Turning a New Leaf

Resolving Growing Issues
at Taylor Street School

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I would like to first thank my parents for letting me do my homework in the backyard carob tree. The time I spent outside as a kid has definitely influenced how I spend it today.

To my committee, I am grateful for the guidance and advice that helped shape this project.

I would also like to thank the students at Taylor Street School for their help as well as their company. They genuinely inspired me throughout this experience.

I am also grateful to my family and friends who always support me...and put up with me.

Quercus lobata...
and a Naz Pouya

One generation plants the trees; another gets the shade.

Chinese Proverb

When one generation cuts them down, what is the other left with? For many children today, childhood no longer includes experiences exploring nearby forests, farms, empty lots, and even backyards- places that created lasting childhood memories just a generation ago. Children possess an inherent affinity for the natural world; however, when faced with a number of factors that prevent interaction with such environments, this natural bond may never form. With decreasing opportunities for children to experience nature in their daily lives, schoolyards are valuable but underutilized resources for maintaining vital frequent contact with the environment. By improving schoolyards parents, teachers, and community members can provide experiences with nature that would otherwise be absent in children's lives. As the proverb suggests, one generation's efforts beget the next generation's sense of happiness, wellbeing, and wonder.

This project explores the relationship between children and natural environments, the growing distance between them, and ways to reunite children and nature. Demonstrating with Taylor Street School in Sacramento, California, this paper illustrates how schools can benefit by enhancing the schoolyard and thereby enhancing children's lives. By transforming an unused portion of their field, Taylor Street School's new nature area presents unique educational opportunities as well as greater aesthetic value and wildlife habitat. Integrating the area into class activities will foster a crucial connection between the students and the natural environment while promoting a greater appreciation of the natural world.

The Need for Nature

"One must ask children and birds how cherries and strawberries taste" writes German playwright and poet Johann Wolfgang von Goethe, alluding to the unique bond shared by children and nature. Studies by Peter H. Kahn, Jr., a University of Washington psychology professor, reveal that "bugs, pets, plants, trees, wind, rain, soil, [and] sunshine" present cross-cultural universal appeal among children (Tai, Haque, McLellan, and Knight, 2006, p.11). Kahn's studies distinguish "a similarity to the structure of children's affiliations with nature across cultures and regardless of children's exposure to unblemished natural environments" (Tai, Haque, McLellan, and Knight, 2006, p.11). In other words, children are innately attracted to natural elements (Figure 1), though for reasons not yet fully understood by science. Environmental psychology professor Louise Chawla theorizes that during Middle Childhood (ages six to twelve), children are "genetically programmed" to explore, understand, and connect with nature since, as hunter-gatherers, they would have been learning survival skills at this stage in their lives (Tai, Haque, McLellan, and Knight, 2006, p.1). Children may be especially predisposed to exploring nature, but humans of any age also find it appealing.

According to Edward O. Wilson of Harvard University, people are inherently drawn to natural forms. While just a theory, biophilia or in Wilson's words, "the urge to affiliate with other forms of life," is corroborated, according to Louv (2008) "by decades of research that reveals how strongly and positively people respond to open, grassy landscapes, scattered strands of trees, meadows, water, winding trails, and elevated views" (Louv 43). However, these elements make less of an impact on adults with limited childhood exposure to nature. In fact, most adults who do feel an attachment to nature attribute their fondness to childhood experiences (Tai, Haque, McLellan, and Knight, 2006, p.2). Thus

Figure 1. "Look- pinecones!"
-student at Taylor Street School

childhood is a critical time to establish a lifetime bond with nature, ensuring lasting delight, appreciation and respect.

Effects

Children cannot be deprived of the natural experiences they seek, especially in light of the numerous and undeniable positive effects of nature. Tai, Haque, McLellan, and Knight (2006) write:

> Researchers have drawn impressive correlations between direct contact with nature during childhood and all aspects of development: mental, physical, and emotional. The richness of nature in childhood even seems to impact and shape values that form life-long behavioral patterns. (p.10)

Mounting research shows that artificial stimuli (even educational computer games) simply do not produce the same effects (Louv, 2008, p.66). Therefore, appropriate resources must be provided to guarantee children healthy development.

Cognitive development in children is significantly enhanced by experiences in nature, according to researcher and horticulturist Charles Lewis. He states that nature stirs "innate responses to environmental stimuli [which] provoke unforgettable cognitive imprints" (Tai, Haque, McLellan, and Knight, 2006, p.12). Molly Dannenmaier reports that dynamic natural environments increase the number and complexity of neural

connections in the brain, thereby raising levels of intelligence in children (Tai, Haque, McLellan, and Knight, 2006, p.12). Nature stimulates every sense: sight, smell, sound, taste and touch. As professor of landscape architecture Robin Moore writes, that "children live through their senses" which makes nature an ideal educational environment (Louv, 2008, p.66). Clearly nature is an underutilized but indispensable tool for fostering learning.

Along with cognition, nature also positively influences mental health. People have known of nature's powerful restorative qualities for hundreds of years and are now backed by hundreds of studies. Louv (2008) proposes that nature can combat "some of the everyday pressures that may lead to childhood depression" (p.50). Moreover, summarizing the findings of numerous studies, Louv (2008) states that "nature can even be a powerful form of therapy for attention-deficit disorders and other maladies" (p.3). In fact, after interviewing parents of children with Attention Deficit Hyperactivity Disorder (ADHD), Louv (2008) also found that "even without corroborating evidence or institutional help, many parents notice significant changes in their children's stress levels and hyperactivity when they spent time outside" (p.102). As today's children face numerous stressors, like academic pressures and limited autonomy, nature can provide effective therapy.

With rising obesity rates, physical health is now a prevalent issue across the U.S. as well as among school age children; fortunately, it too can be remedied with nature. Tai, Haque, McLellan, and Knight (2006) report that among children ages 6 to 19, 15 percent are obese or at least overweight (p.12). Fewer children spend substantial time outside due in part to "the allure of technological entertainment indoors" (Tai, Haque, McLellan, and Knight, 2006, p.14). In fact, Orr (2002) reports that while children in 1981 spent an average of 86 minutes outside each day, by 1997 this number had dropped to 42 minutes. However, providing access to natural environments can reverse the sedentary lifestyles contributing to childhood obesity by inspiring an appreciation of the outdoors. With the numerous benefits nature can provide children, children must be provided with nature.

Figure 2. One of the many bugs I was presented while working with the students.

Obstacles between Children and Nature

The notion of children's decreasing interaction with nature is widely accepted across various disciplines such as environmental psychology, child development, and landscape architecture, after numerous studies. The subject is also accepted as a matter of serious concern. In fact, author Richard Louv (2008), recognizing the epidemic, named the condition "nature-deficit disorder" to convey the gravity of this issue (p.10). Children spend less time in nature and therefore suffer through what naturalist Robert Michael Pyle refers to as "the extinction of experience," as shopping malls and parking lots rob children of natural spaces and the unique experiences they offer (Tai, Haque, McLellan, and Knight, 2006, p.17). Mark Francis (1995), professor of landscape architecture at the University of California, Davis, asserts that children today experience the "Childhood of Imprisonment" due to the restricted, supervised quality that now characterizes childhood (p.9). The negative connotations of these phrases accurately reflect the negative effects of nature deprivation, in an attempt to raise awareness of this widespread issue (Tai, Haque, McLellan, and Knight,2006, p.17).

Cities

Several factors contribute to children's increasingly infrequent exposure to nature; Tai, Haque, McLellan, and Knight (2006) assert that the main factor is simply growing up in an urban or suburban setting where accessibility limits opportunity (p.2). Unfortunately for many children, the majority of Americans reside in cities and suburbs. The U.S. Census 2000 found that 79% of Americans live in urban areas, 58% of which live in areas with populations of over 200,000 (Federal Highway Administration, 2000). City populations are expected to

continue increasing; thus opportunities to create or even preserve open, natural places will continue decreasing since undeveloped spaces are often valued for their development potential.

As populations increase in urban areas, density limits opportunities for children. Apartment buildings grow taller and closer together, while offering little open space for its residents, let alone any natural areas for children to explore. Developers build homes right up to lot lines to accommodate the demand for housing (as well as for the profit), virtually obliterating the backyard. Stine (1997) finds that "backyards and gardens adjacent to a child's home setting evoke strong images, memories we carry with us that influence our attitudes toward outside environments" but fewer children today share this experience (p.190).

Children in the suburbs find nature less accessible as well. The backyard has also disappeared in suburban areas, as more value is placed on building square footage with every new McMansion. According to Orr (2002), the United States loses one million acres each year to suburban sprawl and infrastructure development. Obviously sprawl generates detrimental environmental effects as it destroys undeveloped land and the ecosystems it supports, but it also further alienates children from nature merely by its design. Suburbia is typically designed for cars, not pedestrians and bicycle riders (Thompson, 2008, p.23). Distance often eliminates the option for children to travel without cars to school, to parks, and to friends' houses, discovering nature along the way. The availability of natural space is rapidly declining, as are opportunities for children to experience it.

Recognizing the need for abundant open space, increasing numbers of U.S. cities are in fact working to provide more; however, the quality of these parks is questionable. Louv (2005) asserts that "playgrounds and parks... have become increasingly domesticated, flat, lawyered, and boring (p.248). Perhaps boredom is why a student spent all of recess piling bark along the playground border at the 1st- 3rd grade yard at Taylor Street School (Figure 3). Tai, Haque, McLellan, and Knight (2006) argue that "issues of safety and liability cannot overshadow the various desires and needs of the child" and instead both requirements should be considered (p.16). However, as long as laws enable parents to sue after their child climbs a tree and falls, parks will continue as the stereotypical expanse of grass, spotted with a few trees and the obligatory playground structure. The fear of liability is what primarily guides park design today, not the opportunity to connect children with nature.

Safety

The "Childhood of Imprisonment," (Figure 4) as described by Francis (1995), is a major impediment between children and the natural world (p.9). Francis

Figure 3. Theory of Loose Parts, anyone?

states, "as childhood has become more restricted, opportunities for interaction with nature and natural experience are even more critical" (p.9). Yet fears of child predators, gang violence, traffic accidents and other potential dangers continue to prevent children from exploring their surroundings. Louv (2008) suggests that "fear is the most potent force that prevents parents from allowing their children the freedom they themselves enjoyed when they were young" (p.123). To an extent, these fears are warranted, but the solution to secure safety cannot be locking children indoors and consequently denying them essential experiences in nature.

Presently, few children walk to school, although "walks to and from school were once a time to explore water moving along a gutter, to take a shortcut past a favorite tree, or to discover a place to create a new secret hideaway" (Stine, 1997, 192). Distance is a factor as mentioned, but so are safety risks like traffic and crime. According to Thompson (2008), 15 percent of children walk or bike to school, 60 percent go by car, and 25 percent go by bus (p.23). After interviews with 25 students at Taylor Street School, I found that 12 percent

Figure 4. "The Childhood of Imprisonment"

walk and 8 percent bike to school compared to 48 percent who are driven and 32 percent who are bussed (Appendix A). Sadly children's observations of nature are often reduced to passing blurs through car windows.

