/georgia/clarke-co.

Georgia Wildlife Federation. 2006. "Georgia Schoolyard Wildlife Habitat Planning Guide." Covington, Georgia: Georgia Wildlife Federation, 2006.

Gilbert, Ted. E-mail message to Arpan K. Patel, February 8 - 9, 2016.

Gleason, P. and C. Suitor. 2001. *Food for Thought: Children's Diets in the 1990s*. Princeton, New Jersey: Mathematica Policy Research, 2001.

Graham, Heather, Deborah Beall, Mary Lussier, Peggy McLaughlin, and Sheri Zidenberg-Cherr. 2005. "Use of School Gardens in Academic Instruction." *Journal of Nutrition Education Behavior* 37, No. 3: 147-151.

Graham, Heather, Gail Feenstra, Amy Evans, and Sheri Zidenberg-Cherr. 2004. "Davis School Program Supports Life-Long Healthy Eating Habits in Children." *California Agriculture* 58, No. 4: 200-205.

G.R.O.W. Parent's Committee to Barnett Shoals Elementary School. 2016. In discussion with the G.R.O.W. committee. February 22, 2016.

Gruenewald, D. A. 2005. Accountability and Collaboration: Institutional Barriers and Strategic Pathways for Place-Based Education. *Ethics, Plant and Environment 8* No. 3: 261 - 282.

Hazzard, Eric, Elizabeth Moreno, Deborah Beall, and Sheri Zidenberg-Cherr. 2011. “Best Practices Models for Implementing, Sustaining, and Using Instructional School Gardens in California.” *Journal of Nutrition Education and Behavior* 43, No. 5: 409–413.

Herrington, Susan and Kenneth Studtmann. 1998. "Landscape Interventions: New Directions for the Design of Children’s Outdoor Play Environments." *Landscape and Urban Planning* 42, No. 2-4: 191-205.

Hofferth, Sandra. 2009. “Changes in American Children’s Time – 1997 to 2003.” *Electronic International Journal of Time Use Research* 6, No. 1: 26-47.

Hofferth, Sandra and John Sandberg. 2000. “Changes in American Children’s Time – 1981 to 1997.” Ann Arbor, Michigan: PSC Publications, Sept. 11, 2000.

Hofferth, Sandra and John Sandberg. 2001. “How American Children Spend Their Time.” *Journal of Marriage and Family* 63, No. 3: 295–308.

Institute of Medicine. 2013. “Educating the Student Body: Taking Physical Education and Physical Activity to School.” Washington, DC: The National Academies Press, 2013.

Jarrett, Olga S., Darlene M. Maxwell, Carrie Dickerson, Pamela Hoge, Gwen Davies, and Amy Yetley. 1998. “Impact of Recess on Classroom Behavior: Group Effects and Individual Differences.” *Journal of Educational Research* 92, No. 2:121-126.

Johnson, Julie. 2000. “Design for Learning: Values, Qualities and Processes of Enriching School Landscapes.” Landscape Architecture Technical Information Series. Washington D.C.: American Society of Landscape Architects, 2000.

Joshi, Anupama and Andrea Misako Azuma. 2006. “Year One Evaluation Report: Fresh from the Farm Program Implementation at Lozano Bilingual and International Center School, Chicago.” Los Angeles, California: Center for Food & Justice, Urban & Environmental Policy Institute, Occidental College, October 2006.

Joshi, Anupama, Andrea Misako Azuma, and Gail Feenstra. 2008. "Do Farm-to-School Programs Make a Difference? Findings and Future Research Needs." *Journal of Hunger & Environmental Nutrition* 3, No. 2/3: 229-246.

Joshi, Anupama, T. Henderson, M.M. Ratcliffe, and G. Feenstra. 2014. *Evaluation for Transformation: A Cross-Sectoral Evaluation Framework for Farm to School.* Washington D.C.: National Farm to School Network, 2014.

Kane, Deborah and Rose Hayden-Smith. 2008. “What’s for Lunch? A Review of School Food and Garden-based Education in the United States Using the Portland Public Schools as a Model for Change.” Portland, Oregon: EcoTrust, 2008.

Kann, L., S.K. Telljohann, and S.F. Wooley. 2007. “Health Education: Results from the School Health Policies and Programs Study 2006.” *Journal of School Health* 77, No. 8: 408–34.

Kaplan, Rachel and Stephen Kaplan. 1989. *The Experience of Nature: A Psychological Perspective.* Cambridge, Massachusetts: Cambridge University Press, 1989.

Kaplan, Stephen. 1995. “The Restorative Benefits of Nature: Toward an Integrative Framework.” *Journal of Environmental Psychology* 15, No. 3: 169-182.

Kim, Chankook and Fortner, Rosanne W. 2006. “Issue-Specific Barriers to Addressing Environmental Issues in The Classroom: An Exploratory Study.” *The Journal of Environmental Education 37*, No. 3: 15-22.

Kirkby, Mary Ann. 1989. “Nature as Refuge in Children’s Environments.” *Children’s Environments Quarterly 6*, No. 1: 7-12.

Knai, Cécile, Joceline Pomerleau, Karen Lock, and Martin McKee. 2006. "Getting Children to Eat More Fruit and Vegetables: A Systematic Review." *Preventive Medicine* 42, No. 2: 85-95.

Kohler, Judith. 2013. “Less Water, More Wildlife — What’s Not to Love About Native Plants?” *Blog.nwf.org.* Accessed June 6, 2016. http://blog.nwf.org/2013/05/less-water-more-wildlife-whats-not-to-love-about-native-plants/.

Kohlstedt, Sally G. 2008. “’A Better Crop of Boys and Girls:’ The School Gardening Movement, 1890–1920.” *History of Education Quarterly* 48, No. 1:58–93.

Kolstad, Carolyn, Karleen Vollherbst, and Karen Kelly Mullin. 2011. “Schoolyard Habitat Project Guide: A Planning Guide for Creating Schoolyard Habitat and Outdoor Classroom Projects Second Edition 2011.” Washington, D.C.: U.S. Fish and Wildlife Service, 2011.

Krewer, G.W. and D.S. NeSmith. 1999. “Home Garden Blueberries.” Athens, Georgia: University of Georgia Cooperative Extension, 1999.

Krewer, G.W. and Floyd Hendrix. 1999. “Home Garden Figs.” Athens, Georgia: University of Georgia Cooperative Extension, 1999.

Krewer, G.W. and Stephen Myers. 2001. “Home Garden Muscadines.” Athens, Georgia: University of Georgia Cooperative Extension, 2001.

Krewer, G.W., Marco Fonseca, and Phil Brannen. 2004. “Home Garden Strawberries.” Athens, Georgia: University of Georgia Cooperative Extension, 2004.

Kumar, Revathy, Patrick M. O'Malley, and Lloyd D. Johnston. 2008. "Association Between Physical Environment of Secondary Schools and Student Problem Behavior: A National Study, 2000-2003." *Environment and Behavior* 40, No. 4: 478-481.

Langellotto, Gail A. and Abha Gupta. 2012. "Gardening Increases Vegetable Consumption in School-Aged Children: A Meta-Analytical Synthesis." *Horttechnology* 22, No. 4: 430-445.

Larson, Lincoln R., Gary T. Green, and H. K. Cordell. 2015. "Children's Time Outdoors: Results and Implications of the National Kids Survey." *Journal of Park and Recreation Administration* 29, No. 2: 1-20.

Larson, R. and S. Verma. 1999. “How Children and Adolescents Spend Time Across the World: Work, Play, and Developmental Opportunities.” *Psychological Bulletin* 125, No. 6: 701–736.

Lieberman, Gerald. 2013. *Education and the Environment.* Cambridge, Massachusetts: Harvard Education Press, 2013.

Lieberman, Gerald and Linda Hoody. 1998. *Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning.* State Education and Environmental Roundtable. Poway, California: Science Wizards, 1998.

Louv, Richard. 2008. *Last Child in the Woods.* Chapel Hill, North Carolina: Algonquin Books.

Louv, Richard. 2016a. “Nature Smart.” *National Wildlife (World Edition)* 54, No. 2: 40-43.

Louv, Richard. 2016b. *Vitamin N*. Chapel Hill, North Carolina: Algonquin Books.

Lytle, L.A., D.M. Murray, C.L. Perry, M. Story, A.S. Birnbaum, M.Y. Kubik, and S. Varnell. 2004. “School-Based Approaches to Affect Adolescents’ Diets: Results from the TEENS Study.” *Health Education & Behavior* 31, No. 2: 270–287.

Malone, Karen and Paul J. Tranter 2003a.”'Children's Environmental Learning and the Use, Design and Management of Schoolgrounds.” *Children Youth and Environments* 13, No. 2: 87-137

Malone, Karen and Paul J. Tranter. 2003b. "School Grounds as Sites for Learning: Making The Most of Environmental Opportunities." *Environmental Education Research* 9, No. 3: 283.

Martin, J. 2008. *Overview of Federal Child Nutrition Legislation. In Managing Child Nutrition Programs: Leadership for Excellence*. Sudbury, Massachusetts: Jones and Bartlett, 2008: 145–99.

Matsuoka, Rodney H. 2008. “High School Landscapes and Student Performance.” Master’s Thesis, University of Michigan, 2008.

Matsuoka, Rodney H. 2010. "Student Performance and High School Landscapes: Examining the Links." *Landscape and Urban Planning* 97, No. 4: 273-82.

McAleese, Jessica D. and Linda L. Rankin. 2007. "Research: Garden-Based Nutrition Education Affects Fruit and Vegetable Consumption in Sixth-Grade Adolescents." *Journal of The American Dietetic Association* 107, No. 4: 662-665.

"Measures of Play.” 2012. *Parks & Recreation* 47, No. 8: 12.

Missouri Botanical Garden. 2016 “Honeybees.” St. Louis, Missouri: William T. Kemper Center for Home Gardening, 2016.

Moore, Robin. 1997. “The Need for Nature: A Childhood Right.” *Social Justice* 24, No. 3: 203.

Moore, Robin and Herb Wong. 1997. *Natural Learning: Creative Environments for Rediscovering Nature’s Way of Teaching.* Berkeley, California: MIG Communications, 1997.

Moore, Robin C., Susan M. Goltsman, and Daniel S. Iacofano. 1997. *Play for All Guidelines: Planning, Design and Management of Outdoor Play Settings for All Children*. Berkeley, California: MIG Communications, 1997.

Moore, Roger C. 1989. "Before and After Asphalt: Diversity as an Ecological Measure of Quality in Children's Outdoor Environments." *The Ecological Context of Children's Play*. New Jersey: Ablex Publishing Corporation, 1989: 191-213.

Mozaffarian, Dariush, Ashkan Afshin, Neal L. Benowitz, Vera Bittner, Stephen R. Daniels, Harold A. Franch, David R. Jacobs, William E. Kraus, Penny M. Kris-Etherton, Debra A. Krummel, Barry M. Popkin, Laurie P. Whitsel, and Neil A. Zakai. 2012. “Population Approaches to Improve Diet, Physical Activity and Smoking Habits: A Scientific Statement from the American Heart Association.” *Circulation* 126, no. 12: 1514-1563.

Muntner, Paul, Jiang He, Jeffrey Cutler, Rachel Wildman, and Paul Whelton. 2004 “Trends in Blood Pressure among Children and Adolescents.” *The Journal of the American Medical Association* 291, No. 17: 2107-2113.

National PTA. 2006. “Recess Is at Risk, New Campaign Comes to the Rescue.” Accessed May 24, 2016. http://www.peacefulplaygrounds.com/pdf/right-to-recess/national-pta-recess-at-risk.pdf.

Nicholson, Simons. 1971. “The Theory of Loose Parts.” *Landscape Architecture* 62, No. 1: 30-34.

North Carolina Department of Commerce Energy Division. 2000. “Passive Cooling for Your North Carolina Home.” Raleigh, North Carolina: North Carolina Solar Center, 2000.

“Obesity and Overweight.” 2015. Geneva, Switzerland: World Health Organization, 2015. Fact Sheet No. 311, Updated January 2015.

“Overweight in Children.” 2015. *Heart.org.* Last modified August 17, 2015. http://www.heart.org/HEARTORG/HealthyLiving/HealthyKids/ChildhoodObesity/Overweight-in-Children_UCM_304054_Article.jsp#.Vv4QIfkrKUk.

Parmer, Sondra, Jill Salisbury-Glennon, and David Shannon. 2009. “School Gardens: An Experiential Learning Approach for a Nutrition Education Program to Increase Fruit and Vegetable Knowledge, Preference, and Consumption.” *Journal of Nutrition Education and Behavior* 41, No. 3: 212-217.

Pellegrini, Anthony D. and Peter K. Smith. 1998. “Physical Activity Play: The Nature and Function of a Neglected Aspect of Play.” *Child Development* 69, No. 3: 577–598.

Pellegrini, Anthony D., Patti Davis Huberty, and Ithel Jones. 1995. "The Effects of Recess Timing on Children's Playground and Classroom Behaviors." *American Educational Research Journal* 32, No. 4: 845-864.

Persil UK. 2016. *Free the Kids – Dirt is Good*. YouTube video, 02:37. March 21 2016. https://www.youtube.com/watch?v=8Q2WnCkBTw0.

"Playground Safety Surfacing - Rubber Mulch & Surface." 2016. *Kidstuffplaysystems.com.* Accessed June 14, 2016. http://www.kidstuffplaysystems.com/safetysurface.html.

Plutchik, Robert. 2001. "The Nature of Emotions." *American Scientist* 89, No. 4: 344-350.

Ramey, C.T., F.A. Campbell, and J.E. Nicholson. 1973. "The Predictive Power of the Bayley Scales of Infant Development and the Stanford-Binet Intelligence Test in a Relatively Constant Environment." *Child Development* 44, No. 4: 790-795.

