From Classroom to Garden

Bridging Education and Ecology in School Landscapes

by
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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

From Classroom to Garden explores the integration of permaculture principles into the planning and design of an urban farm strategically located adjacent to the newly constructed Swift Waters Elementary School in Brockville, Ontario. This study focuses on achieving two pivotal objectives: designing outdoor learning spaces and promoting local food production. The broader context of this research is set within the overarching goal of revitalizing the intricate ties that bind individuals to the land, food, and community.

As we confront an environmental crisis, we also find ourselves in an era of nature deficiency. The convergence of climate change, widespread environmental degradation, and a growing disconnect between people - especially children - and the natural world has created a critical need for innovative solutions. Today's children are growing up with limited direct exposure to the natural environment, a reality that not only impairs their understanding and appreciation of ecological systems but also impacts their physical and mental well-being. This disconnection poses challenges to fostering sustainable practices and cultivating environmental stewardship in future generations.

This thesis is a response to the urgent need for reconnection with the environment by providing a multifunctional space that meets both educational and community needs. The 158,200-square-meter urban farm offers diverse opportunities for learning and community engagement. The academic spaces, both indoor and outdoor, enable students to connect with the natural world in ways that extend beyond traditional classrooms. Featuring themed gardens—such as herb and sensory gardens—the farm functions as living laboratories where students can explore plant biology and sustainable agriculture. Indoor facilities, including teaching kitchens and greenhouses, provide hands-on experiences with the entire food cycle, from cultivation and harvesting to cooking and nutrition, giving students a holistic view of food systems and sustainability.

Complementing the farm, a reimagined Ontario Elementary Curriculum is proposed to support outdoor education. Supported by thoughtfully designed outdoor learning spaces, this curriculum aims to inspire a pedagogical shift that reestablishes nature as a central component of education, encouraging students to reconnect with nature and develop sustainable practices for the future. The design process for this thesis is informed by extensive site research, including multiple visits and seasonal analyses to understand the landscape's evolving conditions. Contextual research on the surrounding area further grounds the design in local environmental and social dynamics. Methodologically, the project draws from case studies of outdoor learning environments, literature on experiential education, and an in-depth analysis of the Ontario Elementary Curriculum to ensure the designed spaces effectively support pedagogical goals. By aligning spatial design with curriculum needs, this thesis develops outdoor environments that actively facilitate hands-on learning, ecological literacy, and community engagement, demonstrating a holistic approach to education and landscape design.

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Land Acknowledgments

I acknowledge that my research and studies take place on the traditional territory of the Neutral, Anishinaabeg, and Haudenosaunee peoples. The University of Waterloo is situated on the Haldimand Tract, the land promised to the Six Nations of the Grand River, which encompasses ten kilometers on each side of the Grand River.

Additionally, the site of my thesis is situated on the traditional lands of the Algonquin, Haudenosaunee, and Wendake-Nionwentsïo peoples. These lands have long been places of gathering, learning, and stewardship, cared for by Indigenous nations since time immemorial.

As my thesis seeks to revitalize the intricate ties that bind individuals to the land, I recognize that these relationships have always been integral to Indigenous ways of knowing, being, and caring for the land. I acknowledge the histories of displacement, the ongoing impacts of colonialism, and the responsibilities that come with engaging in land-based research. I am committed to learning from Indigenous knowledge systems and to fostering a relationship with the land that is rooted in respect, reciprocity, and care.

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01 Introduction

| Pedagogy, Permaculture, and Place-Based Learning

1.1 Background and Context

We are living in a pivotal moment of history, where the accelerating environmental crisis—marked by climate change, habitat destruction, biodiversity loss, and pollution—demands urgent and systemic change. One of the most pressing but often overlooked aspects of this crisis is the increasing disconnect between people and nature. Children today spend less time outdoors than previous generations, a phenomenon Richard Louv describes as 'Nature Deficit Disorder.'[1] With urbanization, digital technology, and structured indoor activities dominating childhood experiences, young learners are losing critical opportunities for sensory and experiential engagement with the natural world. This detachment not only impacts individual well-being but also weakens ecological literacy and the motivation to act in defense of the environment.

This growing disconnect presents a profound educational challenge. If students are not meaningfully engaged with their local ecosystems, they are less likely to develop the intrinsic sense of environmental stewardship. The traditional classroom setting often reinforces this separation by prioritizing indoor, abstract learning over hands-on, place-based experiences. Schools hold enormous potential as transformative sites for environmental reconnection. Given their current role of shaping young minds, they are in the unique position to integrate sustainability into everyday learning experiences. By introducing outdoor education model that immerse students in ecological systems from an early age, schools can cultivate a deeper, more personal relationship with nature.

This thesis proposes an immersive outdoor education model that positions schools as central spaces for ecological reconnection, demonstrating how site-specific, permaculture-driven design can foster sustainable education. By embedding nature-based learning into the core curriculum and creating designed landscapes that function as living laboratories, this model equips students with the tools to understand, appreciate, and actively participate in environmental stewardship. The envisioned project at Swift Waters Elementary School exemplifies this approach, transforming a post-industrial, underutilized site into a dynamic, interactive learning environment that bridges the gap between education and ecological responsibility.

1.2 Project Overview

This work introduces the design of an urban learning farm—a multifunctional learning and food production environment that integrates outdoor education with sustainable agriculture, rooted in permaculture principles. Permaculture is an ecological design approach that applies natural systems to create self-sustaining, regenerative environments.[2] Serving as a living laboratory at Swift Waters Elementary School, the urban learning farm provides students with hands-on experiences in ecological systems, sustainable food production, and environmental stewardship, fostering a deeper understanding of sustainability through experiential learning.

This project aims to achieve two primary goals:

- Designing outdoor learning spaces that foster ecological awareness with experiential engagement
- Promoting local food production as a means to enhance community food security and sustainability

By integrating nature-based learning with agriculture, students will actively engage in growing, harvesting, and understanding food systems. This approach not only strengthens ecological literacy but also cultivates lifelong skills in sustainability, nutrition, and land stewardship. Beyond its role as an educational tool, the urban learning farm will contribute to local food networks by providing fresh, locally grown produce through a market storefront, creating an accessible resource for the broader community.

The Swift Waters Urban Learning Farm is designed to function as both an educational and food production hub, offering a range of interconnected spaces that support ecological literacy and community engagement. Outdoor learning spaces will provide interactive environments where students explore food cultivation, permaculture principles, and ecological restoration. These areas act as dynamic classrooms that reinforce curriculum topics in science, geography, and environmental studies. A covered pavilion will extend learning opportunities beyond indoor settings, creating a flexible and sheltered space for group discussions, seasonal programming, and workshops. Indoor teaching kitchens will further enhance the educational scope by introducing lessons on food preparation, nutrition, and sustainable food systems, strengthening students' understanding of farm-to-table processes and environmental responsibility. The farm will also include a dedicated storefront building where the broader community can purchase fresh produce grown on-site. This space integrates storage, processing, and farm management functions, fostering local food accessibility while supporting sustainable economic models. Agricultural spaces, including diverse gardens, crop fields, and polytunnels, will demonstrate principles of biodiversity, soil health, and climate-resilient farming techniques. These growing areas support curriculum-linked projects and contribute to local food security initiatives.

The urban learning farm is structured to remain an accessible resource throughout the year, ensuring ongoing engagement with both students and the broader community. During school hours, it will serve as an integrated learning environment where students participate in structured activities related to food systems, sustainability, and ecological literacy. These experiences will be curated to align with Ontario Elementary Curriculum expectations, reinforcing key educational concepts through hands-on engagement. Beyond school hours, including evenings, weekends, and summer months, the farm will transition into a community resource, offering fresh produce, seasonal workshops, and public programming focused on sustainability and food production. This model extends the farm's impact beyond the school setting, fostering long-term community involvement while ensuring the site remains a dynamic, multifunctional space.

By merging education, sustainability, and community engagement, the Swift Waters Urban Learning Farm serves as a replicable model for integrating outdoor education with regenerative agriculture. Through the application of permaculture principles, the farm will foster food literacy, ecological awareness, and local food production, demonstrating the potential of urban agriculture as both an educational tool and a community asset.

The selected site presents a unique opportunity to integrate environmental regeneration with education, directly supporting the transition between indoor and outdoor learning. Its adjacency to Swift Waters Elementary School enhances accessibility, reinforcing the potential for a seamless, place-based curriculum that immerses students in hands-on ecological learning. By bridging classroom instruction with direct interaction in a living agricultural environment, the urban learning farm fosters a deeper connection between students and the natural systems that sustain their communities.

Originally designated as a brownfield in 2007 by the City of Brockville, the site carries a legacy of industrial activity that necessitates careful environmental remediation. Formerly home to Phillips Cables Limited, a wire and cable manufacturing facility, the land has remained largely underutilized since the demolition of the factory in 2008. While its industrial past presents challenges—such as soil contamination, compacted ground conditions, and limited biodiversity, it also offers a compelling opportunity to explore regenerative design solutions. This thesis investigates strategies for soil restoration and ecological rehabilitation, recognizing the broader potential of transforming a compromised landscape into a productive agricultural and educational space.

Beyond its role as a learning environment, the urban learning farm has the potential to reconnect the site to the surrounding community. Positioned along the Brock Trail, a well-used pedestrian and cycling route, the farm can serve as a public interface, inviting broader participation in sustainability initiatives, food systems education, and ecological stewardship. Its location within the urban fabric presents an opportunity to demonstrate how previously degraded sites can be reintegrated into city life, fostering social, educational, and environmental resilience. By addressing site-specific constraints through adaptive land stewardship, the project models a scalable approach to urban agriculture that prioritizes both ecological restoration and community well-being.

1.3 Theoretical Frameworks

This project is shaped by two complementary frameworks: outdoor pedagogy and permaculture. Together, they create an immersive, ecologically responsive learning environment, allowing students to engage directly with nature, develop sustainable practices, and cultivate environmental stewardship. By integrating these frameworks, the project moves beyond conventional education models to embrace experiential learning in a living landscape. Outdoor pedagogy fosters curiosity, observation, and active participation, while permaculture ensures that the landscape itself functions as a self-sustaining system, demonstrating ecological principles in practice. This convergence not only deepens students' understanding of natural processes but also instills a sense of responsibility and interconnectedness with the environment. Through this approach, the Swift Waters Urban Learning Farm becomes more than an educational site; it transforms into a model for regenerative design, reinforcing the vital relationship between people, place, and ecological sustainability.

Outdoor Pedagogy and Experiential Learning

Outdoor pedagogy is an educational approach that emphasizes direct interaction with the natural environment. Section 02 elaborates on this framework in further detail. By shifting learning outside of the traditional classroom, students develop a deeper understanding of ecological systems, food production and sustainability through hands-on experiences. The Swift Waters Urban learning farm applies this approach by turning the site into an interactive learning landscape, where students participate in growing food, observing biodiversity, and engaging with regenerative land management practices.

A core component of outdoor pedagogy is place-based education, a concept coined by David Sobel and explored in his text *Place-Based Education: Connecting Classrooms and Communities*. Sobel describes place-based education as a teaching approach that roots learning in the local community and environment, making education more contextual, relevant, and engaging.[3] Pedagogies of place encourage students to be mindful of their location, understanding the ecosystem they inhabit, the human systems intertwined with it, and the intricate networks connecting all actions.[4]

Permaculture as a Design Framework

Permaculture provides the ecological and design foundation for the urban learning farm, ensuring that it functions as both a productive agricultural space and an educational tool. Rooted in the principle of working with, rather than against, nature, permaculture prioritizes biodiversity, resilience, and resource efficiency.[5] By integrating ecological processes into the design, the farm operates as a regenerative system where soil health, water conservation, and biodiversity are actively maintained. This approach enhances agricultural productivity while also reinforcing the farm's role as a living laboratory where students engage directly with ecological cycles, applying principles of regenerative agriculture and closed-loop resource management.

As an educational model, the urban learning farm uses permaculture to demonstrate sustainability in action, offering students hands-on experiences that connect theory with practice. Activities such as composting, companion planting, and rainwater harvesting provide opportunities to learn about ecological interdependence while fostering environmental stewardship. These experiences not only build practical skills but also cultivate a system-thinking mindset, encouraging students to see how small-scale regenerative practices contribute to broader sustainability efforts. By embedding permaculture into the learning environment, the project highlights the importance of adaptation, resilience, and long-term ecological responsibility.

Integrating Outdoor Pedagogy and Permaculture

By combining outdoor pedagogy with permaculture, this project creates a dynamic educational setting where students engage directly with ecological systems and sustainable practices. The farm functions as both a learning environment and an interactive ecosystem, allowing students to apply concepts in real-world contexts. Through hands-on participation in food cultivation, biodiversity observation, and land management, students develop a practical understanding of sustainability and its role in daily life and community resilience.

The integration of these frameworks serves as the guiding structure for both the thesis and the design of the urban learning farm. Outdoor pedagogy informs the educational intent, ensuring that the farm is not just a passive green space but an active learning environment. It shapes decisions about programming, spatial organization, and interactive components that facilitate direct engagement with ecological systems. Meanwhile, permaculture principles drive the site's physical design, determining planting strategies, land use planning, and resource management techniques. The farm is structured to function as a living classroom, where ecological cycles, food systems, and land stewardship practices become tangible, experiential lessons.

These frameworks showcase the thesis's core argument that educational spaces should actively foster connections between students and the natural world. Rather than treating sustainability as an abstract concept, the farm situates it within a daily, lived experience. Students do not just learn about ecological principles; they engage with them directly, observing the impacts of their actions and adapting to changing environmental conditions. This approach challenges conventional schoolyard design, advocating for landscapes that are not merely decorative but deeply functional, regenerative, and interactive.

Through this fusion of outdoor pedagogy and permaculture, the Swift Waters Urban Learning Farm embodies the central themes of the thesis—environmental stewardship, experiential education, and sustainable design. By grounding learning in place-based, ecological engagement, the farm serves as both an educational model and a replicable framework for schools seeking to integrate sustainability into their curriculum and built environment.

1.4 Problem Statement and Rationale

The growing disconnect between younger generations and the natural world is not a new concern. In his memoir *The Thunder Tree*, Robert M. Pyle (1993) described humanity's growing separation from nature as the "extinction of experience," explaining that it involves more than just the loss of personal enjoyment from nature. He argues that this disconnection creates a "cycle of disaffection", where individuals become less inclined to protect or engage with the environment, perpetuating further detachment from nature.[6]

This concern has become increasingly urgent in recent years. In *Last Child in the Woods* (2008), Richard Louv introduced the concept of "Nature Deficit Disorder" to describe the adverse effects of reduced interaction with natural environments, particularly among children.[7] While not a medical diagnosis, this term highlights the consequences of rapid urbanization, screen-based entertainment, and highly structured schedules, all of which limit unstructured time in nature.[8]

In response, research increasingly points to nature-based education as an effective way to bridge this gap. Showing that children who regularly engage with natural settings experience notable improvements in social-emotional functioning and behavioral health, improve academic learning, and ultimately foster increased motivation for learning.[9] Beyond the improvements of personal health and well-being, nature-based education fosters ecological literacy—an understanding of natural cycles, ecosystems, and the principles of sustainability.[10]

By interacting directly with their environment, students develop an intuitive awareness of their role within larger ecological systems, leading to stronger environmental values and more sustainable behaviors. Additionally, in educational settings, nature-based learning has been shown to improve attention span, creativity, and critical thinking skills, as well as foster a stronger connection to environmental issues.[11] Together, these benefits emphasize the importance of nature-based education in nurturing well-rounded, environmentally conscious individuals equipped to address the challenges of a rapidly changing world.

1.5 Thesis Objectives and Questions

This thesis establishes an urban learning farm as an integrated educational model, applying outdoor pedagogy and permaculture principles to create a sustainability-focused learning environment. By reimagining underutilized spaces as dynamic outdoor classrooms, the project demonstrates how site-responsive design and ecological practices can transform education, fostering a deeper connection between students and their environment. By embedding ecological literacy and hands-on food systems education into the school environment, the project aims to bridge the gap between theoretical knowledge and experiential learning. The following objectives guide this study:

Objectives:

- Develop an immersive outdoor learning environment that fosters ecological literacy, regenerative agriculture, and place-based education, assessed through student participation rates and curriculum integration.
- Apply permaculture principles in the design of the farm to create a self-sustaining, resilient landscape that supports biodiversity, soil health, and water conservation
- Promote engagement with local food systems by integrating hands-on participation in food cultivation, harvesting, and distribution, measured through student involvement in farm activities and understanding of food production processes
- Bridge the gap between education and community engagement by creating a shared resource that serves both school-based learning and community use, with impact assessed through community participation and program effectiveness
- Develop a replicable framework for sustainability-focused educational spaces, providing a case study on integrating outdoor learning and food production into school curricula

The primary aim of this project is to design an educational model that integrates nature-based learning with sustainable land use practices. Beyond serving as a teaching tool, this model seeks to instill long-term ecological values, nurturing a generation of students who actively participate in environmental stewardship and community resilience. By cultivating a deeper awareness of natural cycles and the interconnectedness of food systems, students will develop critical thinking skills and ecological literacy that extend beyond the classroom. Additionally, the project aims to encourage local food production, reinforcing the connection between students and the food systems that sustain their community. Through direct interaction with regenerative agricultural practices, students will develop practical skills in land stewardship, food cultivation, and climate-responsive farming methods, equipping them with knowledge applicable in both academic and real-world contexts.

Ultimately, this project strives to eliminate what Deric Shannan calls the "epistemic distance" between people—particularly students—and the origin environment of their food, helping them develop a tangible understanding of the processes involved in sustainable food production, and the healthy ecosystems that support it. By redefining the role of school landscapes, this study positions the urban learning farm as a living laboratory, where sustainability education is embedded into the everyday rhythms of school life, fostering a long-term shift in how students perceive and engage with their environment.

Research Questions

This thesis explores how the design of an urban learning farm can function as both an educational tool and a community resource, integrating outdoor pedagogy and permaculture principles. Central to this investigation are several key questions that shape the project's development and theoretical foundation.

One key inquiry examines how design elements can foster engagement with local food systems in educational settings. This includes analyzing spatial planning strategies, interactive growing spaces, and hands-on food cultivation methods that encourage student participation. In parallel, this study asks how permaculture principles can effectively guide the design of the urban learning farm and its educational spaces, evaluating the role of permaculture zoning, companion planting, and regenerative land management in shaping both pedagogical and ecological functions. Additionally, the study considers the integration of closed-loop systems—including composting, rainwater harvesting, and biodiversity corridors—as essential components of a sustainable learning environment.

To better understand the relationship between space and learning, this research also explores how outdoor education spaces can be designed to support ecological literacy and experiential learning. It proposes spatial opportunities for multisensory experiences, seasonal shifts, and direct engagement with natural systems influence knowledge retention and student engagement. Furthermore, it identifies strategies that foster curiosity, exploration, and environmental responsibility in an outdoor classroom context.

Beyond the school, this thesis considers how an urban learning farm can serve as a shared educational and community resource, balancing the needs of student programming with broader urban food security initiatives. This includes investigating how spatial planning can ensure accessibility for both students and the wider community, creating a model that supports education while contributing to local resilience.

