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Title

THE FUTURE OF OUR FUTURE: DESIGNING EARLY EDUCATION FOR ALL

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MASTER OF ARCHITECTURE

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THE FUTURE OF OUR FUTURE: DESIGNING EARLY EDUCATION FOR ALL

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ABSTRACT

“Disability is a natural part of the human experience and in no way diminishes the right of individuals to participate in or contribute to society” (“About IDEA,” n.d.). Starting from a young age, children strive to be wanted, accepted and included. Elementary schools serve as a launching pad for the rest of everyone's lives. Making sure students, in all capacities, are thought of from the beginning is crucial to successful design.

Often, students with learning disabilities are sent to different rooms with different teachers to learn at different rates. What if there was a way to keep all students together and give them equal opportunities? Students with physical disabilities might be given different resources in certain classes because they “cannot” do specific tasks. What if building design helped all students receive the same resources? No one wants to be isolated. Solving the problem of inclusion can be undertaken by understanding universal design.

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LIST OF ABBREVIATIONS

ABA .....Architectural Barriers Act

ADA .....The Americans with Disabilities Act

AG.....Agricultural

IDEA .....Individuals with Disabilities in Education Act

ND.....North Dakota

OPCRC .....Oak Park Community Recreation Center

P/I.....Public/Institutional

SLC .....Student Learning Communities

UD.....Universal Design

LIST OF SYMBOLS

% .....Percentage

& .....And

‘ .....Feet

“.....Inches

1. INTRODUCTION

"Universal Design is not about buildings, it is about building – building community, building better pedagogy, building opportunities for agency. It is a way to move" (Dolmage, 2017). Universal Design is an approach that can be implemented into all architectural designs. It can be defined as designing and composing environments to be accessible and usable by all people regardless of their abilities, sizes, or ages (*About Universal Design*, n.d.). In the field of education, the physical building can help shape the users by understanding individual learning types and implementing those into initial planning. Schools are places to bring together the people of a region. If the focus of an educational building starts with a child, families, communities, and societies can be influenced. Hence, if that school building can serve as a place for everyone to be seen, the community will benefit from happier and healthier users. Identifying the problems within the current education system and modeling creative solutions is the intended objective of universal design within elementary education.

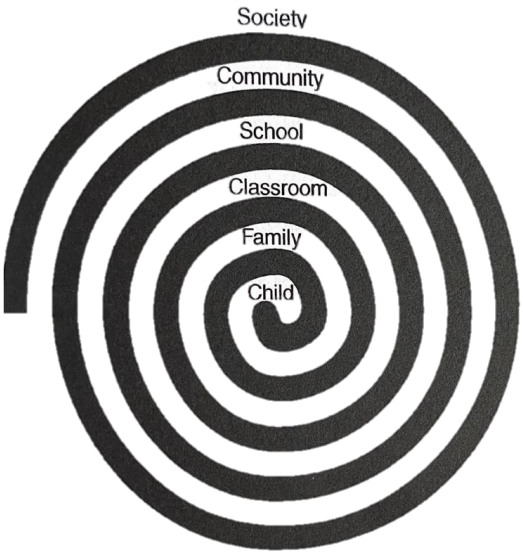

Figure 1. Ecological Model (from McNichol, 2021, p. 71)

1.1. Problem Statement

Solving the issue of inclusion by exclusion of students with disabilities that most schools follow could create a more equitable education space. Currently, many students are taken out of classrooms to get information presented to them differently. Fully understanding different learning types can incorporate all students and guide final design decisions. Contemporary educational models are only conducive to some users. Stopping the segregation of learning types will help improve the mental health of the affected students.

1.1.1. Research Question

How can schools be designed to be more inclusive to students of all abilities (physical, mental, or emotional) and learning characteristics through proper use of Universal Design and sustainable strategies?

1.1.2. Proposed Outcomes

The expected research aims to define universal design, successful elementary schools, and how sustainability can influence the preceding goals. The framework of this proposal is based on inclusion following the Individuals with Disabilities Education Act. Fully understanding the legal requirements can lead to better architectural responses. The impact of a successful design can influence other schools, communities, and even countries. The posterity of a new pedagogy can be supported by research that will influence the built environment.

1.2. Objective

Providing users with multiple ways to absorb and comprehend content has improved their overall understanding of a subject matter (Aisami, 2015). This thesis proposal will consider the typical learning styles supported by both right and left-brained learners. All students (no matter

their physical or emotional abilities) fall somewhere within the range of learning styles. Discovering how to incorporate the styles into initial architectural planning is crucial to successful universal design. Including all students by various means will be the overall intention of the elementary school.

1.2.1. Aim

Establishing an educational framework that is supported by architecture to help students of all abilities learn and develop to become successful and active members of society.

1.2.2. Significance

Research into elementary-aged students is essential because they are at the earliest stages of the American education system. If change is needed, it should be implemented at a young age so the improved model can mold them. Every person must experience education in some way; that is why we should try to accomplish the most successful way for students to learn. Whether they have disabilities or not, they should be learning the same content as everyone else. Allowing each student to learn and grow within their young education is essential for their confidence. "Identifying multiple learning intelligences for students with learning disabilities can help in capitalizing on the students' intelligence strengths, and teach them accordingly" (Aisami, 2015). Therefore, incorporating the multiple learning styles and implementing them into the architecture of a space will better support the students of the future. Giving users the freedom to feel comfortable and confident from a young age will catapult them into a successful future.

2. BACKGROUND

"Accessible design – design that is usable for people with physical, sensory, and cognitive abilities" (Williamson, 2019, p. 1). This concept within architecture and the world

gives all users equal opportunities. There is a rich history of universal design within America that will be introduced in the next subchapter. Recognizing the past can instruct architects to build a better future. The literature review will include ample information on how past design will shape the prospective architecture of this proposal. Applying this approach to elementary schools will create an environment that fosters inclusivity and growth. Understanding how each school functions and how to better that is imperative to advancing the students. Improvement upon consideration of all students within a school will build upon the intention of universal design. Diving into learning types gives a broader consideration to all students and how the original design of the building can support these users. Present-day, all architecture should acknowledge sustainable design in several respects. There are many active and passive ways to create sustainable architecture. The best options for typology and geography will vary. Sustainability can have many different meanings. Interpreting those meanings and making resourceful design choices will better architecture. The literature review below gives the reader insight into universal design, elementary school design, and sustainable design. These three divisions are different but will come together to create an equitable solution for the future of education.

2.1. Universal Design

2.1.1. Historic Applications of Universal Design

The history of Universal Design has evolved over decades or centuries. Most significantly, the 20th century introduced major changes within civil and human rights. This push for equality not only affected women and people of color, but also people with disabilities (*About Universal Design*, n.d.). Within America, accessible design is a subsector of universal design that specifies designing for disabilities. Accessible design is specifically the process of designing spaces that all people can access, regardless of their physical, sensory, or cognitive disabilities

(Williamson, 2019, p. 1). The difference between accessible design and universal design is the level of intimacy. Universal design improves the use of everyone. Accessible design creates a more personal environment catered to a personal need (*About Universal Design*, n.d.).

2.1.1.1. Architectural Barriers Act of 1968

In the 1940s, significant efforts to address barriers in public spaces came to fruition. After World War II, many disabled veterans no longer had equal opportunity upon their return to the civilian world. The first federal law requiring accessibility was the Architectural Barriers Act of 1968.

Figure 2. Paralyzed Veterans After WWII (from *Paralyzed Veterans of America*, 2023)

This was created to ensure that people with disabilities could access the built environment. Facilities that were governed by federal agencies now had to be accessible. They hoped that this would influence other renovations and construction to follow. Veterans Affairs medical facilities, national parks, federal office buildings, U.S. post offices, certain schools, some public housing, and mass transit systems were now under the ABA's rule. In these buildings, ramps, parking,

doors, elevators, restrooms, fire alarms, signs, and more have new specifications they had to meet to comply.

Figure 3. Accessible Ramp at Federal Building (from *Paralyzed Veterans of America*, 2023)

The Department of Defense, the Department of Housing and Urban Development, the General Services Administration, and the U.S. Postal Service now had to enforce the standards of the ABA (*U.S. Access Board - Architectural Barriers Act*, n.d.). The ABA was the first step toward accessibility for all users of the built environment. This has been altered and refined as the years have passed, but we have learned from it and evolved. Without the ABA, the Americans with Disabilities Act may not have had the impact it did at the time of implementation.

2.1.1.2. Americans with Disabilities Act

The United States was the first country to set architectural access as a national law (*Introduction to the Americans with Disabilities Act*, 2023). In 1990, the Americans with Disabilities Act created a legislature for accessibility within all aspects of life. This prohibited discrimination against people with disabilities, different race, color, sex, national origin, age or religion (*Introduction to the Americans with Disabilities Act*, 2023). Giving everyone equal opportunities was the ADA's goal. From there, the United Nations created a committee to initiate

access “to the physical environment, to transportation, to information and communications, including information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public” (Williamson, 2019, p. 2). The sudden focus on inclusive design caused many years of awkward transitions. Regulations on architects and builders were unclear and unevenly imposed, causing decades-long renovations that provided feeble public prospects. By the time the ADA had passed, there were very few successful examples of accessible architecture (Williamson, 2019, p. 147). ADA Title III was influential to the built environment. This created equal access to businesses and nonprofits. Restaurants, hotels, doctors’ offices, stores, taxis, and others must now provide people equal access to the goods they offer (*Introduction to the Americans with Disabilities Act*, 2023). Since 1990, designers have become more comfortable with these requirements and have adapted their designs. They now know what is needed so their designs will not be “compromised” later on. This has challenged but progressed designers to think about all users that will enter a building in its lifetime.

2.1.2. Application of Universal Design

Integrating accessibility approaches allows for seamless and subtle ways for inclusion to happen. The laws of ADA and ABA can seem like hurdles, but creating open and successful universal designs is a part of architecture. Architecture should be universal yet anticipate a range of physical or mental abilities. “Architecture needs to embrace the concept of universal, accessible space for everyone, while also celebrating the unique abilities and differences our bodies, our mobility, and our imaginations” (Woodbury University, 2011).

Within *Rethinking Accessibility*, ten principles for universal specificity were laid out.

- Treat circulation as infrastructure

- Access and egress are not equal
- Integrate accessibility
- Layer activities
- Retrofit accessibility artfully
- Treat wheelchairs as vehicles
- Note that ¼" makes a difference
- Treat design for the disabled as an opportunity to create architecture that is sensual
- Create universal specificity, not "one size fits all"
- Create architecture that offers support (Woodbury University, 2011, p. 8)

These principles help designers think of universal design in a new way. Circulation should be thought of as infrastructure as it is a system within the architecture. Access and egress are not equal. Egress is designed for emergencies, yet access should be an enjoyable or designed moment. Accessibility should be integrated as an experience for all persons. Layering activities and creating multi-purpose spaces allows people of all abilities to unite. Retrofitting accessibility can be done in a meaningful way. This allows designers to create space for all, not just access for people with disabilities. When designers treat wheelchairs as vehicles, segregation is avoided, and all users have equal freedoms. The floor of every environment should be curated carefully. Any small crack, bump, or crevice can change a user's experience. Design for the disabled is an opportunity to create more tactile or exaggerated architecture. Most times, these small details are overlooked. However, new environments are unlocked when designers put themselves in the shoes of people with different abilities. One size fits all is not a concept that works within universal design. Architectural atmospheres should fluctuate and be versatile for the variety of

users entering the spaces. Architecture that offers support is one of the final principles that create successful environments. The details within handrails, grab bars, doorknobs, and others should not be overlooked. These seemingly small items make a huge difference to the users (Woodbury University, 2011). Overall, integrating functional and adaptable architecture allows people of all abilities to feel included in a space.

2.1.2.1. Inclusive Education Practices

"In 2019-2020, the number of students ages 3-21 who received special education services under the Individuals with Disabilities Education Act was 7.3 million, or 14 percent of all public school students. Among students receiving special education services, the most common category of disability (33%) was specific learning disabilities" (Irwin, 2021). Given these statistics, the educational space must be inclusive to all students, even those with learning disabilities. Throughout the past 14 years, it has been shown that keeping students in the traditional classroom benefits their learning. Removing them and giving them additional resources is a dying trend. Supporting them through services that are available to all students has kept them engaged and on track with other students. Ninety-five percent of all students being served by the IDEA are enrolled in public schools (Irwin, 2021). This provides a large market of impact to be improved upon to serve these students best.

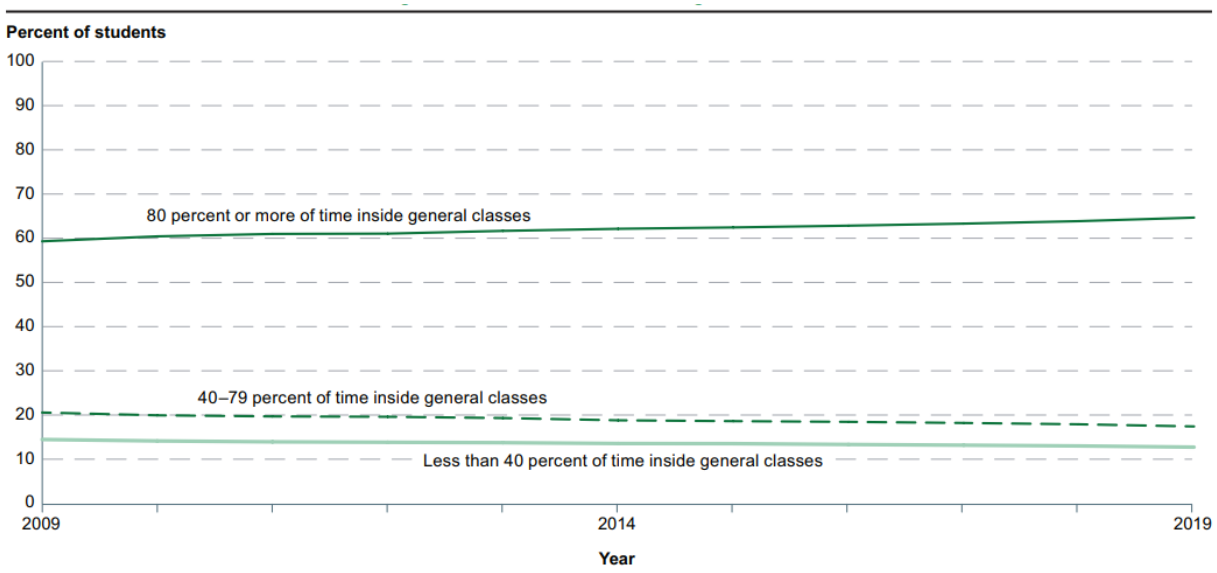

Figure 4. Percentages of Students Inside General Classes (from "Students With Disabilities," n.d.)

In general, there are many findings regarding the evidence supporting or opposing the inclusion of students in school settings. Overall, inclusive educational settings significantly benefit students who are educated alongside students with disabilities. Both groups lead to positive social and educational developments. Mathematics and reading scores, social competence, and improved attendance, among others, are all areas that have been positively proven through research on inclusive education. Including students with disabilities also improves teaching practices within a school. The schools must develop competence that will strengthen each student through better education practices.

Contrary to these findings, a few reports suggest that these types of inclusion can lead to internalizing behavioral issues, lower interpersonal skills, and avoidance of students with physical disabilities (McNichol, 2021). Overall, inclusive education leads to a more successful learning environment. The majority of studies lead to positive effects or no differences. Through proper implementation, educational practices can be altered to benefit all students expectantly positively.

2.1.3. Future of Universal Design

"Designing an accessible America – still a vision left unfulfilled – requires embedding design in systems that can support rights and equality in ways that go beyond the material" (Williamson, 2019, p. 214). Understanding and digesting this quote can make a designer think critically. What about America is not accessible? How could we better design building systems? How can the built environment support equality? Making architects look within themselves and address biases they might have can help create a more equitable environment. When a designer thinks of every user, the space will consequently be more inviting and valuable.

To design universally, a variety of goals should be followed. Comprehending the following ideals leads to successful environments.

- Body fit is the first goal to understand. Accommodating for the range of body sizes and abilities allows for body fit to consider every user.
- Integrating the variety of abilities and body sizes allows users to feel content.
- Comfort is important to keep in mind as it portrays the limits of someone's bodily function.
- Awareness ensures that information is recognized and understood by all.
- Understanding creates precise methods of operations within the architecture.
- Wellness promotes health and the prevention of bodily damage - social integration forces groups to be treated equally.
- Personalization allows for the incorporation of choice or individual expression.
- Finally, cultural appropriateness respects other's values and reinforces the project context.

The preceding eight goals can lead a designer to create universally balanced and comprehensive buildings (Areekkuzhiyil, 2022). Through multiple means of engagement, expression, and representation, the future of universal design is encouraging. As designers become more comfortable and confident in the importance of UD, it will be reflected in their architecture.

2.2. Elementary School Design

2.2.1. Evolution of Elementary Educational Models

From the time settlers landed in America in the late 15th century, educational opportunities were established. Access to education was based on region, race, gender, and social class. 'Public' education had been contrived yet was restricted in many ways. By the 1800s, many states had created schools supported by taxes, governed by trained teachers, and the children within the district must attend school (Paterson, 2021). Since the implementation of public schools, these virtues have remained. Nevertheless, public schools have evolved vastly from their original implementation.

2.2.1.1. Normal School

Normal school describes the concept, "based on the French *ecole normale*, a sixteenth-century model school with model classrooms where model teaching practices were taught to teacher candidates. In the United States, normal schools were developed and built primarily to train elementary-level teachers for the public schools" (Paterson, 2021). This preparation of teachers was to instill in them the skills to further educate students on moral behavior. Teachers were thought of as models of strict moral behavior. They also became responsible for developing new ways to communicate ideas, behaviors, and values to students. The normal schools were two-year training programs that developed into "teacher colleges" with 4-year degrees.

The values of normal schools are still apparent in current educational models. Teachers are tasked with educating and modeling students to become future productive citizens. Although the content of these teachings may have evolved, the importance of elementary education has remained.

2.2.1.2. Classroom Progression

Throughout the earliest stages of public-school implementation, schooling was haphazard and segregated. Income, race, ethnicity, gender, geographic location, and other reasons could prevent students from receiving instruction. For most students and families, church-supported schools, tuition schools, boarding schools, "dame schools," private tutoring, and work apprenticeships were the options. Many of these were expensive or unattainable.

Figure 5. Parochial, Church-Supported School (right) Neighboring the Public School (left) in Hannover, North Dakota (from Henke & Albers, 1997, p. 280)

In the 1830s, Horace Mann advocated for a universal system of free and available schooling opportunities for all students (Kober, 2020). To transform the future citizens of the United States, they had to start by making them literate, moral, and productive.

Common schools were established to teach reading, writing, and arithmetic. The idea of educating all children would prepare them to strengthen the nation's economic position. Future citizens now have better opportunities to obtain good jobs because of their education. Within North Dakota, most common schools were seen as one-room schoolhouses. In the mid-1950s, it was estimated that 3,795 one-room schools existed in North Dakota (Henke & Albers, 1997, p. 102). This influenced the education of what is now many of our grandparents or great-grandparents. This concept of togetherness and flexibility worked for decades. Many different ages, genders, and economic classes came together under one roof to hear lessons from the same teacher. Since then, the organization of schools has adapted.

Figure 6. McHenry County School in 1904 (from Henke & Albers, 1997, p. 161)

As public schools were built in urban areas, the concept of one-room schoolhouses diminished. Now, students were separated into their "age-appropriate" classrooms. Schools were built with classrooms as cubes coming off long halls. This monotonous segregation created new challenges. Finding new ways to arrange schools is a priority. Finding new ways to keep students

engaged is also a priority. Seeing schools break away from basic school design is a way to create more inviting and inclusive spaces for children to learn. The shift has already started, and we are seeing more open-concept or flexible classrooms. In hindsight, this mirrors the original idea of one-room schoolhouses. Having space for students of many abilities to have the opportunity to learn in new and exciting ways is essential for their growth. As design progresses, it is important to understand the advantages and disadvantages of challenging what is the norm.

2.2.1.3. Standards of Curriculum

Academic benchmarks for math and reading emerged throughout the years. This was a system to rate students and individuals. The idea of "equal education" came from a standards-based curriculum. These standards started to emerge from state-wide or federal legislation. Most of these models established a "curriculum first" focus. Students were pushed to conform, achieve, and, most concerning, compete. As new standards emerged, teacher autonomy was censored. The idea was that all classrooms would receive the same material, so everyone was given equal resources (Kober, 2020). Since this scripted legislation was distributed, the diversity of education was suppressed.

Teachers have had to learn to engage and entertain their students in the past few years. The 20-minute attention span has been discovered and has changed how teachers entertain and facilitate (Paterson, 2021). Creativity, ingenuity, persistence, and resourcefulness have all recently expanded. The shift to freedom and flexibility allowed by educators has let students grow in more facets than just math or reading. "Ultimately, however, as even the earliest teacher educators knew, the *art* of teaching is that ephemeral quality that we cannot teach, but which we know when we see it at work, that makes the great teacher excel far beyond the competent teacher" (Paterson, 2021).

2.2.2. Understanding of Learning Types

To successfully instruct the leaders of the future, learning about what processes are most effective is important. The psychology behind how and why some forms of teaching are more successful than others is something that should be studied. The left and right brain learning styles affect every student. Delivering the content to students so each learning style can comprehend it will lead to the deeper development of students. The physical limitations of students also affect how they perceive information. Individual disabilities can be studied, and adaptations can be made to fit the needs of everyone. Overall, helping students learn based on their psychological and physical needs will help them succeed in the classroom setting.

2.2.2.1. Psychological Learning Styles

Learning styles are the concepts that support students who understand information when it is presented in different ways. Some students learn by reading. Other students learn better by socializing. Many students prefer to see the content. Hands-on learning has also proven to be very successful. That is how the seven learning styles were discovered. Visual, verbal, aural, logical, physical, social, and solitary are the learning styles that are supported by most researchers (Aisami, 2015).