Electronics

To keep their children occupied indoors, parents often provide television, video or computer games, and the internet. When asked about their favorite after school activity, 14 of the 25 students I surveyed at Taylor Street School responded with an outdoor activity and 10 replied indoor activities with electronics (Appendix A). Studies conducted by the Centers for Disease Control (CDC) found that in the U.S., six- to eleven-year-olds spend an average of 30 hours every week in front of a television or computer screen (Louv, 2008, p.47). Researchers from the Kaiser Family Foundation call today's children Generation M because of their tendency to multitask and use more than one electronic medium at one time (Louv, 2008, p.119). However educational a television program or computer game claims to be, it does not effectively replace what children can learn first-hand about nature (Louv, 2008, p. 66). There is a clear disconnect from nature when children learn about their world from a screen, discouraged from exploring and experiencing it for themselves.

Some parents rely on electronics to safely entertain their children indoors, while others turn to after school activities like homework centers, clubs, and organized sports. According to Louv (2008), parents often tend to over-schedule their children's week, leaving little opportunity for free time after homework, music lessons, and sports practices (pp.119-120). While these activities certainly have benefits, Casey (2007) suggests that planned programs benefit parents more than children, since children need time to "fall back on their own resources" (pp.6-7). Many organized sports can provide supervised time outside, but standing in a manicured soccer field hardly facilitates interaction with nature.

With the numerous obstructions hindering children's relationship with nature, it is more important than ever to provide children with ample opportunities to develop connections with their surroundings. According to Tai, Haque, McLellan, and Knight (2006), "childhood is a time for discovery, and for many children the most wonderful, powerful, life-changing discoveries they will ever make lie hidden in nature" (p.1). With this in mind, adults need to do their own exploring- to discover solutions to reconnect children and nature.

The Schoolyard as a Resource

While some school sites can easily be mistaken for correctional facilities, schools weren't always dominated by asphalt and chain link fences. In fact, the idea to bring nature to schoolyards emerged during Europe's Industrial Revolution, when urban children were also severely deprived of natural environments (Tai, Haque, McLellan, and Knight, 2006, p.5). In 1837, recognizing industrialization's negative effects on children, Friedrich Froebel opened the first kindergarten (or "garden of children"). It was Froebel's belief that school grounds should "mimic the country life of which most children were deprived" (Tai, Haque, McLellan, and Knight, 2006, p.6). Froebel's kindergarten served as a model for schoolyards for some time, but "early ideals of mimicking nature were abandoned" during the twentieth century (Tai, Haque, McLellan, and Knight, 2006, p.8). Moore (1995) confirms this as "gardening went out of fashion and was replaced by asphalt- most likely as part of a post- WWII neat-and-tidy engineering approach to school environments" still evident in today's schools (p.224).

According to Louv (2008), what eventually became known as the school habitat movement began during the 1970s. Tai, Haque, McLellan, and Knight report that during this time, several "progressive schools" began designing nature into their schoolyards (p.9). In actuality, they were simply returning schoolyards to Froebel's original vision. Nevertheless, the school habitat movement continues today with increased awareness and support.

Advantages

Although schoolyards offer ideal opportunities for interaction with nature, until recently they have rarely

been designed to do so. Stine (1997) states that "school grounds are the primary environments that provide children a chance to be connected to an outdoor environment on a regular basis" (p.194). Children spend five days a week at their schools and are therefore in a position to experience the delight of seeing growth and changes in nature over seasons and even years. Stine (1997) also points out that "all children have access to school grounds regardless of the particular circumstances that may affect their lifestyle" (Stine, 194). In the case of Taylor Street School, 79.8 percent of the students are socioeconomically disadvantaged according to the 2005-2006 School Accountability Report Card (2007, p.1) which may limit access to natural spaces. With schoolyard habitat, nature is available to students regardless of their family's economic status, making school grounds a potentially useful resource in ensuring essential opportunities to all students.

Use of schoolyard natural areas can also reinforce lessons learned in the classroom. Children often learn about nature and other subjects through textbooks and videos rather than with primary experiences. Casey (2007) states:

> Many children's experience of nature is second-hand and on a scale that can be difficult to grasp... Children can watch fantastic images of creatures in far away environments, sea creatures in the deepest part of the ocean...and yet they may not know the fascination of watching ants crossing a doorstep or birds feeding outside their window." (p.9)

Learning with the environment just outside the classroom enables children to relate the lessons about disappearing rainforests to their own more familiar worlds. Children who can recognize their own surroundings as an ecosystem are much more likely to value it as such.

The introduction of environment-based learning (learning with nature, in nature), consistently improves academic performance. According to a study conducted by the State Education and Environmental Roundtable, "environment-based education produces student gains in social studies, science, language arts, and math; improves standardized test scores and grade-point averages; develops skills in problem-solving, critical thinking, and decision-making" (Louv, 2008, p.206). In addition, attendance and behavior significantly improves as well (Louv, 2008, p.208). Likely due to a combination of the aforementioned effects of nature (improved physical health, mental health, and cognition), students undoubtedly excel with the integration of nature into schools.

Taylor Street Treasure Trove: Site Inventory and Analysis

Taylor Street School is an elementary school in Sacramento, California serving approximately 500 students from kindergarten to sixth grade with a variety of different needs. During the 2005-2006 school year, 79.8 percent of the students were socioeconomically disadvantaged, 17 percent were learning English, and 15 percent had disabilities (Taylor Street School, 2007, p.1).

In addition, Figure 5 illustrates the variety of ethnicities that make up the student population. The school is part of the Robla School District; Robla is "a derivative of the Spanish word 'roble' which means 'cluster of British Oak trees'" (Taylor Street School, 2007, p.1). This may actually be referring to the California native Valley Oak trees originally abundant throughout the Central Valley, as both species similarly have acorns and lobed leaves.

Figure 6 displays various features of the school grounds. The main building of the school was built during the 1950s and the additional permanent buildings were completed by 1994 (Arthur Estrada, Elaine DeMers, and Rita Johnson, Personal Communication, June 6, 2008). The Robla School District and the City of Sacramento have a joint-use contract; therefore the area is maintained by the city and is officially a park when school is not in session (Bill Hall, Personal Communication, April 25, 2008).

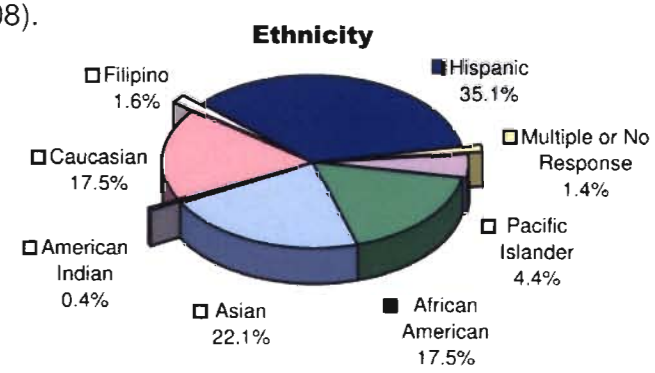

Figure 5. Taylor Street students (Taylor Street School, 2008, p.1)

Taylor Street School Sacramento, CA

School Map

A. School Sign	M. Utilities
B. Benches	N. Tree Wells
C. Hopscotch	O. Soccer Field
D. Picnic Tables	P. Irrigation Box
E. Playground	Q. Culvert
F. Tetherball	R. Gate to Benton Ave.
G. Dodgeball	S. Drainage Ditch
H. Four Square	T. Drain
I. Planter Boxes	U. Building Foundation
J. Track	V. Parking
K. Baseball Fields	W. Student Drop-Off
L. Basketball Courts	X. Bus Zone

- Asphalt Road/Parking Lot
- Asphalt Walkways/Play Areas
- Sidewalks
- Dirt/Weeds
- Buildings
- Overhangs/Covered Walkways
- Grass
- Drainage Ditch
- Existing Trees
- Fences

N

Map Scale

0' 50' 100' 200'

Figure 6

Context

Historically, the Sacramento region of the Central Valley was inhabited by the Nisenan (or Southern Maidu) Native Americans before the settlement of European Americans and their subsequent establishment of agriculture during the early 1800s (Matson, 1972, p.39). The discovery of gold in 1849 and the construction of the Transcontinental Railroad during the 1860s prompted significant growth and urbanization (City of Sacramento, 2008). As the capitol of California, the city of Sacramento now covers 97 square miles with a population of over 440,000 (U.S. Census Bureau, 2008).

The school site is northeast of Sacramento's downtown core and approximately six miles from the State Capitol (Figure 7). Taylor Street School is bordered by Bell Street and Taylor Street, to the east and west respectively (Figure 8). Across Taylor Street and along the school's southern border are single- family homes. To the northeast is a residence and to the southeast is a church. Benton Avenue separates the house and the church and dead ends before the school property. According to Bill Hall of the City of Sacramento, Benton Avenue used to run through the site to intersect Taylor Street. Benton was partially removed over 50 years ago and the school was built over it. (Personal Communication, April 25, 2008).

Across Bell Street is Robla Park, an eight acre park with an adjacent wetland area. While the landscaped portions of the park are accessible, the wetlands in Robla Park are not open to the public. Although close to the school, the park does not provide adequate interaction with nature for the students at Taylor Street School.

Figure 7. Sacramento, CA (Yahoo Maps, 2008)


Robla Park
Bell Avenue
Residential
Taylor Street School
Taylor Street
A and M Auto Dismantling
Empty Lot
Benton Ave
Church
Franesi Way
Naruth Way
Taylor Street School Sacramento, CA
Context Map
Project Site
School
Commercial
Residential
Other
N
Map Scale
0' 50' 100' 200'

Figure 8

Existing Conditions

I conducted the site inventory with the assistance of many students at Taylor Street School. Each Friday for a month teachers sent 2-4 students every hour to work with me while studying, measuring and surveying the site (Figure 10). In addition, many students spent their recess and lunch breaks observing and assisting me, eager to participate in the project.

Taylor Street School's new nature area will use approximately 1.25 acres of the southern field (Figure 8). A day care center was once located at the southwest corner of the project area; the building has been removed but the foundation remains. Between the building foundation and the fence is a 12 inch diameter culvert. Running along the east fence is a drainage ditch with a drain at the southeast corner. There is also a culvert where the drainage ditch moves from Benton Street onto the school site, enabling a path over the ditch and through a gate. Between the soccer field and the gate is the irrigation mainline and valves.

Figure 10. Students locating their position on an aerial photograph of Taylor Street School.