1.6 Significance of Study

This study addresses a critical gap in traditional educational practices by proposing an integrated model that combines nature-based learning with sustainable food production. By developing an urban learning farm closely linked to an elementary school, this project offers a framework for transforming school environments into immersive learning spaces where students can engage directly with ecological and agricultural systems. While there are existing outdoor schools in Ontario, this project would represent the first of its kind within the Upper Canada District School Board, providing a pioneering model for immersive, sustainability-focused education within the district. This model holds potential not only to enrich student learning but also to serve as a blueprint for schools and communities seeking to foster environmental stewardship, promote local food systems, and enhance community engagement through shared, sustainable resources.

This study advocates for embedding environmental ethics directly into educational settings. By integrating sustainable practices and environmental awareness into everyday learning, this model instills a foundational sense of accountability for the natural world. This approach highlights that education should not only convey knowledge but also cultivate an ethical framework that encompasses respect, care, and stewardship for the planet. By embedding environmental ethics within the curriculum, students are encouraged to view themselves as active participants in a broader ecological network, understanding that their choices impact the world around them.

This model reinforces the idea that environmental responsibility is integral to students' personal and social development, not just a separate subject. By positioning ethics as a guiding principle within education, students are prepared to engage with future environmental challenges thoughtfully and responsibly. Ultimately, this project demonstrates that schools play a crucial role in shaping ethically grounded, environmentally individuals who value and prioritize the health of their communities and ecosystems.

1.7 Summary and Thesis Structure

This study proposes an urban learning farm as a model for integrating outdoor education, sustainability, and food systems learning into the elementary curriculum. By applying outdoor pedagogy and permaculture principles, the project reimagines the role of school environments, transforming underutilized spaces into immersive learning landscapes. The farm serves as both an ecological restoration effort and an educational platform, where students engage directly with regenerative agriculture and environmental stewardship.

The research explores how place-based, experiential learning can enhance ecological literacy, bridging the gap between theoretical classroom concepts and real-world application. By embedding sustainability education within the school setting, the project fosters a deeper understanding of food systems, biodiversity, and resource cycles, reinforcing students' connection to their environment.

Thesis Structure

This thesis is structured as follows:

Chapter 2 - Education | Curriculum, Outdoor Learning, and Experiential Pedagogy: This chapter establishes the pedagogical foundation for the study, exploring outdoor education as an experiential learning approach and aligning it with Ontario curriculum standards. It also introduces permaculture as a guiding framework for structuring educational spaces.

Chapter 3 – Permaculture | Ethics, Principles, and Applications: This chapter details the theoretical and applied aspects of permaculture, outlining how its principles support regenerative land use, biodiversity, and sustainability. It further explores how these concepts translate into a design framework for outdoor learning spaces.

Chapter 4 – Site | History, Environmental Context, and Future Use: This chapter examines the Brockville site, its historical industrial use, contamination concerns, and the opportunities and constraints for redevelopment. It provides an in-depth assessment of site-specific conditions, informing the urban learning farm's design.

Chapter 5 – Design Implementation | Structure, Space, and Learning Environments: This chapter presents the reimagined educational landscape, demonstrating how the urban learning farm integrates permaculture-based agriculture with outdoor education. It outlines spatial organization, accessibility, and ecological restoration strategies.

Chapter 6 – Conclusion | Reflection, Adaptation, and Future Potential: The final chapter reflects on the project's findings, evaluating its potential for broader application in urban educational settings. It discusses implementation challenges, long-term maintenance considerations, and opportunities for replication in similar contexts.

Together, these chapters build a comprehensive framework for integrating sustainability education and regenerative land practices into school environments, positioning the urban learning farm as both an ecological restoration initiative and a dynamic educational resource.

Endnotes

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3 David Sobel, Place-Based Education: Connecting Classrooms and Communities, Second edition, Nature Literacy Series (Great Barrington, Massachusetts: Orion, 2013).

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9 Eva Oberle et al., "Support Factors and Barriers for Outdoor Learning in Elementary Schools: A Systemic Perspective," American Journal of Health Education 52, no. 5 (September 3, 2021): 251–65, https://doi.org/10.1080/19325037.2021.1955232.

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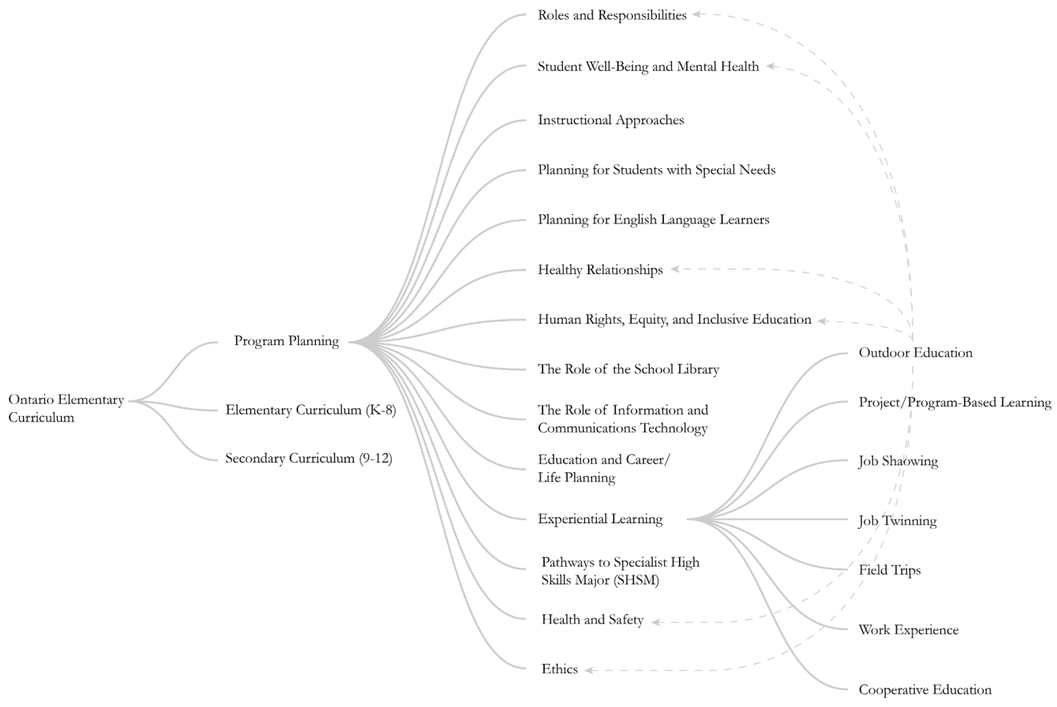


Figure 2. 1 *Ontario Elementary Program Planning flow chart*

2.1 Ontario Elementary Curriculum and Experiential Learning

The Ontario Elementary Curriculum (OEC) provides a structured educational framework for over 4000 schools in the province, setting clear expectations for students from kindergarten to Grade 8.[12] It defines learning objectives across various subjects including Art, French, Health and Physical Education, Language, Mathematics, Native Languages, Science and Technology, Social Studies, and History and Geography. Within each subject, content is further organized into strands, which delineate key areas of focus, ensuring a progressive and comprehensive learning experience.

Beyond subject specific learning, the OEC incorporates a series of Considerations for Program Planning, which outline pedagogical approaches that support diverse learning needs and methodologies. One of these considerations is Experiential Learning, an approach that prioritizes hands-on, inquiry-based education, where students actively engage in real-world contexts to deepen their understanding of core concepts. Experiential learning moves beyond abstract or conceptual learning, allowing students to connect theory to practice and build critical thinking- problem solving, and collaboration skills.

Outdoor Education has already been established by the OEC as an extension of experiential learning. By immersing students in dynamic, outdoor environments, this approach fosters sensory engagement, curiosity, and ecological awareness. Whether through ecological observation, school gardens, or sustainability projects, outdoor education aligns with existing curriculum objectives while providing meaningful, place-based experiences that enhance retention and application of knowledge.

This chapter builds upon the foundational principles of the OEC, advocating for greater integration of outdoor and experiential learning within Ontario's educational framework. The following sections explore how outdoor education aligns with curriculum expectations, common educational practices and present a reimagined approach that demonstrates how specific subjects can be taught through outdoor learning experiences.

2.2 Introduction to Outdoor Education

Outdoor Education is more than just learning outside—it represents a pedagogical shift toward experiential, interdisciplinary and place-based learning. While the Ontario Elementary Curriculum (OEC) recognizes Outdoor Education as a form of Experiential Learning, its educational value extends far beyond traditional curriculum objectives.

Theoretical Foundations of Outdoor Education

Outdoor Education extends beyond learning in nature; it represents a pedagogical shift towards experiential, interdisciplinary, and place-based learning. While the Ontario Elementary Curriculum (OEC) acknowledges Outdoor Education as a form of Experiential Learning, its educational value extends far beyond traditional curriculum objectives. Research indicates that direct engagement with natural environments enhances cognitive development, problem-solving skills, emotional regulation, and ecological literacy, offering a more holistic learning experience.[13]

A foundation for Outdoor Education can be traced to Experiential Learning Theory, developed by David Kolb (1984), which describes how active engagement enhances learning retention. His framework presents a four-stage cycle — concrete experimentation, reflective observation, abstract conceptualization, and active experimentation—that reinforces the importance of hands-on iterative learning.[14] Kolb's model provides a basis for understanding how students learn from direct engagement, reinforcing the value of hands-on, iterative learning alongside traditional instructional methods.

Building on this, David Orr (1992) introduced the concept if Ecological Literacy, arguing that education must equip students with the knowledge, skills, and values necessary to interact responsibly with natural systems.[15] Orr critiques conventional education for its detachment from environmental realities, advocating instead for curricula that embed sustainability, systems thinking, and direct with engagement with nature.[16] While Kolb provides a model for *how* experiential learning occurs, Orr expands on why Outdoor Education should prioritize ecological awareness.

A strong application of Ecological Literacy is seen in Place-Based Learning (PBL), developed by David Sobel (2004), which emphasizes learning within local landscapes. Sobel argues that students form a deeper environmental consciousness when their education is rooted in the specific ecological and cultural context of their communities.[17] His framework suggests that direct interactions with natural and built environments help students understand sustainability, land stewardship, and food systems on a tangible level.[18] By situating learning within meaningful, real-world contexts, PBL strengthens the foundation of ecological literacy that Orr advocates.

Despite the clear benefits of Outdoor Education, modern trends indicate a declining connection between children and the natural world. Richard Louv (2008) coined the term "Nature Deficit Disorder" (NDD) to describe the diminishing time children spend outdoors due to urbanization, structured schedules, and increased screen exposure.[19] He argues that this disconnection negatively impacts children's cognitive, emotional, and physical well-being, reinforcing the urgency of integrating structed Outdoor Education into formal schooling.[20] If students lack informal access to nature, schools must actively facilitate opportunities for direct ecological engagement.

While Louv highlights the issue of nature disconnection, Stephen Schroth (2023) presents a contemporary perspective on how Outdoor Education can bridge this gap through structured pedagogical approaches. Schroth argues that outdoor spaces should not be viewed as occasional learning environments but should be intentionally designed as dynamic classrooms that support creativity, critical thinking, and resilience.[21] His research advocates for embedding Outdoor Education within mainstream curricula, reinforcing its role as a core learning experience rather than an enrichment activity.[22]

Taken together, these theories form a cohesive foundation for Outdoor Education. Kolb explains *how* students learn best through direct experiences, while Orr emphasizes *why* ecological literacy should be a core educational goal. Sobel expands this by demonstrating *where* students learn best—within local environments that make sustainability relevant to their lives. Louv illustrates the *consequences* of disconnection from nature, reinforcing the need for structured outdoor learning. Finally, Schroth advances this discourse by addressing the role of Outdoor Education in curriculum design, arguing that it should be fully integrated rather than treated as supplemental.

2.3 Case Studies: Outdoor Educational Models

Outdoor education takes many forms, from forest schools to school-based farms, each offering unique approaches to experiential learning. Examining established outdoor education models reveals different institutions integrate nature-based learning into their curricula, overcoming challenges and leveraging site-specific opportunities. These case studies highlight successful examples of outdoor learning environments, demonstrating how they support ecological literacy, student engagement, and community involvement.

Each case study is analyzed using a simple framework to ensure consistency and clarity. First, a brief introduction to the project outlines its location, purpose, and key characteristics. Next, the analysis explores how the program successfully implements outdoor education, considering factors such as curriculum integration, learning activities, and site design. Finally, the case study concludes with key takeaways, identifying best practices and potential lessons that can inform the development of the urban learning farm at Swift Waters Elementary School. By examining these models, this section aims to contextualize the broader discussion of outdoor education, showcasing practical applications that reinforce the pedagogical and ecological principles explored in this thesis.

The Edible Schoolyard Project, Berkeley USA

Established in 1995 by chef and food activist Alice Waters, the Edible Schoolyard Project at Martin Luther King Jr. Middle School in Berkeley California transformed a one-acre asphalt lot into an organic garden and kitchen classroom.[23] This initiative aims to integrate garden-based education into the school's curriculum, fostering students' understanding of food systems, ecology, and nutrition.[24]

The Edible Schoolyard is fully integrated into the academic experience of sixth, seventh, and eighth graders, offering approximately 60 classes over three years.[25] In the garden classroom, students engage in hands-on activities such as planting, harvesting, and composting, which reinforce lessons in science and environmental stewardship. The kitchen classroom complements this by allowing students to prepare and share meals, connecting culinary skills with cultural studies and social development. This holistic approach ensures that subjects like literature, biology, and history are experienced through the tangible processes of growing and cooking food.

The success of the Edible Schoolyard Project demonstrates the efficacy of experiential learning in promoting ecological literacy and healthy eating habits among students. Key takeaways include the importance of integrating such programs into the standard curriculum to enhance student engagement and the value of involving the broader community to support and sustain the initiative. Additionally, the project highlights how school gardens can serve as dynamic platforms for interdisciplinary education, connecting academic subjects to real-world applications.

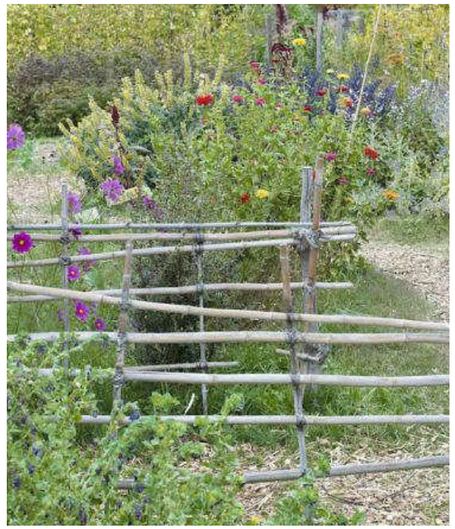


Figure 2. 2 *Garden beds at Edible Schoolyard Berkeley*



Figure 2. 3 *Cooking class at Edible Schoolyard Berkeley*



Figure 2. 4 *Aerial view of garden at Edible Schoolyard Berkeley*

Strawberry Vale Elementary School, BC Canada

Strawberry Vale Elementary School, located in a semi-rural area of Saanich, British Columbia, serves approximately 250 students from kindergarten to grade five.[26] While the school itself has a longer history, its current building, designed by Patkau Architects, was completed in 1996.[27] The school's mission emphasizes environmental stewardship, fostering a community where respect and nature-based learning are integral to the educational experience.[28]

Strawberry Vale integrates outdoor education through its thoughtfully designed campus and diverse nature-based programs. The school grounds feature a Garry Oak meadow, native plant garden, stream, and pond, all serving as dynamic outdoor classrooms. These spaces enable hands-on learning across various subjects, including science, art, and physical education.[29] Teachers employ Project-Based Learning (PBL) methodologies, guiding students through authentic, experiential learning opportunities that connect curriculum outcomes to real-world environmental stewardship. For instance, students engage in activities like monitoring local park conditions, studying indigenous plant use, and participating in the maintenance of native plant gardens.[30]

The success of Strawberry Vale Elementary highlights the importance of integrating environmental education into the core curriculum. Key takeaways include the value of designing school facilities that facilitate interaction with natural surroundings, thereby enhancing student engagement and ecological literacy. The school's collaborative approach, involving partnerships with local municipalities for park stewardship and invasive species removal, highlights the benefits of community involvement in educational initiatives.[31] Additionally, the use of Project-Based Learning fosters critical thinking and a sense of responsibility among students, preparing them to address environmental challenges proactively.

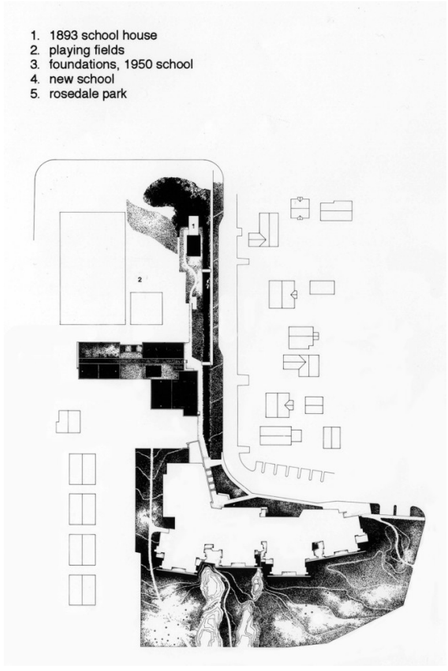


Figure 2. 5 *Site planning drawing Strawberry Vale*

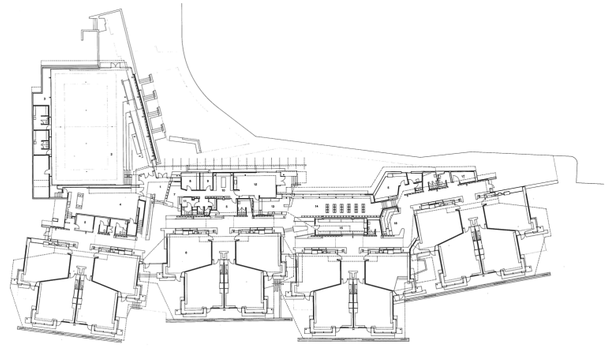


Figure 2. 6 *Strawberry Vale Elementary floor plan*



Figure 2. 7 *Strawberry Vale Elementary image looking onto landscape*

Haus der Waldeulen, Wolfurt Austria

The Haus der Waldeulen (*House of the Forest Owls*) in Wolfurt, Austria, designed by Bernd Riegger Architektur, serves as an immersive outdoor learning environment dedicated to forest education.[32] Completed in 2011, this facility is part of the 'Spielraum Wald' (*Forest Playground*) initiative, which promotes experiential learning and sensory engagement within a natural setting.[33] Rather than a conventional school, the space functions as an ecological learning refuge where children explore the surrounding forest while engaging in structured and unstructured play. Rooted in the principles of the Forest School movement, which originated in Scandinavia and Central Europe, Haus der Waldeulen demonstrates how architecture can support nature-based learning in an ecologically sensitive manner.[34]

The design of Haus der Waldeulen prioritizes direct interaction with the forest through a structure that seamlessly integrates indoor and outdoor learning.[35] The building features an open shelving façade, allowing children to collect, display, and examine natural objects they find in the surrounding landscape. This interactive element transforms the building itself into an evolving learning tool, reinforcing students' engagement with seasonal changes and local biodiversity. Large openings, including a panoramic 'forest view' window, maintain a constant visual and sensory connection to the surrounding trees, fostering a learning environment that remains deeply tied to its natural setting.

