

The Forest Classroom

An Integrated Re-Imagining of Restorative Elementary
School Environments in the Pacific Northwest

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Abstract

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The COVID-19 pandemic highlighted the unpreparedness of most elementary schools in the United States to cope with major climate, health, and wellness crises. The pandemic has heightened stress levels among educators and students and exposed problems in existing school infrastructures, but simultaneously created an opportunity for design to address these challenges by conceiving of schools as restorative environments through an integration with nature. Through strategies that integrate architecture and landscape architecture design approaches, this thesis re-imagines elementary schools in the Pacific Northwest as spaces that can promote the mental, emotional, and physical wellbeing of their users. The intent of the study is to question the conventional boundaries between the built and natural realms to imagine an educational futurism that can adapt to future crises and provide lasting benefits to students and educators.

THE FOREST CLASSROOM

An Integrated Re-Imagining of Restorative Elementary School Environments in the Pacific Northwest



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PART 1 | INTO THE GAP



INTRODUCTION

During the height of the COVID-19 pandemic, the United States and the world experienced a period of uncertainty that resulted in unprecedented mass industry shutdowns and disruptions. Although these widespread disruptions were felt across various industries, the education sector particularly faced substantial challenges (Saavedra et al, 2020). The need for different types of living, learning, and working environments became evident and schools had to adapt and improvise to ensure continued access to education for K-12 students (Garcia and Weiss, 2020). For example, many schools in the United States turned to nature and outdoor education as alternatives to traditional learning environments (Kalish, 2022). Fortunately, this improvisation not only provided alternative spaces for learning, but also brought forth numerous mental, emotional, and physical benefits associated with contact with nature. Exposure to nature can also aid in stress reduction (Kuo et al, 2022; Tidball, 2012), a benefit that can address the exacerbated stress levels

experienced by students and educators during the pandemic (Garcia and Weiss, 2020).

However, the current design of US elementary schools do not prioritize contact with nature (Benfield et al, 2015). Moreover, the current K-12 facilities are not equipped to handle in-person, socially distanced learning and extended periods of online learning are not equitable or feasible for disadvantaged students (Garcia and Weiss, 2020). Thus, the elementary education system in the United States currently finds itself at the significant intersection between the disruptions and challenges caused by the COVID-19 pandemic, the disparities exposed within the education system, and the potential for comprehensive restructuring, including the reimagining of elementary school design.

Although educational reform and restructuring involves multiple disciplines, the realm of design presents an opportunity to bring about impactful changes, a theme that this thesis

incorporates. This thesis focuses on the design of elementary schools, and strategies for seamlessly integrating nature and the natural environment into the built environment to provide mental, emotional, and physical benefits to school users. It specifically focuses on elementary school settings in the Pacific Northwest and examines how they can adapt to future climate changes and crises, while remaining open, accessible, and restorative. The thesis explores design possibilities within two different time scales: current strategies applicable in a post-pandemic era and speculative visions for educational futures over the next 100 years. These investigations and selection of time scales were guided by the following research questions:

How can classrooms be designed with nature at the center?

What types of benefits may emerge from nature-integrated learning environments?

How can design respond to the current challenges and anticipated future of a post pandemic educational setting?

Through integrated design strategies at the site, building, and classroom scales, this thesis explores the physical boundaries of elementary schools by questioning the boundaries between the built and natural realms to imagine an educational futurism that can adapt to future crises. It also re-imagines elementary schools in the Pacific Northwest as restorative spaces that can promote the mental, emotional, and physical wellbeing of their users. The intent of the study is to imagine an educational futurism that can adapt to future crises and provide lasting benefits to students and educators through the purposeful integration of nature.

METHODOLOGY



Figure 1.1 : Methodology Sequence Graphic.
By author.

This project is divided into four distinct and interrelated parts, each contributing valuable insights to the overall thesis. The first part involves a literature review that investigates: challenges that are prevalent in existing educational structures, mental and emotional impacts of the COVID-19 pandemic on students and educators, the therapeutic benefits of nature and future opportunities in design. Building upon the literature review, the second part introduces a design matrix that highlights key themes and proposes a set of design strategies specifically tailored and easily implemented in a post-pandemic educational setting. In the third section, the thesis explores case studies of different types of schools in Seattle. These case studies provide insights into how these schools embody the elements outlined in the design matrix and serve as valuable examples for integrating nature and education in different contexts. Lastly, the project concludes with a speculative design proposal for an elementary school of the future. While the design matrix primarily focuses

on near-future design solutions, the speculative school design serves as an exploratory experiment for elementary school design 100 years in the future. The speculative school design offers a critique and proposal of potential school environments in light of climate change and evolving educational pedagogies. Together, these distinct parts culminate in an integrated re-imagining of restorative elementary school environments in the Pacific Northwest.

BACKGROUND



Figure 1.2 : Outdoor Classroom in Forest.
Image Source: Marcel. Adobe Stock.

The COVID-19 pandemic caused massive tidal waves of change across the globe, and its effects were felt heavily as schools temporarily closed down. Research conducted by the World Bank Group shows that “1.7 billion children and youth had their classes interrupted, and even 7 months after the onset of the pandemic almost 600 million students still had not returned to school” (Saavedra et al, 6). The slow recovery of the education system in the face of disaster is attributed to a multitude of socio-economic and cultural factors. The Economic Policy Institute reports on the shortcomings of educational infrastructure that contributed to the instability of school recovery by stating: “as has been evident in the past few months, there was no national education plan in place to deal with medium-run or

long-run emergencies for the scale of COVID-19” (Garcia et al, n.d.). In other words, educational facilities, as they are now, are ill equipped to handle future long-term crises. The World Bank Group shared that schools are closely tied with crucial social structures meaning that this presents a problem for society at large. The pandemic has underscored the critical role that schools play in the lives of students, staff, and teachers. Researchers at the World Bank Group noted that “although business as usual left much to be desired, school closures have highlighted how important the school is as an institution...” (Saavedra et al, 15). Among other services, schools offer important childcare services that enable parents and caregivers to join the workforce. Moreover, school closures create a chain reaction through the economy that often disproportionately harms students from disadvantaged communities. According to the World Bank Group, “disadvantaged students experience larger learning losses than their peers during out-of-school periods... because they lack resources at home, and are therefore likely to fall even further behind during school closures” (Saavedra et al, 16). Although many

schools across the US have resumed in-person operation, the effects of the pandemic have highlighted the urgent need for reform and better preparation for future crises.

Holistic reform and adaptation of educational institutions will require an interdisciplinary approach but the pandemic has created opportunities for educational reform to move on a path of accelerated progress (Saavedra et al, 7). Experts in education and government agree that policy and educational reform are needed at the frontlines to address the structural problems of the educational system with new approaches (Garcia et al, n.d.), but there is also an opportunity for design to intervene. Various experts in education and design have researched the design and implementation of outdoor educational facilities as a potential strategy and solution to the pandemic crises as noted by Ayotte-Beaudet and co-authors. “While interest in outdoor education has grown in popularity in recent years, the current health crisis has given it a new appeal: it increases the number of safe learning environments” (Ayotte-Beaudet et al, 5).

The consequences of the pandemic extend beyond educational and other socio-economic systems. Recent research conducted by the Institute of Education Sciences (IES) has shown that student and educator mental health and wellbeing has suffered as well. Survey results collected from a national sample of elementary, middle and high school from the IES indicates that seventy percent of public schools report having an increase of students that seek mental health services since the start of the pandemic. Twenty-nine percent of those schools also report that staff have increasingly sought mental health services since the start of the pandemic. (IES, 2022). Researcher Gowri Betrabet Gulwadi who studies teacher stress and restorative environments notes that the added mental health challenges compound on the already high levels of stress in schools, especially for educators. Prior to the pandemic, stress due to curricular pressures, lack of resources, lack of training, low funding, and overall feelings of frustration, have led to high levels of educator turnover rate in schools (Gulwadi, 2006). Gulwadi also noted that increased feelings of stress often negatively impact the quality of the educator's work and their

interactions with students (Gulwadi, 505). The high levels of stress on both educators and students, which have been exacerbated by the pandemic, contribute to the necessity of making school environments become restorative environments that can aid its users in coping with stress.

Gulwadi further observes that educators are already finding ways to cope with the stress of daily events by seeking out natural and restorative settings during breaks (Gulwadi, 2006). This acknowledges that school environments have an influence on mental health and wellbeing, a finding that is also examined by Sapna Cheryan et al in their article "Designing Classrooms to Maximize Student Achievement". Not only that, Cheryan et al offer that students are also affected by their educational environment. The authors note that "many studies have revealed a significant relationship between quality of physical infrastructure and student achievement...this suggests that building and classroom improvements to subpar facilities can increase student learning and achievement" (Cheryan et al, 6). Both Gulwadi and Cheryan et al. agree that the physical design

of school environments has the ability to positively influence the health and wellbeing of its users. "If school environments are to support learning efforts by students with varying abilities and support teaching efforts by teachers with varying vulnerabilities to stressful demands, restorative aspects of schools are worth exploring and sustaining" (Gulwadi, 518).

THE GAP BETWEEN NATURE AND ELEMENTARY SCHOOL DESIGN

Researchers in restorative environments seem to agree that one of the primary ways to create long-lasting therapeutic benefits is by including nature or natural elements in school designs (Gulwadi, 506). Unfortunately, many schools in the US do not provide direct access to nature or the outdoors. A study conducted by Erin Largo-Wight and al regarding the impact of an outdoor classroom on children's wellbeing revealed that "americans today spend at least 90% of their waking hours indoors. School-aged children, in particular, spend less time outdoors than at any other time in

history" (Largo-Wight et al, 653). In an article titled "Nature Views: Evidence of Differing Student Perceptions and Behaviors", authors Jacob Benfield et al raised questions as to why schools have not prioritized incorporating nature in the past and some even go as far as to provide no views at all, a windowless classroom. "Originally proposed as a means for reducing outside noise, distraction, and heating/cooling costs, while increasing space for bulletin boards and bookcases, the windowless classroom is a common design feature in schools" (Benfield et al, 143). However, research on the windowless classroom has shown that they often decrease academic performance and hormone level differences (Benfield et al, 2015).

Researchers Dongying Li and William C. Sullivan provide further insight on the established practices regarding nature on school grounds and why they have not yet been used in a way that prioritizes student learning. "Historically, campus design has been approached from the perspective of visitors to schools—landscape features are designed to enhance the view to the school and give visual identity to

the main entrance” (Li and Sullivan, 156). Their study also recommends that campus landscapes go beyond aesthetic appeal and that designers consider access to nature and green views from the perspective of the educators and students that interact with these spaces daily, particularly during their breaks (Li and Sullivan, 2015). Literature from Benfield et al, as well as Li and Sullivan, have highlighted a gap between the traditional design of school landscapes and landscapes that are tailored to student and educator needs. There is also an opportunity for nature to take on a more central role in the design of school campuses to foster restorative experiences.

The need for restorative spaces that can help mitigate stress and enhance educational experiences is especially important as evidenced by increased educator and student stress due to ongoing effects of the pandemic. Although addressing issues of stress reduction in educational settings involves a multidisciplinary approach, many researchers are inquiring about what the design of a space can do for its users and how.

The effects of the COVID-19 pandemic have also highlighted the existing structural issues surrounding education, created conversations about the future of education, and highlighted ways to respond to the coming climate challenges and other unexpected circumstances. “A vision for the future of learning can be realized only by transforming the entire education system to prioritize and support student learning” (Saavedra et al, 7). This statement from the World Bank organization supports the notion that schools must be reconfigured to center the needs of its users. Research on this topic reveals that a potential solution to this, at least from a design standpoint, includes the incorporation of nature.

As for the World Bank’s assertion that the future of education lies in supporting student learning (Saavedra et al, 2020), research conducted by Ismail Said echoes this statement and discloses that this support is missing in current educational systems. Said argues that spaces for children are restricted and often characterized by adults; that is to say, children have little involvement in the design of those spaces. “...Children have little voice

in the environment that shapes them and they are expected to obey the rules as defined by adults” (Said, 2). Given that children develop cognitively by interacting and changing their environments (Said, 2007), this restriction is especially important to consider when designing schools for the future.

Elementary schools across the US are in need of restorative spaces that can help mitigate stress and enhance their educational experiences. This need was highlighted and exacerbated by the ongoing effects of the pandemic. Research from the World Bank, Economic Policy Institute, and Institute of Education, among others, present potential ways that the education system can reform to adapt to future crises. However, these strategies focus on economic, social, or pedagogical solutions and there is less research being conducted on how the design of the physical spaces can also address the future of education. Although addressing issues of stress reduction in educational settings involves a multidisciplinary approach, researchers are beginning to seriously inquire about what the design of a space can do for its users and how. This research will be crucial to inform the design of elementary schools and landscapes that address the needs of its users, in order to bridge the gap between nature and learning.

PART 1 | REFERENCES

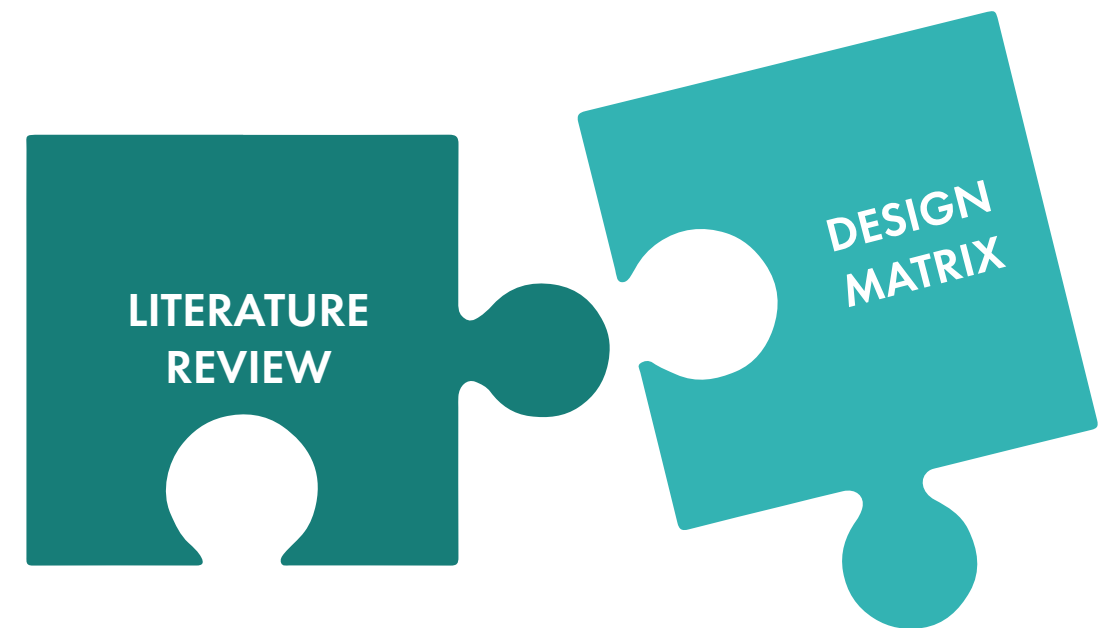
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PART 2

NATURE AND LEARNING



INTRODUCTION

The pandemic has brought to light numerous challenges in education and design, but it has also created opportunities to reimagine them with nature at the center. The following chapter will explore the concept of biophilia, its numerous restorative effects and benefits and the role of nature in aiding teaching and learning. It will also examine how schools have already begun integrating nature through outdoor learning environments (OLEs) and engage in concepts surrounding the future of elementary school design and curriculum. The literature review will culminate in a design matrix that translates the identified strategies and benefits into practical design approaches applicable to post-pandemic educational settings.

BIOPHILIA AND WELLBEING

Biologist Edward Wilson’s biophilia hypothesis states that human beings have an inherent tendency to subconsciously seek nature and other forms of life (Wilson, 1984). While biophilia and biophilic design have

been extensively studied, researcher Tidball introduces the concept of urgent biophilia, adding nuance to our unconscious attraction to nature. Tidball suggests:

“...when humans, faced with urgent disaster or hazard situations, as individuals and as communities and populations, seek out doses of contact and engagement with nature to further their efforts to summon and demonstrate resilience in the face of a crisis, they exemplify an urgent biophilia” (Tidball p. 3).

Urgent biophilia becomes particularly relevant in promoting restoration and resilience in post-pandemic contexts.