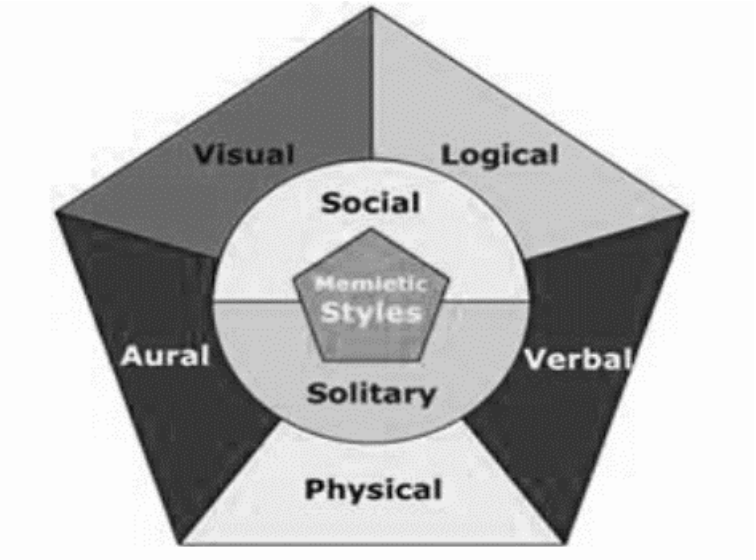

Figure 7. Learning Styles Overview (from Aisami, 2015)

Using these styles to design better learning environments could be monumental regarding inclusion. Multiple instructional strategies should be used because students can have a combination of learning styles. This will allow more students to infer the content. Overall, visuals are very influential when it comes to memory, motivation, and performance. Visuals can be displayed as graphs, models, pictures, maps, photographs, and more. Students are more engaged in learning when images prompt creative thinking and critical analysis. Visuals are a concept that can be successfully and seamlessly integrated into original design or learning spaces. Nevertheless, all learning styles should be considered and supplemented where appropriate.

2.2.2.2. Physical Learning Strategies

Within the learning strategies listed above, physical limitations can have a significant influence on the success of the strategies. Specialized techniques, communications, and assistance must be given to learners with visual impairments, deafness, speech or language difficulties, intellectual disabilities, or physical disabilities. Students with higher needs will require different teaching strategies to get the same value of instruction. Neuroscience gives

outside viewers an understanding of the different needs of learners. Each neurological condition affects the student differently (McNichol, 2021, p. 6). Designing to target the learner's specific needs will change the educational facilities. To be precise, designing a space where students can enjoy their education will impact their health, happiness, and effectiveness.

2.2.2.2.1. Study on Learning Disabilities

A study in the U.S. was conducted to analyze the effects of the inclusive school program on learners with mild to severe learning disabilities in grades 2-6. Special education teachers would work with general education teachers to build upon the curriculum to support learners with more needs. The students with learning difficulties received traditional classroom resources and instruction. Results show that these students made significant progress in mathematics compared to those learning from resource classrooms. Students with severe learning disabilities also progressed in reading and mathematics (McNichol, 2021, p. 61). This study showed that schools often remove students who have difficulties. That is often different from the solution to their difficulties. Finding ways to adapt how information is presented can help give all students an equal opportunity to learn.

2.2.3. Planning of Space Within Elementary Schools

Elementary schools are a place of growing and learning for young people. Making sure that children receive the appropriate care through proper planning is essential. Different developmental guideposts should be provided for learning. Physical, emotional, and social changes happen rapidly within the few years children are in elementary school. From the planning, different amenities arrangements can change the school's dynamics. The net square footage generally can steer the initial design. It is suggested that elementary schools allow 124 square feet per student (Perkins & Bordwell, 2010, p. 15). The planning of the site can also

influence the community. Ensuring the elementary school and surroundings are meticulously planned will cultivate more productive students and a flourishing community.

2.2.3.1. Developmental Guideposts

Early childhood to early adolescence is the age range that students are in elementary school. A lot of changes happened within those six years. Below are some examples of those advancements.

2.2.3.1.1. Physical

Physically, students enter school at the early childhood stage. Their body starts growing, and adult proportions start to establish. Muscle development also begins. Nervous habits also begin around age 7. Their immune systems start maturing. Their motor skills are progressing. Finally, the students may start feeling uncomfortable with scrutiny (Perkins & Bordwell, 2010, p. 4). Keeping these changes in mind can help designers focus on what is happening in the user's life. This leads to a deeper understanding of the needs and wants of each student.

2.2.3.1.2. Emotional

Emotionally, many impactful changes happen in a student's life. Fear and dangers become more apparent to children in early childhood. Taking turns and imitating adults is more apparent. Crying and tantrums start to dissipate. Learning to channel their anger and frustration is a new skill. Independence, fear, control, reassurance, threats, and others are all updated issues or accomplishments (Perkins & Bordwell, 2010, p. 4).

2.2.3.1.3. Social

Potentially most important to school design, social changes are a big part of development. Picking up on social cues, playing with others, having internal conflict, choosing playmates, manners, peer approval, and self-control are becoming increasingly important. The desire to fit in

starts to influence students' attitudes (Perkins & Bordwell, 2010, p. 5). Creating spaces for all these changes to flourish allows designers to connect with the users.

2.2.3.2. Clustering

"The first step of a child's education life must, above all, be an easy one. This means a kindergarten room that welcomes, encourages, and becomes a friend. In design terms, it calls for spaces within the room that are large enough for a wide range of activity, varied and interesting enough to entice the child and hold his attention" (Perkins & Bordwell, 2010, p. 28). Allowing the classrooms to be flexible gives students more options. Beyond the individual classrooms, there are multiple ways to organize the planning of the overall school. Finding what is important to the client will help lead the design of the layout. The clusters of typologies that evolve guide the floor plans. A common clustering of spaces that is emerging in design is student learning communities. This technique brings together smaller groups of students to simulate a 'home base' while at school. SLC also focuses on activity and play spaces, which are important to the development of children (Nair et al., 2009, p. 33). The cluster diagram below shows how the floor plan can reflect that.

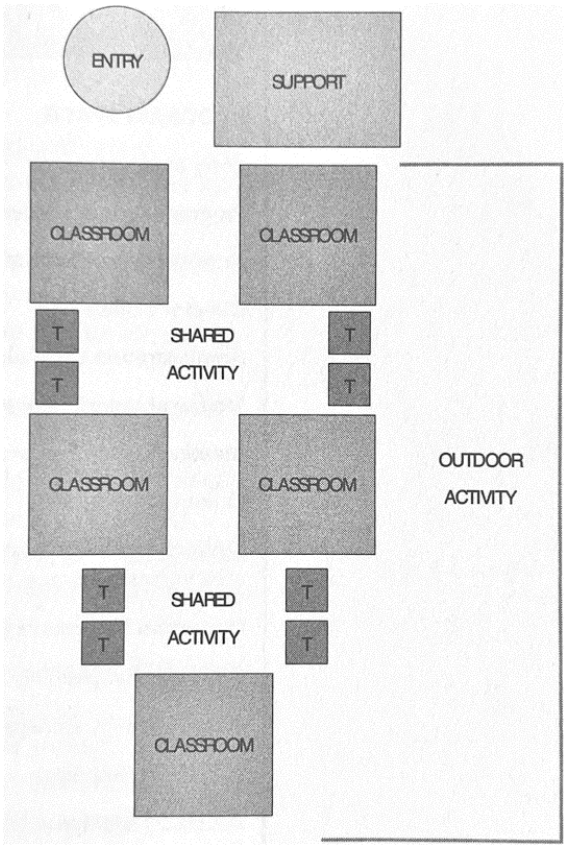

Figure 8. Cluster Floor Plan Focused on Activity (from Perkins & Bordwell, 2010, p. 35)

To further break down cluster floor plans, look into small learning community bubble diagrams. The classroom space above could be further separated for SLCs. This is the simplest way to show how the design pattern can exist within the school building.

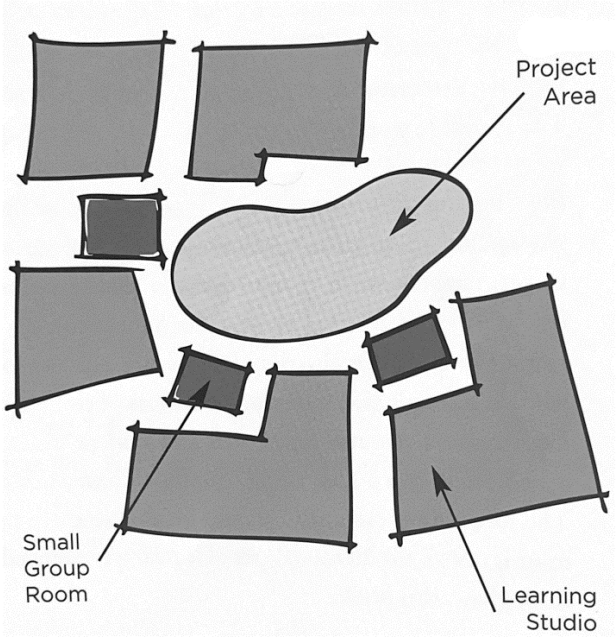

Figure 9. Learning Studio Bubble Diagram (from Nair et al., 2009, p. 33)

2.2.3.2.1. Accessibility within Clustering

Clustering amenities has many benefits. One of the significant benefits to focus on is the new access to resources for children with disabilities. This planning typology cuts down on the distance for students to travel to core functions. Toilet rooms are also closer and allow for reduced time without supervision. Having smaller classrooms with larger shared spaces allows for lower student-to-teacher ratios (Perkins & Bordwell, 2010, p. 74). Overall, becoming more knowledgeable about specific disabilities allows designers to understand the needs of every student fully.

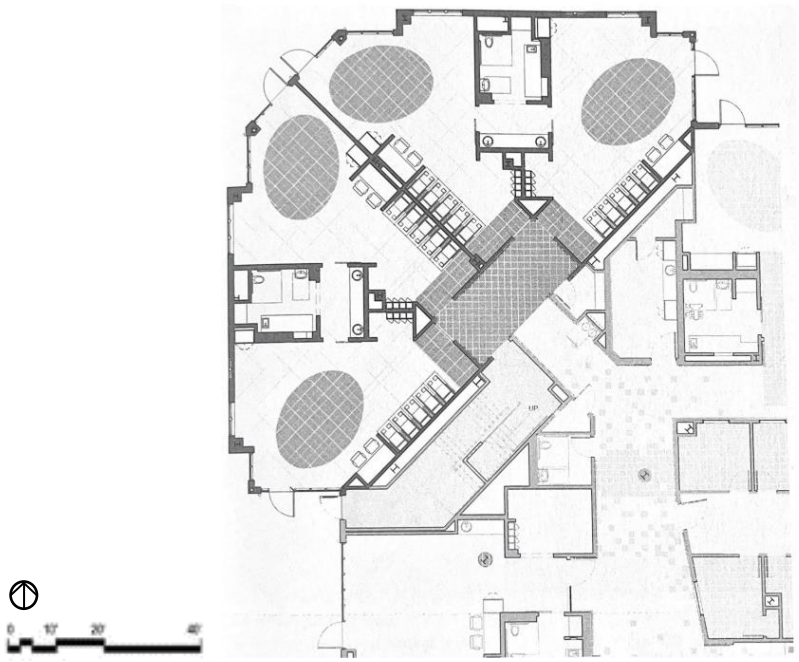

Figure 10. Cluster Floor Plan with Adjacent Toilet Facilities (from Perkins & Bordwell, 2010, p. 75)

2.2.3.3. Planning of Site

When designing the site of a school, many details go into decision-making. Finding a site that has proximity to its population is central to usability. Access, buildable area, costs, topography, and site size and critical to site choice (Perkins & Bordwell, 2010, p. 136). This criterion dictates the physicality of the building and site. To better serve the community, creating a site that invites everyone will be more successful. The site design below shows how focusing on learning communities and exercise paths can contribute to an overall inviting space. Separate student learning communities may not be successful in cold climates, yet the design of parking, play, and utilities serves as a great example of 21st-century site design. The other opportunity this design takes into account is a human-scaled entrance. This entrance blends with the community, parking is away from sight lines, and there are minimal driveways (Nair et al., 2009,

p. 172). These features combined create a community and user-focused site that amplifies the architecture of the built environment.

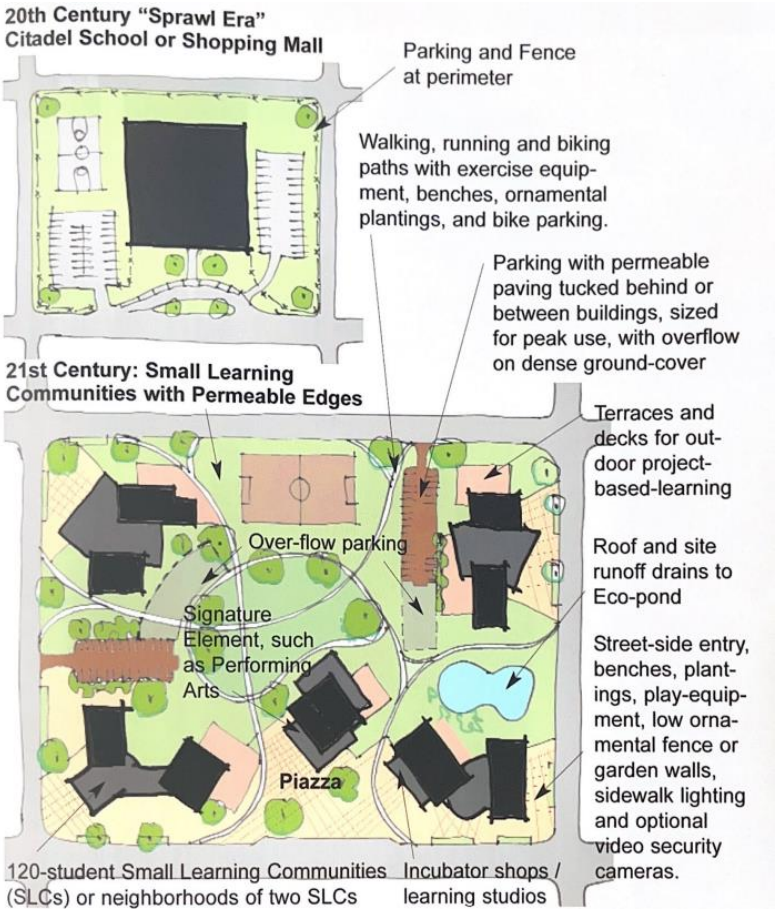

Figure 11. 21st Century Site Planning (from Nair et al., 2009, p. 173)

2.2.4. Future of Elementary School Design

"Public schools reflect our values and influence our future" (Kober, 2020). Preparing students for their future is a top priority. Students will be influenced to be better citizens by merging diverse populations, promoting equity, and balancing opportunities. It is worth exploring the changes that happen to users based on floor plans or site design adjustments. If unity can be achieved through more inviting and inclusive spaces, elementary school design will be changed for the better.

2.3. Sustainable Design

2.3.1. Planning of Space Through Sustainable Design

One-third of greenhouse gas emissions throughout the world are emitted through the built environment. Furthermore, 40% of worldwide energy use is consumed by buildings (AL-Dahash & Imran, 2021). These figures will be minimized if sustainability can be implemented and considered before the building is constructed. The students spend as much time at school as they do awake in their homes. Most of the time they spend learning is indoors (Watchman et al., 2021). It should be standard that school buildings use sustainable strategies since the built environment impacts students. When the school building is efficient, it can also motivate the community to be energy-conscious. While planning the school, outdoors, sunlight, wind, ventilation, and site location should be studied to help create a more efficient and inviting environment for all users.

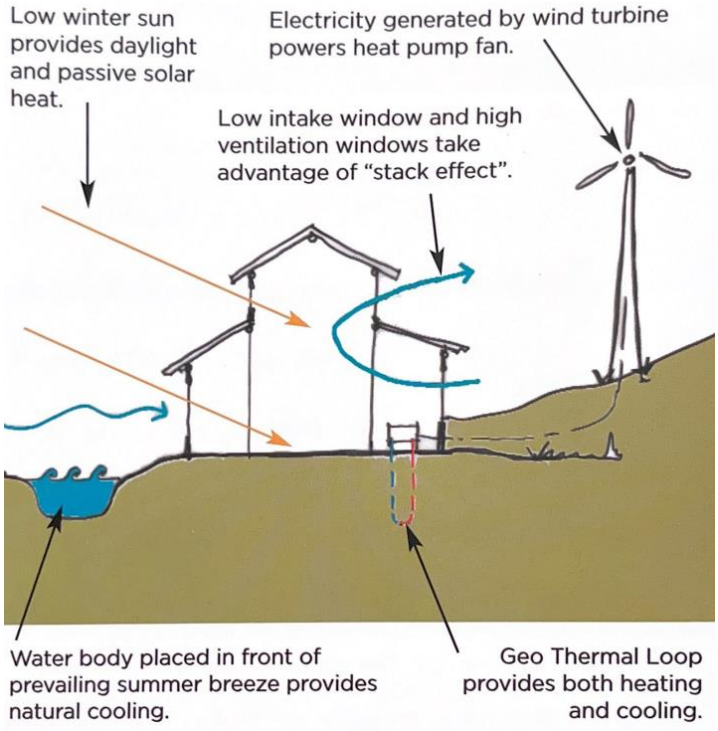

Figure 12. Sustainable Strategies Working Together (from Nair et al., 2009, p. 155)

2.3.1.1. Connection to Outdoors

"Biophilic architecture appeals to people's innate connection with nature. Growing evidence suggests that incorporating natural elements in built environments can offer satisfying experiences and be beneficial for the health and well-being of children and adults" (Watchman et al., 2021). Students will flourish if the connection with nature can be nurtured by design. Schools today are often considered cold, blank spaces that can be physically or mentally draining. Engaging with nature can also strengthen students' memory and attention spans (Melbourne, 2022). Many students today spend their free time using technology, therefore reducing time outdoors. Finding ways to integrate nature inside and outside of the classroom will help those kids get the connection with nature that they biologically need. The restorative properties of their mental health and cognitive function are fundamental to understanding.

Below is a diagram of how vistas can be implemented outdoors. There are many benefits to how outdoor landscaping can influence students positively. Setting a line of trees at least 50 feet away from the students allows for visual breaks needed by those students. When their eyes spend hours focusing on books, screens, and paper, it is proven that looking up and out at objects can exercise the eyes (Nair et al., 2009).

Collectively, nature inside and outside of the classroom will influence a student's time at school. It can serve as a learning tool or a relief. Having these opportunities allows for variety and comfort within the school setting. This sustainable practice is about balancing and avoiding the reduction in our already dwindling resources. Teaching students to uphold nature will have benefits beyond their time in elementary school.

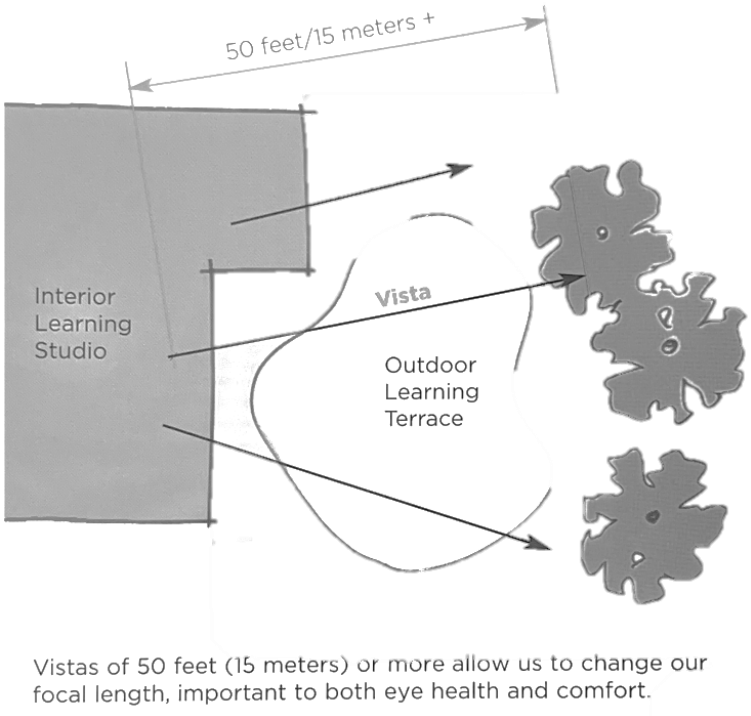

Figure 13. Controlling Connection (from Nair et al., 2009, p. 95)

2.3.1.2. Maximizing Sunlight

Bringing daylight into schools in as many capacities as possible is encouraged. This is important to the physiological well-being of students as it directly is affected by the amount of daylight they get (Nair et al., 2009). Glare and thermal discomfort are the primary deficiencies when maximizing natural light. Direct sunlight can cause distracting reflections or reduce contrast on needed technologies. The heat of sitting in direct sunlight can also distract students from their studies (Watchman et al., 2021). This is why mitigating the sunlight is a key aspect of initial design. Bringing in light shelves, skylights, diffused glass, and other features can help control the direct sunlight. Managing the value of daylight is a skill that designers can utilize. Thoughtfully placed vegetation and building orientation play a key role in external capacities. They change with the seasons, which is needed for hot summer or cold winter days. For these

reasons, deep research into daylighting should be conducted to plan properly for the students' benefit.

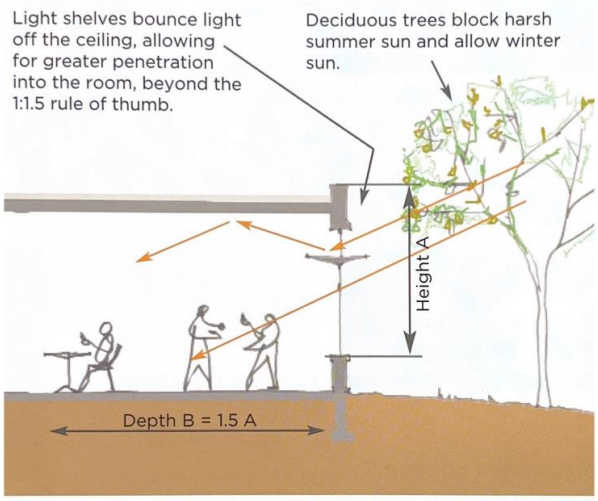

Figure 14. Natural and Built Sun Shading (from Nair et al., 2009, p. 151)

2.3.1.3. Natural Ventilation

A fact that most might not consider while designing elementary schools is that children require more air ventilation because they breathe higher proportions of air than adults do (Watchman et al., 2021). The need for proper ventilation will allow for healthy air to be supplied to these students. Natural ventilation can also help students and teachers connect with the outdoors while being indoors. Furthermore, students have shown higher academic performances, reduced asthma symptoms, and higher attendance (*The Benefits of Improved School Ventilation*, 2022). Many benefits can stem from a simple solution such as operable windows. Operable windows are preferred by teachers, so there is the option to allow for this ventilation when needed or wanted. Unfortunately, operable windows are only beneficial for a few months of the school year in cooler climate conditions. It is still preferred to supply operable windows because of the flexibility it enables. Even when the air may seem cool, it can be helpful to open windows

high off the ground to bring in cool air that mixes with the warm air that rises and escapes through the windows.