The material palette of Haus der Waldeulen enhances its ecological ethos, with locally sourced spruce timber forming both the structural and interior elements.[36] The use of untreated, natural materials strengthens the tactile experience of the space, aligning with forest pedagogy's emphasis on sensory immersion. The design minimizes ecological disruption by using a lightweight foundation system that preserves the natural forest floor, ensuring that the built structure does not sever children's access to the soil, plants, and wildlife that define the space.[37]

Haus der Waldeulen demonstrates how architecture can enhance outdoor education by creating a learning environment that is deeply embedded within the natural landscape. The seamless integration of the built and natural environments fosters curiosity and environmental stewardship, encouraging children to engage with their surroundings on both an intellectual and sensory level. Although not a traditional K-8 school, Haus der Waldeulen provides insights into how architectural strategies can support outdoor education. Its emphasis on materiality, adaptability, and ecological sensitivity offers a model for future educational spaces that seek to balance structured learning with the open-ended possibilities of nature-based exploration.

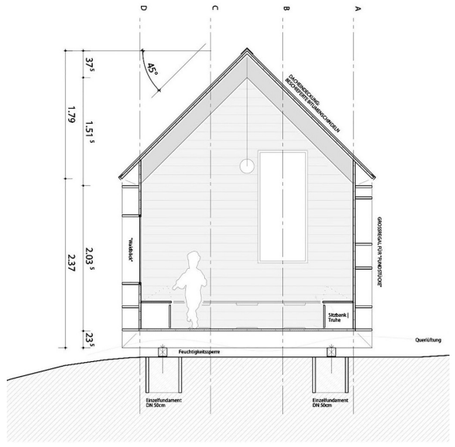


Figure 2. 8 *Haus der Waldeulen section drawing*



Figure 2. 9 *Haus der Waldeulen interior image*



Figure 2. 10 *Haus der Waldeulen exterior image*

2.4 Common Outdoor Educational Practices and Activities

Outdoor education encompasses a diverse range of teaching strategies that leverage natural environments to foster experiential learning. These approaches encourage students to develop ecological awareness, problem-solving skills, and a deeper connection to their surroundings.[38] By engaging in outdoor learning, students gain firsthand experience of ecological systems, reinforcing academic concepts through direct interaction.[39] This section examines common outdoor educational practices and their alignment with curriculum-based objectives.

Sharon Danks, in *Asphalt to Ecosystems: Design Ideas for Schoolyard Transformation*, highlights the value of seasonal and environmental changes in developing student observation and data collection skills. One approach involves tracking how seasonal shifts affect local ecosystems, engaging students in hands-on learning. Activities such as phenology tracking allow students to document changes in weather, plant cycles, and animal behavior over time, fostering an understanding of how organisms adapt to different conditions.[40] Similarly, weather monitoring encourages students to use simple tools like thermometers, rain gauges, and windsocks to track local climate patterns and discuss their broader implications. In addition, comparative studies between urban and natural environments help students analyze how human activities influence ecological systems.[41] These activities integrate well with curriculum areas such as Science and Technology and Climate Education, reinforcing key learning outcomes in environmental awareness and scientific inquiry.

Robin Moore and Herb Wong, in *Natural Learning: Creating Environments for Rediscovering Nature's Way of Teaching*, emphasizes the importance of plant and animal interactions in fostering ecological literacy.[42] From forests to garden beds, they illustrate how direct engagement with diverse species deepens students' understanding of biodiversity, food webs, and ecological relationships.[43] Through pollinator surveys, students observe and document bees, butterflies, and other pollinators, analyzing their role in supporting plant life.[44] Wildlife habitat mapping further expands their understanding by identifying bird nests, animal tracks, and insect shelters, helping students recognize the habitat needs of various species. Additionally, companion planting demonstrations introduce students to mutualistic relationships in plant systems, such as the Three Sisters planting method (corn, beans, and squash), which exemplifies Indigenous agricultural knowledge.[45] These activities align with Life Systems (Science and Technology), Sustainability Education, and Indigenous Knowledge Systems, promoting an integrative approach to ecological literacy.

Güliz Karaarslan-Semiz, in *Outdoor Education for Sustainability with Systems Thinking Perspective*, highlights that outdoor education provides a diverse learning environment, helping students understand the interactions between Earth's systems and fostering a deeper connection with the planet.[46] She emphasizes that cyclic thinking, dynamic thinking, and interrelated feedback loops are essential for grasping sustainability concepts.[47] For example, students explore how water systems function in cycles, how river management impacts entire ecosystems, and how climate change, river systems, and urban development are interconnected.[48] Reflecting this systems-based approach, students also engage with sustainability and human impact, critically assessing how human activities affect the environment while exploring solutions for conservation and regeneration. For example, waste audits prompt students to investigate school waste streams and design reduction strategies through recycling, composting, and repurposing materials.[49] Similarly, rainwater harvesting experiments allow students to set up small-scale rain barrels or bioswales, exploring sustainable water management techniques.[50] Soil health assessments involve testing and comparing soil quality in different locations, analyzing factors such as moisture, compaction, and organic matter content to determine soil vitality and suitability for planting. These activities intersect with Science and Technology, Social Studies, STEM, and climate resilience, fostering an applied understanding of sustainability challenges.

Alice Waters, in *Edible Schoolyard: The Universal Idea*, describes food as a fundamental academic subject, emphasizing that a school's garden, kitchen, and cafeteria should be central to its educational mission.[51] By actively participating in gardening and cooking, students develop their senses, engage more deeply with their studies, and gain a greater awareness of the world around them.[52] Expanding on this perspective, outdoor education supports community and food systems by connecting students with local food networks, cultural traditions, and regenerative agricultural practices. Farm-to-table learning engages students in growing, harvesting, and preparing food, helping them understand the journey from soil to plate.[53] Garden planning and crop rotation introduce students to seasonal planting schedules, incorporating principles of permaculture and traditional farming methods. Furthermore, food justice and local food system mapping encourage students to explore where food is grown, sold, and accessed in their community, prompting discussions on equity and sustainability in food distribution.[54] These activities directly relate to Social Studies and Health and Physical Education, reinforcing place-based learning and community engagement.

By participating in these hands-on sustainability initiatives, students cultivate problem-solving skills, ecological literacy, and a sense of environmental responsibility. These outdoor educational practices naturally intersect with core curriculum areas such as Science and Technology, Geography, Social Studies, and Health and Physical Education, providing interdisciplinary learning experiences that reinforce academic concepts through direct engagement with the environment. The following section will illustrate how these outdoor educational approaches align with Ontario Elementary Curriculum expectations, mapping potential overlaps and reinforcing how outdoor learning can be intentionally embedded within formal educational frameworks.

2.5 Alignment with the Ontario Elementary Curriculum

Outdoor Education can be meaningfully integrated into the Ontario Elementary Curriculum and The Kindergarten Program to enhance experiential learning across multiple subject areas. This section examines how outdoor learning aligns with existing curricular expectations, focusing on Kindergarten, Grade 1 and Grade 6, as representative points in a child's elementary education.

This analysis focuses on Kindergarten, Grade 1 and Grade 6, as they provide a comprehensive spectrum of learning progression within Ontario's elementary education system. Kindergarten serves as the foundation for lifelong learning, emphasizing a play-based and inquiry-driven approach that nurtures children's natural curiosity while addressing their developmental needs holistically.[55] Grade 1 marks the transition to structured, curriculum-based learning, where students begin to engage in more formalized educational experiences, building upon foundational skills with a greater emphasis on literacy, numeracy, and problem-solving.[56][57] By Grade 6, students are refining their critical thinking abilities, ecological literacy, and interdisciplinary connections in preparation for more complex academic exploration in middle school.[58] By analyzing these three grades, this study highlights how outdoor education aligns with existing curricular expectations at different developmental stages, ensuring that experiential learning opportunities are both age-appropriate and pedagogically effective.

By engaging in tangible sustainability initiatives, students develop problem-solving skills, ecological literacy, and a sense of environmental responsibility. These projects provide meaningful ways for students to apply classroom knowledge to real-world sustainability challenges, reinforcing the importance of hands-on, inquiry-based learning.

Based on an analysis of common outdoor educational practices in section 2.4, there is clear potential for alignment with the Ontario Elementary Curriculum. Subjects with the strongest integration potential include:

- Science and Technology: focuses on fundamental science and technology concepts and on science, technology, engineering, and mathematics (STEM) skills.[59]
- Social Studies, History and Geography: focuses on helping students develop a sense of sent and community, a sense of time, and a sense of place.[60]
- Health and Physical Education: focuses on developing mental health and well-being, physical, and health literacy. Along with the comprehension and capacity and commitment they will need to lead healthy, active lives. [61]

Mapping Common Outdoor Education to Curriculum Expectations

Outdoor education easily aligns with curriculum expectations across multiple subjects, fostering experiential learning that deepens student engagement. By integrating outdoor activities into formal education, students develop scientific inquiry skills, explore sustainability concepts, and build a personal connection to place through hands-on experiences. Rather than being treated as an extracurricular or supplementary activity, outdoor education directly supports core curriculum objectives.

This mapping exercise highlights key areas where outdoor learning enhances Ontario's Elementary Curriculum, reinforcing its relevance and instructional value. The curriculum areas selected for mapping are based on direct thematic connections, experiential learning potential, and place-based learning relevance. Subjects such as Science and Technology, Social Studies, and Health and Physical Education contain specific expectations related to environmental awareness, sustainability, and active engagement with outdoor spaces. Outdoor activities provide opportunities for inquiry-based learning, reinforcing key skills such as observation, experimentation, and problem-solving that align with curriculum goals. Additionally, outdoor education grounds learning in a real-world context, allowing students to explore their local environment and connect academic content to their lived experiences.

Figure 2.11 visually represents the extent of overlap between specific curriculum expectations and four key outdoor education categories: Plant and Animal Interactions, Seasonal and Environmental Changes, Community and Food Systems, and Sustainability and Human Impact. Through this mapping analysis, 352 individual learning expectations were identified across Kindergarten, Grade 1, and Grade 6 within Science and Technology, Social Studies, Health and Physical Education, and the Kindergarten program. Of these, 140 expectations—nearly 40%—were found to align directly with outdoor education principles. Of the 140, 27 expectations fall into the Plant and Animal Interactions (*pink*) category, 42 in Seasonal and Environmental Changes (*blue*), 18 in Community and Food Systems (*green*), and 53 in Sustainability and Human Impact (*yellow*).

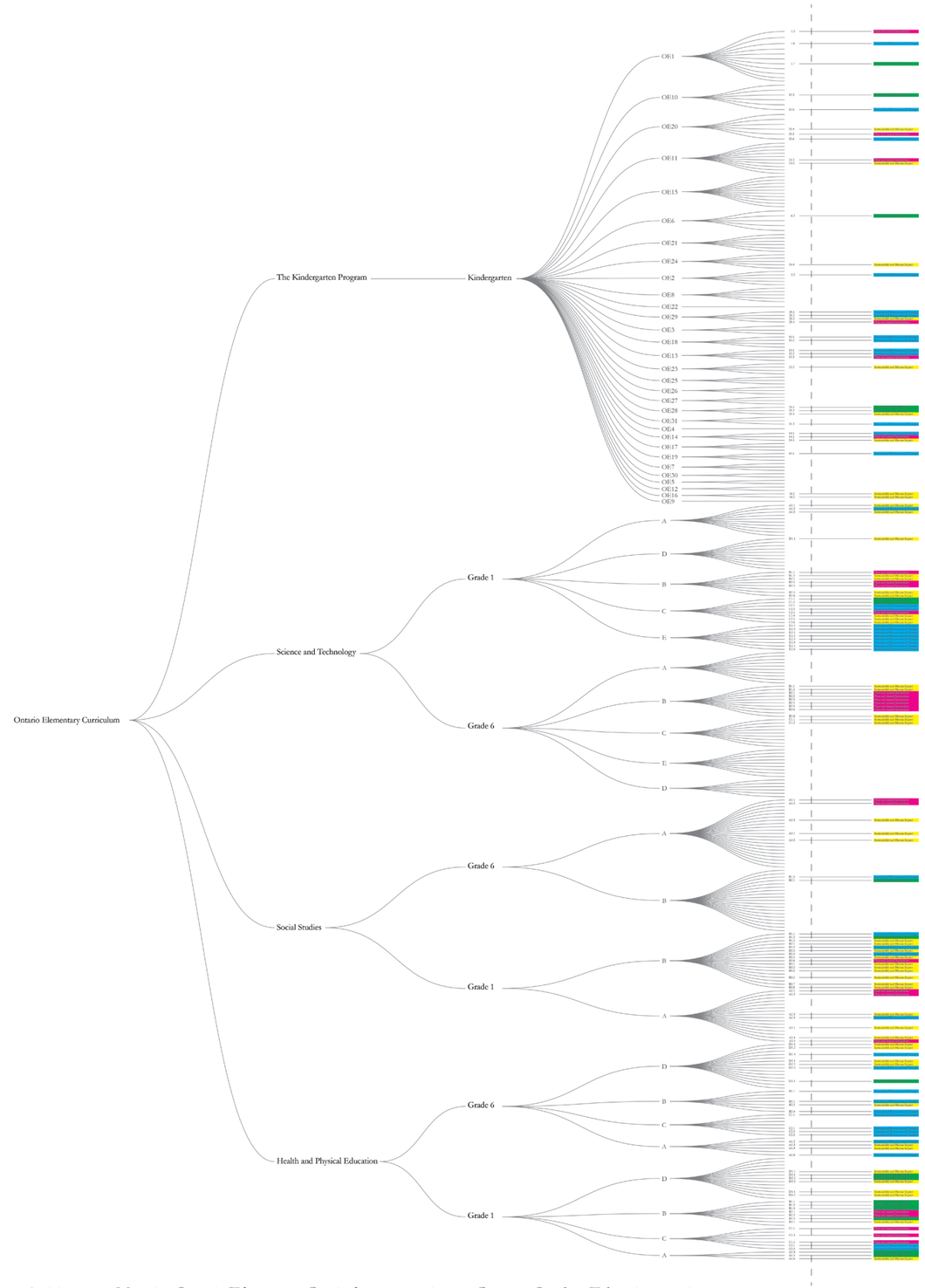


Figure 2. 11 *Mapping Ontario Elementary Curriculum expectations to Common Outdoor Education practices*

Key Takeaways from the Mapping Exercise

This mapping exercise demonstrates the substantial overlap between outdoor education and the existing Ontario Elementary Curriculum. Nearly 40% of learning expectations across the analyzed grade levels and subjects are directly supported by outdoor education principles, reinforcing their integral role in formal learning. The alignment across multiple disciplines suggests that outdoor learning should not be considered an additional or separate program but rather an embedded educational approach that enhances core curriculum delivery.

By identifying these key areas of overlap, this analysis also begins to outline the specific needs that outdoor learning spaces must accommodate. For example, the strong presence of expectations in the "Sustainability and Human Impact" category highlights the importance of designing spaces that facilitate activities such as waste audits, composting, and discussions on local environmental issues. Similarly, the number of expectations related to "Plant and Animal Interactions" suggests that outdoor learning environments should incorporate biodiverse habitats, such as pollinator gardens, food forests, and aquatic ecosystems, to support hands-on ecological observation.

Overall, this mapping exercise not only reaffirms the educational value of outdoor learning but also provides a foundational framework for designing outdoor spaces that effectively support curriculum integration. By aligning site planning and activity design with identified curriculum expectations, the development of outdoor learning environments can be both pedagogically effective and functionally relevant, ensuring that students engage in meaningful, place-based education that directly connects to their formal studies.

Next Steps: Moving Toward a Reimagined Curriculum

While this section establishes the potential alignment between outdoor education and the existing curriculum, the next section, Reimagined Ontario Elementary and Kindergarten Curriculum, explores a structured approach to fully integrating outdoor learning into formal lesson planning.

This reimagined approach builds upon Ontario's established curriculum, shifting learning into an outdoor, experiential setting that enhances environmental literacy, sustainability awareness, and community engagement.

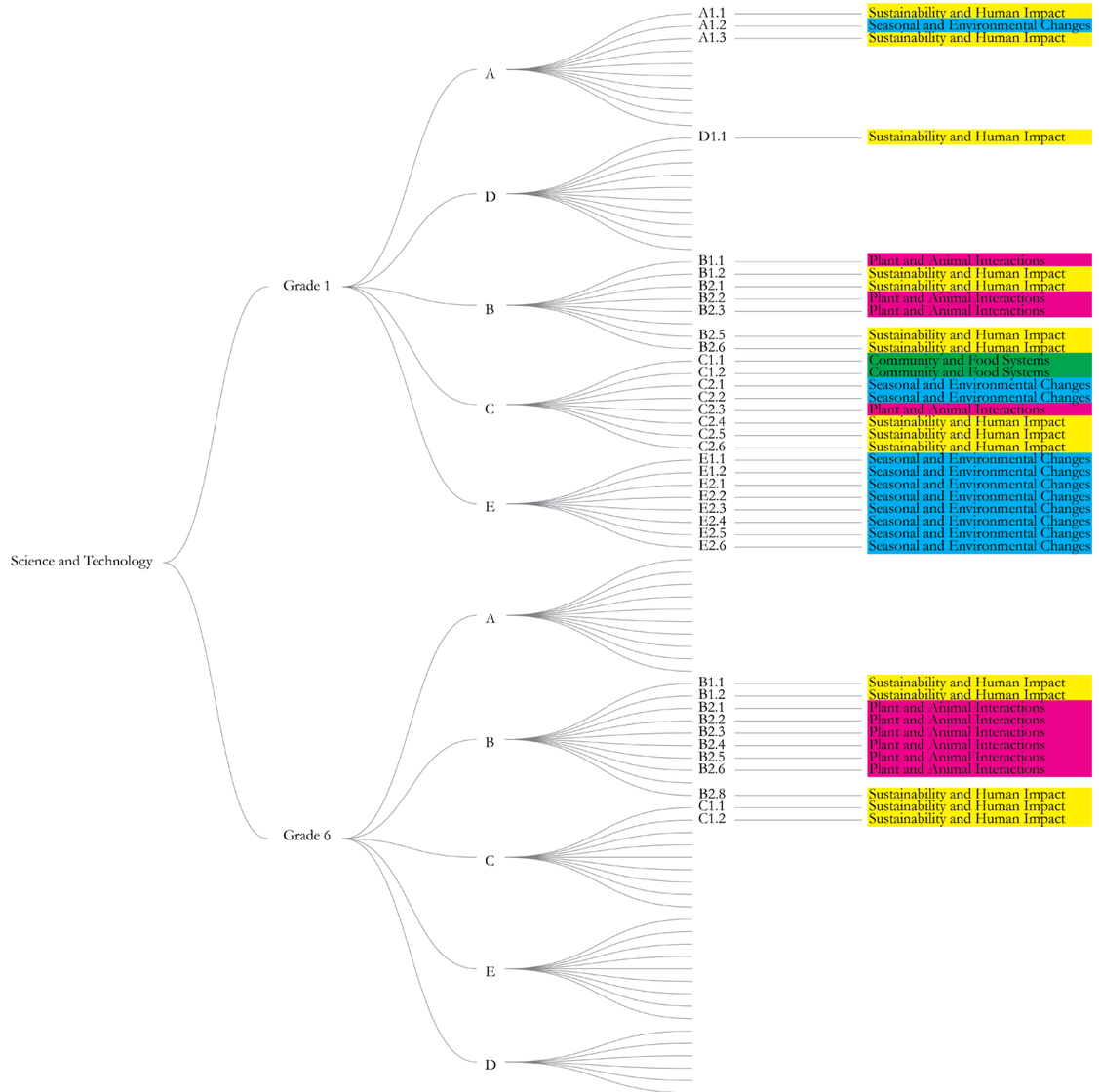


Figure 2. 12 Enlarged section of Figure 2.11, to communicate the flow of information

2.6 Reimagined Ontario Elementary and Kindergarten Curriculum

The Reimagined Ontario Elementary Curriculum (Reimagined OEC) builds upon existing learning standards by fully integrating outdoor and place-based education into the school experience. Designed for Kindergarten, Grade 1 and Grade 6, this approach aligns with current curriculum objectives while relocating learning to the urban learning farm environment and surrounding landscape. Through hands-on activities, students engage directly with plant biology, sustainability, ecological systems, and community-based food networks, reinforcing experiential learning as a core pedagogical tool.

