

**SHIFTING PERCEPTIONS:  
A SYSTEMATIC APPROACH TO URBAN ENVIRONMENTAL STEWARDSHIP**

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**ABSTRACT**

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We as a species face a fundamental disconnect with our surroundings that has created an existential threat to our continued survival on this planet. If we are to change we need to allow ourselves the opportunities to make deeper connections with our environment once again.

The idea of nature is socially constructed. It is different from person to person, culture to culture and situation to situation. This means that our perception of nature can be altered and improved to help motivate and empower the everyday person to protect the sources of our good life.

This thesis focuses on a systematic approach to urban environmental stewardship. Through the construction of an urban environmental learning center the project seeks to challenge the current relationships that we have within our urban context. The project will utilize its site, existing environmental learning centers and the city of Seattle as a resource to form a network of educational opportunities focusing on stormwater, pollution, agriculture, and plant and animal habitat.



*To my family, friends, peers, and professors, thank you very much for all of your continued support and input during this year-long endeavor. I could not have done it without you.*



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## CHAPTER 1 | INTRODUCTION

We as a species face a fundamental disconnect with our surroundings that has created an existential threat to our continued survival on this planet. In order to remedy this problem we need to reconnect with our fundamental understanding of nature to allow us a better chance of survival. I believe that we need to give ourselves opportunities that enable us to make the connection with our environment once again. We need to focus on a large scale, systematic and cross-generational approach that emphasizes shifting perceptions through education and awareness.

This project seeks to reconnect people with the sources of our good life; access to clean water and clean air. This systematic approach focuses on two timelines; a short-term timeline focused on an immediate change of the environmental ideas held by the current generation and a long-term timeline that shifts our perceptions of our environment for future generations. Before this is possible a better understanding of our context is necessary. To do this we need to educate ourselves on the historic relationships to nature, the impact of biophilia to our built environment and only then can we focus on environmental education.

This project will consist of an exploration into environmental teaching paradigms, a local environmental mapping network, a mobile outreach learning center, and an urban environmental learning center hub.



## CHAPTER 2: OUR ENVIRONMENTAL HISTORY

### Background

The late Theodore Roszak states that we have become alienated from our own natural environment and we need to invest in a “therapeutic” response to heal the separation (Roszak, 1992). If we want to better our world for future generations we need to start bridging that gap and reconnecting with our environment. Robert M. Pyle, a lepidopterist, founder of the Xerces Society, and well published author has coined this separation phenomena as the “extinction of experience.” In 1978 Pyle stated that most of the developed world experiences the natural world indirectly and vicariously through the overexposure of media; keep in mind this well was before the internet and cellphones (Jones D. R., 2013). As majority of the world’s population has moved to cities we have become desensitized to the environment that surrounds us. (Human Population: Urbanization, n.d.) We have grown to experience nature through the screens of our electronic devices and we compare our experiences in life to ones that we have seen through media.

We are at a time in our history where change is needed. Our environment is and will continue changing over the next few generations due to climatic shifts, which will

be severely detrimental to our way of life. Some blame fossil fuels and industry, while others believe that it is a cycle of natural phenomena. Whether it is human involvement or of natural causes, we as citizens of this one world need to work together to help ensure our own as well as our planet’s continued survival. We may not be able to change the ebb and flow of our changing climate but we can change our relationship with it. The evolutionary and societal changes that the human population has made over the course of its duration have all led us to this point in time but that does not mean we must remain stagnant in our current situation.

Today is the best day to make the shift; to create a better world for future generations. In his book *Biophilia*, Edward O. Wilson writes that values are time-dependent. It is safe to say most people think about time in terms of hours and days thus, very few people will go out of their way to make an effort without seeing a measurable return in their lifetime. E.O. Wilson, an American biologist and naturalist, says, “Only through an unusual amount of education and reflective thought do people come to respond emotionally to far-off events and hence place a higher premium on posterity.”

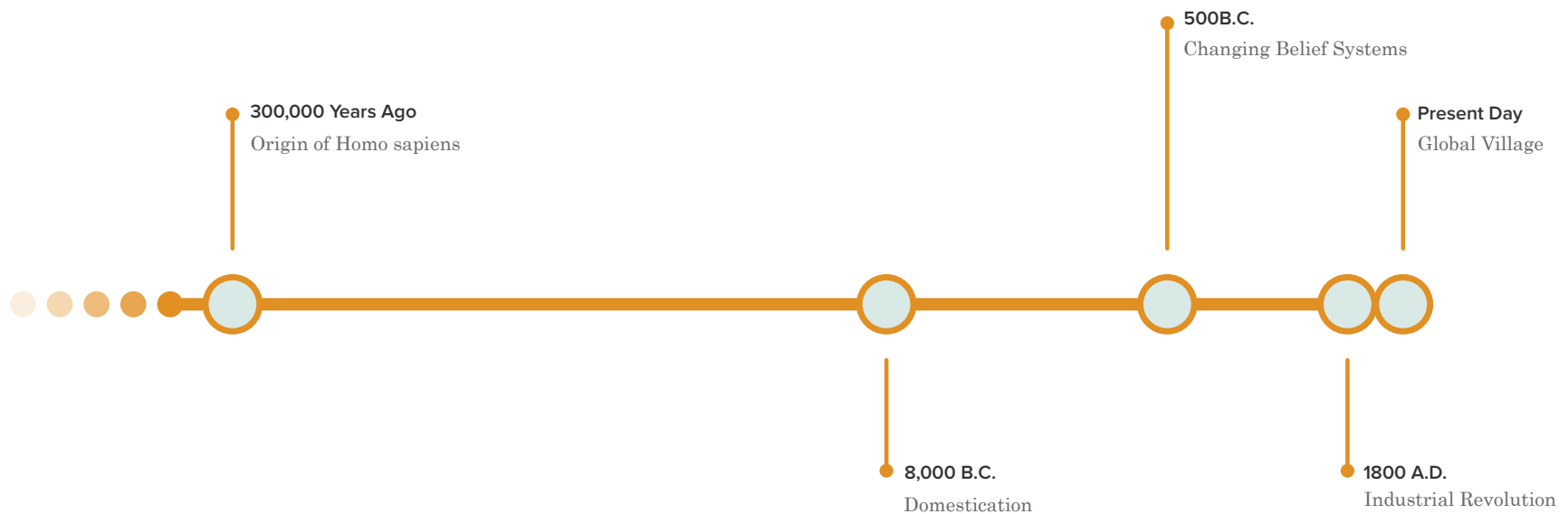


Figure 2.1: Timeline of Key Environmental History Moments

(Wilson, 1984). The more opportunities to educate the populous, the better chance we have at developing the society-wide shifts needed to remedy our problems.

Cities have been in existence for thousands of years and they have nurtured our cultural growth and prosperity. They have given us the ability to specialize and provide our world with amazing technology, arts, and culture. Compared to early civilization, the more recent civilizations have not seen a lot of change in their relationship to the environment. There has always been a separation between the urban and the rural, the built environment and the natural. This separation has created a lack of empathy towards the natural

environment in a large populous of our world, especially in the western countries. Our environment used to play a vital role in the lives the everyday person but now it seems that our lack of connection with it has led to a level of indifference. Prior to the Industrial Revolution this lack of integration was not as problematic, however, with the proliferation of steam and coal power, efficiency of mechanization and the population explosion we were able to exponentially alter the future course of the world's environment. Today we have an idyllic view of nature and that it only exists outside of our urban regions and through our culture it has become a proliferated concept.

## Prospect and Refuge

Until recently, our species history was thought to date back 200,000 years, (Smithsonian, What does it mean to be human, 2017) however, recent discoveries have revised this evolutionary period to roughly 300,000 years (Greshko, 2017). Throughout this time we have had to react to our environment to ensure our survival, working with the landscape and being aware of our surroundings. Every subconscious and conscious choice we as a species have made since then has affected our relationship to our world. There are many pivotal moments in our species timeline that have caused noticeable changes to our attitudes and understanding of the role of nature in western society.

Homo sapiens have been in existence for 300,000 years. During this time, we were not at the top of the food chain, and were just another species fighting its way through life. It is through these hardships that we learned distinct ways to interact with our environment to survive (Heerwagen, 2016). The way we currently relate to our surroundings is influenced by this period of time. Even though our species' culture has evolved at an exponential rate, our biologics have not yet caught up (Heerwagen, 2016). This means that we still interact with our environment in a similar manner as we did thousands of years ago. Figure 2.2 showcases the environment that the Homo sapiens species would have

inhabited. From this image, we can begin to speak to the many different characteristics of the environment that have helped to shape our relationship with it. These associations not only allowed us to survive, but to thrive and become the species we are today.

It is from these relationships that the idea of biophilia was developed. The love of the living is a hypothesis, written by E.O. Wilson in his book *Biophilia* in 1984. This hypothesis has been applied in areas of psychology as well as in many mediums of design. The basic ideas of biophilia state that we as a species grew and evolved in a bio-centric world and we still have these innate needs to be immersed in these similar



Figure 2.2: The Original Habitat of the Homo sapiens

Principles	Stress Reduction	Cognitive Performance	Emotion, Mood & Preferences
Visual Connection w/ Nature	Lowered blood pressure and heart rate.	Improved mental engagement and attentiveness.	Positively impacted mood and overall happiness.
Non-Visual Connection w/ nature	Reduced systolic blood pressure and hormones.	Positively impacted cognitive performance.	Perceived improvements in mental health and tranquility.
Non-Rhythmic Sensory Stimuli	Positively impacted heart rate, systolic blood pressure and sympathetic nervous system activity.	Observed and quantified behavioral measures of attention and exploration.	
Thermal & Airflow Variability	Positively impacted, well-being & productivity.	Positively impacted concentration.	Improved perception of temporal and spatial pleasure (alliesthesia).
Presence of Water	Reduced stress, increased feelings of tranquility, lower heart rate and blood pressure.	Improved concentration and memory restoration. Enhanced perception and psychological responsiveness.	Observed preferences and positive emotional responses.
Dynamic & Diffuse Light	Positively impacted circadian system functioning. Increased visual comfort.		
Connection w/ Natural Systems			Enhanced positive health responses; shifted perception of environment.
Biomorphic Forms & Patterns			Observed view preference.
Material Connection w/ Nature		Decreased diastolic blood pressure. Improved creative performance.	Improved comfort.
Complexity & Order	Positively impacted perceptual and physiological stress responses.		Observed view preference.
Prospect	Reduced stress	Reduced boredom, irritation and fatigue.	Improved comfort and perceived safety.
Refuge		Improved concentration, attention and perception of safety.	
Mystery			Induce strong pleasure response.
Risky & Peril			Resulted in strong dopamine or pleasure responses

**Table 2.1: The 14 Principles of Biophilic Design**

The table shows the relationship between the principle and the human body. The dots to the left side of the chart correlate to the empirical evidence and research done to back up the effects.

experiences, surrounded by other living things (Heerwagen, 2016). Stephen Kellert is a well-known environmental psychologist that has taken a leading role in the study of biophilia. In his book, *The 14 Principles of Biophilic Design*, Kellert talks about many of the different ways we have learned to interact with our environment (Table 2.1). Prospect and refuge are two of the main environmental cues that are often referenced.

Prospect is the ability to have vantage over a large area, such as on the plains, where we could see for miles (Figure 2.1) This was important to our survival as it allowed us to see danger coming from many directions. Refuge is the sense of security that usually stems from a having an object at our back. These two work simultaneously to create a sense of security. In present day, this can often be seen in the similar vein that we orient ourselves in a restaurant or a large open area. We will often position ourselves with our backs against an object with our eyes facing the entrance or direction of danger to minimize the possibility of unknown situations.

Another survival technique that our species adapted to using was the ability to be cognizant of light variation. This sensory awareness was critical to our survival. Being able to notice the variability of light allowed us to understand when it was time to seek shelter because of nightfall or an



Figure 2.3: Variation of Light Quality

impending storm (Figure 2.3). We could use this to protect ourselves from the possibility of danger. This meant that we could now think in terms of the future and in a sense, we were able to mentally keep track of time (Heerwagen, 2016). This is one of the most important abilities we derived from our environment because it set us up for the next stages of our evolution, when we began to domesticate plants and animals.

## Domestication

Roughly 10,000 years ago the *Homo sapiens* species domesticated plants and animals (Smithsonian, *Human Characteristics: Tools & Foods*, 2016). We applied our



Figure 2.4: The Domestication of Plants

awareness skills that were developed hundreds of thousands of years prior to aid us during the agricultural domestication process. By being cognizant of changing light, we could understand time and thus, we could map out the patterns associated with the river flood plains and the different seasons (Figure 2.4).

Some of the first animal species to be domesticated were herbivores like goats, as they were the easiest to provide sustenance for. These species provided us with sustainable meat, milk and hides. Later we began to domesticate larger herbivores like oxen to help us with farming and transportation. The ability to transport goods helped to

facilitate trade (Rutledge, et al., 2011). As we spent more time creating these stable food sources, we no longer had to live nomadic lifestyles following animal migrations. As a result the first permanent civilizations were created. This stability allowed for other trades, such as arts and crafts, to prosper (Smithsonian, Human Characteristics: Tools & Foods, 2016). For thousands of years we built up a strong relationship with our context to help ensure our survival. We had to be aware of locations we could obtain food, water, and shelter. Now that we had a more efficient and stable source of food, segments of the population began to lose their knowledge of working the land and every generation thereafter was that much more removed.

## Religion

Religion has always played a substantive role in our connection to the environment. Around 500 B.C. there were many polytheistic religions. The Greeks, Romans, Norse and many other cultures worshiped multiple gods. Within these religions every pattern that occurred within the world had an explanation provided by their beliefs. For example, the Greeks thought that the sun and moon rose each day because of Helios. The seasons were created because of Demeter's sadness of missing her daughter for a few months of the year while she went to live with Hades. Every occurrence in

*Genesis 1:26 And God said, 'Let us make man in our image, after our likeness: and let them have dominion over the fish of the sea and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth (Gn 1:26 KJB).*

*Genesis 1:28-29 And God blessed them, and God said unto them, 'be fruitful and multiply, and replenish the earth, and subdue it: and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth.' And God said, 'behold, I have given you every herb bearing seed, which is upon the face of all the earth, and every tree, in the which is the fruit of a tree yielding seed; to you it shall be for meat' (Gn 1:28-29).*

the world had a relationship to the gods because this land, Earth, did not belong to the humans, it belonged to the gods. This association to our world meant these cultures often revered the land. They treated it with respect as it did not belong to them, their lives were in the hands of the gods. A similar relationship to the environment can be seen in the Native American belief system. They too have explanations for different environmental phenomena that relate back to the gods. Everything in this world has a spirit and we are all brothers and sisters living together in equality (White, 1999).

During this time Judaism, which was a polytheistic religion, changed to a monotheistic belief system and its



Figure 2.5: The Start of the 1889 Oklahoma Land Rush

teachings began to change as well (Ancient Jewish History: The Birth and Evolution of Judaism, n.d.). The teachings of Judaism are recorded in the Bible's Old Testament. The readings state in Genesis, the first book of the bible, that our environment was created for man to have dominion over, that the environment had been gifted to us by God himself.

This Christian view that grants permission to subdue the land and animals is drastically different than that of the Greeks or Native Americans. Since much of the western world was built upon a Judeo/Christian based belief system, we can still see its prevalence in all aspects of our culture, whether we identify with the religion or not. The associations are apparent when we look at historical land rushes, the movement to the suburbs, the current culture of

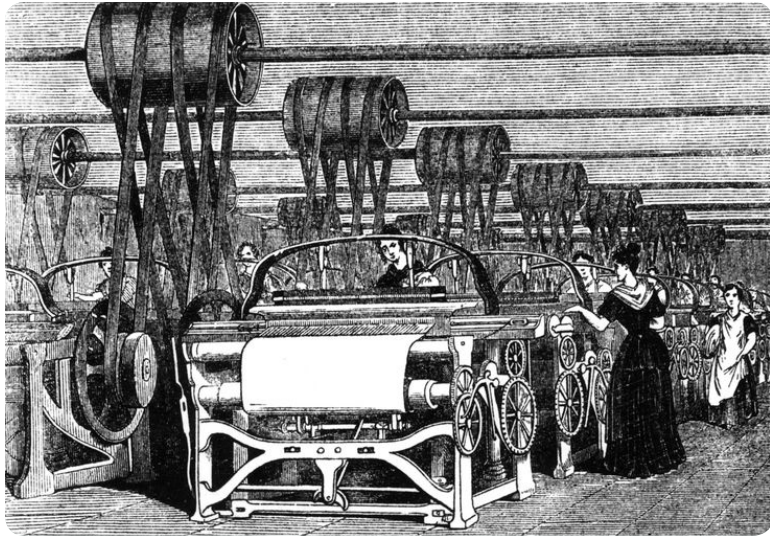


Figure 2.6: Machinery of the Early Factories

homesteading or even in our consumer driven economy. We view our environment as a submissive and inexhaustible resource to extract goods from without any sense of stewardship. While not every westerner follows Judeo/Christian precepts, it has been around for centuries and has become ingrained in our cultural view of the world.

## Industrial Revolution

The next big event that altered our relationship with our environment was the Industrial Revolution. During the 1800's, with the introduction of mechanization, we as a society pushed for increased production, revenue, and demand of



Figure 2.7: Claude Monet painting of the Waterloo Bridge

consumer goods. We were able to apply new sources of energy such as the water wheel, coal, and steam engines to power these industrial processes at all times of the day without exhausting much human energy. Production of these goods were once created in the home, but were then consolidated into large production factories for efficiency (Figure 2.6). These facilities led to an explosion of cheap labor as the machines did most of the work.

The population surrounding these factories began to increase and urban centers began to grow around these industrial nodes. Solely focused on production, the economy pushed for more factories and an exploitation of Earth's

natural materials proliferated. Cities began to develop exponentially with no regard to their environmental context setting the precedent that cities would follow for centuries.

The Industrial Revolution was a period of rapid technological breakthroughs changing our ways of life (Staff, 2009). During this time, travel, energy production and consumerism changed rapidly but it also paved the way for pollution, the exploitation of our environment, and the mentality that urban centers are separate entities to our natural environment (Figure 2.7).