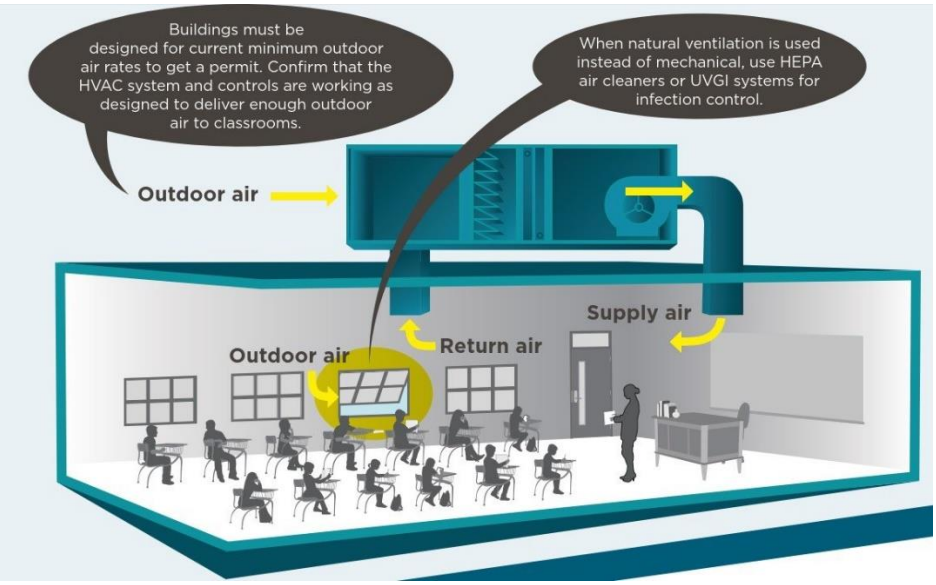

Figure 15. Natural and Supplied Ventilation in a Classroom (from *The Benefits of Improved School Ventilation*, 2022)

2.3.2. Sustainability Within Site Geography

The location of a proposed building can significantly affect the options for sustainable implementations. Precipitation, sun patterns, humidity, wind, and weather can all affect the sustainability of a building. The aim is to create a regional example of how feasible it is to make a successful and sustainable building.

2.3.2.1. How Climate Affects Sustainability

Regarding building design, the local climate can change the choices designers make. When climate is studied, efficient, comfortable, and sustainable buildings are possible. Temperature, precipitation, wind, and sunlight are the major factors impacting future building and design decisions. “With the right design, one can maximize a structure’s energy efficiency, sustainability, and safety levels, while reducing the need for energy consumption and other costly maintenance” (*Exploring the Impact of Climate on Building Design*, 2023).

Since construction for this project is set to happen in a cold climate zone, studying those needs prior to design will save hours of work in the future. Arguably, the most important feature to keep in mind when designing buildings in cold temperatures is that appropriate structural integrity must be calculated. The strength and stiffness vary because the cold increases the building's movement, which can lead to structural failure. Highly insulative materials are essential to keeping the building envelope effective. Furthermore, foam insulation, radiant barriers, wood, and clay will help hold heat or block out cold. Metal roofs can protect against snow and ice accumulation. Concrete block walls resist the cracking and deformation that can happen in the cold. Deep overhangs, walls with high thermal mass, and wind barriers will help keep buildings comfortable in cold climates.

Building orientation is a practice that can optimize energy throughout a building by proper initial planning. Facing a building to maximize street appeal, views, drainage, and capturing free energy from the sun are major components while planning. Orienting the overall plan will help develop the building’s layout. More frequently used spaces should be located on the southern side of the building. This brings in sun rays during the winter and blocks the sun in the summer. The northern side of the building can be used as a buffer against the harsh winter winds. Every detail that can help keep a building comfortable in a cold climate is important (Gromicko, 2023).

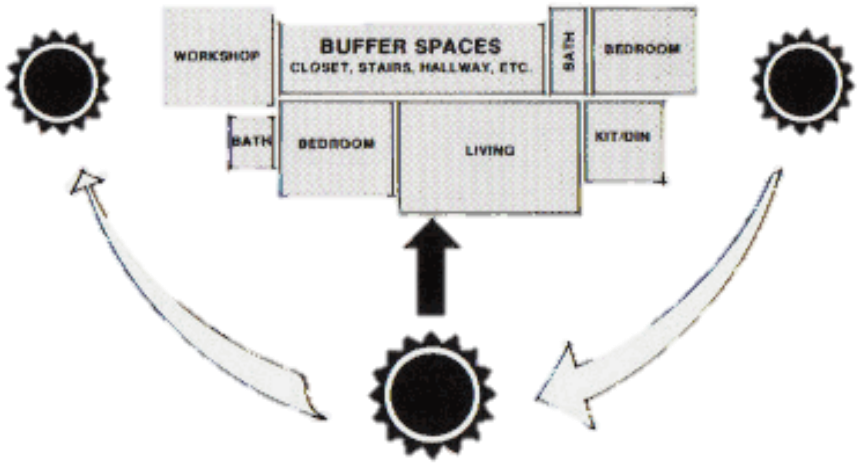

Figure 16. Orienting Buildings for Sunlight (from *Building Orientation for Optimum Energy*, n.d.)

Aesthetically, the design of the building should reflect the environment it is surrounded by. In a cold climate, minimizing heat loss through ample insulation, operable windows, and other details help keep the building physically comfortable (*Exploring the Impact of Climate on Building Design*, 2023). To keep the building aesthetically pleasing, using natural materials can create a warm atmosphere. Wood, stone, and biophilia can mimic the warmth that is wanted outdoors. “The seasonal variations of cold climates highlight the necessity to adopt climatic-based approach to biophilic architecture” (Watchman et al., 2021). Even when there are feet of snow outdoors, the interior of the building can feel comforting.

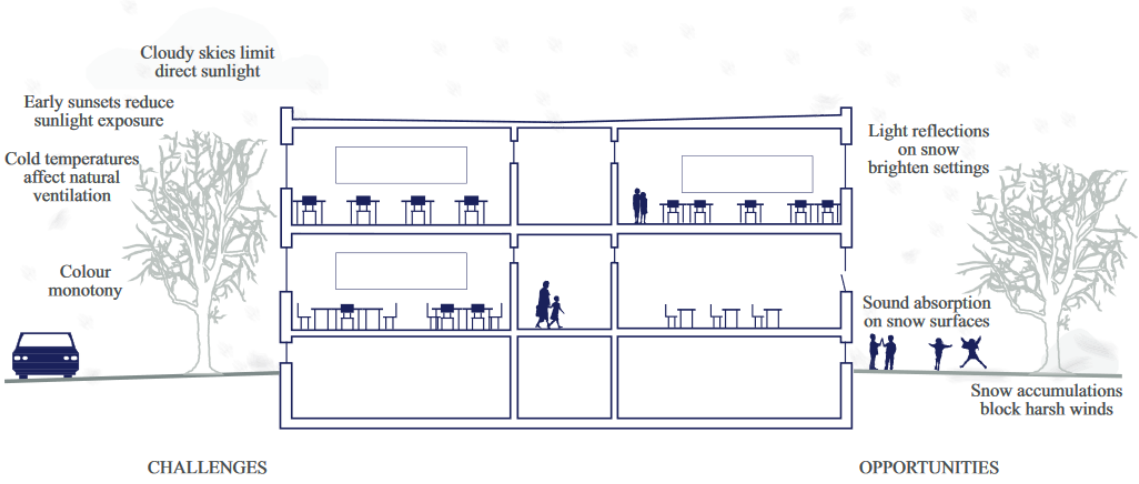

Figure 17. Winter Affects Buildings (from Watchman et al., 2021)

2.3.2.2. Becoming a Regional Example

Besides a few homes throughout the city, there are few examples of sustainable architecture in Fargo, North Dakota. The market for major construction with sustainability at the forefront has yet to be utilized. Using the strategies listed above, the construction of a new elementary school that is sustainable will be possible. Throughout the case studies in Chapter 3.5, sustainability is proven in similar climates.

Architecture, engineering, and construction industries use 50% of natural material resources and are major consumers in this sector (AL-Dahash & Imran, 2021). Using local resources is a considerable way to utilize regional assets and stimulate economic growth. Wells Concrete, which has a location in Fargo, is a prefabricated building solution that could be utilized. Hebron Brick is manufactured in Hebron, ND, and has a supplier location in Fargo. This would be an excellent opportunity to use resources from this state. Many local lumber companies could supply the needs of the construction.

2.3.3. How Sustainability Will Affect the Future

"Buildings are responsible for one-third of global greenhouse gas emissions as they consume 40% of the energy use worldwide. A considerable overall amount of energy consumption in public buildings is highly contributed by the energy consumption of school buildings due to their high number in the country" (AL-Dahash & Imran, 2021). If refining school construction is a priority, these numbers can be lowered significantly. Sustainable choices lead to happier users, long-term savings, and meeting standards of future goals such as net-zero and carbon neutrality.

2.3.3.1. Satisfactory Learning/Working Environment

"Aspects of interest for indoor spaces comprise views of nature, daylight, variable lighting, natural ventilation and cool temperatures. The reported benefits include less stress, inattention and hyperactivity symptoms, and absenteeism as well as increased physical activity, enhanced child development, better learning and achievement, and improved social behaviour" (Watchman et al., 2021). These benefits are applicable to all users, including teachers and students. This proves that prioritizing sustainable practices has more benefits than economic or environmental interests. In the table below, many statistics support sustainable schools as a satisfactory environment. When users are exposed to green buildings in the long term, their health is positively affected (*Press: Benefits of Green Building | U.S. Green Building Council,* n.d.). A healthier, happier climate can be proven through many different aspects involving the school.

Topic	Statistic	Notes
Higher Student Test Scores	11% Increase	In Colorado and Washington, students exposed to better daylighting presented better standardized test scores.
Reduced Absenteeism	4% Increase	In Washington, school attendance rates increased because of healthier air conditions
Reducing Asthma Incidence	25% Reduction	Asthma episodes are reduced because of healthier air conditions
Reducing colds and flu	9-20% Reduction	Cold and flu sicknesses are reduced because of healthier air conditions
Teacher turnover	5% Reduction	Teachers are happier and leave these schools less often
Teacher sick days	7% Reduction	Teachers are sick less often, which equates to 1 day a year

Table 1. Statistics Supporting Sustainable Environments as Learning/Working Spaces (modeled after AL-Dahash & Imran, 2021)

2.3.3.2. Long-Term Savings

Sustainable design within schools can be presented in many ways. Sustainable sites, water efficiency, energy efficiency, atmosphere conservation, materials and resource management, and indoor air quality are all areas that designers consider when achieving sustainable status (Perkins & Bordwell, 2010). Specifically, energy conservation can be achieved through some of the major sources of consumption in typical schools. Lighting, heating, air conditioning, ventilation, hot water, and mechanical/electrical equipment are all facets that can be improved upon to lower overall energy utilization.

In general, upfront investments in sustainable buildings can be higher. However, that initial investment makes the properties more valuable. The green buildings' day-to-day costs are lowered, so savings add up annually. One study conducted by the National Institute of Building Sciences found that $1 spent on energy mitigation saves $6 in response costs. When carbon

dioxide is lowered by 34%, energy by 25%, and water by 11%, those costs needed to supplement the needs are saved (*Press: Benefits of Green Building | U.S. Green Building Council*, n.d.). The average savings per square foot in a new school is shown in the graph below. When looking into the financials, $71/sq ft will save school districts money and make them pillars in the community.

Area of Impact	**Cost Savings ($/sq ft)**
Energy	9
Emissions	1
Water and Wastewater	1
Increased Earnings	49
Asthma Reduction	3
Cold and Flu Reduction	5
Teacher Retention	4
Employee Impact	2
Total	74
Cost of Greening	3
Net Financial Benefits	**71**

Table 2. Financial Benefits of Green Schools (modeled after Perkins & Bordwell, 2010)

2.3.3.3. Future Sustainability Goals

Many cities throughout the United States and the world have promised to become more sustainable. Over one-hundred and thirty American cities have pledged to the Cities Race to Zero. This is a UN-backed campaign to bring sustainable growth to cities through goals such as zero carbon. Becoming net zero by 2050 is the overall goal, but cities will start with a smaller goal of halving emissions by 2030 (*More than 100 American Cities Make Historic Pledge to Accelerate Net-Zero Emissions, Deliver Action Needed to Meet National Climate Goals*, 2021).

Regionally, North Dakota has ambitious goals for sustainability. North Dakota is currently not seen as a leader in sustainability. These objectives could change that point of view. Currently, coal, oil, wind, and solar are abundant energy sources that fuel the state. Incentivizing new renewable energy projects has been a way to make change. Uniquely, carbon sequestration optimizes the production of energy exports (*Energy and Natural Resources*, n.d.). North Dakota has geology that supports carbon sequestration. The deep porous rock holds the carbon dioxide over a mile below the earth's surface. It is estimated that ND can sequester up to 25 billion tons of CO_2. That is over 4,400 years of the state's annual production. (*Energy and Natural Resources*, n.d.) To better understand the carbon sequestration process, see Figure 15.

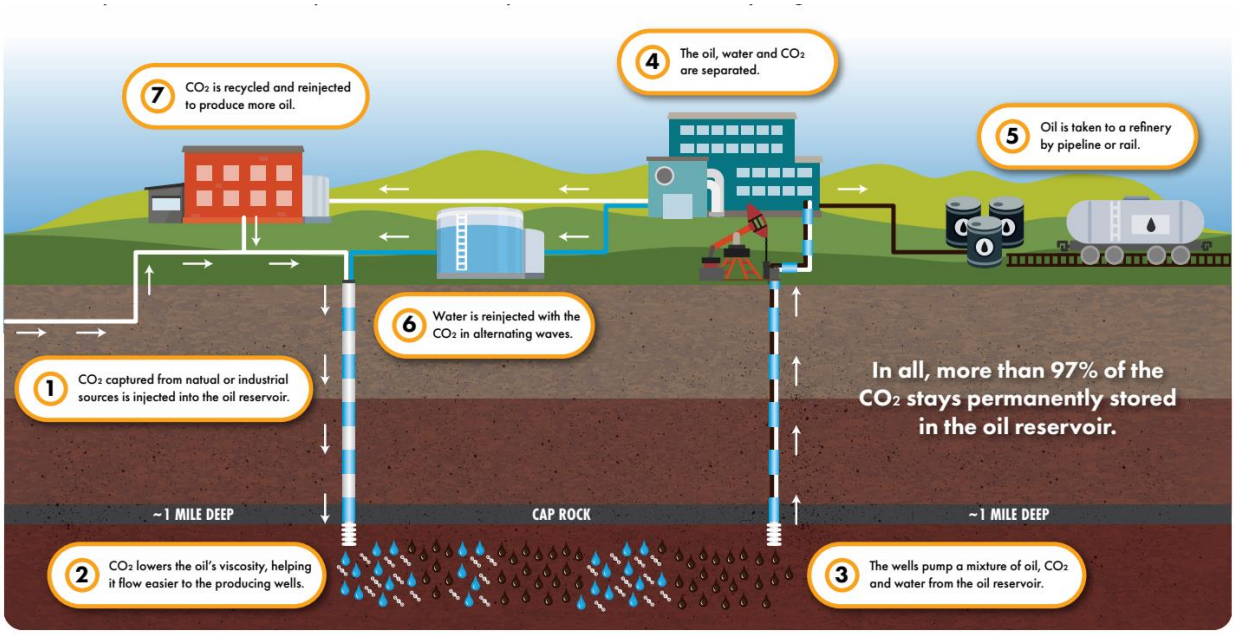

Figure 18. Carbon Sequestration Process (from *Energy and Natural Resources*, n.d.)

The current North Dakota governor, Doug Burgum, has been vocal about the state's shifting towards more sustainable processes. Burgum has announced a goal to have ND become carbon neutral by 2030. This intention will only be possible with the help of carbon sequestration. For centuries, North Dakota has practiced carbon capturing. Through cover-

cropping, rotational grazing, and no-till, farmers and ranchers have been using carbon to their advantage. The shift now will happen between not only using it to aid farmers and ranchers but also promote the overall reduction of emissions in the state. “The carbon neutral goal sends a strong message that no one holds a monopoly on the path toward a healthy environment. No one cares more about our land and air than farmers and ranchers who live and do business here in North Dakota. We have a great story to tell, and we can leverage economic opportunity and flip the carbon narrative while continuing to lead the nation in agriculture and energy production – Doug Burgum” (Drake, 2021).

The push for healthier atmospheres is happening all over the world. Luckily for users in the state of North Dakota, these goals may be achieved sooner than others. Construction and building in our state should now mirror the goals established in the energy and farming districts. If the state is improving the conditions of the earth and air, buildings should do the same. Designing sustainably is the future of every building. To support the individual goals of countries, states, and cities, our buildings should reflect the health and safety of the community.

2.4. Gap Identification

Throughout the preceding research, many areas of exploration were observed. The comprehensive information on universal design, schools, and sustainability gives a foundation for design to take place. The most prominent gap in the preceding research is the combination of these principles. There is an extensive analysis of universal design, school design, and sustainable design individually. What is lacking is the connection between these principles. This knowledge of sustainability, education design, and universal design will lead to a cohesive concept to solve these concerns.

2.5. Project Type

Within the past ten years, the number of students served under the IDEA grew by 800,000 (Irwin, 2021). This growing number shows the importance of caring for and considering the needs of all students. An elementary school, or primary school, serves students aged anywhere between 5-13. The focus of these years is establishing reading, writing, arithmetic, social studies, and science skills (*Elementary Education | Definition, Goals, & Facts | Britannica*, 2023). Elementary school is the first step of formal education that students attend. When users are required to spend 13 years in school, it should be imperative that elementary schools set a proper foundation for student's growth. The city of Fargo lacks schools that support education in alternative ways. Having an elementary school where students feel more welcome will support their overall education. This school will be the first environment in Fargo to serve the public yet specialize in the education of all learners through architecture and alternative teaching styles.

2.6. Project Issues

There is a lot within the world of education that can be improved upon. The focus on equal opportunity will lead to the development of this project. Creating a space for all users to feel welcome and grow will alter the community. Every community should have schools that serve all. Communities are stronger when they have innovative schools to shape their children. The sustainability of this project will also guide the community to be more open to renewable sources. When they see sustainability at work, it allows others to see how it functions and supports the users. Bringing together all these ideas will address and solve any issues.

3. METHODOLOGY

Design methodology is the roadmap that leads from idea conception to the final product. The definition of the problem has been introduced in the preceding chapters. Now, idea generation can happen. This will lead to finding the best solution for the issue at hand. Once that solution is implemented, evaluation of the final result can happen. This system allows innovative ideas to be incorporated and developed to better the users. This chapter focuses on idea generation and evaluating solutions through case studies. An established approach to a project is crucial to answering questions related to research. Site analysis processes provided for a deeper understanding of the community that will be affected. Finally, relevant case studies were examined through community, sustainability, and school precedents that could lead to more innovative projects. All of these intentions provided the relevant information to lead to design.

3.1. Approach

The approach taken to answer the following questions was dynamic. A conclusion was reached through multiple forms of data collection and analysis techniques.

3.1.1. Data Collection

The data collection process was thorough and varies by each researcher. Understanding and dissecting literature has led most of the research thus far. Resources such as the architectural library, online databases, and many journals have yielded important information. Furthermore, conversations and interviews give a more personal approach to discernment. Immersive experiences in the fields of education and supporting those with disabilities have also guided the data collection development. Overall, there are many ways to accrue the information needed to solve complex issues in society and design.

3.1.2. Analysis

A majority of research analysis has happened through readings. Saving information in platforms such as Zotero has led to a more refined and organized approach to analyzing information. Taking notes, highlighting relevant material, and compiling it into categories helps the information to be easily digestible. Allowing ample time to process and grasp new information has helped in the complete interpretation to be utilized within the paper and design.

3.1.3. Conclusion

Comprehensively, this project has gathered many different views and aspects of architecture that lead to a successful architectural response. Through the inclusive design of elementary schools, happier and more successful students will emerge from these informative years. The sustainable design allows the community to evolve into more understanding members of the environment. Together, these three main ideas allow for an innovative space Fargo seeks.

3.2. Regional Project Location

3.2.1. City History

The city of Fargo got its start in 1871 through the Northern Pacific Railway. The railway needed to cross into new land from Moorhead, Minnesota. Fargo was named after William George Fargo, a pioneer in the shipping industry. The rail and steamboat businesses allowed Fargo to flourish. Once the industries such as transportation, marketing, and distribution had grown, immigrants were attracted by the fertile soil. Soybeans, sugar beets, wheat, corn, sunflowers, and others all grow very well in the unique soil of the Red River Valley. Today, Fargo is known for its software production, agriculture, North Dakota State University, regional medical centers, and an international airport (*Red River of the North | Map, Minnesota, History*,

& Facts | Britannica, 2023). From its inception in 1871, the city has boomed to become the most populous in the state.

3.2.2. Population

The population of Fargo, North Dakota, is currently 128,557 persons. Since the city was founded, it has consistently grown. Since 2020, the city has grown 2.15%. It has also been ranked as the 4th fastest-growing city in the country. The 2029 population is estimated to be 134,100 persons (*Fargo, North Dakota Population 2023*, 2021). Clearly, the city of Fargo has grown and is projected to continue growing for years to come.

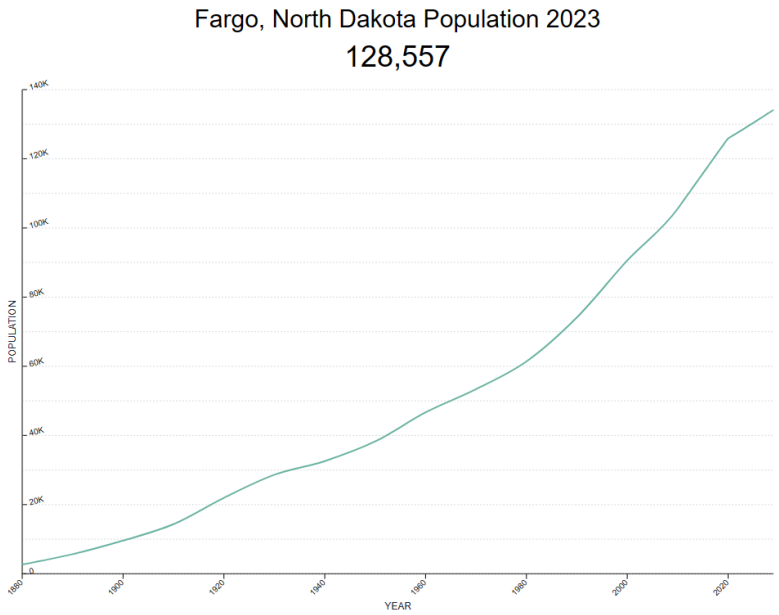

Figure 19. City of Fargo Population Growth (from *Fargo, North Dakota Population 2023*, n.d.)