Topography, Hydrology, and Soil

Legend

- Asphalt Road/ Parking Lot
- Asphalt Walkways/ Play Areas
- Concrete
- Buildings
- Utilities
- Grass
- Saturated Areas
- Trees
- Water Flow
- Contours
- Culverts
- Soil Types

N

Map Scale

0′ 50′ 100′ 200′

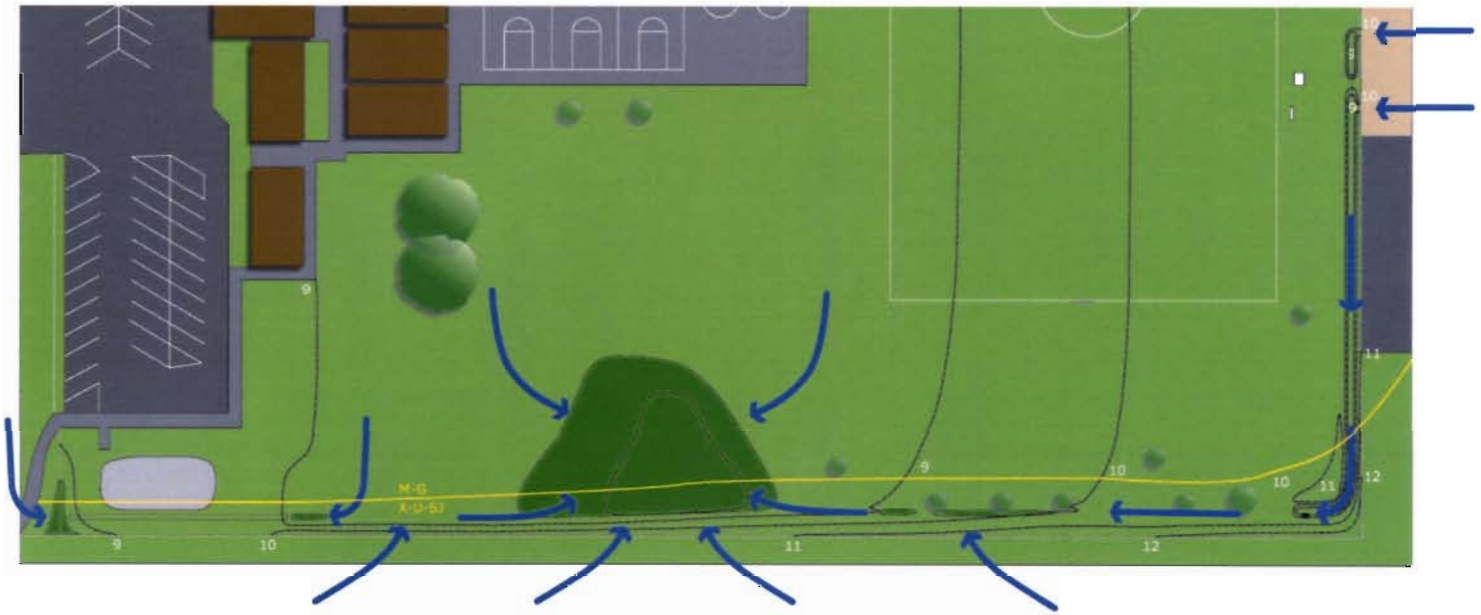

Figure 11

Soil

The majority of the school property contains Madera-Galt complex soil with zero to two percent slopes as shown in Figure 11. Along the south fence and southeast corner Xerarents- Urban land- San Joaquin complex soil is found with zero to five percent slopes. Both soil types are found on terrace landforms and are composed of "alluvium derived from granite," while neither soil type presents limitations (Natural Resource Conservation Service, 2008). Bill Hall also informed me that there are patches of asphalt under the grass, left over when Benton Street was removed and the school constructed (Personal Communication, April 25, 2008).

Topography

Using a transit, a measuring rod, and a few students, I surveyed the area after laying out a 50' grid with irrigation flags (Figure 12). I set the benchmark to an arbitrary number (10') and through interpolation I developed contour lines to represent relative elevations (Figure 11). Along the southern border the grade slopes downward into the field at about a 2:1 rate. There is also a slight depression, though not quite a drainage ditch. Along the east fence, however, there is a drainage ditch 2-3' deep with a slope of about 1:1. The rest of the site slopes gradually inward towards the middle.

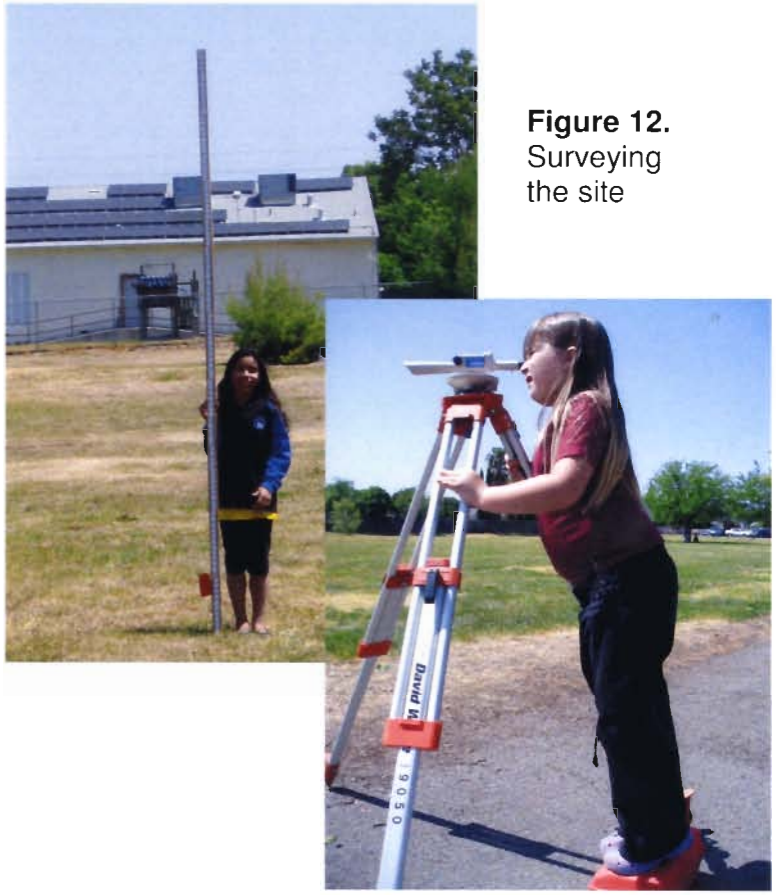

Figure 12. Surveying the site

Hydrology

The project area experiences seasonal flooding creating a wetland environment during the winter. Figure 13 compares the wetland area in March (looking east) to the same area in May. Runoff flows from the south properties as well as both sides of the field (Figure 11). It generally collects in the middle of the field, although it also pools in the depressions near the southeastern fence (Figure 14). Water also flows from two drainage ditches on either side of Benton Avenue into the school's east drainage ditch, then into a 2'-0" drainpipe. I was unable to determine which way water flows through the culvert on the southwest side. It is unclear if the design for this culvert was to use the school's field as a floodplain or collect the water if the field floods.

Figure 13. March (above) and May (left)

Figure 14. Pooling along the southeast fence

Figure 16 depicts the field's irrigation lines. I obtained the eastern half of the irrigation plans from the City of Sacramento Parks and Recreation Department, but I had no information for the western half. Fortunately, I was able to determine possible sprinkler locations from an aerial photograph (Figure 15). Several students and I created a map for the western half by confirming the locations of sprinklers shown on the aerial. Once we found two sprinkler heads in a row, I taught them how to measure with paces so we knew how many steps to walk to find another. I was able to locate an underground irrigation device on this side of the field because during one visit workers from the Parks and Recreation Department dug it up to make adjustments.

Figure 15. Sprinkler heads (Google Earth, 2008)

Existing Irrigation

Legend

- Asphalt Road/ Parking Lot
- Asphalt Walkways/ Play Areas
- Concrete
- Buildings
- Grass
- ?

- Sprinkler Heads
- Quick Coupler
- 4" Backflow Preventer
- Automatic Control Valve
- 6" Concrete Pipe
- Mainline
- Lateral

N

Map Scale

0' 50' 100' 200'

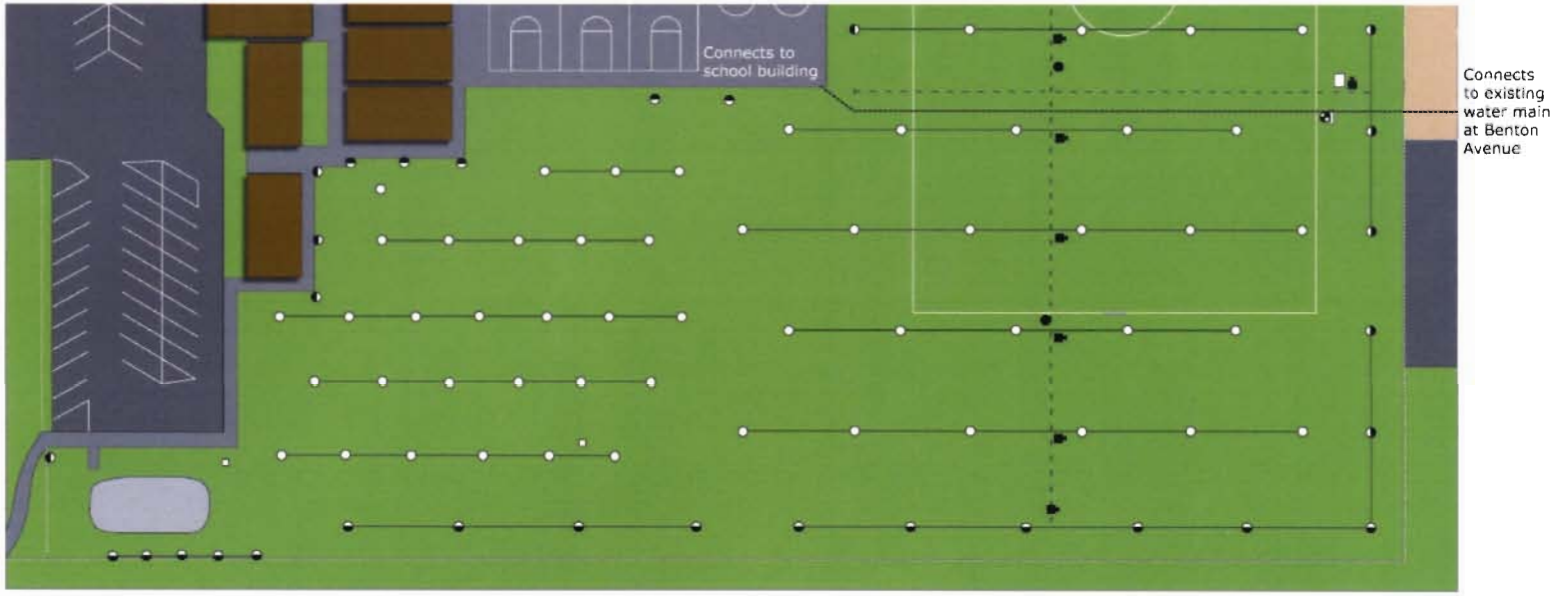

Figure 16

Existing Vegetation

Legend
- Asphalt Road/ Parking Lot
- Asphalt Walkways/ Play Areas
- Concrete
- Buildings
- Drainage Ditch
- Utilities
- Grass
- Trees