Ratcliffe, Michelle M., Kathleen A. Merrigan, Beatrice L. Rogers, and Jeanne P. Goldberg. 2011. "The Effects of School Garden Experiences On Middle School-Aged Students' Knowledge, Attitudes, And Behaviors Associated with Vegetable Consumption." *Health Promotion Practice* 12, No. 1: 36-43.

Reeves, Walter. 2011. "Pond – Plants for Ponds." *Walterreeves.com*. Accessed June 14, 2016. http://www.walterreeves.com/landscaping/pond-plants-for-ponds/.

Rickinson, Mark, Justin Dillon, Kelly Teamey, Marian Morris, Mee Young Choi, Dawn Sanders, and Pauline Benefield. 2004. *A Review of Research On Outdoor Learning.* National Foundation for Educational Research and King's College London. Telford, United Kingdom: Field Studies Council Publications, 2004.

Rideout, Victoria, Ulla Foehr, and Donald Roberts. 2010. *GENERATION M^2: Media in the Lives of 8- to 18-Year Olds.* Menlo Park, California: The Henry J. Kaiser Family Foundation, 2010.

Roberts, Christian K., Benjamin Freed, and William J. McCarthy. 2010. "Low Aerobic Fitness and Obesity Are Associated with Lower Standardized Test Scores in Children." *The Journal of Pediatrics* 156, No. 5: 711-718.

Robinson-O'Brien, Ramona, Mary Story, and Stephanie Heim. 2009. "Impact of Garden-Based Youth Nutrition Intervention Programs: A Review." *Journal of the American Dietic Association* 109, no. 2: 273–280.

Romeo, Nicole. 2013 "Brader Gets Grant to Make Garden Handicapped-Accessible." *Newarkpostonline.com*. May 15, 2013. http://www.newarkpostonline.com/news/article_1cebc97a-bd2b-11e2-a9b0-0019bb2963f4.html.

Rushin, Steve. 2006. "Give the Kids a Break." *Sports Illustrated*, Dec. 4, 2006: 17.

Scherr, Rachel, Rachel Cox, Gail Feenstra, and Sheri Zidenberg-Cherr. 2013. "Integrating Local Agriculture into Nutrition Programs Can Benefit Children's Health." *California Agriculture* 67, No. 1: 30-37.

Sebba, Rachel. 1991. "The Landscapes of Childhood: The Reflection of Childhood's Environment in Adult Memories and in Children's Attitudes." *Environment & Behavior* 23, No. 4: 395 – 422.

Shearer, Lee. 2014. "School Officials Want to Replace Barnett Shoals Elementary Instead of Renovating It." *Athens Banner-Herald Online*, June 7, 2014. Accessed June 14, 2016. http://onlineathens.com/local-news/2014-06-06/school-officials-want-replace-barnett-shoals-elementary-instead-renovating-it.

Shore, Stuart M., Michael L. Sachs, Jeffrey R. Lidicker, Stephanie N. Brett, Adam R. Wright, and Joseph R. Libonati. 2008. "Decreased Scholastic Achievement in Overweight Middle School Students." *Obesity* 16, No. 7: 1535-1538.

Silverman, Howard, Jen Marlow, and Deborah Kane. 2006. “New on the Menu: Districtwide Changes to School Food Start in the Kitchen at Portland’s Abernethy Elementary.” Portland, Oregon: Abernethy Elementary, Portland Public Schools Nutrition Services, Injury Free Coalition for Kids, and Ecotrust, October 2006.

Slusser, Wendelin M., William G. Cumberland, Ben L. Browdy, Linda Lange, and Charlotte Neumann. 2007. "A School Salad Bar Increases Frequency of Fruit and Vegetable Consumption among Children Living in Low-Income Households." *Public Health Nutrition* 10, No. 12: 1490-1496.

“Soccer Field Dimensions.” 2016. *Trumarkathletics.com*. Accessed June 30, 2016. http://www.trumarkathletics.com/soccerfield.aspx#Dimensions.

Society of Health and Physical Educators. 2016. "2016 Shape of the Nation: Status of Physical Education in the USA." *Shape of Health and Physical Educators.* Accessed May 25, 2016. http://www.shapeamerica.org/advocacy/son/2016/upload/Shape-of-the-Nation-2016_web.pdf.

Sorrow, April Reese. 2011. “Edible Fruits in the Landscape.” *Caes.uga.edu.* Published February 24, 2011. Accessed June 14, 2016. http://apps.caes.uga.edu/gafaces/?public=viewStory&pk_id=4039

South Carolina Energy Office. 2016. “Landscaping for Energy Efficiency.” Columbia, South Carolina: South Carolina Energy Office, 2016.

State Botanical Garden of Georgia. 2016. “Full Sun Native Plant List.” Athens, Georgia: State Botanical Garden of Georgia, 2016. http://botgarden.uga.edu/docs/conserve/c2pplants.pdf.

State Education and Environment Roundtable (SEER). 2000. *California Student Assessment Project Phase One: The Effect of Environment-based Education on Student Achievement.* Sacramento, California: California Department of Education, 2000.

State Education and Environment Roundtable (SEER). 2005. *California Student Assessment Project Phase Two: The Effect of Environment-based Education on Student Achievement.* Sacramento, California: California Department of Education, 2005.

Sternberg, Esther. 2009. *Healing Spaces: The Science of Place and Well-being*. Cambridge, Massachusetts: Harvard University Press, 2009.

Story, Mary, Marilyn Nanney, and Marlene Schwartz. 2009. “Schools and Obesity Prevention: Creating School Environments and Policies to Promote Healthy Eating and Physical Activity.” *The Milbank Quarterly* 58, No. 1: 71 – 100.

Taylor, Andrea Faber, and Frances E. Kuo. 2006. "Is Contact with Nature Important for Healthy Child Development? State of the Evidence." *Children and Their Environments: Learning, Using and Designing Spaces*. New York, New York: Cambridge University Press, 2006.

Taylor, Andrea Faber, Angela Wiley, Frances E. Kuo, and William C. Sullivan. 1998. "Growing Up in the Inner City: Green Places as Places to Grow." *Environment and Behavior 30*, No. 1: 3-27.

Tennessen, C. M. and B. Cimprich. 1995. “Views to Nature: Effects on Attention.” *Journal of Environmental Psychology* 15, No. 1: 77-85.

The Food Trust. 2007. “Kindergarten Initiative Evaluation Report.” Philadelphia, Pennsylvania: A Report of the Food Trust, February 2007.

The National Association for the Education of Young Children. 1997. “The Value of School Recess and Outdoor Play.” *The National Association for the Education of Young Children*. Accessed May 25, 2016. http://www.education.com/pdf/Ref_Value_School_Recess/.

The National Environmental Education & Training Foundation. 2000. “Environment-Based Education: Creating High Performance Schools and Students.” Washington, D.C.: National Environmental Education and Training Foundation, 2000.

“The Nueva School, Hillsborough, CA.” 2016. *Discoverdesign.org*. Accessed June 6, 2016. http://www.discoverdesign.org/discover/site.

The University of Vermont. 2006. “Burlington School Food Project: Evaluation Report Executive Summary December 2006.” Burlington, Vermont: The Center for Rural Studies, University of Vermont, December 2006.

“Tips for Landscaping Around Your Air Conditioning Unit.” 2016. *Trane.com*. Accessed June 20, 2016. https://www.trane.com/residential/en/resources/for-your-home/landscaping-around-outdoor-units.html.

“Tips for Parents – Ideas to Help Children Maintain a Healthy Weight.” 2015. *CDC.gov*. Last modified June 5, 2015. Accessed June 20, 2016. http://www.cdc.gov/healthyweight/children/.

Titman, Wendy. 1994. *Special Places; Special People: The Hidden Curriculum of Schoolgrounds.* Surrey, United Kingdom: World Wide Fund for Nature, 1994.

Ulrich, Roger. 1984. "View through a Window May Influence Recovery from Surgery." *Science* 224, No. 4647: 420-421.

Ulrich, Roger, Robert Simons, Barbara Losito, Evelyn Fiorito, Mark Miles, and Michael Zelson. 1991. "Stress Recovery during Exposure to Natural and Urban Environments." *Journal of Environmental Psychology* 11, No. 3: 201-230.

United Nations. 1989. *Convention on the Rights of the Child.* Geneva, Switzerland: United Nations, 1989.

University of Georgia. 2009a. "Vegetable Gardening in Georgia." Athens, Georgia: University of Georgia Extension, 2009.

University of Georgia. 2009b. "Vegetable Planting Chart." Athens, Georgia: University of Georgia Extension, 2009.

University of Georgia. 2013. "Planning an Edible Garden." Athens, Georgia: University of Georgia Extension, 2013.

U.S. Consumer Product Safety Commission. 2015. *Public Playground Safety Handbook*. Bethesda, Maryland: U.S. Consumer Product Safety Commission, 2015.

U.S. Department of Agriculture. 2007a. "Native Grasses for Wildlife Habitat." Washington, D.C.: Natural Resources Conservation Service, 2007.

U.S. Department of Agriculture. 2007b. *School Nutrition Dietary Assessment Study—III: Volume I: School Foodservice, School Food Environment, and Meals Offered and Served.* Alexandria, Virginia: Department of Agriculture, Food and Nutrition Service. U.S. Report No. CN-07-SNDA-III.

U.S. Department of Agriculture. 2016. “School Programs Meal, Snack, and Milk Payments to States and Schools Food Authorities.” Alexandria, Virginia: U.S. Department of Agriculture, Food and Nutrition Service.

U.S. Department of Education. 2014. “Enrollment in Elementary, Secondary, and Degree-Granting Postsecondary Institutions, By Level and Control of Institution, Enrollment Level, and Attendance Status and Sex of Student: Selected Years, Fall 1990 through Fall 2024.” Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

U.S. Department of Education. 2015. “Fast Facts.” Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

U.S. Department of Health and Human Services. 2001. *The Surgeon General’s Call to Action to Prevent and Decrease Overweight and Obesity*. Rockville, Maryland: U.S. Department of Health and Human Services, Public Health Service, Office of the Surgeon General.

U.S. Department of Health and Human Services. 2008. *2008 Physical Activity Guidelines for Americans*. Washington, D.C.: U.S. Department of Health and Human Services.

U.S. Department of Health and Human Services. 2013. *Results from the School Health Policies and Practices Study 2012.* Washington, D.C.: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

U.S. Department of Transportation. 1972. *Nationwide Personal Transportation Study: Transportation Characteristics of Schoolchildren.* Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

U.S. General Accounting Office. 2003. *School Meal Programs: Revenue and Expense Information from Selected States*. Report No. GAO-03-569. Washington, D.C., U.S. General Accounting Office.

Wade, Gary, Elain Nash, Ed McDowell, and Brenda Beckham. 2013. "Native Plants for Georgia Part IV: Grasses and Sedges." Athens, Georgia: The University of Georgia Cooperative Extension, 2013.

Wade, Gary, Elain Nash, Ed McDowell, Brenda Beckham, and Sharlys Crisafulli. 2011. "Native Plants for Georgia Part III: Wildflowers." Athens, Georgia: The University of Georgia Cooperative Extension, 2011.

Waliczek, T. M., J. C. Bradley, and J. M. Zajicek. 2001. "The Effect of School Gardens on Children's Interpersonal Relationships and Attitudes Toward School." *HortTechnology* 11, No. 3: 466-468.

Weber, J.A. 2008. "Increasing Food Costs for Consumers and Food Programs Straining Pocketbooks." *Journal of the American Dietetic Association* 108, No. 4: 615–17.

Weier, John and David Herring. 2000. "Measuring Vegetation (NDVI & EVI)." *NASA.* Accessed May 20, 2016. http://earthobservatory.nasa.gov/Features/MeasuringVegetation/measuring_vegetation_1.php.

Weinstein, Carol S. and Patricia Pinciotti. 1988. "Changing A Schoolyard: Intentions, Design Decisions, And Behavioral Outcomes." *Environment and Behavior* 20, No. 3: 345-371.

Wells, Nancy M. and Gary W. Evans. 2003. "Nearby Nature: A Buffer of Life Stress among Rural Children." *Environment and Behavior* 35, No. 3: 311-330.

"Why Dirt Is Good." 2016. *Dirtisgood.com.* Accessed June 14, 2016. http://www.dirtisgood.com/uk/truth-about-dirt.html.

World Health Organization. 1998. *Obesity: Preventing and Managing the Global Epidemic.* Geneva, Switzerland: World Health Organization, 1998.