3.2.2.1. Growth

The city of Fargo is currently conducting its Fargo Growth Plan 2024. This is an effort to decide where and how to continue the city's growth. This research has led to the awareness of southern growth in Fargo. More specifically, the Fargo Growth Plan addressed different sectors, such as: What will our neighborhoods and housing look like? How will we get around? And

What should be the character and quality of our public buildings and civic spaces? Preferences for residential options in structures and land uses, civic and commercial life, getting around the city, and preferred footprints were noted. The graphs below note where growth has happened recently and where growth is anticipated.

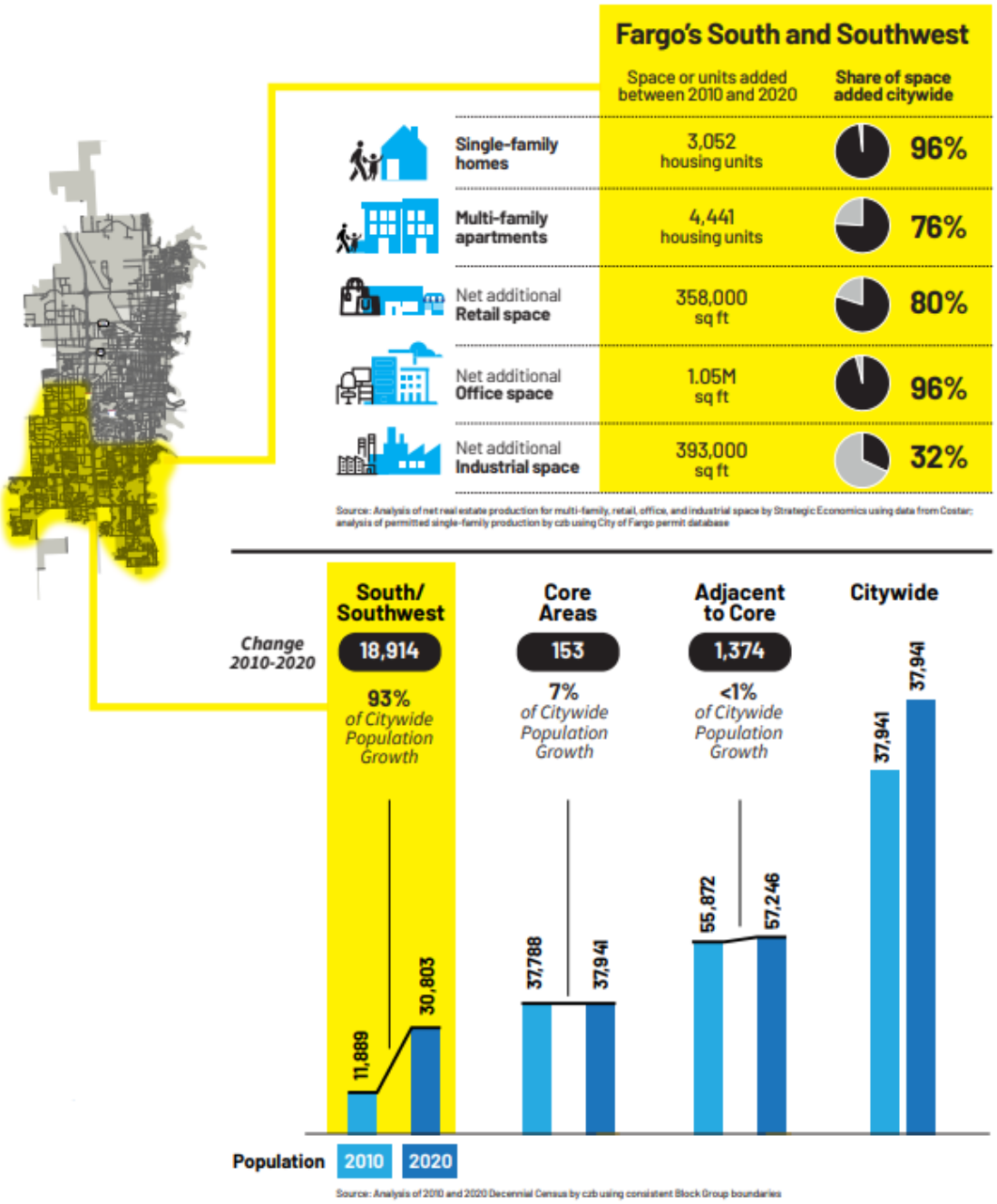

Figure 20. City of Fargo Southern Growth (from *Fargo Growth Plan*, n.d.)

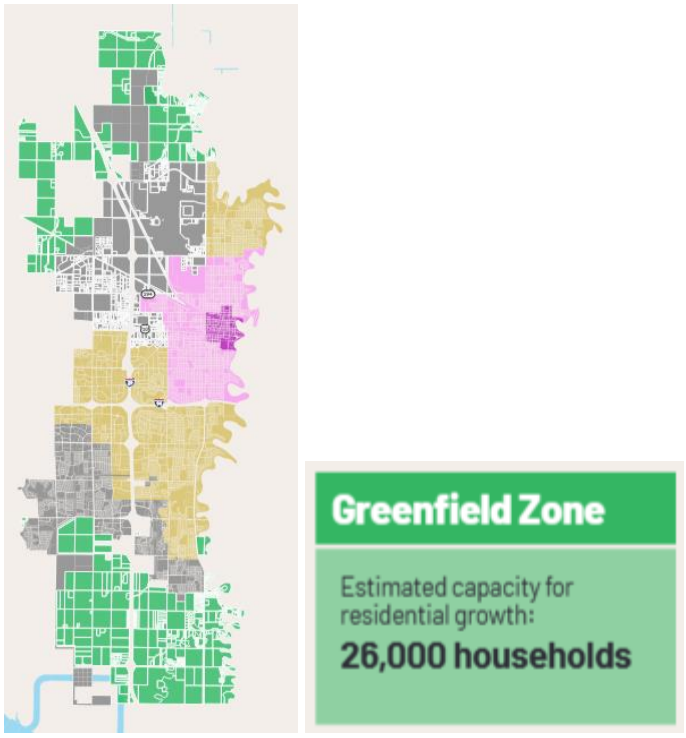

Figure 21. City of Fargo Greenfield Zones (from *Fargo Growth Plan*, n.d.)

3.2.3. Climate

Climate is an essential aspect to consider when designing in Fargo, North Dakota. There are unique challenges that other locations may not face. Below, more information can be found on temperature, precipitation, wind, and sun patterns. Using this information will help guide building design and site development.

3.2.3.1. Temperature

The temperature in Fargo, North Dakota, varies widely throughout the year. This can lead to challenges in insulation, thermal bridging, ventilation, and other means of protection. If the designer understands the patterns of hot and cold within the region, it is possible to design a comfortable space successfully.

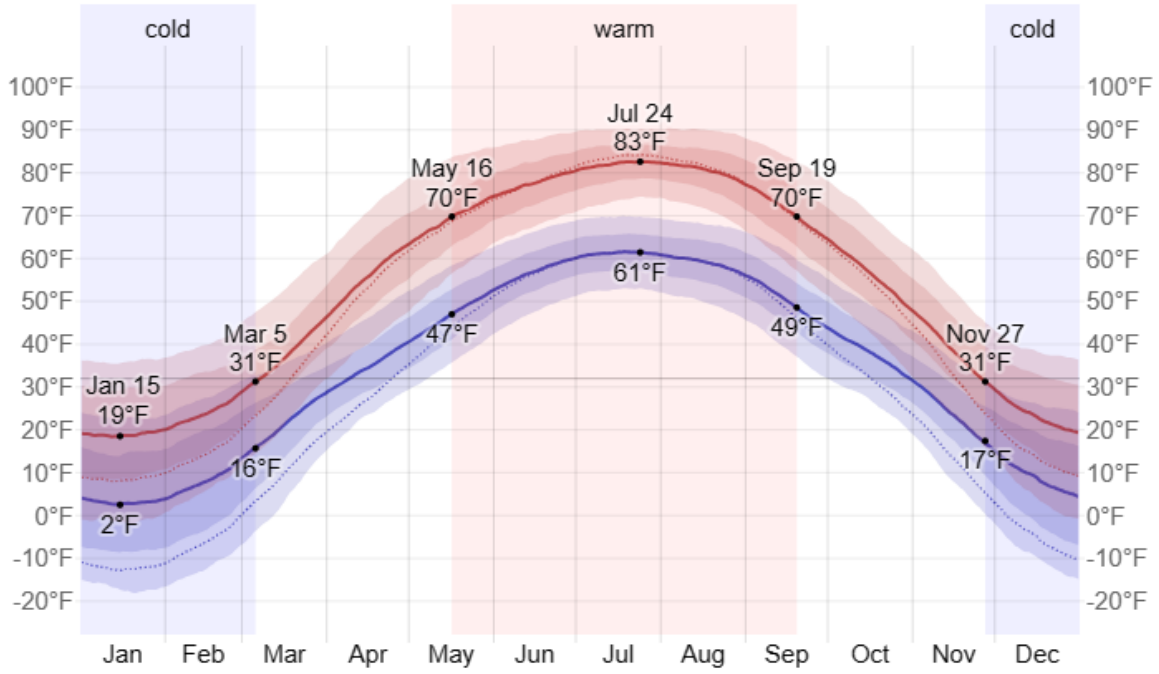

Figure 22. Average High and Low Temperature in Fargo (from *Fargo Climate, Weather By Month, Average Temperature (North Dakota, United States) - Weather Spark*, n.d.)

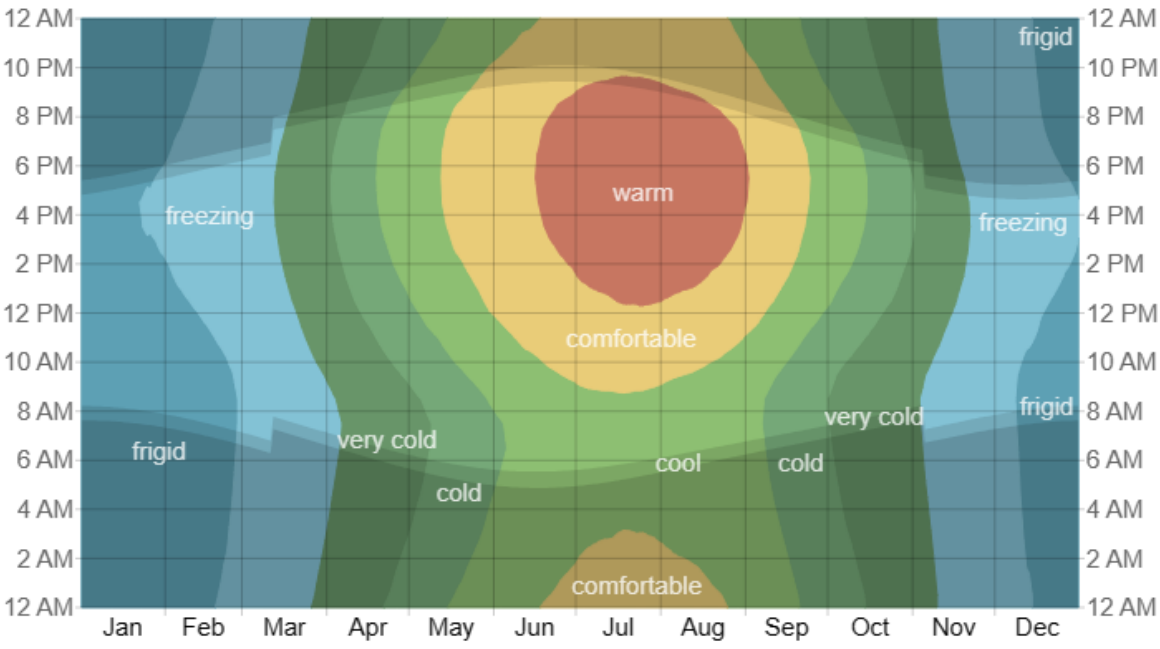

Figure 23. Average Hourly Temperature in Fargo (from *Fargo Climate, Weather By Month, Average Temperature (North Dakota, United States) - Weather Spark*, n.d.)

3.2.3.2. Precipitation

Throughout the year, Fargo gets rain and snow in varying amounts. Discerning the patterns between snow and rain can help when it comes to building and site design. Capturing or mitigating rain is important to avoid buildup causing pooling, mold, or water re-use. The impact snow has on a site and the building is also crucial. A building in this region must be able to handle feet of heavy snow. This creates unique issues in roof composition. All in all, it is essential to note that Fargo gets plenty of each precipitation type.

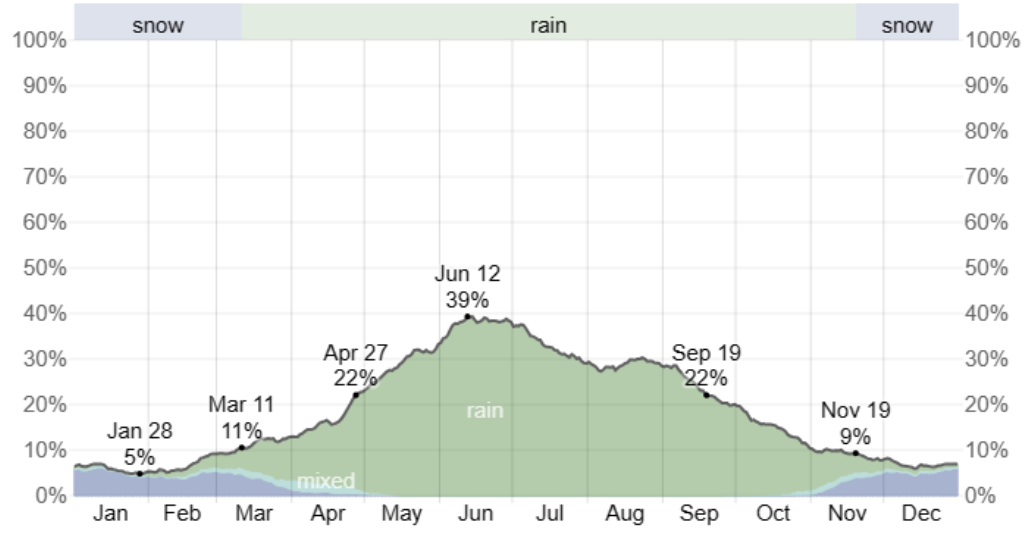

Figure 24. Daily Chance of Precipitation in Fargo (from *Fargo Climate, Weather By Month, Average Temperature (North Dakota, United States) - Weather Spark*, n.d.)

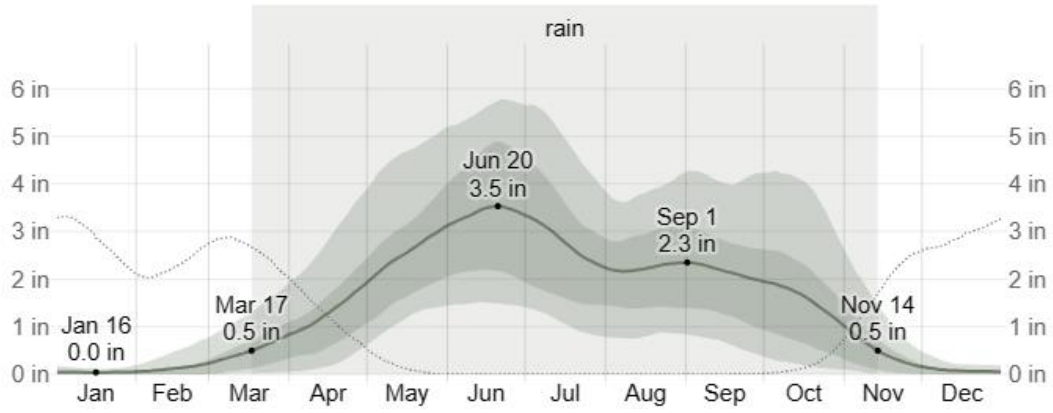

Figure 25. Average Monthly Rainfall in Fargo (from *Fargo Climate, Weather By Month, Average Temperature (North Dakota, United States) - Weather Spark*, n.d.)

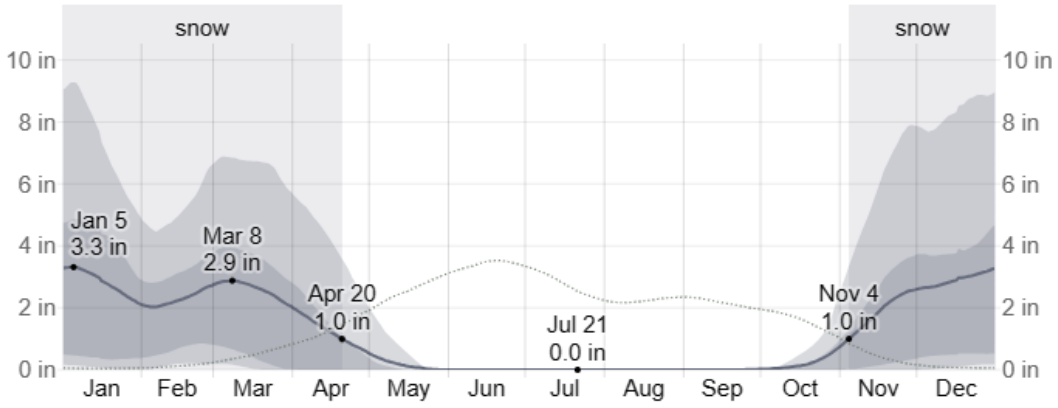

Figure 26. Average Monthly Snowfall in Fargo (from *Fargo Climate, Weather By Month, Average Temperature (North Dakota, United States) - Weather Spark*, n.d.)

3.2.3.2.1. Flooding

Fargo is uniquely located along the Red River. The Red River is a low-gradient and northward-flowing tributary. This can lead to southern climates warming up and leading to ice jams up the river in the north. The Red River Valley is noted as one of the most flood-prone areas in the U.S. because of this uncommon composition (*Bringing Permanent, Reliable Flood Protection to the Fargo-Moorhead Area*, 2022). Because of the disastrous floods of the past, a permanent and reliable flood protection system has been under construction and will be complete by 2027. The FM Area Diversion will protect 235,000 people from flooding of the Red River. Once complete, almost all of Fargo will be protected from one of the most dangerous natural disasters known to this region. Many know of this area of the region as a flooding zone, but that will soon be a thing of the past.

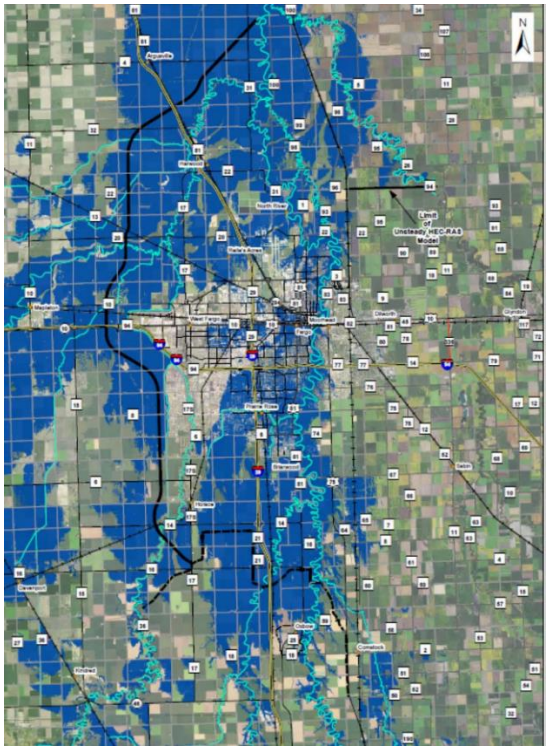

Figure 27. FM Area Flood Plain Prior to Diversion (from *Floodplain Maps*, n.d.)

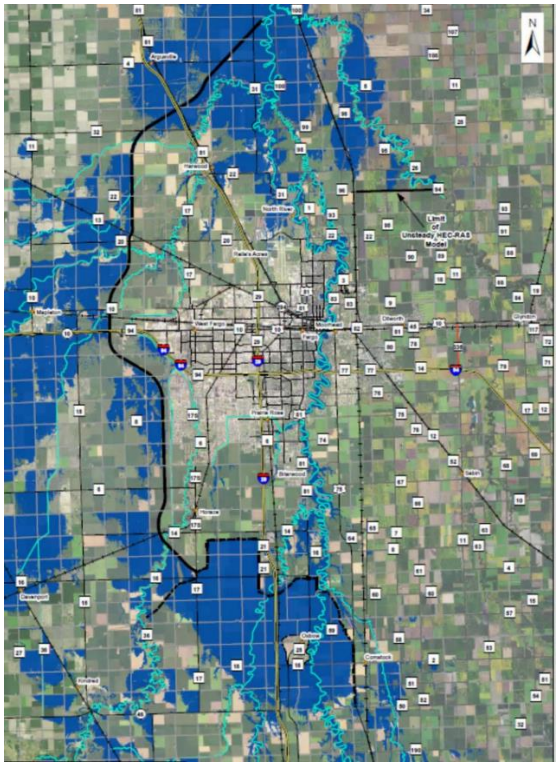

Figure 28. FM Area Flood Plain Succeeding the Diversion (from *Floodplain Maps*, n.d.)

3.2.3.3. Wind

Fargo is known for being a very windy city. The flat plains allow for wind to travel far and at high speeds. The wind directions change throughout the year. September through May are considered windy months, with prevailing north and west winds. The winds in North Dakota are known to change designs to avoid wind tunnels but also to create more efficient ventilation of spaces and protect from thermal bridging. Wind can be harmful to a design, but if utilized correctly, it can amplify an overall plan.

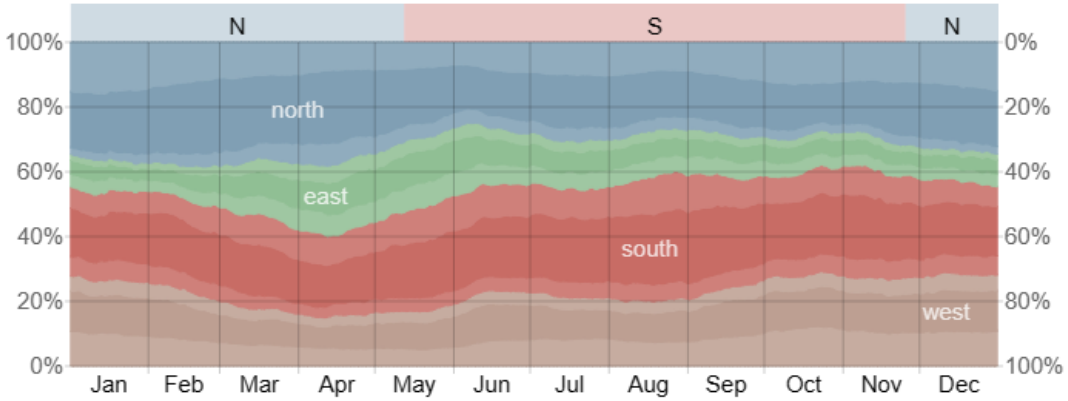

Figure 29. Wind Direction in Fargo (from *Fargo Climate, Weather By Month, Average Temperature (North Dakota, United States) - Weather Spark*, n.d.)