N

Map Scale
0′ 50′ 100′ 200′

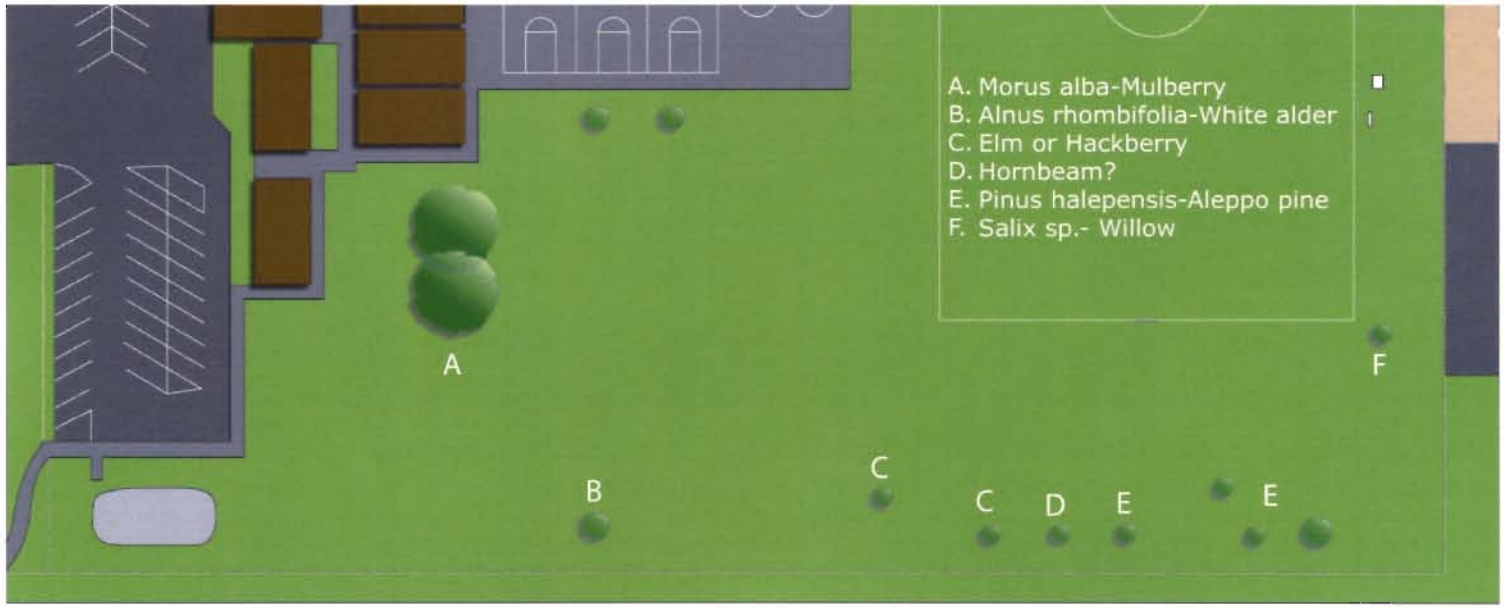

Figure 17

Figure 18. Purple needle grass?!

Vegetation

As shown in Figure 17, there is little existing vegetation apart from the grass and weeds. However, I may have found Purple Needle Grass (California's State Grass!) among the weeds (Figure 18). The white alder tree is also a California native (Figure 19) and the willow may be as well. Three of the trees to the southeast are non-native evergreen pines and the remaining are deciduous and also non-native. Several of the trees are in poor condition, either sick or leaning over.

Weeds

Numerous weed species dominate the field. The species I identified include dandelions, rabbitfootgrass, cheeseweed, burclover, and scarlet pimpernel, among others. Many types of weeds are poisonous to animals so initial weed control will be important if the area is to support wildlife.

Figure 19. White alder

Animals

Teachers at Taylor Street School reported seeing a variety of animals on the field. Birds include killdeer, kites, hawks, pheasants, egrets, crows, and sparrows. Frogs and snakes are occasionally found in the area as well as coyotes and foxes. Insects include dragonflies, ladybugs, bees, butterflies, crickets, and many others (Figure 20).

Pests

During my site visits I saw numerous domestic cats likely there for the birds (Figure 21). Also, because of the water saturation in areas of the field, mosquitoes are a potential problem. The Mosquito and Vector Control District currently monitors the site regularly.

Figure 20. The students bugging me again

Figure 21. On the prowl

User Needs

The teachers at Taylor Street School would like to use the site to enhance and increase learning opportunities. They have expressed a desire to create different habitats and control flooding while incorporating elements relevant to the curriculum. They would also like to use California native plants as well as those important to the Native Americans. They prefer not to have standing water year-round, as with a pond, due to the potential risk of mosquitoes. In addition, they would like to define the boundary of the nature area to clearly designate restricted areas for students on recess and lunch breaks.

Working with the students every week gave me a chance to hear their opinions and ideas. Appendix A lists the questions and responses of a survey of 25 students but to summarize, the students' favorite aspect of the schoolyard is the spaciousness while garbage is their least favorite. Shady areas are the students' favorite place to hang out and plants, shade, seating, and sports were among the items they thought were lacking. Suggestions for the nature area included (beginning with the most common responses): flowers, butterflies, plants, animals, big trees, pond, birds, bugs, benches, hills, ladybugs, a creek, and a science center.

In another survey (Appendix B), the students chose their favorite picture from four different landscape types (Figure 22). The results are listed below:

- Chaparral- 22%
- Riparian- 36%
- Wetland- 28%
- Oak savanna- 14%

I assumed the two pictures with water would be the most popular and they were, but the votes were more evenly distributed than I expected. The chaparral photograph contained dense and flowering plants, which may have been a factor in the number of votes it received. The riparian photo features a creek and many shady trees, which may be another indication of the students' desire for large shade trees.

Figure 22. Landscape Survey

Figure 23. Plant Survey

I also received input from the students as to which plants I should use for the nature area (Figure 23). I created a poster with photographs of various California natives and to help them choose, I indicated if they attracted wildlife or were drought tolerant (Appendix C). Their favorite plants were as follows:

- Large tree- cottonwood
- Small trees- coffeeberry/western redbud
- Shrub- California wild rose
- Vine- California blackberry
- Forbs- California poppy/California fuchsia

Not surprisingly, the most popular choices were plants with the most colorful flowers or berries.

Public use of the school grounds also needs to be taken into account since it is a city park. According to Bill Hall of the City of Sacramento "the Soccer People have big political influence" (Personal Communication, April 25, 2008). In addition, the field is used by the Little League, so the nature area cannot interfere with the soccer field or either of the baseball fields.

In addition, the design must consider the needs of the wildlife in order to attract them to the site. Animals have three basic requirements: water, food, and cover. In addition, wildlife benefits most when provided with diverse habitats (Tufts and Loewer, 1995, pp. 14-15).

Opportunities

After a thorough assessment of the site conditions and user needs, numerous opportunities exist for Taylor Street School. Already abundant with wildlife, the field can be enhanced to provide even more quality habitat and varied ecosystems (as well as aesthetic value). The seasonal wetland already creates a diverse environment, but this could improve with regrading and revegetating with native plants. California natives provide valuable habitat and food, require less maintenance and water, and live longer than many exotic species. The drainage ditch presents opportunities to create a riparian area and control erosion, also with regrading and revegetating. Native grass stands would thrive in the drier areas. In addition, chain link fences border much of the site and would easily support native vines, providing greenery and screening of neighboring properties.

Water and sun are both vital for most plants, both of which are already available on the site. The field's existing irrigation lines can be modified to support the new plantings, while in fact using less water than the turfgrass. Many native plants require full sun, which the field provides in abundance.

While plants may enjoy the sun, the students at Taylor Street School don't always feel the same, as I learned with the survey (Appendix A). Many of their suggestions included incorporating more shade trees. Shade is scarce on the school grounds and under one of the few trees is a favorite spot for many students (Figure 24). Many students also requested more plants in general. In addition, places to sit are also lacking as reported by the students; so along with plants and shade, seating could also be incorporated into the new nature area.

Figure 24. The cool place to hang out

The new nature area does not have to be exclusively for the students. The faculty and staff at the school would also benefit from the shade, seating, and nature the area could offer. The site could provide quiet places to sit as well as places to meet for the adults at the school.

The site also presents an alternative learning environment as yet another opportunity. As discussed in this paper, children and adults alike benefit from mere exposure to nature, but nature also has a unique influence on children and learning. Environment-based learning offers new insights and experiences, while improving students' academic performance in all subjects. By designing the site around the curriculum and by implementing lessons in math, science, social studies and language arts in the new nature area, students at Taylor Street School may share in the advantages associated with environment-based education.

Above all, the chance to reconnect children with nature is the most significant opportunity the site offers. As mentioned, many of the students belong to economically disadvantaged families with limited resources; therefore they would benefit greatly from regular exposure to nature, as contact may be infrequent at present. The site's potential along with the motivation and dedication of the teachers is evident, but most importantly, so is the excitement of the students. Working with the students as closely as I did only confirmed what my research suggests about children and nature. I've worked with children before and expected them to at least be curious about a college student poking around their field, but the students stayed interested. Many of the students even spent their lunch breaks helping and watching me work. I witnessed firsthand their heightened senses by just being outside and their excitement upon discovering things in or just about their environment. Nature nurtures, but it educates and excites as well; with some work, Taylor Street School can provide these essential experiences.

Constraints

Despite the many opportunities at the site, there are considerable constraints to address. Cost is arguably the most significant constraint. The realization of this project will rely on the availability of grants and donations and the commitment of volunteers. Resources like funding and labor are required for initial work such as site construction and earthmoving, as well as ongoing tasks like irrigation maintenance and weed control (which is a constraint by itself).

While water availability is an opportunity, it can also be considered a constraint. The new design will have to work with and around the existing underground irrigation pipes so that the field still receives water as well as the nature area. The site experiences seasonal flooding, so while this is essential for the wetland area, the rest of the site should be protected and usable during the wet season. Water flow and perhaps soil types also present limitations. The east drainage ditch shows evidence of erosion as it rounds the southeast corner. In addition, the soil may also be a constraint due to the possibility of patches of asphalt under the grass. These will have to be removed for regrading and planting.

Several factors create disturbances at the site. Both ends of the field are next to parking lots and the cars may create noise and distractions. The location of the soccer field may damage the vegetation and disturb wildlife if balls were to roll into the area. The new site may attract more birds, but this may also attract more domestic cats.

Surveillance is another constraint. During my site visits I have found empty bottles of alcohol (Figure 25), indicating that the field is likely being used at night. Even with little cover, the open field appears to be used by undesirables. Adding more vegetation will make surveillance of the area more difficult and vandalism, along with other illegal activities, may occur. Also, the school has experienced theft; on one occasion, mulch was stolen over night after it had been applied to various plantings on the grounds.