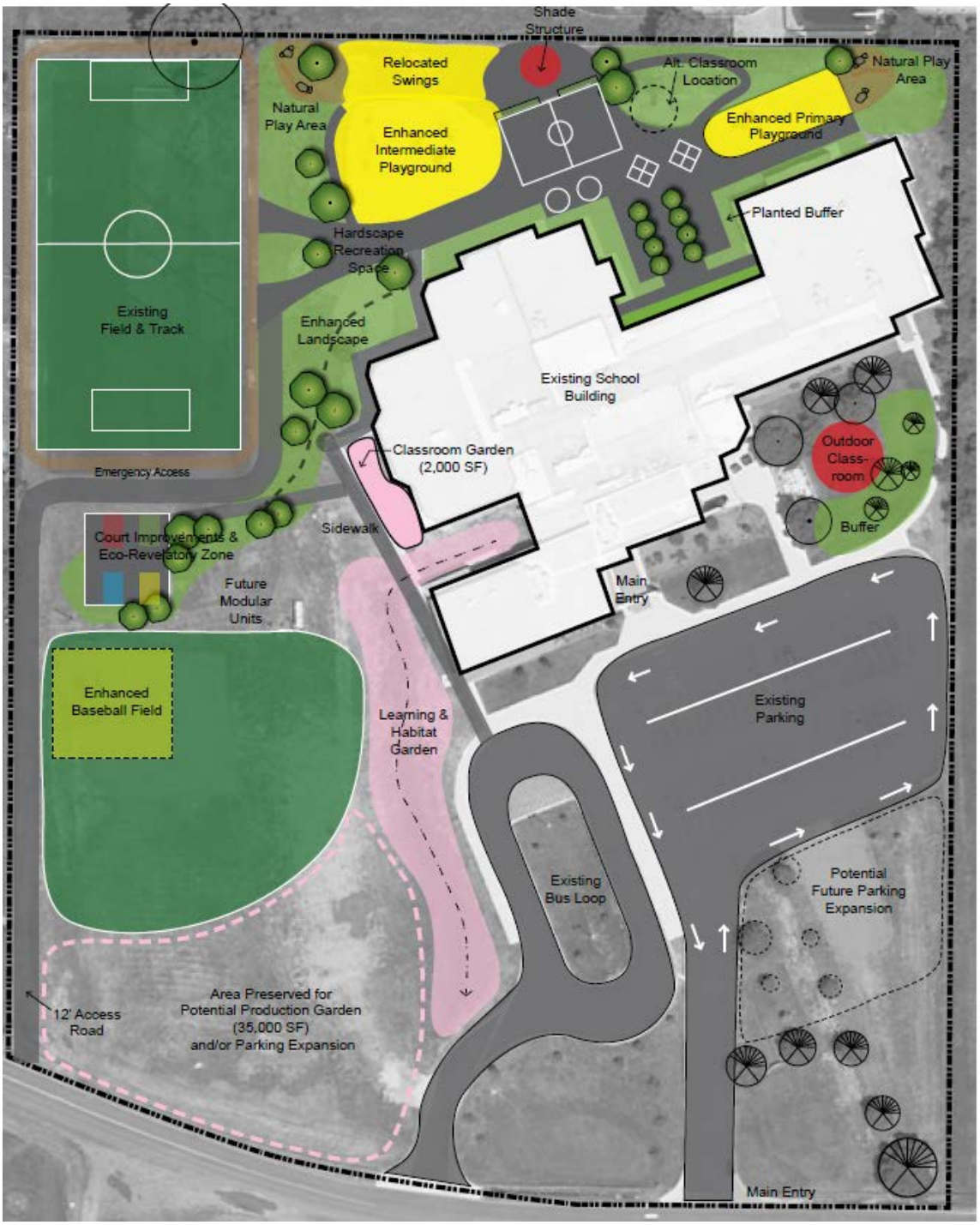
Wu, Chih-Da, Eileen McNeely, J. G. Cedeño-Laurent, Wen-Chi Pan, Gary Adamkiewicz, Francesca Dominici, Shih-Chun Candice Lung, Huey-Jen Su, and John D. Spengler. 2014. "Linking Student Performance in Massachusetts Elementary Schools with the 'Greenness' of School Surroundings Using Remote Sensing." *PLoS One* 9, No. 10.

Zeichner, Lauren. 2016. In discussion with the author. May 27, 2016.

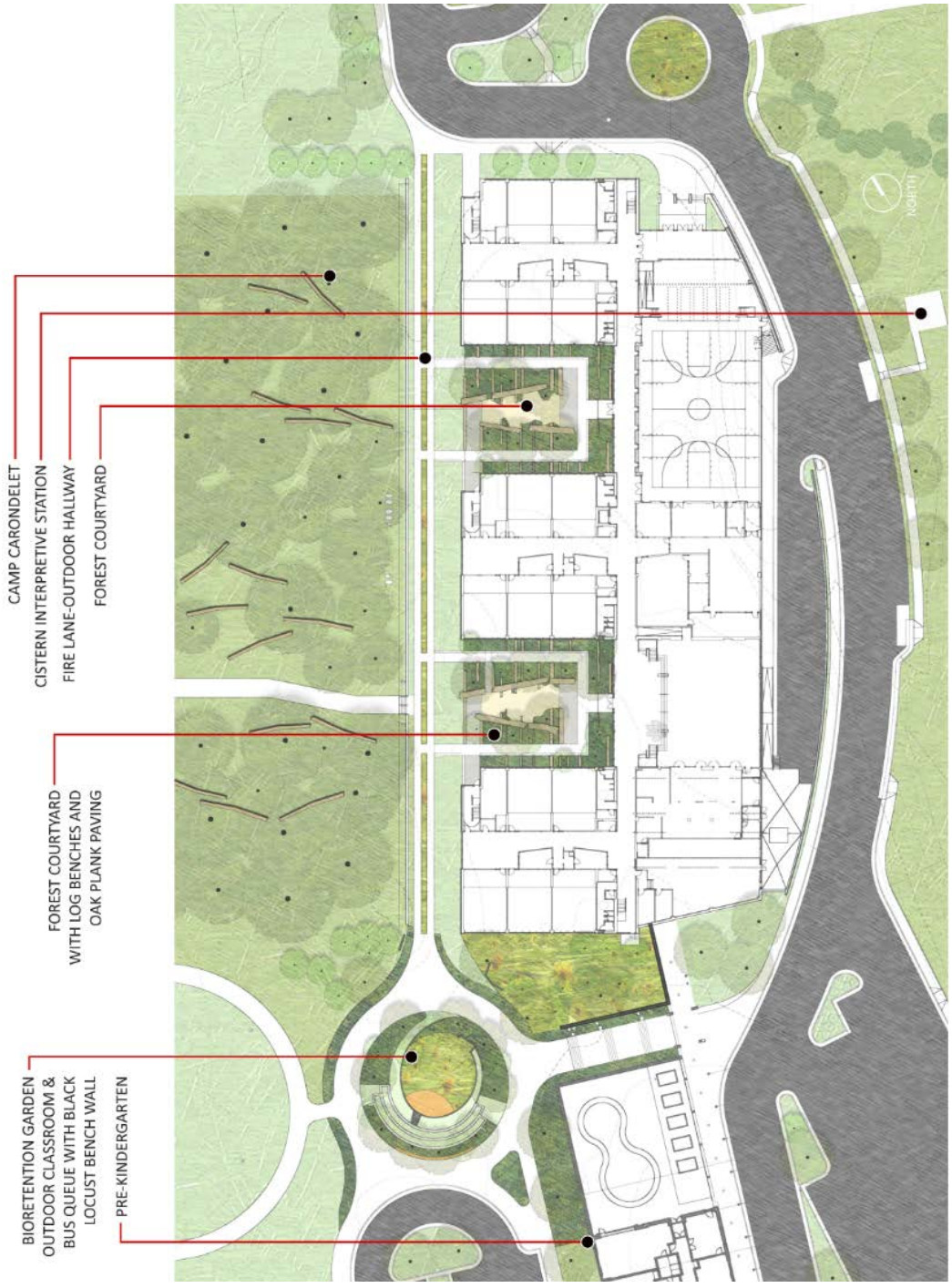
APPENDICES

Appendix A - Existing Site Plan of Fairmount Elementary School

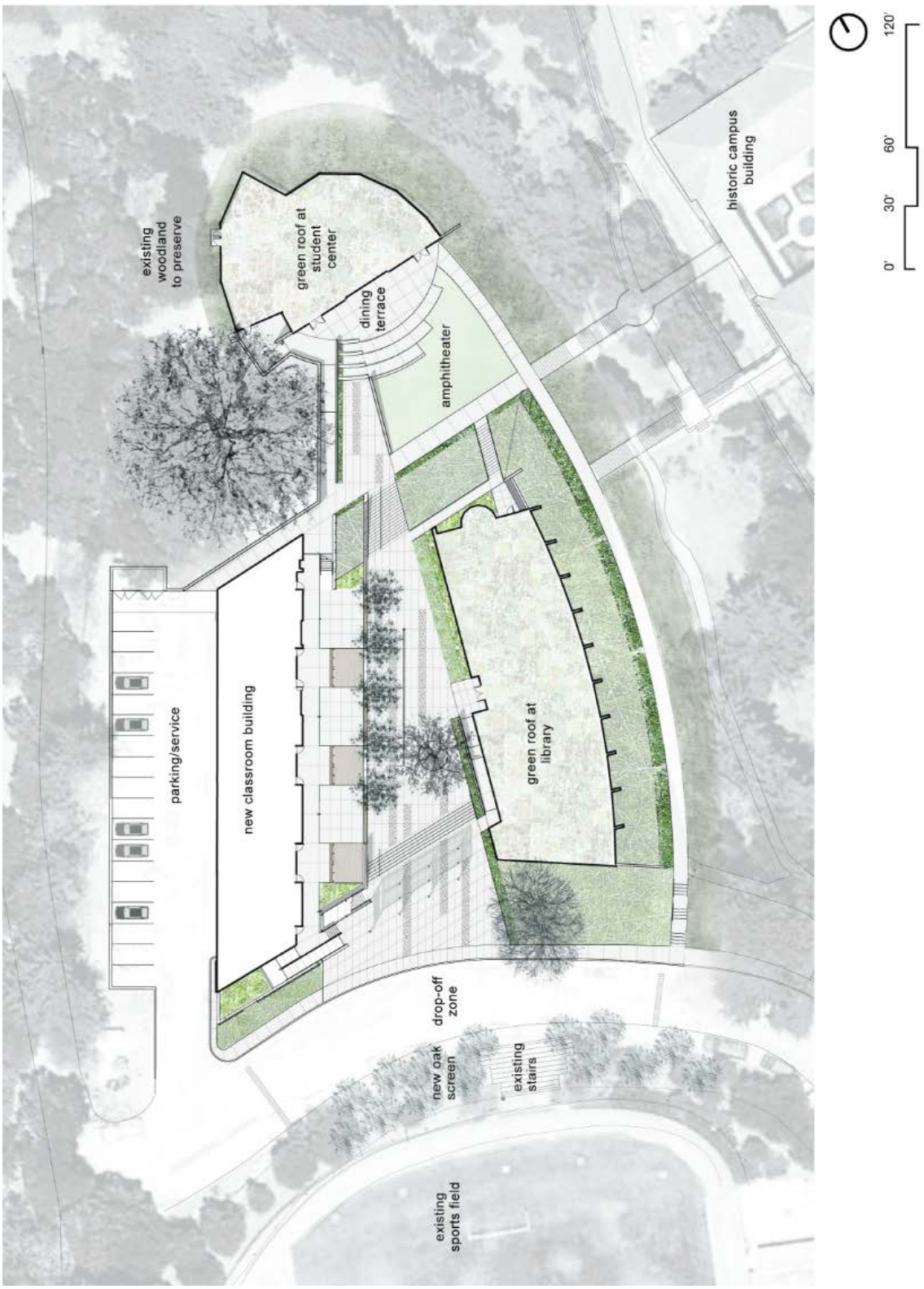
Appendix B - Final Master Plan of Fairmount Elementary School



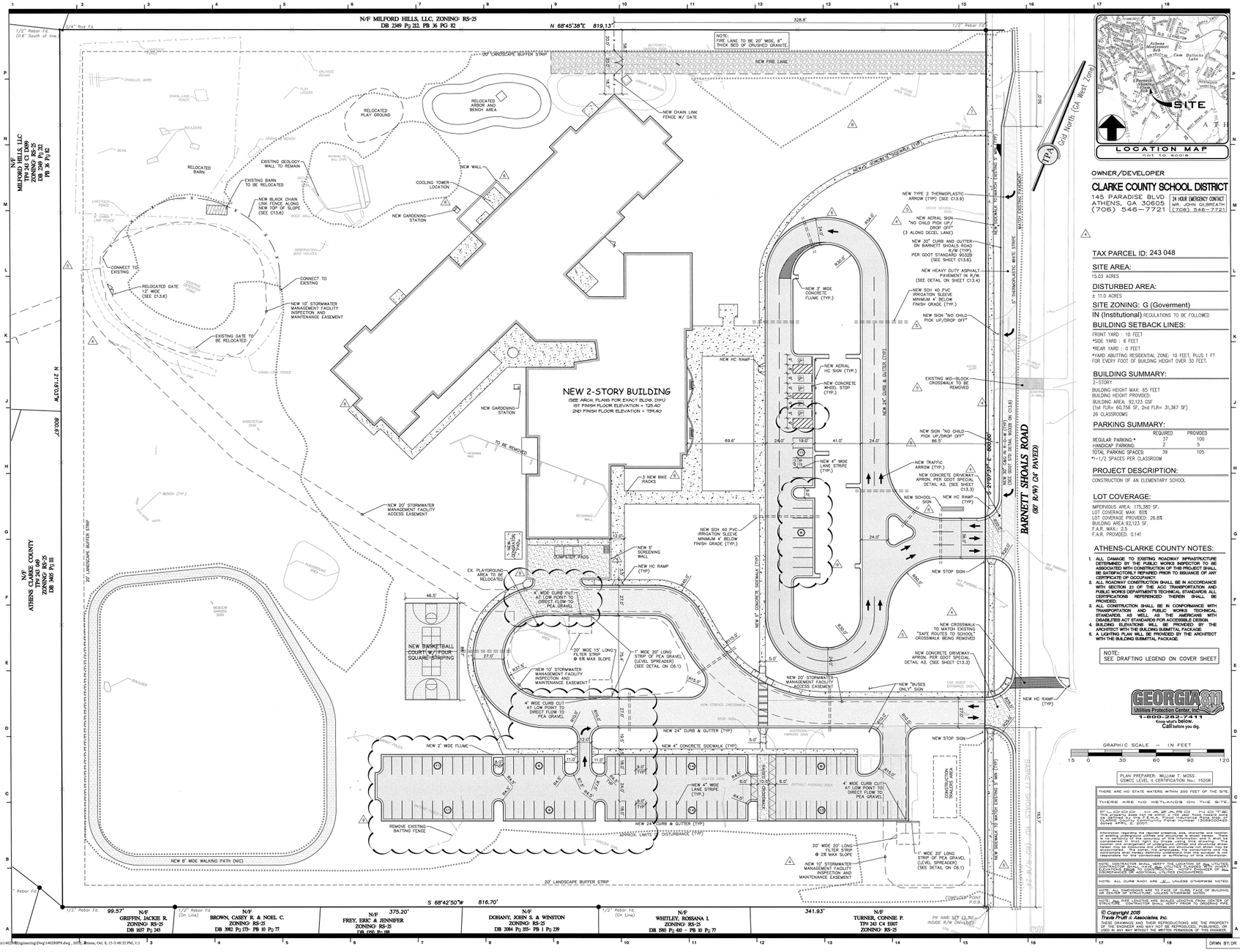
Appendix C - Final Site Plan of Manassas Park Elementary School