By shifting select lessons outdoors, the Reimagined OEC seeks to deepen students' engagement with real-world environmental challenges, sustainability practices, and systems thinking, encouraging them to engage with the land in a meaningful way. This shift also nurtures a sense of environmental responsibility, allowing students to connect abstract classroom concepts to their lived experiences through direct interaction with natural systems. While some subjects align naturally with outdoor education, others demonstrate flexibility in incorporating outdoor learning elements where possible. To ensure that outdoor learning is embedded throughout the academic year, educational activities are structured seasonally, aligning with natural cycles, agricultural rhythms, and ecological changes. This seasonal approach reinforces the importance of cyclical processes in both nature and human systems, helping students recognize patterns in ecological changes, climate variations, and plant life cycles. This framework not only reinforces long-term environmental awareness but also ensures that students develop a deep, firsthand understanding of nature's processes through continuous engagement.

Subjects Best Suited for Outdoor Learning

As outlined in Section 2.4, certain subjects naturally lend themselves to outdoor education, making them key areas of focus within the Reimagined OEC. Science and Technology benefit from direct engagement with natural systems, fostering hands-on exploration of ecosystems, biodiversity, and sustainable agriculture. Students can observe ecological succession in action, conduct soil quality tests, or experiment with regenerative farming techniques to understand sustainability at a practical level. Health and Physical Education align with outdoor learning by encouraging movement-based activities, sensory experiences, and food literacy initiatives. Beyond structured physical activities, outdoor settings provide opportunities for mindfulness exercises, balance and coordination challenges, and nature-based cooperative games that foster both mental and physical well-being. Social Studies offers opportunities to examine land use, environmental responsibility, and Indigenous knowledge systems in a real-world context. By studying how communities interact with the land, students can critically engage with questions of sustainability, resource management, and cultural relationships to place. By integrating these subjects into outdoor education, the curriculum supports experiential learning that enhances both academic understanding and ecological awareness.

Subjects with Outdoor Learning Potential

While these subjects are traditionally taught indoors, outdoor education adds flexibility to certain lessons, reinforcing place-based learning. These include:

- The Arts: Students engage with visual arts, music, dance, and storytelling using the natural environment as inspiration. Activities include landscape drawing, sculpture with natural materials, movement inspired by ecological cycles, and site-specific performances. Outdoor environments also provide opportunities for environmental art installations, ephemeral sculptures using found natural materials, and storytelling circles that emphasize oral traditions and cultural narratives.

- Language: Nature journaling, outdoor reading spaces, and creative writing exercises inspired by direct engagement with the farm's landscape cultivate literacy skills while strengthening students' connection to place. Poetry inspired by the sensory details of nature, reflective writing on seasonal changes, and discussions around Indigenous storytelling traditions enhance language learning through immersive experiences.

- Mathematics: The outdoor environment serves as a living laboratory for measurement, estimation, data collection, and pattern recognition. Students calculate plant growth rates, estimate harvest yields, measure garden plots, and explore geometric principles in nature. Data visualization exercises using weather tracking, biodiversity counts, and ecological mapping further reinforce mathematical reasoning skills.

- Native Languages: Provides opportunities for land-based learning, incorporating Indigenous languages in connection with traditional ecological knowledge, place-based storytelling, and cultural teachings about plants, animals, and land stewardship. Through activities such as learning plant names in Indigenous languages, exploring seasonal ecological indicators, and participating in oral histories, students build deeper cultural and linguistic connections to the land.

Subject	Common Outdoor Educational Practice	Expectation Code	OEC Description	Month	Example Activity
Problem Solving and Innovating	Sustainability and Human Impact	OE24.4	select and use tools, equipment, and materials to construct things	October	"Building Bug Homes" – Students will use natural and recycled materials, such as sticks, leaves, pinecones, and cardboard tubes, to construct small shelters for insects like ladybugs and bees. They will learn how these bug homes help beneficial insects find shelter as the seasons change. After placing their bug homes around the farm, students will observe and discuss how their creations support tiny creatures, reinforcing the idea of caring for nature through hands-on building.
"Demonstrating Literacy and Mathematics Behaviours"	Sustainability and Human Impact	OE11.6	use prior knowledge to make connections to help them understand a diverse range of materials read by and with the educator team	November	"Stories of the Land: Connecting to Nature Through Books" Students will listen to a read-aloud of a picture book related to sustainability, farming, or Indigenous perspectives on the land. After the reading, they will discuss connections between the story and their own experiences on the urban farm. Educators will guide students in making personal connections, such as recognizing familiar plants, animals, or farming practices. To reinforce their learning, students will create a simple drawing or collage representing a part of the story that reminds them of something they've seen or done on the farm.
Belonging and Contributing	Sustainability and Human Impact	OE28.3	develop an awareness of ways in which people adapt to the places in which they live	January	"Winter Readiness: How People Adapt to the Cold" Students will explore how people adapt to winter conditions by discussing clothing, shelter, food, and activities that help them stay warm and safe. They will compare their winter clothing (mittens, hats, scarves) to what they wear in warmer months and engage in a hands-on activity where they dress life-size cutouts in seasonal clothing. Educators will introduce real-life examples, such as how farmers continue working in winter (using greenhouses, storing food), and students will experiment with insulation by wrapping objects in different materials to test which keeps them the warmest. This activity helps students understand how humans modify their behaviors and surroundings to adapt to seasonal changes.
Problem Solving and Innovating	Plant and Animal Interactions	OE14.2	sort and classify groups of living and nonliving things in their own way	February	""Winter Survivors and Sleepers" Students will take a guided walk around the farm in winter to observe and classify which plants are still alive and which have gone dormant until warmer seasons return. They will look for evergreen trees, hardy winter vegetables, and any signs of plant life that persist despite the cold. Using simple sorting methods, they will group plants into ""Winter Survivors"" (plants that stay green or continue growing) and ""Sleepers"" (plants that lose their leaves or die back in winter but regrow in spring). Afterward, students will discuss their findings and create a simple visual chart or collage showing their plant classifications. This activity helps students develop observation and classification skills while reinforcing the idea that plants have different strategies for surviving seasonal changes.
"Demonstrating Literacy and Mathematics Behaviours"	Seasonal and Environmental Changes	OE19.1	ask questions that can be answered through data collection, collect data, and make representations of their observations, using graphs	March	"Spring Sprouts: Tracking Growth in the Garden" – Students will plant seeds in different areas of the farm and make predictions about their growth. They will observe the changes over time, recording their findings by using simple pictorial graphs (e.g., drawing how tall the plants are each week). Through guided discussions, they will compare growth patterns and talk about what plants need to thrive, fostering curiosity about seasonal environmental changes and early data collection skills.

Figure 2. 13 Ontario Elementary Curriculum "reimagined" for outdoor learning in a Kindergarten Class (1)

Subject	Common Outdoor Educational Practice	Expectation Code	OEC Description	Month	Example Activity
Problem Solving and Innovating	Seasonal and Environmental Changes	OE13.2	make predictions and observations before and during investigations	April	"Farm Weather Watch: Predicting and Observing Seasonal Changes" – Students will visit the urban farm and make predictions about the weather and how it might affect the plants, animals, and environment. They will observe the sky, temperature, wind, and any changes in the garden (such as leaves falling, plants wilting, or soil becoming damp). Throughout the day, they will compare their predictions to what actually happens and discuss how seasonal changes impact farm life. This activity builds curiosity and early scientific thinking skills.
Belonging and Contributing	Plant and Animal Interactions	OE29.4	participate in environmentally friendly experiences in the classroom and the schoolyard	April	"Nature Helpers: Taking Care of Our Farm" – Students will engage in simple, environmentally friendly activities around the urban farm, such as watering plants, picking up litter, and gently observing insects without disturbing them. They will learn how small actions help care for nature and discuss why it is important to be kind to plants and animals. This hands-on experience fosters a sense of responsibility and belonging in their outdoor learning space.
Self-Regulation and Well-Being	Community and Food Systems	OE6.2	investigate the benefits of nutritious foods and explore ways of ensuring healthy eating	May	"Rainbow Picnic: Eating the Colors of the Farm" – Students will explore the urban farm to find fruits and vegetables of different colors, learning about how eating a variety of foods helps keep them strong and healthy. They will participate in a "Rainbow Picnic," where they taste different farm-grown produce and sort foods by color. Afterward, they will create a "My Healthy Plate" collage using cutouts of different foods, reinforcing the importance of balanced and nutritious eating.
Problem Solving and Innovating	Plant and Animal Interactions	OE20.5	investigate and describe how objects can be collected, grouped, and organized according to similarities and differences	June	" Sorting Farm Discoveries " – Students will explore the urban farm to collect natural objects such as leaves, seeds, rocks, and flowers. They will work together to sort these items based on similarities and differences, such as color, shape, texture, or size. Through hands-on play, they will describe their observations and discuss why different plants and animals have unique characteristics. This activity will help develop early classification skills while encouraging curiosity about the natural world.
Belonging and Contributing	Seasonal and Environmental Changes	OE29.1	identify similarities and differences between local environments	June	"Exploring Our Changing Farm" – Students will take a guided walk around the farm and compare different areas, such as the garden beds, the greenhouse, and a natural grassy space. They will observe how each space looks, feels, and functions differently. Through simple prompts, they will describe what they see—Are the plants growing? Is the ground soft or hard? Where do they hear birds? After the walk, they will create a group collage using natural materials from each area to visually represent the different environments on the farm.

Figure 2. 14 Ontario Elementary Curriculum "reimagined" for outdoor learning in a Kindergarten Class (2)

Subject	Common Outdoor Educational Practice	Expectation Code	OEC Description	Month	Example Activity
Health and Physical Education	Community and Food Systems	D2.1	describe how Canada's Food Guide can help them develop healthy eating habits	September	Example Activity: "Harvest to Table: Exploring Canada's Food Guide" – Students will explore the urban farm and learning landscape, identifying fresh produce that aligns with the recommendations in Canada's Food Guide. They will harvest seasonal fruits and vegetables, discuss food group proportions, and learn about how locally grown food contributes to a balanced diet. The activity will conclude with a hands-on food preparation experience, such as making a fresh salad or smoothie using harvested ingredients, reinforcing the connection between healthy eating and food accessibility.
Social Studies	Sustainability and Human Impact	B1.3	create a plan that outlines some specific ways in which they can responsibly interact with the built and/or natural environment in the local community, and describe how their actions might enhance the features of the local environment	September	"Caring for Our Outdoor Classroom: Creating a Responsibility Plan" – Students will work together to create a simple responsibility plan for taking care of the urban farm and learning landscape. They will discuss ways to respect and protect nature, such as picking up litter, staying on pathways, watering plants, and being gentle with insects and animals. Using pictures and simple words, they will develop a classroom poster outlining their plan, reinforcing the idea that small actions can help make their environment a better place for everyone.
Art	Seasonal and Environmental Changes	D1.1	create two- and three-dimensional works of art that express feelings and ideas inspired by personal experiences	October	Example Activity: "Autumn Farm Impressions" – Students will explore the farm during peak fall foliage, observing the changing colors, textures, and seasonal shifts. Using natural materials collected from the site (leaves, twigs, soil pigments), they will create two- and three-dimensional artworks, such as leaf rubbings, soil-based paintings, or small land art sculptures that reflect their personal experience of autumn on the farm. They will then share their work and discuss how the farm's seasonal changes inspire their artistic expression.
Mathematics	Seasonal and Environmental Changes	C1.1	identify and describe the regularities in a variety of patterns, including patterns found in real-life contexts	October	"""Pattern Hunt in the Garden"" – Students will explore the urban farm to identify and document patterns in nature, such as the arrangement of leaves, spirals in sunflowers, symmetry in plant growth, and seasonal planting cycles. They will sketch or photograph the patterns they find and then discuss how these patterns help plants grow and thrive. The activity will conclude with a hands-on exercise where students create their own repeating patterns using natural materials like seeds, leaves, and stones.
Language	Community and Food Systems	A3.2	demonstrate an understanding of the contributions, lived experiences, and perspectives of a diversity of individuals and communities, including those in Canada, by exploring the concepts of identity, self, and sense of belonging in culturally responsive and relevant texts	November	"Storytelling and Food Traditions" – Students will explore culturally relevant texts that highlight food traditions from diverse communities in Canada, including Indigenous, immigrant, and local farming histories. They will then engage in a storytelling session at the urban farm, where they share personal or family food traditions. The activity will conclude with a collaborative reflection where students create a visual or written piece illustrating how food connects people to culture, identity, and a sense of belonging.

Figure 2. 15 Ontario Elementary Curriculum "reimagined" for outdoor learning in a Grade 1 Class (1)

Subject	Common Outdoor Educational Practice	Expectation Code	OEC Description	Month	Example Activity
Science and Technology	Plant and Animal Interactions	B2.6	describe ways in which living things provide for the needs of other living things	December	"Winter Wildlife: Helping Animals in Cold Weather" – Students will explore the urban farm to look for signs of animal activity in winter, such as tracks in the snow, burrows, or birds searching for food. They will learn about how different animals adapt to the cold—some migrate, some hibernate, and others stay active. As a hands-on activity, they will make simple bird feeders using pinecones, sunflower seeds, and nut-free peanut butter, which they will hang around the farm to support local wildlife. This activity teaches students about the ways living things provide for one another, even in the colder months.
Science and Technology	Seasonal and Environmental Changes	E2.1	demonstrate an understanding of Earth's relationship to the Sun and that this relationship results in daily and seasonal changes on Earth	December	"Tracking the Sun: How Light Changes in Winter" – Students will measure shadows at different times of the day to observe how the sun's position changes in winter. Using simple tools like sticks or chalk markings, they will track the length of shadows and discuss how this relates to the Earth's tilt and the shorter daylight hours of winter. This activity helps them understand seasonal shifts in daylight and their impact on plants, animals, and humans.
Social Studies	Sustainability and Human Impact	B2.5	evaluate evidence and draw conclusions about some aspects of the interrelationship between people and natural and built features of their local community, and some of the effects of this interrelationship	February	"Winter Noticing Walk: Observing Seasonal Changes" – Students will explore the urban farm and learning landscape to observe how the environment changes in winter. They will look for signs of the season, such as bare trees, snow-covered garden beds, and animal tracks, and discuss how plants, animals, and people adapt to colder weather. Using simple prompts, they will compare their observations to previous seasons and reflect on how living things respond to environmental changes. After the walk, students will create a "Winter Change" drawing to share their observations, fostering awareness of seasonal shifts in nature.
Native Languages	Sustainability and Human Impact		demonstrate basic communication skills by participating in simple activities	March	"Seasonal Changes and Traditional Language" – As winter transitions into spring, students will explore the farm and identify signs of seasonal change, such as budding plants, migrating birds, or changes in daylight. Using a Native language, they will practice basic communication skills by learning the names these natural elements and describing their observations. This activity connects language learning with environmental awareness and Indigenous knowledge of seasonal cycles.
Mathematics	Plant and Animal Interactions	D1.2	collect data through observations, experiments, and interviews to answer questions of interest that focus on a single piece of information; record the data using methods of their choice; and organize the data in tally tables	April	"Pollinator Count & Data Collection" – Students will observe different pollinators (bees, butterflies, and other insects) visiting flowering plants on the urban farm. They will record their observations in tally tables, tracking the number of pollinators spotted in different areas and at different times of the day. After collecting data, students will analyze their findings and discuss what factors (such as plant variety, time of day, or weather) may influence pollinator activity. This activity connects math skills with ecological awareness.

Figure 2. 16 Ontario Elementary Curriculum "reimagined" for outdoor learning in a Grade 1 Class (2)

Subject	Common Outdoor Educational Practice	Expectation Code	OEC Description	Month	Example Activity
Science and Technology	Sustainability and Human Impact	B1.2	identify actions that can be taken to contribute to a healthy environment	April	"Lunch Scraps to Soil" – Students will bring compostable food scraps from their lunches and learn how to properly sort organic waste. They will contribute their scraps to the farm's compost system, observe the decomposition process, and discuss how composting reduces waste and enriches soil. A brief demonstration on how to create a small compost system at home will reinforce the lesson.
Social Studies	Plant and Animal Interactions	A3.5	demonstrate an understanding that it is important to treat other people and the environment with respect	April	"Reciprocity in Action: Preparing Habitat Spaces for Pollinators" – Students will learn about the importance of reciprocity in nature—how caring for the environment supports both human and non-human life. They will prepare habitat spaces for pollinators by constructing bee hotels, planting native wildflowers, or creating small brush piles for beneficial insects. This hands-on experience reinforces the importance of respecting and supporting biodiversity.
Native Languages	Sustainability and Human Impact		read a variety of simple written texts	May	"Storytelling in the Garden" – Students will gather in a shaded area of the urban farm to read and discuss simple written texts related to sustainability, traditional ecological knowledge, and Indigenous perspectives on land stewardship. They will then reflect on the readings and discuss how these ideas apply to the farm's environment, reinforcing the connection between language, sustainability, and cultural knowledge.
Art	Plant and Animal Interactions	C2.1	"express initial reactions and personal responses to musical performances in a variety of ways"	May	Example Activity: "Soundscapes of the Farm" – Students will sit in different areas of the farm (near plants, animals, water sources) and listen to the natural sounds. Afterward, they will respond by creating a movement piece or mimicking sounds using natural materials (e.g., tapping sticks, rustling leaves). They will then discuss how different elements of nature contribute to the "music" of the farm and how this makes them feel.
Health and Physical Education	Community and Food Systems	D2.2	"know and recognize cues to hunger, thirst, and the feeling of fullness, and explain how they can use these cues to develop healthy eating habits"	June	"Mindful Eating in the Garden" – Students will engage in a guided mindfulness exercise in the urban farm, focusing on recognizing their body's natural hunger and thirst cues. They will participate in a taste-testing activity, where they eat freshly harvested foods (e.g., tomatoes, cucumbers, apples) and describe how their body responds to different textures and flavors. The discussion will include how hydration and balanced meals contribute to well-being, and students will track their personal cues over the course of the day.