## Global Village

Since the beginning of the Industrial Revolution the world's population has multiplied by more than a factor of seven. The population in the 1800's was estimated to be one-billion inhabitants, with roughly 3% living in urban areas (Figure 2.7). Today, we have a world population of roughly 7.4 billion with 54% living in urban areas (Human Population: Urbanization, n.d.). These numbers will continue to increase and if we do not change how we interact with our environment we will continue to negatively impact our world at an exponential rate.

Today our world is called the Global Village because of how interconnected we are. The Global Village is [a] world

viewed as a community in which distance and isolation have been dramatically reduced by electronic media (Global Village, 2017). Our economy and our way of life are more connected than ever before and the with increased population and the advancement of our technology, the smaller this world will feel.

Our Global Village currently needs 1.5 Earths to sustain its consumption (McDonald, 2015). What we are currently consuming is 150% times that which the earth can provide. With its static supply of resources, the Earth is dwindling. The need for 1.5 earths is the average of the entire world which means many populations live well within the means that the Earth can provide. This also means that many populations live well outside this appropriate number. If everyone lived like the United States the world would

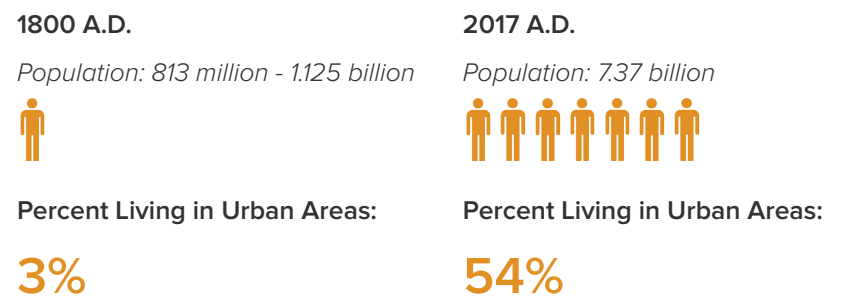


Figure 2.8: Population Diagrams

need a total of 4.1 Earths to sustain our existence, in which two full Earths would be needed just to sequester the amount of carbon emissions that we produce (McDonald, 2015).

There is no easy explanation to describe why we continue to impose on our world. It is a relationship we have cultivated across many different cultures over hundreds of thousands of years. Until we become more aware of our impact on our one and only Earth and make changes to remedy the impact, we will continue to deplete our world at an exponential rate. Thus, normalizing our condition and denying ourselves of the sources of our good lives.

# CHAPTER 3: THE PROBLEMS WITH NATURE

## Background

As the world's population grows so does the percentage of people living in urban areas (Human Population: Urbanization, n.d.) (Chart 3.1). It is this population that has the largest impact on our consumption. There are many factors that play into our exploitation of the world but there are steps that we can take to remedy this. We can begin to change this population's lifestyle and perception of the environment to reduce our footprint on the world and sustain the sources of our good life. One of these problems that has plagued the urban population for centuries is the equitability of experiencing what we call nature. The ability to openly travel outside of the urban centers was once reserved for those with either prestige, power or wealth. This is not too far from the current situation today.

## Nature as an Equity Based Problem

Today, nature is expensive to experience. It has been driven by consumerism and political endeavors that have commodified it. In the state of Washington, it is mandatory to purchase a pass in order to enter state or federal park facilities. From observations, in the Pacific Northwest, many people feel it is also necessary to have the top of the line technical

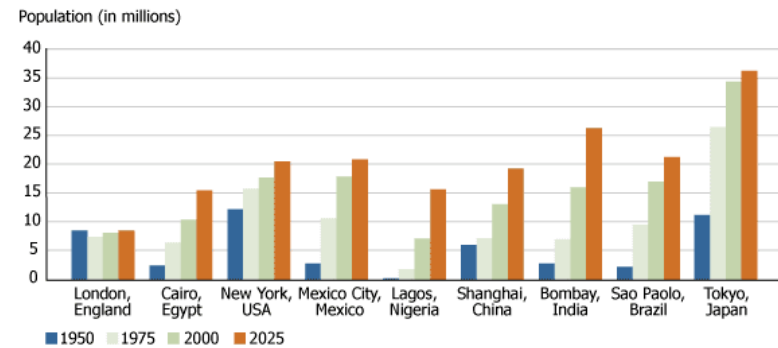


Chart 3.1: Population Growth Chart

gear. Consumers will purchase technical gear developed by Patagonia, Arc'teryx, or REI etc. with the false assumption that this is necessary to have a positive experience. Another potential issue that is often encountered in the urban realm is the lack of proper transportation. Cost and access are the limiting factors that make this environment difficult to experience. As more people begin to live in urban environments the reliance on public transportation increases. Currently, the primary function of public transportation is to move people in and out of the urban centers and not to the wild natural settings. This separation of the urban areas and natural environments fuels the divide that already exists.



Figure 3.1: King County Metro Northwest Transit Network

## Nature as a Perception Based Problem

The following excerpt is derived from information gathered through informal interviews with peers. Nature itself is a very subjective term. Access to “nature” may be an equity based problem but that depends on our definition of nature.

*Q: What is nature?*

*A: Nature is the mountains, it is lakes and rivers, it is the forest and the meadows*

The answers to this were predominately a large-scaled view of the environment (Figure 3.2).

*Q: How do you experience nature?*

*A: Nature is experienced through activities like hiking, camping, fishing and skiing*

While these are ways to experience nature they are all very specific physical activities and do not tap into the emotional and spiritual experience of nature (Figure 3.3).

*Q: How often do you experience nature?*

*A: Nature is experienced couple times a month; whenever they can get time off from work; when the weather is nice.*



Figure 3.2: Example of Nature in Accordance to Interviews



Figure 3.4 Naturalist Teaching Youths about the Environment



Figure 3.3 Experiencing Nature through Fly-Fishing

While it may seem like we experience nature in sporadic bursts, in truth we experience the natural environment on a daily basis. Tying nature solely to specific physical activities sets us up to overlook the nature that constantly surrounds us. When we walk past a weed growing through a crack in the sidewalk, we experience nature. When we hear seagulls calling out to each other over the water, that too is nature. It is possible to change this limited perception of nature. The way to do this is through education.

### Nature as an Education Based Problem

Many schools that are fortunate enough to teach

about the environment do so with a macro-scale ecosystem based approach, through visits to national parks, wilderness retreats, fisheries, and animal refuges (Figure 3.4). While there is merit to teaching at this scale, it only perpetuates the perception that nature occurs separate from the city and separate from humans. It is this separation wherein lies the root of the problem. When we are constantly taught that nature occurs outside of our own environment, we never develop ownership over our own context and therefore lack the knowledge to empower and protect ourselves.

## CHAPTER 4: UNDERSTANDING OUR ENVIRONMENT

### Biophilia

Nature is a socially constructed word that is different from person to person, culture to culture and situation to situation. Over the past 300,000 years we as a species have experienced and interacted with our environment in many different ways in order to ensure our survival. As we have evolved culturally and with societal innovations we have appropriated the word nature as we see fit (Evernden, *The Social Creation of Nature*, 1992).

The term biophilia was popularized by Edward O. Wilson in his 1984 book *Biophilia*. He states that if we can spend time understanding other organisms, then we will place more value on them and in turn ourselves (Wilson, 1984). Biophilia is the understanding we have an innate connection with our environment. This was grown out of the way that we evolved with the landscape. Traits such as the ability to create patterns, to observe change in time, and spatial relations such as prospect and refuge helped us to survive and are still present in our biological self. While technology and society have evolved at a rapid pace nullifying the need for our survival traits, we continue to experience our urban environments in the same way (Weiss, 2017).

Stephen Kellert and Judith Heerwagen are both environmental psychologists who have pushed Wilson's ideas to new heights. In their book, *Biophilic Design : The Theory, Science, and Practice of Bringing Buildings to Life* (2008), they provide a compilation of essays explaining the depth as well as the breadth of biophilia and its importance in our built environment (Kellert & Heerwagen, 2008).

Kellert's book, in collaboration with Elizabeth Calabrese, called *The Practice of Biophilic Design*, begins to apply these principles to our built environment (Kellert & Calabrese, 2015). By looking at their three overarching ideas, direct experience of nature, indirect experience of nature and experience of space and place we can begin to apply Biophilic principles into our built environment. Direct experience of nature has to do with existing elements found in the natural environment such as light, air, water, plants, animals, weather etc. Indirect experience of nature consists of ideas that evoke natural elements within themselves such as, images of nature, natural materials and colors, change through time etc. The last category of Biophilic design is experience of space and place and this deals with

our relationship within a spatial location. This category is associated with prospect and refuge, transitional spaces, cultural and ecological attachment to place (Browning, Ryan, & Clancy, 2014).

Based on the book by Steven Kellert, it has been found that the implementation of biophilia within design can help with different biological aspects such as stress reduction, cognitive performance, and emotions and mood (Browning, Ryan, & Clancy, 2014) (Table 2.1). There are many design firms that have taken this framework as a foundation to their design approach such as Mithun, the firm that designed IslandWood Environmental Learning Center.

## Environmental Education

Since becoming a species, we have been learning from the world around us. Originally, this was a completely subconscious learning approach (Heerwagen, 2016). The more we interacted with our environment the more we began to see patterns and understand the interactions and processes of the world. Today, environmental education has become a luxury. The opportunity to learn about the environment is limited by political, cultural, and social challenges. The way we interact and experience our environment has shifted over thousands of years and our disconnect with it has been perpetuated through our formal and informal education.



Figure 4.1: Ralph Waldo Emerson

Ralph Waldo Emerson wrote:

*We are shut up in schools and college recitation rooms for ten or fifteen years and come out at least with a bellyful of words and do not know a thing. We cannot use our hands, or our legs, or our eyes or our arms. We do not know an edible root in the woods. We cannot tell our course by the stars, nor the hour of the day by the sun (Orr, Earth in Mind: On Education, Environment, and the Human Prospect, 2004).*

There are some inherent problems with environmental education methods. Environmental education, suffers from equitability, perception, and its relationship to the user groups. Like large-scale nature in the urban realm,

most environmental education is not equitably available to the population. The schools that offer environmental education opportunities are usually private schools or public schools in more affluent areas because it is often seen as a non-vital subject. The second problem is perception. The environment is consistently taught through the macro-scale processes. Teaching about the environment in school usually focuses on “untouched” landscapes such as forests, mountains, or meadows to showcase systematic functions. While there is merit to this methodology, it perpetuates the idea that nature exists solely in the wild typologies of nature. The third problem with education is understanding who the users are, as well as identifying the appropriate time to teach environmental education. In many readings such as *The Biophilic University: A De-familiarizing Organizational Metaphor for Ecological Sustainability?* (Jones D. R., 2013), *The Nature of Design* (Orr, *The Nature of Design: Ecology, Culture, and Human Intention*, 2002), and *Earth in Mind* (Orr, *Earth in Mind: On Education, Environment, and the Human Prospect*, 2004) the authors state that environmental education is best taught at the higher education levels when students are learning and gaining perspective on their civic responsibilities. Contrary to this train of thought, there are many authors that agree that childhood is the best time to teach the populous about environmental education (Louv, *Last Child in the Woods*, 2008). Studies probing this

questions have yielded interesting insight into the effects of childhood education and its role within the community.

In 2001 a group of scholars set out to study the hypothesis that children could, “learn and retain conservation principles in school environments and transfer them to their parents.” (Vaughan, Julie, Solorazano, & Ray, 2003). The study took place in the town of Quebrada Ganado located in Costa Rica. Led by an extremely qualified team consisting of Christopher Vaughan, Julie Gack, Humberto Solarzano, and Robert Ray, the study found that by teaching children, you in effect teach the whole community. The study was oriented around a 21 question test that revolved around Scarlet Macaw conservation and natural history. Three groups were given the test at three separate times, a pretest and two posttests. The groups were then evaluated on how well they did and how they improved.

The first group consisted of roughly 60 third and fourth grade children who were taught about Scarlet Macaw conservation and natural history, twice a week for a month. The second group was roughly 50 parents of the students who were enrolled in the study. The last group was the control group. There were 50 adults in this group who were chosen because their children, if they had any, were not involved in the study.

The first test was administered before the teaching had

begun, in order to set a baseline. The next test occurred about a week after the class had ended, with the final test being given 8 months after that. What they found was that after taking the class, 71% of the students' grades on the test increased, while 38% of their parents' grades increased. The control group's grades did not improve, however, the results still showed that there was a transfer of information from the children to their parents.

The second posttest's data was very interesting and inspiring because not only did the first two groups' grades improve, but so did the control group's. After a period of 8 months, the control group's grades increased by 29% (Vaughan, Julie, Solorazano, & Ray, 2003). This information is enlightening because it shows that by investing energy into one group, the children, we can see its influence spread throughout the others over time. We can take these findings and begin to apply it to environmental education throughout the rest of the world. While the rate of return, by teaching the youth and in turn educating the whole populous, is admirable, it would be fascinating to see how quickly knowledge could spread if we took a two-prong approach and concurrently taught the rest of the population.

Outside of school most environmental education is available through Environmental Learning Centers (ELCs) located in national parks. These are great opportunities to

learn about nature at a large-scale but it often is hard to reappropriate these teachings to the urban environment. This leads to a lack of empowerment to the urban population.

Jason Medeiros, a graduate of the University of Washington completed his thesis on environmental educative design. In his thesis, *Outside Lies Learning: Landscape Architecture and Principles of Educative Design*, Medeiros looked at the way environmental education is taught, what aspects of design can help to push education forward and he compared the effectiveness of three of the most funded local Environmental Learning Centers (ELCs).

Medeiros created a critiquing framework that he called the 10 Principles of Educative Design. (Figure 4.2) The framework was based off his investigation into museum and educative design. Within this framework, the different categories were chosen based on all aspects that lead to powerful educative learning opportunities. The categories include topics such as: strive to instill wonder, provides interactive elements, supports teacher facilitated learning, supports individual learning, invites play etc.

The three ELCs Medeiros critiqued using his framework were IslandWood, Cedar River Watershed Environmental Education Center, and Mercer Slough Environmental Learning Center. What Medeiros found



Strive to Instill Wonder



Supports Teacher Facilitated Learning



Provides Manipulable or Interactive Elements



Creates Multi-Layered Experiences



Allows for Observable Change or Comparisons



Invites Collaboration



Balances Clarity & Mystery, Novelty & the Familiar



Invites Play



Supports Self Directed Learning



Provides Social or Cultural Relevance

Figure 4.2: Jason Medeiros' 10 Principles of Educative Design

was that while these facilities all did a great job at instilling wonder, layering experiences and supporting teacher facilitated learning, they lacked in supporting individual facilitated learning, inviting play, and social/cultural relationships (Figures 4.3 through 4.8)

The use of the large ecosystem scales for teaching purposes has merit. However, Brigitte Fischerlehner, an environmental psychologist, wrote that "...building up emotional bonds with nature can serve as motivation to protect it." (Fischerlehner, 1993). While at the surface this quote holds value, it is realized upon closer analysis that how these bonds are formed, when they are formed, and with what definition of nature are they formed in accordance to, can greatly change the direction that her argument takes. If we are constantly taught about our obligation to protect the environment and we only develop empathy for it at a large, wild scale, we then lose the awareness that our own urban environments may need the same protections. We focus on the problems afflicting the wild environment and fail to become aware of the harm we are inflicting upon ourselves through pollution. The lack of attention to smaller, urban-scale nature prevents us from developing empathy for it and thus we are not motivated to

protect it. Therefore, we begin to perpetuate and normalize environmental neglect within our urban realms from generation to generation.

Peter Khan, a Professor in the Psychology Department and the Director of the Human Interaction with Nature and Technological Systems (HINTS) Lab at the University of Washington has researched and written extensively on the human population's moral and physical relationships to the environment. In 1995 Peter Khan, in collaboration with Batya Friedman, completed a study called Environmental Views and Values of Children in an Inner-City Black Community (Kahn Jr. & Friedman, 1995). This study was based in Houston, Texas; one of the most polluted cities in the nation. The purpose of this study was to shine light on the common held perception that inner-city populations do not care about the environment and to better understand the extent of children's moral relationships with nature itself. They wanted to determine if children were able to develop and could comprehend what it meant when told, "...we have a moral obligation not to harm the natural environment". While the study was focused on a distinct locale of population, their findings were unexpected. This study has since been repeated in other locations around the globe with similar results.

What the study found was that when asked if they thought about the environment, 96% of the children responded that they did in varying capacities. Most of them,

## IslandWood Environmental Education Center



Figure 4.3: IslandWood's Location on Bainbridge Island

*"To provide exceptional learning experiences and to inspire lifelong environmental and community stewardship."*

**Parent Organization:** None

**Current Facility Opened:** 2002

**Construction Cost:** \$32 million

**Age of Program:** +15 years

**Location:** Bainbridge Island, WA

**Size:** 255 acres (70,000 sqft.)

**Annual Visitors:** 4,000 elementary students, 5,000 adults

**Programs:** 4 Day educational programs for 4-6th graders;  
Conferences and weekend programs for community/adults

**Number of Staff:** 16 Educational Staff, 16 Graduate Student Interns

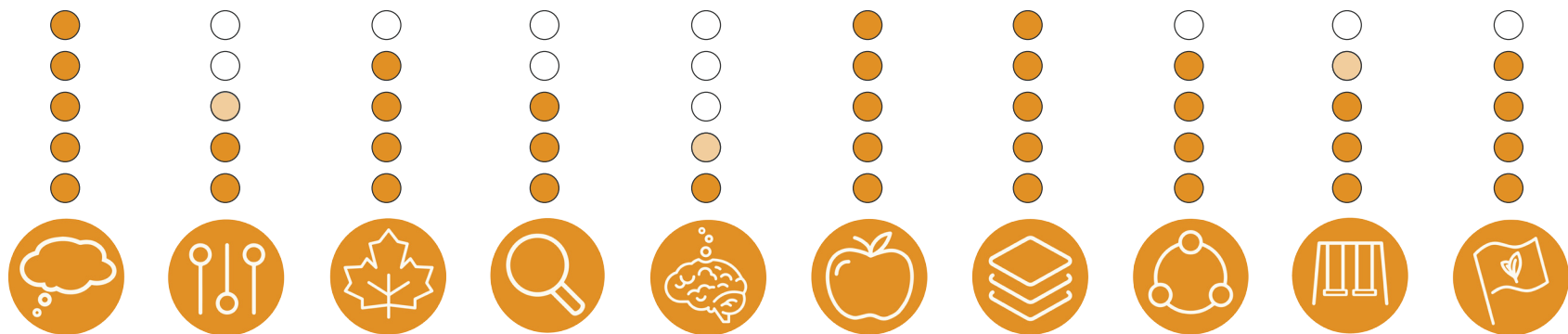


Figure 4.4: IslandWood's Critique on the 10 Principles of Educative Design  
The diagram is my quantification of Jason Medeiros' qualitative critiques.