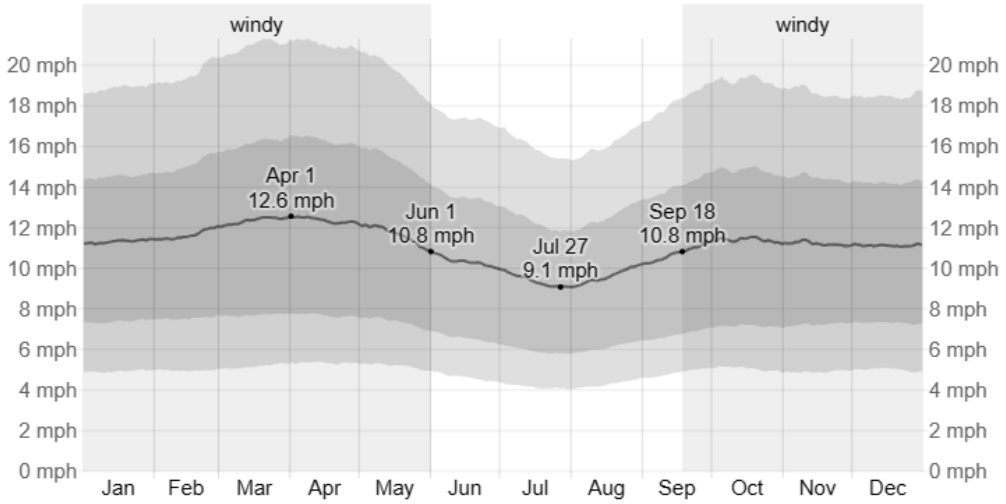

Figure 30. Average Wind Speed in Fargo (from *Fargo Climate, Weather By Month, Average Temperature (North Dakota, United States) - Weather Spark*, n.d.)

3.2.3.4. Sun

The sun patterns vary greatly throughout the year in this northern state. From almost 16 to 8.5 hours of sunlight in the winter, there are many ways to utilize this sunlight. From March to October, there is significantly more sunlight. This peaks in the summer when students are not in school. Finding ways to capture the available sunlight for energy or natural heating could help lower costs in schools. If the sunlight patterns are accurately studied, they can be used to the school's advantage when designing.

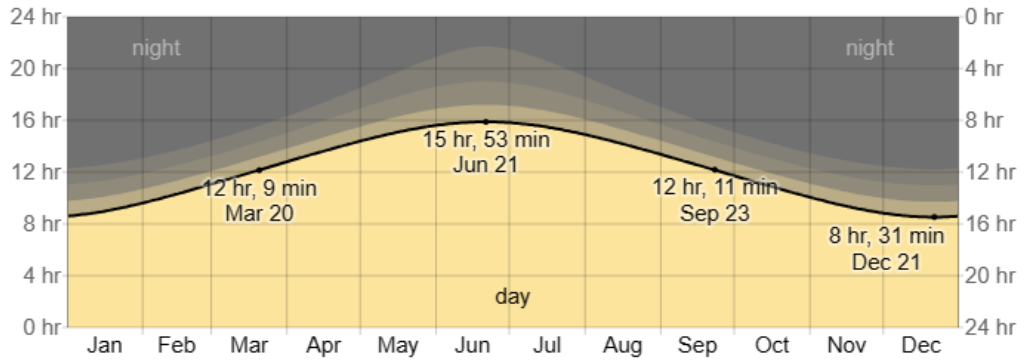

Figure 31. Hours of Daylight and Twilight in Fargo (from *Fargo Climate, Weather By Month, Average Temperature (North Dakota, United States) - Weather Spark*, n.d.)

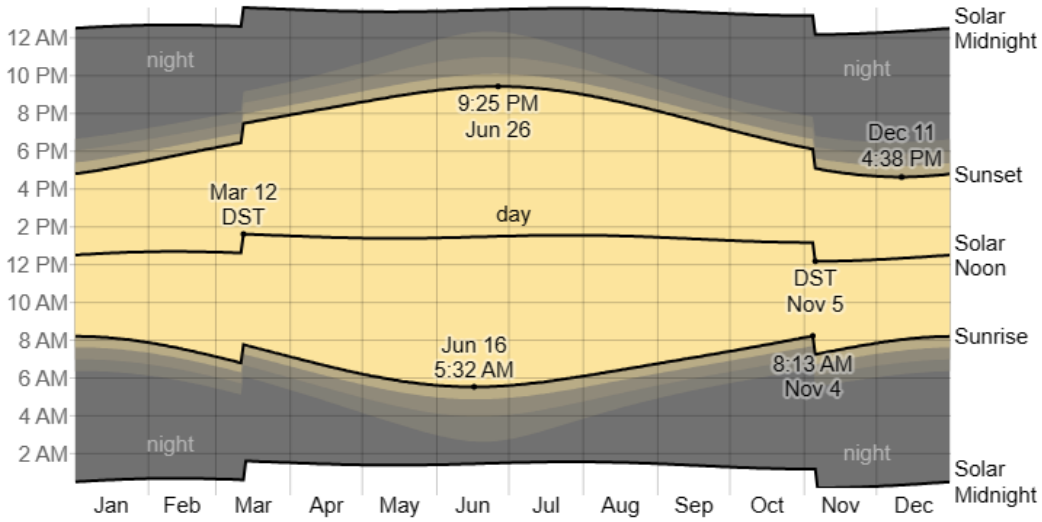

Figure 32. Sunrise & Sunset with Twilight and Daylight Saving Time in Fargo (from *Fargo Climate, Weather By Month, Average Temperature (North Dakota, United States) - Weather Spark*, n.d.)

3.3. Specific Project Location

3.3.1. Neighborhood

The Davie's Neighborhood in Fargo is a new development in the city. The area was annexed into the city in 1995 (*The City of Fargo - Davies*, 2023). Within even the past five years, this area has boomed. New housing developments have grown and been successful. This led to more families to be making a home in this area. The more families that come to the area, the more students attend the respective schools of that area. Bennett Elementary currently serves this area. According to population growth figures, this school has already outgrown and will continue in this direction. The need for a new elementary school is imminent. The district notes that Bennett Elementary is above target enrollment and is projected to increase in future years (Fargo Public Schools, 2022). With most growth happening in the southern parts of Fargo, it is apparent that more educational needs should be addressed through new opportunities.

School	Student Location	Past School Enrollment					Future Enrollment Projections				
		2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Bennett	Res/Att	464	470	521	575	630					
Target Enrollment 682	Reside	475	480	535	581	638	667	710	761	803	826
Grades K-5	Attend	477	483	533	585	647	679	719	770	812	835
Centennial	Res/Att	505	523	553	509	542					
Target Enrollment 660	Reside	531	544	580	524	561	562	555	552	547	582
Grades K-5	Attend	542	550	576	524	560	562	554	551	546	581
Clara Barton	Res/Att	164	175	193	195	173					
Target Enrollment 198	Reside	174	191	196	199	177	181	166	179	184	189
Grades 3-5	Attend	174	183	199	200	178	183	167	180	185	190
Eagles Elementary	Res/Att	300	308	332	304	274					
Target Enrollment 396	Reside	319	330	348	314	288	289	298	291	290	293
Grades K-5	Attend	322	327	350	326	305	305	315	308	307	310
Ed Clapp Elementary	Res/Att	487	458	452	449	438					
Target Enrollment 550	Reside	509	485	474	478	469	477	488	500	495	495
Grades K-5	Attend	512	484	479	473	453	456	472	484	479	479
Hawthorne	Res/Att	217	184	196	151	179					
Target Enrollment 264	Reside	221	192	200	154	184	187	192	191	186	183
Grades K-2	Attend	220	187	199	154	183	184	191	190	185	182
Horace Mann	Res/Att	161	162	179	170	174					
Target Enrollment 264	Reside	176	182	199	186	195	198	216	209	205	206
Grades K-2	Attend	169	174	188	174	177	183	198	191	187	188
Jefferson	Res/Att	353	316	302	273	277					
Target Enrollment 396	Reside	381	339	320	299	293	310	319	321	317	323
Grades K-5	Attend	361	324	314	282	299	320	325	327	323	329
ELEMENTARY TOTAL											
Target Enrollment 6,952	Reside	5,435	5,325	5,372	5,136	5,242	5,353	5,430	5,518	5,561	5,718
Grades K-5	Attend	5,435	5,325	5,372	5,136	5,242	5,353	5,430	5,518	5,561	5,718

Source: RSP & Associates, LLC - December 2021 (Woodrow Wilson/Dakota HS and FPS Virtual Academy students in the projections)

Note 1: Student Projections are based on the residence of the student and Boundary Changes

Note 2: School Choice Options between Facilities are depicted in the Projections

Note 3: PreKindergarten and students utilizing the alternative educational programming are not in the enrollment projections

Note 4: Reside is based on the student address

Note 5: Attend is based on which facility a student may attend

Note 6: Res/Att is are students who reside in the attendance area and attend that facility

Note 7: Target Enrollment for each school provided by the District

Exceed Target Enrollment

Figure 33. Outgrowing of Bennett Elementary Projections (from Fargo Public Schools, 2022)

3.3.2. Population

The population of the Davies neighborhood has grown dramatically in recent years. It was opened in 2011 and has continued to multiply. In 2010, the city noted that the population of this neighborhood was 64 persons and 23 housing units. It is now estimated that there are 3935 residents and at least four subdivisions (*The City of Fargo - Davies*, 2023). In the subsequent aerial images, the dramatic growth that resulted from the expansion of the Fargo Public Schools is shown. With that southern growth, more families are moving into the area. This has caused overpopulation of the surrounding elementary school. If another elementary school was built, class sizes could decrease, and grades could also be adjusted to assist middle school

overpopulation. At the time, it seemed surprising to build Bennett and then Davies so far south. The growth happened how the city and school district planned, as they are now embedded into their communities. It is important to take the future into account; that is how the site for this project was considered.

Figure 34. 2003 – Resulting Growth of Bennett Elementary (modeled after Google Earth Pro, 2022)

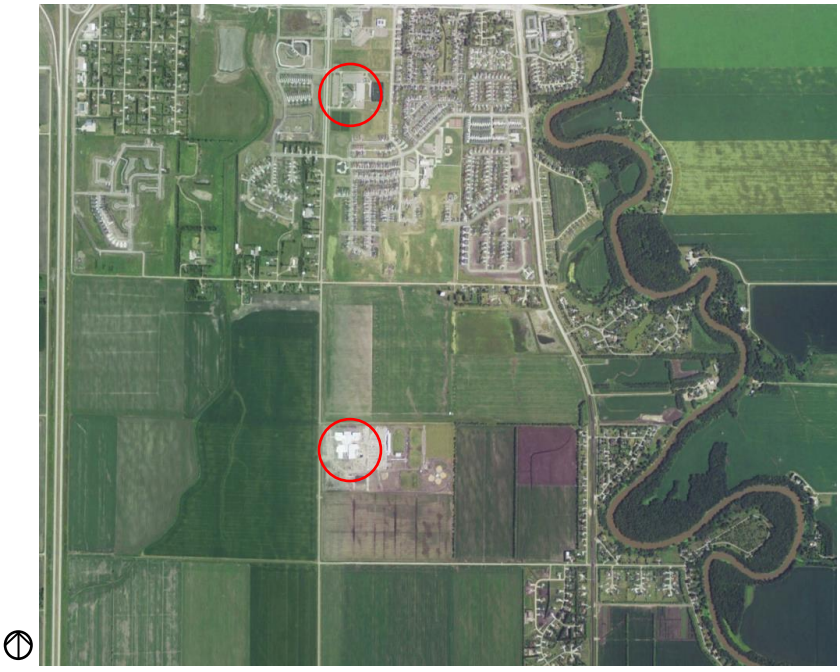

Figure 35. 2011 – Resulting Growth of Davies High School (modeled after Google Earth Pro, 2022)

Figure 36. 2023 – Resulting Growth of Bennett and Davies (modeled after Google Earth Pro, 2022)

3.3.3. Characteristics

The characteristics of this neighborhood make it distinct from the rest of the city. Since it is so new, most of the built environment lacks the history of the city. The neighborhood consists of new construction homes, a high school, a few parks, a pond, and is near the Red River (*The City of Fargo - Davies,* 2023). Some may argue that this neighborhood lacks character because of the sprawl and quick growth that happened in this location. Nevertheless, there is a tight community of people that ties together this neighborhood. The landscaping of the area leaves a lot to be desired. Since it is reformed farmland, there are minimal mature trees. Bringing back vegetation could add a lot of character to the area. Below are examples of the typical characteristics of the neighborhood.

Figure 37. 2023 – Davies High School Exterior (modeled after Google Earth Pro, 2022)

Figure 38. 2023 – Typical Street View (modeled after Google Earth Pro, 2022)

Figure 39. 2023 – Neighborhood Park with Pond Beyond (modeled after Google Earth Pro, 2022)

3.4. Site

3.4.1. Selection Process

Within Fargo, extensive growth has happened in the southern region. To follow the growth patterns of the city, it was important to look for sites in the southern part of Fargo. After studying the preceding community growth once Bennett Elementary and Davies High School were built, it was clear that this area of town was on the rise and adaptable to change. This neighborhood is very focused on vehicular movement and pedestrian options. This means that there are ample opportunities for access to major roads and amenities. It may seem far from other important features of Fargo, but it follows the future growth plan. Southern growth is the best option for the city as it provides space for new buildings and infrastructure that is not cut off from the rest of its community. The 2024 Fargo Growth Plan supported this option as well as providing more diversity in terms of housing and infrastructure models for the community. This will supply more options for living in this area of town.

After realizing the need for an elementary school in the southern regions of Fargo, Bennett Elementary was important to study. The process the city took to push development south to infill once this school was built showed the adaptability of Fargo. Bennett has outgrown its capacity, and the city has grown even further south. This means that a new facility will be needed to provide for all the young families in the Davies Neighborhood.

The next step to study was all existing elementary school locations throughout Fargo. A map of Fargo was made, noting every location throughout the city. The distance between each school was recognized, so this could be imitated at the new location. It was found that the average distance between schools was 1.8 miles. This means that most students are within walking distance of the school. If they don't walk, it is a short bus ride. Providing elementary schools within reasonable distances can strengthen communities by giving them a new heart in the neighborhood. Since the 1.8-mile radius was discovered and the need for elementary schools in southern Fargo was important, that left few options available for a new location.

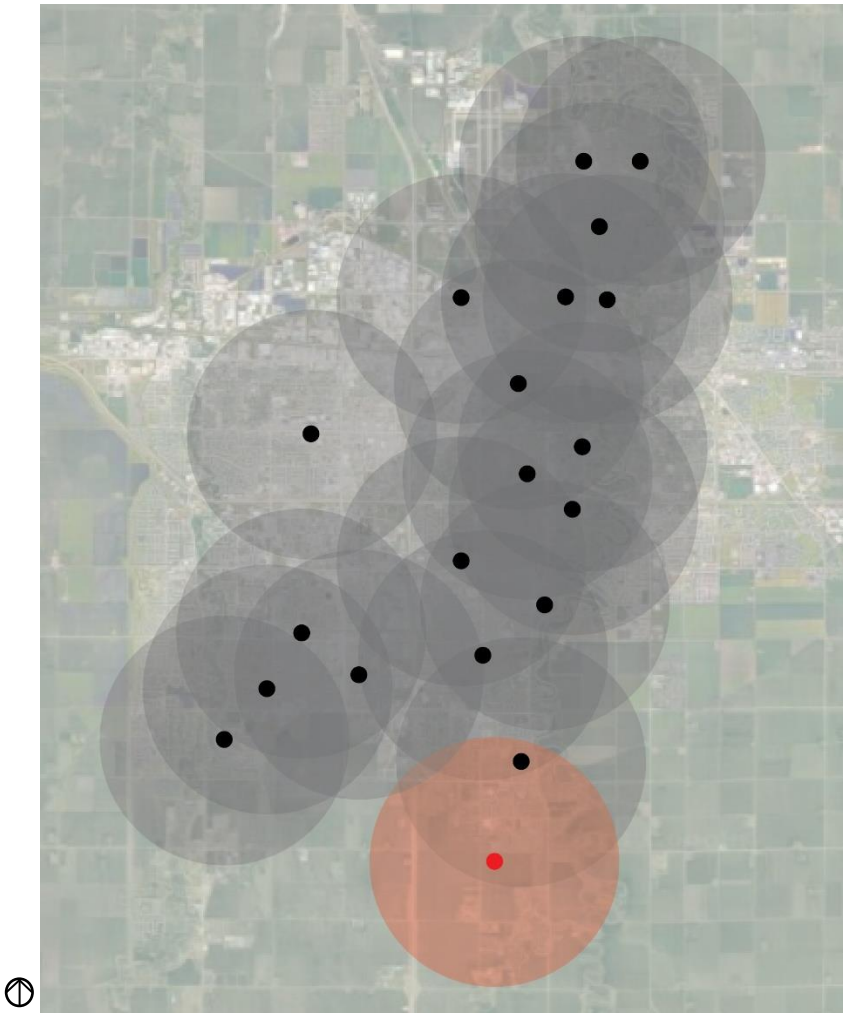

Figure 40. Map of Existing Elementary School Locations (modeled after Google Earth Pro, 2022)

The map above shows the location of all Fargo Elementary Schools. The gray circles denote a 1.8-mile radius. The red location shows the site that was chosen. The 1.8-mile radius shows the proper distance from Bennett Elementary. This location will provide for all of the growth that Fargo is enduring.

The specific site was the furthest area in south Fargo that had ample room for school development. Once the area was chosen, it was realized that the plot of land was already owned by the Board of Education of the City of Fargo. The city has done extensive research into new facilities for the education of Fargo. This land is supposedly slated to be developed into a new

elementary school after the 2027 completion of the FM Diversion (*Bringing Permanent, Reliable Flood Protection to the Fargo-Moorhead Area*, 2022).

3.4.2. Site Map

The site of this project is located at 2038 76th Ave. S in Fargo, North Dakota. This is a parcel owned by the Board of Education of the City of Fargo. The current site is 36.25 acres that were annexed into the city in 2009. The site is owned by the city but rented out for agricultural purposes. This site is currently surrounded by land to the east, west, and south that is not owned by the city (*Interactive Map*, n.d.). As Fargo grows, this site will be purposefully integrated into the community.

Figure 41. Current Site GIS (from Interactive Map, n.d.)

Figure 42. Current Parcels Near the Site (from Interactive Map, n.d.)

3.4.2.1. Nearby Amenities

The neighborhood where this site is located has experienced urban sprawl. This has caused some amenities to be further from the site than what is desired. The closest grocery store is 3.2 miles, but only an 8-minute drive. There are a few religious options for families. Thankfully, there are plenty of park amenities for the residents of the area. Another exciting new amenity for this neighborhood is the Fargo Parks Sports Center. The 100-acre project will provide spaces for 13,000 kids in the community (*Fargo Parks Sports Center | Fargo Parks*, 2023). The Fargo Parks Sports Center will be less than 3 miles from the new elementary school. This will give exciting opportunities for collaboration between the two places. This neighborhood is not considered very walkable because of the distance between a lot of these necessities. Building a new elementary school will help in some aspects of walkability.

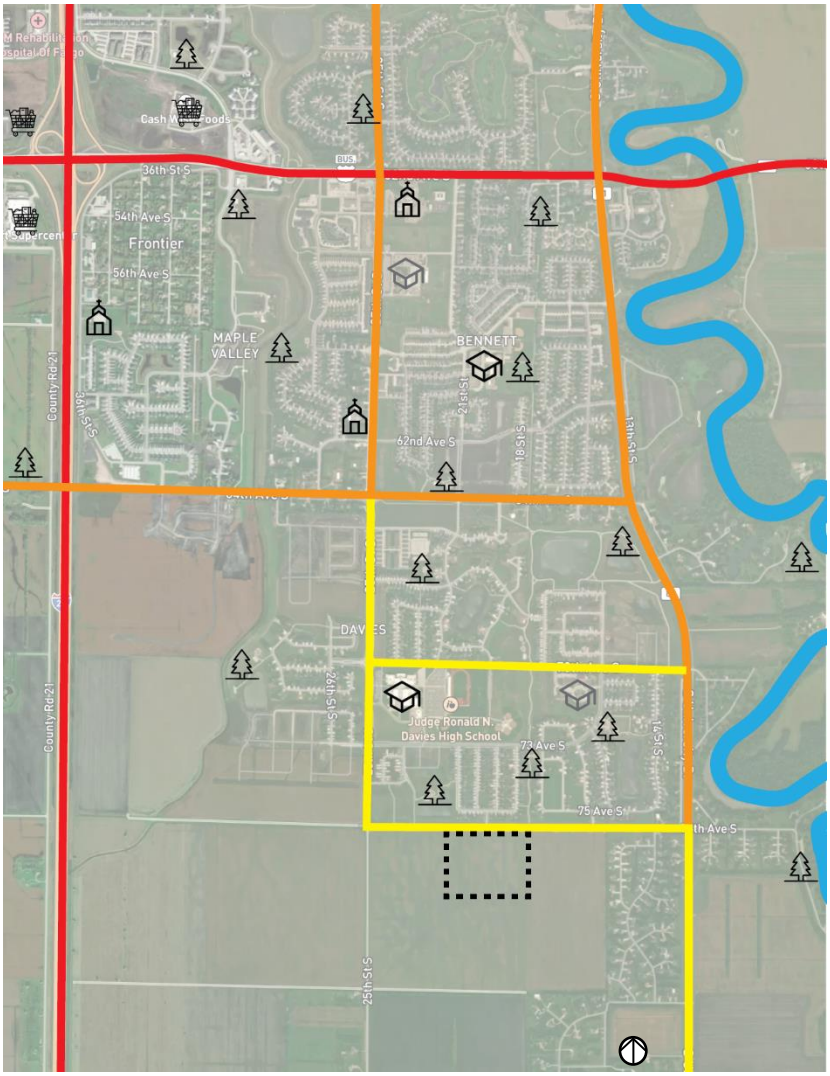

Figure 43. Amenities Near Site (modeled after Interactive Map, n.d.)