The study of biophilia has been extensively explored in architecture and design. Terrapin Bright Green’s research identifies patterns of biophilic design, which researchers Rokhshid Ghaziani et al. further adapt to reflect these patterns (Figure 2.1). These patterns and features can also be applied in educational settings, including schools,

Theme	No.	Patterns	Features
Nature in the Space (Direct Experience)	1	Visual Connection with Nature	- Animals (e.g., birds and pets) - Landscape in school ground - Plants inside the classrooms
	2	Non-Visual Connection with Nature	- Sound of water - Sound of birds’ song - Smell of flowers - Natural materials to touch (bamboo, wood, and stone)
	3	Non-Rhythmic Sensory Stimuli	None
	4	Thermal and Airflow Variability	- A lot of fresh air from the windows
	5	Presence of Water	- A pond in school ground - An aquarium in the building
	6	Dynamic and Diffuse Light	- Lots of natural light from the windows - Skylight/ roof window (in classrooms and school hall)
	7	Connection with Natural Systems	- View to outside to see plants and trees - Plants to grow and look after
Natural Analogues (Indirect Experience)	8	Biomorphic Forms and Patterns	- Natural form for seats and spaces - Circular or oval windows - Patterns of plants on walls (flowers and leaves) - Patterns on creatures on walls and floors (butterflies and shells) - Curved forms and spaces - Images of landscape on walls - Images of seaside on walls
	9	Material Connection with Nature	- Natural materials (bamboo and wood) inside the building to see and touch - Natural materials in school ground (bamboo, wood, and stone) - Colourful walls and ceiling - Colourful glasses on the windows and doors
	10	Complexity and Order	None

Figure 2.1 : Table Showing Biophilic Design Patterns and the associate attributes. Table from *Biophilic Design Patterns for Primary Schools* (Ghaziani et al, 2021).

and hold potential for integrating nature within their environments.. “Biophilic design patterns...can be used in school grounds and in indoor spaces for greater connectivity between interior design and nature to promote children’s well-being, especially for post-pandemic school design” (Ghaziani et al, 1).

Biophilic design when implemented in an elementary school setting can provide a wide range of psychological, biological, sociological, and environmental benefits. The following section describes these benefits and their implications on teaching and learning.

RESTORATIVE BENEFITS OF NATURE

Drawing further insights on the study conducted by Gowri Betrabet Gulwadi, research suggests that incorporating nature and natural elements into educational facilities can provide therapeutic benefits for its users, a theory that echoes the basic premise of biophilia in design. Researchers Grinde and Patil further describe the biophilic effects of nature on humans by

suggesting: “contact with Nature has been reported to have psychological benefits by reducing stress, improving attention, by having a positive effect on mental restoration, and by coping with attention deficits” (Grinde and Patil, 2335). They add that having visual access to nature, as opposed to direct contact with nature, has the ability to influence mental health and wellbeing as well. Experts Bjorn Grinde and Grete Grindal Patil further explain that stress reduction happens at a faster rate if the visual environment is situated in nature rather than an urban environment (Grinde and Patil, 2009). Research done by Ming Kuo and team further affirm this notion that nature views from a classroom can promote stress reduction in individuals. The authors note specifically that “recently, an experimental study showed that a window view of vegetation from a high school classroom yields systematic decreases in heart rate and self-reported stress, whereas built views do not” (Kuo et al, 2022).

However, Kuo et al take this concept of biophilia and explore it beyond the visual aspect by looking at the psychological effects of natural

settings, such as outdoor educational environments, on its users. They found that “student motivation, enjoyment, and engagement are better in natural settings” and that “greener environments may foster learning because they are calmer and quieter” and provide a more supportive context for learning (Kuo et al, 2, 4).

In addition to highlighting nature’s restorative effects, Kuo et al’s research on experiences with nature and education also illuminates that nature can aid with teaching and learning. “Converging evidence strongly suggests that experiences of nature boost academic learning, personal development, and environmental stewardship” (Kuo et al, 1). That is to say, the greener an academic environment is, the better the students can perform. Li and Sullivan also discuss this topic of increased student focus and attention when exposed to nature or natural views. For example, their research found that students assigned to classrooms with views of nature perform better on concentration tests than those students without. “Results demonstrate that classroom views to green landscapes cause

significantly better performance on tests of attention and increase student’s recovery from stressful experiences” (Li and Sullivan, 149). Exposure to nature can also increase test performance and retention abilities. Kuo et al’s research supplements Li and Sullivan’s by describing that “the greener a school’s surroundings, the better its standardized test performance – even after accounting for poverty and other factors....and classrooms with green views yield similar findings” (Kuo et al, 2022).

HOW NATURE PROMOTES LEARNING

Largo-Wight et al discuss the important role of nature in early childhood and theorize “nature contact appears to be critical for healthy child development and well-being, a disconnect from nature – excessive indoor time – may be problematic” (Largo-Wight et al, 662). As discussed earlier, US students spend at least 90% of their waking hours indoors which has serious socio-cultural implications (Largo-Wight et al, 2018). Ismail Said’s research contextualizes these implications and posits that in indoor settings “much of the children’s cognitive development is the result of routine experience in a confined space” (Said, 2009). Said argues that indoor settings that are not designed for children’s needs, do not stimulate their cognitive development as much as dynamic and sensorial outdoor environments (Said, 2009). Li and Sullivan make similar assertions that “... millions of children are trying to learn in settings that may be significantly less supportive than they might otherwise be” (Li and Sullivan, 149).

The research team led by Kuo posit that being in contact with nature improves learning by creating relaxing environments that improve attentiveness and motivation for learning. “Nature may promote learning by improving learners’ attention, levels of stress, self-discipline, interest and enjoyment in learning, and physical activity and fitness” (Kuo et al, 1). This research is important when considering the healing and restorative effects that nature can provide for stressed educators and students, especially from the added stressors of the ongoing pandemic. Their research also describes the importance of contact with nature on children’s development. “First, not only do experiences of nature enhance academic learning, but they seem to foster personal development – the acquisition of intrapersonal and interpersonal assets such as perseverance, critical thinking, leadership, and communication skills” (Kuo et al, 5). Developing intrapersonal and interpersonal skills is important

for other areas of education such as socialization and community building.

Schools are places where students can interact with each other and develop social networks, an important aspect of the school environment. Research from the World Bank organization reveals some of the consequences that the pandemic had on socialization due to the need for closures and online learning. “An ominous trend during the pandemic has been reports that students are feeling disconnected from their learning community and unmotivated to learn” (Saavedra et al, 20). The loss of community also contributes to the decline in scholastic performance. These findings echo research conducted by Grinde and Patil regarding the potential of nature to help build these communities. “Nature activities often implies socializing, e.g., in the form of walking together or sitting in a park with friends. Building social networks has a well-documented potential for improving health” (Grinde and Patil, 2335). Although improving health is an added benefit, the evidence of nature supporting community building is an important potential solution to consider to combat students’

feelings of disconnection and lack of motivation.

Integration with a natural environment not only improves community building and social relationships between students, but among students and educators as well. The Kuo research team describe how the provision of outdoor facilities creates more cooperative learning environments that promote student engagement and academic performance. “Finally, learning in nature facilitates cooperation and comfort between students and teachers, perhaps by providing a more level playing-field wherein the teacher is seen as a partner in learning” (Kuo et al, 2022). This research is important because the cooperation between students and teachers can help reduce stress and improve the quality of teaching and learning as discussed in the previous subsections.

Finally, research has shown that natural environments, or regular contact with nature can also benefit students with learning disabilities. Gulwadi explores this phenomena and claims that “recent studies exploring environments of children who experience attention deficit



PSYCHOLOGICAL

- Increased attention and concentration
- Increased stimulation
- Increased self-discipline and emotional regulation



BIOLOGICAL

- Stress reduction
- Decreased stress recovery time
- Health improvement
- Increased physical activity



SOCIOLOGICAL

- Improved community relationships
- Increased motivation for learning
- Community and leadership building



ENVIRONMENTAL

- Sustainability
- Environmental stewardship
- Increase in natural ecosystems
- Environmental enrichment

Figure 2.2 : Benefits on Children from the interaction with nature. Image by author.

disorder (ADD) establish links between green play spaces and children’s attention retention abilities” (Gulwadi, 507). This research is important when considering how school facilities can be designed equitably for disadvantaged students as well as students with learning difficulties, groups that were impacted disproportionately by the COVID-19 lockdown. “In children, nature contact has been tied to greater self-discipline in children... These benefits have been shown for neurotypical children as well as for children with ADHD and learning difficulties” (Kuo et al, 2022).

In summary, contact with nature has been shown to have the capacity to create numerous psychological, biological, sociological, and environmental impacts and benefits (figure 2.1). The challenge now lies in determining how to effectively integrate nature into schools to provide users with access to these benefits. The following section will explore outdoor education as a potential solution to this question.

OUTDOOR LEARNING AND THE INTEGRATION OF NATURE

Recent research has focused on the design and implementation of outdoor educational facilities as a potential strategy and solution to the pandemic crises as described by Ayotte-Beaudet et al. “While interest in outdoor education has grown in popularity in recent years, the current health crisis has given it a new appeal: it increases the number of safe learning environments” (Ayotte-Beaudet et al, 5). However, it’s important to recognize that outdoor education is not a new concept, and its interpretation and in meaning and practice vary across cultures (Waite, 2020). Various movements worldwide, such as the European Waldschule forest school movement, green schoolyards, and nature-based play, exemplify different manifestations of outdoor learning (Charles, 2020). Regardless of the form of interpretation, nature remains at the core of outdoor education, and outdoor learning environments (referred to as OLEs hereafter) provide alternative educational spaces that facilitate

immersion in nature and provide various substantial benefits as explored in the previous section.

While the benefits of outdoor education and green schoolyards are well-established, their implementation in the United States remains limited (Largo-Wight et al, 2018). Researcher Dymont outlines potential barriers to their implementation that shed light on this phenomenon. These barriers include: fear and concern about young people’s health and safety, teacher’s confidence and expertise in teaching and learning outdoors, the requirements of school curricula, shortages of time, resources, and support, and wider changes within the education sector and beyond (Dymont, 2005).

These challenges currently hinder the widespread use of Outdoor Learning Environments (OLEs) and prevent them from becoming viable options for teaching and learning. However, Dymont argues that, “...in order to

fully maximize the potential of green school ground learning, there must be a fundamental shift to recognize that outdoor learning on school grounds is a legitimate form of learning and teaching” (Dyment, 41). This recognizing and centering OLEs as primary learning spaces, rather than supplementary to the core curriculum, paves a viable way to the future of restorative elementary schools that promote health and wellbeing.

FUTURE OF ELEMENTARY SCHOOLS

While much research and speculation has been conducted on the future of elementary school education in a curricular sense, there is also a need to explore the potential shifts in school design. Researcher Peter Lippman reviews historical trends and developments that have shaped education in the United States and emphasizes the need for a shift in twenty-first century school design to reflect changing pedagogies and design

needs. However, Lippman argues that current educational settings often lack an understanding of how to implement these evolving needs into the design of educational settings by sharing:

“...The designs, for the most part, are not based on an understanding of how people acquire knowledge, rather, they are based on the values and norms that designers have developed in professional practice” (Lippman, p. 95).

His research suggests that twenty-first century elementary school design lies in the development of learning communities that are tailored to the diverse needs of a wide range of school users (Lippman, p. 39, 155). Lippman proposes guidelines for growing these learning communities that include: the provision of privacy and personal space, control of the physical environment, team mobility, flexibility of both the learner and learning environment, layered and overlapping spaces, prospect and refuge, and place attachment (Lippman, 2010). These guidelines are especially relevant following the urgent need

for educational reform in the aftermath of the COVID-19 pandemic and the opportunities for change that it presented. The desire for spaces that prioritize collaboration, small groups, and hands-on learning has sparked a demand for design features such as movable partitions and furniture, areas dedicated to healing and restoration, multi-purpose spaces, visual transparency, socialization areas, and access to nature and OLEs (Kingson, 2022). The future of educational design lies in the reflection of user needs.

TRAUMA RESPONSIVE DESIGN

As we envision the future of schools, it is also crucial to incorporate methods that prioritize trauma informed design and pedagogy practices. The harmful impacts of the pandemic have only heightened the importance of trauma-informed care in child and family services (Collin-Vexina, Brend, & Beeman, 2020). Additionally, with future climate predictions and their associated challenges and changing conditions that are likely to cause increased stress and exposure to trauma, schools of the future must plan accordingly to promote healing and restoration. “Using the pandemic as a glimpse into the future, the effects of massive, collective trauma will linger for many of us for decades” (Dietkus, 2022).

Recognizing the significance of trauma-informed and trauma-responsive approaches, the American Association of School Administrators (AASA, 2020) published guidelines for reopening schools in 2020 that encouraged educators to become trauma-skilled, and trauma-informed.

“Trauma can range in its impact from the obvious physical signs to lasting effects on student and staff psychological well-being, coping mechanisms, and their capacity to feel safe and secure within the physical school environment” (AASA, 2020).

While resources exist on becoming trauma-informed and trauma-skilled, there is limited research on how these principles can be translated into design, particularly in the context of elementary schools. For example, the Centers for Disease

Control (CDC) and Substance Abuse and Mental Health Services Administration (SAMHSA) created guiding principles to a trauma-informed approach including: safety, trustworthiness and transparency, peer support, collaboration and mutuality, empowerment, voice, and choice, and cultural, historical & gender issues (CDC, 2020). However, further exploration is needed to understand how these principles can be translated into the design of elementary schools. Elementary Schools of the future must reflect careful consideration of trauma-responsive design techniques that aid in resilience and restoration.

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DESIGN MATRIX

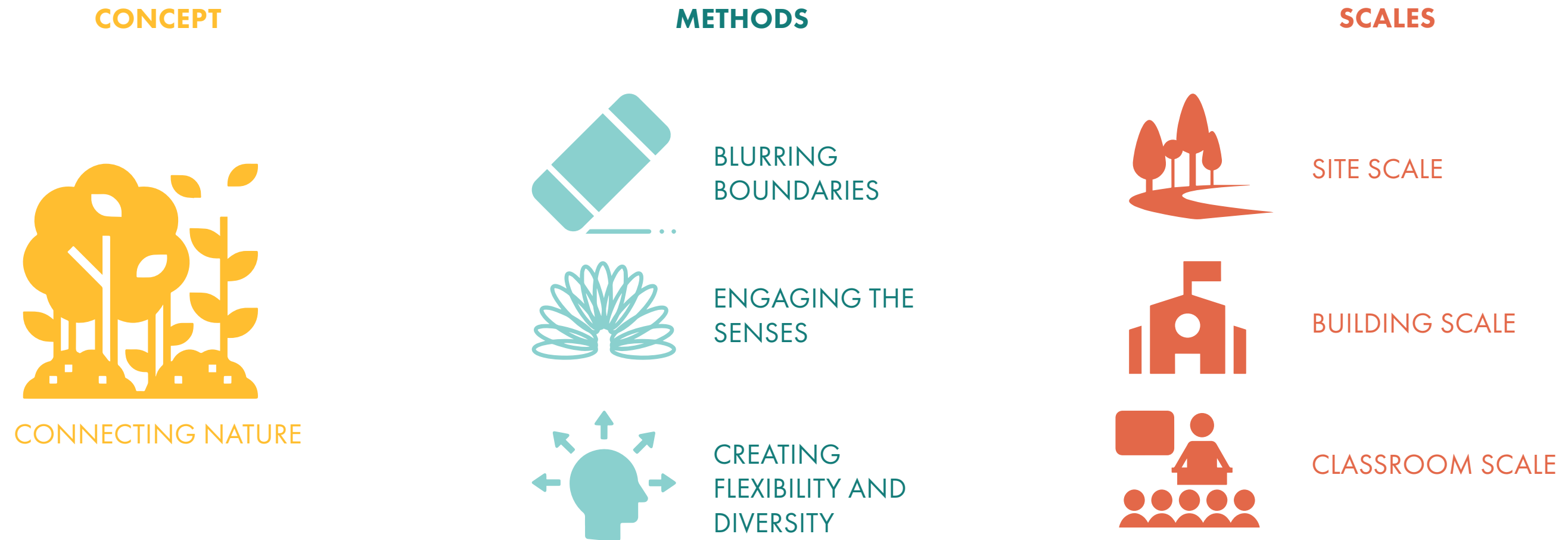


Figure 2.3 : Design Matrix Concept.
Image by author.

The emergent themes that arose from the review of the literature related to stress and mental wellbeing, the negative impacts of prolonged school closures, and the many opportunities that the exposure to nature provide, served as the basis for developing a design matrix aimed at enhancing the integration of nature within elementary school environments. These guidelines describe design processes that are applicable in a post-pandemic context. The matrix shows that three different methods to achieve the integration with nature are by blurring boundaries, engaging the senses, and creating flexibility and diversity (figure 2.3). These three

methods can be implemented at various scales and the following design matrix provides strategies for nature-integrated schools across three in particular: site, building, and classroom. The following sections describe the design strategies that are categorized under these distinct methods and scales, to establish a more deliberate and seamless connection between school users and the natural environment.



BLURRING BOUNDARIES

Blurring the boundaries, as a means of integrating nature into an elementary school at a site scale, can be expressed with four design strategies. The first strategy involves incorporating exterior circulation pathways to provide school users with frequent exposure to the outdoors (figure 2.4). Another approach is the implementation and utilization of OLEs (Outdoor Learning Environments), that facilitate diverse outdoor experiences in various contexts (Figure 2.5 and 2.6). These OLEs can be formally designed spaces or informal spaces that allow for spontaneous use. Finally, providing covered outdoor spaces allows for year-round use through all types of weather conditions (figure 2.7).