Figure 2. 17 Ontario Elementary Curriculum "reimagined" for outdoor learning in a Grade 1 Class (3)

Subject	Common Outdoor Educational Practice	Expectation Code	OEC Description	Month	Example Activity
Health and Physical Education	Community and Food Systems	D3.1	"explain how healthy eating and active living work together to improve a person's overall physical and mental health and well-being and how the benefits of both can be promoted to others"	September	"Fueling Our Bodies: Exploring Healthy Eating and Movement" – Students will begin by exploring the urban farm, identifying fresh, locally grown foods that contribute to a balanced diet. They will discuss how different nutrients support physical and mental well-being and compare these with processed or fast foods. Next, they will engage in a movement-based activity, such as a relay challenge or a farm scavenger hunt, to highlight the connection between nutrition and energy levels. After the activity, students will reflect on how food choices impact performance, mood, and overall health.
Language	Community and Food Systems	A3.3	explain themes explored in First Nations, Métis, and Inuit cultures to demonstrate an understanding of the varied identities, perspectives, relationships, legacies, truths, and ways of knowing, being, and doing	October	"Roots of Identity: Land, Culture, and Belonging" – Students will explore culturally responsive texts that highlight how First Nations, Métis, and Inuit communities, as well as immigrant groups, have formed relationships with the land for survival, farming, and cultural preservation. Following a guided walk around the urban farm, students will reflect on how different cultural traditions influence agricultural practices, food systems, and community-building.
Social Studies	Sustainability and Human Impact	A2.3	analyse and construct print and digital maps as part of their investigations into different perspectives on the historical and/or contemporary experience of communities, including First Nations, Métis, and/or Inuit communities, in Canada	November	Mapping Histories: Indigenous Perspectives on Land and Community" – Students will investigate the historical and contemporary experiences of First Nations, Métis, and Inuit communities through map analysis and creation. They will begin by exploring different types of maps that reflect Indigenous histories, such as traditional territories, relocation maps, or thematic maps showing the impact of historical events on Indigenous communities.
Science and Technology	Sustainability and Human Impact	B1.1	assess the benefits of biodiversity and the consequences of the diminishing of biodiversity	December	"Winter Biodiversity: How Nature Adapts" – Students will investigate how plants and animals survive in winter by exploring winter crops, hibernation strategies, and cold-weather farming techniques (e.g., greenhouse growing, overwintering crops. They will compare dormant vs. active plant life, explore adaptations in farm animals, and discuss how biodiversity helps ecosystems survive extreme conditions.

Figure 2. 18 Ontario Elementary Curriculum "reimagined" for outdoor learning in a Grade 6 Class (1)

Subject	Common Outdoor Educational Practice	Expectation Code	OEC Description	Month	Example Activity
Art	Sustainability and Human Impact	D1.4	use a variety of materials, tools, techniques, and technologies to determine solutions to design challenges	April	"Sustainable Creations: Art Inspired by the Land" – Students will explore the urban farm and collect natural and repurposed materials to use in a mixed-media art piece that reflects themes of sustainability and human impact on the environment. They will experiment with techniques such as making plant-based dyes, creating textural collages using found objects, or constructing sculptures from repurposed farm materials.
Language	Sustainability and Human Impact	A3.2	demonstrate an understanding of the historical contexts, contributions, lived experiences, and perspectives of a diversity of individuals and communities, including those in Canada, by exploring the concepts of identity, self, and sense of belonging in a variety of culturally responsive and relevant texts	April	"Sustainability in Stories: Indigenous Teachings on Stewardship" – Students will engage with culturally relevant texts that highlight Indigenous perspectives on sustainability and land stewardship. After reading or listening, they will explore the urban farm, examining sustainable practices such as composting, crop rotation, and seasonal planting through the lens of traditional ecological knowledge. In small groups, students will create a collaborative piece focusing on environmental responsibility and their personal connections to sustainable practices.
Health and Physical Education	Community and Food Systems	D3.1	"explain how healthy eating and active living work together to improve a person's overall physical and mental health and well-being and how the benefits of both can be promoted to others"	May	""The Power of Plants: How Food Fuels Our Bodies"" Students will begin by exploring the urban farm with a ""nutrient detective"" challenge, where they identify different fruits, vegetables, and grains and match them to the nutrients they provide. Next, they will engage in a hands-on food transformation activity, where they learn about different ways to prepare and preserve farm-fresh produce. This could include dehydrating herbs, making infused water, or preparing simple fermented foods like quick-pickled vegetables.
Science and Technology	Plant and Animal Interactions	B2.2	demonstrate an understanding of biodiversity as the diversity of life on Earth, including the diversity of organisms within species, among species in a community, and among communities and the habitats that support them	May	"Connections in Nature: How Plants and Animals Support Each Other" – Students will explore the urban farm to observe and document the relationships between plants and animals. They will investigate pollinators visiting flowers, birds feeding on seeds, decomposers breaking down organic matter, and how different plants provide shelter or food for various species. Working in small groups, they will create "interaction maps" that illustrate these relationships, showing how species depend on each other for survival.
Health and Physical Education	Sustainability and Human Impact	D2.1	apply their knowledge of medical, emotional, practical, and societal factors that influence eating habits and food choices to develop personal guidelines for healthier eating	June	"Farm to Table: Tasting the Benefits of Healthy Eating"" Students will explore the urban farm, identifying fresh, locally grown foods and discussing how they contribute to a balanced diet. They will examine different food groups, nutrients, and their roles in maintaining physical and mental well-being, comparing these with processed or fast foods. Next, they will participate in a ""Harvest & Taste"" activity, where they select seasonal ingredients directly from the farm. Working in groups, students will prepare a simple farm-fresh dish, such as a salad, a fruit and herb-infused water, or a vegetable wrap.

Figure 2. 19 Ontario Elementary Curriculum "reimagined" for outdoor learning in a Grade 6 Class (2)

Conclusion

The Reimagined OEC positions outdoor education as a core component of learning, demonstrating its interdisciplinary potential and adaptability across subjects. By embedding outdoor education into multiple disciplines, this curriculum model moves beyond conventional classroom structures to create a more immersive, dynamic, and participatory learning experience. By balancing fully integrated subjects with flexible learning opportunities, this model creates a dynamic educational experience that fosters ecological literacy, problem-solving, and environmental stewardship. This approach also helps cultivate a lifelong relationship between students and the land, ensuring that they not only acquire knowledge but also develop a sense of responsibility and care for their environment.

As a direct outcome of this curricular model, the design of the urban learning farm is shaped to support year-round outdoor education. By identifying the types of formal outdoor learning activities that could take place—such as observation, exploration, gathering, growing, reflecting, and restoring—the Reimagined OEC provides a clear framework for determining the spatial needs of the site. In this way, pedagogy and design are developed in tandem, ensuring that the farm is both educationally grounded and experientially rich, with spaces that actively support the curriculum and enhance student engagement with the land.

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3.1 Permaculture: Definition and Overview

"*Permaculture is a direction, not a destination.*"[62]

Permaculture is a sustainable design system that integrates ecological principles to create resilient, regenerative environments.[63] Initially developed as a method for permanent agriculture – focused the use of perennial plants – permaculture has since evolved into a comprehensive design approach to food systems, landscapes, urban planning, education, and community development.[64] It promotes closed-loop systems, where resources are cycled efficiently, mimicking natural ecosystems to support long-term sustainability.

The term *permaculture* was first introduced by Bill Mollison and David Holmgren in their book *Permaculture One (1978)*, initially focused on perennial plant-based agriculture. Mollison later expanded the concept in *Permaculture: A Designer's Manual* (1988), framing it as a design philosophy that extends beyond farming to include land management, settlement planning, and ecological restoration, accompanied by an ethics of care.[65] Holmgren's *Permaculture: Principles and Pathways beyond Sustainability* (2002) further developed this framework, reinforcing permaculture as a holistic approach to sustainable living that imitates patterns and relationships observed in natural ecosystems, resulting in plenty of food, materials, and energy for local needs.[66]

Permaculture stands apart from other sustainable agricultural models due to its emphasis on design thinking. Unlike traditional farming methods that focus on productivity, permaculture adapts to diverse environments—from rural landscapes to urban learning farms, school gardens and community projects. It prioritizes working with nature rather than against it, integrating water cycles, soil regeneration, biodiversity and renewable energy into a self-sustaining system. This adaptability makes permaculture a powerful framework for educational and community initiatives, where ecological literacy and hands-on sustainability practices can be directly applied in real-world contexts.

Permaculture has been widely adopted in both educational settings and community-driven projects as a framework for sustainability, food systems education, and environmental stewardship. Some schools have implemented permaculture-based gardens and outdoor learning spaces to engage students in hands-on learning. A notable example is the Edible Schoolyard Project in Berkeley, California, where students participate in growing, harvesting, and preparing food, connecting academic subjects to real-world sustainability practices. [67]

Beyond school-based applications, permaculture has also been successfully implemented in community-led projects that address urban food security, climate adaptation, and ecosystem restoration. One notable example is the Beacon Food Forest in Seattle, Washington, a public food forest designed using permaculture principles. This project transforms urban land into a multi-layered, regenerative food system that produces free food for the community, all while restoring native ecosystems.[68] By applying permaculture techniques, the Beacon Food Forest exemplifies how permaculture can be scaled up to serve a broader community, creating resilient landscapes that can support both people and the environment.

The success of such initiatives demonstrates permaculture's adaptability across different contexts—from formal education to grassroots urban agriculture. As a regenerative design framework, permaculture serves as both a pedagogical tool and a strategy for fostering resilient, ecologically integrated communities.

This study builds on permaculture's educational applications by exploring how its principles can inform the design and programming of an urban learning farm. By integrating place-based learning, students engage with regenerative agricultural practices, ecological observation, and sustainability initiatives that reinforce curriculum-based learning outcomes. Permaculture serves as a bridge between outdoor education and sustainable landscapes design, creating an immersive learning environment where students can develop a deeper connection to nature and their local ecosystems.

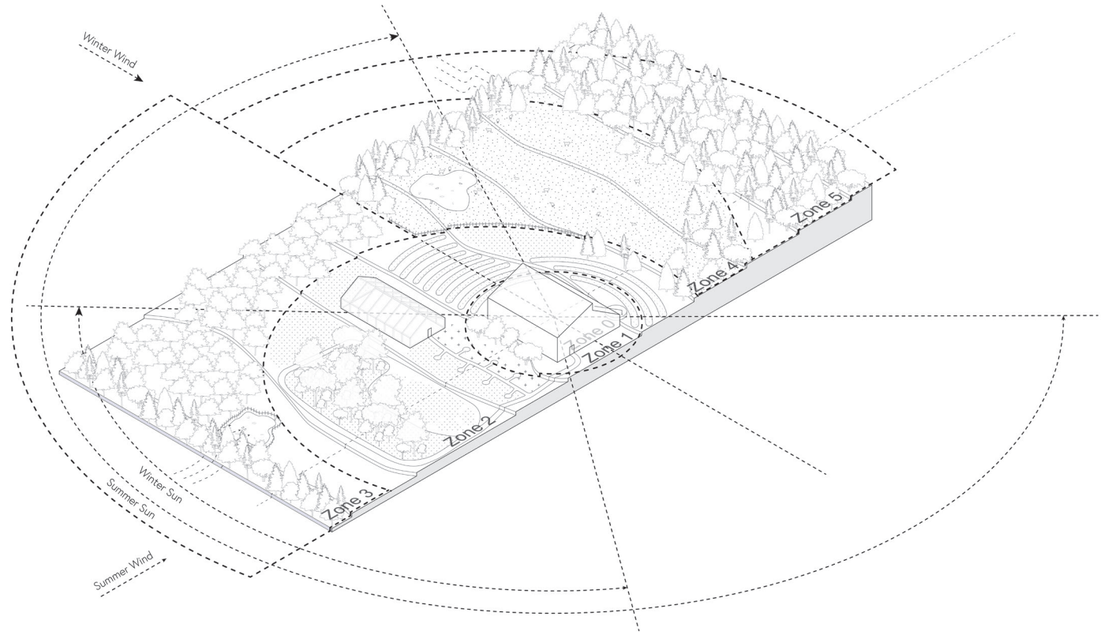


Figure 3. 1 *Permaculture planning diagram*

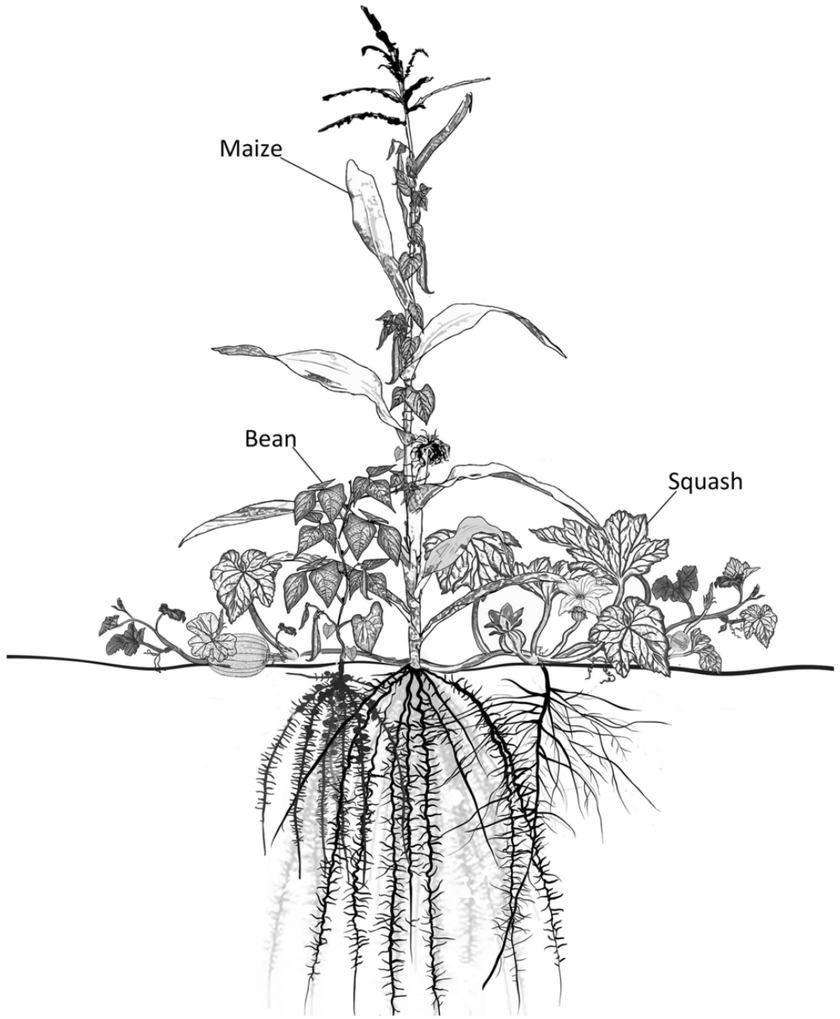


Figure 3. 2 Drawing of the Three Sisters

3.2 Historical Context

Permaculture has evolved from a synthesis of traditional ecological knowledge, Indigenous land stewardship, and modern sustainability into a globally recognized design framework for regenerative living. While the term "permaculture" was formally introduced in the late 20th century, its foundational principles have been practiced for centuries by Indigenous communities and traditional agricultural societies worldwide. These communities have demonstrated sustainable living practices, resource management techniques, and a profound respect for the interconnectedness of all life on Earth.

Origins and Evolution

While Bill Mollison and David Holmgren synthesized permaculture as a formalized design system in the 1970s, their work was deeply influenced by the ecological knowledge of Indigenous cultures. Mollison's formative experiences living with Australia's Aboriginal Tasmanian Palawa people profoundly influenced his understanding of sustainable land management practices.[69] Through his interactions with indigenous communities, Mollison gained invaluable insights into holistic approaches to ecosystem management, regenerative agriculture, and harmonious living with nature. The Palawa people, like many other indigenous cultures worldwide, had developed sophisticated systems of agriculture and land stewardship that sustained them for centuries.[70]

Despite this long-standing wisdom, Indigenous frameworks such as permaculture are often promoted as novel innovations, with little acknowledgment of their deep roots in Indigenous ecological knowledge. Kyle Whyte explains that when Indigenous communities assess sustainability frameworks, they do so through the lens of their collective memories, cultural knowledge, historical experiences, and lived realities of marginalization.[71] This perspective influences their understanding of environmental change, as well as their critiques of dominant sustainability discourses that often overlook Indigenous contributions. This tendency to present Indigenous ecological knowledge as supplementary rather than foundational erases its origins while benefiting from its insights.

Robin Wall Kimmerer in *Braiding Sweetgrass* similarly reflects on how Western science frequently disregards Indigenous ecological knowledge, only to late "rediscover" these principles through reductionist methods.[72] She argues that true sustainability must recognize Indigenous land stewardship as a primary knowledge system rather than an auxiliary influence.[73] Similarly, Dina Gilio-Whitaker in *As Long as Grass Grows* explores how mainstream environmental movements often fail to credit Indigenous land management practices while incorporating them into conservation and agricultural strategies.[74]

By contextualizing permaculture within these broader histories, we recognize that the ethical and ecological frameworks underpinning it are not new. Instead, they are part of a continuum of Indigenous knowledge that has sustained ecosystems for generations. Moving forward, any application of permaculture—especially in urban and educational settings—should acknowledge and respect the Indigenous land-based traditions that inform it.

3.3 Core Ethics of Permaculture

Permaculture is built on a foundation of ethical principles that guide its approach to sustainability and design. Bill Mollison, in *Permaculture: A Designer's Manual* (1988), formalized these ethics as Earth Care, People Care, and Fair Share—principles that provide a framework for decision-making in both ecological and social sustainability.[75][76] These ethics emphasize reciprocity, long-term stewardship, and equitable resource distribution, drawing inspiration from traditional ecological knowledge and Indigenous land stewardship practices. They serve as an ethical compass for designing human systems that function in harmony with the natural world, promoting regenerative cycles rather than exploitative ones. These principles have emerged as fundamental constraints on unsustainable growth, guiding responsible action in a world facing ecological and social challenges. By applying these ethics at multiple scales—from individual behaviors to global systems—permaculture encourages a shift away from extractive practices toward models of interdependence and renewal. By embedding these ethics into design and education, permaculture fosters resilient communities and landscapes that prioritize regeneration over extraction, collaboration over competition, and long-term ecological health over short-term gains.

Earth Care: Protecting and Regenerating Natural Systems

The first ethic, Earth Care, recognizes the intrinsic value of the environment and emphasizes the importance of preserving and regenerating natural systems. This principle extends beyond conservation to proactive restoration, aiming to heal damaged ecosystems and create conditions for biodiversity to thrive. This principle aligns with Indigenous ecological knowledge, which sees land as a living entity requiring reciprocal care and stewardship. In permaculture practice, Earth care is expressed through regenerative agriculture, soil conservation, biodiversity preservation, and designing landscapes that mimic natural systems. Techniques such as food forests, no-till farming, and agroecological systems reflect this commitment by creating self-sustaining ecosystems that support both human and non-human life.

People Care: Fostering Healthy Communities

People Care highlights the social dimension of permaculture, advocating for equitable access to resources, strong community networks, and individual well-being. This principle highlights the importance of mutual aid, shared responsibility, and resilience-building within communities, fostering support systems that withstand environmental and economic disruptions. It recognizes that sustainable systems must support human health and happiness alongside environmental resilience. This ethic encourages participatory decision-making, education, and localized food systems, ensuring that communities have the knowledge and tools to sustain themselves in harmony with their environment.