Figure 25. Beer bottle

Taylor Trail: The Design

The design for the new nature area, Taylor Trail, follows three sets of guidelines: designing for children, designing for schools, and designing for nature. Under each category is a list of goals, followed by the program elements for Taylor Trail that satisfy each requirement.

Design Goals

Designing for Children

1. Entice the five senses
   - Variety of plants for smell, touch, taste, sight, and sound
   - Wildlife for sight and sound

2. Provide small-detail interest
   - Natural artifacts (berries, flowers, leaves, and bark)
   - Insectary plants (bees and butterflies)

3. Provide spaces for retreat
   - Group- picnic tables, outdoor classrooms, clearings, observation deck
   - Individual- benches, clearings
   - Shade

4. Attract wildlife
   - Diverse habitats (wetland, grassland, riparian, compost, and brush piles)
   - Native plants
   - Evergreen and deciduous trees and shrubs
   - Flowering and berry-producing trees and shrubs
   - Insectary plants

5. Ensure safety
    - Perimeter fence
    - Defined pathways
    - Plants with thorns located away from pathways
    - Educate about edible plants

(Tai, Haque, McLellan, and Knight, 2006, pp.24-33)

Designing for Schools

1. Incorporate the curriculum
    - History
    - Social Studies
    - Biology
    - Geology

2. Provide gathering areas for groups of 30
    - Outdoor classrooms
    - Observation deck
    - Picnic tables
    - Grassland

3. Accommodate children and adults
    - Seating
    - Scale (small details for children, vistas for adults)

4. Aesthetics
    - Native plants
    - Student-made signs
    - Student-decorated tree tubes
    - Garbage collection program

5. Student involvement
    - Assistance with site inventory
    - Student input (surveys)
    - Assistance with installation
    - Grow and transplant seedlings
    - Assistance with maintenance
    - Student-made signs
    - Student-decorated tree tubes

(Coffey, 2001, pp. 32-33; Stine, 1997, pp. 47-87 and 167-184)

Designing for Nature

1. Conserve water
    - Replacement of turfgrass with native grasses
    - Native trees and shrubs
    - Implementation of drip irrigation

2. Conserve energy
    - Adaptation to existing land conditions
    - Shade trees
    - Replacement of turfgrass with native grasses

3. Reduce maintenance
    - Appropriate plant selection
    - Replacement of turfgrass with native grasses

4. Reduce waste
    - Compost from cafeteria waste and plant debris
    - Brush piles
    - Logs and tree stumps for seating

5. Provide wildlife habitat
    - Diverse habitats (wetland, grassland, riparian, compost, and brush piles)
    - Native plants
    - Evergreen and deciduous trees and shrubs
    - Flowering and berry-producing trees and shrubs
    - Insectary plants

(Tai, Haque, McLellan, and Knight, 2006, pp.227-247;
Tufts and Loewer, 1995, pp.12-15)

Taylor Trail

Taylor Street School
Sacramento, CA

Map Scale

0′ 50′ 100′ 200′

N

Figure 26. Taylor Trail

Legend

- Asphalt Road/ Parking Lot
- Asphalt Walkways/ Play Areas
- Decomposed Granite Pathway
- Drainage Ditch
- Turfgrass
- Upland Grasses
- Moist Zone-Upland Grasses
- Moist Zone Plants
- Existing Trees
- New Trees and Shrubs

1. Entry sign and trellis
2. Perimeter pathway
3. Split-rail perimeter fence
4. Benches
5. Native American Garden
6. Shade structure and picnic tables
7. Interpretive sign about water
8. Bug Garden
9. Compost boxes
10. Outdoor classroom
11. Grassland with mowed pathways
12. Wetland zone and habitat island
13. Observation deck
14. Riparian plantings
15. Grass-lined drainage ditch
16. Rock Collection
17. Oak savanna berm
18. Hardy shrubs behind goal post

Figure 27. Taylor Trail

Program Elements

The design for Taylor Trail satisfies the goals listed above with various program elements (Figure 27). The following section describes each item in detail. The design places significant emphasis on connecting program elements to the State Education Standards (Appendix D) and making them adaptable to the curriculum because at this point in time, students will not be permitted to play in the nature area during breaks due to limited staff and surveillance issues. While the wildlife will benefit from this, students are still distanced from nature, especially kindergarten to 3rd grade classes whose play area is not directly adjacent to Taylor Trail. The perimeter path is roughly located at the existing extent of the 4th- 6th grade play area; therefore the design maximizes that space for use by the 4th- 6th graders, offering shade, seating, and nature. Perhaps students can eventually play in the nature area on a weekly or monthly basis. Nevertheless, it is essential to provide teachers ample opportunities to bring their classes outside, since they will ultimately determine how much time students will spend at Taylor Trail.

1. Entry Trellis and Sign

A wood trellis and sign mark the east and west entrances to Taylor Trail. Wild grape will cover the trellises, which should be made of untreated (non-toxic) rot-resistant wood like white cedar and at least six feet wide. The sign should be student-made and may be effective in discouraging vandalism. Their signs will serve as a reminder that schoolchildren use Taylor Trail and may inspire as sense of guilt for damaging a place belonging to them.

2. Decomposed Granite Pathways

Pathways through the site are four to five feet wide and made of decomposed granite. Decomposed granite creates a more natural look compared to concrete. The pathways provide structure and guide visitors through the area to protect planting areas. The perimeter path also serves as a buffer zone between the turfgrass and the native plantings. In addition, the path provides a distinct boundary as to the limit of the play area during breaks. The path connects to the school with an existing asphalt pathway and also extends to the gate leading to Benton Street.

3. Perimeter fence

Following the perimeter decomposed granite pathways is a simple wood fence. The height should be approximately three feet tall. It is not intended to keep people out; rather, the fence will visually demarcate Taylor Trail from the rest of the field and add to overall aesthetics. Near the middle of the site is an opening in the fence to allow equipment access.

4. Benches

To provide the much requested seating for the 4th-6th grade students, benches are located along the perimeter path. This provides more private seating areas in the shade near vegetation, within the limits of their play area boundaries.

5. Native American Garden

The Nisenan used the plants of the Central Valley extensively but ecologically for hundreds of years and this garden features several important species. The garden also includes a tule dwelling, perhaps a future class project, as well as acorn grinding boulders which can also function as seating. Below is the garden's plant list with the Nisenan uses for each according to Hill (1972):

- Achillea spp. (yarrow)
  - Medicinal tea
  - Poultice for sores
- Asclepias, spp. (milkweed)
  - Fibers for string, nets, lines, twine, and bowstrings
- Cercis occidentalis (western redbud)
  - Bark and wood for basketry
- Ceanothus cuneatus (buck brush)
  - Withe used in rough work baskets
- Eschscholzia californica (California poppy)
  - Greens boiled or roasted
- Heteromeles arbutifolia (toyon)
  - Berry juice for dye
  - Berries cooked, mashed, and eaten
- Lupinus, spp. (lupine)
  - Leaves cooked, leached and eaten cold
- Quercus lobata (valley oak)
  - Acorns processed for food
  - Sugar that drips from leaves used as a sweetener
  - Wood for posts
  - Leaves for wrapping bread in earth oven
- Rhamnus californica (coffeeberry)
  - Root and leaves boiled for medicinal tea
  - Root and leaves to treat poison oak
  - Berries eaten as laxative
  - Berries strung as beads
  - Roots heated and used for toothaches
- Sambucus mexicana (blue elderberry)
  - Fruit skins to treat poison oak
  - Wood for flutes, whistles, and clappers
  - Hollow sticks for firemaking
  - Berries as food
- Vitis californica (wild grape)
  - Fruit as food
  - Vine as cordage
  - Stem as rim binding for baskets
  - Leaves for wrapping acorn bread in earth oven

6. Picnic Tables and Shade Structure

Using the existing concrete building foundation as a base, the area will be used for an outdoor classroom, large enough to accommodate two classes (Figure 28). Gravel will be used to cover the concrete and picnic tables will be installed. The shade structure should measure 25'-0" by 50'-0" and be constructed using untreated (non-toxic) rot-resistant wood such as white cedar. The surrounding area will be vegetated with upland plant species to create a buffer between the outdoor classroom and the street and parking lot. The plant list for this area can feature the student's favorites according to the survey (Appendix C).

Figure 28. Shade Structure

7. Interpretive Signage

Interpretive signage will inform visitors about various aspects of the site or the environment in general (Figure 29). For example rather than screen the culvert and drain with vegetation, they have been deliberately left exposed. A possible class project could be researching where this water comes from and where it goes. They could then transfer this information onto an interpretive sign to educate visitors about water conservation and quality, as well as the role wetlands play.

Figure 29.
Signage

8. Bug Garden

During my site visits, I lost count of how many bugs the students would bring me to or bring to me. Their fascination with insects led me to design the Bug Garden. Located near the existing mulberry trees, a food

source for silkworms (which are often raised in classrooms), the garden features insect-attracting plant species. The plant list includes:

- Achillea spp. (yarrow)
- Aesculus californica (California buckeye)
- Asclepias, spp. (milkweed)
- Atriplex lentiformis (quail bush)
- Baccharis pilularis (coyote brush)
- Ceanothus cuneatus (buck brush)
- Cercis occidentalis (western redbud)
- Heteromeles arbutifolia (toyon)
- Rhamnus californica (coffeeberry)
- Sambucus mexicana (blue elderberry)

Adjacent to this garden is a grove of elderberries, serving as an outdoor classroom, but also as habitat for the endangered Valley Elderberry Longhorn Beetle. The compost boxes located in the garden will bring worms as well.