Grocery

Parks

Schools (Grey = Private)

Churches

3.4.3. Site Zoning

The current zoning of this site is AG or agricultural. The zoning would have to be modified to become P/I or public institutional. Once zoned as P/I, the project will have to be reviewed by the city under an Institutional Master Plan. The City Planner reviews the application. Then a hearing is scheduled along with a public notice. The planning commission decides on the applicability of the project. Because of this process, there are many planning requirements under the Conditional Use Permit. There must be a ten-year master plan. Site plans, land use, floor area, building height, and parking must be included in the initial proposal. Finally, neighborhood protection is important to consider when zoning. Ensuring the quality of the surrounding neighborhoods is maintained or enriched is important when creating new possibilities for the city. The City of Fargo has clear planning required for P/I projects. (*ARTICLE 20-09 - DEVELOPMENT REVIEW PROCEDURES | Code of Ordinances | Fargo, ND | Municode Library*, 2023)

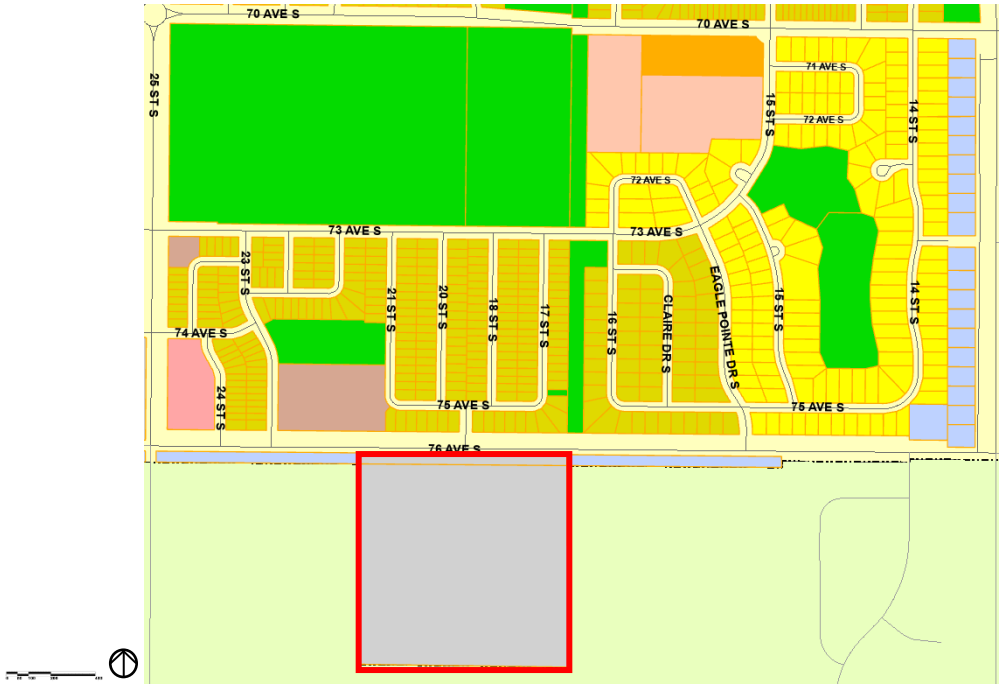

Figure 44. Current Zoning of Site (from Interactive Map, n.d.)

3.4.4. Physical Features

Currently, the land that will be used for the school is agricultural land. The acreage owned by the Board of Education of the City of Fargo blends into the surrounding landscape. Developing former farmland into usable institutional land can provide unique challenges. Utilities, soil types, runoff control, erosion control measures, and potential flooding can make developing more difficult. Thankfully, the FM Diversion will safeguard this area in terms of flooding. Utilities are present because of the developed housing districts surrounding this site. Runoff and erosion can be mitigated through proper site planning.

This site lacks any vegetation. That proposes its own challenges for an educational site. Vegetation can add to the privacy and security that schools need. Vegetation is also important to sustainable strategies. Developing the site by planting greenery will help bring in the natural vegetation that the site is lacking. Fast-growing trees will be important to implement as soon as possible.

The site is very flat. The greatest elevation change is the ditches alongside the road north of the site. The image below shows 1ft elevation changes. Given that this land is currently farmed, those small changes can happen often. Since this site is level, it will give ample opportunity for new and exciting landscaping and site development options.

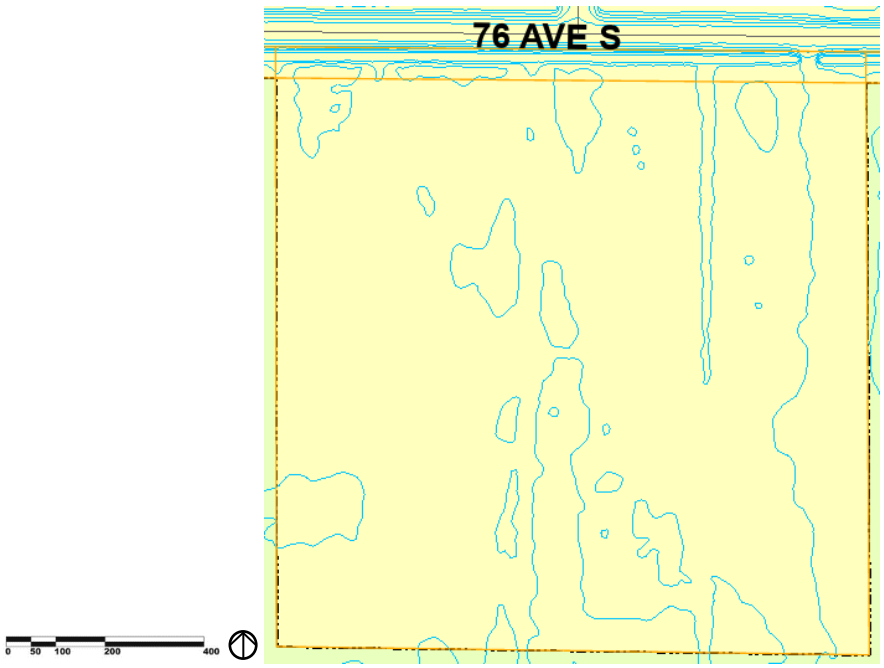

Figure 45. Current Topography of Site (from Interactive Map, n.d.)

3.4.5. Photos

The photos below were taken on October 18, 2023. This was a good opportunity to survey the land in its most typical form. This was after harvest, so the site was bare. These photos were taken in the evening, prior to sunset. It was overcast, so the sun patterns were hard to note. Nevertheless, the images help give context and connection to the land that will be used.

Figure 46. Current Site (photo by Anne Manstrom, 2023)

Figure 47. View North of Site (photo by Anne Manstrom, 2023)

Figure 48. View East of Site (photo by Anne Manstrom, 2023)

Figure 49. View South of Site (photo by Anne Manstrom, 2023)

Figure 50. View West of Site (photo by Anne Manstrom, 2023)

3.5. Case Studies

Studying existing architecture can help highlight successful projects. Case studies can be chosen to demonstrate different impacts of design. The following case studies were chosen on educational, psychological, community, and regional influences. The four case studies contain information gathered through multiple sources. Bringing together this information is essential to inform future design.

Case Studies				
At A Glance				
	Laurentian Elementary School	**Ehrman Crest Elementary School**	**Oak Park Community Recreation Center**	**Anne Carlsen Center**
Typology:	School	School	Community	Healthcare
Location:	Eveleth, MN	Cranberry Township, PN	Oak Park, IL	Jamestown, ND
Architect:	Cuningham Group	CannonDesign	Perkins&Will	JLG Architects
Year Completed:	2022	2022	2023	2024
Size:	88,500 sq ft	198,000 sq ft	42,000 sq ft	110,000 sq ft
Relation to Proposal				
Educational:	X	X		X
Universal Design:	X	X	X	X
Sustainable Design:	X	X	X	
Community Focus:	X	X	X	
Cold Climate:	X		X	X
Alternative Planning:		X		X

Table 3. Case Study Quick Information (table by Anne Manstrom, 2023)

3.5.1 Laurentian Elementary School

Project Type: Elementary School

Location: Eveleth, Minnesota

Size: 88,500 square feet

Distinguishing Characteristics: The Laurentian Elementary School is a part of the Rock Ridge Public School District. These Northern Minnesota communities came together to form a larger district comprised of three small Minnesota towns. This district bonded over the central idea of creating programs to support 21st-century skills. Creativity, character, entrepreneurship, critical thinking, communication, collaboration, citizenship, and global competence are the differentiating factors they focus on.

Program Elements: The elements that Laurentian Elementary concentrated on were the next-century learning neighborhoods. These neighborhoods offer collaborative learning that most students don't get the opportunity to experience. The multi-story commons connect each neighborhood while welcoming students into school each day. "With breathtaking views of the surrounding forest, the commons connects users to the landscape and inspires play, both inside and outside" (*Laurentian Elementary School*, 2023).

Social Impact: Assembling the communities of Eveleth, Gilbert, and Virginia created new opportunities for their students. Creating a larger district allowed for updated facilities that better the future. The design of a new facility allowed for social growth through the learning neighborhoods. The updated ideology of bridging typical learning with new opportunities allows growth through students. The social impact of this building will create well-rounded students

stemming from design. The overall composition of this building creates a comprehensive climate bringing together the community and Northern Minnesota's nature.

Analysis: The exploration of space planning, sustainability, and connection to community and nature is what made this project stand out. Allowing cold climates to drive design in a positive way is something that others should emulate.

Figure 51. Laurentian Indoor Playground (from Laurentian Elementary School, n.d.)

Figure 52. Laurentian School Wings (from Lamppa, 2021)

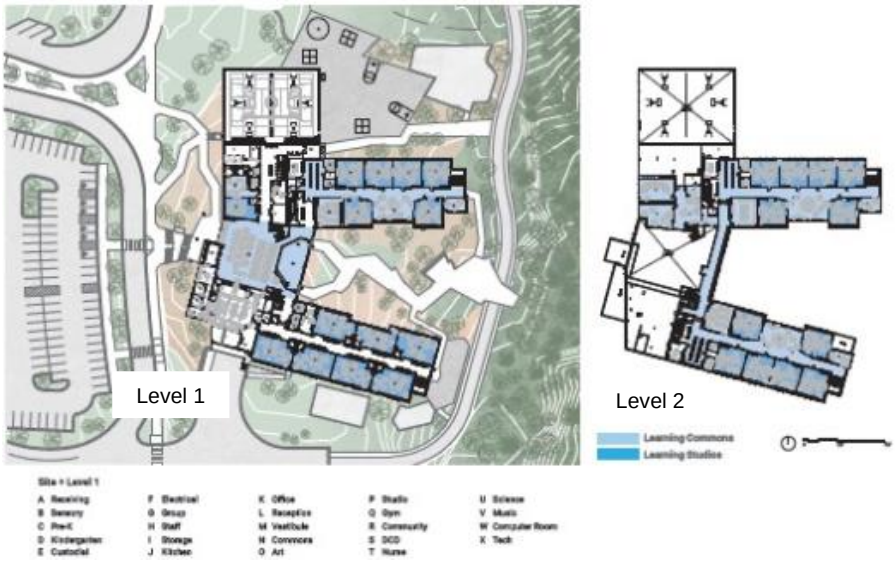

Figure 53. Laurentian School Wings (from Hometown Focus, 2023)

3.5.1. Ehrman Crest Elementary and Middle School

Project Type: Elementary and Middle School

Location: Cranberry Township, Pennsylvania

Size: 198,000 square feet

Distinguishing Characteristics: The Ehrman Crest Elementary and Middle School is a unique new construction project. The architects teamed up with a children's museum to create a new approach emphasizing interactive and playful fundamentals. Most elementary and middle schools focus on classrooms. Corridors are used as a funnel from one room to another. This efficient mindset fails to utilize valuable square footage. This square footage could be used to help students learn at different paces and create new resources.

Program Elements: "The overall goal of Ehrman Crest is to make learning more engaging and interactive. All elements blend together smoothly and playfully" (Gormly, 2023). The standard classroom design went by the wayside. Collaboration spaces serve as an extension for learning. Flexibility allows spaces to combine or divide spaces depending on the purpose. Fun, exciting, and comfortable furniture can be chosen by educators. This allows for personalization between spaces.

Social Impact: "I think for some kids, it really creates some opportunities to learn in different ways… It takes away some of the stigma or anxiety or stress about being in school. When they come to the children's museum, all that goes away. We see some kids flourish"(Gormly, 2023). Play has been thrown out when it comes to education. This design has brought excitement and new experiences back into education. Hands-on learning allows students of all abilities to interact and respond better to lessons. Creating a setting that allows all students to flourish is what makes this project successful.

Analysis: The floor plans of this project helped gain insight into how to create new learning spaces in typical buildings. The use of color and texture is unmatched. This served as a realistic example of how the future of schooling could look. Bringing excitement and fun to students is how to get them to enjoy their time at the institution.

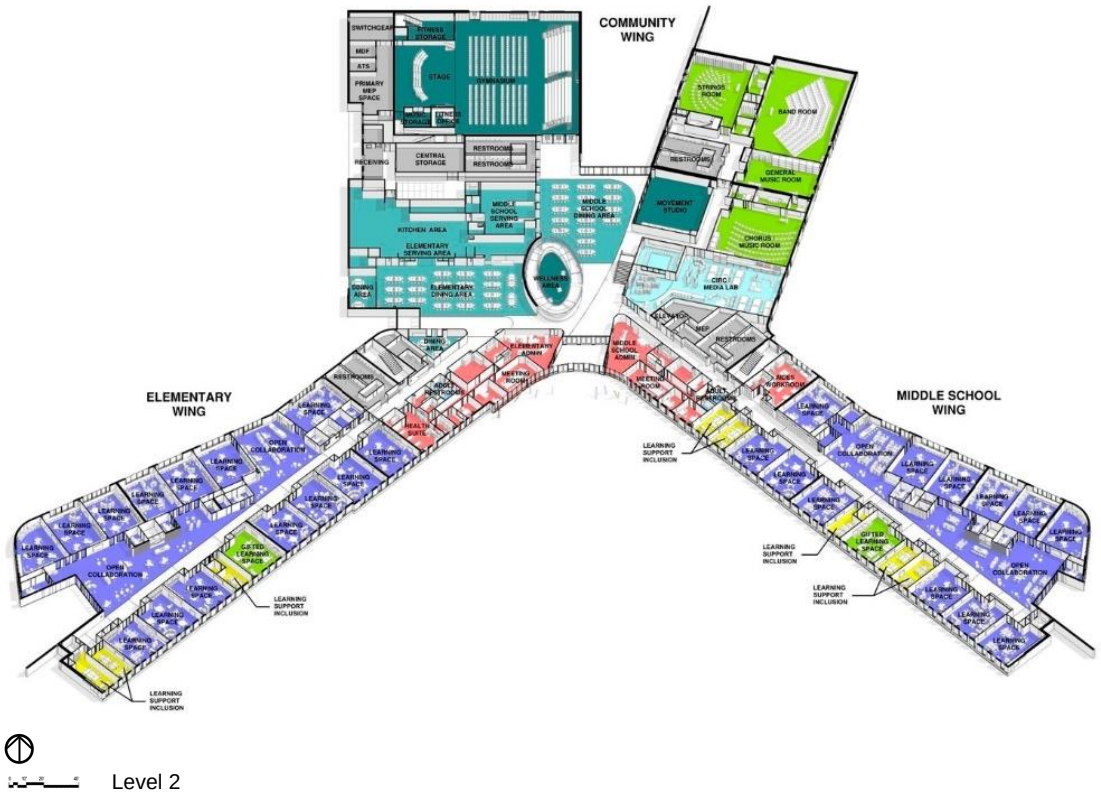

Figure 54. Ehrman Crest Floor Plan (from *Seneca Valley School District, Ehrman Crest Elementary and Middle School / CannonDesign*, 2023)

Figure 55. Ehrman Crest Exterior Facade (from *Seneca Valley School District, Ehrman Crest Elementary and Middle School / CannonDesign*, 2023)

Figure 56. Ehrman Crest Interior Breakout Spaces (from *Seneca Valley School District, Ehrman Crest Elementary and Middle School / CannonDesign*, 2023)

3.5.2. Oak Park Community Recreation Center

Project Type: Community

Location: Oak Park, Illinois

Size: 42,000 square feet

Distinguishing Characteristics: The Oak Park Community Recreation Center brings together diverse neighborhoods by supporting inclusion, fairness, and sustainability. This building serves as the inspiration for the start of the revitalization of the region. This community center was designed to be net zero with programming for everyone. This brings together the focus on creating healthier communities physically and architecturally.

Program Elements: There are elements on every floor that serve as spaces for the community. Conference rooms, childcare centers, locker rooms, esports, fitness centers, gymnasiums, and

offices for the Community Mental Health Board serve as options for everyone to grow individually or as a collective. The inclusion of people with different abilities stood out while in the research phase. Options within locker rooms, fitness equipment, and others create inclusive choices for the community.

Social Impact: The building is oriented east-west with glazing on the north side of the structure. This allows for daylighting within and visibility to the community. Since the building was designed to be net-zero, intentional products were chosen to help lower energy costs. Triple-paned glazing, photovoltaics, and canopies on the façade all end up saving the client $80,000/year. There are batteries on-site to support spaces in case of power outages. The sustainability of this building is what showcased its impact successfully. Hopefully, the community can take inspiration from this space and appreciate it.

Analysis: The design of this building was successful in terms of inclusion and sustainability. These two can be harmonious as shown in this structure. Their communities will benefit from the initial planning put into this project.

Figure 57. OPCRC Exterior Façade (from *Oak Park Community Recreation Center / Perkins&Will*, 2023)

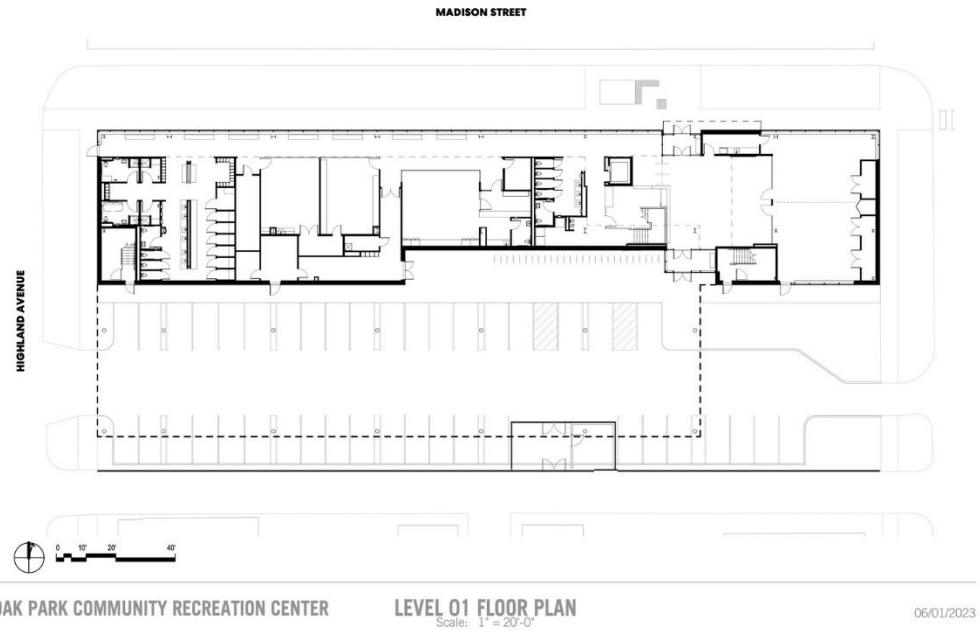

Figure 58. OPCRC Floor Plan (from *Oak Park Community Recreation Center / Perkins&Will*, 2023)

Figure 59. OPCRC Accessibility Options (from Oak Park Community Recreation Center / Perkins&Will, 2023)

3.5.3. Anne Carlsen Center

Project Type: Healthcare

Location: Jamestown, North Dakota

Size: 110,000 square feet

Distinguishing Characteristics: The Anne Carlsen Center is a new construction project to replace the existing facility that supports individuals with disabilities. This project is currently under construction and will be completed in the spring of 2024. The current facility has been outgrown and they need advances in technology and components. The new facility will support 34 individuals with medically complex needs and behavioral challenges. There will be six buildings that surround an outdoor courtyard. This allows residents to focus on the courtyard and big outdoor space for them to enjoy. The circulation within will allow children to ride bikes and scooters around while indoors. The overall design was to help promote freedom and accessibility.

Program Elements: Within the building, it was important to have a variety of spaces to support these residents. The new building needed to support the administration and leadership of this company. They need the opportunity and space to grow in numbers while their company grows. There are inpatient and outpatient therapy areas for community members to come in or stay while getting treatment. Multipurpose spaces will be used for learning spaces, gymnasiums, chapel, special events, and more. The residents now have individual bedrooms and private bathrooms to promote individuality and privacy. They created flexible spaces to be functional for every resident in this space. The entire building was designed with the residents in mind. That comes out when you analyze the spaces and how they will function for the resident's day-to-day.

Social Impact: The visibility of this project will forever change the landscape of Jamestown. They have created this campus right off the interstate outside of Jamestown. They used to be deep inside the city. It was beneficial to change location to help with accessibility but also visibility. It is important to bring awareness to people of all abilities. That's why even the change of location impacts the social fabric of Jamestown. Seeing how this updated building was designed perfectly for the users shows how everyone's voice is important.

Analysis: This building was designed perfectly for the users. Children and young adults with disabilities should be given the same opportunities as everyone else. This building shows that they are seen and respected. The Anne Carlsen Center has a deep history and importance to the community. This building will help their vision continue for years to come.

Figure 60. Entrance to Anne Carlsen Center (from "Pathways," 2023)

Figure 61. Anne Carlsen Center Courtyard Focused Design (from “Pathways,” 2023)

Figure 62. Anne Carlsen Center Floor Plan by Typology (from “Pathways,” 2023)

3.6. Detailed Space Program

It is estimated that a new elementary facility will need to accommodate 450 students. This will allow relief for Bennett Elementary, Kindred Elementary, and other surrounding areas. This will also support the growth of Fargo in the southern region. The new building can be broken down into spaces, square footage, and overall needs. The chart below shows an estimate of what will be needed for the new elementary school. Based on the number of students, it can be estimated that there will be 65 staff to support these numbers (*Calculation Tables for Elementary Schools*, n.d.). Using this initial information will guide the design into a more developed and detailed program. These numbers serve as a starting point for expansion.