Appendix D - Final Master Plan of Nueva School



Appendix E - Barnett Shoals Elementary School Site Plan



BARNETT SHOALS ELEMENTARY SCHOOL

3220 BARNETT SHOALS ROAD
ATHENS, GEORGIA 30601

Goode Van Slyke Architecture

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dmoore@piedcontructiongroup.com

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Specifications
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Decatur, GA 30030
Contact: Betty Spiker
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404.373.9075

seal/signature

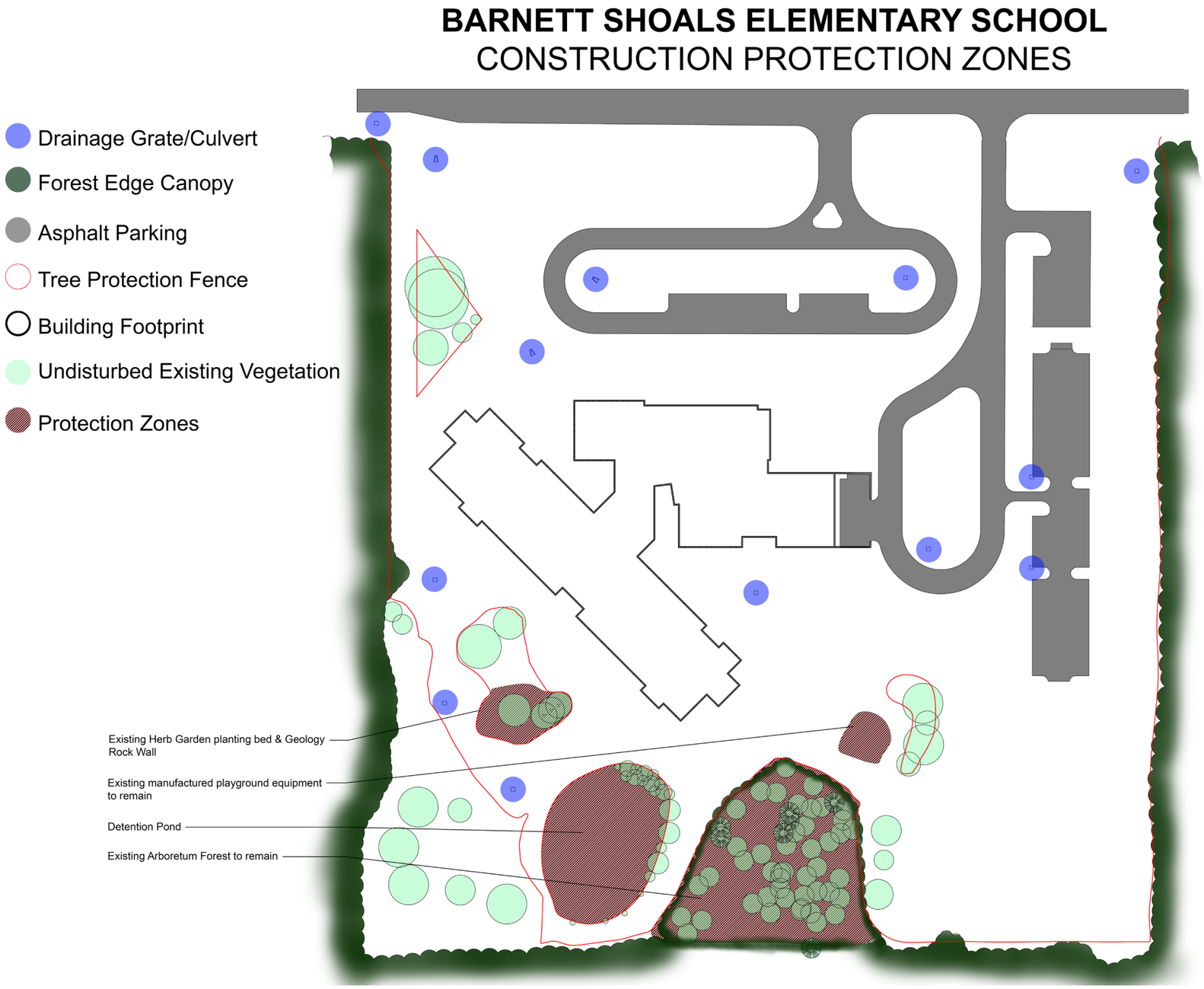
GEORGIA REGISTERED PROFESSIONAL ENGINEER WILLIAM THOMAS MOSS
10-8-2015
For The Firm
Travis Pruitt & Associates, Inc.

no.	date	description
1	8/22/14	Scope Reduction
2	9/12/14	50% Design Development
3	9/19/14	100% Design Development
4	10/03/14	Address ACC Comments
5	11/11/14	Address ACC Comments
6	12/22/14	Permit Revision #1
7	1/15/15	Client Revisions
8	6/24/15	Fire Marshall Comments
9	10/7/15	Pavement Revision

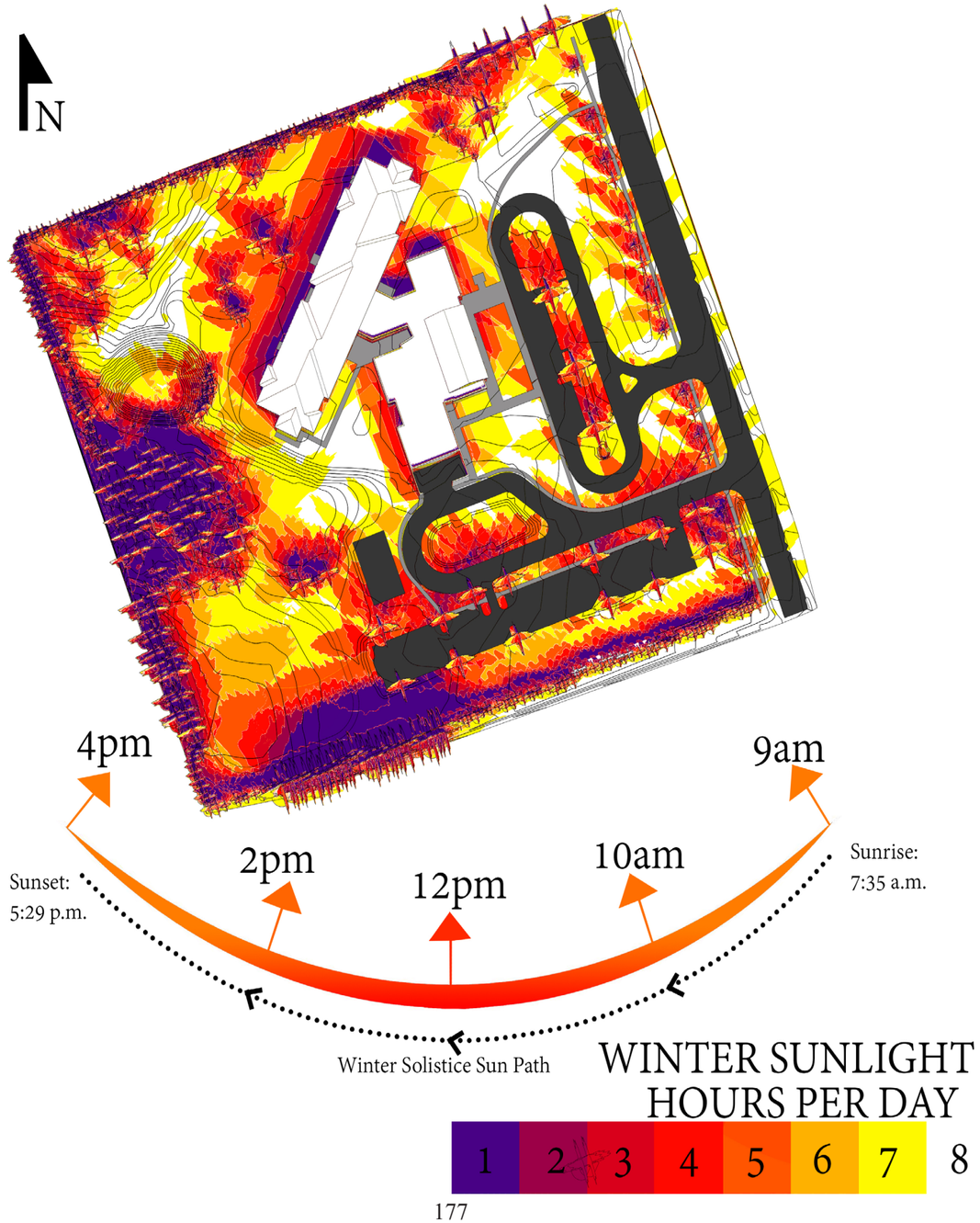
date Dec 22, 2014
phase 100% CONST DOCUMENTS
issued for CONSTRUCTION
project number 20143.00