At the building scale, a design strategy for blurring boundaries involves the intentional integration of nature through the incorporation of plants and other materials, like water, to establish a seamless connection between the building and its surrounding landscape (figure 2.8).

At the classroom scale, operable doors and windows play a role in connecting nature by providing fresh air, promoting circulation, and allowing ambient sounds to permeate the space (figure 2.9). Additionally, creating framed views that showcase nature can further enhance a connection to the natural environment (figure 2.10).



ENGAGING THE SENSES

To engage the senses at the site scale, the school can explore the inclusion of aromatic or textural plants both within and around the premises to offer diverse and enriching sensorial experiences (figure 2.11). School gardens can also play a role in directly connecting students with nature and providing both an experiential and sensorial learning experience (figure 2.12).

At the building and classroom scale, the strategic use of various textural surface materials (figure 2.13), natural elements (figure 2.14), and lighting conditions (figure 2.15) reflect biophilic design principles and foster a connection with nature while positively influencing stimulation and concentration levels.



CREATING FLEXIBILITY AND DIVERSITY

Creating flexibility and diversity at the site scale, the final approach to integrating nature and educational environments, can first be expressed through the creation of a variety of scales of outdoor spaces that respond to different user needs and offer diverse experiences (figure 2.16). Careful consideration and incorporation of diverse and native plantings can ensure ease of maintenance and resilience against changing climate conditions and create opportunities for teaching and learning (figure 2.17 and 2.18).

Creating a variety of shared spaces at both the building and classroom scale allows for the different needs and requirements of students and educators to be accommodated and creates opportunities for community building (figure 2.19). The final set of design strategies emphasize flexibility in both spaces and seating arrangements to foster a sense of agency and accommodate a wide range of lesson plans (figure 2.20 and 2.21).


SITE SCALE

EXTERIOR CIRCULATION



Figure 2.4 : Exterior Circulation
Image Source: Tacoma Public Schools. (n.d.).

OLEs (INFORMAL)



Figure 2.5 : Informal OLEs.
Image by author.

OLEs (FORMAL)



Figure 2.6 : Formal OLEs.
Image Source: Linden Waldorf School. (2013-2023).

COVERED OUTDOOR SPACES



Figure 2.7 : Covered Outdoor Space.
Image Source: Scale Architecture. (2012).


BUILDING SCALE

BRINGING NATURE IN



Figure 2.8 : Bringing Nature In.
Image Source: The Bertschi School. (n.d.).


CLASSROOM SCALE

OPERABLE DOORS/WINDOWS



Figure 2.9 : Operable Doors and Windows.
Image Source: Lionakis. (2023).

CREATING VIEWS



Figure 2.10 : Creating Views
Image Source: Mithun. (2020).

SITE SCALE

SENSORY EXPERIENCE

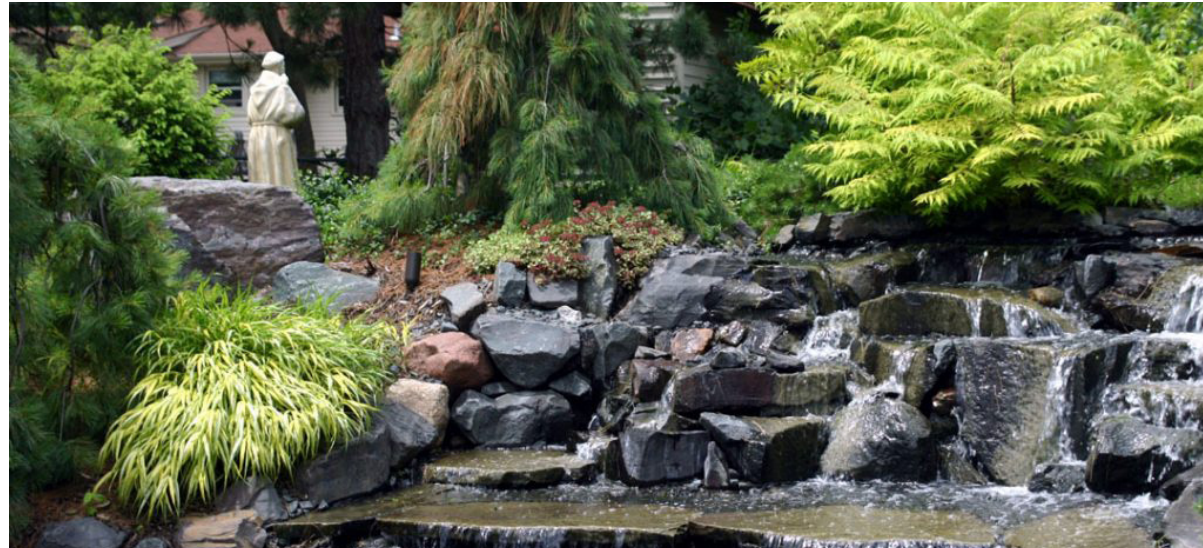


Figure 2.11 : Sensory Experience.
Image Source: CWGPROG. (2021).

SCHOOL GARDENS



Figure 2.12 : School Gardens.
Image Source: Colorado State University. (2023).

BUILDING AND CLASSROOM SCALE

SURFACE MATERIALS

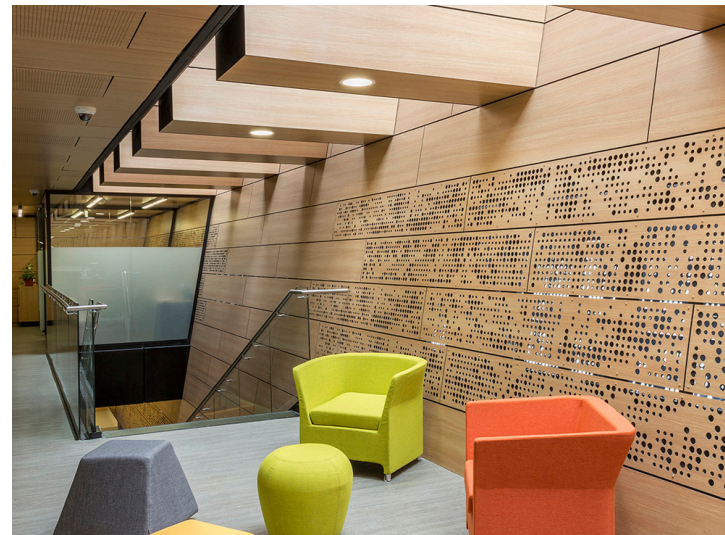


Figure 2.13 : Surface Materials.
Image Source: Surface Materials. (2021).

NATURAL MATERIALS



Figure 2.14 : Natural Materials.
Image Source: Mithun. (2020).

LIGHTING CONDITIONS



Figure 2.15 : Lightng Conditions
Image Source: Georgia Institute of Technology. (2023).

SITE SCALE

VARIETY OF SCALES



Figure 2.16 : Variety of Scales.
Image Source: Newport This Week, Newport Now. (2023).

DIVERSE PLANTING



Figure 2.17 : Diverse Planting.
Image Source: Greg Shepherd. (n.d.).

NATIVE PLANTING



Figure 2.18 : Native Planting.
Image Source: Alamy. (2012).

BUILDING AND CLASSROOM SCALE

SHARED SPACES



Figure 2.19 : Shared Spaces.
Image Source: PSi Ltd. (2023).

FLEXIBLE SPACES



Figure 2.20 : Flexible Spaces.
Image Source: Common Walls_@HMC Architects (n.d.)

FLEXIBLE SEATING



Figure 2.21 : Flexible Seating.
Image Source: Smith System. (2023).

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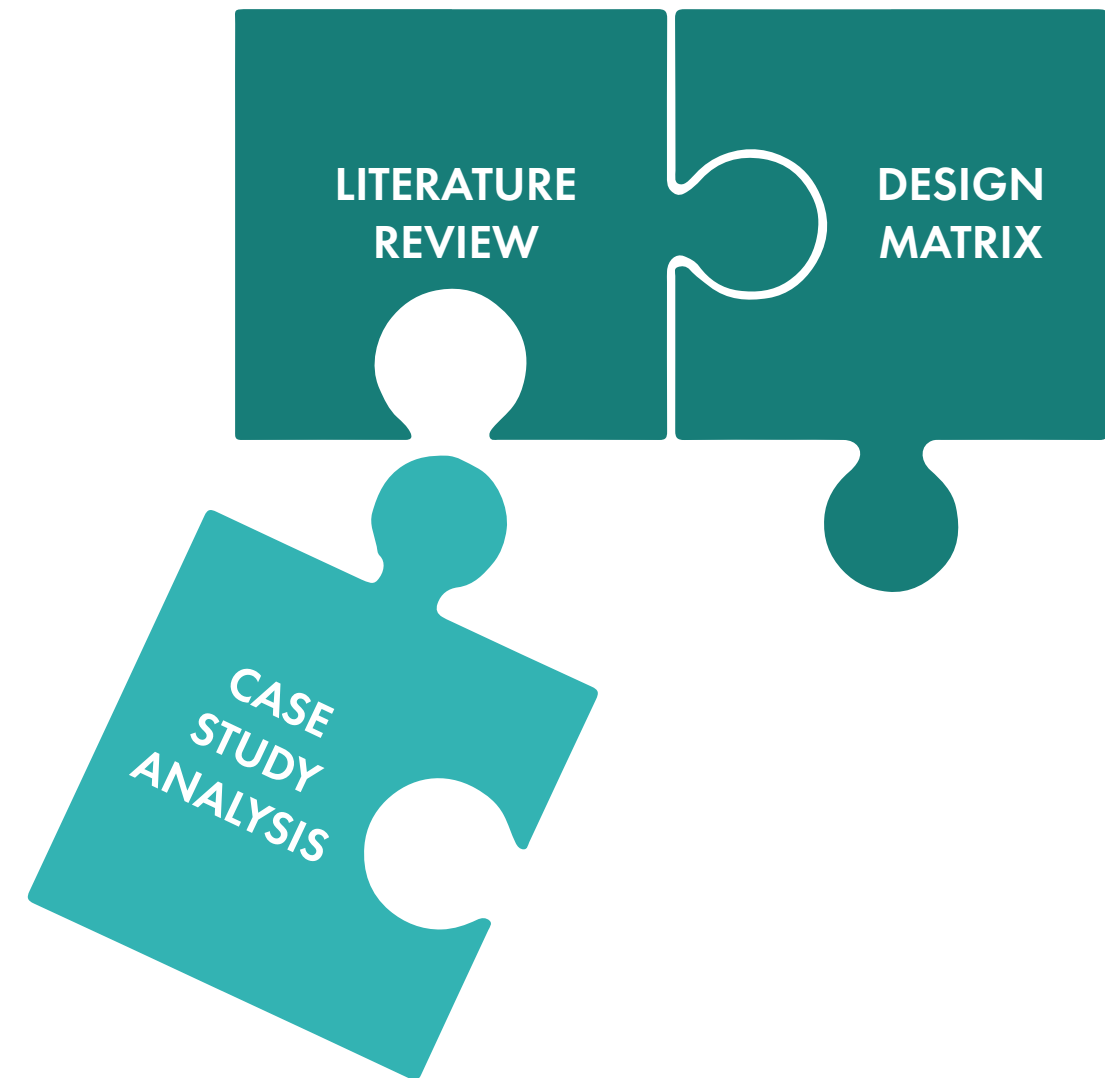
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PART 3

THE BLURRING OF NATURAL AND BUILT ENVIRONMENTS



INTRODUCTION

“Adding trees, shrubs, and other plants to a schoolyard—and designing them in ways that invite interaction—is important. Plants in a green schoolyard should not just be there to add to curb appeal for adults but should be designed first and foremost to facilitate child development and children’s happiness”

Quote from Sharon Danks in Green Schoolyards: An Interview with Sharon Danks, Part 2 (Iverson, 2020).

The integration of nature and education has been reflected in the design of a diverse range of elementary schools across the United States over the years. While the previous chapter explored various design strategies that schools can employ to integrate nature into educational settings, this chapter will use the design matrix created in the previous section to analyze how elementary schools in the Pacific Northwest exemplify these design principles. The focus is on schools located in the greater Seattle region in three different contexts: urban, semi-urban, and natural. Schools are often limited by their surroundings, and studying schools in these distinct settings can uncover diverse strategies to address both the challenges and opportunities presented by each site.

Each case study, along with providing a brief overview, will analyze the characteristics of each school within the framework of the design matrix (blurring boundaries, engaging the senses, and creating flexibility and diversity). The three elementary schools selected for this case study exploration are Bright Water Waldorf School (Seattle, WA), Madrona K-8 School (Edmonds, WA), and Islandwood (Bainbridge Island, WA)(figure 3.1). Although each school serves a distinctly different community with a diverse range of amenities and access, each offers valuable insights as to how elementary schools can enhance their integration with nature while creating restorative environments that support mental and emotional wellbeing.



Figure 3.1 : Context Map of Case Study School Locations. Base Image: Google Earth Pro (2023).

URBAN SCHOOL: BRIGHT WATER WALDORF



Figure 3.2 : Bright Water Waldorf School Building Exterior. Image Source: Bright Water Waldorf School. Google Street View (2023).

ABOUT THE SCHOOL

Founded in 1998, Bright Water Waldorf School emerged in response to the growing demand for increased access to Waldorf education in Seattle. Located in Capitol Hill, Seattle, the school centers its pedagogy around a commitment to deepening its understanding of each child’s individual gifts and needs under the evolving traditions of Waldorf education (Bright Water Waldorf School, n.d.). The founding group’s initial goal for the school was to create a space, located in an urban setting, that valued diversity and nurtured a student’s ability to thrive in adulthood (Bright Water Waldorf School, n.d.).

Waldorf pedagogy draws upon the educational principles established by Rudolf Steiner that emphasize life-long learning through the integration of the arts in all

academic principles (Waldorf Education, n.d.). At Bright Water Waldorf School, these pedagogical principles are reflected in the embodiment of a student-centered learning approach where children are nurtured to enhance their understanding, resilience, capabilities, and curiosity for learning (Bright Water Waldorf School, n.d.).

Bright Water Waldorf School incorporates early childhood, grade school, and middle school curriculum and provides a rigorous academic curriculum. Subjects such as English, History, Sciences, and Mathematics are complemented by an integration of music, movement, and the arts (Bright Water Waldorf, n.d.). Additionally, Bright Water Waldorf School makes use of its location in an urban environment and ensures that its students enjoy the benefits of diverse urban playgrounds such as Judkins Park and Playfield, Pratt Park, and Wisteria Park (figure 3.9). The core Waldorf philosophies that are found reflected in the design and layout of the school include the need for play and learning through the realm of feelings and senses (Bright Water Waldorf, n.d.). The following sections will describe how the integration of nature and education are achieved in a school located within an urban setting through the application of the design matrix outlined in the previous chapter.



Figure 3.3 : Bright Water Waldorf School located in an urban context of Capitol Hill, Seattle.
Base Image Source: Google Earth Pro (2023).

ELEMENTS OF DESIGN

SITE

Situated in an urban setting, the school shares its building and campus with the Japanese Cultural Community Center of Washington. Bright Water Waldorf School has limited access to park space within its site boundaries and while plans are underway to add a playground and outdoor classroom in the adjacent open space, students currently make use of nearby parks and fields for their recreational activities (Bright Water Waldorf School, n.d.).

BUILDING

The school is composed of nine main classrooms, two large dojos that are used as multipurpose rooms, two early childhood classrooms, and a large enclosed play space located directly off the early childhood classroom wing (Bright Water Waldorf School, n.d.).

APPLYING THE MATRIX



BLURRING BOUNDARIES



Figure 3.4 : Shared, Informal OLE at Bright Water.
Image Source: Bright Water Waldorf School. (n.d.).

The covered outdoor space of the neighboring Community Center is used as an informal **Outdoor Learning Environment (OLE)**.

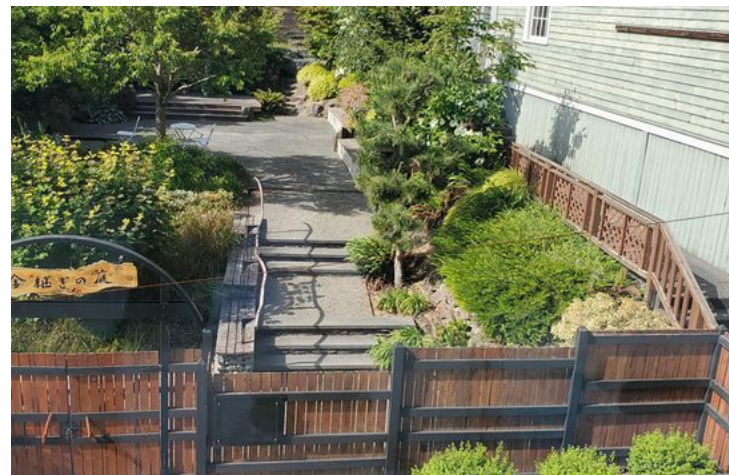


Figure 3.5 : View from classroom window to neighboring garden.
Image Source: Bright Water Waldorf School. (n.d.).