9. Compost Boxes

Implementing a composting program will reduce waste by recycling food scraps from the cafeteria and plant debris from the schoolyard (Figure 30). The compost boxes are located on the northwest side of the site, which is closest to the cafeteria. The compost boxes should be constructed using untreated (non-toxic)

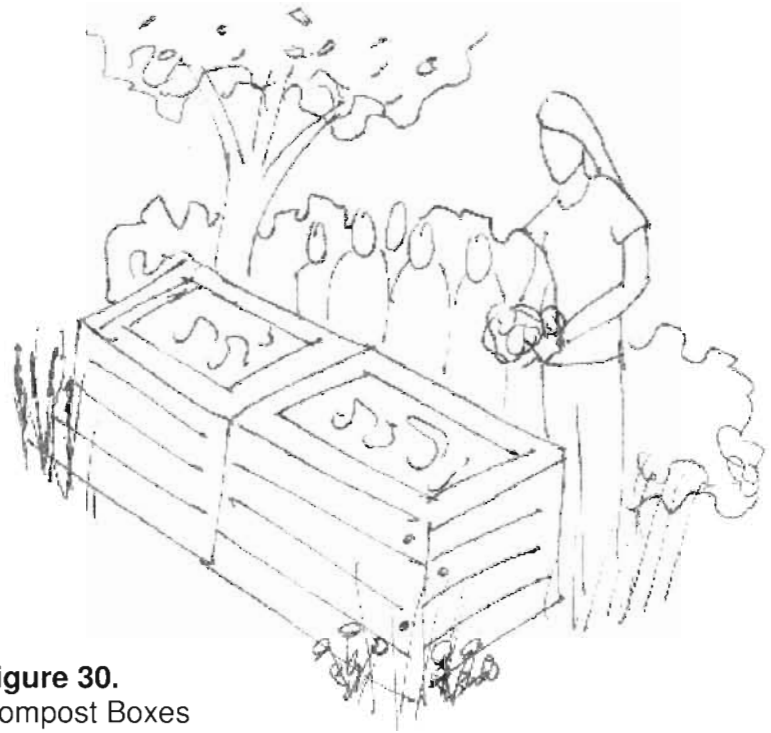

Figure 30.
Compost Boxes

rot-resistant wood such as white cedar. They should also open on the bottom and be installed on bare soil to allow worms to crawl up through the ground. According to the Natural Resources Conservation Service, "leaves, grass clippings, straw, woody brush, vegetable and fruit scraps, coffee grounds...and shredded paper" can all produce quality compost, while "diseased plants, meat scraps...and dog or cat manure" should not be used (2001, p. 18). The compost boxes should be placed in

the center of the clearing of trees and shrubs to allow students to gather around in a circle for demonstrations. In addition, planter boxes can also be installed for experiments or demonstrations with organic compost.

10. Outdoor Classrooms

The design for Taylor Trail includes two outdoor classrooms. One is located towards the northwest side, in an elderberry savanna clearing. This area provides habitat for the endangered Valley Elderberry Longhorn Beetle. The other outdoor classroom is located near the southeast corner, amid riparian plantings. Both utilize natural seating such as logs, stumps, or boulders and accommodate a class of 30 students each.

11. Native Grassland with Mowed Pathways

To suppress weeds, stabilize soil and provide habitat, native grasses will be established throughout the area. The moist area (Zone 2) seed mix includes meadow barley, creeping wildrye, and purple needlegrass. The upland (Zone 3) seed mix includes blue wildrye, California oniongrass, and purple needlegrass. Mowed pathways through the native grasses can provide access to the wetland areas using the most optimal route (shortest or driest). Changing the paths will also create a dynamic, more interesting experience for the students. In addition, in case of a wet year or flooding, the water will not damage any permanent paths.

Purple Needle Grass

Purple needlegrass will be seeded throughout the site in both of the seed mixes because of its ability to withstand different conditions, and because it is California's State Grass.

California Poppy

California poppies (Eschscholzia californica) will also be seeded around the site and can be mixed in with the Zone 3 seed mix. I featured this flower on the plant survey and most students recognized it as California's State Flower and many proceeded to vote for it (Figure 31).

Figure 31. California Poppy

12. Wetland Enhancement

Taking advantage of the existing drainage patterns, regrading the middle section of the site will expand the existing seasonal wetland and control flooding (Figure 31). In addition, "wetlands filter excess nutrients, chemicals, and sediment from runoff, keep ground water pure, ...provide habitat for migratory birds and local wildlife, and add beauty to the landscape" (Natural Resource Conservation Service, 2001, p.17). Wetland slopes can range from 4:1 to 20:1 (Steve Greco, Personal Communication, June 2, 2008). Taylor Trail's wetland includes slopes between 8:1 and 11:1. The shape simply exaggerates the naturally occurring drainage patterns, though it was also influenced somewhat by the location of the existing irrigation pipes. The area should be seeded with the moist zone grasses; cattail can also be planted but may get weedy.

13. Observation Deck

Adjacent to the perimeter path and facing the wetland is an observation deck with a railing and trellis along three sides (Figure 32). The 20'-0" by 40'-0" structure provides a space for bird-watching, since the school was recently awarded a grant for multiple pairs of binoculars. The deck will accommodate a class of 30 along the front edge. Under the front edge railing is a blind, providing safety but actually designed to keep wildlife in the wetland area less aware of human presence and more likely to remain there. Because the blind will block the view of younger (shorter) students, an eight inch ledge will be installed along the front edge to act as a step. Two benches are on either side for seating during recess and lunch and a trellis with grape vines lines the edge of the deck.

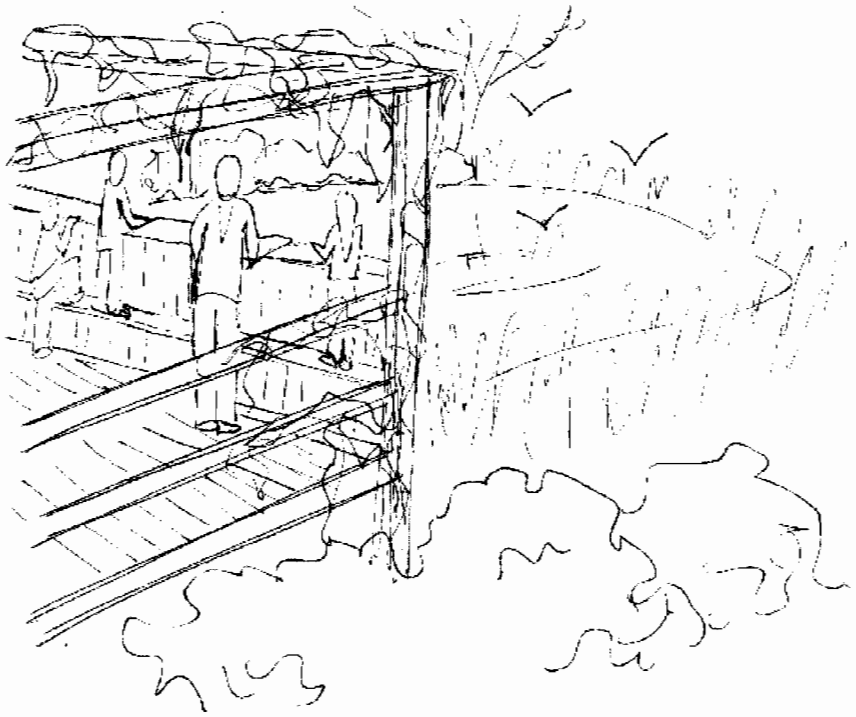

Figure 32. Observation deck

14. Riparian Plantings

Riparian plants will thrive along the southeastern fence where water naturally pools. Plants for this area include:

- Acer negundo (box elder)
- Artemisia douglasiana (mugwort)
- Baccharis salicifolia (mulefat)
- Cephalanthus occidentalis (California button willow)
- Platanus racemosa (California sycamore)
- Populus fremontii (cottonwood)
- Salix gooddingii (black willow)
- Salix laevigata (red willow)

15. Grass-Lined Drainage Ditch

The east drainage ditch presents significant opportunities for riparian enhancement by cutting a terrace into the bank and revegetating with moisture-tolerant plants. This would achieve more aesthetic value, more varied habitat, and less erosion. However, space is too limited in this area to execute this practice effectively. An irrigation line runs inches away from the edge of the ditch. It is possible to remove this line, but this would remove the water source required for establishment of any plantings in this area, especially considering that the ditch dries out significantly. Therefore the banks will be seeded with upland native grasses.

16. The Rock Collection

The boulders located throughout the site provide seating; however, they can also be used to educate students. By acquiring different types of rocks, teachers can walk their students through the trail examining, for example, differences in composition and weathering. The Native American Garden features rocks as well, which were adapted for processing food. These boulders should be large enough to discourage any individuals from attempting to take them.

17 and 18. Oak Savanna Berm and Shrubs

The fill soil from the wetland regrading will be used to create a berm behind the soccer field, protecting Taylor Trail from wayward soccer balls (Figure 30). The berm will be planted with native grasses and valley oaks. In addition, hardy shrubs between the wood fence and the oaks also create a protective buffer. The dense shrubs (quail bush, coyote brush, and buck brush) will catch soccer balls and prevent it from damaging other more fragile plants within the area. Interspersed in these shrubs is also sage, which will release fragrance when disturbed.

Tree Tubes

Painting tree tubes (protective plastic tubes around the trunks of young trees) as a class project would give students a chance to connect with the site,

knowing that they are contributing to its success. They may even feel a sense of ownership for the tree protected by their tree tube, as well as for the site itself. In addition, this may reduce the likelihood of theft of the landscaping supplies, since the using stolen hand-painted tree tubes at a job site might lead to awkward questions. Like the signs, they may also discourage vandalism by acting as a reminder that Taylor Trail is a special place cared for by young schoolchildren.

Transplanted Seedlings

Another potential class project could be to grow native plant seedlings indoors and transplant them in Taylor Trail. Seeds are less expensive than plugs or cuttings, so this project is economical and educational. Students have a chance to help with the restoration process which can help foster a sense of ownership and pride.

Grading

The wetland area to be excavated will result in approximately 175 cubic yards of soil (Figure 34). 140 cubic yards will be used to create the berm to the east, while the remaining 35 cubic yards will build up the northwest side and fill in low spots.

Irrigation

Figure 35 illustrates the plan for modifying the existing irrigation lines. Several of the lines will be converted to drip, with emitters extending to trees and shrubs. For three of the lines, all of the sprinkler heads will be capped except for the ends, which will water the wetland area as needed during dry seasons. The angles of the sprinklers outside of Taylor Trail will be adjusted to water the turf and avoid the path. Below is the suggested irrigation schedule for the drip system, as regular irrigation is required to establish plants during the first three years:

Irrigation Schedule

Year 1
N/A (see Installation Schedule)

Year 2

Spring/Fall	4 hours, every 2 weeks
Initial establishment/ dry season	4 hours, every week

Year 3

New plantings: spring/fall	4 hours, every 2 weeks
Initial establishment/ dry season	4 hours, every week
Year 2 plantings: all seasons	4 hours, every 2 weeks