SITE PLAN

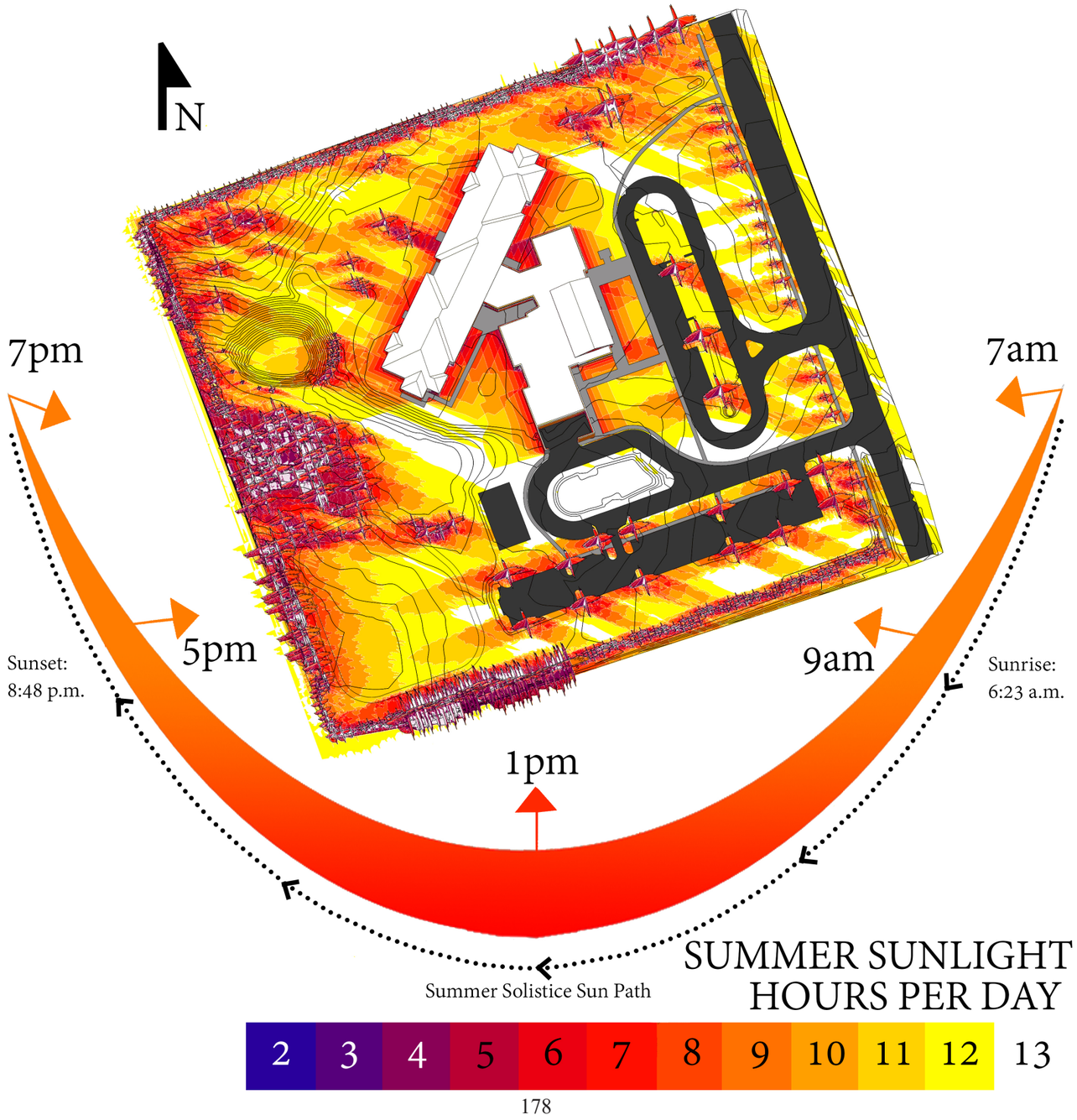
sheet number C3.1

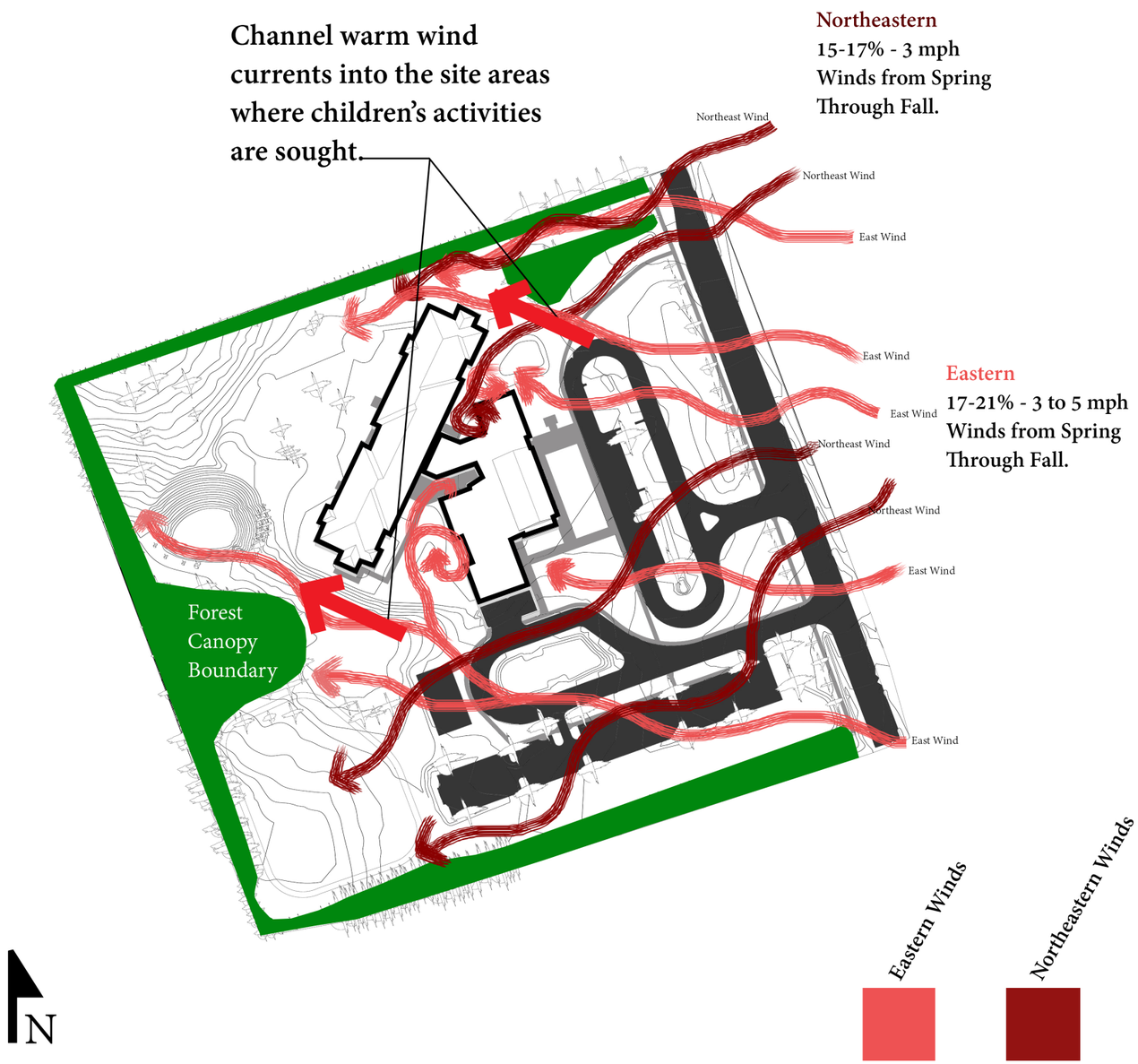

BARNETT SHOALS ELEMENTARY SCHOOL
CONSTRUCTION PROTECTION ZONES
Drainage Grate/Culvert
Forest Edge Canopy
Asphalt Parking
Tree Protection Fence
Building Footprint
Undisturbed Existing Vegetation
Protection Zones
Existing Herb Garden planting bed & Geology Rock Wall
Existing manufactured playground equipment to remain
Detention Pond
Existing Arboretum Forest to remain

Appendix G - Barnett Shoals Elementary School Construction Winter Sun Exposure Analysis

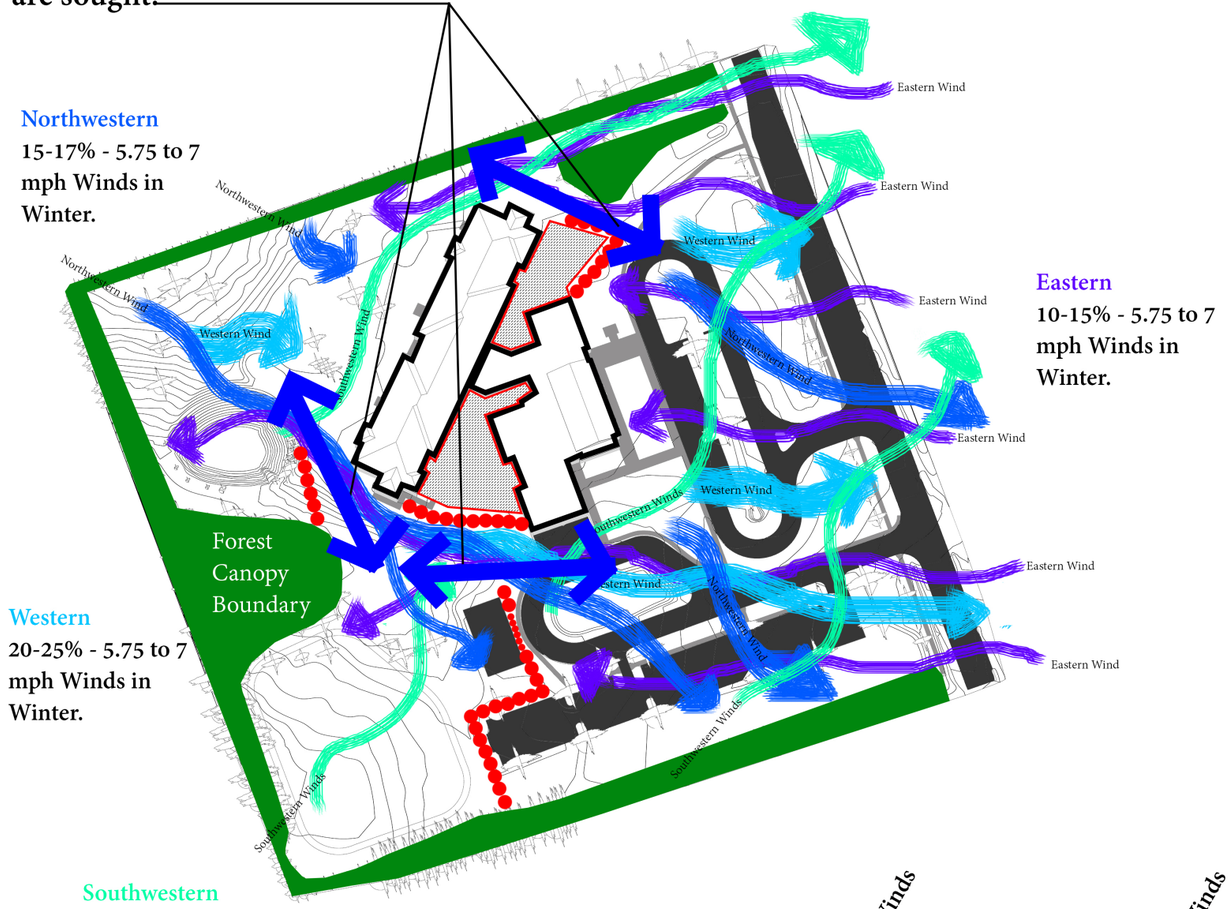


Appendix H - Barnett Shoals Elementary School Construction Summer Sun Exposure Analysis

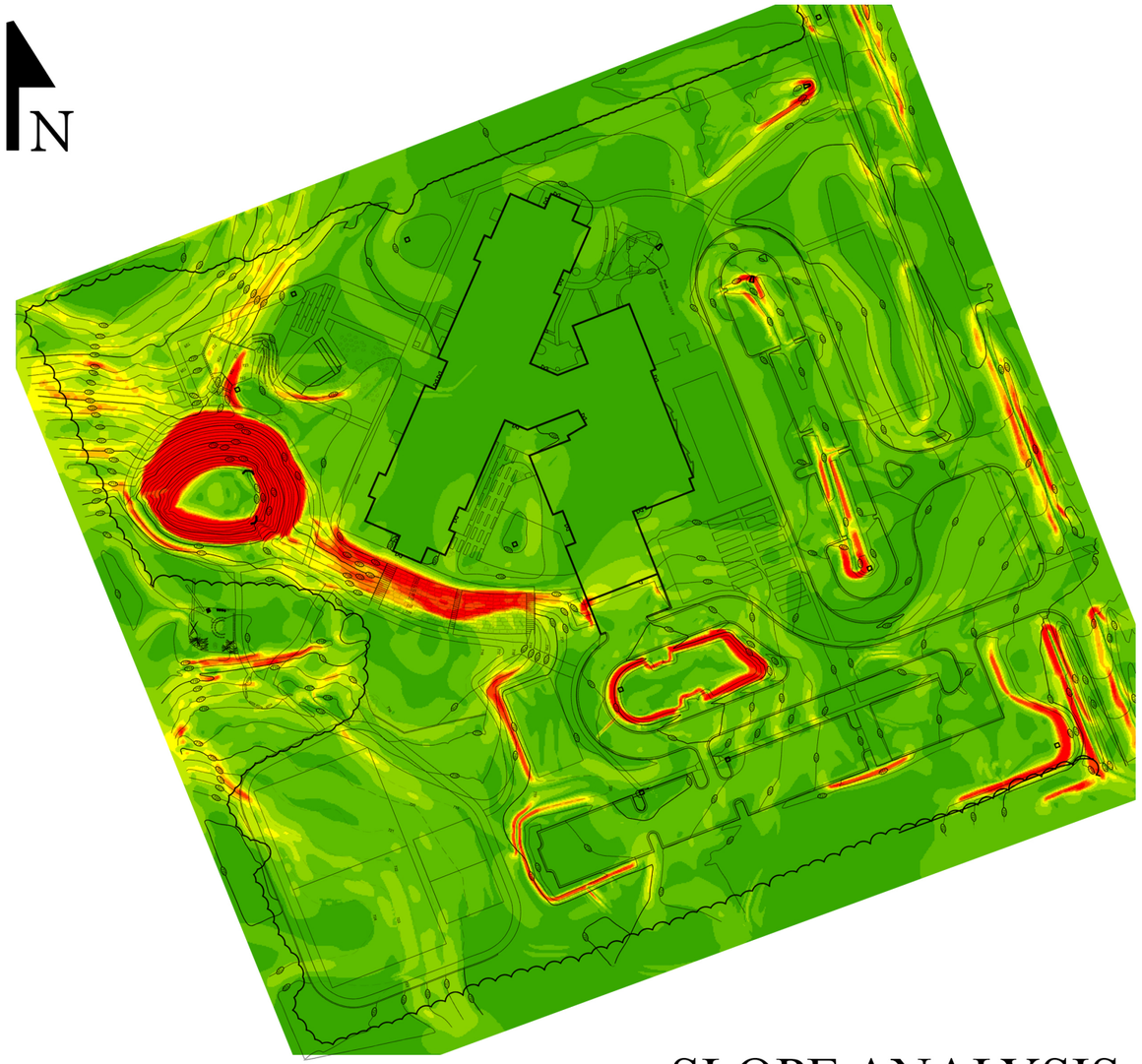


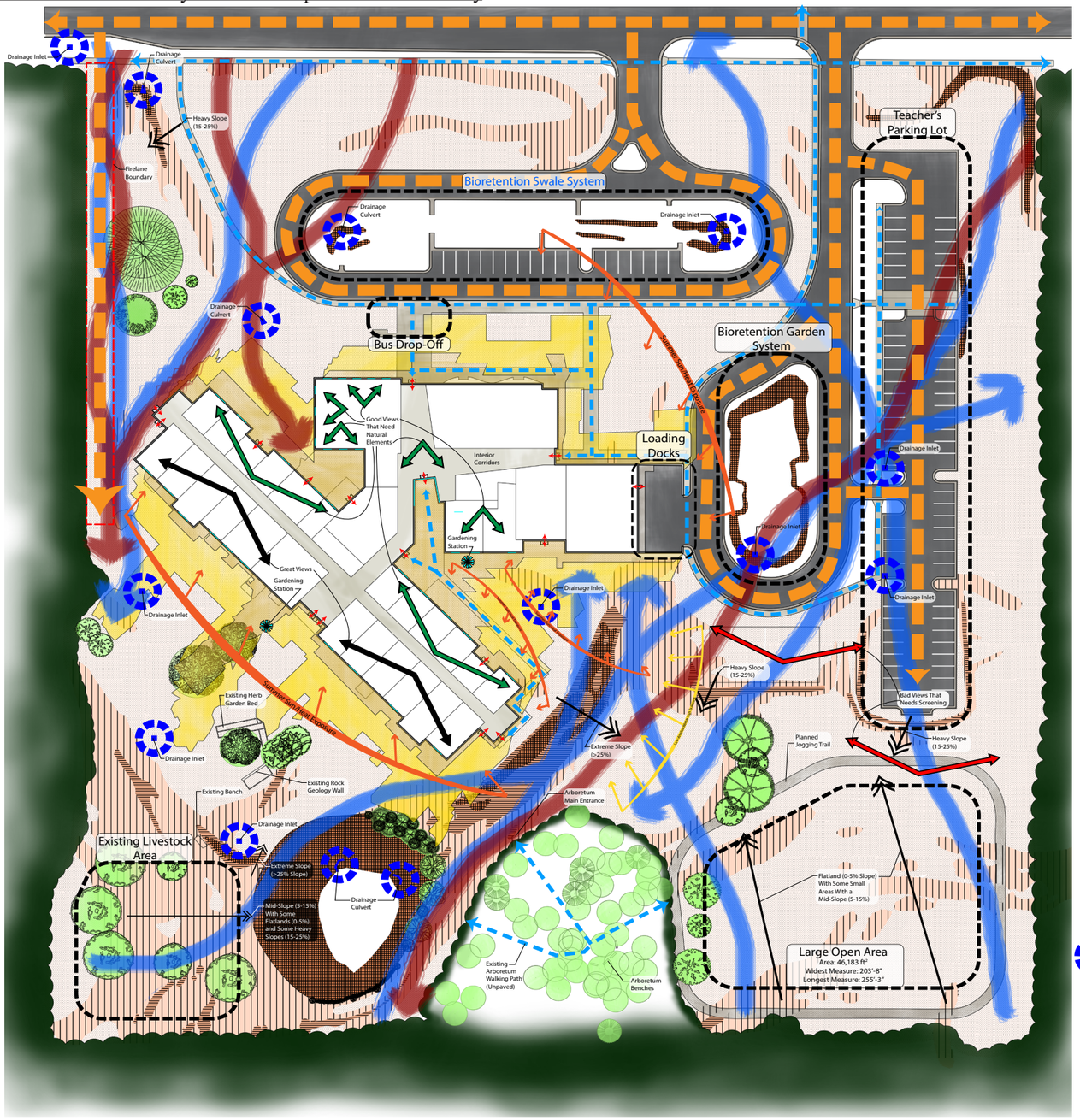

Channel warm wind currents into the site areas where children's activities are sought.
Northeastern
15-17% - 3 mph
Winds from Spring Through Fall.
Northeast Wind
Northeast Wind
East Wind
East Wind
East Wind
Northeast Wind
Northeast Wind
East Wind
East Wind
Eastern
17-21% - 3 to 5 mph
Winds from Spring Through Fall.
Forest Canopy Boundary
N
Eastern Winds
Northeastern Winds

Channel cold wind currents away from the site areas where children's activities are sought.