# Mercer Slough Environmental Learning Center

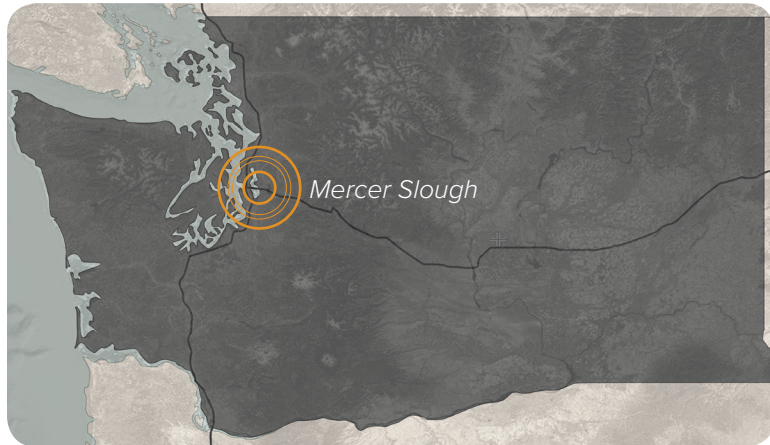


Figure 4.5: Mercer Slough's Location on Lake Washington

"We use science-based education programs to inspire lifelong awareness, understanding, appreciation, and a sense of stewardship for the natural world."

**Parent Organization:** *Bellevue Department of Parks and Recreation, Pacific Science Center*

**Current Facility Opened:** 2008

**Construction Cost:** \$10.8 million

**Age of Program:** 7 years (current facility) | 9 years (old facility)

**Location:** Bellevue, WA

**Size:** 320 acres (10,000 sqft.)

**Annual Visitors:** 25,000 (future 40,000) | 8,000 (old facility)

**Programs:** *K-8th school programming (full-day programs), high school seasonal programming, community events, drop-in*

**Number of Staff:** 15

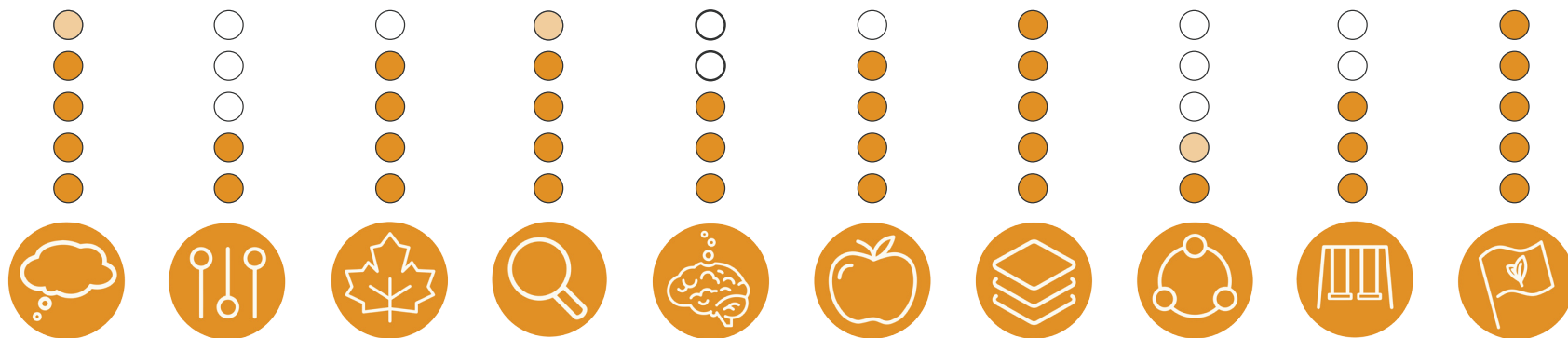


Figure 4.6: Mercer Slough's Critique on the 10 Principles of Educative Design  
The diagram is my quantification of Jason Medeiros' qualitative critiques.

## Cedar River Watershed Education Center



Figure 4.7: Cedar River Watershed's Location on Rattlesnake Lake

*"The Cedar River Education Center is a regional education facility created as a gathering place to connect people with the source of their water. The Center provides opportunities for thousands of visitors to learn about the complex issues surrounding the region's drinking water, forests, and wildlife."*

**Parent Organization:** *Seattle Public Utilities*

**Current Facility Opened:** *2001*

**Construction Cost:** *\$4.7 million*

**Age of Program:** *+20 years*

**Location:** *Cedar Falls, WA*

**Size:** *~90,000 acres (10,000 sqft.)*

**Annual Visitors:** *30,000 all ages*

**Programs:** *Full-day school programs K-12, community use, drop-in*

**Number of Staff:** *15*

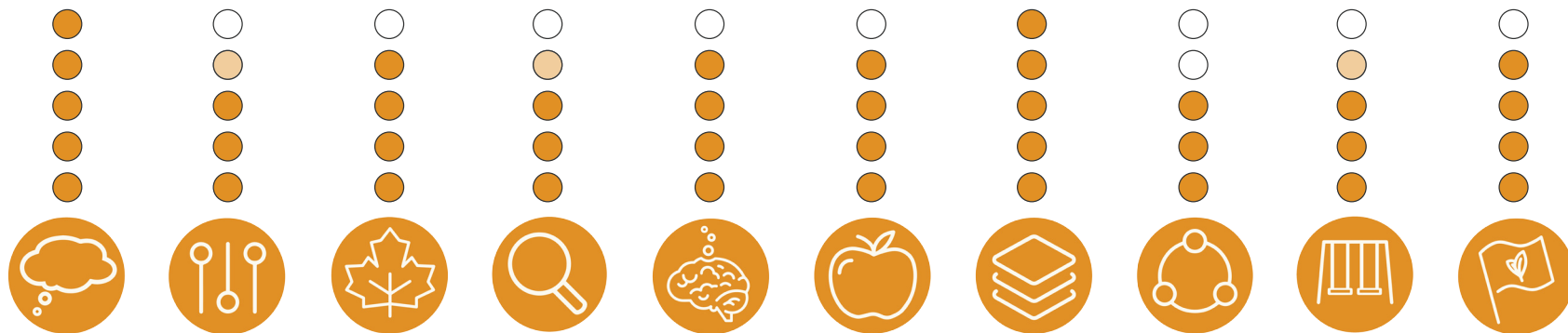


Figure 4.8: Cedar River Watershed's Critique on the 10 Principles of Educative Design  
The diagram is my quantification of Jason Medeiros' qualitative critiques.

when asked, stated that they thought about environmental issues as well; the majority regarding plants (54%) and animals (59%), with a minority thinking about litter (20%), water (10%) and air (7%) pollution, and drugs/human violence (7%).

The students were then presented with different scenarios based around the concept of dumping garbage into the local bayou (Figure 4.9). The students agreed (96%) that it was not okay to litter into the bayou. However, the study uncovered a discrepancy with their perception of the environment in that 66% of the testing group could understand and describe water and air pollution but failed to relate it to their own environment. When asked if Houston was polluted only 33% said yes. What the researchers realized was even though the environment was a common discussion topic in the households, there was a normalization of the pollution in their local community. As we grow up, we take our context as a baseline by which we compare other environments against. In comparison to the wild forests and mountain ranges, Houston was not seen as being more polluted, it was just different. This lack of awareness is what Peter Khan calls “environmental generational amnesia”. The study sums it up simply stating:



Figure 4.9: Houston Pollution of Buffalo Bayou

*If one's only experience is with a certain amount of pollution, then that amount becomes not pollution, but the norm against which more polluted states are measured. If we are right about this, then it would speak to the importance of keeping environmental preserves, refuges, and parks close to (and even within) cities, and of providing means for children to experience these areas. Indeed, what we perceive in the children we interviewed might well be the same sort of psychological phenomenon that affects us all from generation to generation. People may take the natural environment they encounter during childhood as the norm against which to measure pollution later in their life. The crux here is that with each generation, the amount of environmental degradation increases, but each [subsequent] generation takes that amount as the norm – as the non-polluted condition.*

The larger problem comes into play when a populous has had multiple generations becoming oblivious to the harm that is being created in their own environments. They continue to live in a worsening area and when needed they escape that environment by going out to the wild nature. They develop an appreciation for the wild but forget that they should be working to improve their own environment as well. The environmental generational amnesia begins to edge its way into our education systems and if the parents' generation is not aware of the problems, they will not be able to educate the future generations about their moral obligations to the health of the environment and to the health of themselves (Kahn Jr. & Friedman, 1995).

With this research, it had become apparent that this thesis needed to focus on urban environmental stewardship. “Nature” in the urban realm takes on many different meanings. The environmental education curriculums must have flexibility in application in order to empower students to protect their own environment. The idea of urban nature has been discussed for a long time and it is not second to “wild” nature, it is just a different scale and ecosystem typology. There are countless opportunities for environmental education in the urban realm. Emma Marris, in her Ted Talk, reveals the educational opportunities that lie within urban nature. She speaks to the vacant lots and how they have a

vivid bio-diversity full of plants and insects, but, we need to train our eyes to be able to notice these lush ecosystems (TED, 2016). By teaching about water pollution and storm water runoff in conjunction with large-scale watersheds ecosystems, we could educate a future populous that is better suited for the continually growing urban world they will inhabit.

## The Built Environment and its Role in Environmental Education

Ecosystems occur on different scales but they all correlate with one another. An ecosystem is “a system, or group of interconnected elements, formed by the interaction of a community of organisms with their physical environment.” (Ecosystem, n.d.). As such, we can say that an entire watershed can be its own ecosystem. Within the watershed, the decomposition of a pile of leaves under a tree is its own ecosystem as well, however, between the two there is a level of interconnectedness that is often overlooked. Likewise, our city, neighborhood, and backyard all operate within a single ecosystem or they can be viewed as separate entities. It is a noble cause to protect certain species from extinction, to build trails in national parks, or to restore waterways along the glacial floodplains but we must not forget the importance of healing our own damaged ecosystem.

By the year 2050 the world's population living

## Seattle population milestones

Last year, Seattle passed the 700,000 mark for the first time. New census data estimate the city's 2016 population at 704,352.

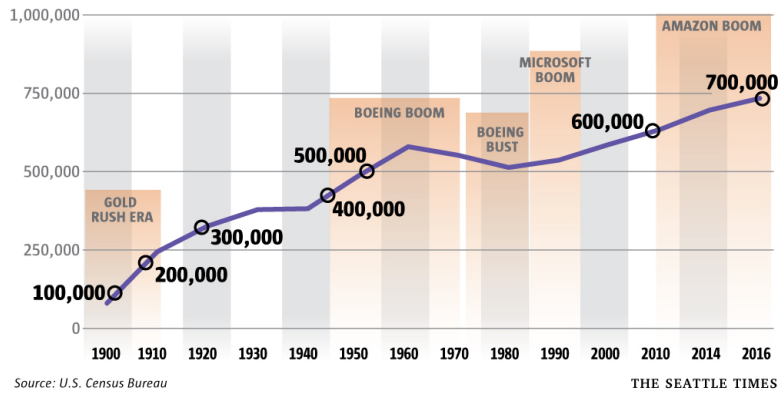
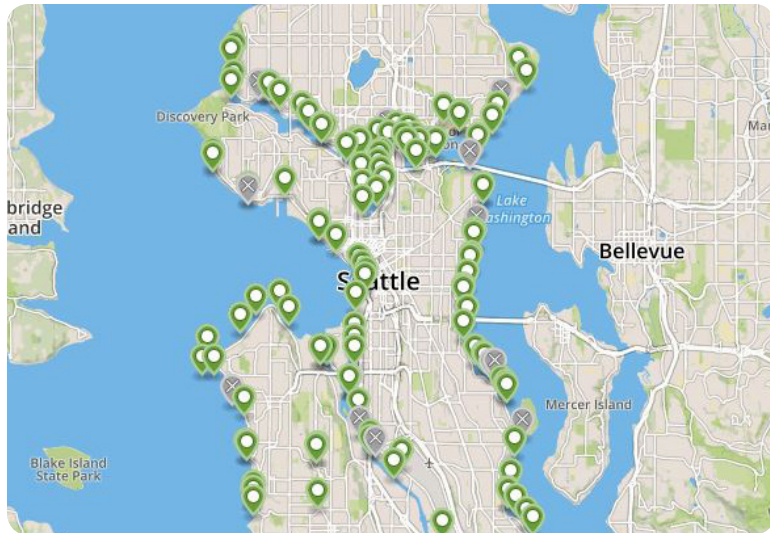


Chart 4.1: Seattle Population Milestones

in the urban environment will be roughly 70% (Human Population: Urbanization, n.d.). The population of Seattle, by that time, with current growth rates will increase up to around 1.2 million people (Division, 2016) (Chart 4.1). With an increase in population, we can expect to see an increase in environmental pollution. This is typically associated with poorer air quality due to automobile emissions as well as an increase in refuse. In Seattle, the positive impacts we have gained on the economic front due to a successful industrial sector has also resulted in great environmental degradation. However, as we have grown into this age of environmental awareness we are now understanding the extent of the damage to our waterways from these industrial

practices. Generations of native peoples relied on the Duwamish River as a main source of sustenance but in 2001, the Environmental Protection Agency (EPA) designated the Duwamish as a Superfund site (Duwamish River Cleanup Coalition, n.d.). A Superfund site is a location where there is uncontrolled toxic pollution and remediation efforts will be funded by the Federal Government (Type of Contaminated Sites, n.d.).

Another issue we face as a city is due to short-sighted infrastructure planning during Seattle's infancy. Similar to many older cities, Seattle was designed with a combined sewer and stormwater system. This means that wastewater from use of facilities such as laundry and bathrooms travel through the same pipes as the stormwater from the roads' surface. Each year Seattle receives roughly 34-38 inches of rain (Climate Seattle - Washington, n.d.) and during these heavy rainfall periods our water treatment centers become overrun with sewage and stormwater. This excess water must be released to prevent issues with flooding and backflow and unfortunately, it is dumped into our waterways (Figure 4.10). In Seattle, there are over 300 combined sewer overflows (CSOs) that dump millions of gallons of raw sewage and runoff into prominent bodies of water such as Elliot Bay, Lake Union, numerous locations along Lake Washington. Large bio-diverse ecosystems such as Magnuson Park, the Chittenden



**Figure 4.10: CSO Status on King County Website**  
 Green means the CSOs are not overflowing, yellow means they have within the past 48 hours and red means they are currently overflowing. This is a screenshot from May 30, 2017.

Locks, and the Union Bay Natural Area are also designated as outfall locations (Combined Sewer Overflow Status, n.d.). Signs are posted stating that you must wait 48 hours before swimming if the CSO is in use because it may cause you to get sick (Figure 4.11). The CSOs are one of the worst environmental injustices of the area yet it goes relatively unnoticed until emergency situations occur. A prime example occurred in February of 2017. Heavy rainfall and neglected mechanical systems caused the West Point Treatment Plant to fail (Willmsen & Mapes, 2017). The facility which processes 300 million gallons of wastewater a day was flooded. This resulted in raw sewage and stormwater being dumped

directly into the Puget Sound for months (Kamb, 2017). Fortunately, after more than a century of our dependence on the use of CSOs, a plan has been implemented to reduce CSO outfall pollution quantities. The city has passed a long-term control plan that will help to mitigate this overflow occurrence, however, the renovations to this system are still a decade out (Utilities, 2015).

## Environmental Learning Centers

Seattle has many environmental learning centers located in parks or designated green spaces to promote education about the local flora and fauna. Some of the prominent ELCs in the urban area are Carkeek Park (Nancy



**Figure 4.11: CSO Warning Sign near Outfall**

Malmgren) ELC, where people can watch the salmon spawn and help release the fry (Figure 4.12); Discovery Park ELC where students can learn about the original ecosystem that used to cover much of Seattle; Camp Long an adventure camp located in a forested ecosystem within the greater metro area, and Seward Park Audubon Center a collaboration with the Audubon society that focuses our local bird population. These nodes of ELCs provide a great opportunity for people to learn about our cities natural habitats but in order to provide a holistic approach to environmental education for our built environment, we need to provide an ELC that can speak to urban environmental issues (Figure 4.13). To have a cohesive



Figure 4.12: Preparing 30,000 Salmon Eggs for Hatching



Figure 4.13: Map of ELC Nodes in Seattle

The central orange location will be the urban ELC site location for this thesis project, helping to fill in the ELC network.

network of environmental education we need to expand our conversation to include pollution, stormwater management and development.

## Buildings

The role of a building in environmental education should be seen as another tool in the repertoire of the organizations' educators. The topics of study within an urban environmental education curriculum differ than that of its rural counterpart and so too should the design and program of the building that houses it. Within the urban environment buildings often lend themselves to the opportunities of adaptive reuse.

In the book, *How Buildings Learn: What Happens after They're Built*, by Steward Brand, he focuses on different types of buildings and their ability to be reappropriated by their inhabitants. Brand refers to both Low Road and High Road buildings. The difference between these two typologies is that Low Road buildings are more easily manipulated by their users. They are often simple structured buildings that allow inhabitants to operate within the space in whatever capacity that best suit them. Whereas High Road buildings are often hard to manipulate and change. They are structures that are usually over designed or use materials that are not easily altered (Brand, 1994). Jane Jacobs, in the *Death and*

*Life of Great American Cities*, states that, "Old ideas can sometimes use new buildings but new ideas must come from old buildings." (Jacobs, 2011). This statement emphasizes the importance of these Low Road buildings. Due to their construction they are typically more affordable, offering more flexibility and this thesis, changing people's perceptions of the base idea of what nature is, could benefit from an old building.