Year 4

Year 2 plantings: N/A	
Year 3 plantings, all seasons	4 hours, every 2 weeks

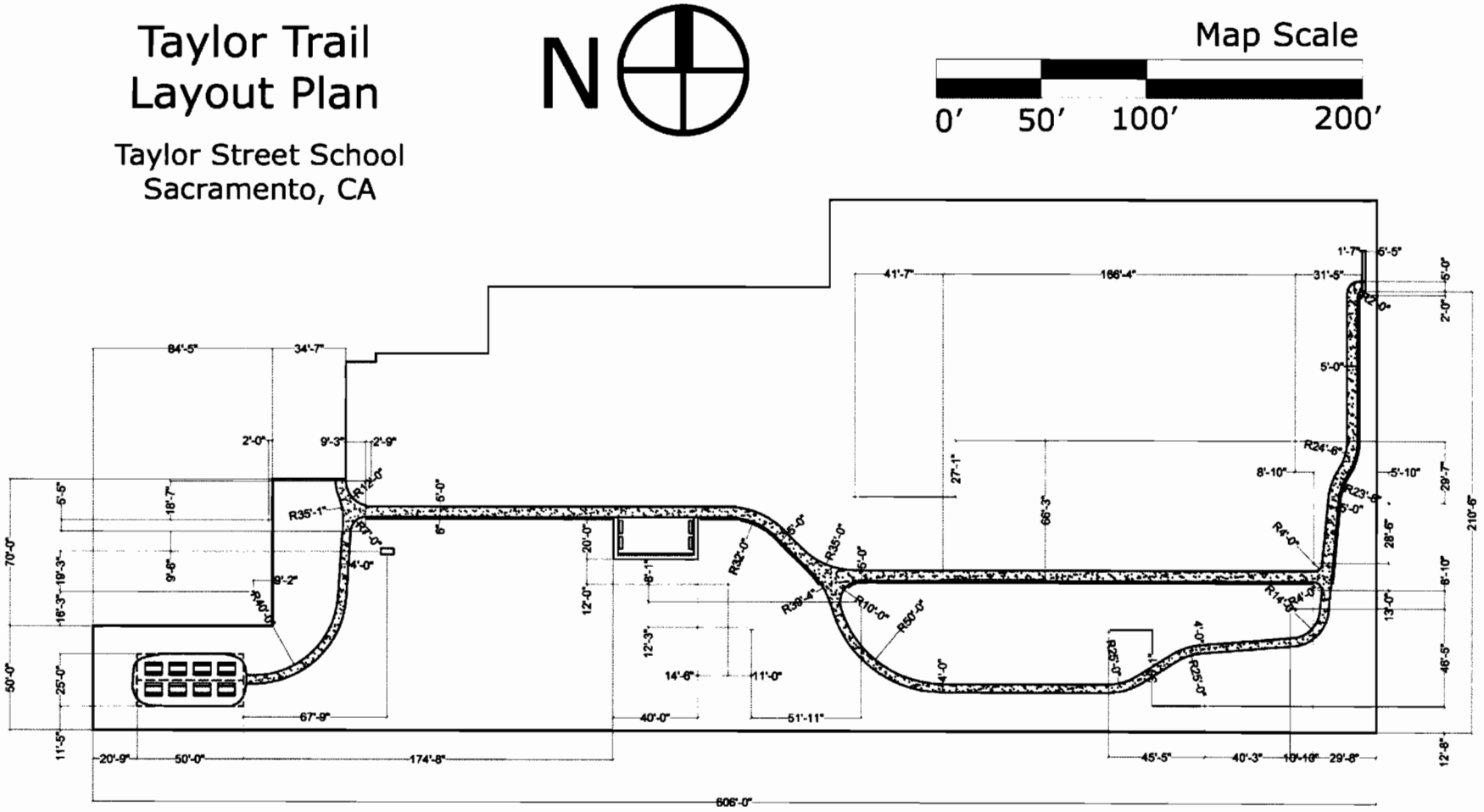

Figure 33. Layout and dimensions

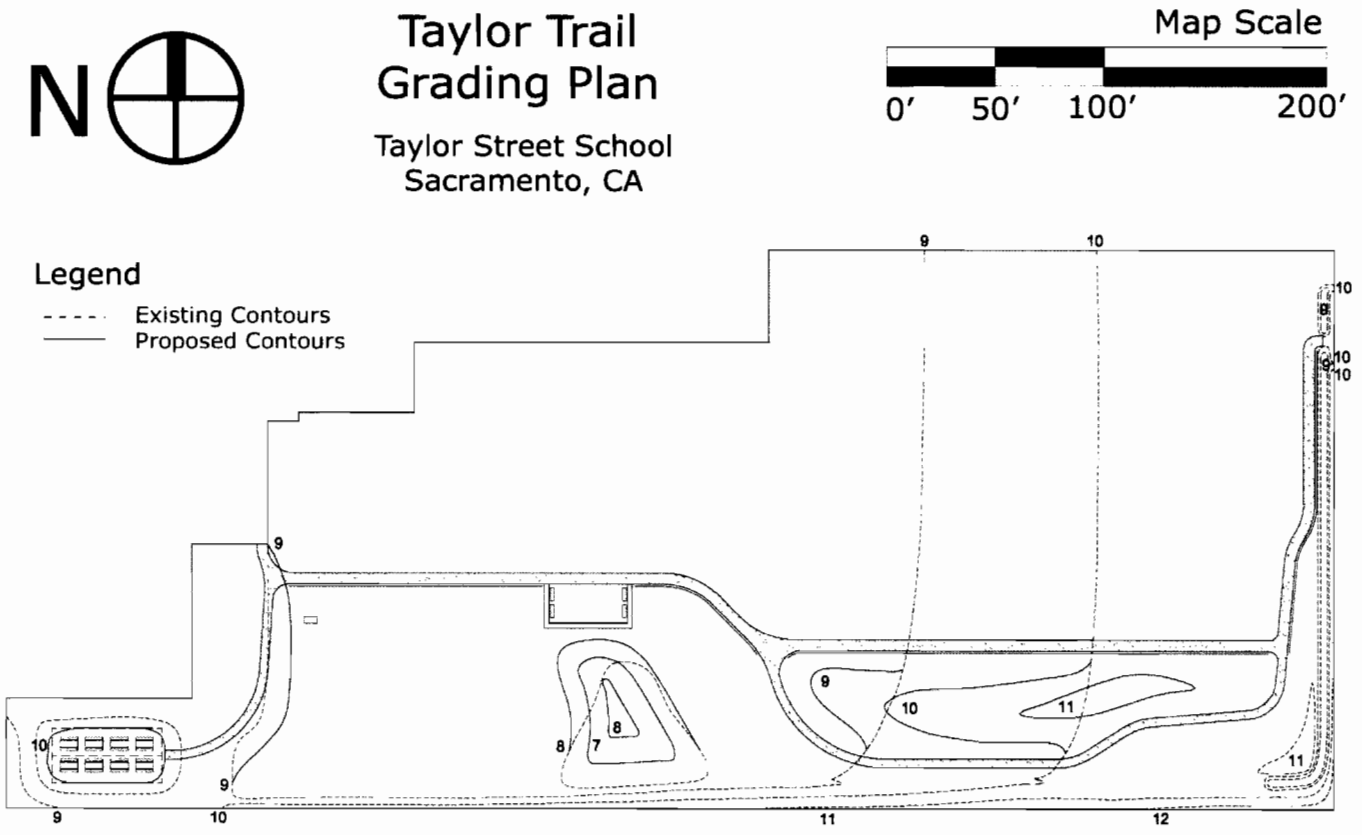

Figure 34. Proposed Grading

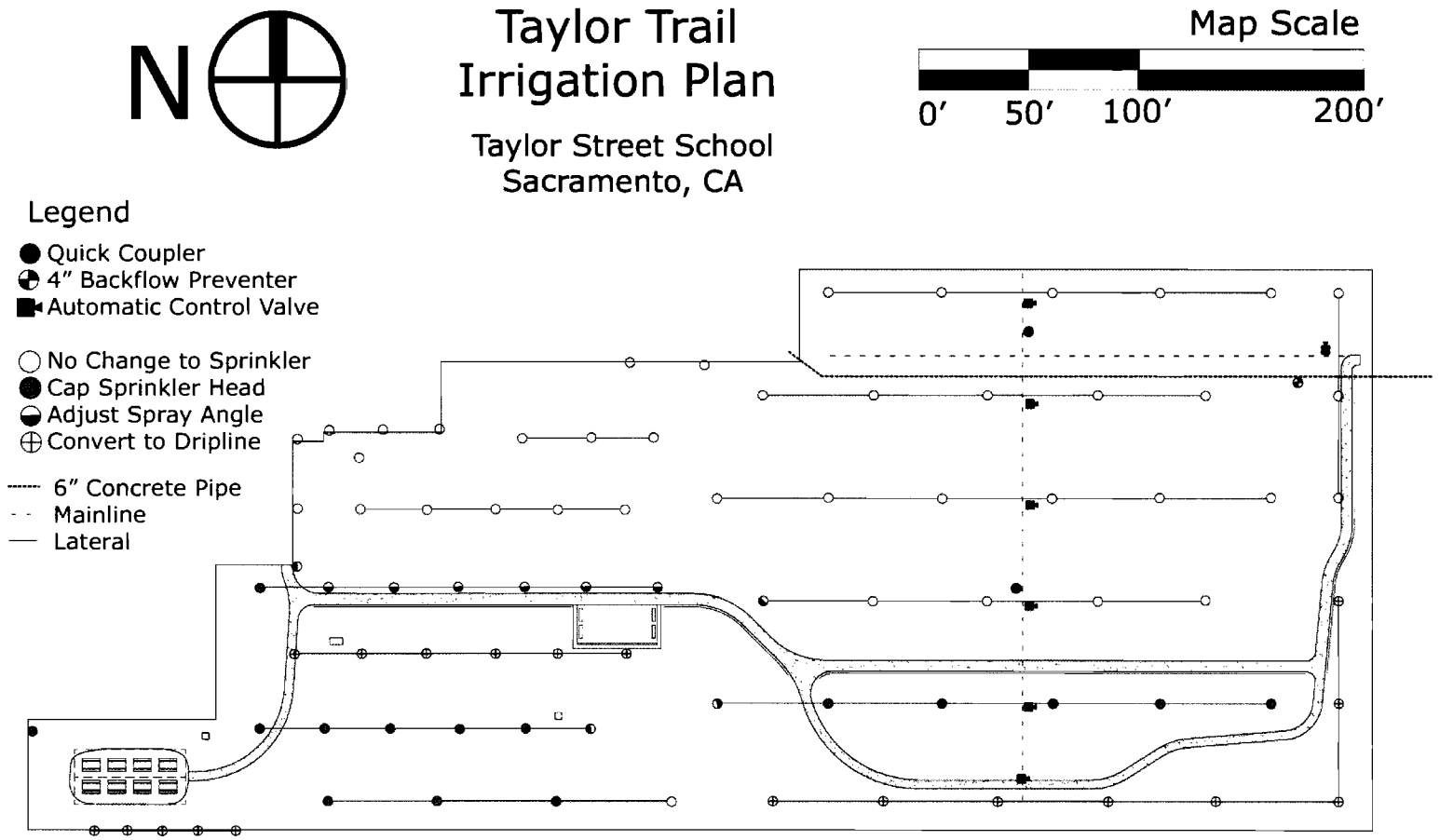

Figure 35. Irrigation Plan

Installation Schedule

The construction of Taylor Trail will take place over at least three years. The first year consists primarily of establishing the framework and eliminating weeds. During the spring and summer volunteer groups can build the structures, and the vegetation should be planted during the wet season. Phasing the project over several years can seem discouraging, but on the other hand, more students can see it develop.