Large, **operable classroom windows** provide views into the neighboring garden and allow for air circulation.



ENGAGING THE SENSES



Figure 3.6 : School Garden at Bright Water Campus.
Image Source: Bright Water Waldorf School. (n.d.).

A small **school garden** on site provides an opportunity for active engagement and a variety of sensorial experiences.



Figure 3.7 : Bright Water School Classroom Space.
Image Source: Bright Water Waldorf School. (n.d.).

Natural materials such as wood are found throughout the classroom, and large windows provide ample **natural light**.



CREATING FLEXIBILITY AND DIVERSITY

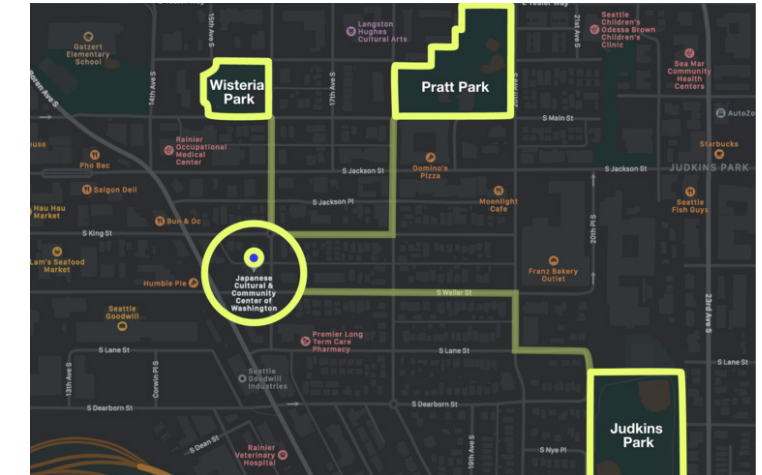


Figure 3.8 : Nearby Parks used by Bright Water School.
Image Source: Bright Water Waldorf School. (n.d.).

Adjacent playfields at Judkins, Pratt, and Wysteria parks provide access to open and natural spaces across a **variety of scales**.



Figure 3.9 : Configurable classroom setting at Bright Water.
Image Source: Bright Water Waldorf School. (n.d.).

Open classrooms and large dojos and are used as multi-purpose spaces. These **shared spaces** allow for flexibility and collaboration.



SEMI-URBAN SCHOOL: MADRONA K-8



Figure 3.10 : Madrona K-8 School Building Exterior. Image from Forma Construction.

ABOUT THE SCHOOL

Madrona K-8 School is a public school located in the Edmond’s School District in Washington. In 2016, the school district voted to replace the existing building with a new school facility. The decision was made to replace the original school built in 1963 when it was faced with issues of functionality and the need for extensive repairs. Additionally, the previous school was

designed for middle school grades 7th through 9th and as a result, did not fit the integrated, multi-age curricular style employed at Madrona K-8 school (ESA, 2016). The new 80,000 square foot construction replaced the outdated building and consists of five new classroom buildings, and an additional building that houses various shared areas including the entry, administration, gym, cafeteria, kitchen, library, music and science programs.



Figure 3.11 : Bright Water Waldorf School located in an urban context of Capitol Hill, Seattle. Base Image Source: Google Earth Pro (2023).

In addition to the replacement, Madrona K-8 school project completed renovations to improve pedestrian access and vehicular circulation and create new stormwater management facilities and playfields (ESA, 2016).

The design of the school was led by Mahlum Architects who used a collaborative and student-led approach (Madrona School, n.d.). Design goals for the new school, presented by

Mahlum in a school board meeting, included the desire to create spaces that maintain continuity from inside to outside and enhance opportunities for outdoor learning (Mahlum, n.d.). The architects describe the design of the school as “a richly interwoven, inside/ outside quilt of learning that maximizes educational space, communal gathering areas, and connection to the outdoors by minimizing interior circulation” (Madrona School, n.d.). It is also a

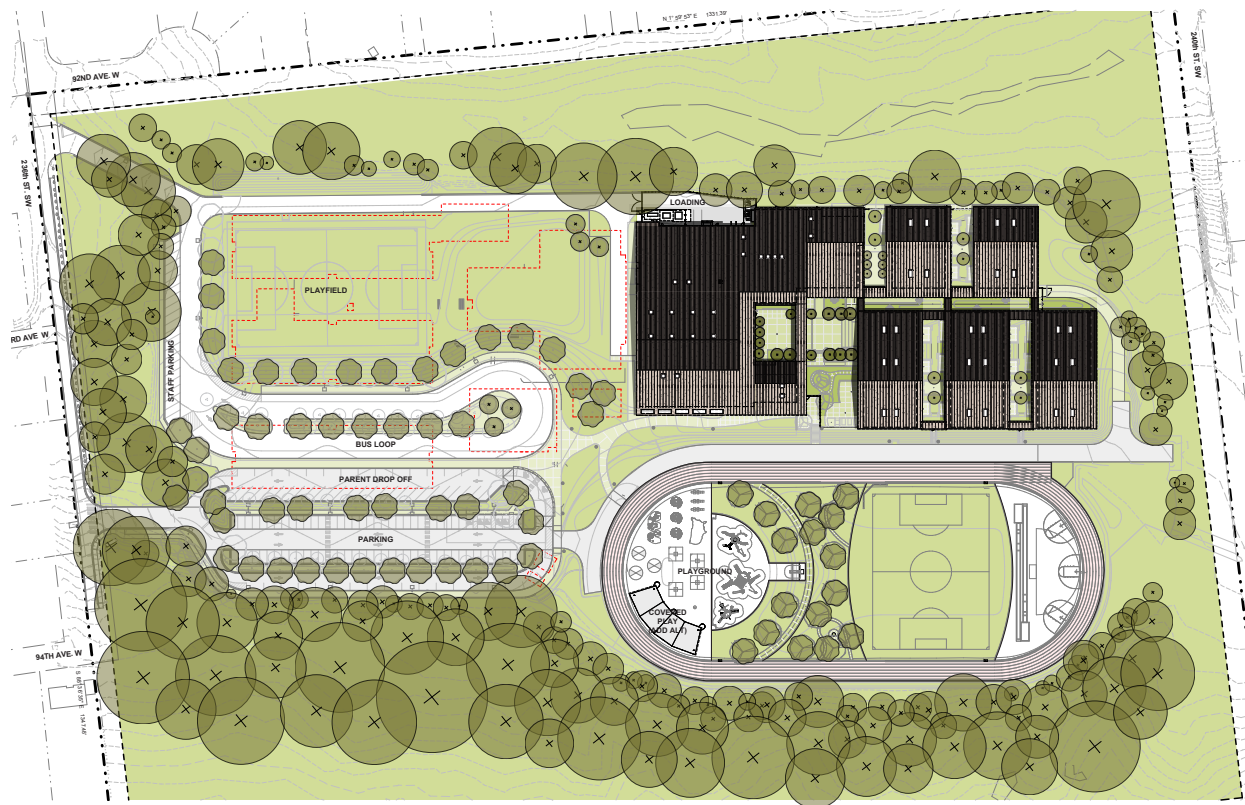


Figure 3.12 : Site Plan Concept presented by Mahlum at Edmonds School Board Meeting .
Image Source: Madrona K-8 School. <https://www.edmonds.wednet.edu>



Figure 3.13 : Building Plan Concept presented by Mahlum at Edmonds School Board Meeting.
Image Source: Madrona K-8 School. <https://www.edmonds.wednet.edu>

design that balances and enhances the unique curriculum and pedagogy at Madrona K-8 school.

The curriculum structure is composed of multi-age instructional settings, known as learning centers, that groups grade levels into four different categories; preschool and kindergarten, primary (1st-3rd grade), intermediate (4th – 6th grade), and Middle School (7th-8th grade). The multi-age structure encourages collaboration and fosters a “community of learners” (Madrona School, n.d.), a pedagogical principle that is reflected in the design of the school.

ELEMENTS OF DESIGN

SITE

The site itself is located within a semi-urban fabric and is surrounded on all sides by a dense canopy of trees. The ecology of the surrounding land includes wetland areas and a diverse sample of native plants and trees. The recreation spaces include: two playfield spaces, covered play area and a track within the vicinity of the school

BUILDING

The school maximizes connection with the outdoors by utilizing exterior circulation connecting the classroom buildings and creating a campus-like environment. Additionally, the interior circulation of the main building is strategically oriented towards the designed courtyards, offering views to the outside. There are a number of collaborative spaces that are expressed in various ways, both internally and externally. The external elements include shared OLEs located in close proximity to the classroom areas. An interior shared space is located in the circulation zone of the main building. This learning space is lined with a diverse array of tables and chairs that create an open and adaptable spaces for the students. Within the immediate vicinity of the main building is an outdoor theater space and school garden accessible to students to engage in a variety of educational ventures.

APPLYING THE MATRIX



SITE SCALE



BUILDING AND CLASSROOM SCALE



BLURRING BOUNDARIES



Figure 3.14: Outdoor Circulation at Madrona K-8. Image by Forma Construction (n.d.).

A **covered, exterior circulation system** connects students with nature, and offers protection from the elements.



Figure 3.15: OLE at Madrona K-8. Image by MyEdmonds News (n.d.).

Formal OLEs are located adjacent to the exterior circulation system and are accessible by students and educators.



ENGAGING THE SENSES



Figure 3.16: School Garden at Madrona K-8. Image Source: Madrona K-8. (n.d.). Edmonds School District.

The **courtyard gardens** provide aromatic and visual stimulation to engage the students in a robust sensory experience.



Figure 3.17: Interior Shared Space at Madrona K-8. Image by Forma Construction (n.d.).

The building utilizes glass and **natural surface materials** to provide a direct connection to the outside.



CREATING FLEXIBILITY AND DIVERSITY



Figure 3.18: Exterior planting at Madrona K-8. Image by Forma Construction (n.d.).

A **diverse range of scales and planting** is used for outdoor learning and play spaces within the school grounds.

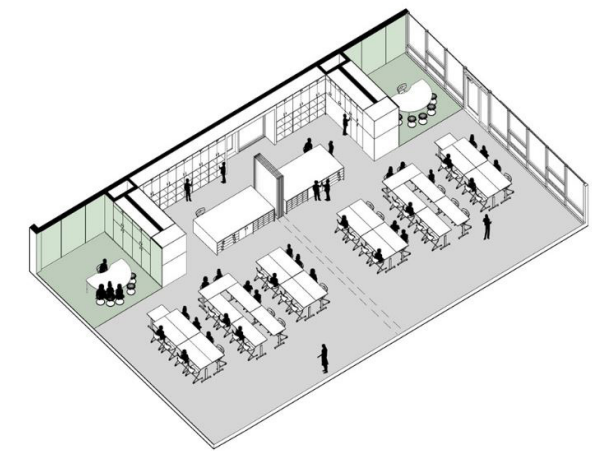


Figure 3.19: Configurable classroom setting at Madrona K-8. Image by Mahlum Architects, n.d.

The classroom pods are designed to function as collaborative spaces that can **adapt to fit different** arrangements and group sizes.

NATURAL SCHOOL: ISLANDWOOD



Figure 3.20 : Garden Classroom at IslandWood.
Image Source: IslandWood (n.d.).

ABOUT THE SCHOOL

IslandWood is a non-profit educational program located in Bainbridge Island that serves the Puget Sound region. With a commitment to delivering a comprehensive environmental education program, IslandWood aspires to instill a sense of wonder and facilitate meaningful experiences with the natural world for educators and students alike. Through a diverse range of programs that span hours, days, and even months, IslandWood aims to provide

exceptional learning experiences that foster a lifelong dedication to environmental and community stewardship (IslandWood, n.d.).

IslandWood's founder, Debbi Brainerd, assembled a team of designers and planners with the goal of integrating the ecological qualities of the site with extensive participatory programming (Cipalla, 2021). The careful planning and design closely aligns with the site's ecological characteristics, emphasizing the creation of a "site and buildings that teach" (IslandWood, n.d.). Seattle-

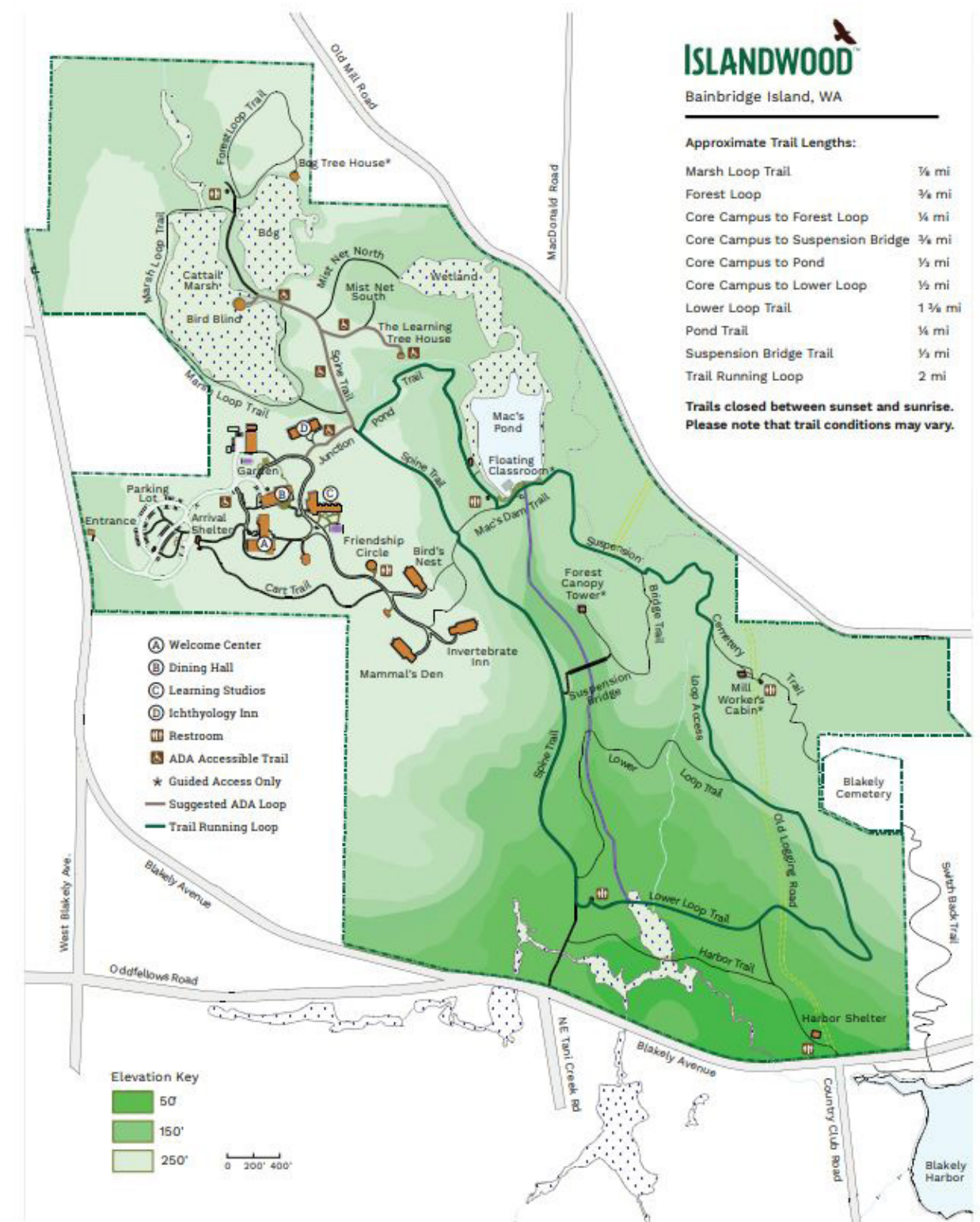


Figure 3.21 : IslandWood Site Map.
Image Source: IslandWood (n.d.).

based architecture firm Mithun, in collaboration with the landscape architecture firm Berger Partnership, was selected to spearhead the design aspects of the project.

Currently, IslandWood serves approximately 4,300 students in fourth through sixth grade through short-stay overnight and summer day camp programs. There are four lodges on site that can accommodate these students as well as their robust and dynamic docent program. The site often hosts public tours that promote community engagement. (IslandWood, n.d.).

ELEMENTS OF DESIGN

SITE

The property's boundaries encompass an extensive watershed and wildlife habitat, salmon spawning streams, and a complex array of diverse ecosystems. Among these are a four-acre pond, a cattail marsh, a bog, a stream, and a ravine. Additionally, the complex enjoys convenient access to an adjacent salt-water estuary park. During the planning and design phase of the IslandWood complex, meticulous attention was paid to the site's ecological characteristics.

The complex and diverse ecosystems are also used as educational tools that enhance exploration, curiosity, and knowledge about the natural world (IslandWood, n.d.). Primary pedestrian circulation follows a historic logging road, and trails are constructed using native soil. New trails, boardwalks, and bridges are threaded through the site to avoid sensitive habitat and natural systems. The large variety of nature trails allow students to be in contact with nature throughout the campus. (Enlow, 2003).