Jason Medeiros, states that the building is a very important and often underutilized tool for environmental education. The problems he noticed were that design intentions were not always apparent to the users of the facility and/or the educators found more importance in teaching about the natural ecosystems than how the buildings could work within their context (Medeiros, 2011). Ecosystems are not exclusive entities; the buildings are just as important to that environment as are creeks that run through them. Medeiros also critiqued the effectiveness of educational design decisions in the facilities. He posed the question that if the design decisions were not readily understood by the users, were they worth the cost and effort that went into them? An example of one of the designed subtleties is the fireplace at IslandWood (Figure 4.14). The fireplace was meant to show the geological stratification that occurred beneath the site (Medeiros, 2011). Another design intention that was not as

effective was located at the Cedar River Watershed ELC was the use of green roofs (Figure 4.15). The science behind the green roofs is very fascinating but they're rendered relatively useless in terms of conveying their processes. While they may speak to a user on a visual level, the specific reasoning and benefits behind them is lost. Without an educator, or proper signage to explain the purpose of the green roof, the intention for them as an educative tool is diminished. For a designer these are interesting design opportunities, however, if the user is unaware of them, the effectiveness of their teaching ability can negate the purpose behind the design.

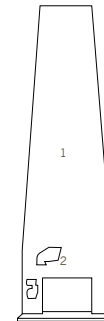


Figure 4.15: Green Roofs at Cedar River Watershed ELC

LESSONS IN STONE: Each of the three Sleeping Lodges features a 'geological' fireplace made with native rock – examples of buildings that teach, using art, space and architectural detail to create connections with the natural world.

Sedimentary

- 1 Sandstone
- 2 Fossils



Igneous Stone

- 1 Basalt Seats
- 2 Gabbro
- 3 Granite
- 4 Diorite



Figure 4.14: Fireplace at IslandWood

# CHAPTER 5: METHODOLOGIES

## Goals & Objectives

The objective of this thesis is to start a conversation regarding the loss of the sources of our good life: access to clean water and clean air. The current relationship to our environment has led to polluted cities and waterway. Our exploitation of Earth’s depleting resources has plagued our population. If we ever hope to increase our ability to survive on this planet we to become cognizant of the issues that we face. We must focus on our approach to environmental education and empower the everyday person to take control of their relationship with the environment.

## Teaching Paradigms

There are three teaching paradigms that have been researched in this thesis; they are individual led, expert led and emergent curriculum learning. All three of these paradigms approach learning from a different perspective. Learning styles are highly individualized and if our goal is to make a large-scale and systematic impact it important that we use all three approaches collectively.

The individual led curriculum is primarily focused around educating adults (Figure 5.1). This approach is great

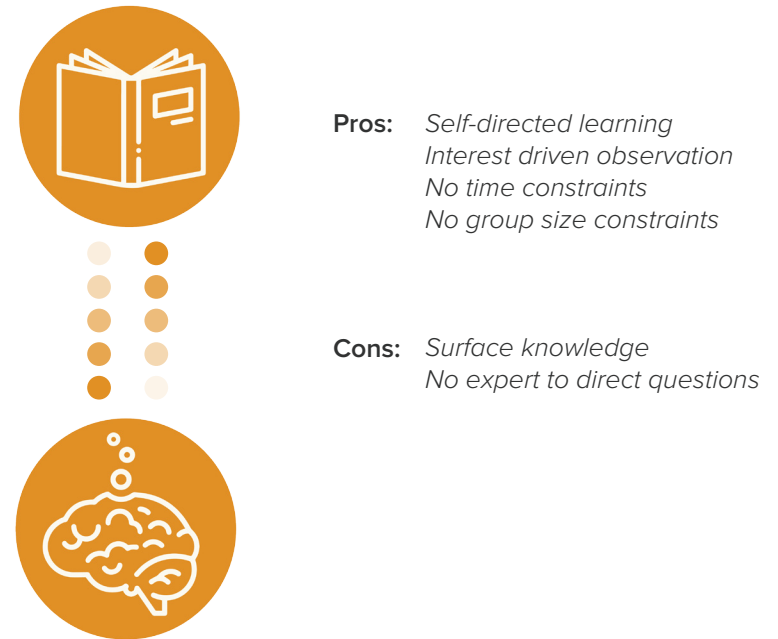
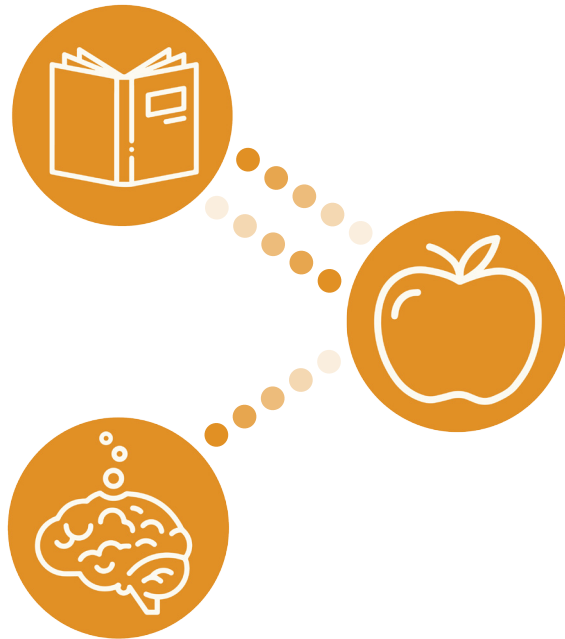


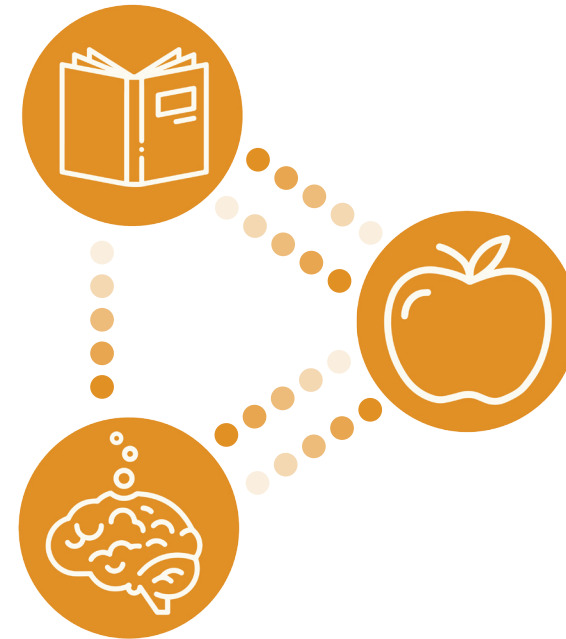
Figure 5.1: Individual Led Learning Diagram



**Pros:** *Self-directed learning*  
*Interest driven observation*  
*No time constraints*  
*No group size constraints*

**Cons:** *Surface knowledge*  
*No expert to direct questions*

Figure 5.2: Expert Led Learning Diagram



**Pros:** *In-depth learning*  
*Interest driven curriculum*  
*Long-term learning approach*  
*Local site empowerment*

**Cons:** *Long-term learning approach*  
*More difficult for experts/teachers*

Figure 5.3: Emergent Curriculum Learning Diagram

for people who are looking to learn at their own pace, during their own time or are interested in guiding their own learning endeavors. The downside of this approach is that the knowledge can often be superficial and it can also be limiting as there is no expert with whom to ask questions.

The expert led learning approach is a more in-depth experience (Figure 5.2). This type of learning caters to all ages and is effective because it focuses on a certain topic of the teachers choosing. Another difference is that there is opportunity to provide poignant answers to questions. The downside to this type of teaching is that it must often be prescheduled for a set time, there might be fees, there is a pre-defined pace of learning and they can have size restrictions. This type of learning is what is usually found in our public education system.

The third teaching paradigm is the emergent curriculum learning system (Figure 5.3). This style of learning is often seen in the Montessori typology of education and while it is used for younger students it has been applied to many others. This approach combines the two previous styles, which allow for self-guided direction that is facilitated by an expert. To illustrate how this approach works, taken an everyday experience of outdoor play time where children have taken an interest in some worms that they found. The next class session the teacher would capitalize on their curiosity of

the worms, by leading an investigation into vermicomposting. The students' attention would be focused on this learning endeavor and being a topic that had piqued their interest, learning retention would be at a high level (Jones E. , 2012). Another example of this teaching paradigm is discussed by Janine Benyus' book, *Biomimicry: Innovation Inspired by Nature* (1997), as well as in her TED Talks. Her consulting firm will often take scientists or designers out into the environment to look to the natural world. The attendees will have provided the subject of interest and an expert will lead an investigation to help them approach their problem from a different angle and collectively find solutions (Benyus, 1997).

The benefits of this teaching paradigm are that the information is all relevance driven, it helps to keep the students attentive, and often culminates in a hands-on learning experience. The downside of this approach are that the expert may be put on the spot to lead a discussion without preparation. Unlike the other paradigms this style of teaching is often viewed as a long-term approach, as it takes multiple reoccurring sessions to identify interests, lead an investigation and stretch the thinking of the participants.

## Types of Projects

The projects for this thesis concentrate around these three teaching paradigms and they take place over two generational

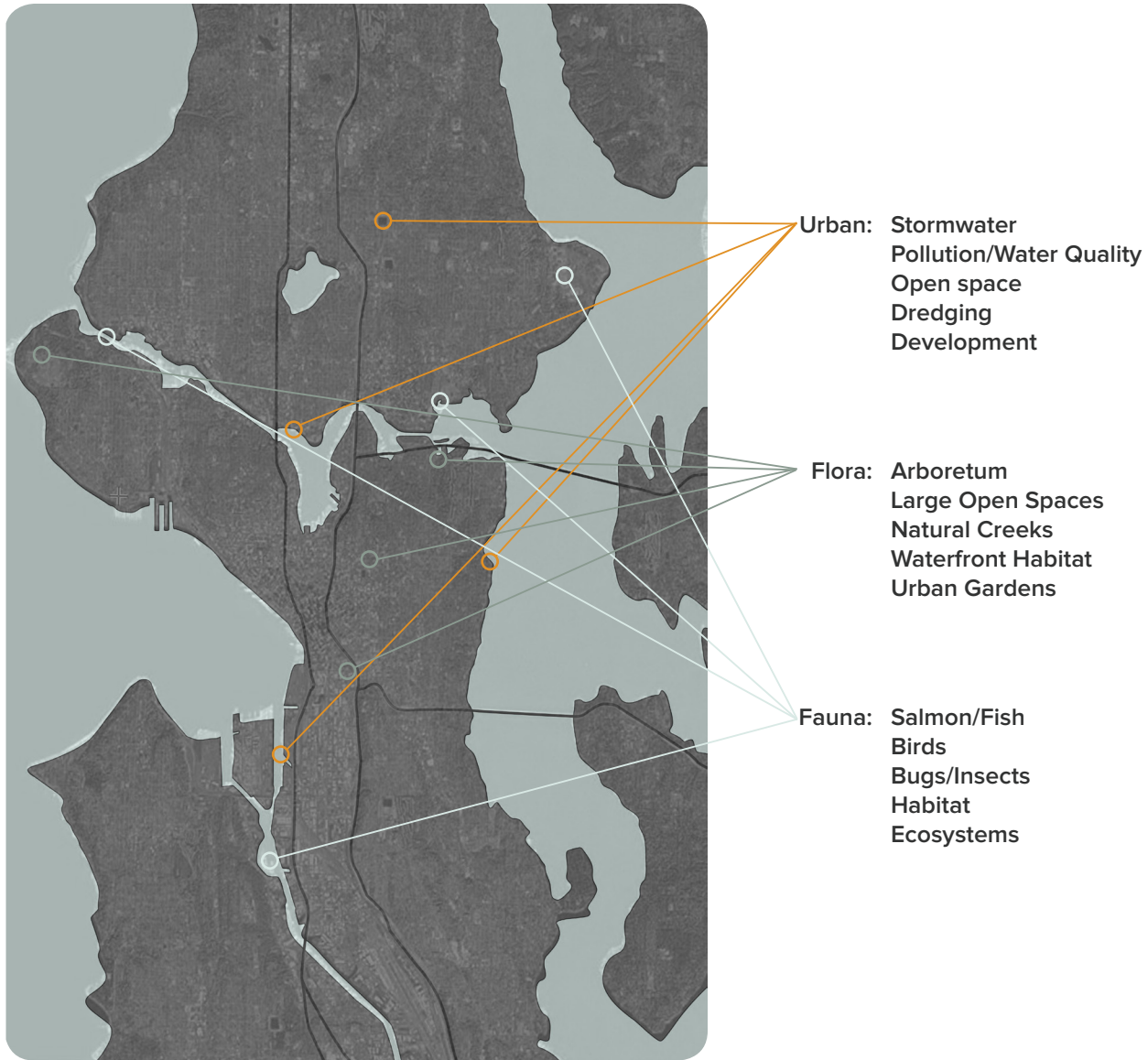


Figure 5.4: Seattle as a Resource for Environmental Education

time scales. This investigation acknowledges the importance of the time scales because it focuses on the current generation and the subsequent generations as it looks to create a systematic and cross-generational approach to urban environmental stewardship.

The first project follow the general approach to individual-led learning. The method takes form as a map with an accessible online application and with the use of QR Codes, will help users to become more aware of their urban environment and the ecosystem networks that exists within it (Figure 5.4). As users explore their city they will become more aware of the environmental happenings and will begin to build empathy and ownership over their city on an altruistic and/or biocentric level.

The second project is a mobile environmental learning center that utilize the emergent curriculum. The goal of this approach is to reach out to the younger generation and help them begin developing empathy and ownership with the environment they live in and inhabit every day (Figure 5.5 | 5.6). The mobile learning centers are designed to travel to schools or community centers and initiate discussions and investigations on site. By focusing on a smaller scale environment, users can build stronger emotional and personal ties with their locale. The idea is that this will help set the foundation to grow and create these bonds in the future with



Figure 5.5: Two Students Studying the Stages of Salmon Life



Figure 5.6: Students Learning about Vermicomposting

any area they inhabit. It will help them to see the world in a new way. Similar to the investigation in Costa Rica, this project seeks to educate the children in their environment. When they pass by a tree, a bird's nest or a vacant lot in their locale, they will naturally relay these observations to the people around them and knowledge beings to spread on a city-wide scale. The students become the educators.

The third project and the final showcase for this thesis is an Urban ELC Hub. This project is designed to utilize all three teaching paradigms, but with a driving focus on expert-led. The building will provide an urban ELC that will fill the gaps missing in the environmental education network currently existing in Seattle. By situating itself proximal to public transportation and well-known urban environmental sites the program provides an equitable opportunity for all to learn about our urban setting. The goal is to build empathy and empower individuals to take control of our environment by showing them the vivid bio-diversity that lives within our city, as well as to reveal the implications of our actions and its effect on us.

## CHAPTER 6: PROJECT INFORMATION

### Site Selection

The project's site location was based on prior research and a list of parameters that needed to be met. As earlier described, the urban realm is continuing to densify and increasingly people will be leveraging the public transportation networks that we have in the city. This was a deciding factor behind choosing a project site with proximity to the light rail and bus lines. Over the next decade, the light rail rapid transportation system will continue to expand across the greater metro area connecting neighborhoods and cities that currently are difficult to reach. Thus, it is this system of transportation that became the main driver of the project's location (Figure 6.1).

The next parameter was based on proximity to urban environmental sites that are problematic to our city. Seattle's heavy industrial sector located near the mouth of the Duwamish and combined sewer overflows located throughout the city have been polluting our waterways for decades (History of our mission, n.d.). Being located within walking distance to these examples of pollution zones would be very beneficial for the educators.



Figure 6.1: Lightrail Stop Adjacent to Project Site Selection



Figure 6.2: ST3 Future Public Transportation System Plan

The final parameter was the ability to find a site that would lend itself to adaptive reuse. There is a saying that states, “The most sustainable building is one that is already built.” With this project focused on our environmental impact within the urban realm, it made sense to look for a site location where this condition existed.

The area chosen for the site is in the SODO district of Seattle. In addition to meeting the above parameters it is also located along the SODO Trail, a heavily traveled bike path for commuters (Figure 6.3 | 6.4). The location of the current public transportation lines were once used by the railroads. On the western side of the site was a large warehouse originally used for servicing locomotives and was just recently demolished in the early 2000’s. The building that currently sits on the site is a steel frame warehouse constructed in 1952 (King County Department of Assessments, 2016)(Figure 6.5 through 6.8).

This area of Seattle is predominately commercial and light industrial but it provides this project the possibility to set a precedence for future industrial development in response to its context. SODO is rather sparse compared to the density of the downtown district. However, as population increases, the number of commuters utilizing public transportation will increase. This will naturally lead to increased development along the light rail corridor. While the future of this area is



Figure 6.3: Site Selection's Adjacency to Lightrail

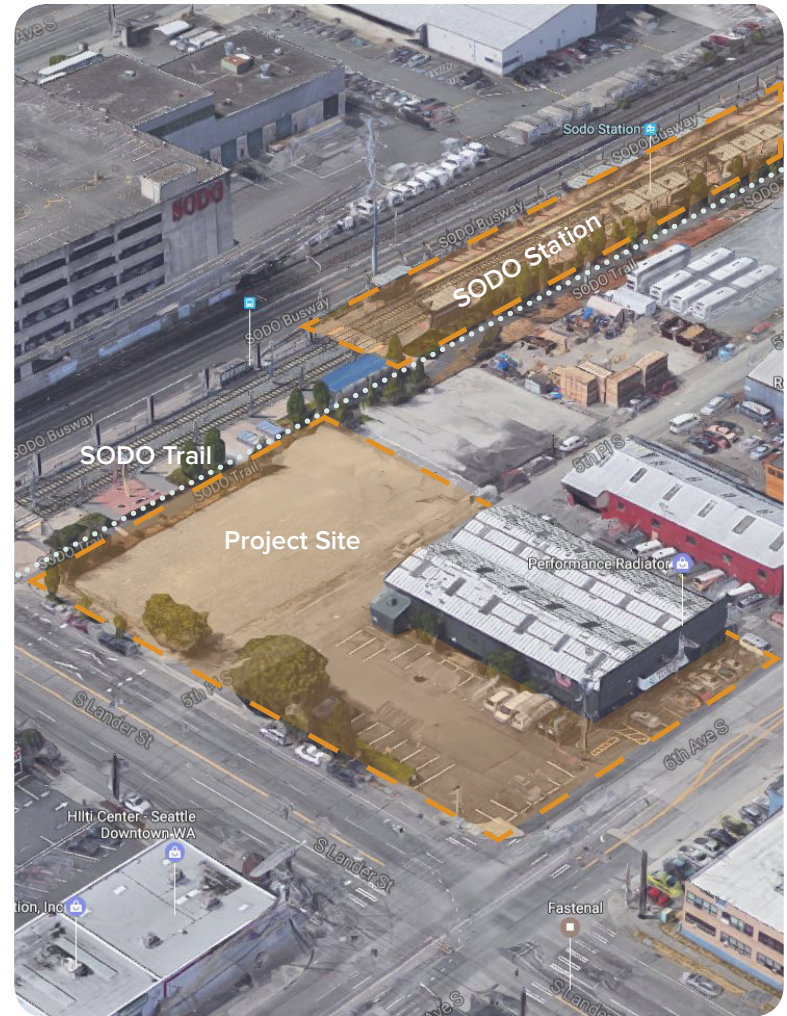


Figure 6.4: Site Selection's Adjacency to Lightrail



Figure 6.5: Site Photo from South East

relatively unknown, the factors that currently exist suggest that there will be a need for jobs, housing, and work spaces. This area of SODO is ripe for growth and this project's program can not only provide the missing link within the network of ELCs in the city, but it can also become a cornerstone of the community to be used for community events and as a hub for other environmental groups.