Appendix K - Barnett Shoals Elementary School Construction Slope Analysis

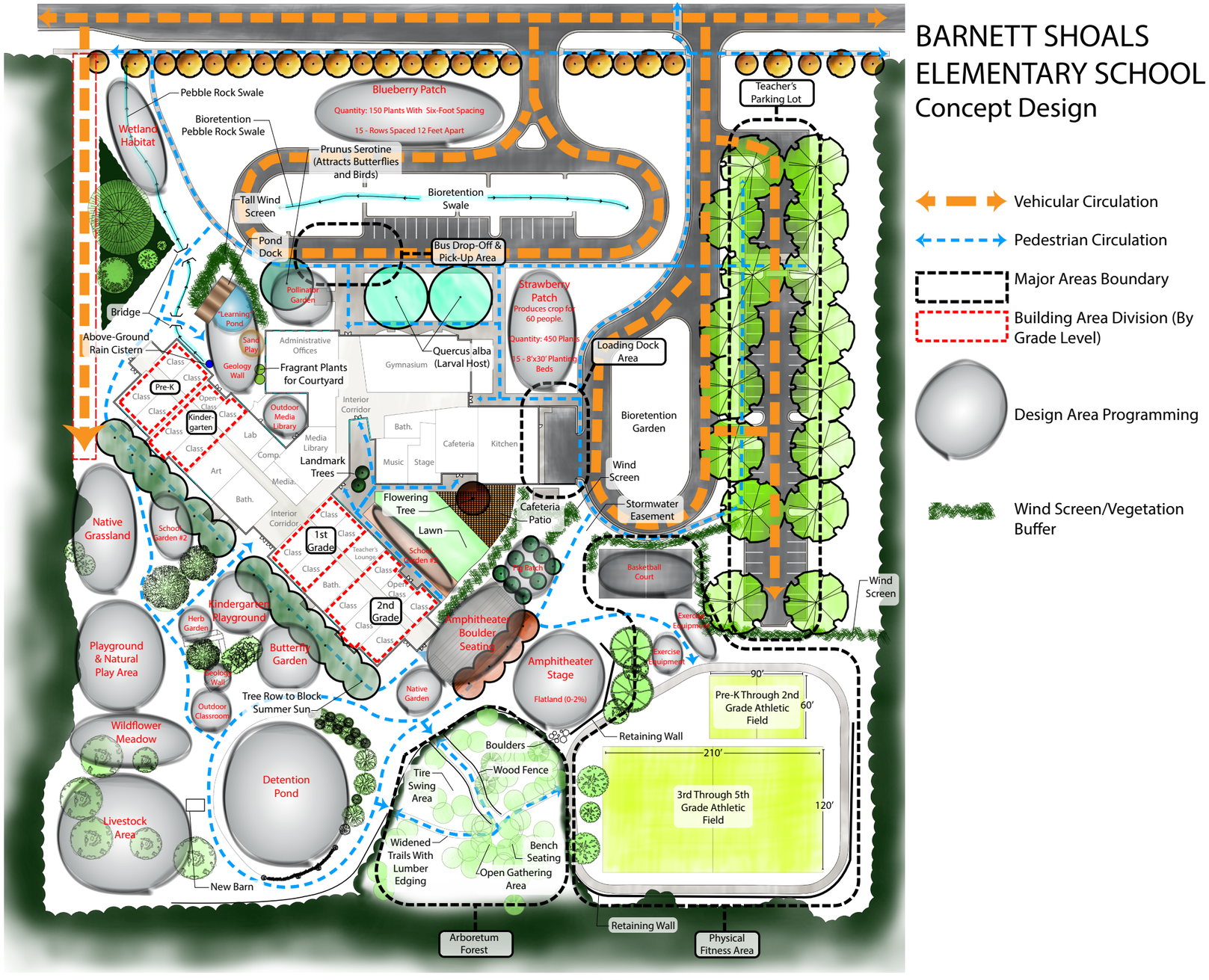




BARNETT SHOALS ELEMENTARY SCHOOL
Composite Site Inventory

- Vehicular Circulation
- Pedestrian Circulation
- Extreme Slope (>25%)
- Heavy Slope (15-25%)
- Mid-Slope (5-15%)
- Flatlands (0-5%)
- 5 - 7 Hours of Summer Sunlight Exposure
- 8 - 10 Hours of Summer Sunlight Exposure
- Major Areas Boundary
- Door Entrances
- Good Views
- Good Views That Need Natural Elements (i.e. Vegetation and Greenery)
- Bad Views
- Gardening Station Location
- Drainage Culvert or Inlet
- Slope Arrow
- Cold Wind Currents
- Warm Wind Currents

Appendix M - New Barnett Shoals Elementary School Concept Plan



Appendix N - New Barnett Shoals Elementary School Final Design Site Plan

BARNETT SHOALS ELEMENTARY SCHOOL

WETLAND HABITAT

Plants (Trees): *Liquidambar styraciflua, Quercus Phellos, Quercus nigra*
Plants (Shrubs, Vines, Woody): *Cephalanthus occidentalis, Lindera benzoin,*
Plants (Grass, Sedge, Rush): *Chasmanthium latifolium*
Plants (Forbs/Wildflowers): *Solidago rugosa,Helianthus angustifolia, Hibiscus grandiflolia, Eupatorium fistulosum, Aquilegia canadensis, asclepias incarnata, Tiarella cordifolia*

Wildlife: *Birds, Hummingbirds, Butterfly, Moth, Deer, Squirrels*

Grasses and Wildflowers Display: A walkable display of grasses and wildflowers used in the grass and wildflower meadows in the back of the school.

Prunus serotina: Black Cherry is a host plant for over 450 species of butterflies and moths and over 53 different species of birds eat their fruits. It has a high wildlife value.

Evergreen Windbreak: Eastern Red Cedars are used as windbreaks to block cold winds in the winter from the Media Library Courtyard and Pre-K/ Kindergarten Wing. Dominant winds from the east and northeast are channed to the playground during the warmer months to provide "natural air-conditioning."

Pre-K/Kindergarten "Loose Parts" Play Area: A Loose Parts" play area has been design next ot the Pre-K/K playground to facilitate creative play and provide greater options for play for children. The "Loose Parts" play area will be furnished with bamboo shoots, PVC pice, branches, grass, stumps, stones, and boulders so that children can create their own games.

POND/AQUATIC HABITAT

Plants (Trees): *Morelia cerifera, and Ilex verticallata*
Plants (Marginal/Emergent): *Eupatorium fistulosum, Typha latifolia, Sagittaria latifolia, Juncus effusus 'spiralis,' Saururus cernuus, and Asclepias incarnata*
Plants (Floaters): *Lemna minor, Azolla caroliniana, nymphea pygmaea 'Alba,' and Pistia stratiodes*
Plants (Oxygenators): *Elodea canadensis and Ceratophyllum demersum*

Wildlife: *Birds, Hummingbirds, Butterfly, Moth, Amphibians, Insects*

Sand Play & Logs: A sand lot will be provided for younger kids to play across from the pond area. logs will be installed: seating logs for children and rotting logs for amphibians, insects, and birds.

Fragrant Courtyard: *Osmanthus fragrans* and *Clethra alnifolia* 'rosalis' will provide a sweet fragrance for both Library frequenters and Kindergarten children.

Five Sensory Media Library Courtyard: A hardscape will be added to the Media Library exit on the north side of the building's northern courtyard. Wind chimes, water sounds and visuals, seating, and a rain cistern with a runnel to show stormwater movement will be installed. Muscadine will grow on the fence.

Westend Energy Efficient Landscaping: Tulip Poplar trees will lin the western facade of the building and spaced to allow winter sun into the classrooms, and to block hot summer sun exposure. The trees will also shade the mechanical systems along the facade for better energy efficiency.

New and Old Playground Equipment: Both group-oriented play and independent play will allow.

MEADOW/WILDFLOWER HABITAT

Plants (Grass, Sedge, Rush): *Sorgastrum elliotii, Andropogon glameratus, and Andropogon gyrans, Andropogon Gerardii, and Panicum virgatum*
Plants (Forbs/Wildflowers): *Phlox paniculata, Liatris spicata, Asclepias tuberosa, Monarda punctata, Rudbeckia laciniata, Solidago nemeralis, Asclepias syriaca, Aquilegia canadensis, and Salvia azurea*

Wildlife: *Birds, Hummingbirds, Butterfly, Mammals*

Outdoor Classroom: Four exterior rooms will be created around a central *Ulmus parvifolia* 'Allee' by using *Cephalotaxus harrintonia* 'Fastigiata' as the seperating walls. Each "room" will be supplied with a large flat boulder for the teacher and smaller boulders for the kids. Outdoor chalkboards will also be installed.

School Garden #1: A school garden will be installed with raised beds and handicap access. Area get full sun (>8 hours).

Existing Herb Garden and Geology Wall: New herbs will be planted.

NATURE PLAY AREA

Stormwater Drain Runnel: *A Stormwater pipe is partially covered leading to a rock swal e going into a storm inlet.*
Log Seating Amphitheater: *Logs are placed along a hill for seating.*
Low-Branching Multi-Trunked Climbing Tree: *Acer Griseum*
Climbing Wall: *A six-foot climbing wall leading to a sand pit.*
Sand Play: *A sand pit is installed with logs stumps used for retaining walls.*
Hill Embankment Slide: *A slide is insalled along the natural hill formation.*
Shallow Cave: *A 3-foot deep shallow cave is installed in the hill.*

Muscadine Fencing: Muscadine will be planted botha a screening element and edible landscape.

Livestock Area: The original livestock are will remain in the same area with a fenced are for animal grazing, a barn for storage, and a chicken coup. Kids can play in the natural playground while playing with the animals.

Woodland Forest Restoration: *Antennaria plantaginifolia, Chrysogonum virginianum, Prunella vulgaris, and Smilax pumila* will be planted.

Blueberry Patch: 150 Rabbiteye Bluberry plants (Vaccinum ashei 'Alapaha' and 'Ochlockonee') with a walkable wood chips trail along the perimeter. Birds are highly attracted to the berries.

BIORETENTION SWALE

Plants (Trees): *Betula nigra and Morella cerifera*
Plants (Shrubs, Vines, Woody): *Lindera benzoin, Hydrangea quercifolia, and Cephalanthus occidentalis, and Xanthorhiza simplicissima*
Plants (Grass, Sedge, Rush): *Chasmanthium latifolium*
Plants (Forbs/Wildflowers): *Solidago rugosa and Asclepias incarnata*
Plants (Herbaceous): *Mitchiella reptans, Hibiscus grandiflorus, and Aquilegia canadensis*

Wildlife: *Birds, Hummingbirds, Butterfly, Moth, Deer, Squirrels*

Quercus alba: These White Oaks supply many butterflies with larval hosting.

Edible Garden: Strawberry varieties and Fig trees will line the front entrance of the building. nine *Ficus carica* 'celeste' trees and over 450 Strawbery plants will create an "Edible Garden & Orchard"

BIORETENTION SYSTEM

Plants (Trees): *Nyssa sylvatica and Morella cerifera*
Plants (Shrubs, Vines, Woody): *Lindera benzoin, Hydrangea quercifolia, Cephalanthus occidentalis, and Xanthorhiza simplicissima*
Plants (Forbs/Wildflowers): *Solidago rugosa and Asclepias incarnata*
Plants (Herbaceous): *Hibiscus grandiflloras and Asclepias tuberosa*

Wildlife: *Birds, Hummingbirds, Butterfly, Moth, Deer, Squirrels*

Parking Lot Shade Trees: *Quercus Shumardii* will line the parking lot for plenty shade in hot weather.

Unique Plant Showcase: *Ilex vomitoria* 'pendula' will be plated in the main exterior courtyard as a showcase or interesting gathering place.

Fragrant Cafeteria Courtyard: The children will not only be smelling Sloppy Joes, square pizzas, steamed vegetables, and last weeks fried chicken, but they will also be graced with the sweet fragrance of *Osmanthus fragrans.*

Cafeteria Outdoor Seating: A hardscape will be installed outside of the cafeteria for kids to eat outside.