BUILDING

IslandWood exemplifies collaborative spaces at a variety of scales. The campus itself hosts a diverse range of OLEs including formally and informally designed. The buildings on campus are integrated with the surrounding forest and allow the students to blur the boundary between the inside and outside. Additionally, IslandWood incorporates sustainable and environmentally friendly design elements throughout its site. All of the campus buildings were positioned on level areas that had been previously cleared. Because of the desire to limit construction impacts and vehicular

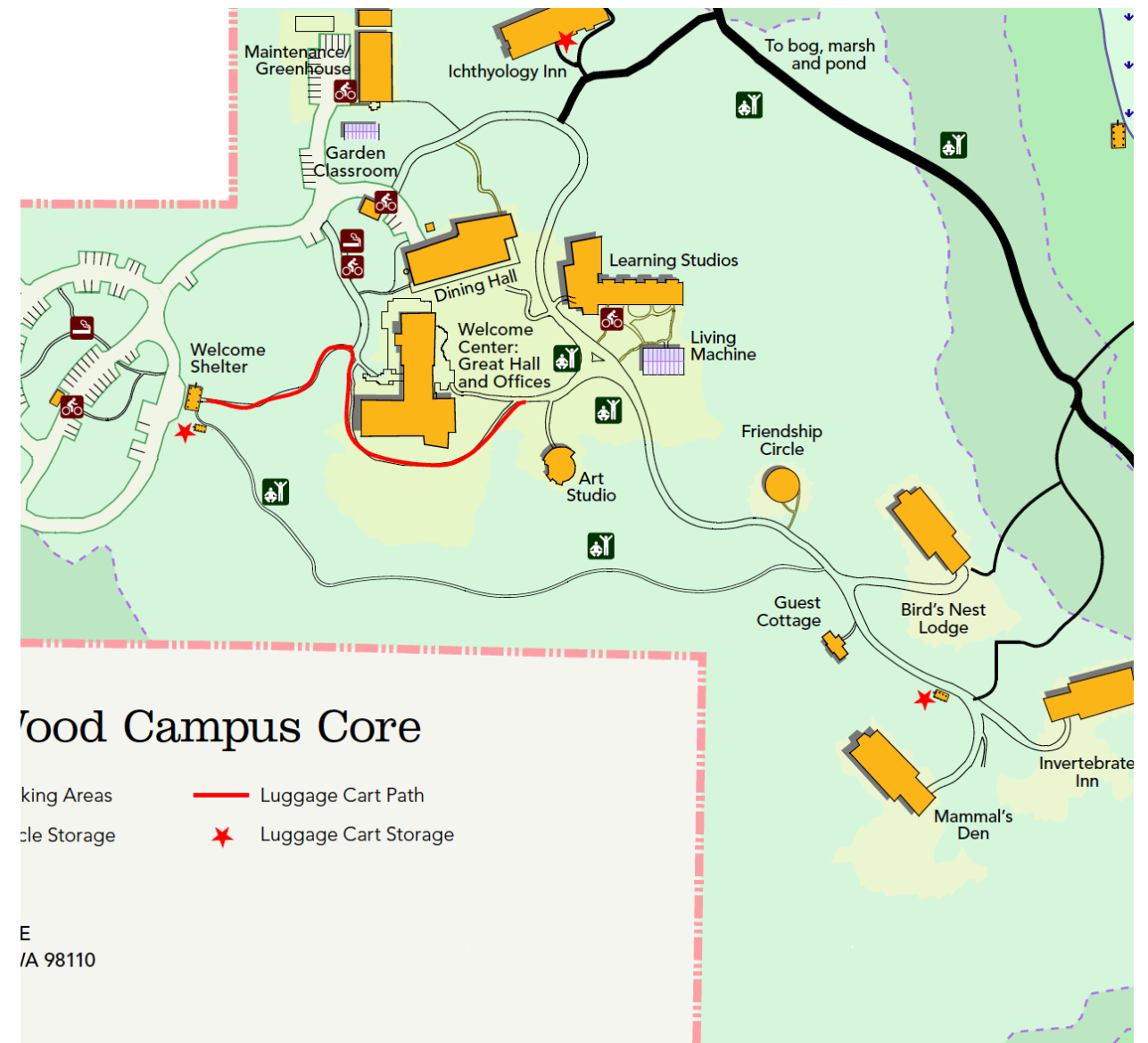


Figure 3.22 : IslandWood Campus Map.
Image Source: IslandWood (n.d.).

access, clusters of buildings were placed at or near property perimeters. Crushed recycled concrete is used for parking and walking surfaces to minimize runoff from pavement, and trail paving is made of a crushed recycled concrete aggregate base. Sustainable bike racks were constructed on site using site-salvaged cedar logs and the walkway connecting the main lodge and dining hall is built with a natural-looking recycled material. These design elements additionally serve to foster environmental stewardship in students. (Enlow, 2003).

APPLYING THE MATRIX



SITE SCALE



BUILDING SCALE



BLURRING BOUNDARIES



Figure 3.23: Outdoor Circulation at IslandWood.
Image by IslandWood (n.d.).

A **covered, exterior circulation system** connects students with nature, and offers protection from the elements.



Figure 3.24: IslandWood Main Building Interior.
Image by Mithun (n.d.).

The incorporation of locally sourced wood from the surrounding forest serves to create a **seamless connection to the exterior**.



ENGAGING THE SENSES



Figure 3.26: Floating OLE at IslandWood.
Image by author.

A **floating OLE**, allowing students the opportunity to immerse themselves in a unique aquatic experience.



Figure 3.27: IslandWood Classroom Interior.
Image by Mithun (n.d.).

Operable windows and natural materials within the buildings provide passive ventilation and a direct connection to the outdoors.



CREATING FLEXIBILITY AND DIVERSITY



Figure 3.29: Treehouse Classroom at IslandWood.
Image by Mithun (n.d.).

A **large variety of OLEs at different scales** provide the user for different types of teaching and learning experiences.



Figure 3.30: Treehouse Classroom Interior at IslandWood.
Image by Mithun, n.d.

Shared spaces enhance collaboration and allow for **flexibility of use**.


**CLASSROOM
SCALE**



BLURRING BOUNDARIES



Figure 3.25: Covered OLE at IslandWood.
Image by Mithun (n.d.).

The school provides a wealth of **OLEs**, both formally designed and informally used, that are connected by a network of trails.



ENGAGING THE SENSES



Figure 3.28: School Garden at IslandWood.
Image Source: Mithun (n.d.).

An **enclosed gardens** provide aromatic and visual stimulation to engage the students in a robust sensory experience.



**CREATING FLEXIBILITY AND
DIVERSITY**



Figure 3.31: Informal OLE at Islandwood.
Image by author.

Smaller, **informal OLEs** allow for **spontaneous learning sessions**.

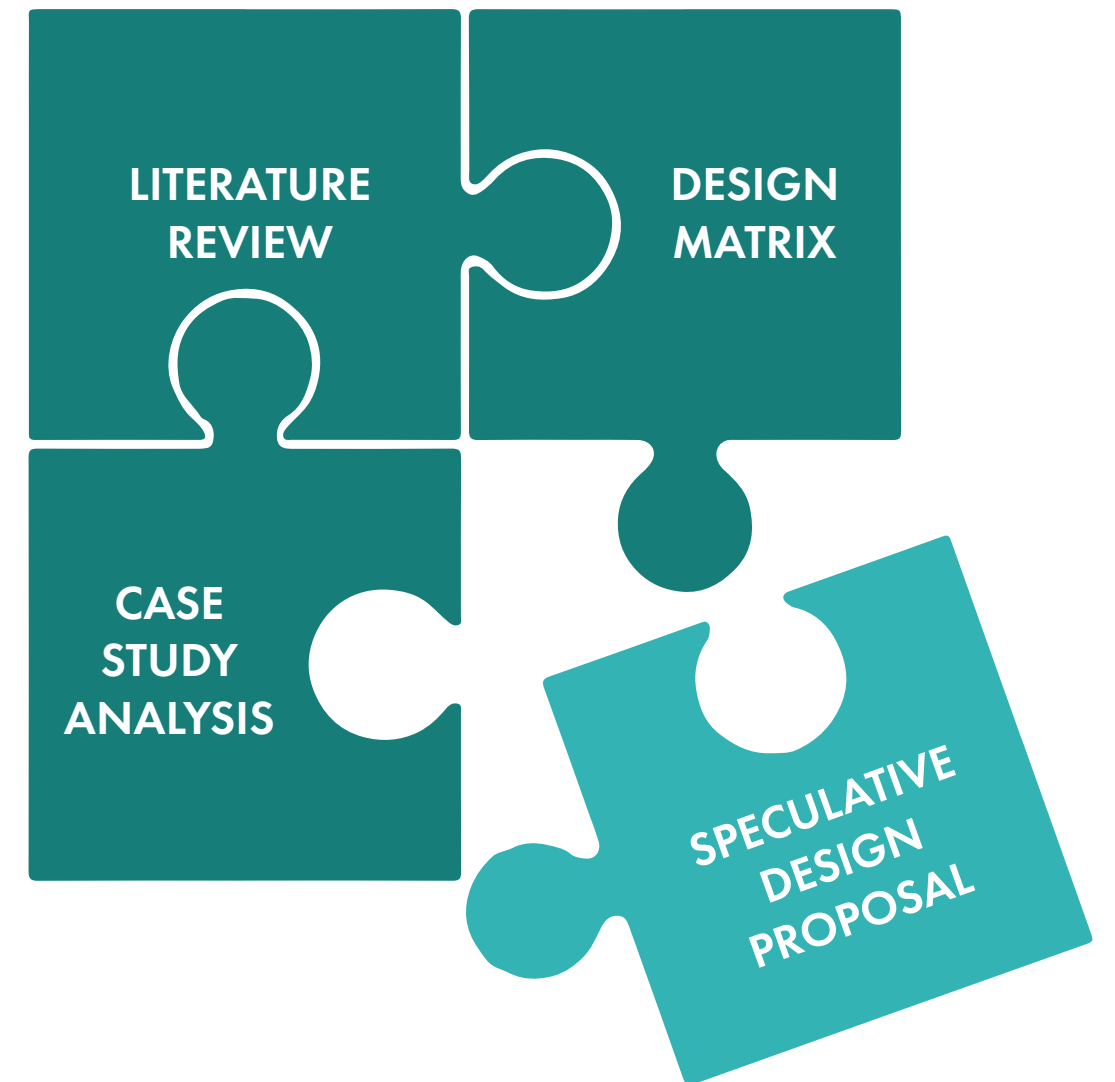
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PART 4

SPECULATIVE VISIONS OF EDUCATIONAL FUTURES



INTRODUCTION

"But also, speculative fiction has a revolutionary potential that is perhaps unique. Why do I say this? Because imagination — that faculty that expands the human mind to the size of the universe, that makes empathy possible (you have to have some imagination to put yourself in another's shoes) — also allows us to dream. Science fiction and fantasy posit other paths, alternative futures, different social arrangements as well as technologies, other ways that we could be. Before we do, we must dream."

Quote by Vandana Singh, "A Speculative Manifesto" (Singh, 2021)

The realm of alternative futurisms and speculative fiction allows for creative freedom to explore a wealth of ideas without being bound by the preconceived notions of reality. The quote by Vandana Singh, a notable speculative fiction writer, shows that speculative fiction can have the potential to inspire great change. Until now, the previous explorations have focused on current challenges faced by education in the United States following the COVID-19 pandemic, design strategies to integrate the natural and built environments, and case studies of elementary schools incorporating nature in various contexts. In this chapter, these insights are used to inform an explorative and alternative design proposal for a futuristic elementary school in the Pacific Northwest.

The goal of this speculative exploration is to initiate a conversation around how alternative visions of educational futures can challenge existing educational design standards and constraints to promote restorative experiences for its users. Additionally, it aims to reimagine the role of a school as more than just a place for learning. As Vandana Singh notes, "before we do, we must dream" (Singh, 2021).



Figure 4.1 : *Precedents in Speculative Fiction* by Olalekan Jeyifous.
Image Source: Olalekan Jeyifous (2023)

Futurisms and their applications are not new concepts to the world of design. This thesis draws inspiration from various forms of alternative futurisms, specifically Afrofuturism and Indigenous futurisms. In this endeavor, the work of Olalekan Jeyifous, a Nigerian-American architect and visual artist, is particularly insightful in highlighting fresh perspectives on the possibilities of the built environment that are not constrained by present day conventions. His work in Afrofuturism and speculative fiction "re-imagines social spaces that examine the relationships between architecture, community, and the environment" (Jeyifous, 2021). In his exhibition, "[TFN] The Froze Neighborhoods" he re-imagines Brooklyn, New York within a science fiction, Afrofuturist perspective where ecology and technology work together in balance to serve marginalized and excluded communities in the

face of global climate change and climate laws (Jeyifous, 2021).

Similarly, this speculative design for an elementary school of the future explores how ecology, technology, and the built environment intersect to create diverse and dynamic educational spaces. By utilizing a speculative approach, we can envision opportunities that are unconstrained by present or past limitations. These speculative futures not only provide creative solutions for our current challenges but also prompt us to contemplate the societal changes required to achieve them—the necessity and purpose behind such transformation.

In summary, this chapter proposes a speculative design concept for an elementary school set in the Pacific Northwest in 2100. The design framework for the envisioned elementary school of the future takes into account climate change projections specific to the Puget Sound region. It aims to seamlessly integrate nature with the built environment and erode the boundaries between them. By doing so, the design seeks to create learning spaces that are both adaptable and

restorative, offering an environment that mitigates stress, cultivates resilience, and can effectively respond to unforeseen situations.

CONTEXTUALIZING THE NARRATIVE

The following section provides a comprehensive overview of the context surrounding the elementary school of the future. This includes an examination of key aspects such as the school's location, projected climate patterns, demographic considerations, and the underlying framework guiding its design.

CLIMATE PREDICTIONS

In 2015, a report prepared by the University of Washington's Climate Impacts Group examined changes in forces that shape the Puget Sound climate including temperature, precipitation, rainfall, and natural variability (UW Climate Impacts Group, 2015). As this speculative project is set in the Pacific Northwest 100 years in the future, it is important to consider climate forecasts to better understand the changing environment.

AVERAGE ANNUAL TEMPERATURES IN THE PUGET SOUND REGION ARE PROJECTED TO INCREASE RAPIDLY IN THE COMING DECADES
{ Temperature difference relative to 1950-1999 average }

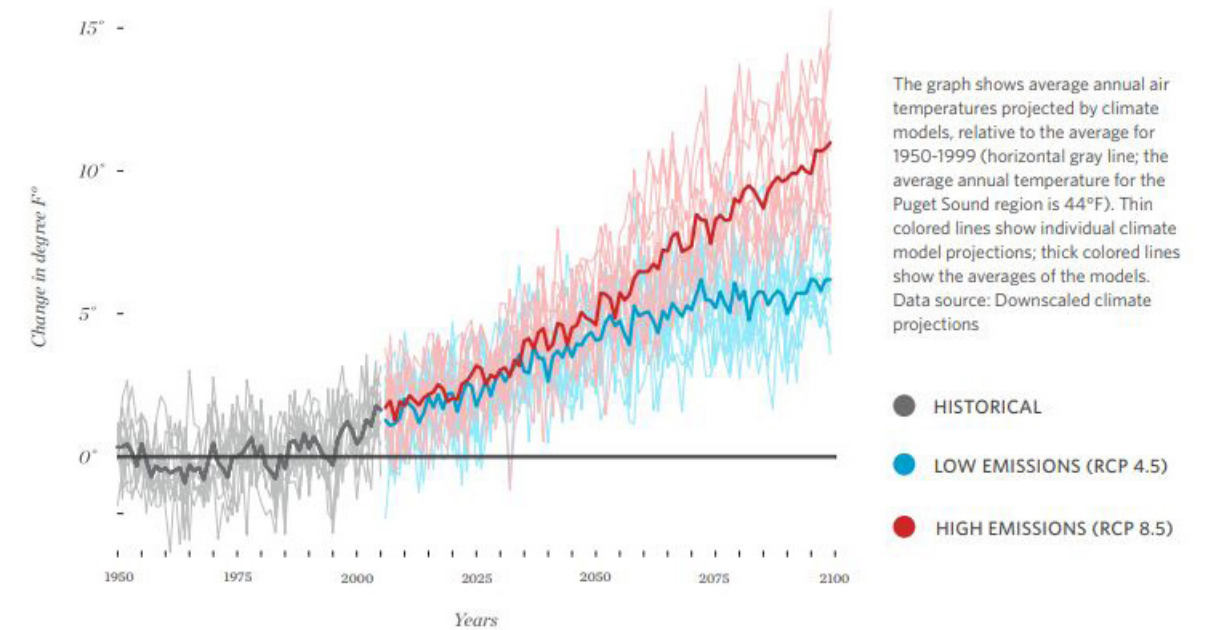


Figure 4.2 : Graph Showing Project Average Annual Temperatures in the Puget Sound. Image Source: UW Climate Impacts Group, 2015

Among the key drivers of change, temperature is a crucial factor shaping the design process. According to the report, the temperature in the Puget Sound region is expected to increase significantly, surpassing the warming observed in the 20th century by a factor of 2 at the low to 10 at the high (figure 4.2). This temperature increase is anticipated across all seasons, with a particular emphasis on summer warmth. Additionally, the report predicts an increase in the frequency of extreme heat events, accompanied by a decline

in extreme cold events (UW Climate Impacts Group, 2015). The increased frequency of heat waves can lead to human health concerns including, but not limited to, the risk of wildfires, low air quality, and increased allergen levels. These findings identify the need for the provision of heat relief strategies and the potential for natural solutions to mitigate the impact of rising temperatures.