## Building Program

The building's program was derived from precedent studies of other ELCs as well as conversations with the ELC employees. The program listed in Table 6.1 is the finalized



Figure 6.6: Site Photo from South

program for the project. Most of the program is designed to have multiple functions to allow for the manipulation by its users to meet their needs.

The building consists of a large exhibition area where the curated urban education will take place. This space would be similar to other learning centers or museums with boards of information, photographs and interactive elements to teach across all ages. However, when rented out, this space could become a venue to host a small convention, community event or private gatherings. The building will also include rentable meeting rooms, a kitchen where cooking classes will be offered, a greenhouse, café, as well as different educating



Figure 6.8: Site Photo from SODO Station



Figure 6.7: Site Photo looking West from Bisecting Alleyway

Program	QTY.	Sqft. (ea.)	Total Sqft.
Exhibition Area	1	1500-2000	1500-2000
Auditorium (100-150 Occ.)	1	800-1000	800-1000
Library	1	600	600
Office	8	100	800
Laboratory	3	400	1200
Kitchen	1	400	400
Meeting Room	4	150	600
Greenhouse	1	2000	2000
Cafe	1	400	400
Restrooms	4	100	400
Storage	1	500	500
Mechanical	1	500	500
Outdoor Covered Space			
Teaching Garden			
Stormwater Management			
			<b>Total: 10,400 sqft.</b>

Table 6.1: Building Program

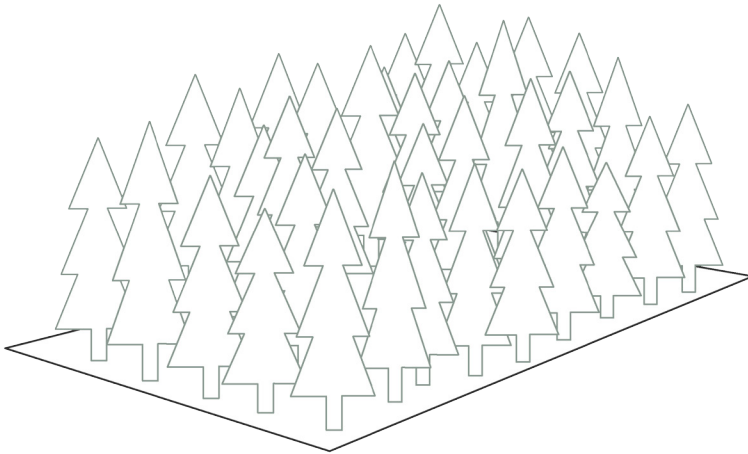
opportunities within the landscape itself.

## Design Methods

The project utilized various processes to move the design forward. Research played a large part in the understanding of the function of the building as well as helping to choose site location and methodological approach to overall design. Precedent studies, mood boards, Biophilic principles and information derived from Jason Medeiros' thesis helped to develop the program and overall feel of the building in relation to its context and users.

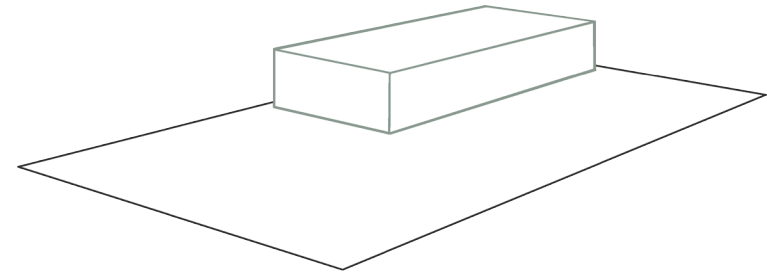
## Initial Concepts and Sketches / principles

The design process was broken up into three main parts focusing on site design, building design and the integration between the two. The first step of the design process was deciding how to approach the site and its relationship to the surrounding context. The project's location to the urban trail and public transportation corridor lent itself to a focused approach from the west side of the site as well as capitalizing on the future expansion and usage of the public transportation system as the city grows. The project site was split by an alley way and in order for the project to read as one, the site needed to be reconnected.



### What does one acre of forest provide us with?

- 125 trees/acre (103 conifers)
- 1 acre site = 1.031 million gal./year
- 288,747 gal./year infiltration
- 464,058 gal./year evapotranspiration
- 1% of water goes to runoff
- Animal habitat, water purification, air purification, carbon sync (storing carbon up to 1000 years)



### What does a one acre lot provide us with?

- 9600 sqft. building vs. 33,960 sqft. vacant
- 1 acre site = 1.031 million gal./year
- 51,562 gal./year infiltration
- 226,873 gal./year evaporation
- 752,805 gal./year runoff to stormwater (73%)
- Radiator and car parts, park and ride, semi-truck staging area, pollution and refuse

**Figure 6.9: Forest vs. Industrial Site**

This comparison shows the stark difference in how a site functions given two different programs. On one hand the forest produces clean water and clean air while allowing only 1% of the water that falls onto the site to runoff. Compare this to the industrial site where over 73% of the water that falls up into the stormwater system and helps to lead to the overflow of CSOs. This comparison is not meant to say that we need to revert back to the “wild” environment. It is setting a standard of site management that we as a populous need to strive for within our built environments. Information based off The State of Seattle’s Conifer Forest (Elman & Salisbury, 2009)

The existing building was a simple, open, shell structure that allowed for complete manipulation of the interior space. This steel framed construction method allowed for the ease of adaptive reuse. The main building concepts were to allow for the expression of the Biophilic design principles as well as to provide the ability for the communities and other environmental groups to utilize the space for events, gatherings, and teaching opportunities.

There were several driving factors that influenced the relationship between the site and the building. The main relationship between the site and the building are that while separate, they are very much a part of the same design thinking and experience. The goal was not to make one or another feel like an afterthought but to show that the design moved forward together, that they belonged together. Another driving factor was that they work together to teach and explain about issues in the urban environment. The hub would act as a working model to showcase proper ways to interact within an urban setting. By applying similar metrics that were used for the design of the Bullitt Center we can begin to understand the extent of the damage that this mainly vacant lot poses (Figure 6.8). By thinking how a forest would act on this site and replicating its effects with current technologies and building practices we can begin to set the precedent for future buildings in this area. We can

begin to design our built environment with similar efficiencies that the natural world already operates with. By managing site conditions, such as stormwater and waste, on-site the project can help cut down on pollution and minimize its environmental footprint.

It is key to state that this area was once a part of Elliot Bay and never a forest. While it is poetic to think that the project is trying to act like the natural environment that once stood in this location, it is more important to draw attention to how much the human race has altered the world. This is an area that a little more than a century ago would have been salt water, however, it was decided that filling this area in with dirt was the best use of this area. The natural ecosystems inhabiting these locations were destroyed to meet the needs of the new users.

# CHAPTER 7: DESIGN FINDINGS

## Concept Diagrams

The final design of the project was achieved by applying the design concepts to the site and has come about through the following steps:

1. Understand the structural language and the materiality of the existing building.

*The existing structure of the building is a simple side-by-side steel portal framed warehouse consisting of 6 bays. The structural columns sit 20' on center along a 3' board-form foundation stem wall. The frame has purlins above to help distribute the loads of the standing seam metal roof. The walls are also clad with a standing seam metal siding (Figure 7.1).*

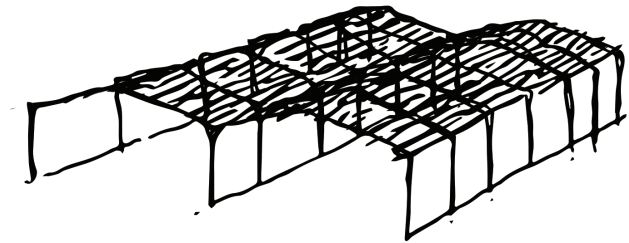


Figure 7.1: Structural Bays

2. Utilize the structural language to reconnect the site across the alley-way

*Duplicate the existing structure to span over the 20' alley way continuing the 20' on center spacing. The new side-by-side structure contains three bays and will sit upon the board form concrete stem walls to speak to the existing construction method. The board form concrete is key. This method not only relates to the existing building, but the natural concrete material with the wood texture conveys a few of the Biophilic principles (Figure 7.2).*

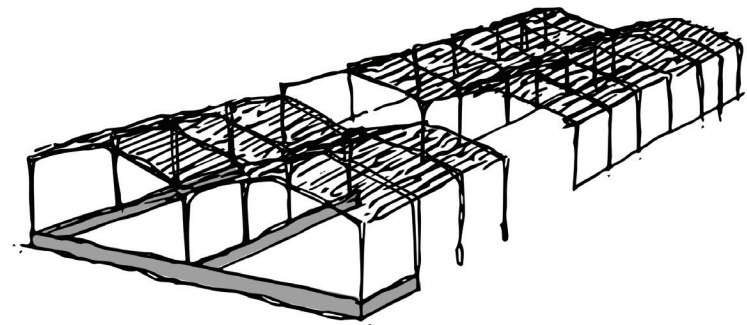


Figure 7.2: Extending Structural Bays

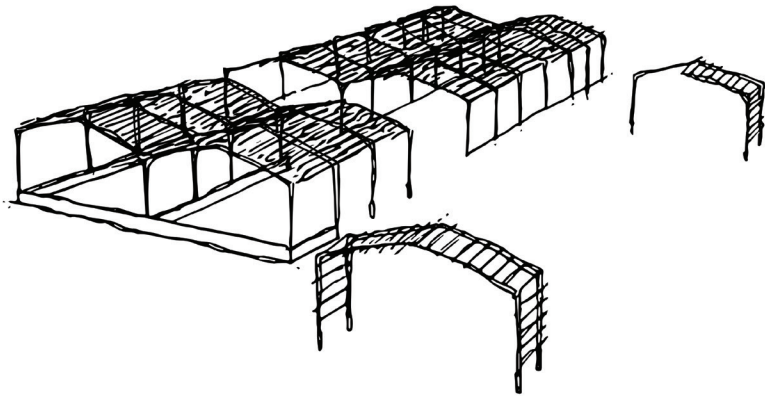


Figure 7.3: Bringing Structure into Site

### 3. Integrate the structure and building into the site

*To ensure the building feels connected to its site the structural portal frames will be brought into the landscape to function as gateways, armatures for planting, as well as to denote spaces for gathering (Figure 7.3).*

### 4. Utilize Biophilic ideas when choosing cladding materials

*The two structures will be clad in similar materials as the existing warehouse. The existing metal roof and siding will be used, as they are efficient, simple, and durable materials. The siding and roof will not be painted in forest green as they are currently. They will instead be left untreated so that overtime they will begin to show wear and the impact of their environment. This is another way to relate people back to the Biophilic experience,*

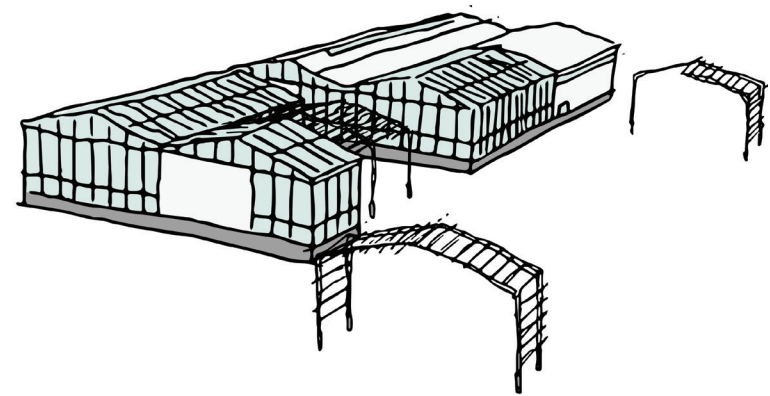


Figure 7.4: Biophilic Materials

*as it will help to show the connection with natural systems. The metal will dull overtime and in some areas it might rust, but since it is only a cladding system it will not harm the integrity of the structure.*

*The glass wall and roof systems are key to the project. Externally, the material will help to not only attract users to the site, providing transparency to passersby, but they will also act as beacons or billboards to those utilizing the public transportation by lighting up at night. Internally the glass will allow an abundant amount of natural light into the gathering spaces and the greenhouse. Open sightlines will also provide a connection to the site from inside the building (Figure 7.4).*

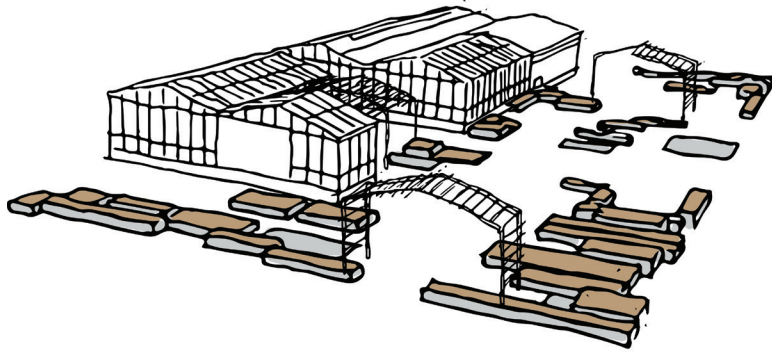


Figure 7.5: Planting Design

5. Incorporate structural layout with site design

*The design of the landscape was meant to relate back to the structural grid as well as the urban context that it sits in. The gridded landscape features planters that are made of board form concrete and rusting steel. There are also areas of gravel, called opportunity planters, that lie flush with the pathways and are left to go wild. These are meant to relate back to the vacant lots that are littered throughout the urban realm as well as to show the vivacity of the ecological world's ability to grow in harsh conditions (Figure 7.5).*

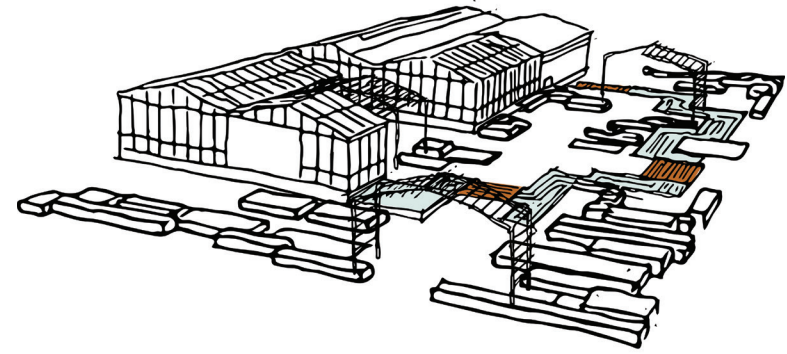


Figure 7.6: Swale Design

6. Stormwater channel to weave through site

*The design of the stormwater channel was designed to relate back to the structure and landscape as it weaves its way through the site. The detention area collects water from the site, filtering it and restoring it back to the aquifer. The design itself is stepped with corrugated concrete to aerate the water as well as to allow ledges for bio-remediation and in certain areas, to allow users to sit and inhabit the space for gathering and teaching opportunities (Figure 7.6).*

## System Diagrams

The diagram to the right (Figure 7.7) shows how the project helps to mitigate the pollution produced on and around the site. Historically this location was adjacent to heavy rail lines and on the west side a train maintenance warehouse existed. This led to pollutants seeping into the ground. The removal of soil from the bio-swale on site reveals the existence of the toxic chemicals and heavy metals. These toxins will need to be remediated. This is a common issue found throughout the industrial areas in the urban realm. The orange boxes are rusted steel planters that will be filled with the cut material. Within the planters, phyto-remediating plants will be used to clean the soil (Table 7.1). These plants will help to accumulate, breakdown, and fix these harsh toxins, eventually cleaning the soil. These planters can be used by the workers and environmental groups to help teach about our toxic legacies and to monitor soil conditions.

The pollution produced from the project itself will be mitigated to allow for minimal output. The site will feature composting toilets that will not use any water. The treated waste and leachate from these facilities will be used to support the non-edible flora on the site. Compostable waste from the kitchen and greenhouse will be placed in either on-site vermicomposting bins or picked up for use in the municipals industrial composting center. Vermicomposting is

an expedited composting process that utilizes worms to help break down the compostable materials. The material created from these will be used as additives for all of the edible plantings.

Flora in the urban realm is extremely important. Not only does it help to reduce the heat island effect by providing shade and transpiration, releasing water into the air, but flora plays a crucial role in cleaning air pollution and providing habitat. Trees and other broad-leafed plants are some of the best air purifiers. Plants are an essential component to our urban environment.

These implementations provide opportunities for educators and individuals to teach and observe how we can better work with our environment to limit our pollution. There will be QR codes located near all of the installations that will connect back to the online environmental application. When a person scans the QR code, other locations where similar processes occur within the city will appear. It will also show additional information explaining in greater detail the science and concepts behind what they are viewing. In certain cases, such as the vermicomposting bins, the information given will include steps for residential applications.