Space Programming			
Project Elements Provides for 450 Students:			
	# of Spaces	SF/Space	Total SF
Teaching Space:			
General Classroom	18	1,050	18,900
Library	1	2,000	2,000
Physical Education	1	7,000	7,000
Art/Music Education	2	1,500	3,000
Total Square Feet:			30,900
15% Circulation			4,635
Total with Circulation			**35,535**

	# of Spaces	SF/Space	Total
Building Support:			
Toilet Rooms	8	325	2,600
Storage	2	390	780
Kitchen/Cafeteria	2	2,000	4,000
Administration	1	1,600	1,600
Custodial/Mechanical	3	1,100	3,300
Total Square Feet:			12,280
20% Circulation			2,456
Total with Circulation			**14,736**

Total Square footage:	**50,271**

Table 4. Space Program by Square Footage (modeled after *Calculation Tables for Elementary Schools*, n.d.).

4. RESULTS AND CONCLUSIONS

4.1. Project Description

The proposed project aims to create a framework for designing inclusive elementary schools through Universal Design and sustainable strategies. The project investigated many facets that can affect the success of a school. History, climate, universal design, sustainability, site analysis, and case studies all were researched to gain new perspectives. The project delivered a comprehensive report and a framework that was used to design an inclusive elementary school that caters to the needs of all students.

The physical building was designed with many goals in mind. The overall plan was driven by including sunlight into every classroom. The importance of shared learning centers was also very influential to the design. From accessing the plan, you can see the rest of the programming fill in between these two spaces. Centralized art, music, library, cafeteria, and gym were important to accessibility. That's how the younger and older wings of the school were formed. Therefore, those shared spaces bridged that gap. The exterior design was driven by precast concrete options and playing with color and pattern. Overall, the school's design depended on a lot of factors.

In conclusion, the proposed project aims to create a framework for designing inclusive elementary schools through Universal Design and sustainable strategies. Throughout the next semester, a comprehensive design will be developed. This will be in response to the preceding research. A final project description will be written to outline the goals of this project. Next, the project design will be refined and become a final deliverable. Through proper documentation, the final project will be clear and concise. The aim is to have an influential and successful project by the end of this academic year.

4.2. Project Objective

After studying many floor plans and designs, the most important goals of my design emerged. Creating spaces that were flexible for sharing and learning with others was valuable. The students and staff both benefit from these shared amenity areas. The support or staff spaces should mostly be ingrained into the overall building, so most of the focus stays on the student. Much of the programming of this building follows typical elementary school needs. Yet, I focused on implementing universal design and sustainability. This allows for goals that students and the community benefitted from.

4.2.1. Universal Design Implementation

A single level design was a viable option because of the site. Having sprawl eliminated any need for stairs or elevators. This allows students and teachers of all abilities to have a simpler path of travel. Shared learning spaces are emerging in many new designs. This technique brings together smaller groups of students to simulate a ‘home base’ while at school. SLC also focuses on activity and play spaces, which are important to the development of children. Clustering amenities has many benefits. One of the significant benefits to focus on is the new access to resources for children with disabilities which cuts down on the distance for students to travel to core functions. Restrooms are also closer and allow for reduced time without supervision. Flexible spaces and furniture provide for different opportunities for students with different learning styles to focus and succeed. Overall, providing spaces that feel more home-like and personalized allows students to feel more at ease in their surroundings.

4.2.2. Sustainability Implementation

Sustainability is an aspect of design that all architects should consider early on in their processes. Bringing daylight into schools in as many capacities as possible is encouraged. This is important to the physiological well-being of students as it directly is affected by the amount of daylight they get. Mitigating the sunlight is a key aspect of initial design. Bringing in light shelves, clerestory, diffused glass, and other features can help control the direct sunlight. Managing the value of daylight is a skill that designers can utilize. Thoughtfully placed vegetation and building orientation play a key role in external capacities. They change with the seasons, which is needed for hot summer or cold winter days. This site has the perfect opportunity for daylighting. Because of the benefits of sunlight to students focus and wellbeing, I knew that this concept would be a driving factor to my overall design. I studied the sun patterns in this location and found the optimal times that students would be in the building. This helped me in positioning of classrooms to utilize that natural light and heat, especially during our cold winters.

A green roof is a great option for this flat-roofed school. Green roofs help mitigate storm water and conserve energy with their insulative powers. Green roofs also provide for biodiversity. Birds, bugs, and other animals or insects can benefit from a protected biophilic area. Green roofs also are proven to lengthen the life of a typical roof. The membrane should last 30-50 years compared to typical roofs 15-20 years. The ROI on green roofs are generally between 8-20 years, which should be returned many times in the typical lifespan of a school building.

Geothermal heating and cooling is a great option for this location. Because of the single level design, a lot of the heating components can be implemented into the flooring, allowing for radiant heating. North Dakota is well-suited for deep enhanced geothermal systems because of

the geology. Geothermal is a clean and renewable power that does not emit pollutants into student's systems.

Finally, because of the location, solar capture will be ideal. This site receives on average 12 hrs of direct southern sunlight per day. According to average electricity rates, the school will spend $48,240 a year on electricity. With early implementation of solar panels, this cost will be greatly reduced and the solar panels will soon pay for themselves. With the average of 10 kwh needed per square foot of school, we would need around 700,000 kwH a year. With a correctly specified solar array, much electricity for the school could be procured through solar power. This also would provide for a teaching opportunity to classes and therefore may influence some of the community members to think more green.

4.3. Project Design and Documentation

4.3.1. Site & Floor Plan

Figure 63. Site and Floor Plan (modeled by Anne Manstrom, 2024)

The overall site and floor plan focuses on the student. Inviting them in with safe site design was important. The school is split into a western and eastern wing, with K-2 and 3-5 classrooms. The classrooms surround a shared learning space for all to use and meet. All of the shared classrooms such as art, music, library, cafeteria, and gym bridge the gaps left between the classrooms. The classrooms drove the design by following the sunlight patterns for this area so every class can have access to sunlight.

4.3.1.1. Furniture Plan

Figure 64. Furniture Plan (modeled by Anne Manstrom, 2024)

The furniture plan shows how every space will be utilized. Flexible furniture and availability of different formations helps keep student interest and focus throughout the day.

4.3.1.1.1. Child Focus

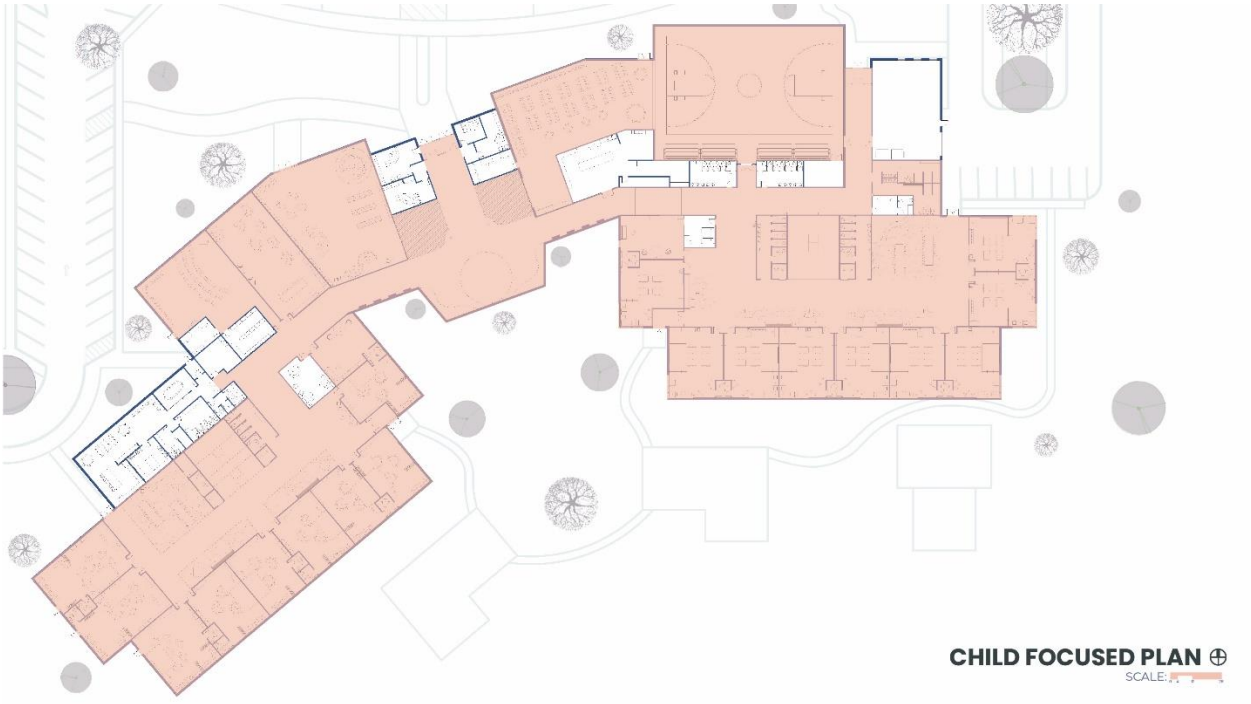

Figure 65. Child Focused Plan (modeled by Anne Manstrom, 2024)

This plan shows how much of this school was designed with the child at the front of mind. These spaces are solely for student use or bettering students. Designing for student's allows for the form to follow.

4.3.1.1.2. Staff Focus

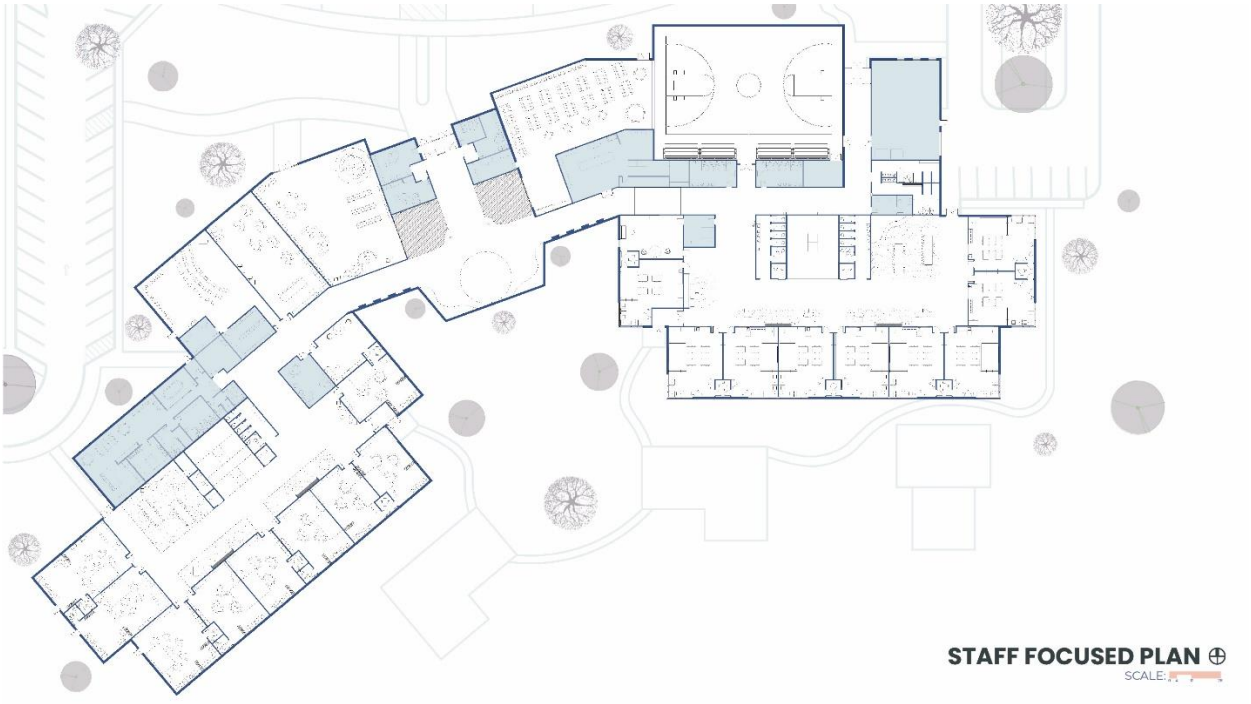

Figure 66. Staff Focused Plan (modeled by Anne Manstrom, 2024)

Staff is very important to education and schools as a whole. The highlighted spaces won't be utilized by students but will better them in the long term by providing ample resources for the staff that supports them.

4.3.1.1.3. Community Focus

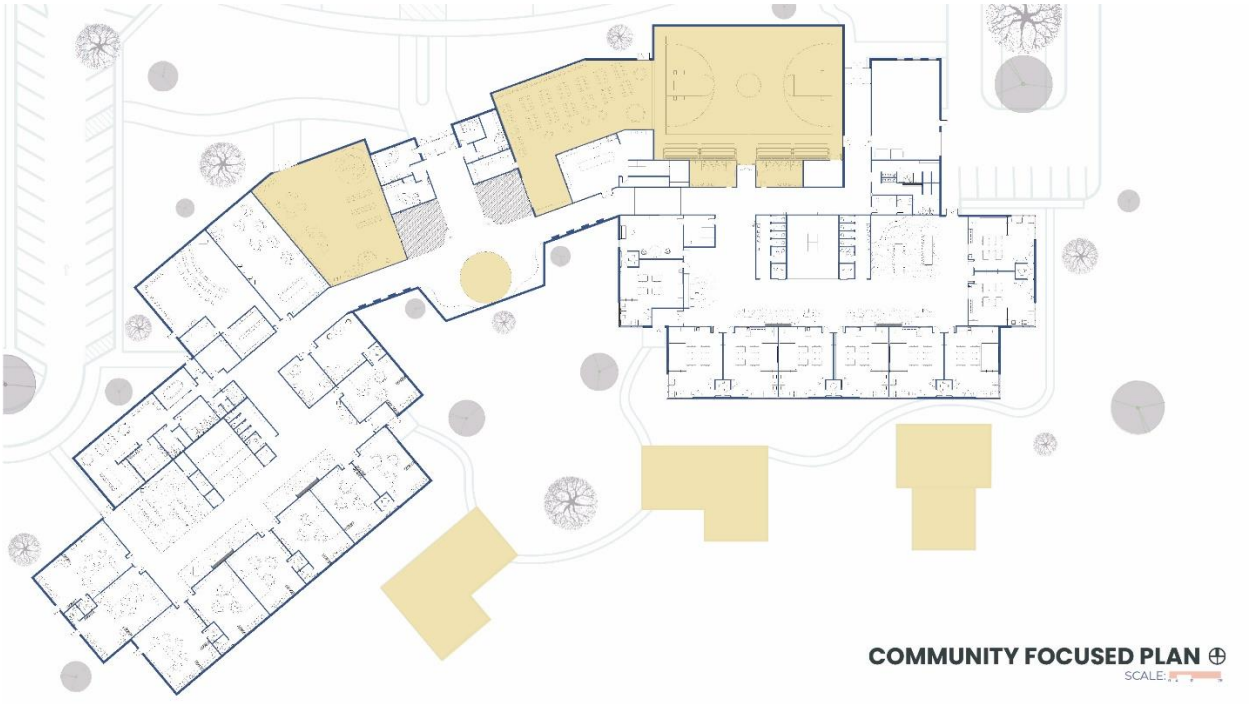

Figure 67. Community Focused Plan (modeled by Anne Manstrom, 2024)

The community spaces are integral to a school. Schools are supported by their community and users. Creating a school that invites everyone in was a way to make it more comfortable to young students. The gym and cafeteria will be used for games, practices, tournaments, and performances. The library has an external entrance. It could be used for book clubs or after school programs. The playgorounds and community garden and shelter are a great way to bring families to the area. Bringing kids here to play adds to their comfortability with the area. A young child feels more at ease when it is encouraged by parents.

4.3.2. Overall Views

Figure 68. Exterior Money Shot (modeled by Anne Manstrom, 2024)

4.3.2.1. Entry Perspective

Figure 69. Entry Perspective (modeled by Anne Manstrom, 2024)

Establishing a positive first impression at the entrance and site will influence how visitors react to the activities within. Clearly defined external signs and wayfinding are essential for lowering fear, fostering a sense of welcome, and fostering connections. This will reduce confusion, ease visitors' nervousness, and greet pupils. The new norm is a secure front door,

which can include glassed entries that let reception see who is approaching and let them into the area.

4.3.2.2. Commons Perspective

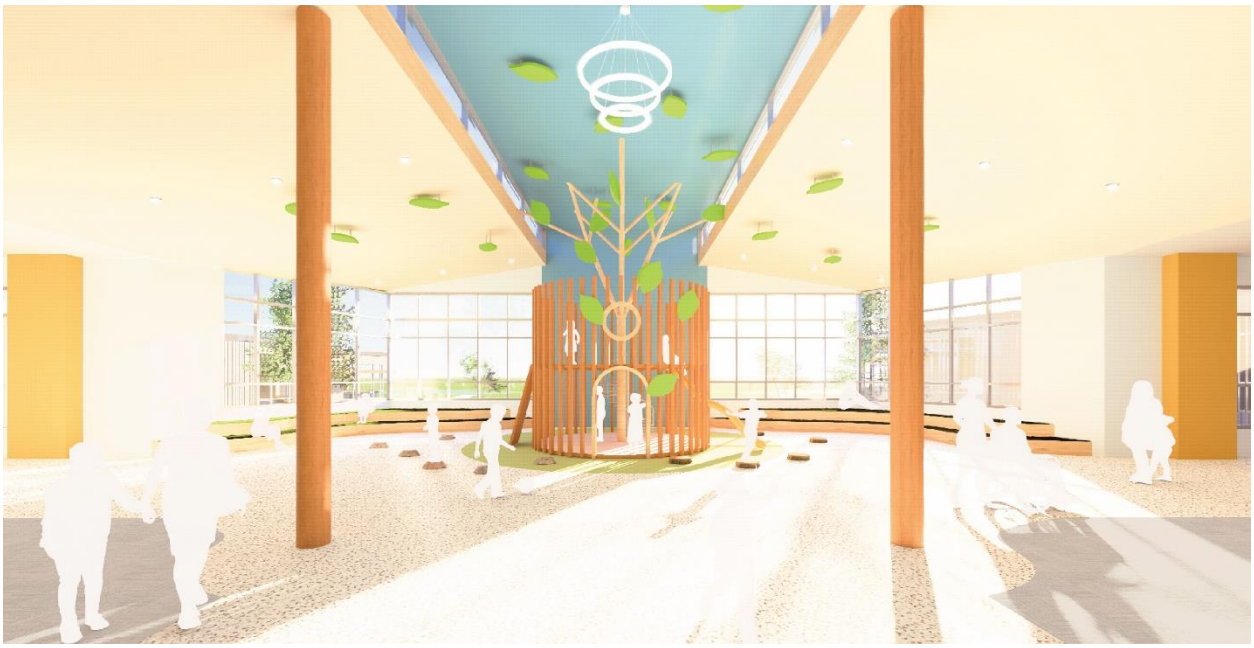

Figure 70. Commons Perspective (modeled by Anne Manstrom, 2024)

The commons area is an opportunity to welcome everyone to the space. It provides a space to breathe and choose your direction for the day. Ample daylighting is brought in through glazing. There's also a small indoor playground that can be utilized between classes or on cold days when kids can't go outdoors. This also reflects the treetops theme in a more direct sense.

4.3.2.3. Cafeteria Perspective

Figure 71. Cafeteria Perspective (modeled by Anne Manstrom, 2024)

Lunch is sometimes the most stressful time of the day for students because of schedule conflicts, stored-up energy, and social pressures. Many seating alternatives, such as high tables, low circular tables, individual bistro tables, or soft sitting, can divide big spaces with different ceiling heights and dining zones. Additionally, this area has visual connections to adjacent areas for greater passive oversight.

4.3.2.4. Library Perspective

Figure 72. Library Perspective (modeled by Anne Manstrom, 2024)

The library is seen as an inviting space for students and community members. It was important to involve art, colors, variety in seating and meeting areas. The librarians will have many different approaches to lessons and learning techniques because of this space. It also utilizes indirect lighting from the south and north. This prevents glare that is common on technology that might be used in the library.

4.3.2.5. Gymnasium Perspective

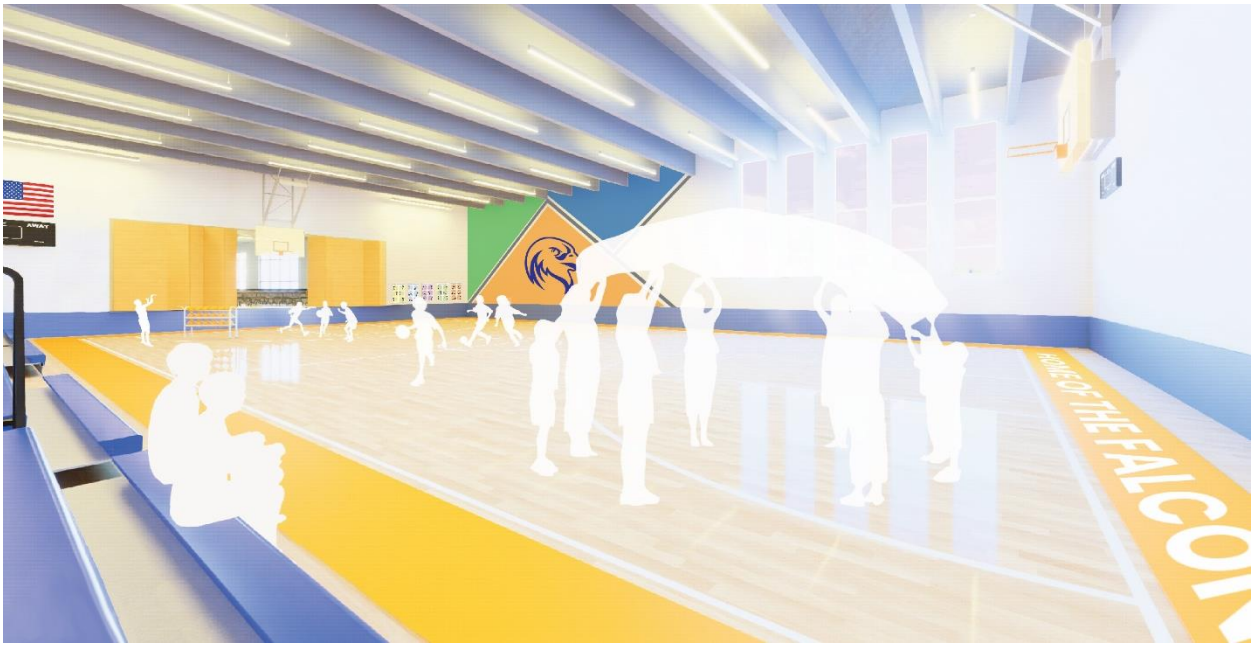

Figure 73. Gymnasium Perspective (modeled by Anne Manstrom, 2024)

The gym is an exciting space for all ages to utilize in different ways. Including natural lighting, acoustic paneling for comfortability, and colors help create a welcoming space that will be enjoyable to all.