Precipitation is another key factor that affects the design of the futuristic

elementary school. “Changes in annual fall, winter, and spring precipitation will continue to be primarily driven by year-to-year variations rather than long-term trends” (UW Climate Impacts Group, 2015). However, summer projections indicate drier summers with an overall decline in precipitation. Conversely, winter precipitation is expected to increase and extreme rainfall events are expected to become more severe. Figure 4.3 illustrates that these extreme rainfall events may extend for an average of 5 days longer than historical trends. The projected increase in rainfall events can also lead to

increased flood risk. This presents both a challenge and an opportunity for the school of the future to address solutions to mitigate flood risks while fostering a resilient learning environment.

Finally, the design proposal will be shaped by the inherent natural variability of the climate. “Seasonal, year-to-year, and decade-to-decade variations will remain an important feature of the local climate, at times amplifying or counteracting the long-term trends caused by rising greenhouse gas emissions” (UW Climate Impacts Group, 2015). This indicates

that standard design solutions must be flexible and adaptable to accommodate fluctuations in wet and dry conditions overtime. By embracing a design approach that considers and responds to the dynamic and changing nature of the climate, the proposed elementary school of the future can better withstand and thrive amidst the ever-changing environmental conditions.

SITE SELECTION

The climate change predictions outlined above, while providing an overall model for the Puget Sound, can vary in severity and impact across different areas. For example, climate-related effects, particularly on human health, often disproportionately affect underserved and vulnerable populations (UW Climate Impacts Group, 2015). Therefore, the intentional selection of the project site became important. Consideration of the school’s placement and design can effectively serve the communities that face a higher risk than others.

When examining climate predictions for the city of Seattle, one area that emerges as particularly susceptible to flood risks due to sea level risk

estimates and an increase in severe rainfall events is along the Duwamish River (figure 4.4). A closer look upstream the Duwamish River leads to Tukwila, a small and diverse city in King County. The site chosen for this project is Tukwila Elementary School. The school is situated near the 100 year floodplain outlined by FEMA (figure 4.5), surrounded by soils susceptible to high landslide risks, and in the vicinity of a multitude of parks and forested areas (figure 4.6). Through the analysis of the predicted climate extremes, it is likely that heavy rainfall and increased flooding in the Duwamish and Green River Basins will impact the development (industrial and residential) in this region. Redevelopment will not be a viable option. In response to this, the proposed design strategies for the speculative elementary school will consider natural flood mitigation systems that foster resilience and adaptation within the school and its surroundings.

<i>Variable</i>	<i>Projected Long-term Change</i>				
<i>Geography of Change</i>	<i>Changes in precipitation are expected to be different from place to place, but it is not known how patterns will shift with warming.</i>				
<i>Heavy Precipitation</i>	<p><i>Heavy precipitation events are projected to become more intense.</i></p> <p>Projected changes in western Oregon and Washington precipitation extremes for the 2080s (2070-2099, relative to 1970-1999) for a high (RCP 8.5) greenhouse gas scenario:^{N,32}</p> <p>Annual 99th percentile of 24-hour precipitation: +22% (range: +5 to +34%)</p> <p>Frequency of exceeding the historical 99th percentile of 24-hour precipitation:</p> <table border="0"> <tr> <td>Historical (1970-1999):</td> <td>2 days / year</td> </tr> <tr> <td>Future (2070-2099):</td> <td>7 days / year (range: 4 to 9 dys/yr)</td> </tr> </table>	Historical (1970-1999):	2 days / year	Future (2070-2099):	7 days / year (range: 4 to 9 dys/yr)
Historical (1970-1999):	2 days / year				
Future (2070-2099):	7 days / year (range: 4 to 9 dys/yr)				

Figure 4.3: Table Showing Project Long-term Change in Precipitation for the Puget Sound. Image Source: University of Washington Climate Impacts Group. (2015)

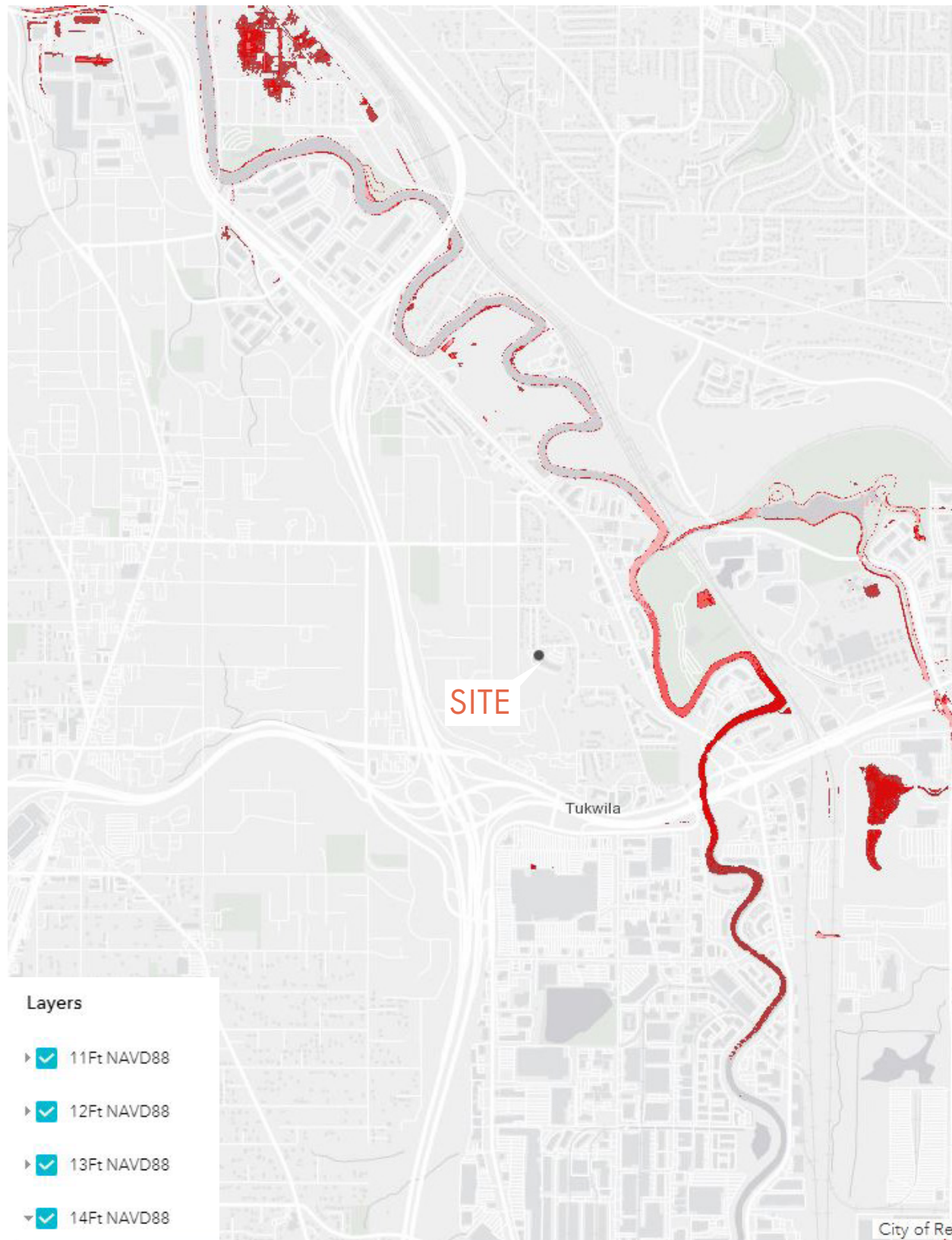


Figure 4.4 : Project Sea Level Rise by 2, 3, 4, and 5 ft. Image Source: Seattle Public Utilities (2022).

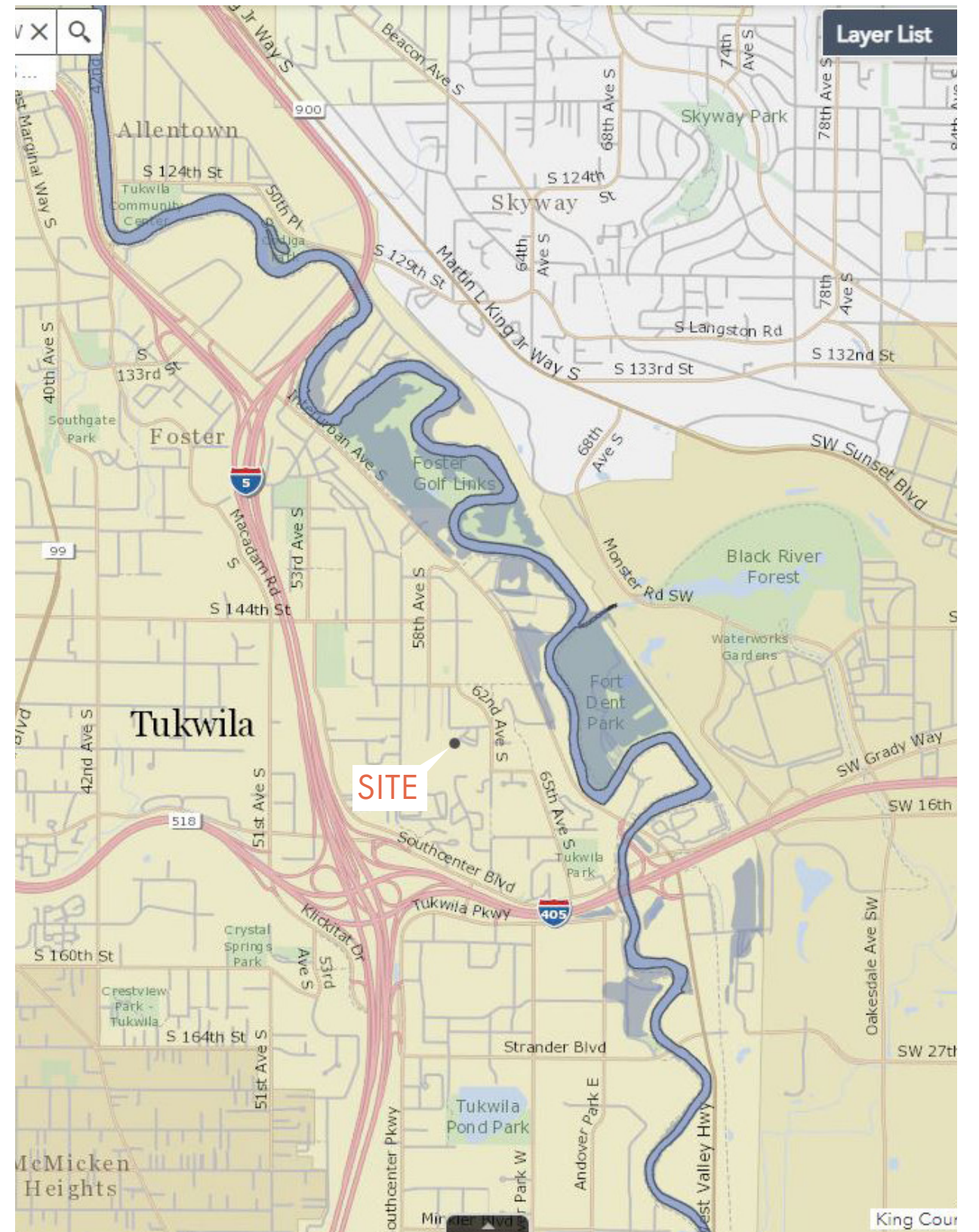


Figure 4.5 : Tukwila 100 year floodplain. Image Source: Tukwila iMap (2017).

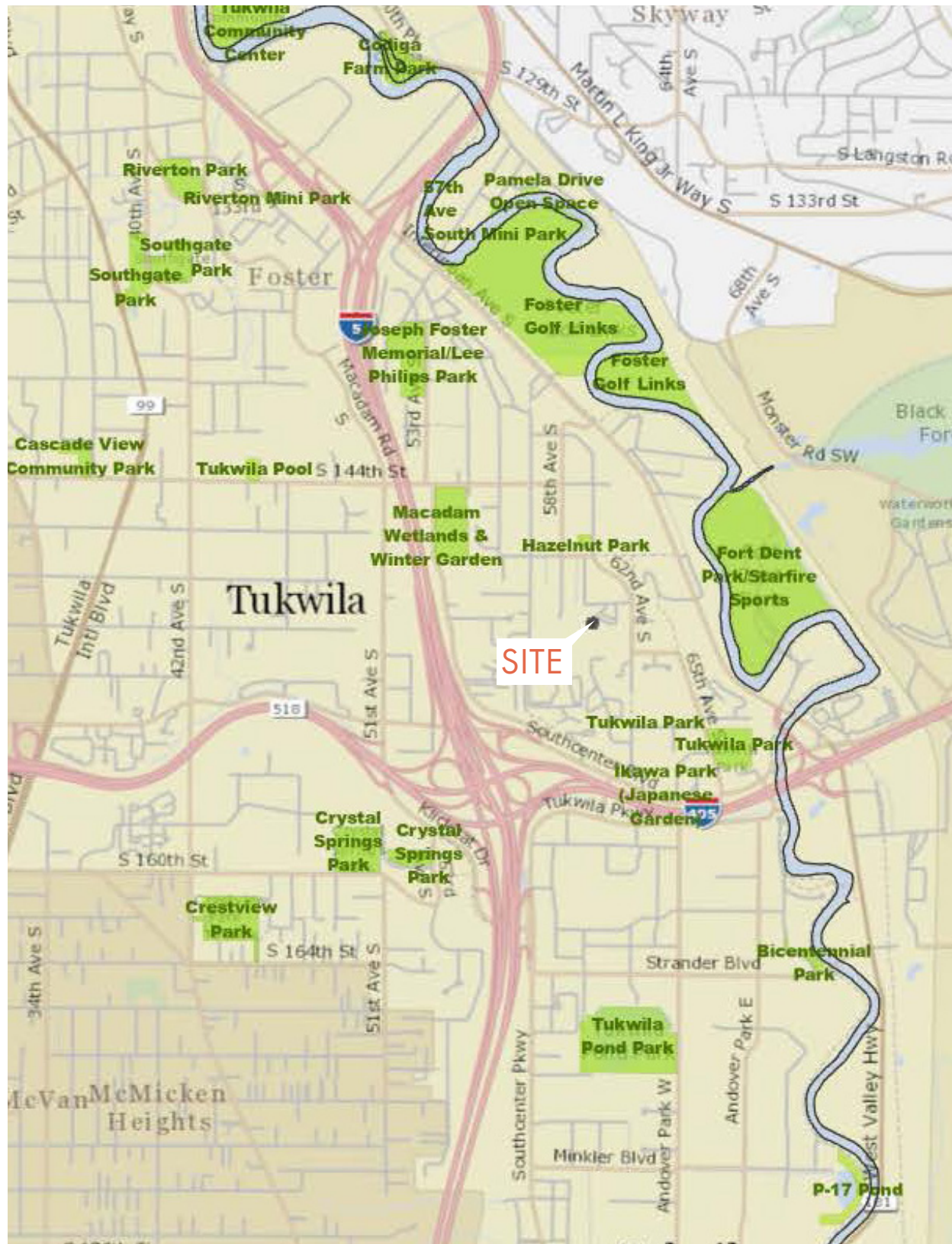


Figure 4.6 : Nearby Parks and Forested Areas. Image Source: Tukwila iMap (2017).