Month	Project	Description
Year 1		
August	Weed control	Apply initial herbicide
August-September	Earthmoving and pathway installment	Regrade site; install pathways
September	Prepare seed bed	Till the soil
September-March	Seeding and weed control	Broadcast and harrow seed; spray glyphosate on first flush of weeds before native grasses emerge
February-March	Broadleaf weed control	Spray phenoxy herbicides to eliminate broadleaf weeds in planted area
May-August	Shade structure and picnic tables	Construct shade structure and install picnic tables
June	Late grass weed control	Mow area to remove annual grasses before they go to seed
Year 2		
October-November	Fall weed control	Pre-emergent herbicides or a broadleaf herbicide after emergence

December	Plant trees and shrubs	West side- Native American Garden, Bug Garden, adjacent outdoor classroom and shade structure area.
February	Plant cuttings, grasses, sedges, and rushes	Wetland plants
March	Modify irrigation system	Convert necessary sprinkler lines to drip for the new plantings and modify other sprinkler heads
April	Monitor plants	
April-June	Broadleaf herbicides or mowing depending on types of weeds	
May-August	Observation deck	Construct observation deck

- **Boulders, tree stumps and tree logs can be placed in Taylor Trail as they are obtained.**

Year 3

October- November	Fall weed control	Pre-emergent herbicides
December	Plant trees and shrubs	East side- observation deck, oak berm, and drainage ditch
March	Modify irrigation system	Convert necessary sprinkler lines to drip for the new plantings and modify other sprinkler heads
April	Monitor plants	
April-June	Broadleaf herbicides or mowing depending on types of weeds	
May-August	Fence and trellises	Install fence and two trellises

Year 4 and Beyond

October- November	Fall weed control	Pre-emergent herbicides
June	Summer management	Mow each year after school ends

Funding

The realization of this plan for Taylor Trail will depend almost entirely on the availability of funding and resources. School fundraisers can provide money and support for the project and local businesses are potential of sources for donations and labor. In most cases, cost estimates are required for grants; unfortunately I was unable to provide one before the presentation of this project. The teachers at Taylor Street, however, have already been looking into grant programs offered by Home Depot, Target, Wal-Mart, Lowe's PG&E, and SMUD (Sacramento Municipal Utility District). Below is a list of possible sources of grants and donations for schoolyard habitat projects:

- Schoolyard Habitat, National Wildlife Federation www.nwf.org/habitats/schoolyard/
- National Gardening Association www.kidsgardening.com
- Learn and Serve America, www.learnandserve.com
- Environmental Protection Agency, Office of Environmental Education, www.epa.gov/enviroed
- USDA Natural Resources Conservation Service, Resource Conservation and Community Development Division, www.rcdnet.org
- Community Tree Planting Program, National Tree Trust, www.nationaltreetrust.org
- Center for Ecoliteracy, www.ecoliteracy.org
- California Native Plants Society, www.cnps.org
- ReLeaf, Trust for Public Lands, www.tpl.org/cal/

Something for Everyone

Environmentalist Aldo Leopold believed that "when we see land as a community to which we belong, we may begin to use it with love and respect" (Murray, 2001, p.46). I hope that I helped the students see it that way with this project and that students in the future will too because of Taylor Trail. With childhood exposure to nature at its lowest, entire generations risk growing up without developing this connection. Not only is this detrimental to the environment, but also to the individual spirit.

As stated by Tai, Haque, McLellan, and Knight (2006), "When nature no longer occurs naturally in childhood, it is imperative that parents, educators, designers, planners, policy makers, and others work to provide ample opportunities for children to explore nature" (p.2). This is especially true since despite fewer opportunities and more distractions, children still crave nature though denied it. Therefore, these same individuals need to reevaluate the school environments created for children and take advantage of the resources they provide. I received letters from students (along with daisies and hugs) on my last day working with them. One student wrote:

> Dear Naz,
> Thank you for coming to our school! We hope that when you're done the field would look great. It was fun helping you with your designing. Me and my friend Stephanie had a great time with you and the more we're over at the field we learn more about the plants and the enviro[n]ment. You are awesome and thank you!

The students' appreciation further justifies implementing schoolyard habitat and should further motivate parents, teachers, and other community members. The students are visibly interested and excited for nature at their school; not only did this validate my work on this project, but it also made working on it incredibly rewarding. A project like Taylor Trail really does offer something for everyone.

Appendix A: Student Survey Questions

10 females, 15 males ages 6-11

What do you like about the school yard?
- Hopscotch (1)
- Lots of space (10)
- Sports (5)
- Insects (2)
- Dirt (2)
- Playground bark (1)
- Playground (4)

What don't you like about the school yard?
- Mud (3)
- Crunchy grass (1)
- Soccer field (3)
- Garbage (6)
- No football field (2)
- No trees in the field (2)
- No jungle gym on the big kids side (1)
- Playground bark (2)
- Falling down (5)

Where is your favorite place to hang out at school?
- Monkey bars (2)
- Basketball court (1)
- Tether ball courts (2)
- Computer lab (1)
- Bench in the shade (1)
- Under shade trees (6)
- In shade trees (1)
- Back (southern) fence (4)
- Behind the playground rock wall (1)
- Library (1)
- Playground (4)
- Field (1)

Where is your favorite outdoor place away from school?
- Park near home (7)
- Robla Park (3)
- Backyard at home (2)
- Friend's backyard (3)
- Family member's backyard (3)
- Under/in big trees (2)
- Skatepark (2)
- Campgrounds (1)
- Theme park (2)

What do you usually do afterschool?
- START program (5)
- Homework (9)
- Football practice (1)
- Play in backyard (3)
- Skateboard (2)
- Watch TV (2)
- Video games (2)

- Clean (1)

What is your favorite thing to do afterschool?

- Sleep (1)
- Play outside (8)
- Play video games (6)
- Play soccer at park (1)
- Skateboard (3)
- Watch TV (3)
- Swimming at public pool (1)
- Read outside (1)
- Arcade games at John's Incredible Pizza (1)

How do you get to and from school?

- Car (12) 48%
- Walk (3) 12%
- Bus (8) 32%
- Bike (2) 8%

What is the schoolyard missing?

- Swings (2)
- Flowers (3)
- Football field (3)
- Skateramp (3)
- Plants (3)
- Decoration (1)
- Farm animals (1)
- More places to sit (3)
- More trees for shade (3)
- Tree house (1)
- Swimming pool (2)

What would be cool to have in the new nature area?

- Flowers (6)
- Animals (4)
- Big trees (3)
- Ladybugs
- Cherry tree
- Pond (3)
- Creek
- Birds (3)
- Butterflies (4)
- More plants (4)
- More bugs (2)
- Science center
- Hills
- Benches

Appendix B. Landscape Survey

36 students

A. Chaparral- 22% (8)
B. Wetland- 28% (10)
C. Riparian- 36% (13)
D. Oak savanna- 14% (5)

A

D

B

C

Appendix C. Plant Survey

36 students

Large tree
California sycamore- 22% (8)
Valley oak- 31% (11)
Cottonwood- 47% (17)

Small trees
Blue elderberry- 13% (9)
California buckeye- 6% (4)
California holly- 18% (13)
Box elder- 4% (3)
Coffeeberry- 33% (24)
Western redbud- 26% (19)

Shrub
Button willow- 14% (5)
California wild rose- 69% (25)
Lemonade berry- 17% (6)

Vine
California blackberry- 64% (23)
California grape- 25% (9)
Dutchman's pipevine- 11% (4)

Forbs
California poppy- 33% (24)
California fuchsia- 33% (24)
Mugwort- 3% (2)
Mulefat- 13% (9)
Yarrow- 18% (13)

Appendix D. Sample State Education Standards

Below are samples of standards from the California Department of Education. The underlined items indicate lessons that can be implemented using Taylor Trail.

Grade 2- Science

1. Physical Sciences

a. Students know the position of an object can be described by locating it in relation to another object or to the background.
b. Students know an object's motion can be described by recording the change in position of the object over time.
c. Students know the way to change how something is moving is by giving it a push or a pull. The size of the change is related to the strength, or the amount of force, of the push or pull.
d. Students know tools and machines are used to apply pushes and pulls (forces) to make things move.
e. Students know objects fall to the ground unless something holds them up.
f. Students know magnets can be used to make some objects move without being touched.
g. Students know sound is made by vibrating objects and can be described by its pitch and volume.

2. Life Sciences

a. Students know that organisms reproduce offspring of their own kind and that the offspring resemble their parents and one another.
b. Students know the sequential stages of life cycles are different for different animals, such as butterflies, frogs, and mice.
c. Students know many characteristics of an organism are inherited from the parents. Some characteristics are caused or influenced by the environment.
d. Students know there is variation among individuals of one kind within a population.
e. Students know light, gravity, touch, or environmental stress can affect the germination, growth, and development of plants.
f. Students know flowers and fruits are associated with reproduction in plants.

3. Earth Sciences

a. Students know how to compare the physical properties of different kinds of rocks and know that rock is composed of different combinations of minerals.
b. Students know smaller rocks come from the breakage and weathering of larger rocks.
c. Students know that soil is made partly from weathered rock and partly from organic materials and that soils differ in their color, texture, capacity to retain water, and ability to support the growth of many kinds of plants.

d. Students know that fossils provide evidence about the plants and animals that lived long ago and that scientists learn about the past history of Earth by studying fossils.
e. Students know rock, water, plants, and soil provide many resources, including food, fuel, and building materials, that humans use.

4. Investigation and Experimentation
a. Make predictions based on observed patterns and not random guessing.
b. Measure length, weight, temperature, and liquid volume with appropriate tools and express those measurements in standard metric system units.
c. Compare and sort common objects according to two or more physical attributes (e.g., color, shape, texture, size, weight).
d. Write or draw descriptions of a sequence of steps, events, and observations.
e. Construct bar graphs to record data, using appropriately labeled axes.
f. Use magnifiers or microscopes to observe and draw descriptions of small objects or small features of objects.
g. Follow oral instructions for a scientific investigation.

Grade 3- History and Social Science

3.1 Physical and human geography
1. Identify geographical features in their local region (e.g., deserts, mountains, valleys, hills, coastal areas, oceans, lakes).
2. Trace the ways in which people have used the resources of the local region and modified the physical environment (e.g., a dam constructed upstream changed a river or coastline).

3.2 Local American Indian nations
1. Describe national identities, religious beliefs, customs, and various folklore traditions.
2. Discuss the ways in which physical geography, including climate, influenced how the local Indian nations adapted to their natural environment (e.g., how they obtained food, clothing, tools).
3. Describe the economy and systems of government, particularly those with tribal constitutions, and their relationship to federal and state governments.
4. Discuss the interaction of new settlers with the already established Indians of the region.

3.3 Local historical events
1. Research the explorers who visited here, the newcomers who settled here, and the people who continue to come to the region, including their cultural and religious traditions and contributions.
2. Describe the economies established by settlers and their influence on the present-day economy, with emphasis on the importance of private property and entrepreneurship.
3. Trace why their community was established, how individuals and families contributed to its founding and development, and how the community has changed over

time, drawing on maps, photographs, oral histories, letters, newspapers, and other primary sources.

(California State Board of Education, 2008)

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