School Garden #2: A second school garden will be installed with raised beds and handicap access. Area gets full sun (>8 hours).

Cafeteria Courtyard Windbreak: *Acca sellowiana* 'Varieties' will be planted between the Cafeteria Courtyard and the Boulder Rock Amphitheater to block incoming cold winds in the winter.

Eastern Site Windbreak: *Acca sellowiana* 'Varieties' will be planted between the Basketball Court and the Bioretention System to clock cold winter winds and creat a shelterbelt.

Boulder Seating Amphithteater: Flat boulders will be installed on the steep hill leading from the cafeteria to the forest.

Butterfly Garden Installments: Various Butterfly Gardens will be installed (both full sun and part shade plants will be considered) throughout the site. *Asclepias spp.* is a staple for butterfly gardens.

New Outdoor Fitness Playground: A new fitness playground and independent fitness equipment will be installed at the entrance of the Athletic Fieds.

Exterior Stage: Retaining walls will become the backdrop fo the Boulder Amphitheater stage. Prunus serotina andboulders will be installed as natural settings for props and environments for plays. Also school can hold functions here. Seating for over 700 students is provided.

MID-SLOPE FOREST HABITAT

Plants (Trees): *Asimina triloba*
Plants (Shrubs, Vines, Woody): *Callicarpa americana and Calycanthus floridus*
Plants (Grass, Sedge, Rush): *Chasmanthium sessiflorum and Saccharum alopecuroides*
Plants (Herbaceous): *Heuchera americana, Smilax pumila, Antennaria plantaginifolia, Chrysogonum virginianum, Prunella vulgaris, and Phlox divaricata*

Wildlife: *Pollinators, Birds, Hummingbirds, Butterfly, Moth, Deer, Squirrels*

Wood Chips For Trail: *Wood chips used for trail material*
Main Entrance Sign Entry and Widened Trail: *The main entrance will feature a formal entry sign and a 10-foot wide trail.*
Trail Edge Definition: *The trail edge will be formally defined with permanent edging.*
Extra Bench Seating: *More benches will be installed for seating.*
Tire Swings: *The buried tires will become a tire swing area. It is an open area.*
Fenced Perimeter: *The perimeter of the forest and trails will be fenced.*
Natural Construction Play: *An open lot will be compacted and used for "Natural Construction" play. Kids can use branches, logs, boulders, pipe, leaves, and other items to creative play and construct the world around them.*
Edible Forest Fruit: *Asimina triloba will be planted in the forest for consumption and wildlife value.*

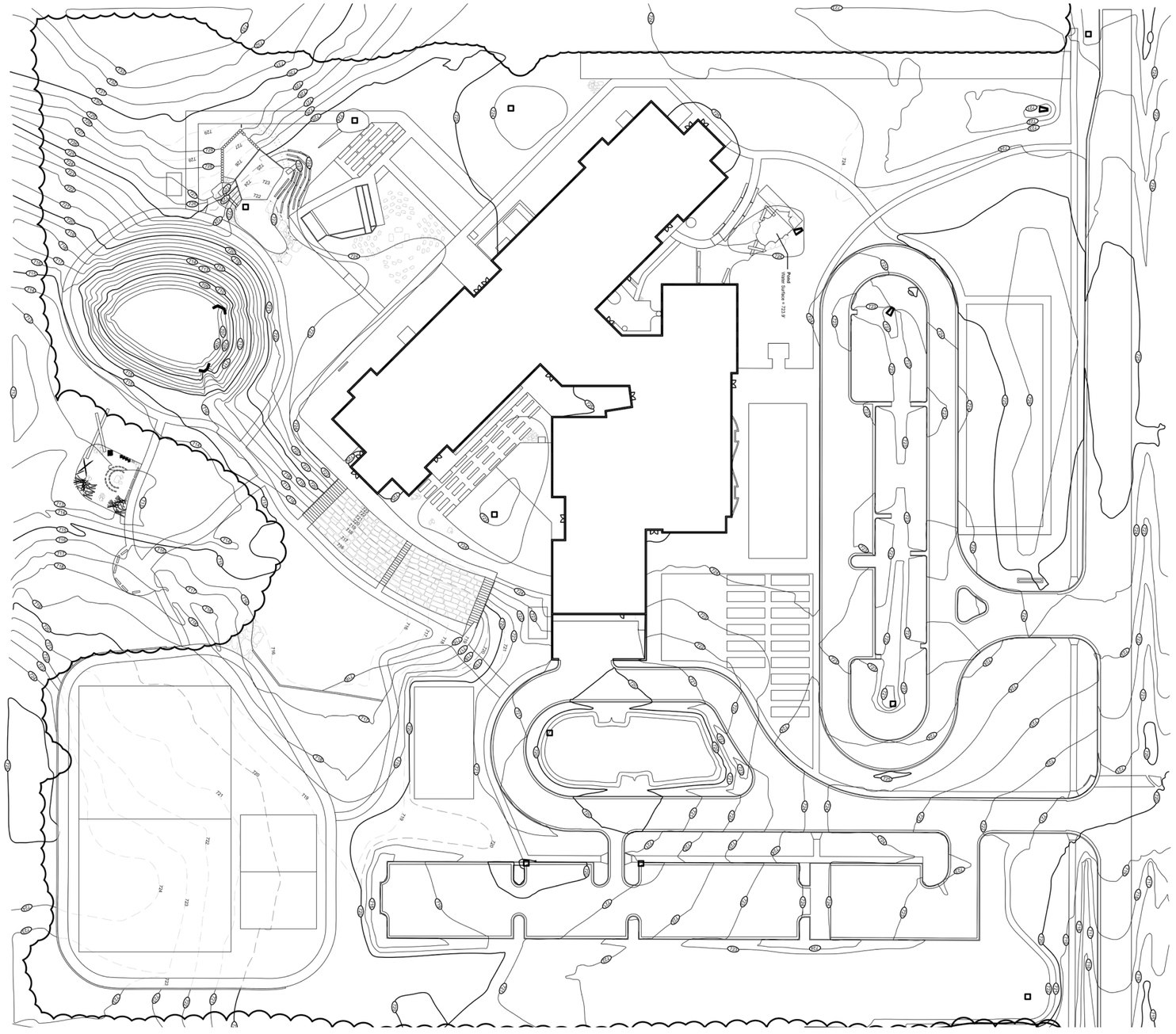
Athletic Fields & Jogging Track: One athletic field for Pre-K to second-grade use will be installed. Another field for third-grade to fifth-grade use will be installed. A joggin track will encircle the fields.

Retaining Wall: Retaining walls will hold back the natural sloping hill.

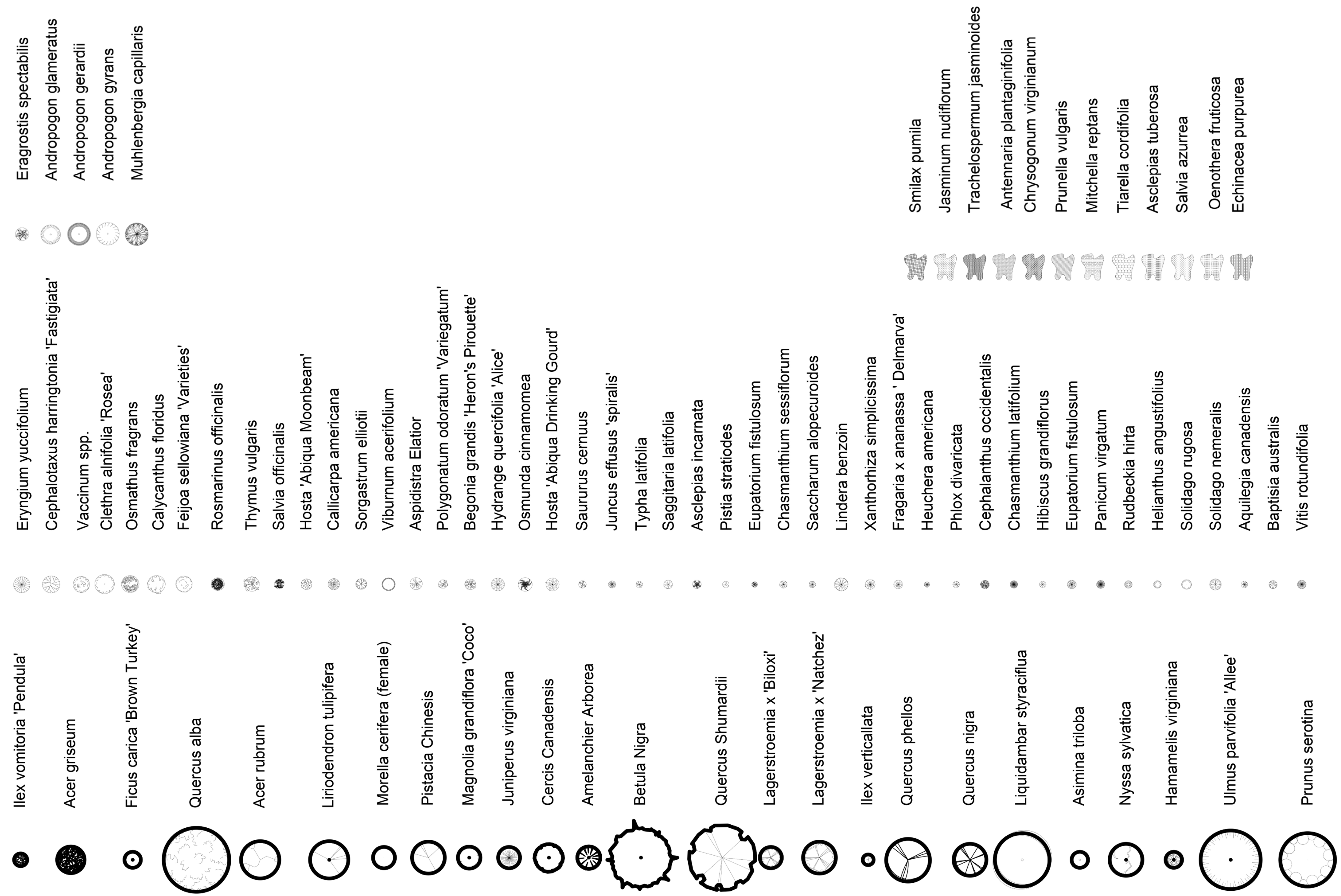
32 16 0 16 32 64 FEET
8 24 48

North

Appendix O - New Barnett Shoals Elementary School Final Grading Plan



Appendix P - New Barnett Shoals Elementary School Planting Landscape Symbols



Appendix Q - New Barnett Shoals Elementary School Preliminary Construction Cost Estimate

Material/Task	Quantity	Unit	Material Cost	Total Cost Incl Labor	Total Cost
PLANTS					
Cercis Canadensis, 6' to 8'	12.00	Ea	$ 152.00	$ 152.00	$ 1,824.00
Arborea Arborea, 15 Gal	15.00	Ea	$ 65.00	$ 65.00	$ 975.00
Betula Nigra, 1.5" to 2" Caliper	5.00	Ea	$ 100.00	$ 100.00	$ 500.00
Muscadine 'Triumph', 20' Apart	3.00	Ea	$ 10.00	$ 10.00	$ 30.00
Quercus alba, 7' to 8'	2.00	Ea	$ 74.95	$ 74.95	$ 149.90
Osmanthus Fragrans, 15 gal	3.00	Ea	$ 55.00	$ 55.00	$ 165.00
Clethra arnifolia rosalis	9.00	Ea	$ 26.50	$ 26.50	$ 238.50
Juniperus Virginiana, 5' to 6'	12.00	Ea	$ 85.00	$ 85.00	$ 1,020.00
Liriodendron tulipifera , 15 gal	13.00	Ea	$ 58.00	$ 58.00	$ 754.00
Fragaria x ananassa ' Delmarva', Plant	450.00	Ea	$ 17.95	$ 17.95	$ 8,077.50
Vaccinum virgatum 'Vernon', 8" to 12"	150.00	Ea	$ 1.10	$ 1.10	$ 165.00
Feijoa sellowiana 'Coolidge', 'Apollo', and 'Mammoth'	21.00	Ea	$ 17.00	$ 17.00	$ 357.00
Lagerstroemia x 'Natchez', 2" Caliper	6.00	Ea	$ 115.00	$ 115.00	$ 690.00

Lagerstroemia x 'Biloxi', 5' to 6'	1.00	Ea	$ 39.95	$ 39.95	$ 39.95
Magnolia grandifloria 'Coco', 2' to 3'	3.00	Ea	$ 29.95	$ 29.95	$ 89.85
Magnolia grandifloria 'Coco', 7' to 8'	3.00	Ea	$ 129.95	$ 129.95	$ 389.85
Pistacia chinensis, 6' to 8'	2.00	Ea	$ 79.95	$ 79.95	$ 159.90
Ilex vomitoria 'pendula', 5' to 6'	2.00	Ea	$ 89.95	$ 89.95	$ 179.90
Morella cerifera, 6'	12.00	Ea	$ 85.00	$ 85.00	$ 1,020.00
Asimina triloba, 7' to 8'	9.00	Ea	$ 79.95	$ 79.95	$ 719.55
Jasminum nudiflorum, 1 gal @ 5' O.C.	96.00	Ea	$ 8.65	$ 8.65	$ 830.40
Trachelospermum jasminoides, 7 Gal @ 4' O.C.	103.00	Ea	$ 15.00	$ 15.00	$ 1,545.00
Acer rubrum, 25 Gal	1.00	Ea	$ 85.00	$ 85.00	$ 85.00
Ilex vomitoria, 5' to 6'	1.00	Ea	$ 64.95	$ 64.95	$ 64.95
Quercus shumardii, 7' to 8'	16.00	Ea	$ 74.95	$ 74.95	$ 1,199.20
Ficus carica 'Brown Turkey', 1" Caliper, Instant Fruiting	9.00	Ea	$ 49.95	$ 49.95	$ 449.55
Callicarpa americana, 7 gal	22.00	Ea	$ 45.00	$ 45.00	$ 990.00