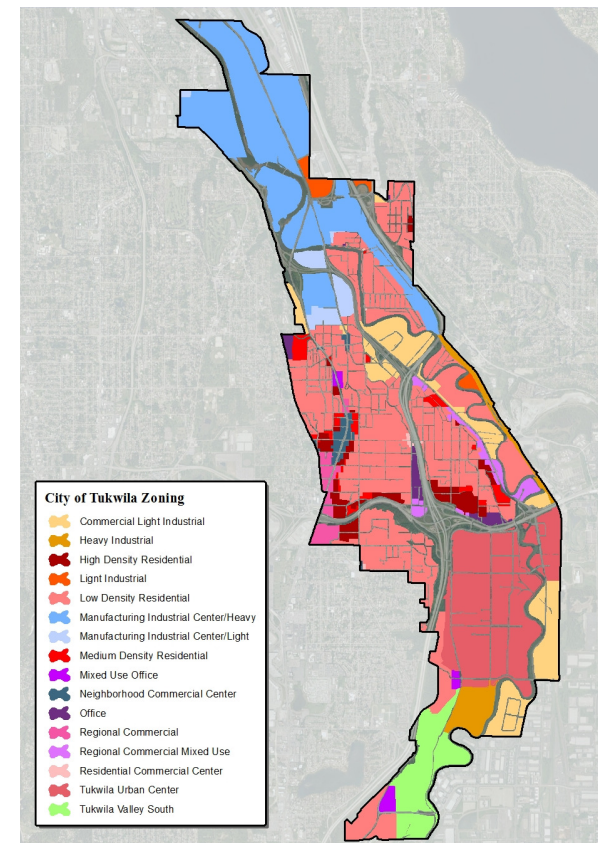


Figure 4.7 : City of Tukwila Zoning. Image Source: City of Tukwila Urban Tree Canopy Assessment (2012)

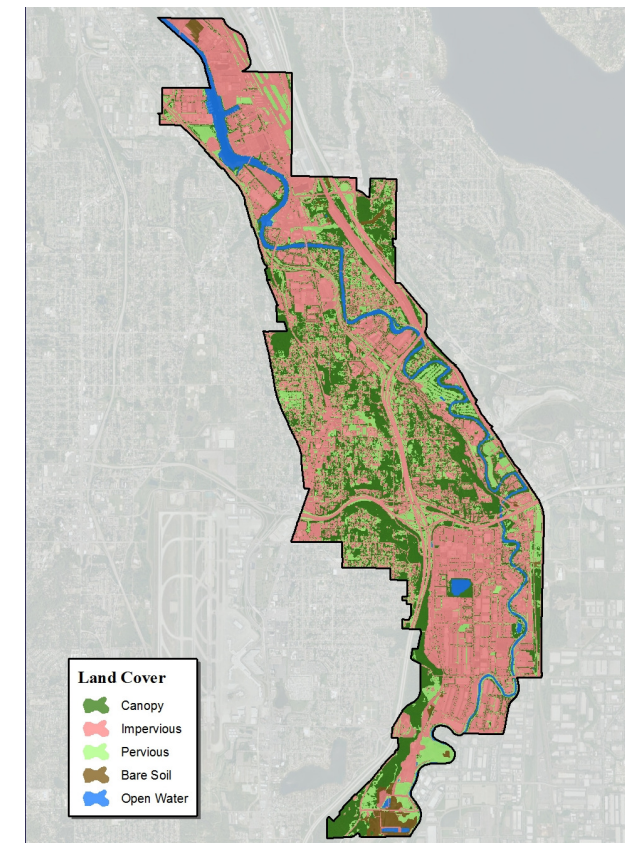


Figure 4.8 : City of Tukwila Landcover. Image Source: City of Tukwila Urban Tree Canopy Assessment (2012)

A study of the City’s zoning and land cover also reveals that this site is well suited for an intervention (figures 4.7 and 4.8 above). For example, a significant portion of the city is zoned for commercial and industrial uses. This correlates with the map showing the impervious surface cover to be 51%. Additionally, the current average

tree canopy cover of 25% reveals an opportunity for design to intervene to help mitigate the forecasted heat and precipitation effects that are predicted for this region.

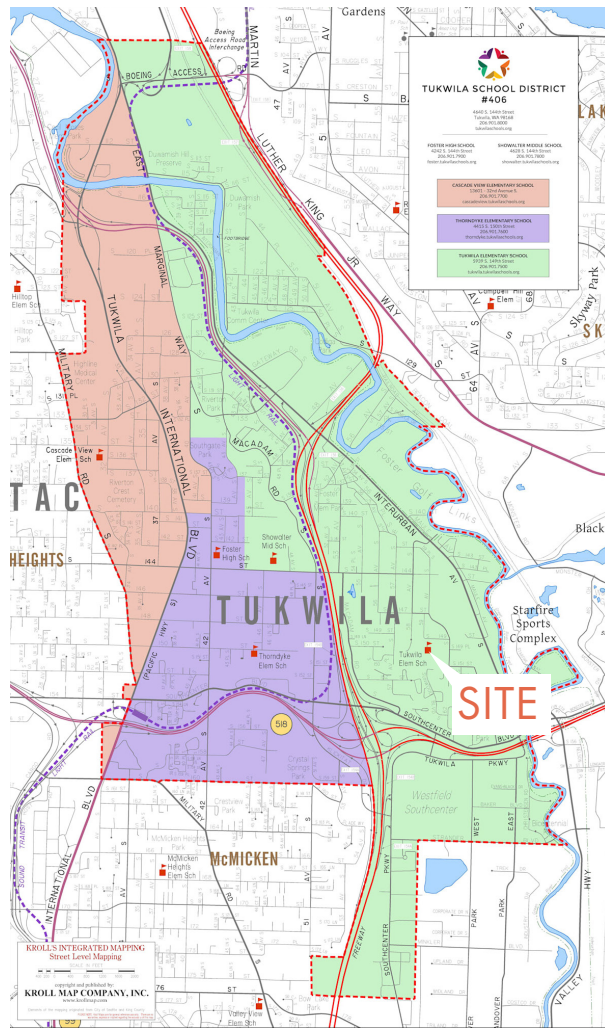


Figure 4.9 : Tukwila School District Zone Map. Image Source: Tukwila School District (n.d.)

DATA AND DEMOGRAPHICS

POPULATION (PER 2012 CENSUS):

- 44% White
- 19% Asian
- 18% African American
- 9% Other races
- 6% Two or more races
- 1% Native American
- 12% Latino

Figure 4.10 : Tukwila Data and Demographics per 2012 Census. Image Source:

Tukwila also presents statistics that reveal that its public education system is in need of repair. Tukwila Elementary School plays a crucial role in serving a significant portion of the city’s population, as indicated in Figure 4.9. According to the 2020 census, Tukwila is a highly diverse area (figure 4.10) with a significantly lower median household income of \$71,688, as compared to Seattle’s median household income of \$105,391 (U.S. Census Bureau, 2021). A Health Needs Assessment Report conducted by King County in 2019 reports that the Tukwila school district has the second highest rate (79%) of students qualified for free and reduced-price lunch, compared to the King County rate of 35.7% (King County Community Health Needs Assessment, 2021/2022). In addition, statistics from this report revealed that one in four students were not able to graduate on time within this school district. (King County Community Health Needs Assessment, 2021/2022) Research has shown that climate-related impacts often disproportionately affect underserved and vulnerable populations, like the one found in Tukwila (Garcia & Weiss, 2020). Given these statistics, it becomes apparent

that a future school could play a crucial role in supporting these students who may be disproportionately affected by school closures or climate-related emergencies.

FRAMEWORK SUMMARY

The current demographics, land cover, and zoning of Tukwila provide context for the speculative design of the school and a survey of the climate change impacts on the Duwamish River Basin illustrates the urgent need for solutions that can effectively mitigate these risks. Notably, Tukwila faces heightened vulnerabilities such as increased flooding and more frequent and severe heat waves. The prevalence of impermeable surfaces and a limited tree canopy further contribute to the exacerbation of these conditions. To support the design framework, the imagined narrative below creates the following scenario:

The city of Tukwila, recognizing the need for alternative learning environments that foster restoration and resilience, has decided to make a strategic investment to regenerate a forest that surrounds Tukwila Elementary School. The deliberate reforestation efforts tackle the pressing need for increased forest canopy and green infrastructure in response to predicted flooding in the Duwamish River basin, increased rainfall, and risk of extreme heat events for the area. This initiative additionally provides an immersive natural setting for refuge and healing, the capacity to decrease stress, address trauma, enhance learning and promote adaptability in the face of impending climate change. The city recognizes that this school project is also a community investment that offers safety, healing, and refuge to all. By integrating nature and prioritizing well-being, the school becomes a transformative space that supports the holistic development and resilience of its students, teachers, and the broader community.

DESIGN EXPLORATIONS AND PROVOCATIONS

THE FOREST SCHOOL DESIGN PROPOSAL

Over the course of a century, the regrown forest gradually expands, connecting the once scattered pockets of greenery around the site. Eventually, it extends its reach outward, reaching the banks of the Duwamish and Green rivers. This transformative process results in the creation of a shared community campus, that provides shade relief and resilient flood mitigation networks while fostering a sense of belonging for all.

CURRENT CONDITIONS

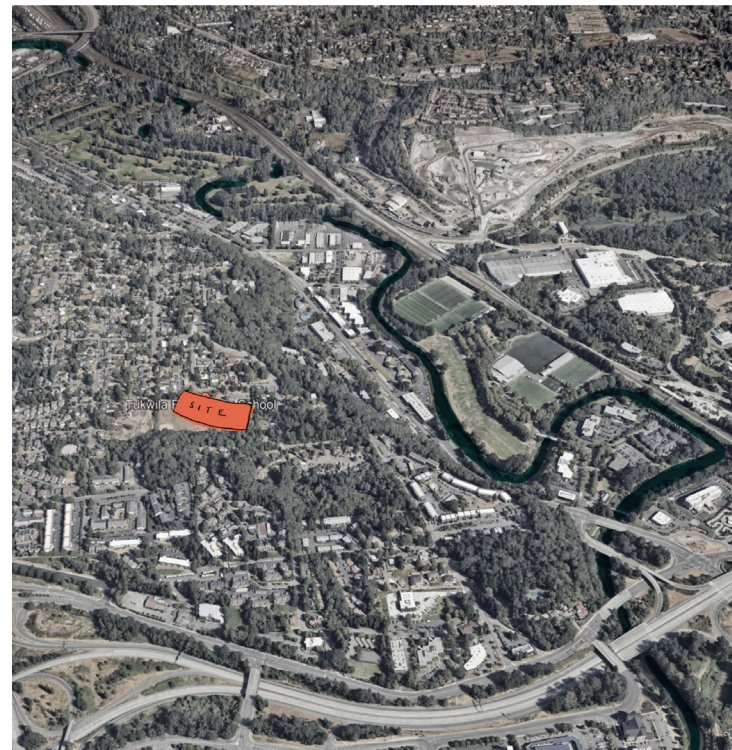


Figure 4.11 : Current Conditions. Base Image Source: Google Earth Pro (2023).

INDUSTRIAL AREA REGROWTH (+50 YEARS)



Figure 4.12 : Industrial Area Regrowth. Base Image Source: Google Earth Pro (2023).

FOREST POCKETS CONNECT (+100 YEARS)



Figure 4.13 : Forest Pocket Connectors. Base Image Source: Google Earth Pro (2023).

SITE PLAN

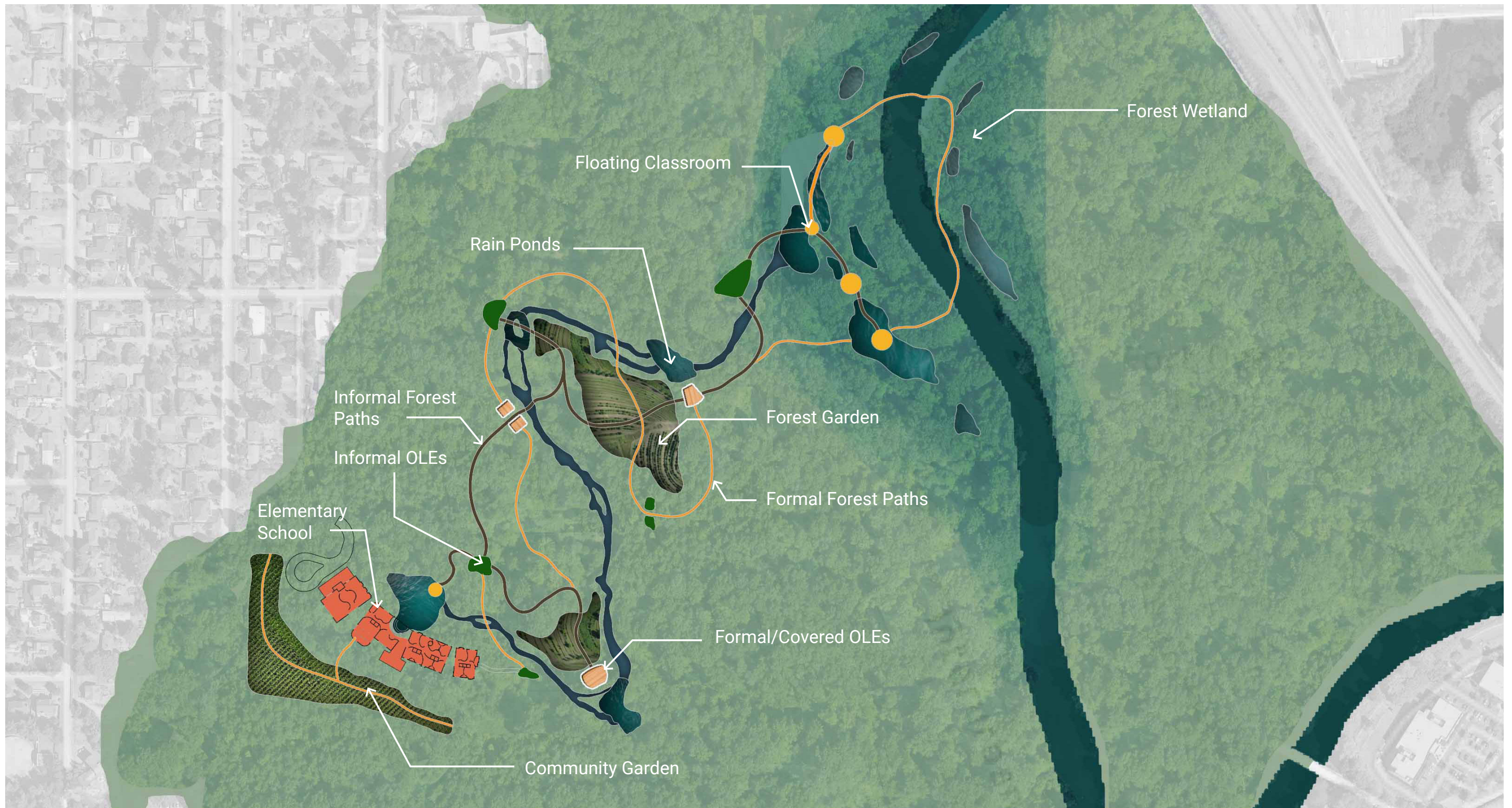
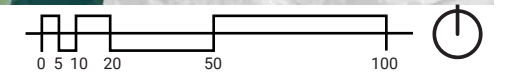


Figure 4.14 : Speculative School Design Site Plan. Base Image Source: Google Earth Pro (2023).



The site plan draws inspiration from the IslandWood case study and incorporates its design strategies. These strategies include: the creation of a natural forest setting, a scattered variety of OLEs that encourage exploration and engagement with nature, opportunities for connection to water, and rentable community spaces that foster community investment and interaction. The site is also designed in accordance with the design matrix to offer integrated strategies for engagement with nature.

BLURRING BOUNDARIES

The extensive network of trails and pathways of different material types, allow for a continuous connection with the natural environment. This approach serves to blur the boundaries between learning spaces that are formally designed, and informally planned. This design strategy encourages a sense of exploration, discovery, and immersion enabling students to embrace the opportunities offered by nature beyond the traditional classroom setting.

ENGAGING THE SENSES

The site features a variety of gardens, serving both the community and

school, and allowing students valuable opportunities for active engagement in cultivation and environmental stewardship. Additionally, the scattered inclusion of different plant typologies found in nature and the incorporation of natural footpaths invite students to engage with the forest school using multiple senses.

FLEXIBILITY AND DIVERSITY

A diverse range of OLEs catering to both small and large-scale spaces can be found on site. These OLEs provide students and educators with the freedom to explore a multitude of options for teaching and learning. This fosters flexibility and adaptability in the learning process. Students can benefit from a wide range of immersive experiences.