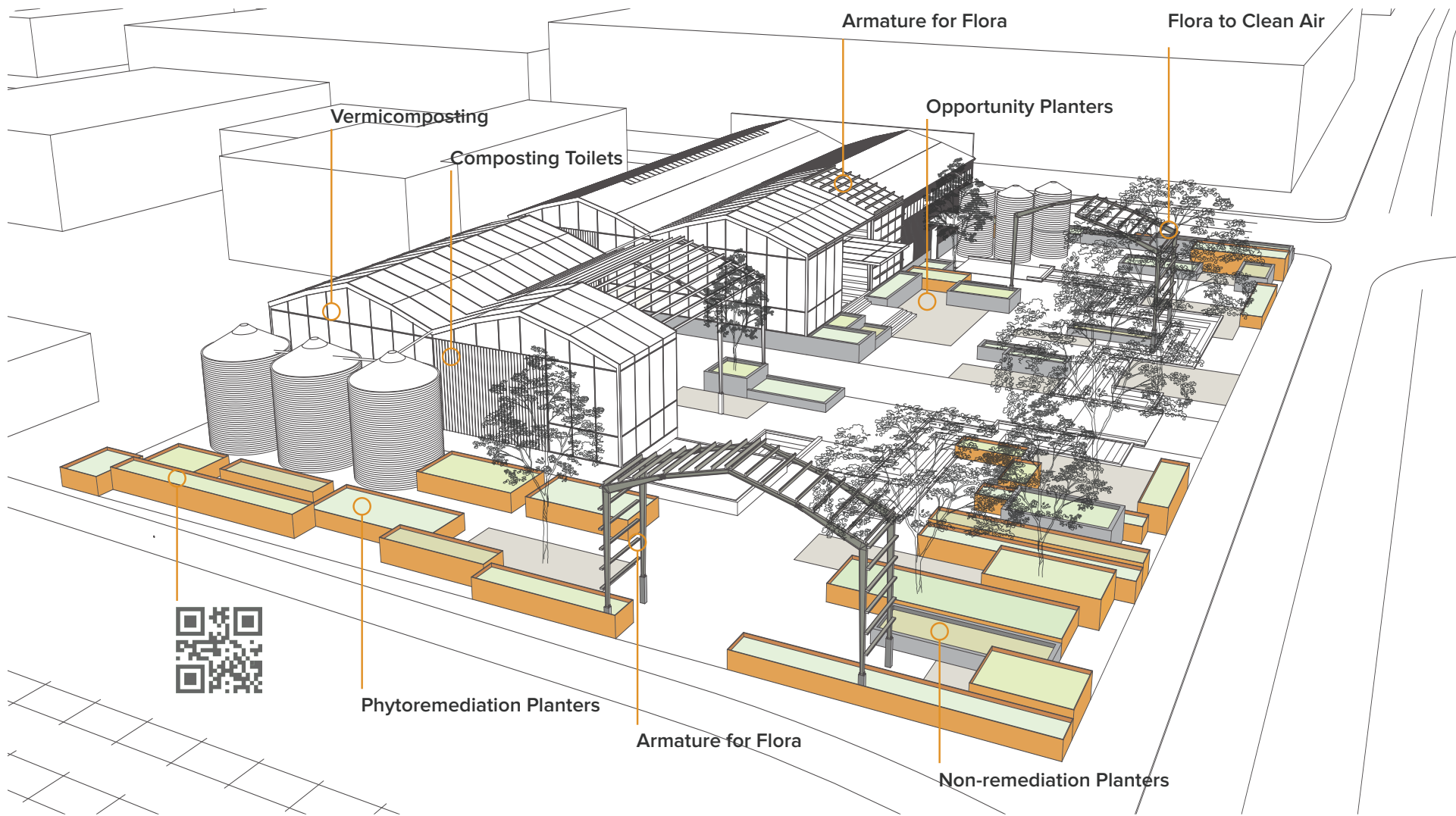


Figure 7.7: Pollution Systems Diagram

Heavy Metals



**Helianthus annuus**  
*Common Sunflower*  
*Extraction, Metabolism, Rhizodegradation*



**Populus tremula / tremuloides**  
*European Aspen / Quaking Aspen*  
*Phytoextraction*



**Brassica juncea**  
*Mustard Greens*  
*Hyperaccumulation, Rhizodegradation*



**Viola spp.**  
*Violet*  
*Phytoextraction, Hyperaccumulation*

Arsenic



**Lupinus arcticus**  
*Arctic Lupine*  
*Rhizoaccumulation*

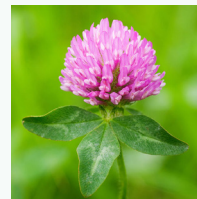


**Pteris spp. (multifida)**  
*Brake Fern (Spider Brake)*  
*Hyperaccumulation*

Hydrocarbons  
(TPH)



**Bouteloua gracilis**  
*Blue Gamma Grass*  
*Rhizodegradation*

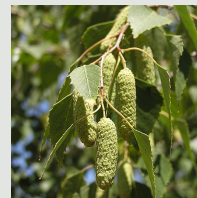


**Trifolium pratense**  
*Red Clover*  
*Hyperaccumulation*

PCB's (PAH's)



**Atriplex hortensis**  
*Garden Orache*  
*Metabolism*



**Betula pendula**  
*Silver Birch*  
*Phytodegradation*

Table 71: Phytoremediation Plant Palette

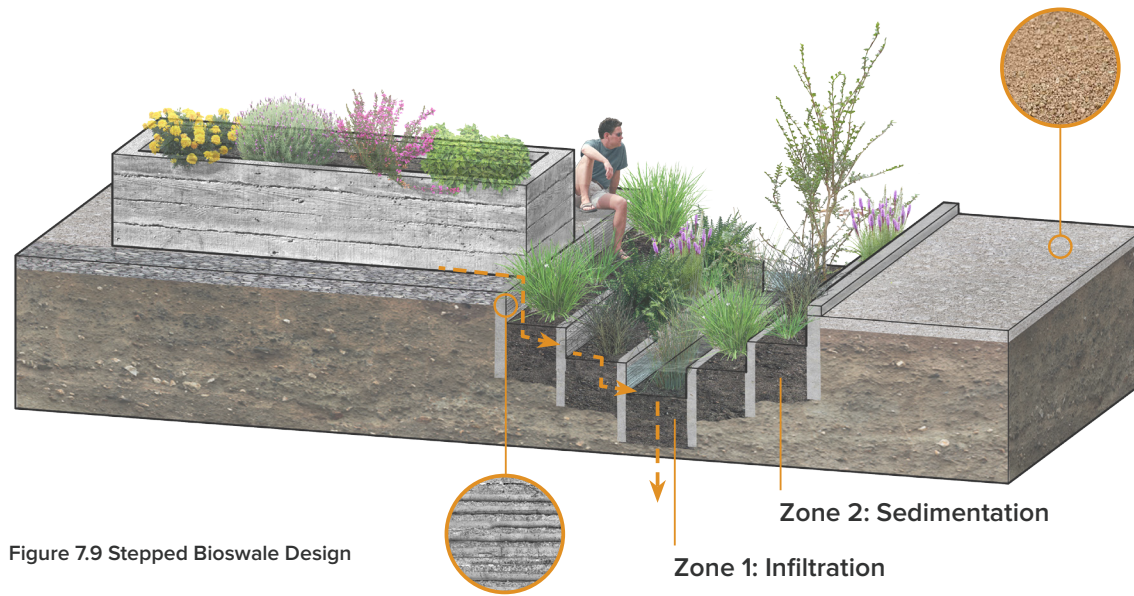


Figure 7.9 Stepped Bioswale Design

The diagram on the following page (Figure 7.8) shows how water is managed on site. Throughout most large cities there is an overwhelming amount of impervious surfaces. One of the best ways to help limit the outflow into our sewer system and CSOs is to provide permeable surfaces on the site. This will allow the water to drain through the soils and into the water table. Areas that take a lot of runoff from road surfaces will contain chemicals and heavy metals from automobiles. These toxins are not healthy and we do not want them to seep into the water table. There are two ways to deal with this. One way is for the water to be placed into a bio-swale that either slows down the water, cleans it and eventually drains into the sewer. A second method,

which is used on this project, is for it to be slowed down, aerated, cleaned, and slowly filtered into the water table (Figure 7.9). There are many plants that naturally clean toxins. The sample plant list shows the plants chosen for this site and their function (Table 7.2). None of the water used by occupants or that falls onto the site will drain into the sewer system. All water that falls onto the site will either be collected into the rainwater cisterns and used to wash hands and water plants, or it will permeate through the ground to the water table. Water from the sinks will be held in gray water storage tanks. It will then be cleaned and used to water the plants on the site.

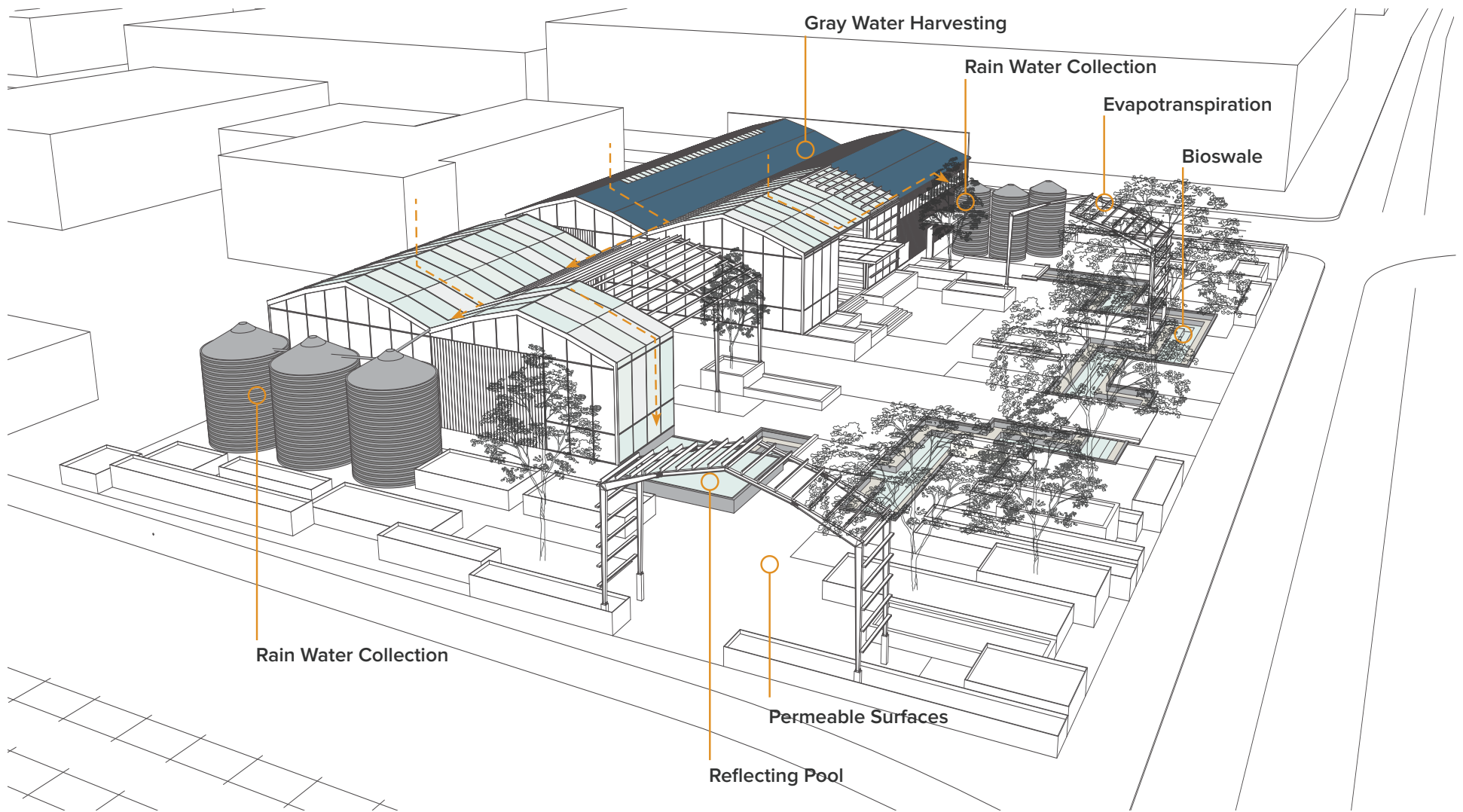
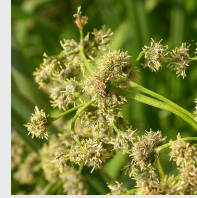


Figure 7.8: Water Systems Diagram

Zone 1



**Juncus acuminatus**  
*Taper-tipped Rush*  
Evergreen  
Sun: full, partial



**Scirpus microcarpus**  
*Small-fruited Bullrush*  
Evergreen  
Sun: partial, shade



**Juncus ensifolius**  
*Dagger-leaf Rush*  
Evergreen  
Sun: full



**Sidalcea hendersonii**  
*Henderson's Checker-mallow*  
Deciduous  
Sun: full, partial

Zone 1-2



**Spiraea douglassii**  
*Douglas Spirea*  
Deciduous  
Sun: full, partial

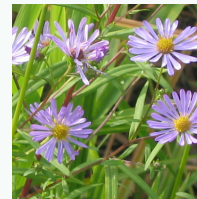


**Spiraea densiflora**  
*Subalpine Spirea*  
Deciduous  
Sun: full, partial

Zone 2



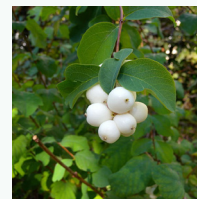
**Polystichum munitum**  
*Western Sword-fern*  
Evergreen  
Sun: partial, shade



**Symphyotrichum subspicatum**  
*Douglas Aster*  
Deciduous  
Sun: full, partial



**Cornus Sericea 'Kelsey'**  
*Dwarf Red-twig Dogwood*  
Deciduous  
Sun: full, partial



**Symphoricarpos albus**  
*Snowberry*  
Deciduous  
Sun: full, partial, shade

Table 7.2: Bioswale Plant Palette

In order to connect people with water in the urban realm the water that falls on the café roof will roll down and gather in a reflecting pool. The water from this pool will help visitors realize that when it rains it is collected somewhere. Every inch of rain over 1000sqft equates to 627 gallons of water. It does not just disappear. To put this in perspective, 1000sqft is equivalent to roughly five parking spots. By implicitly connecting people to the cycle of rainwater we can begin to instill in them the idea that we need to capture and slow down our water runoff. We need to give our treatment plants the ability to handle the loads we put on them.

Not all pollutants are created directly on our site. The generation of electricity can often create underlying environmental issues dependent upon the method by which it is produced. Seattle is very fortunate for the fact that the majority of our electricity comes from hydro-electric dams located throughout the state. However, there are some states that still use coal plants to generate electricity. While dams are not the best form of production due to the habitat loss and migration cycles that they disrupt, it is better than coal.

The best way to be able to provide cheap free electricity is to utilize renewable energy sources. This project not only capitalizes on renewable energy in the form of a photovoltaic (PV) array located on the roof, but it also takes advantage of access to natural light, limiting the need for

electricity (Figure 7.10). This project is also designed to use passive systems. By using cross-ventilation, the building can be cooled down in the summer and in the winters the concrete floors that are located under the large expanse of glass will act as thermal mass to hold and collect heat during the day, releasing it when the sun goes down. These combined interventions are meant to help limit the energy draw of this building.