Fair Share: Equitable Distribution and Resource Limits

Also known as Return of Surplus, Fair Share emphasizes responsible consumption and redistribution of excess resources. This principle acknowledges that Earth's resources are finite, and that overconsumption threatens ecological balance. This ethic acknowledges planetary limits and promotes sharing resources, reducing waste, and ensuring that human activities do not exceed the carrying capacity of the land. Fair Share challenges extractive economic models and instead encourages regenerative, community-centered approaches to production and consumption.

Permaculture Ethics in Practice

These three ethics work in together to inform permaculture design and implementation. By embedding Earth Care, People Care, and Fair Share into education, urban and community planning, permaculture fosters systems that are not only environmentally sound but also socially just. These ethics directly inform the proposed urban learning farm and outdoor education frameworks operate, ensuring that ecological restoration, community well-being, and equitable access to resources remain central to the design process. Through hands-on engagement with permaculture practices, students and community members experience firsthand how these ethics translate into practical actions—whether through composting systems, rainwater harvesting, or cooperative land stewardship models.

The ethical principles of permaculture serve as guidelines, steering actions toward positive outcomes while deterring negative ones. Acting as constraints on survival instincts and self-interest, these principles promote inclusivity and a deeper understanding of consequences, significantly as human civilization expands in power and scale, necessitating long-term cultural and biological survival, particularly in energy descent.

While not explicitly outlined in early permaculture literature, these ethical principles, distilled into care for the Earth, care for people, and setting limits to consumption while redistributing surplus, draw from research into community ethics and resonate with indigenous tribal cultures' harmonious relationship with the environment. Many Indigenous communities have practiced these principles for generations, emphasizing sustainable resource use, reciprocal relationships with the land, and collective responsibility. Permaculture advocates learning from these cultures, recognizing their resilience and balance with nature over millennia.

Bill Mollison's *Permaculture: A Designers' Manual* highlights the development of an earth-care ethic within permaculture, stressing cooperation and interdependence in fostering healthy communities.[77] This can be seen as an expansion of Aldo Leopold's Land Ethic, as introduced in "A Sand County Almanac," urging for a holistic approach that intertwines ethical, aesthetic, and economic considerations in land use. This further emphasizes responsible stewardship and a profound shift from viewing land as a mere commodity toward recognizing its intricate interconnectedness with all living things. By reframing land as a shared, living entity rather than an exploitable resource, permaculture ethics contribute to a paradigm shift in how human societies interact with the natural world.

3.4 Permaculture Principles Aligned with Outdoor Education

Permaculture, as a design system, is guided by 12 principles formulated by David Holmgren. These principles provide a framework for sustainable interaction with natural systems. While originally applied to land-based practices like agriculture and ecological design, they also offer valuable insights for outdoor education, fostering experiential learning, systems thinking, and environmental stewardship.

This section introduces all 12 permaculture principles and highlights the ones that are the most relevant to outdoor education and this thesis's exploration of place-based learning on an urban learning farm.

The 12 Permaculture Principles

1. Observe and Interact – Deep learning starts with careful observation of nature before acting.[78]
2. Catch and Store Energy – Collect and retain energy from natural sources like sunlight, water, and organic matter.[79]
3. Obtain a Yield – Systems should provide useful returns, whether food, knowledge, or well-being. [80]
4. Apply Self-Regulation and Accept Feedback – Adjust actions based on outcomes to improve sustainability[81]
5. Use and value Renewable Resources and Services – Prioritize sustainable, regenerative inputs.[82]
6. Produce no Waste – Emphasize closed-loop systems, reducing, reusing and recycling materials.[83]
7. Design from Patterns to Details – Recognize larger natural patterns before refining the specific.[84]
8. Integrate Rather than Segregate – Encourage cooperation and beneficial relationships between elements.[85]
9. Use Slow and Small Solutions – Favour incremental, adaptable improvements, over rapid interventions.[86]
10. Use and value Diversity – Foster ecological and social diversity for resilience.[87]
11. Use Edges and Value the Marginal – Recognize innovation and opportunities in transitional spaces.[88]
12. Creatively use and Respond to Change – Adapt to environmental and social shifts with resilience. [89]

Key Principles Aligned with Outdoor Education

Outdoor education provides a unique opportunity to bridge theoretical knowledge with hands-on learning, creating an immersive environment where students can directly engage with ecological systems and sustainable practices. By aligning with permaculture principles, outdoor education moves beyond traditional teaching methods, fostering deeper connections between students, their environment, and their communities. Permaculture offers a structured yet flexible framework that emphasizes observation, resource management, biodiversity, and regenerative systems—elements that naturally support experiential learning. While all permaculture principles contribute to sustainable land management, the following are the most applicable to outdoor learning, experiential education, and place-based engagement on the proposed urban learning farm:

Observe and Interact: This principle encourages students to slow down and actively engage with their environment before making changes. Observation is a key scientific and creative process in outdoor education, whether studying plant life, tracking seasonal changes, or engaging in sensory exploration. By learning to observe patterns in nature before intervening, students develop patience, attention to detail, and a deeper appreciation for natural systems. In practice, students might participate in nature journaling, recording patterns in plant growth, weather shifts, or soil conditions. They may also engage in long-term studies of local biodiversity, tracking pollinator activity, plant succession, or soil regeneration over multiple seasons. This continuous engagement fosters an understanding of how ecosystems evolve over time. By documenting their surroundings before taking action, they develop an awareness of ecological relationships and natural cycles.

Obtain a Yield: Outdoor education should be experiential and rewarding, reinforcing the idea that learning outcomes, personal growth, and ecological literacy are as valuable as harvesting food. The concept of "yield" can extend beyond physical harvests; it also includes knowledge gained, community benefits, and personal empowerment. On the urban learning farm, students might cultivate fast-growing crops such as radishes or lettuce, allowing them to see the results of their efforts within a season. This tangible experience strengthens their understanding of cause-and-effect relationships in nature and fosters a sense of accomplishment.

Produce No Waste: Sustainability education teaches students that waste is simply a resource in the wrong place. By learning to close loops, they gain insights into resource conservation, ecological cycles, and personal responsibility. One application of this principle is the implementation of a compost system, where students collect food scraps from school lunches and observe the decomposition process. Through this, they connect biological concepts like soil health and nutrient cycles with broader sustainability practices.

Use and Value Renewable Resources and Services: Outdoor education fosters an understanding of natural cycles and sustainable resource management. This principle helps students recognize and engage with renewable resources within their learning environment. A practical example includes exploring rainwater harvesting systems on the urban learning farm. By observing how water is naturally collected and reused, students discuss its role in plant growth and compare its benefits to municipal water use. Through these practices, they not only learn about ecological benefits but also recognize how cultural traditions have shaped sustainable agricultural systems for centuries. This hands-on learning promotes water conservation awareness and reinforces the importance of utilizing sustainable resources.

Use and Value Diversity: Biodiversity in both ecological and social systems is essential for resilience and sustainability. Outdoor education highlights the interconnectedness of species while also emphasizing diverse perspectives and knowledge systems. On the farm, students might design polyculture planting beds, combining species such as corn, beans, and squash (the Three Sisters) or other companion planting arrangements. This exercise illustrates how diversity strengthens ecosystems and reinforces principles of mutual support in natural and human communities.

Integrate Rather than Segregate: The best learning environments integrate subjects, disciplines, and community members rather than keeping them separate. Outdoor education thrives on interdisciplinary connections, blending science, art, and civic engagement into cohesive experiences. By designing projects that combine multiple disciplines, students see the interconnected nature of knowledge—how environmental science informs urban planning, how art can convey ecological messages, and how social studies help contextualize sustainability within cultural and historical frameworks. A project-based initiative, for example, could have students design a pollinator-friendly garden, incorporating plant biology (science), insect life cycles (ecology), creative spatial planning (art), and urban biodiversity awareness (civic responsibility). By fostering cross-disciplinary thinking, this approach encourages students to see learning as interconnected, just as natural systems are.

By incorporating these permaculture principles into outdoor learning environments, students gain a holistic understanding of sustainability that extends beyond isolated lessons or activities. They not only develop practical skills in food production, waste management, and ecological stewardship but also cultivate a mindset of responsibility and resilience. These principles encourage students to think critically about how they interact with the land, reinforcing the importance of long-term environmental health and community well-being. These permaculture principles naturally align with outdoor learning environments, fostering hands-on exploration, systems thinking, and ecological responsibility. By incorporating these principles into the urban learning farm's educational framework, students develop a deeper, more meaningful connection to the land, reinforcing the goals of sustainability, environmental literacy, and holistic learning.

3.5 Permaculture in Practice

Permaculture offers practical strategies for designing resilient, self-sustaining food systems in urban environments. Unlike conventional farming, which often prioritizes short-term yield over long-term ecological health, permaculture integrates site-specific solutions that restore soil, conserve water, maximize biodiversity, and reduce waste. This section focuses on key techniques that directly support the urban learning farm's sustainability while aligning with its role as an educational and community resource.

A thoughtful site analysis is the foundation of a productive and resilient urban learning farm. Cities pose unique challenges, such as limited soil permeability, microclimate variability, and water access constraints, requiring strategic design interventions. Rainwater collection systems, such as cisterns and barrels, store water for irrigation, reducing reliance on municipal supplies, while passive water harvesting techniques like swales, rain gardens, and contour beds slow and absorb rainwater, minimizing runoff and erosion.

Urban soil often suffers from compaction, erosion, or contamination due to past land use. Regenerative soil practices help rebuild fertility while enhancing the carbon-sequestering capacity of the farm. Composting transforms organic waste into nutrient-rich soil amendments; while mulching and cover cropping suppresses weeds, retain moisture, and improve soil structure. Additionally, phytoremediation—using specific plants like sunflowers, willows, and mustard greens—helps extract heavy metals and toxins from contaminated urban soil, improving long-term soil health and viability.

Productive planting strategies are essential for optimizing limited urban space while promoting biodiversity and resilience. By mimicking natural ecosystems, permaculture ensures high yields with minimal inputs. Polyculture and companion planting integrate mutually beneficial plants to enhance soil fertility and pest resistance, while perennial edible crops, such as fruit trees, herbs, and nut-bearing plants, reduce soil disturbance and provide long-term yields. Food forests, a multi-layered system incorporating trees, shrubs, groundcovers, and vines, further foster biodiversity, carbon sequestration, and low-maintenance food production.

Urban learning farms must also address climate resilience and habitat integration to support long-term sustainability. Temperature extremes, wind exposure, and fragmented green spaces necessitate microclimate design strategies such as windbreaks, shade structures, and reflective surfaces that moderate temperature fluctuations. Creating pollinator and insect habitats with flowering perennials, nesting sites for bees, and undisturbed soil patches supports local biodiversity. Additionally, edible hedges and living fences provide wind protection for crops while serving as food sources and habitats for wildlife.

To reduce external inputs and minimize waste, the farm will incorporate closed-loop resource management systems. Waste-to-resource strategies, such as composting and biochar production, repurpose organic materials into valuable soil amendments. On-site nutrient cycling ensures that farm waste, including plant residues, is reintegrated into soil-building processes. Finally, renewable energy integration—such as solar panels, human-powered tools, and thermal composting—enhances the efficiency and sustainability of the urban learning farm, further reinforcing its role as a regenerative and educational space.

Comparing Permaculture to Industrialized Agriculture

Industrial agriculture has been instrumental in feeding large populations by maximizing efficiency and crop yields. However, its reliance on synthetic inputs (e.g., chemical fertilizers, fossil fuels) has contributed to challenges such as soil degradation, biodiversity loss, and climate vulnerability. In contrast, permaculture works with natural cycles to enhance long-term resilience, balancing food production with ecosystem health.

One key distinction between these systems is their approach to food production. Industrial agriculture prioritizes *high-yield, large-scale production*, often at the expense of ecological balance. It relies heavily on *monocultures*, where vast areas are planted with a single crop species to optimize efficiency. This method, while productive in the short term, makes crops more vulnerable to pests and diseases, necessitating the use of chemical fertilizers and pesticides to maintain productivity.

Permaculture, on the other hand, emphasizes *regenerative, closed-loop systems* that sustain soil health and ecological diversity over time. Instead of monocultures, permaculture embraces *biodiverse*, *polyculture planting*, where multiple species are grown together in mutually beneficial relationships. This diversity not only enhances soil fertility but also reduces pest outbreaks by creating a balanced ecosystem where natural predators and plant synergies control populations.

Another major contrast lies in how food systems are structured. Permaculture favors *localized, community-based food systems* that prioritize regional sustainability and self-sufficiency. This model strengthens local economies, reduces food transportation emissions, and fosters stronger connections between people and their food sources. In contrast, industrial agriculture operates through *large-scale, globally integrated supply chains*, where food is often produced far from where it is consumed. While this system allows for mass distribution, it increases dependence on fossil fuels for transportation and creates vulnerabilities in food security when supply chains are disrupted.

Ultimately, while industrial agriculture has driven food production advancements, permaculture offers a model for long-term sustainability by regenerating natural systems, preserving biodiversity, and promoting resilient, localized food networks. By shifting toward permaculture-inspired approaches, communities can work toward food systems that nourish both people and the planet.

3.6 Permaculture as a Design Framework for the Urban Farm

Permaculture offers a systematic approach to designing resilient, multifunctional landscapes that integrate ecological principles with human needs. On the urban learning farm, these principles guide the layout, zoning, and spatial organization to maximize productivity, accessibility, and long-term sustainability.

Zoning Concepts in Permaculture Design

One of the key design strategies in permaculture is zoning, which organizes spaces based on frequency of use, energy efficiency and natural resources. This hierarchical approach ensures that areas requiring frequent interaction (e.g., high maintenance crops, teaching spaces) are located near activity hubs, while low maintenance zones (e.g., orchards, wildlife habitats) are placed farther away.

To integrate traditional permaculture zoning with the urban learning farm's layout, the design preserves the fundamental principles of classic permaculture while adapting them to the context of a school environment. By integrating permaculture principles into the urban learning farm's design, this framework supports not only sustainable food production but also ecological resilience, biodiversity, and hands-on learning opportunities for students. Each zone is intentionally planned to balance productivity, accessibility, and environmental stewardship, ensuring that the farm operates as a closed-loop system that regenerates its own resources while serving as a dynamic educational tool.

These design strategies lay the groundwork for the farm's practical implementation and curriculum integration, reinforcing its role as both a learning landscape and a model for sustainable urban agriculture. Moving forward, these principles will guide the farm's operations, ensuring that it remains a regenerative, student-driven space that evolves with the needs of both its ecosystem and its community.

Zone 1 (Frequent Human Activity – Intensive Management)

- Educational Hub & Teaching Spaces: Outdoor teaching spaces, shaded seating, and demonstration gardens where students interact daily.
- Small Edible Gardens & Raised Beds: Easily accessible, high-maintenance crops like herbs, greens, and strawberries are grown for hands-on learning.
- Rainwater Collection & Compost Stations: To facilitate efficient water capture and distribution while supporting waste-to-resource learning.
- Pollinator Gardens & Sensory Spaces: Featuring fragrant herbs, native flowers, and interactive elements to engage multiple senses.

Zone 2 (Moderate Management – Productive Growing Spaces)

- Perennial Vegetables & Food Forest: Layers of fruit trees, shrubs, and ground cover plants to demonstrate ecological succession.
- Ponds & Small Water Features: Supporting biodiversity, passive irrigation, and potential aquatic plant or small fish integration.
- Larger Composting Systems & Vermiculture: Managing organic waste while teaching soil-building techniques.

Zone 3 Extensive Cultivation – Low-Maintenance Production)

- Orchards & Larger Fruit Trees: Long-term food production with lower input requirements.
- Perennial Farming Crops: Features cold-hardy edible perennials such as rhubarb, asparagus, and berry bushes.

Zone 4 (Resource Production – Minimal Intervention)

- Timber & Fuel Crops: Could incorporate fast-growing coppicing trees for potential use in farm structures or student projects.

Zone 5 (Wilderness & Conservation Areas)

- Regenerative Natural Spaces: Allowing local native ecosystems to thrive, supporting biodiversity, and serving as an observation zone for students.

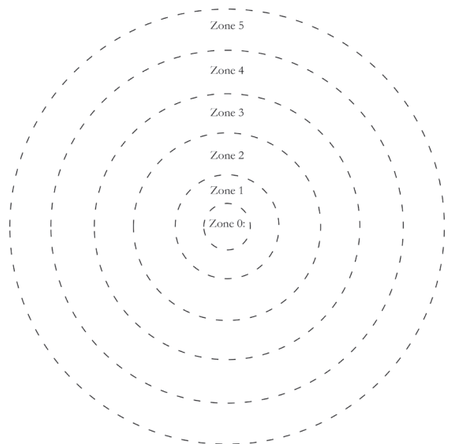


Figure 3. 3 Permaculture zoning diagram

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04 Site

| *History, Environmental Context, and Future Use*



Figure 4. 1 *Brockville context plan 1:50000*

4.1 Brockville Site Introduction

Brockville, Ontario, is a mid-sized city situated along the St. Lawrence River in Eastern Ontario. It experiences a humid continental climate, with cold winters and warm summers, conditions that influence the feasibility and implementation of outdoor education initiatives.[90] Located within the Thousand Islands region, Brockville is positioned between major urban centers such as Ottawa, Kingston, and Montreal, yet retains characteristics of a smaller community.

Brockville falls within Plant Hardiness Zone 6A, meaning that the growing season and plant selection for the proposed urban learning farm must align with regional temperature fluctuations and soil conditions.[91] This classification is particularly relevant when considering phytoremediation strategies, as the effectiveness of certain plant species in soil restoration depends on their adaptability to Brockville's specific climate and soil composition.

Recently, the development of new educational infrastructure in Brockville has included the construction of Swift Waters Elementary School, which is situated adjacent to a former industrial brownfield site. This location presents a unique opportunity to integrate permaculture-based outdoor education within an urban setting, repurposing underutilized land into a productive learning landscape.

This chapter contextualizes the site's history, current conditions, and its relationship with Swift Waters Elementary School to establish a foundation for the proposed urban learning farm and outdoor education framework.