KEY MAP

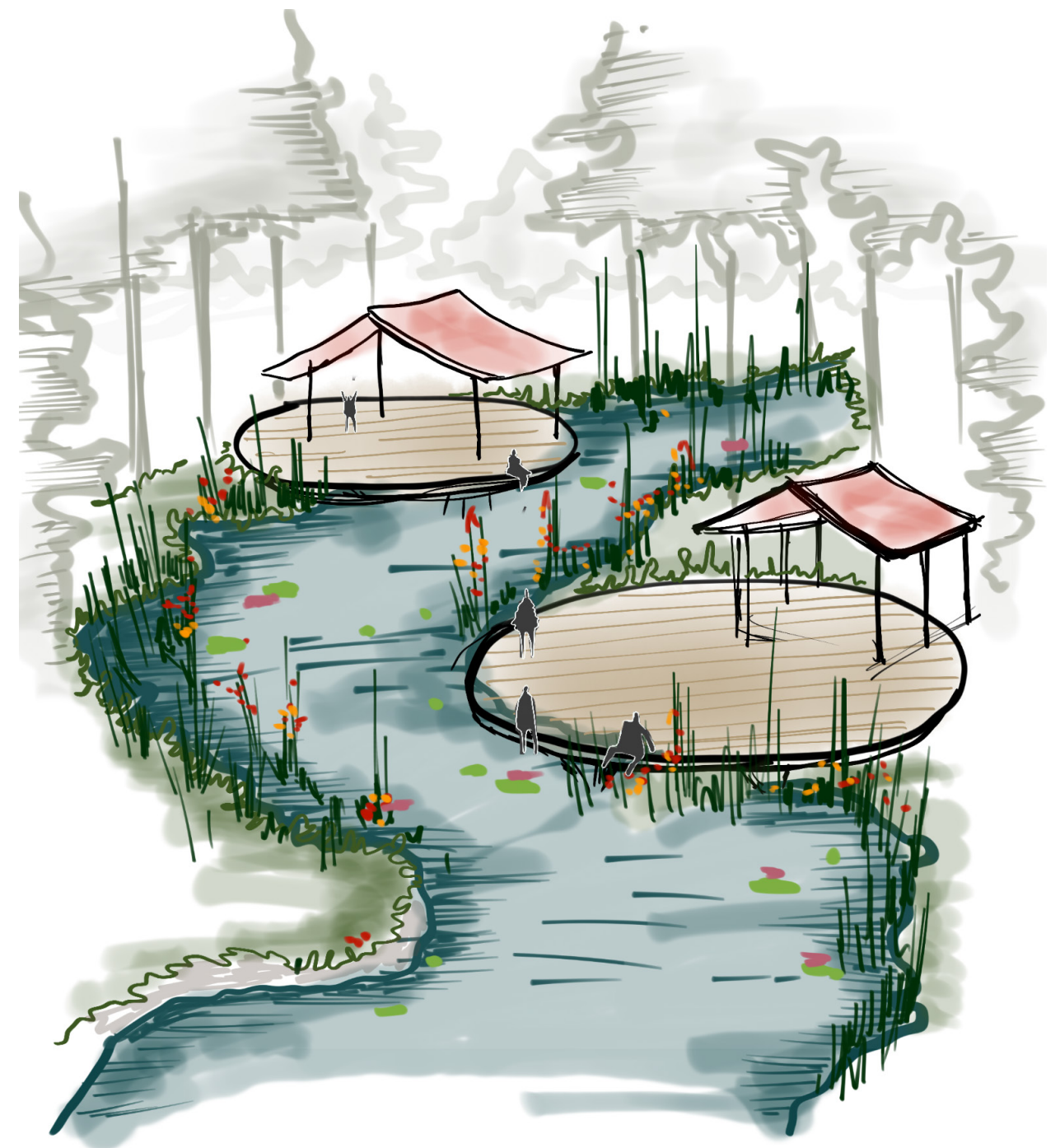


Figure 4.16 : Floating Wetland Classrooms at Tukwila school of the future. Image by author.



SCHEMATIC FLOOR PLAN



Figure 4.17 : Speculative School Design Floor Plan. Image by author.

BLURRING THE BOUNDARIES

The design of the school prioritizes sustainability and resilience through the preservation, rather than rebuilding, of the exterior walls that aims to maintain their integrity as much as possible. The outer walls provide structural support and cohesion, thereby freeing the interior space from conventional boundaries and allowing for a seamless integration of nature. As a result, the design creates a fluid transition between the built and natural environment that blurs the distinction between the two. This design strategy allows the space to adapt and evolve to accommodate diverse needs and uses. The flexibility of the design encourages a dynamic interaction between the outside and inside to promote stress reduction, attention restoration, and a multitude of other benefits.

ENGAGING THE SENSES

The design draws inspiration from trauma-informed design strategies that have been explored in various design frameworks including those for health care and supportive housing. These strategies prioritize creating environments that are sensitive to the experiences and needs of individuals

who have experienced trauma. The plan incorporates design guidelines suggested in Bollo and Donofrio's research (2022) that are aimed at promoting a sense of community and collaboration. This is shown in the shared spaces located within each of the school bays (figure 4.17). The design guidelines also suggest reducing and removing adverse stimuli and stressors which are addressed in the healing pods that are integrated into each classroom space (figure 4.18). The healing pods allow for overwhelmed and overstimulated users to retire and decompress for a time. Additionally, the incorporation of curved interior walls serve as soothing elements that improve site lines and contribute to a heightened sense of safety (Jewkes et al., 2019). The curved walls also reflect the incorporation of biomorphic forms, a strategy for biophilic design, that serves to connect the user with nature and natural elements (Ghaziani et al., 2021).

CREATING FLEXIBILITY AND DIVERSITY

The design also promotes a dynamic and multi-sensory environment (Bollo



Figure 4.18 : Inside the healing pod. Image by author.



Connection to nature through views.



Separate healing rooms for visual and auditory stimuli.





Adaptable and configurable to student needs.

& Donofrio, 2022) by engaging school users through connections with natural elements such as plants and water (figure 4.20). The flexible and multi-use environments within the school provide user control that fosters a sense of identity and ownership and reflect the need for empowerment and personalization that are key elements of trauma-informed design (Bollo & Donofrio, 2022). (Figure 4.19).

By integrating these trauma-responsive design principles and embracing biophilic elements, the overall design aims to create an environment that promotes healing, supports well-being, and enhances the overall educational experience.

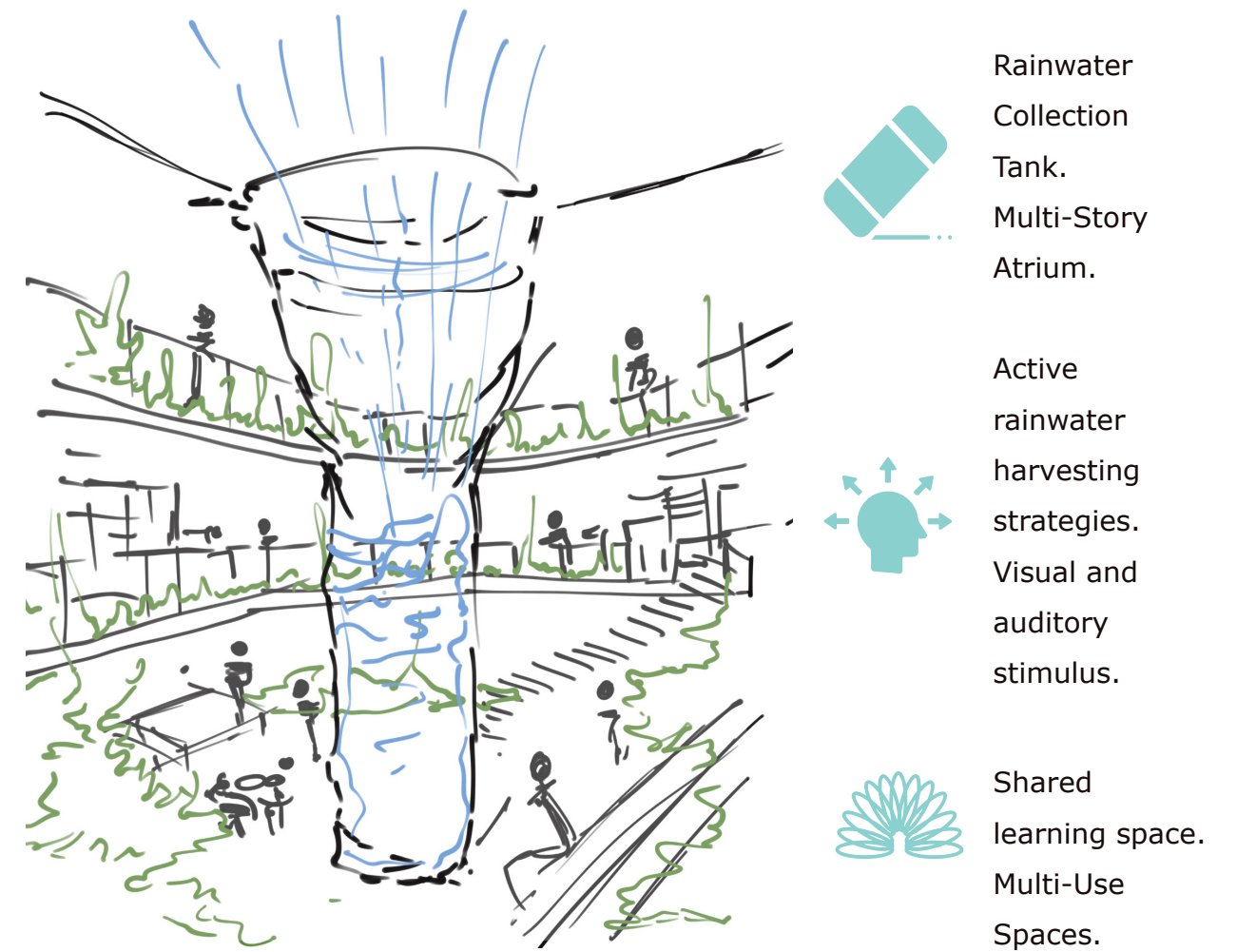


 Large windows and skylights provide views to the outside.

 Auditory and Visual stimulation.

 Flexible Spaces. Multi-Use bookshelf/ Planter. Movable furniture.

Figure 4.19 : Speculative School Library. Image by author.



 Rainwater Collection Tank. Multi-Story Atrium.

 Active rainwater harvesting strategies. Visual and auditory stimulus.


 Shared learning space. Multi-Use Spaces.

Figure 4.20 : Future Tukwila School Atrium Space. Image by author.

The realm of speculative design creates an avenue to envision alternative possibilities and futures of the present. This explorative vision of future elementary schools shows their potential to serve multiple functions, become integral parts of the community, act as assets during crises, and provide restorative spaces for healing and therapy in a rapidly changing and increasingly stressful world. These visionary elementary schools are designed to be resilient and adaptable, capable of responding to unforeseen circumstances, and harmoniously integrated with natural systems. This design proposal goes beyond the idea that schools are merely places for learning. They have the potential to become vibrant hubs for community interaction and well-being. The elementary schools of the future present boundless possibilities, limited only by imagination and willingness to change.

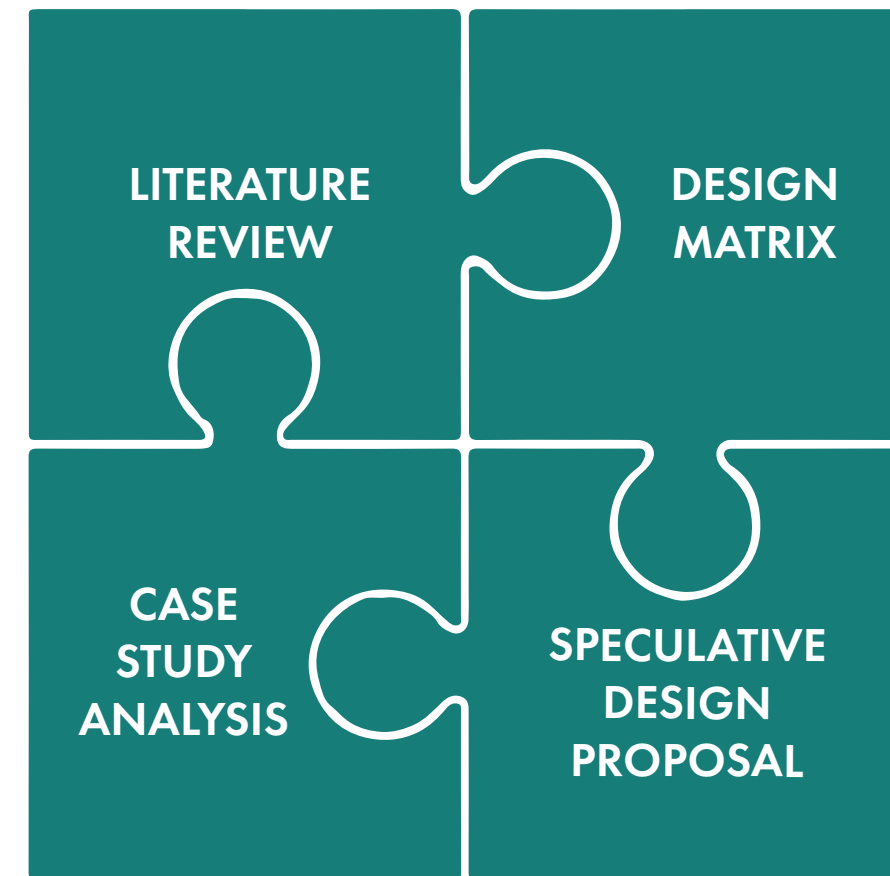
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PART 5

REFLECTIONS AND CONCLUSIONS



DISCUSSION

In summary, this thesis suggests that although the COVID-19 pandemic exposed weakness in the United States elementary school education system that resulted in increased stress on students and educators, trauma, loss of school community, and declining mental and emotional well-being, it also highlighted the need for design interventions to mitigate future crises and reimagine schools as restorative spaces that are seamlessly integrated with nature. Departing from the boundaries between the natural and built environments in traditional school design, the thesis proposes integrated design solutions and strategies that offer numerous benefits for health, mental well-being, and academic performance of school users.

The four interrelated methodologies employed in the thesis: literature review, design matrix, case study analysis, and speculative design proposal, build upon one another to generate knowledge and connections. The literature review identifies gaps and opportunities for designing with nature

to promote restoration and cognitive development that were then translated into a design matrix of design strategies applicable in a post-pandemic context. The design matrix was later applied to three distinct case study schools in Seattle for lessons on how to apply it in different contexts. Lastly, the insights gained from these methodologies informed a speculative design for an elementary school of the future that challenged conventional practices and restrictions in the elementary school design. This process also helped to explore and expand on the thesis framing question of how design can respond to the current challenges and anticipated future of post-pandemic educational settings.

By examining both present-day applications and speculative design futures, this thesis explores different time scales, allowing for a comprehensive understanding of the realities and challenges faced in elementary school design. While predicting the speculative future is challenging due to factors like climate

change and evolving educational pedagogies, studying present-day design strategies offers interim solutions until that future is realized.

STUDY LIMITATIONS

This research thesis acknowledges certain limitations regarding the scope and context of the study on the design of elementary schools of the future. Firstly, it recognizes the interconnectedness between the public school system and the political and social economy of the United States. Achieving a desired future for elementary schools requires mutual support and adaptation between these spheres. The exploration of the political sphere, beyond the discussions of how school closures disproportionately affect underprivileged students, was not included in the scope of research. To realistically study the future development of elementary school design, further connections and investigations across these two areas are necessary.

Similarly, this thesis does not comprehensively explore pedagogy and the specific teaching practices employed

by educators. To create schools that effectively cater to user needs, more research and interviews with educators would be required to inform this interrelated aspect of design.

Additionally, there is limited research available on trauma-responsive design, particularly within the context of elementary schools. Given the increased risk of future pandemics and the influence of climate change, the importance of trauma-responsive design to facilitate recovery and healing becomes even more apparent and necessary. Further research in this field would be valuable in informing the design of elementary schools with regard to trauma-responsive design.

THEMES TO EXPLORE

The research has generated various avenues for further exploration and research. For example, one area of further study is the connection between the benefits of nature and the design considerations for neurodivergent students. By incorporating these linkages into the future design of elementary schools, a more inclusive and diverse design can be achieved,

accommodating the needs of a wide range of users. This area of study would also inform the necessity to comprehensively understand the needs and desires of school user groups in order to translate them into a targeted design solution. Understanding these needs and preferences necessitates comprehensive studies and discussions with both educators and students.

Another theme to explore, particularly with the speculative design of an elementary school, is its relationship with the broader educational context. While the school was designed as a singular unit in this research, it has the potential to become a model for the entire educational system. Further investigation into the practicalities and processes involved in implementing this as a model would provide valuable insights in the expression of its design.

The speculative design also allowed for the exploration of alternative educational futures that were unconstrained by current realities. However, it raised questions about the logistical aspects of maintenance resulting from the integration with nature. This aspect is also tied with

the need for development (or study) of technologies that can facilitate the school's adaptability to different weather conditions and open nature and help bridge the gap between proposed futurisms and current realities.

Finally, the exploration of the speculative design for the school has raised new considerations on the theme of schools serving as more than just places for learning. It suggests that the future model of education could be community-based in order to foster investment, safety, resilience, and social relationships. Investigating how this model could be applied as the foundation for all forest schools of the future would contribute to a better understanding of the benefits of integrated schools.

CONCLUSION

Elementary educational systems are at a crossroads for transformation and the COVID-19 pandemic has highlighted the need for designers to reimagine the potential for elementary schools of the future. It is crucial to view schools not merely as educational spaces, but as environments that foster recovery, restoration, nurturing, and community building. By integrating nature holistically into design, elementary schools have the power to become sanctuaries of healing and refuge for students, educators, and the community alike. The current circumstances call for the exploration of alternative trajectories in education systems to ensure a promising future.