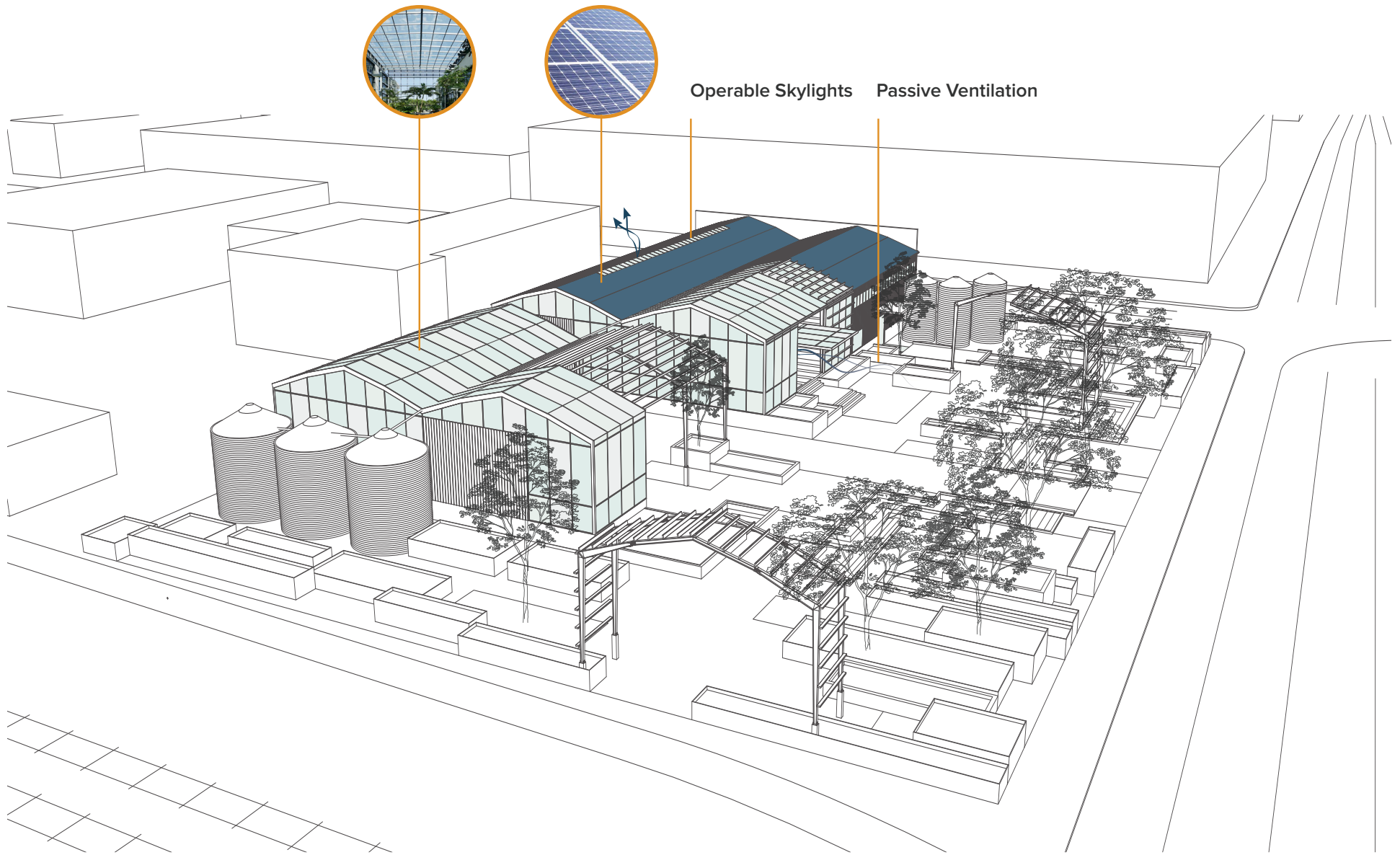


Figure 7.10: Energy Systems Diagram

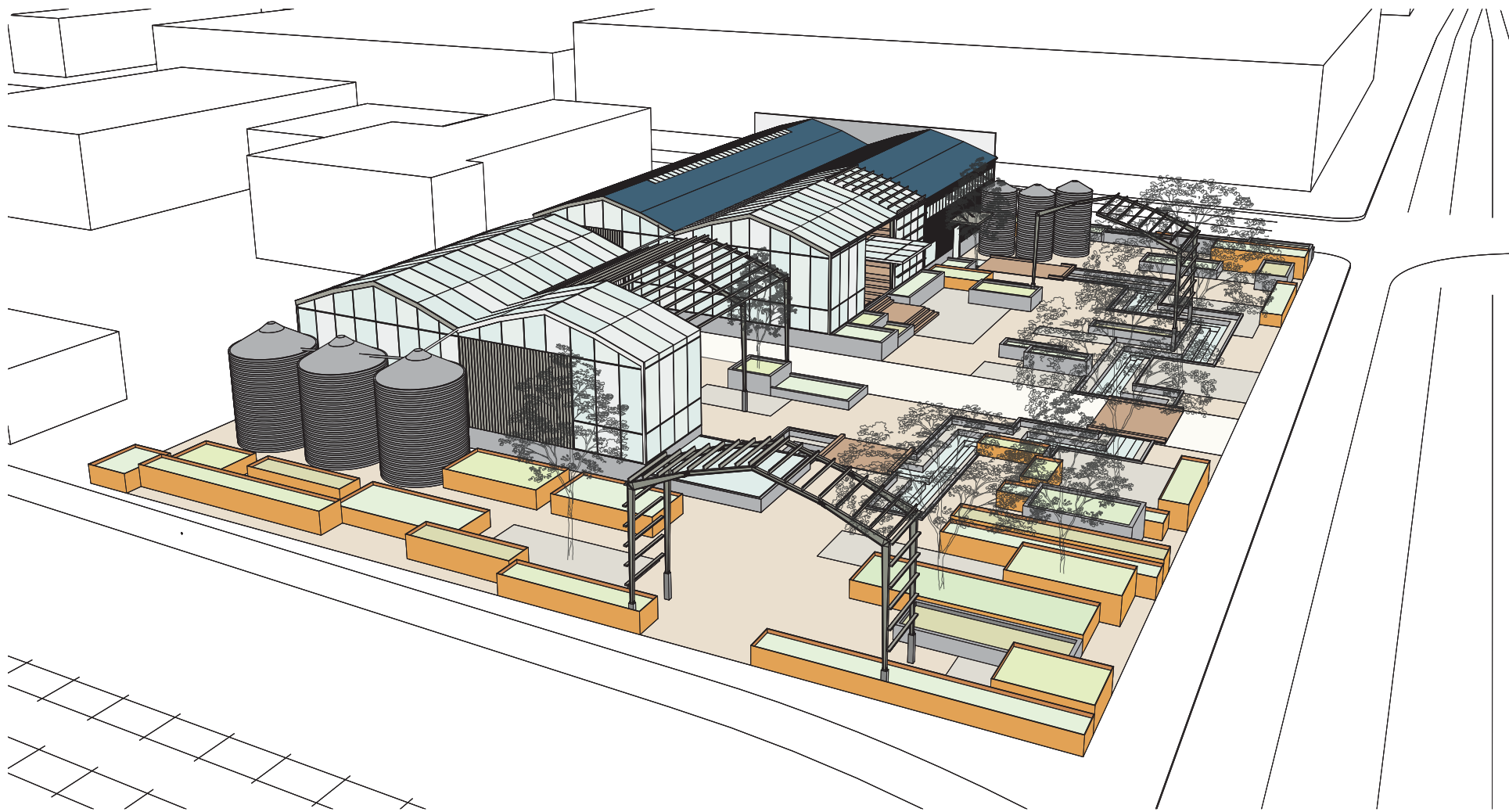


Figure 7.11: Combined Systems Diagram

## Building Design

One of the focal points of this project was being able to capitalize on the public transportation systems. Thus the walkthrough of the project will begin from the east entrance, adjacent to the SODO Station light rail stop and the SODO Trail. Entering the project (Figure 7.12) through the structural gateway creates an immediate connection to the built structures that inhabit this plot of land. To the left and right next to the entrance are CorTen planters filled with phytoremediating plants (Table 7.1). Looking to the left is an area for groups to gather and just behind that is the location for rain water harvesting that is used to water the surrounding vegetation.

The first building on the left upon entering the site is the cafe and greenhouse. The glass roof of this building is meant to showcase the structural systems from outside as well as to become a beacon to passersby as it glows during the night. The reflecting pool to the front will collect water from the roof to reiterate the connection that we have to the rain in our environment to the quantities that flow into our stormwater system. As it overflows it will fall into the bioswale that winds its way through the site. The more ways the user can experience the connection to an element the more likely it is to stay with them. Crossing the bridge over the bioswale is another relationship that the user will experience.

Not only is the spatial relationship to the water changing but so is the materiality beneath the users feet.

Turning to the left brings us to the front of the cafe and greenhouse. This outdoor gathering space utilizes the structural system of the existing building to expose the architecture but to also integrate into the site as it becomes an armature for nature. Planted beneath the structure will be climbing plants to help increase evapotranspiration as well as provide shade to the space and a Biophilic relationship to the users.

The cafe will be a light-filled area with great views to the surrounding site and foliage. In the back of the cafe is a window that peers into the greenhouse to further the connection between that we can have with our natural environment. The greenhouse will offer many classes in gardening, beekeeping, composting, germination, and agriculture production within our urban environment. The composting and beekeeping are located in the back of the greenhouse for security purposes. In combination with the kitchen, the seasonal food produced in the greenhouse will be used to teach cooking classes. It is one thing to teach people about urban agriculture, but if users do not know how to cook the food they grow it can become a worthless endeavor.

Walking out of the greenhouse towards the east brings

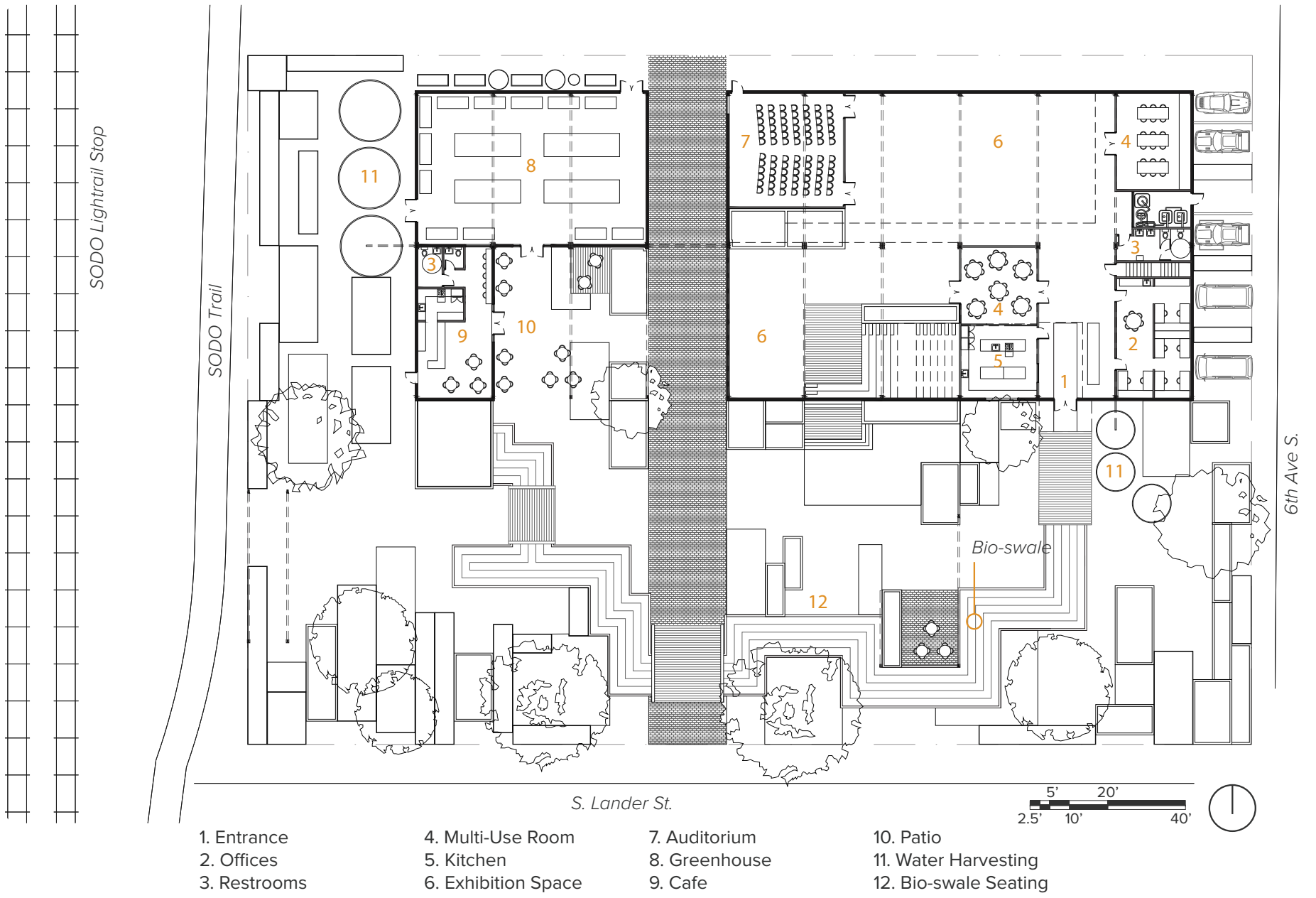
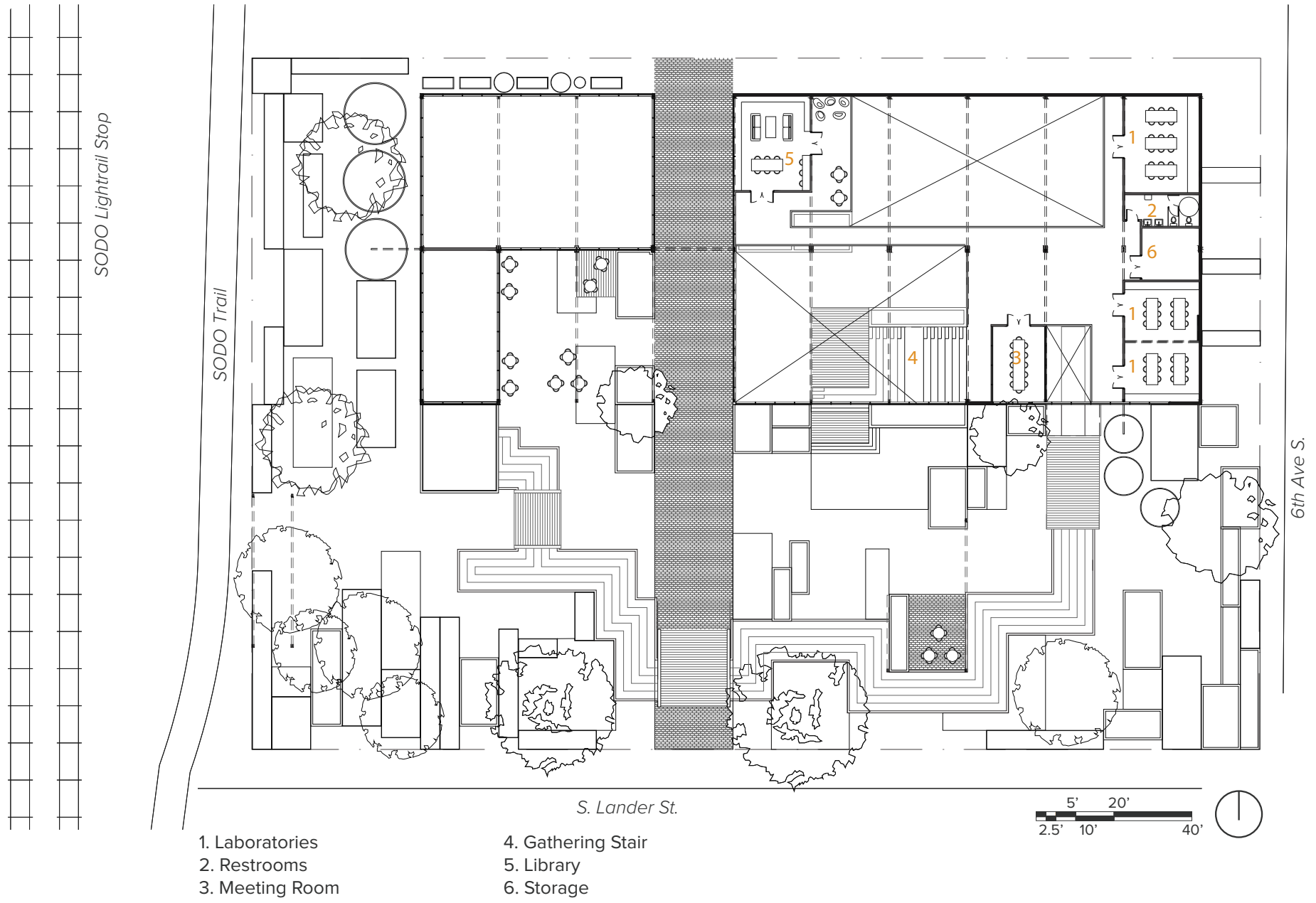


Figure 7.12: Ground Floor Plan



- 1. Laboratories
- 2. Restrooms
- 3. Meeting Room

- 4. Gathering Stair
- 5. Library
- 6. Storage

Figure 7.13: Second Floor Plan

us to the next building. As we cross the paved alleyway we can see through the glass, into the large double-height open auditorium space with a large gathering stair. The planters located in front of these windows are made of board form concrete and tie into the foundation stem walls blending them together. Adjacent to these planters is a wooden deck and opportunity planter. The wooden deck is the element that connects the inside to the outside when the large window wall lifts open. The materiality connection from the interior to the exterior helps to blend the site together. The metal cladding strips to the right of this wall seen in the elevation (Figure 7.14) were added to reinforce the purlin structure of the building, as well as to provide an armature for foliage to grow. The final goal of this element is to provide shade for users gathered on the stairs in the summer months.

Turning around and walking south brings the user to the bio-swale seating area designed to allow groups to gather and learn about the function of the swale. Inhabiting this space helps to reemphasize the knowledge being taught as the students and teachers can interact on an intimate level and use it as a teaching tool. This space along with the paved gathering area beneath the structure provides a location for people to talk, eat, and relax.

Continuing walking east we reach the end of the bio-swale and arrive at the entrance of the main building.

The entrance to the building is abutted by water harvesting tanks that will be used for watering plants and in the future, potable water. The bridge in-front of the entrance is a similar materiality to the other bridge near the entrance. The idea was to reiterate the idea that the bio-swale was running underfoot. As the user enters the building there is another materiality change and the floor becomes a thick slab of glass. Beneath the glass is a deep hole, lit by lights, that reaches down to the water table. With this site historically being located in the middle of Elliot Bay, the water table is very high. The connection between the bio-swale, to the bridge, and to the glass is to relate to people the process of water from the sky, to the roadways, to our water table. While the depth of the hole beneath the users feet might be startling, it is this shock factor that will be capitalized on to make a strong point; that the pollutants, such as oil in the streets, eventually make its way into our water.

To the right of the entrance is the front desk with the offices located behind. To the left is the kitchen where classes can be carried out as well as catering for large events when the space is rented by the community. Just north of the kitchen is a multi-purpose room that can be rented. This space can be combined with the kitchen by collapsing the dividing wall to create a single open space.

Across the way from the multi-use room looking east

is the stair to bring management to the composting toilet and mechanical systems. Next to that is the entrance to the main floor restroom and a glass window that showcases the mechanical systems used to clean and compost the upstairs restroom's waste. At the end of the east wall is another multi-purpose room to be rented out and utilized by the learning center or the community.

Moving into the large open space brings us to the main, double-height, exhibition hall. Located in this area is the exhibition that will be driven by individual learning. This space will be similar to a museum or the Cedar River Watershed ELC exhibition area. It will have interactive elements as well as boards of information that outline our city's relationship to its environment from the regrades, to the Duwamish River, up to our future plans for dealing with stormwater. The exhibition in this space will not be completely permanent as the space is meant to be able to open up and be used for large gatherings and events.

At the end of the exhibition space is the auditorium. The auditorium is a large 150 person hall that can be used for lectures, presentations, gatherings and other events.

To the south of the auditorium is a large double height multi-use space. This area can be used for overflow exhibition space and it can be utilized for event space. This area

provides the ability for more public lectures where attendees can gather on the large steps.

Ascending the steps takes us to the second floor (Figure 7.13). At the top of the floor is a glass conference space that can be used by the ELC or rented out for outside meetings. Walking past the meeting room brings you to two of the laboratory rooms. These rooms will be used as classrooms where students can carry out experiments regarding the different urban environmental topics. The first two labs can be opened up to create one large room by hiding away the divider wall. Next to the labs are the upstairs restroom and a storage room. The final laboratory is located at the end of this east wall and is a bit larger in size.

Turning around and walking across the bridge takes one to the library. Outside of the library are different seating opportunities for carrying out conversations, lounging, and reading books. The library will not only serve as an area of knowledge regarding the different urban environmental issues and topics, but it will also offer story time and events for families.