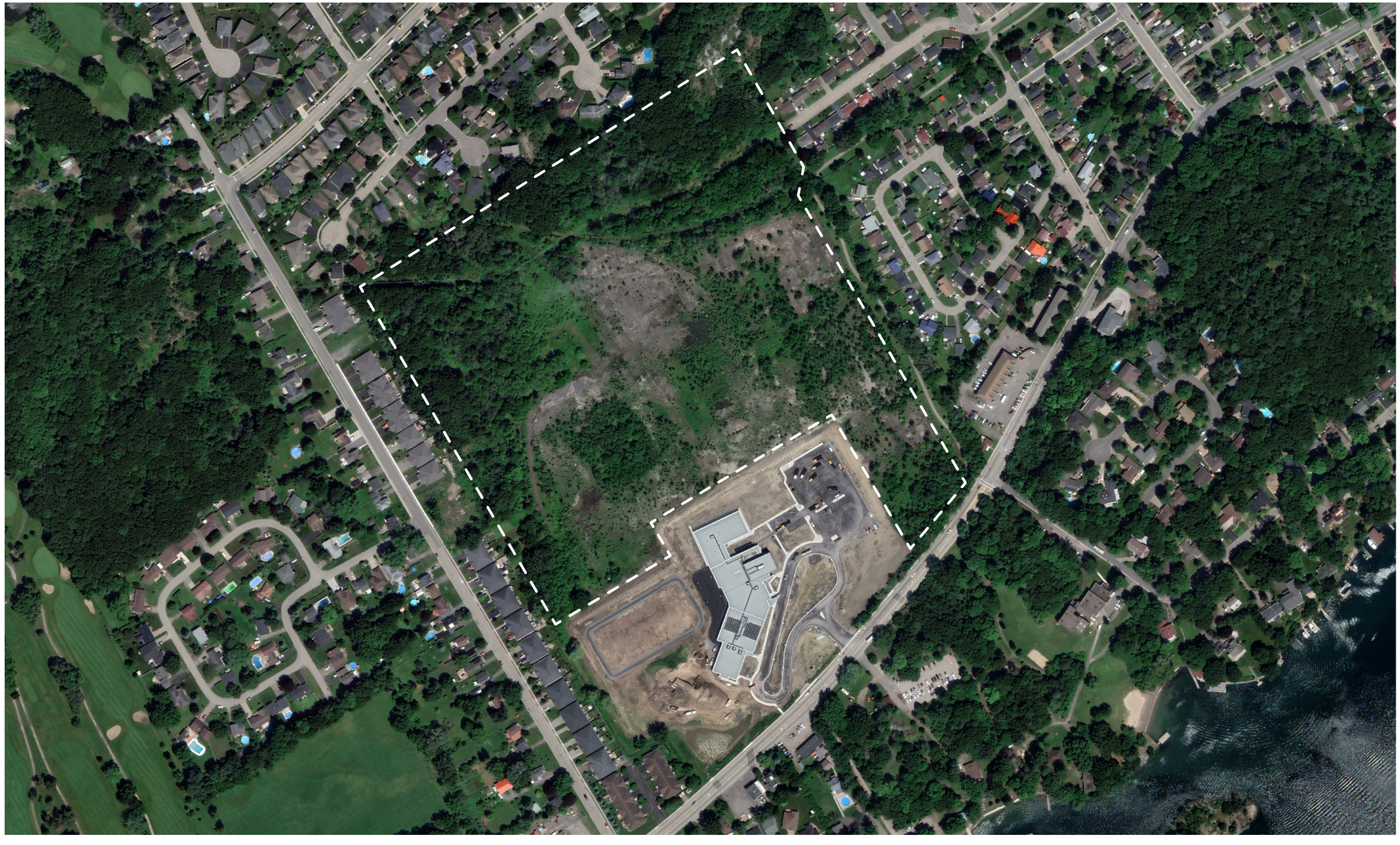


Figure 4. 2 *Aerial image of thesis site*

4.2 Site History

The proposed urban learning farm site, currently a vacant brownfield, was historically home to Phillips Cables Limited, a major industrial facility that operated in Brockville for much of the 20th century. Originally established as Eugene F. Phillips Electrical Works Ltd., the company was a key player in Canada's electrical manufacturing sector, specializing in wire and cable production.[92] Over the decades, the site underwent multiple expansions to accommodate growing industrial operations.

Established in Montreal, the company expanded operations to Brockville in 1922, constructing a new copper rod-rolling mill along King Street West. Over the following decades, additional manufacturing buildings were added to accommodate wiredrawing, enamel magnet wire production, and cable winding.[93] By 1940, the company further expanded with the construction of a new facility dedicated to large-scale power and telephone cables, reflecting the growing demand for electrical infrastructure.



Figure 4. 3 *Phillips Electrical Works expansion construction image, exterior, October 4th 1927*



Figure 4. 4 *Phillips Electrical Works expansion construction image, interior October 4th 1927*

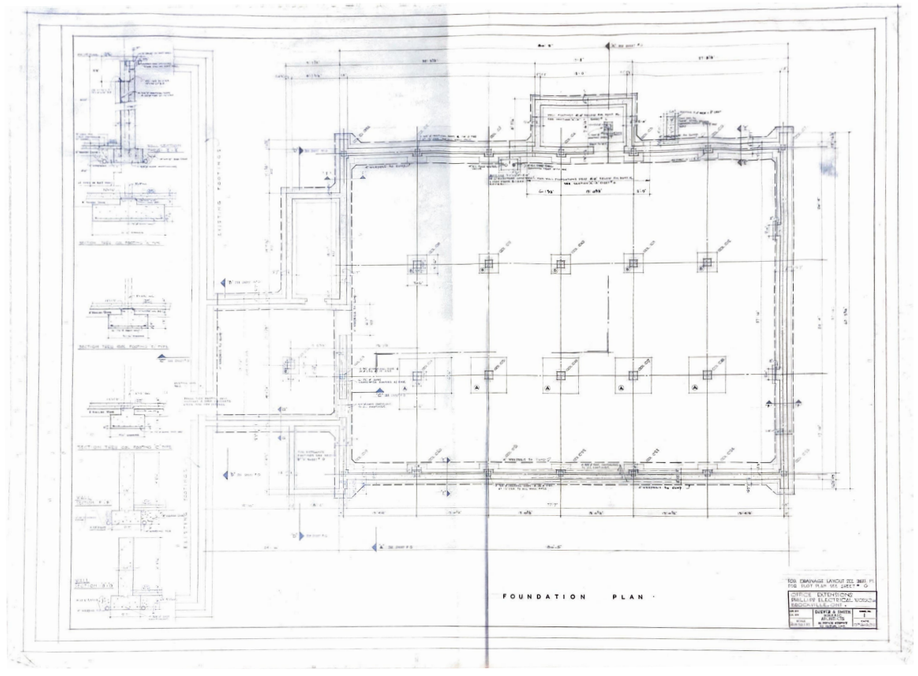


Figure 4. 5 *Phillips Electrical expansion architectural drawing (office building foundation plan and details),Power & Son, 1932*

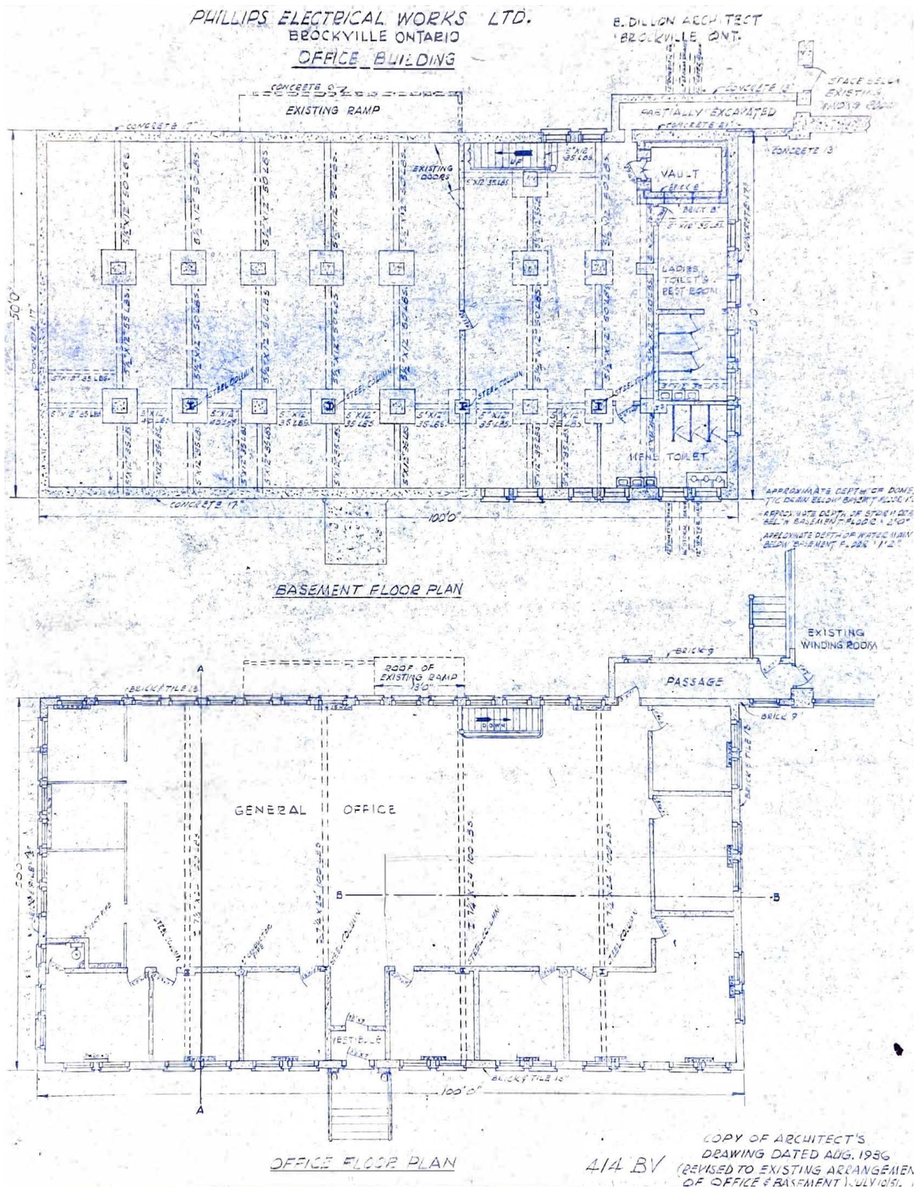


Figure 4. 6 *Phillips Electrical expansion architectural drawing (office plan and foundation plan), Power & Son, 1936*

In the post-war era, the Brockville plant became the company's central hub, with the head office relocating from Montreal in 1948. A series of major investments followed, including a $3 million modernization project in 1953 and a subsequent $7.5 million expansion in 1956, adding new production wings, an enameling department, plastics processing, and raw materials storage.[94] By 1964, the company rebranded as Phillips Cables Limited, solidifying its place as a key industrial employer in the region.

Despite its long history in Brockville, Phillips Cables faced growing economic challenges in the 1990s, leading to the plant's closure in 1996.[95] The shutdown resulted in the loss of 350 jobs and left the 484,000-square-foot facility vacant. In 2008, the former industrial complex was demolished, leaving the site largely underutilized for over a decade.

With its industrial past, the site presents a unique opportunity for transformation. Its history as a manufacturing hub aligns with the principles of adaptive reuse, offering potential for ecological restoration and the reintegration of productive land uses. The following section examines contamination assumptions based on the site's former industrial operations, informing remediation and redevelopment strategies.

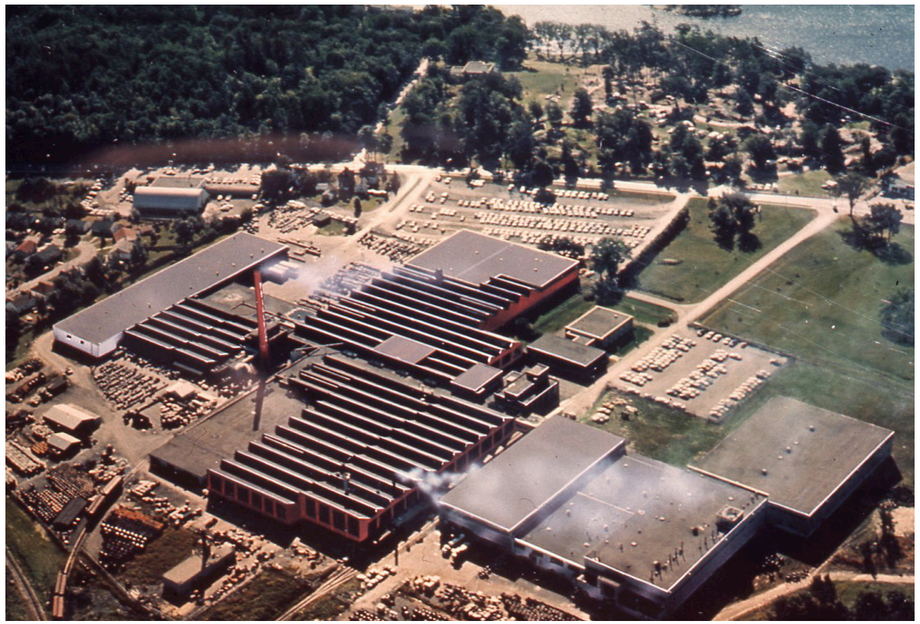


Figure 4. 7 *Aerial view of Phillips Cables*



Figure 4. 8 *Demolition of Phillips Cables, June 24, 2008*



Figure 4. 9 *LandSAT image of Phillips Cables, 1966*

4.3 Industrial Legacy and Contamination Assumptions

For much of the 20th century, Phillips Cables Limited operated as a major wire and cable manufacturing facility. Industrial processes on-site included metal processing, wire coating, electrical component storage, and large-scale transport, all of which likely contributed to soil contamination. Common pollutants associated with wire and cable manufacturing include petroleum compounds, heavy metals, and persistent organic pollutants (POPs). Petroleum-based residues, used as lubricants in wire drawing and metal finishing, were introduced through fuel spills and transport operations.[96] Heavy metals such as copper, lead, and zinc were central to manufacturing processes—copper serving as the primary material for wire production, lead coatings historically applied for insulation and durability, and zinc used for corrosion resistance on wires and metal components.[9798] Additionally, polychlorinated biphenyls (PCBs) were widely used in transformers and electrical insulation before being banned in Canada in 1977.[99]

Without access to detailed contamination reports, this thesis relies on historical aerial photographs, site maps, and knowledge of common pollutants associated with wire and cable manufacturing to inform contamination assumptions. The storage and loading zones, where materials were transported and temporarily held, are likely contaminated with petroleum compounds, including polycyclic aromatic hydrocarbons (PAHs) and BTEX compounds (benzene, toluene, ethylbenzene, and xylene). These contaminants stem from fuel spills, lubricants, and transport residues, accumulating in soil over decades of industrial use.[100] In manufacturing and processing areas, where metalworking and wire coating operations took place, are expected to contain heavy metals such as lead, zinc, and copper. These elements were introduced through wire coating residues and other metal-processing waste, posing risks to soil and water quality.[101]

Transport corridors, including railway and trucking areas, likely contributed additional petroleum-based contamination (PAH and BTEX), through fuel spills, exhaust residues, and prolonged contact with asphalt and other transport infrastructure.[102] The former transformer and electrical storage areas may contain PCB contamination from the historical use of insulating oils in transformers and other electrical equipment. Waste disposal and scrap areas present a further risk, as these spaces were historically used to discard metal scraps, insulation materials, and outdated electrical components, all of which could have contributed to heavy metal and PCB contamination.[103]

These contamination assumptions serve as a guiding framework for soil remediation, helping to identify priority areas for phytoremediation interventions. By integrating site-specific planting strategies, the urban learning farm will facilitate long-term ecological restoration and sustainable land use.



Figure 4. 10 *Phillips Cables interior image, showing manufacturing area*



Figure 4. 11 *Phillips Cables Construction image showing transport corridor, 1928*



Figure 4. 12 *Phillips Cables interior image, showing storage area*

Soil Testing and Methodology

To assess potential contamination, three soil samples were collected from distinct locations on-site, each selected based on their industrial history and likelihood of contamination. The methodology aimed to capture variations in soil conditions across different site areas, providing a comparative analysis of contamination presence and severity.

Former Facility Footprint: This sample was taken from an area where the main industrial building once stood, representing soil that was directly impacted by manufacturing operations. This location was expected to show higher levels of industrial pollutants, particularly petroleum compounds (PAHs, and BTEX), and potential PCB residues from electrical equipment use

Former Asphalt-Paved Area: A second sample was extracted from an area previously covered with asphalt, likely used for transportation, or loading operations. Given its history, this sample was expected to contain petroleum-based contaminants, such as BTEX compounds from fuel spills or PAHs from asphalt degradation.

Undisturbed Soil (Control Sample): The final sample was collected from an area that remained untouched by industrial activity, serving as a control sample. This located provided a baseline soil sample, helping to distinguish naturally occurring soil characteristics from contamination linked to past industrial use.

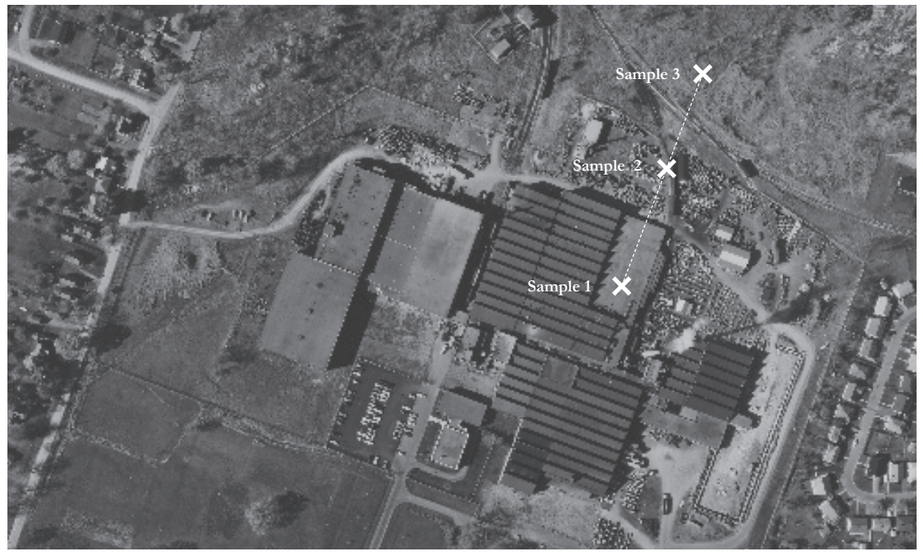


Figure 4. 13 *Diagram showing soil sample locations on LandSAT image of Phillips Cables, 1966*

Testing Process and Findings

The soil samples were submitted to Chromatographic Specialties Inc. in Brockville, Ontario, where they were analyzed for BTEX contaminants (Benzene, Toluene, Ethylbenzene, and Xylene). However, due to resource limitations, other key contaminants—including PAHs, PCBs, and heavy metals—were not tested in this phase. Additional soil assessments would be required to fully evaluate contamination levels.

When cross-referenced with the most recent Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health, the results indicate that Benzene levels fall within the safety thresholds for agricultural use.

However, the absence of PAHs, PCBs, and heavy metal testing limits the completeness of this analysis. Given the site's industrial legacy, further testing would be beneficial to develop a comprehensive remediation strategy before any agricultural activities begin.

Implications for Remediation Strategies

The findings from soil testing and contamination assumptions will directly inform the selection of phytoremediation techniques. These strategies will be tailored to address assumed contamination risks based on historical land use and target specific pollutant groups. The next chapter will explore plant-based remediation methods suited for site recovery and long-term sustainability.