4.3.2.6. Outdoor Community Space Perspective

Figure 74. Outdoor Community Space Perspective (modeled by Anne Manstrom, 2024)

I envision this space being used by the cafeteria workers and classrooms. Also, members of the community can be invited in to care for and harvest the crop.

4.3.2.7. Playground Perspective

Figure 75. Playground Perspective (modeled by Anne Manstrom, 2024)

This is the playground for kindergarten-2nd grade. There is more properly sized and age-appropriate equipment and games. You can also see there are accessible options for all, such as the surface-level merry-go-round which is truly safer for all students.

4.3.2.7.1. Overall Playground Perspective

Figure 76. Overall Playground Perspective (modeled by Anne Manstrom, 2024)

This view shows both playgrounds and how they connect. There are appropriate spaces for all ages. These have direct connections to their classroom wings and also to each other.

4.3.2.8. Classroom Perspective

Figure 77. Classroom Perspective (modeled by Anne Manstrom, 2024)

This is an example of a 5th grade classroom. This shows the flexibility of space. Students are able to work with themselves, the teacher, a para professional, or other classmates, all within the same room. You also can see in this rendering the open cubbies that were opted for. This allows for easing stresses with students. When their belongings are in an open area and watched all day, there is less opportunity for stealing or medeling with other student's belongings. Also being in North Dakota, when they come in from a wet playground, it allows them to air out and not stink up the entire room. You can see the implementation of natural light in this space as well. The natural light helps with focus, improved test scores, and better circadian rhythms that the parents will be thankful for.

4.3.2.8.1. Kindergarten Classroom Perspective

Figure 78. Kindergarten Classroom Perspective (modeled by Anne Manstrom, 2024)

This is an example of a kindergarten classroom. The use of color, texture, pattern, and natural light are all present in the space. You can see the flexibility in options for students and a connected rest room for supervision and access.

4.3.2.9. Shared Learning Perspective

Figure 79. Shared Learning Perspective (modeled by Anne Manstrom, 2024)

Shared learning environments have a significant impact on students' capacity to concentrate, comprehend the information, and handle stress because they are in the classroom for the majority of their waking hours. All kids can benefit from sensory decompression rooms, even though they are frequently found in special education programs. Spaces of refuge and solitary reflection/study areas can be created with furniture, small group rooms, and recessed nooks to lessen tension and enable involvement without being overstimulating. Students who are more mature want greater autonomy in making decisions. In a more personal setting, students can practice social-emotional skills and build confidence in a peer-centered learning center that is passively observed. A customized area is created by the adaptable furnishings.

4.3.2.9.1. Auditory Perspective

Figure 80. Auditory Perspective (modeled by Anne Manstrom, 2024)

Aural learners absorb lessons through hearing. Being able to listen to information allows the aural learners to process and comprehend instruction at their pace.

4.3.2.9.2. Logical Perspective

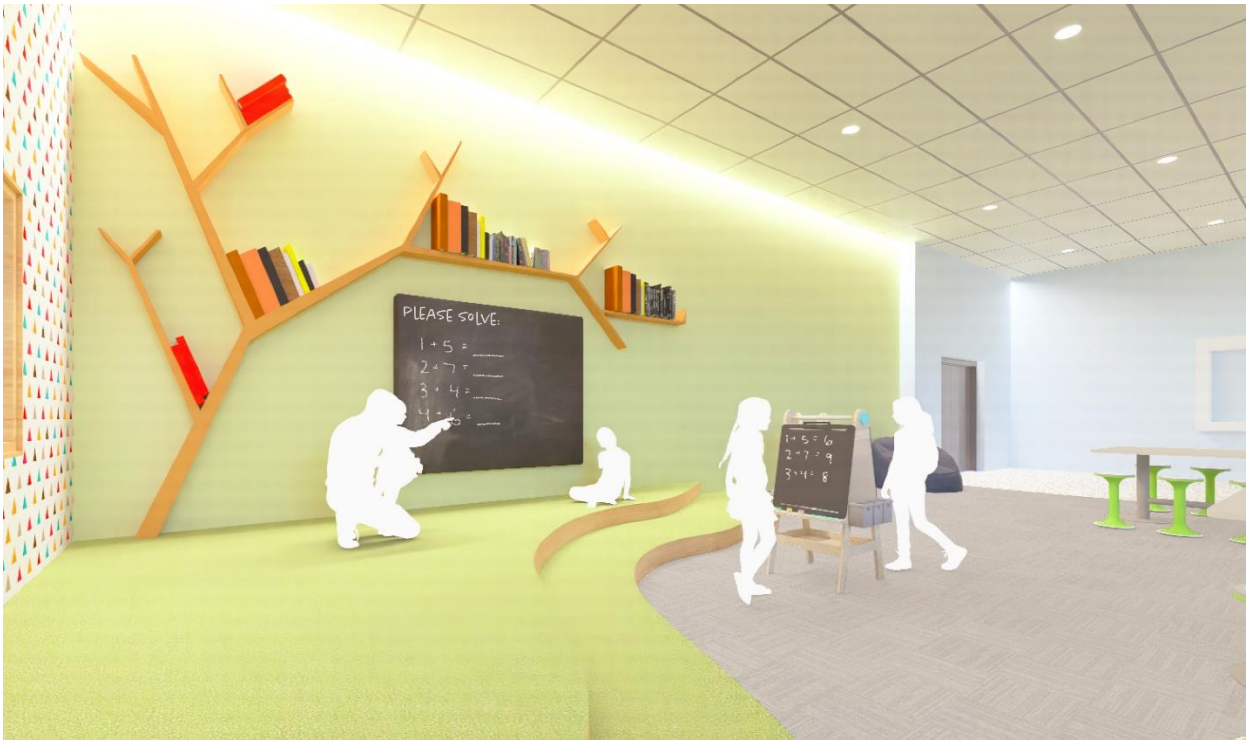

Figure 81. Logical Perspective (modeled by Anne Manstrom, 2024)

Logical learners recognize connections, concepts, and rationale. Dealing with numbers and categories are compatible with these students.

4.3.2.9.3. Solitary Perspective

Figure 82. Solitary Perspective (modeled by Anne Manstrom, 2024)

Intrapersonal learners do best when having time to reflect and work in solitude. Operating with minimal distraction grants these students comprehension in their lessons.

4.3.2.9.4. Physical Perspective

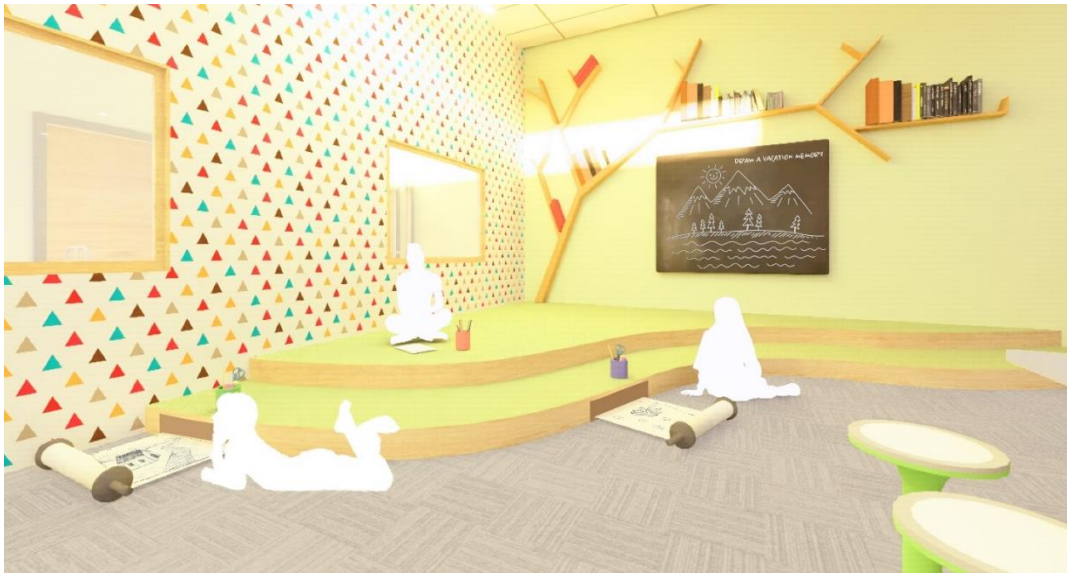

Figure 83. Physical Perspective (modeled by Anne Manstrom, 2024)

Physical learners respond positively to hands-on lessons. Performing tasks and having opportunity to discover through their senses allows for new concepts and ideas to be generated.

4.3.2.9.5. Collaborative Perspective

Figure 84. Collaborative Perspective (modeled by Anne Manstrom, 2024)

Collaborative learners work well with peers. Having study activities with others allows for verbal and non-verbal connection that strengthens their empathetic nature.

4.3.2.9.6. Verbal Perspective

Figure 85. Verbal Perspective (modeled by Anne Manstrom, 2024)

Verbal learners respond well to spoken word. Rhymes, acronyms, role playing, and mnemonic devices are techniques that teachers and students can use to support verbal learners.

4.3.2.9.7. Visual Perspective

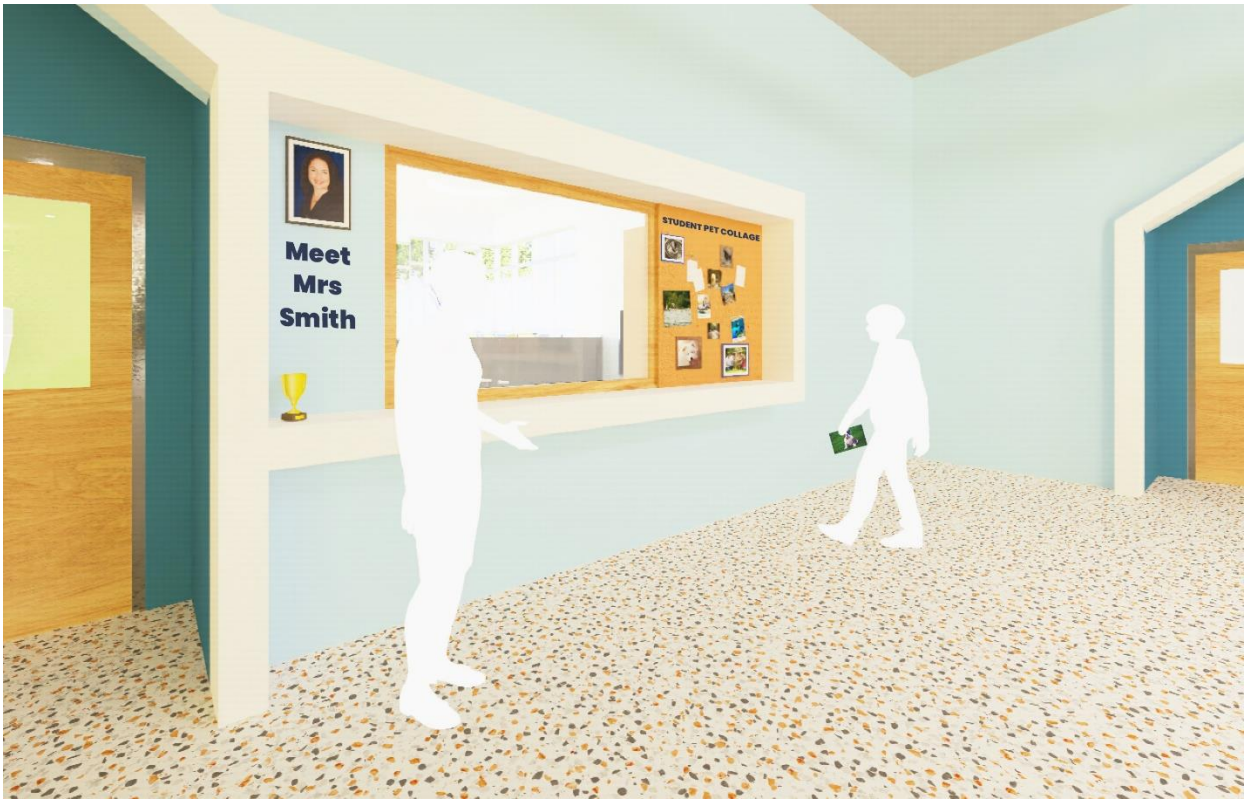

Figure 86. Visual Perspective (modeled by Anne Manstrom, 2024)

Visual learners retain information through images, maps, colors, and pictures. Providing spaces for students to see and absorb content allows for that visual connection.

4.3.3. Technical Information

4.3.3.1. Site Diagram

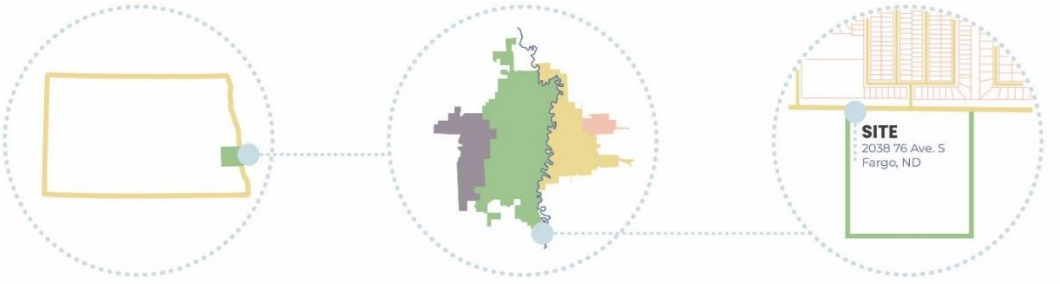

Figure 87. State, City, Site Diagram (modeled by Anne Manstrom, 2024)

4.3.3.2. Section Perspective

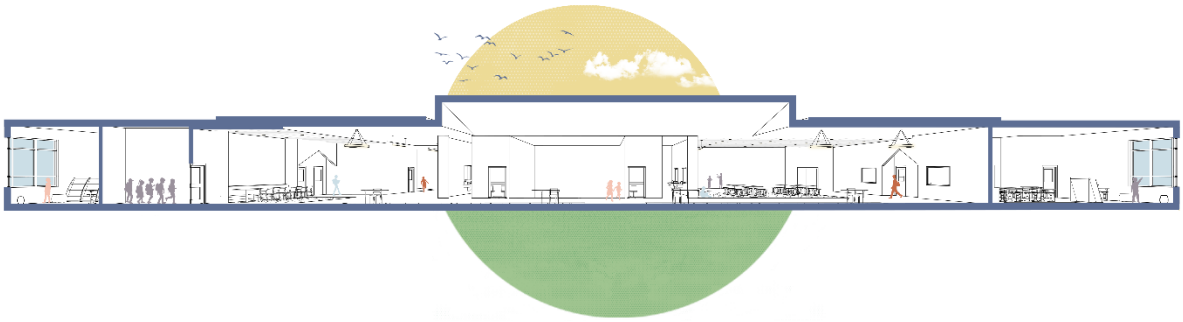

Figure 88. Section Perspective (modeled by Anne Manstrom, 2024)

The section perspective cuts through the 3rd and 5th grade classrooms along with the shared learning space. This shows how all of these spaces tie together.

4.3.3.3. Details

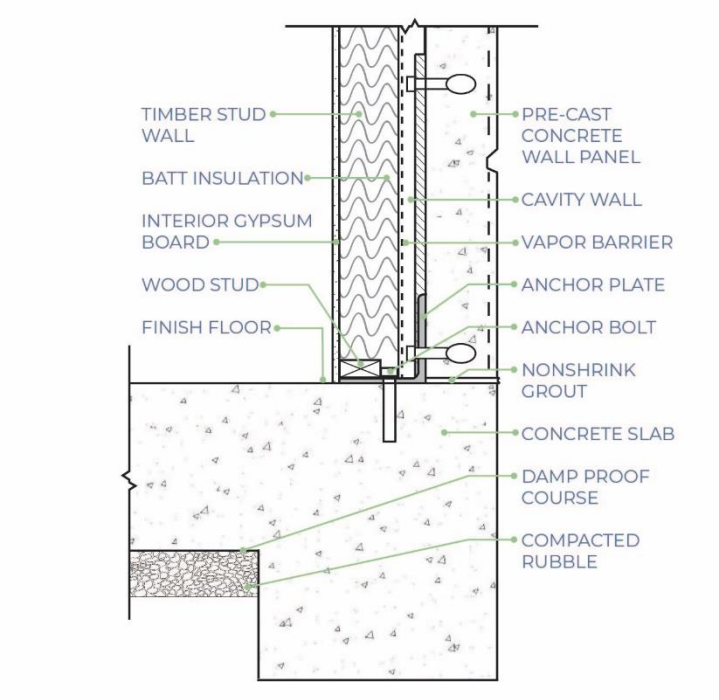

Figure 89. Precast Concrete Wall Detail (modeled by Anne Manstrom, 2024)

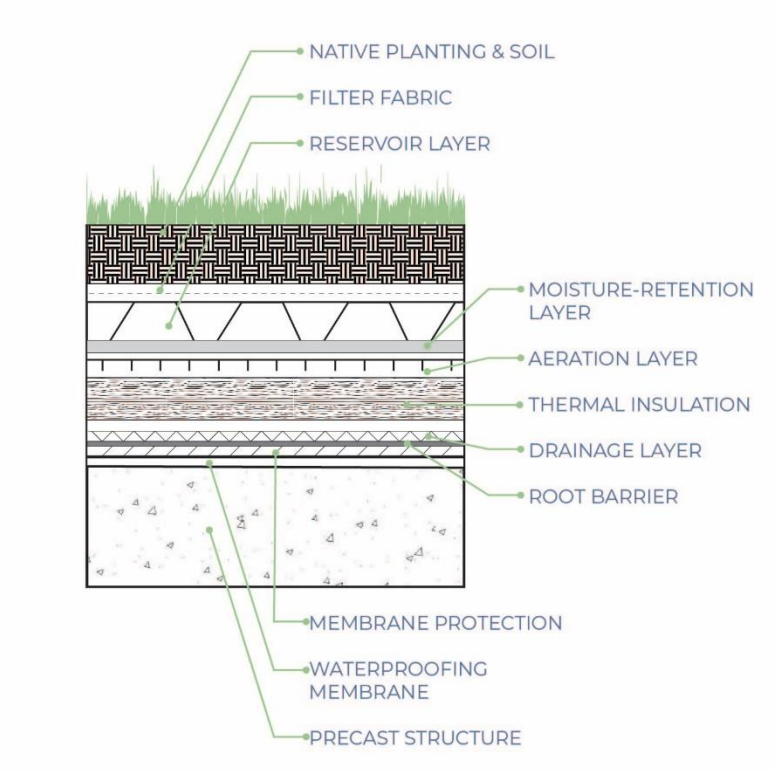

Figure 90. Green Roof Detail (modeled by Anne Manstrom, 2024)

4.3.3.4. Sustainable Diagrams

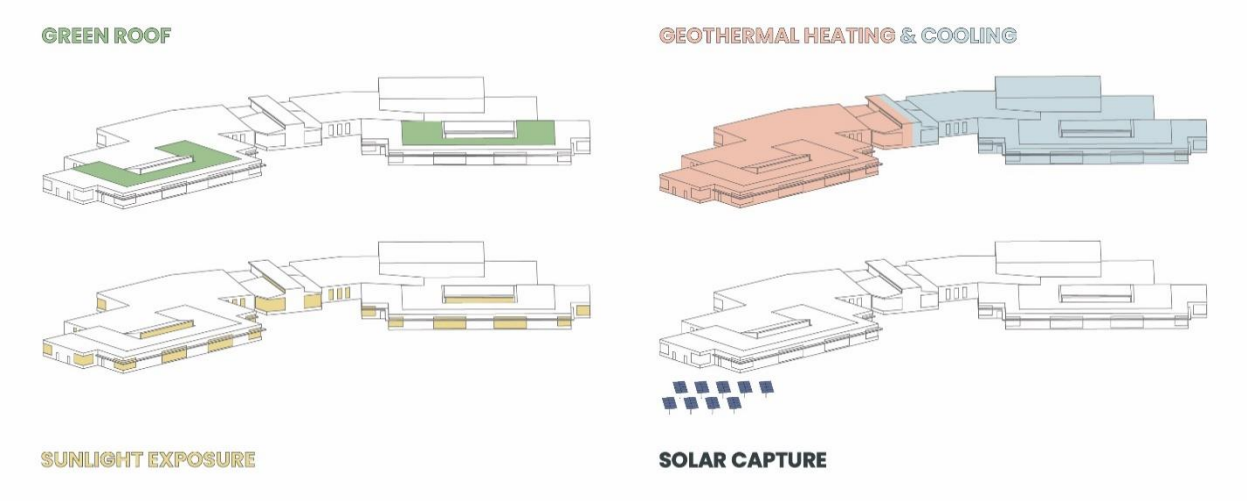

Figure 91. Sustainable Diagrams (modeled by Anne Manstrom, 2024)

These diagrams were made to model exactly how a green roof, geothermal heating and cooling, sunlight exposure, and solar capture will be used in this building.

4.3.3.5. School Name Information

Figure 92. Falcon Logo (modeled by Anne Manstrom, 2024)

Florence “Treetops” Klingensmith is an icon of aviation with deep roots in North Dakota. She worked for years breaking down barriers by apprenticing at Hector International Airport and eventually became North Dakota’s first licensed woman pilot. Florence serves as an example for the students to overcome obstacles and push expectations. She exemplified flight and the Falcon mascot reminds students to do the same by soaring above.

4.4. Conclusions

Throughout this disquisition, relevant history on the educational model and accessibility have been introduced. The location, site and context gave insight to the community that is being affected by this proposal. The process showed some of the important factors that were involved earlyl on. The program briefly explains how some of these factors are integrated into the design. Finally, the proposed design and accompanying information were showcased.

Following the presentation of this material, there was time for questions and thoughts. Creating a two-level school would have helped reduce costs and conserve energy. This concept was not brought up before the defense portion of the presentation, so it was interesting to hear how that could have altered the final design. Some other comments were made on procuring

fixed and architectural furniture. I disagreed, with this concept as it contradicted the freedom and flexibility I provided through an open design. After presenting, the only regret I have is not designing in section more often. The building could have had a more interesting form if I hadn't focused so much on function. Overall, the critiquers were pleased with this work. I was very proud of what I accomplished and how it was perceived by the public.

As you can see, the future of our children and education system can be greatly influenced by the design. I hope you take away the ideas of designing inclusively and apply them to works or every day life.

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