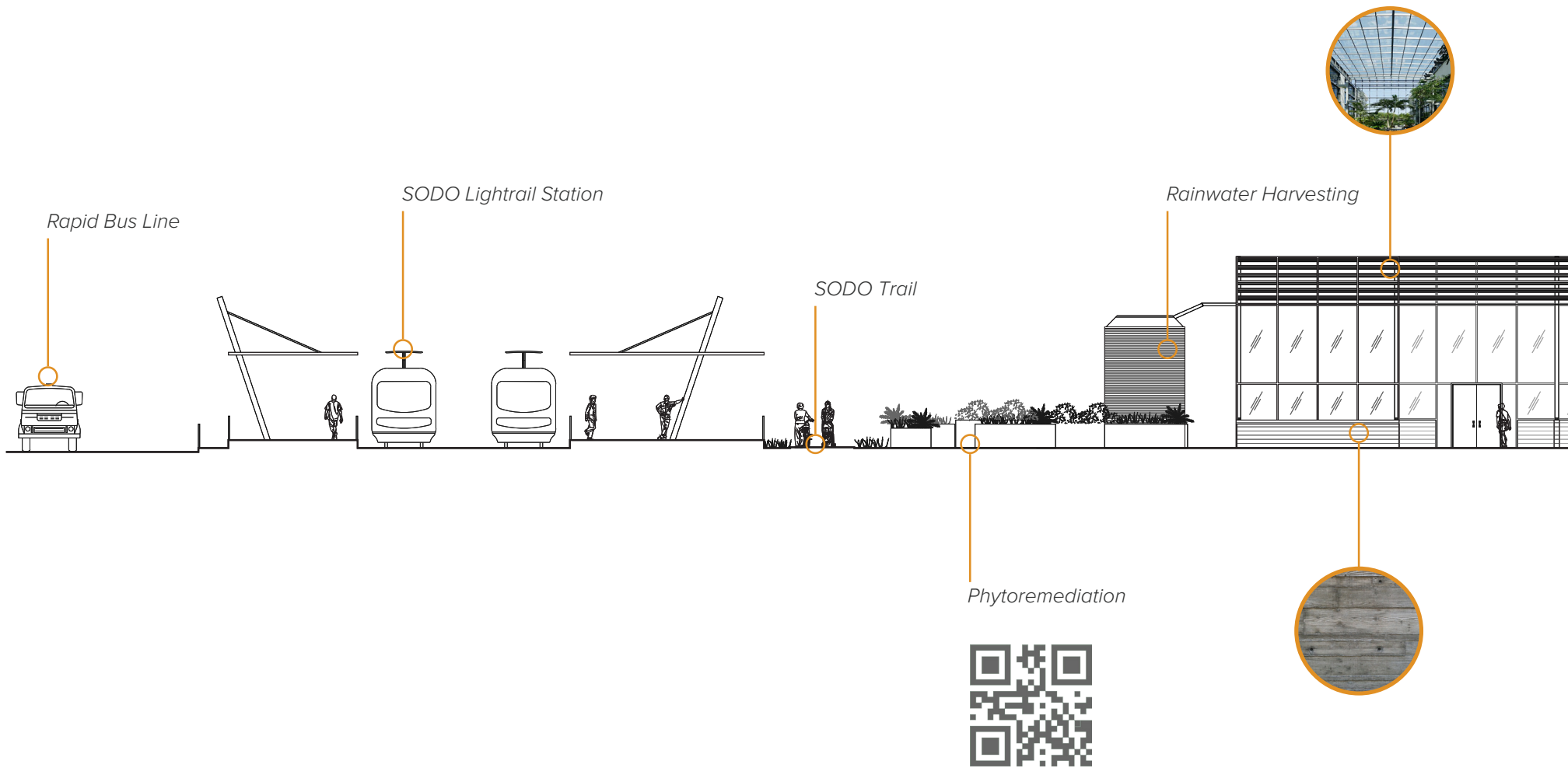
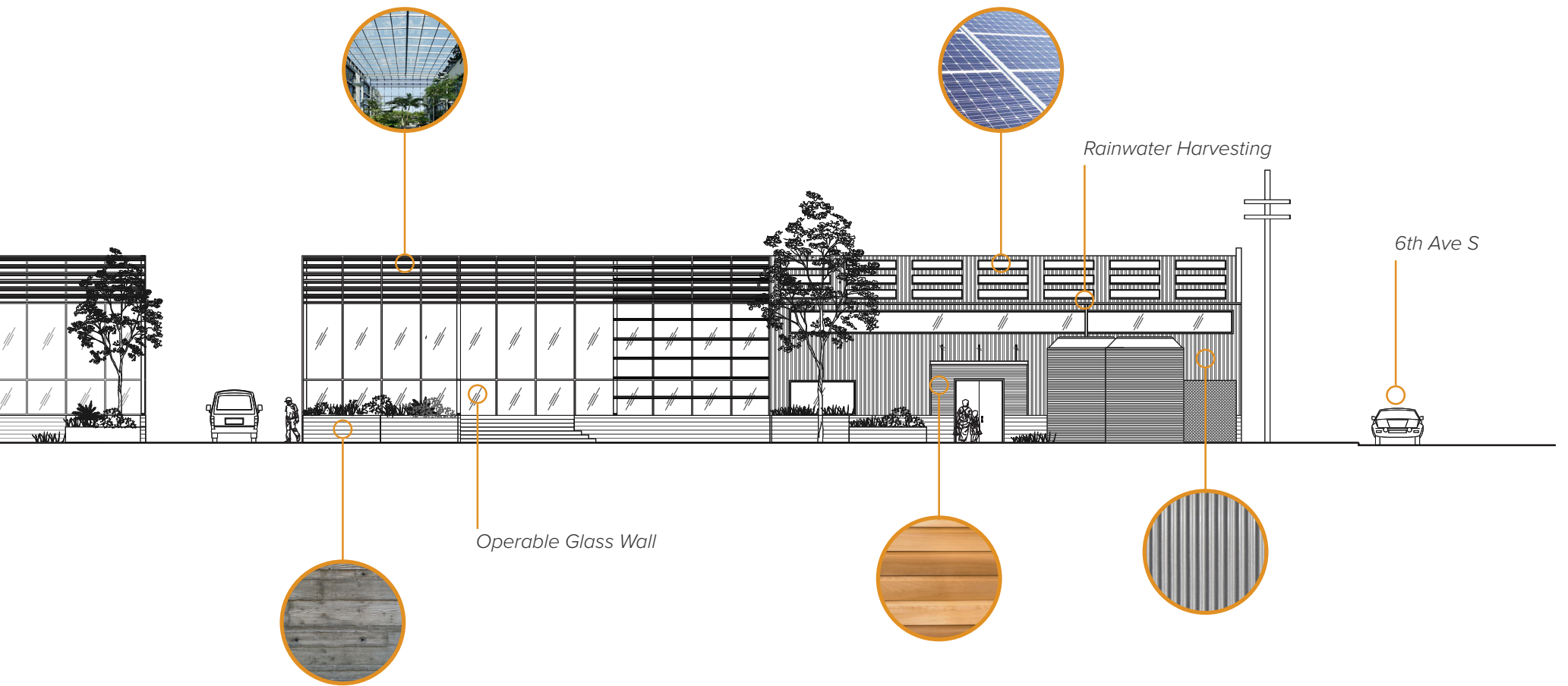


Figure 7.14: South Elevation



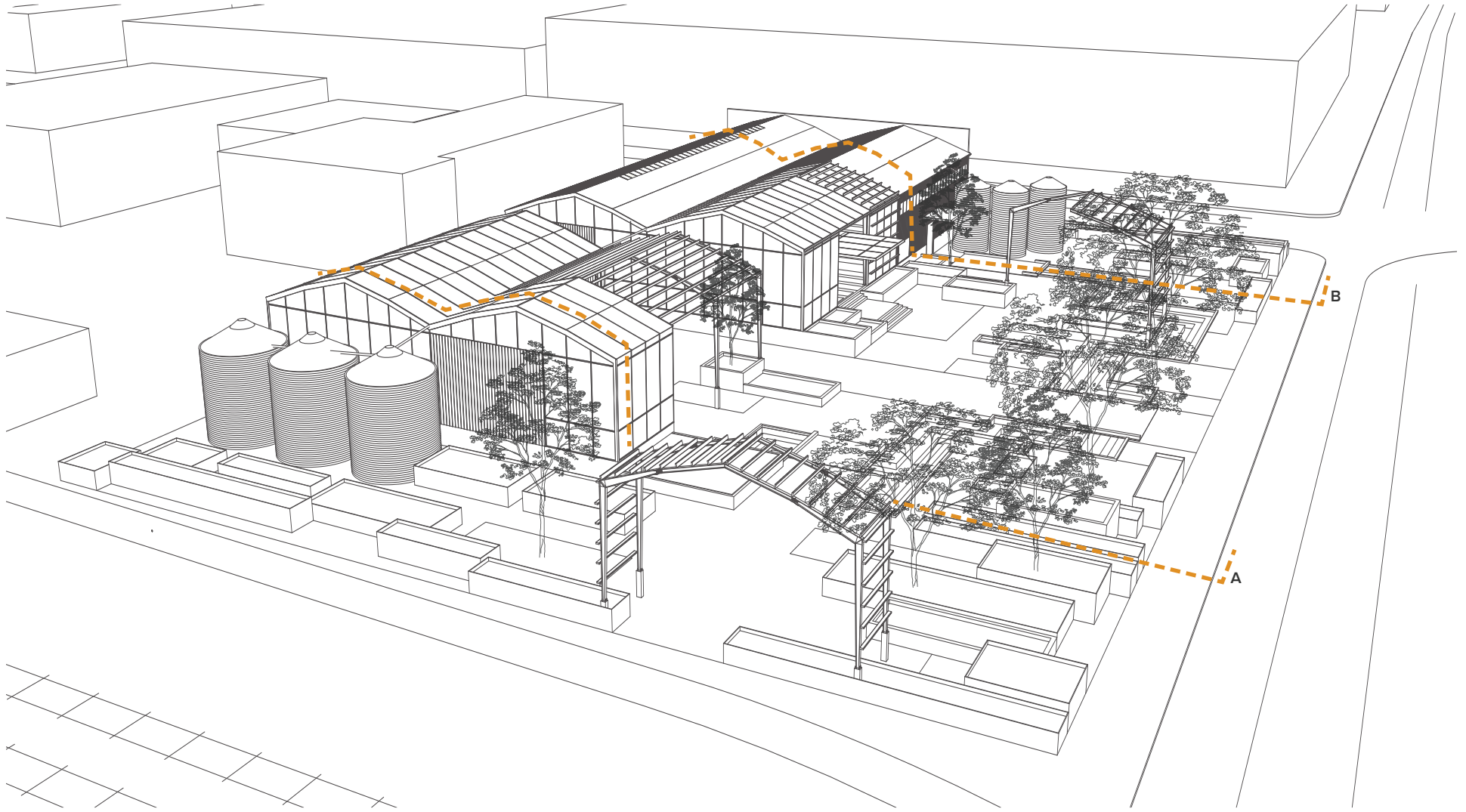


Figure 7.15: Section Cuts

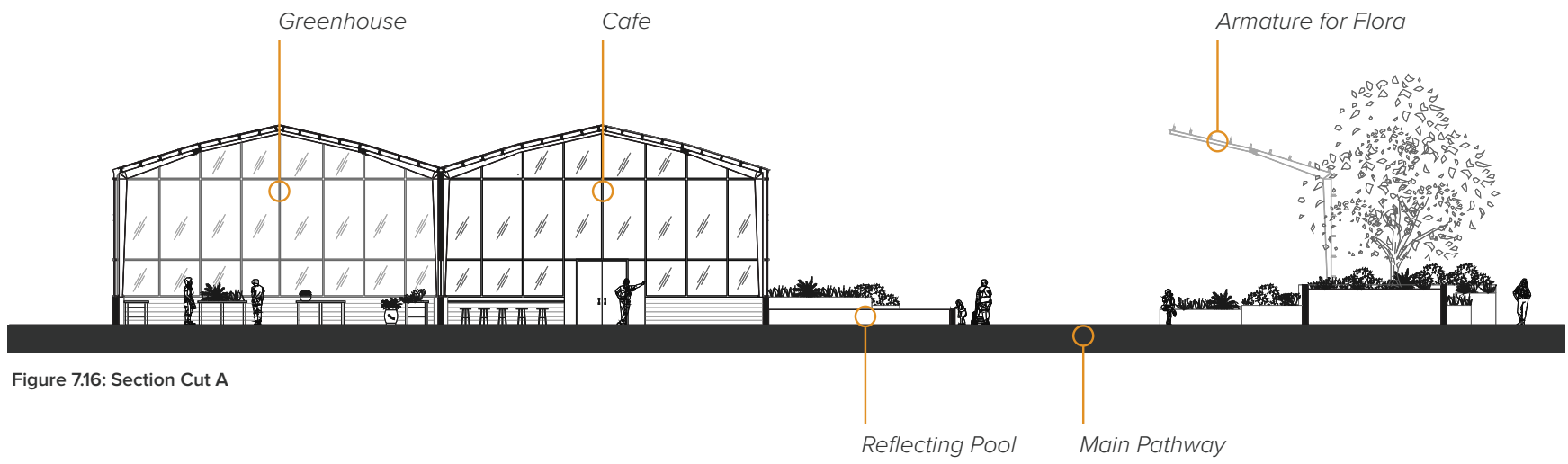


Figure 7.16: Section Cut A

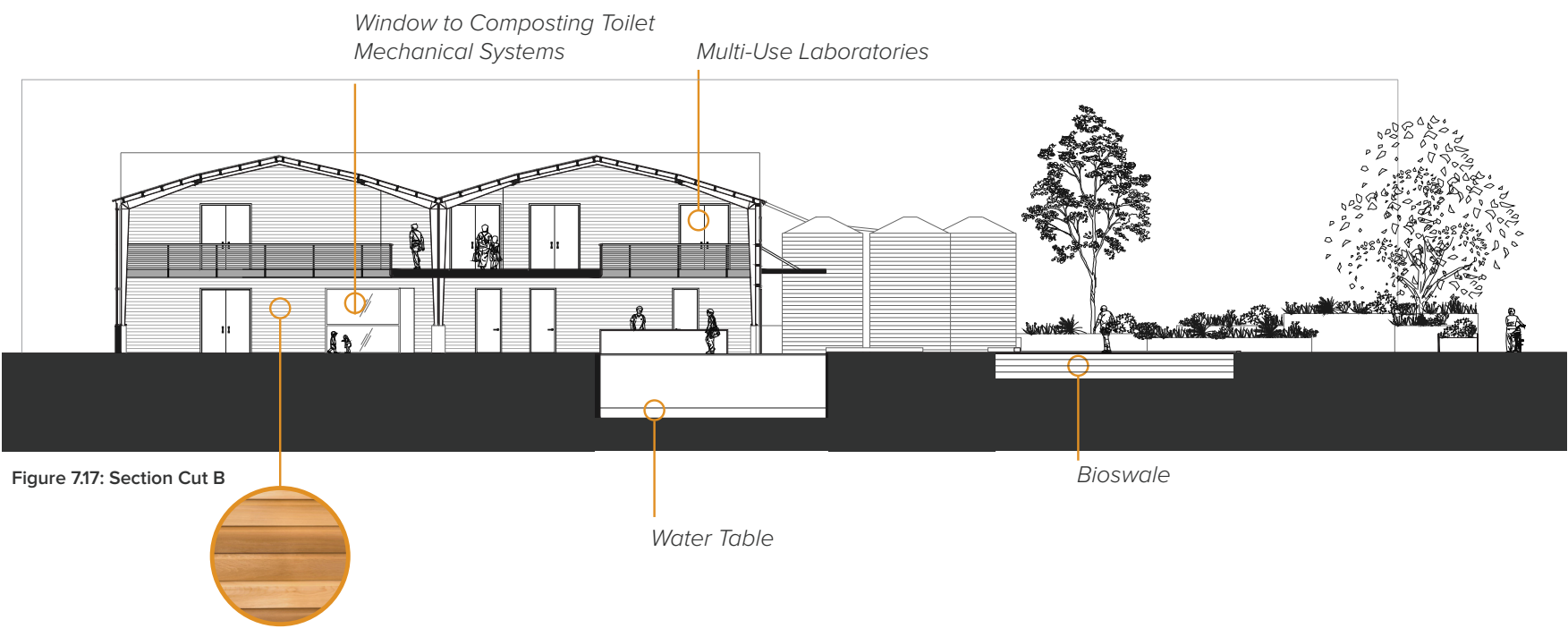


Figure 7.17: Section Cut B



## CHAPTER 8: CONCLUSIONS

### Final Thoughts

The intent of this thesis is not to insult our current mode of environmental education. Through research, a missing link in the current environmental education network existing in Seattle was identified. While we had multiple education centers throughout the region focusing on large-scale rural environments, we lacked a center that focused solely on our urban context. This project is meant to bolster our current environmental education opportunities with the goal of increasing the awareness of our urban populous. We need to realize that we are normalizing the destruction of our planet. We cannot continue to work solely on protecting large-scale wild nature; we must also work together to fix our urban environments. In doing so we may ensure the continuation of the sources of our good life; access to clean water and clean air.

The organization of this thesis is very deliberate. While the project is an accumulation of all the research, what I realized in documenting this thesis is that the design portion is less important than starting the conversation. In order to fully comprehend the problems we face, we need to thoroughly understand our historic relationship to our environment.

This history, the foundation of Biophilic principles and our current environmental education system are all essential in developing an approach to future improvement. Many factors have led us to our current predicament. In order to move forward we need to figure out how to convey this message to current and future generations. We need to become stewards of our land. We need to stop perpetuating the idea that a separation exists between humans and nature. We cannot forget that we live in a symbiotic world. To fix the problems we have created, we need to look to history to solve for the future.

The limits of this thesis lie solely on the ability to keep it manageable. I struggled to keep the design in focus as I wanted to apply all of my research towards the project. Many times the scope of the research seemed out of control and it needed to be brought back in. There is a lot of information included in this thesis but there is even more that was left out. This thesis is meant to start a conversation and in the end, I feel that I was successful in that endeavor.

## Critiques

The following critiques were given by a guest panel during the final presentation of this thesis. The critiques mainly revolve around the design intervention as it was stated that the thesis research and investigation were strong.

- The main critique was about acknowledging who the center catered to. Who were the user groups? I struggled with this answer because through research I found that everyone could benefit from additional environmental education. The idea was that the building would be a hub and catered to all people. It was designed with the idea of a Low Road building in mind; to be able to adapt to its future users and the environment. This hub was meant to be a one-stop shop at a basic level to develop empathy with the urban environment through visual and interactive elements.
- The mobile learning center garnered much support and positive feedback. The only critique was its lack of integration with the final project during times when the mobile ELC was not in use.
- The lack of DIY exhibits and a relevance to the everyday person within their own residential context was mentioned as a miss. One of the goals of the thesis was to

reach out to the everyday person to help them understand their role in the urban environment but they stated that project could have been overdesigned. While this might be the case, this critique could easily be addressed through the use of the QR codes and the online application. A quick click on a QR code could link the user to a multitude of information related to the residential application of interventions located at the Urban ELC.

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