Viburnum acerifolium, 3' to 4'	3.00	Ea	$ 33.00	$ 33.00	$ 99.00
Aspidistra elatior, 5 gal	10.00	Ea	$ 18.00	$ 18.00	$ 180.00
Polygonatum odoratum 'Variegatum', 3.5" Pot	4.00	Ea	$ 16.00	$ 16.00	$ 64.00
Begonia grandis 'Heron's Pirouette', 3.5" Pot	8.00	Ea	$ 16.00	$ 16.00	$ 128.00
Hydrangea quercifolia 'Alice', Trade gal	17.00	Ea	$ 26.95	$ 26.95	$ 458.15
Osmunda cinnamomea, 1 Quart	6.00	Ea	$ 8.00	$ 8.00	$ 48.00
Hosta 'Abiqua Moonbeam', 4.5" Pot	5.00	Ea	$ 10.95	$ 10.95	$ 54.75
Hosta 'Gentle Giant', 4.5" Pot	3.00	Ea	$ 19.95	$ 19.95	$ 59.85
Asclepias incarnata, 2" Plugs	67.00	Ea	$ 1.48	$ 1.48	$ 99.16
Eupatorium fistulosum	77.00	Ea	$ 1.12	$ 1.12	$ 86.24
Ilex verticallata, 4' to 5'	10.00	Ea	$ 49.95	$ 49.95	$ 499.50
Andropogon glameratus, Plugs @ 2' O.C.	381.00	Ea	$ 1.10	$ 1.10	$ 419.10
Andropogon gerardii, Plugs @ 2' O.C.	381.00	Ea	$ 1.10	$ 1.10	$ 419.10
Andropogon gyrans, Plugs @ 2' O.C.	381.00	Ea	$ 1.10	$ 1.10	$ 419.10

Chasmanthium latifolium, Plants from State Botanical Gardens of Georgia	92.00	Ea	$ 7.00	$ 7.00	$ 644.00
Chasmanthium sessiflorum, Plants from State Botanical Gardens of Georgia	158.00	Ea	$ 7.00	$ 7.00	$ 1,106.00
Panicum virgatum, Plugs @ 2' O.C.	381.00	Ea	$ 1.10	$ 1.10	$ 419.10
Panicum virgatum, Plants from State Botanical Gardens of Georgia	72.00	Ea	$ 7.00	$ 7.00	$ 504.00
Saccharum alopecuroides, Plants from State Botanical Gardens of Georgia	137.00	Ea	$ 7.00	$ 7.00	$ 959.00
Sorgastrum elliotii, Plugs @ 2' O.C.	381.00	Ea	$ 1.10	$ 1.10	$ 419.10
Antennaria plantaginifolia, Plugs @ 2' O.C.	1125.00	Ea	$ 1.10	$ 1.10	$ 1,237.50
Asclepias incarnata, Plants from State Botanical Gardens of Georgia	104.00	Ea	$ 7.00	$ 7.00	$ 728.00
Phlox paniculata, Plugs @ 1' O.C.	212.00	Ea	$ 1.10	$ 1.10	$ 233.20
Liatris spicata, Plugs @ 1' O.C.	212.00	Ea	$ 1.10	$ 1.10	$ 233.20
Asclepias tuberosa, Plugs @ 2' O.C.	722.00	Ea	$ 1.10	$ 1.10	$ 794.20
Baptisia australis, Plants from State Botanical Gardens of Georgia	137.00	Ea	$ 7.00	$ 7.00	$ 959.00
Chrysogonum virginianum, Plugs @ 3' O.C.	1359.00	Ea	$ 1.10	$ 1.10	$ 1,494.90
Echinacea purpurea, Plugs @ 2' O.C.	305.00	Ea	$ 1.10	$ 1.10	$ 335.50

Eryngium yuccifolium, Plants from State Botanical Gardens of Georgia	121.00	Ea	$ 7.00	$ 7.00	$ 847.00
Helianthus angustifolius, Plants from State Botanical Gardens of Georgia	25.00	Ea	$ 7.00	$ 7.00	$ 175.00
Hibiscus moscheutos, Plants from State Botanical Gardens of Georgia	100.00	Ea	$ 7.00	$ 7.00	$ 700.00
Monarda punctata, Plugs @ 2' O.C.	212.00	Ea	$ 1.10	$ 1.10	$ 233.20
Oenothera fruticosa, Plugs @ 3' O.C.	148.00	Ea	$ 1.10	$ 1.10	$ 162.80
Prunella vulgaris, Plugs @ 2' O.C.	634.00	Ea	$ 1.10	$ 1.10	$ 697.40
Rudbeckia laciniata, Plugs @ 2' O.C.	212.00	Ea	$ 1.10	$ 1.10	$ 233.20
Rudbeckia hirta, Plants from State Botanical Gardens of Georgia	81.00	Ea	$ 7.00	$ 7.00	$ 567.00
Solidago rugosa, Plants from State Botanical Gardens of Georgia	102.00	Ea	$ 7.00	$ 7.00	$ 714.00
Solidago nemeralis, Plants from State Botanical Gardens of Georgia	75.00	Ea	$ 7.00	$ 7.00	$ 525.00
Solidago nemeralis, Plugs @ 2' O.C.	212.00	Ea	$ 1.10	$ 1.10	$ 233.20
Asclepias syriaca, Plugs @ 1' O.C.	212.00	Ea	$ 1.10	$ 1.10	$ 233.20
Aquilegia canadensis, Plugs @ 1' O.C.	212.00	Ea	$ 1.10	$ 1.10	$ 233.20
Aquilegia canadensis, Plants from State Botanical Gardens of Georgia	216.00	Ea	$ 7.00	$ 7.00	$ 1,512.00

Heuchera americana, Plants from State Botanical Gardens of Georgia	57.00	Ea	$ 7.00	$ 7.00	$ 399.00
Hibiscus grandiflorus, Plants from State Botanical Gardens of Georgia	53.00	Ea	$ 7.00	$ 7.00	$ 371.00
Mitchella repens, Plugs @ 1' O.C.	1000.00	Ea	$ 1.10	$ 1.10	$ 1,100.00
Phlox divaricata, Plants from State Botanical Gardens of Georgia	172.00	Ea	$ 7.00	$ 7.00	$ 1,204.00
Salvia azurrea, Plugs @ 2' O.C.	664.00	Ea	$ 1.10	$ 1.10	$ 730.40
Tiarella cordifolia, Plugs @ 2' O.C.	316.00	Ea	$ 1.15	$ 1.15	$ 363.40
Xanthorhiza simplicissima, Plugs	402.00	Ea	$ 1.10	$ 1.10	$ 442.20
Quercus phellos, 7' to 8'	1.00	Ea	$ 74.95	$ 74.95	$ 74.95
Quercus nigra, 7' to 8'	2.00	Ea	$ 74.95	$ 74.95	$ 149.90
Liquidambar styraciflua, 2" Caliper	1.00	Ea	$ 160.00	$ 160.00	$ 160.00
Cephalanthus occidentalis, 5' to 6'	49.00	Ea	$ 12.50	$ 12.50	$ 612.50
Lindera benzoin, Quick Grow Pot	35.00	Ea	$ 14.95	$ 14.95	$ 523.25
Calycanthus floridus, Plants	52.00	Ea	$ 23.00	$ 23.00	$ 1,196.00
Nyssa sylvatica, 5' to 6'	2.00	Ea	$ 79.75	$ 79.75	$ 159.50

Hamamelis virginiana, 4' to 5'	4.00	Ea	$ 43.50	$ 43.50	$ 174.00
Vitis rotundifolia, 3 Year Old (Fruiting Size)	20.00	Ea	$ 16.00	$ 16.00	$ 320.00
Cephalotaxus harringtonia 'Fastigiata', Plant	42.00	Ea	$ 29.99	$ 29.99	$ 1,259.58
Ulmus parvifolia 'Allee'	1.00	Ea	$ 99.95	$ 99.95	$ 99.95
Prunus serotina, 2" Caliper	3.00	Ea	$ 199.00	$ 199.00	$ 597.00
Acer griseum, 2" Caliper	1.00	Ea	$ 310.00	$ 310.00	$ 310.00
Plant Total					$ 53,122.48
HARDSCAPE					
Roads, Crushed 3/4" Stone Base, Compacted, 3" Deep	3899.99	S.Y.	$ 2.76	$ 3.89	$ 15,170.97
Concrete, Cast-in-Place 4000 psi, 4" Slab	1268.00	S.F.	$ 1.39	$ 3.16	$ 4,006.88
Engineered Wood Fiber, 9" Depth, Playground Surfacing	7866.00	S.F.	$ 2.00	$ 2.00	$ 15,732.00
Severe Weather Pressure Treated Landscape Timber (Actual: 2.75-in x 4-in x 8-ft), Trail Edging	669.63	Ea	$ 3.17	$ 3.50	$ 2,343.69
Sand Pit, Sand, 6" Deep	49.61	C.Y.	$ 72.00	$ 72.00	$ 3,572.00
Hardscape Total					$ 40,825.53

PLAYGROUND EQUIPMENT					
Laguna Treehouse, Pre-K to Kindergarten	1.00	Ea	$ 2,000.00	$ 2,200.00	$ 2,200.00
The Reserve II w/Green Vinyl Canopy, Early Childhood to Middle Aged Children	1.00	Ea	$ 3,599.00	$ 3,800.00	$ 3,800.00
Primary Bipod Swing Set - 10', 4 Bay, 8 Seats	1.00	Ea	$ 1,981.00	$ 2,100.00	$ 2,100.00
Treated Pine Fence Universal Post for Agility Poles, 8' Tall, 3.5" Radius, Fitness Play	8.00	Ea	$ 6.99	$ 7.50	$ 60.00
Pressure Treated Pine Lumber for Balance Beam, 8' Tall, 4x4, Fitness Play	7.00	Ea	$ 8.97	$ 9.50	$ 66.50
Vault Bar, Fitness Play	1.00	Ea	$ 294.00	$ 245.00	$ 245.00
Parallel Bar, Fitness Play	1.00	Ea	$ 237.00	$ 300.00	$ 300.00
Stall Bar Fence, Fitness Play	1.00	Ea	$ 539.00	$ 559.00	$ 559.00
Rope Climb, Fitness Play	1.00	Ea	$ 635.00	$ 655.00	$ 655.00
Boarding Net, Fitness Play	1.00	Ea	$ 649.00	$ 669.00	$ 669.00
Pull Slide, Fitness Play	1.00	Ea	$ 686.00	$ 706.00	$ 706.00
Horizontal Ladder, Fitness Play	1.00	Ea	$ 714.00	$ 734.00	$ 734.00
Freestanding Log Roll, Fitness Play	1.00	Ea	$ 767.00	$ 787.00	$ 787.00

Triple Horizontal Bar, Fitness Play	1.00	Ea	$ 395.00	$ 415.00	$ 415.00
Embankment Slide With Sit Down Bar, 7'	1.00	Ea	$ 2,618.95	$ 2,850.00	$ 2,850.00
Playground Equipment Total					$ 16,146.50
SITE FEATURES					
1' Birch Log	299.50	Ea.	$ 11.29	$ 11.50	$ 3,444.25
Tree Stumps	10.00	Ea.	$ 100.00	$ 100.00	$ 1,000.00
Small Hay Bale	20.00	Ea.	$ 3.50	$ 3.50	$ 70.00
Site Features Total					$ 4,514.25
MISCELLANEOUS					
Poly-Mart 1500 Gallon Rain Harvesting Tank, Above Ground, D-93" H-63"	1.00	Ea	$ 729.95	$ 1,000.00	$ 1,000.00
Treated Timber Retaining Wall, 6" x 6"	560.00	L.F.	$ 2.00	$ 3.11	$ 1,741.60
Drilling Holes in Timber for Fastening, 1/2", Timber Retaining Wall	560.00	L.F.		$ 0.82	$ 459.20
Reinforcing Rods fopr Fastening, 1/2", Timber Retaining Wall	560.00	L.F.	$ 0.37	$ 1.31	$ 733.60
Gravel Backfill, Timber Retaining Wall	32.00	C.Y.	$ 19.90	$ 40.90	$ 1,308.80

75,000-100,000 S.F., Rough Grading	1.00	Ea.		$ 5,050.00	$ 5,050.00
6" - 12" Rip Rap, Swale Boulder	90.15	C.Y.	$ 22.00	$ 23.00	$ 2,073.41
Mossback Flagstone Boulders	10.00	Ton	$ 310.00	$ 325.00	$ 3,250.00
Flat Fieldstone Boulders, Boulder Amphitheater	70.00	Ton	$ 210.00	$ 225.00	$ 15,750.00
Pedestal Birdbath	2.00	Ea.	$ 22.54	$ 25.00	$ 50.00
Raised Garden Planting Bed, 24" Raised, 4' x 12'	42.00	Ea	$ 50.00	$ 55.00	$ 2,310.00
Miscellaneous Total					$ 33,726.61
MULCH					
Pine Straw, 1" Deep, Hand Spread	53211.00	S.F.	$ 0.10	$ 0.25	$ 13,302.75
GRAND TOTAL					**$ 161,638.12**

[i] California Department of Education, Colorado Department of Education, Florida Office of Environmental Education, Iowa Department of Education, Kentucky Environmental Education Council, Maryland State Department of Education, Minnesota Department of Families, Children, and Learning, Minnesota GreenPrint Council, New Jersey Department of Education, Ohio Department of Education, Pennsylvania Department of Education, Texas Education Agency, and Washington Office of the Superintendent of Public Instruction.