Figure 4. 14 *Images of soil samples taken from the thesis site, arranged from right to left (Sample 1 on the right, Sample 2 in the middle, Sample 3 on the left)*

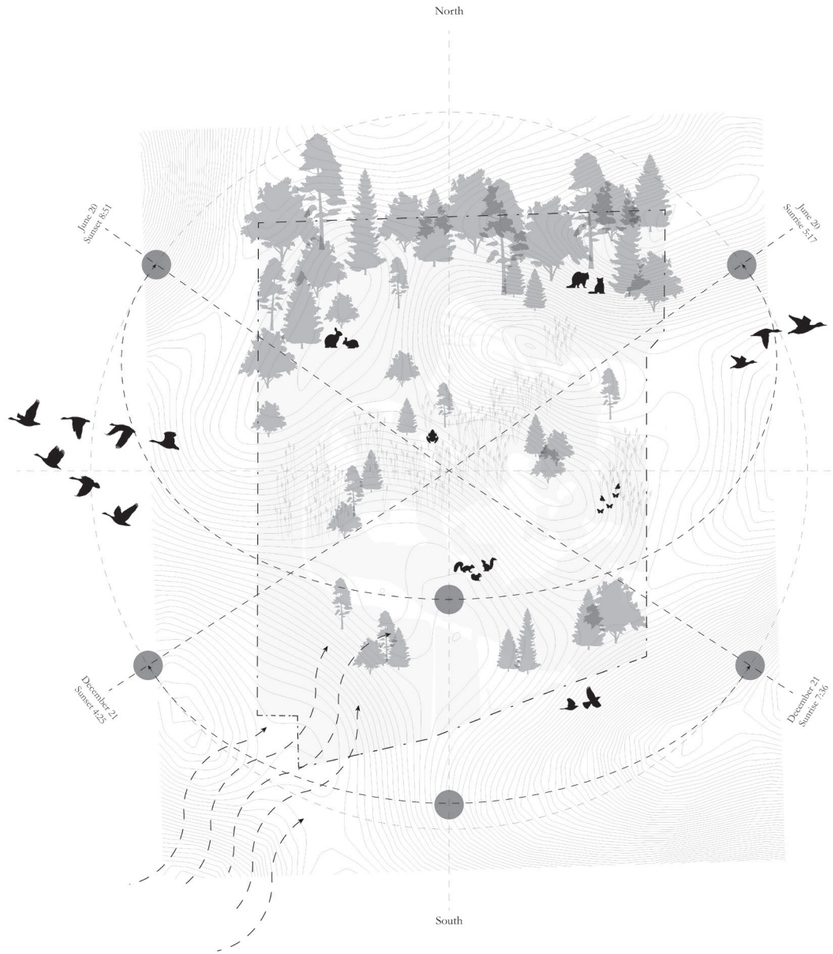


Figure 4. 15 *Diagram illustrating site conditions, ecological features, and environmental influences*

4.4 Site Specifics

The transformation of the Phillips Cables site into an urban learning farm and outdoor education space requires a thorough understanding of its topography, soil composition, vegetation, water dynamics, and climatic influences. These physical and environmental characteristics shape the feasibility of agricultural production, biodiversity restoration, and overall site functionality. Brockville is situated within the St. Lawrence Lowlands, a region characterized by temperate deciduous and mixed forests shaped by glacial history and a humid continental climate.[104] Ecologically, it falls within the Mixedwood Plains Ecozone, which supports a variety of forest communities, wetlands, and riparian habitats. More specifically, Brockville is in Lake Simcoe-Rideau Ecoregion (*6E*), known for its rich floodplain forests.[105] The vegetation is relatively diverse, including rich floodplain forests, contain green ash (*Fraxinus pennsylvanica*), silver maple (*Acer saccharinum*), red maple (*Acer rubrum*), eastern white cedar (*Thuja occidentalis*), yellow birch (*Betula alleghaniensis*), balsam fir (*Abies balsamea*), and black ash (*Fraxinus nigra*).[106] The Lake Simcoe-Rideau Ecoregion (6E) supports a diverse range of wildlife, including mammals such as white-tailed deer, northern raccoon, and woodchuck, as well as wetland and upland bird species like wood ducks, great blue herons, and eastern meadowlarks.[107] The region also sustains various reptiles and amphibians, including American bullfrogs, snapping turtles, and eastern gartersnakes, along with fish species such as smallmouth bass, walleye, and northern pike, reflecting the ecological diversity of its wetlands, forests, and open habitats.[108]

The site's history as an industrial facility presents unique challenges, particularly in soil contamination and land rehabilitation, which must be addressed through remediation strategies. Despite these challenges, historical data and field observations offer valuable insights into the site's original ecological conditions and potential for regeneration. By examining the site's pre-industrial soil classification, topographic characteristics, and environmental patterns, this study establishes a foundation for designing a productive and ecologically responsible agricultural landscape. Understanding these factors is essential not only for ensuring the viability of food production but also for supporting long-term environmental sustainability and fostering a resilient outdoor learning environment.

Topography and Soil Conditions

A 1968 Soil Survey by the Department of Soil Science, the site is classified as Farmington loam (FI), a well-drained, fine-textured soil type historically used for agriculture in the region.[109] The survey also identifies the land as gently sloping (CO) with a stoniness rating of 0 (Stone-Free), indicating relatively even terrain with minimal rock obstructions—ideal conditions for crop production and farming. [110] These characteristics suggest that before industrial development, the site had strong agricultural potential, supporting a range of crops and traditional farming practices.

The survey map follows a standardized classification system, where Farmington loam (FI) is recognized for its fine texture, good drainage, and nutrient retention, while gently sloping (CO) and stone-free conditions reinforce the land's historical suitability for diverse agricultural use. However, decades of industrial activity have likely altered the soil's chemical composition, introducing contaminants that impact fertility and safety for cultivation. While the original classification provides insight into pre-industrial conditions, contemporary soil testing is necessary to assess current viability and remediation needs.

Restoring soil health will require targeted remediation strategies, such as phytoremediation, compost amendments, and regenerative land management techniques to rebuild fertility and mitigate contamination risks. Understanding the site's historical classification informs these efforts, offering a baseline for soil restoration and guiding decisions on crop selection, water management, and overall farm design. By integrating ecological restoration with agricultural planning, the urban learning farm aims to reclaim the site's productive potential while fostering long-term environmental resilience.

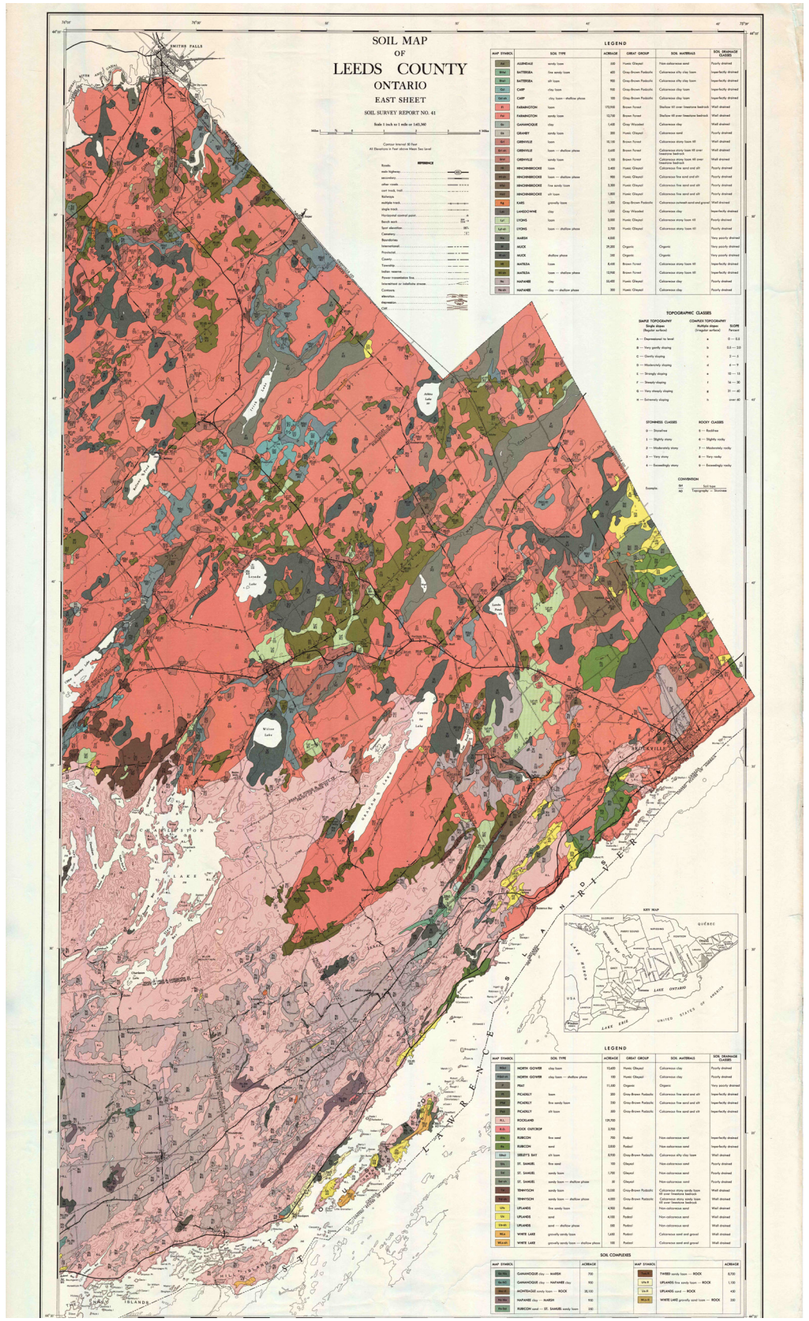


Figure 4. 16 *Soil Map of Leeds Country, soil survey report no. 41, 1968*

Vegetation & Wildlife

The site exhibits a mix of early successional vegetation and resilient species adapted to disturbed soils. Observations made during multiple site visits indicate the presence of both native and invasive plant species. Balsam poplar (*Populus balsamifera*), trembling aspen *(Populus tremuloides)*, white cedar (*Thuja occidentalis*), and red cedar (*Juniperus virginiana*) dominant tree species, establishing in open areas. While these species demonstrate the site's capacity for natural regeneration, the presence of invasive shrubs such as Tatarian honeysuckle (*Lonicera tatarica*) suggests competition for resources, which may pose challenges for future restoration efforts.[111] The majority of groundcover consisted of mosses and grasses, additionally wild strawberry (*Fragaria virginiana*), and watercress (*Nasturtium officinale*), which further illustrates the site's transition toward greater biodiversity, though long-term ecological monitoring will be necessary to assess the sustainability of these plant communities.

Wildlife observations further demonstrate that the site provides habitable for pollinators, small mammals, and birds, despite its degraded state. The presence of bumblebees *(Bombus spp.)*, silvery blue butterflies *(Glaucopsyche lygdamus)*, and little yellow butterflies *(Eurema spp.)* indicates some pollinator activity, which is critical for future agricultural productivity. Additionally, species such as blue jays *(Cyanocitta cristata)*, robins *(Turdus migratorius)*, and ground-nesting killdeer *(Charadrius vociferus)* highlight the site's role as a transitional habitat. Mammals such as eastern cottontail rabbits (*Sylvilagus floridanus*) and squirrels were also observed, suggesting the availability of food sources and shelter.

These observations inform the site's potential for biodiversity restoration and habitat enhancement within the urban learning farm design. By integrating native perennial plantings, pollinator-friendly crops, and controlled management of invasive species, the site can support greater ecological diversity while improving soil conditions.



Figure 4. 17 *Trembling Aspen Sample*



Figure 4. 18 *White Cedar*

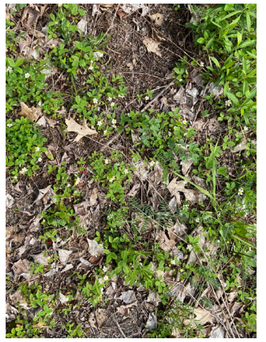


Figure 4. 19 *Wild Strawberry*



Figure 4. 20 *Trembling Aspen*

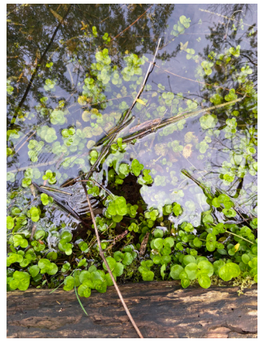


Figure 4. 21 *Watercress*



Figure 4. 22 *Horsetail Sample*

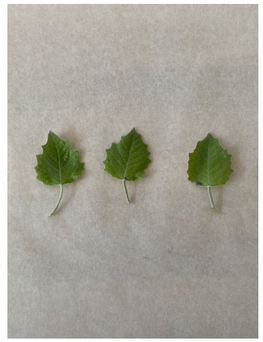


Figure 4. 23 *White Poplar Sample*



Figure 4. 24 *Red Cedar*



Figure 4. 25 *Tartarian Honeysuckle*

Water Features and Drainage

The site does not contain natural water features such as ponds or streams, yet its industrial past has left behind drainage challenges due to soil compaction and remnants of paved surfaces. These conditions limit water infiltration, increase surface runoff, and create localized pooling in certain areas. Low-lying depressions across the site accumulate water after heavy rainfall, indicating poor infiltration and potential soil compaction. Additionally, remnants of asphalt and industrial surfaces further disrupt natural percolation, exacerbating runoff and restricting soil moisture retention. Stormwater flow trends suggest that water primarily moves toward the western edge of the site, likely shaped by historical grading and industrial modifications. Notably, Swift Waters Elementary School has incorporated a bioswale in the southwest corner of its site, providing an existing example of passive water management that could inform future interventions.

To address these challenges, integrated water management strategies will prioritize improving infiltration, reducing runoff, and capturing water for productive use. Low-lying areas will be transformed into functioning ponds, which will help retain stormwater, enhance biodiversity, and support natural filtration processes. These ponds will work in conjunction with strategically placed rain gardens, which will slow surface water flow, filter pollutants, and enhance groundwater recharge, improving overall soil health. Pathways will be designed between the newly established ponds and the existing bioswale, ensuring accessibility while guiding water movement across the site. Additionally, rainwater harvesting systems will be introduced to collect and redistribute water for agricultural and educational purposes, reducing reliance on external water sources. These combined approaches will ensure that stormwater is managed sustainably, supporting soil restoration while enhancing the long-term resilience and functionality of the urban learning farm.



Figure 4. 26 *Site images illustrating water retention and accumulation trends, predominantly observed along Phillips Cables transport corridors*

Wind Patterns & Microclimate

An analysis of regional wind data indicates that winds predominantly originate from the west and west-southwest (WSW), with occasional shifts from the northwest (NW) during winter months.[112] The site's proximity to the St. Lawrence River may influence localized airflow patterns, contributing to seasonal variations in wind strength and temperature regulation. Winter winds, primarily from the northwest and west, tend to be strong and cold, increasing wind chill and posing potential frost risks. In contrast, summer breezes from the west provide natural cooling, which could be advantageous for temperature regulation within the urban learning farm.[113]

The site's open terrain and lack of established windbreaks present exposure-related challenges, including soil erosion, crop vulnerability, and temperature variability. Persistent westerly winds can accelerate soil dehydration and cause mechanical stress on crops, impacting plant stability and growth.[114] Additionally, remnants of asphalt and compacted concrete surfaces could contribute to localized heat retention, creating thermal variations that would affect plant development. The relatively flat topography limits cold air drainage, allowing cold air to settle in lower areas, increasing frost risk for temperature-sensitive plants.

To mitigate these challenges, several wind-adaptive strategies will be implemented. Establishing tree and shrub buffers along the western boundary will help diffuse wind intensity and reduce erosion risks. Mulching and cover cropping will improve soil stability and moisture retention by protecting against wind-driven dehydration. Additionally, strategic planting will ensure that delicate or temperature-sensitive crops are positioned in sheltered microclimates, such as along structures, hedgerows, or sun-exposed walls, to moderate temperature fluctuations. By incorporating these strategies, the site can enhance growing conditions, minimize weather-related stressors, and create a more resilient microclimate for urban agriculture and outdoor learning.

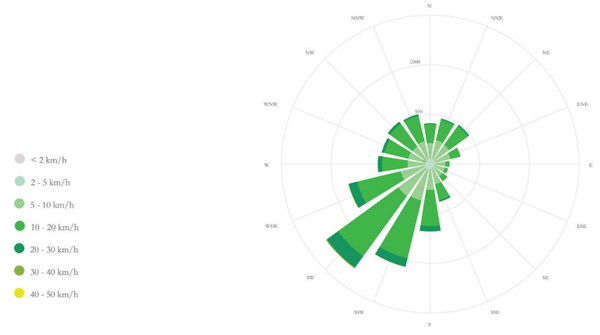


Figure 4. 27 *Wind rose illustrating prevailing WSW winds*

Sun Exposure and Solar Potential

The site benefits from full sun exposure throughout most of the year, making it highly suitable for both agricultural production and solar energy collection. Its southern exposure provides optimal sunlight for crop growth and greenhouse operations, ensuring that plants receive sufficient energy for photosynthesis. A tree line to the west offers partial afternoon shade, which can be advantageous for heat-sensitive plants that require protection from excessive sun exposure. Additionally, adjacent buildings cast minimal shadows, preserving the site's access to direct sunlight throughout the day.

Given these conditions, the site presents strong solar potential for various forms of infrastructure. Greenhouses and polytunnels can be strategically positioned to capture maximum sunlight, extending the growing season and supporting year-round cultivation. At the same time, shade structures will be necessary in designated outdoor learning areas to ensure a comfortable balance of sun and shade for students and visitors. Thoughtful integration of solar-responsive design will enhance both agricultural productivity and the overall usability of the site.

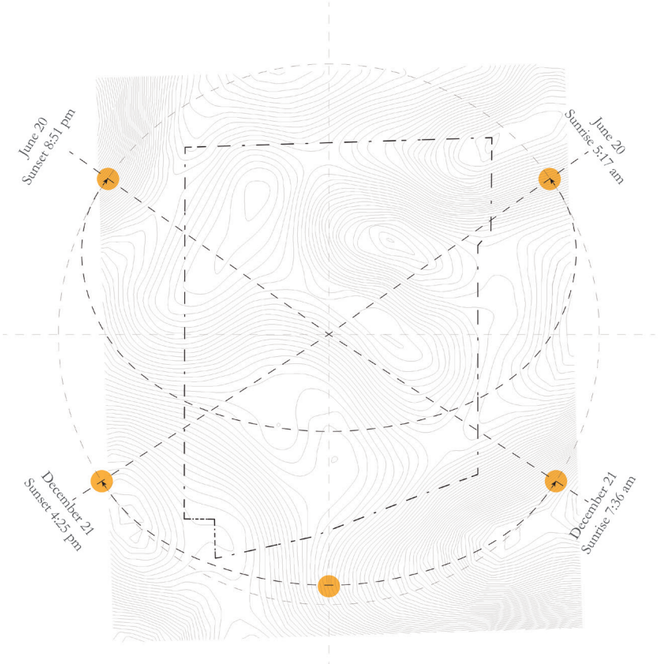


Figure 4. 28 *Solar diagram illustrating sun paths during winter/ summer solstice*

Implications for Site Redevelopment

By analyzing these site-specific conditions, the urban learning farm design can strategically integrate permaculture principles while mitigating environmental challenges. This redevelopment process not only restores ecological functions but also transforms the site into an interactive, educational landscape that demonstrates sustainable land management in action.

Soil regeneration will be a central focus, addressing compaction and contamination through phytoremediation and organic amendments to restore fertility and improve growing conditions. Cover cropping and compost applications will be explored as additional strategies to improve soil structure and microbial diversity. Raised beds and container growing methods may also be incorporated in early stages to facilitate immediate planting while long-term soil restoration takes place.

Water management strategies will be implemented to not only reduce runoff and ensure a sustainable water supply for agricultural use but also enhance on-site hydrological resilience. Bioswales and permeable pathways will be designed to slow water movement, allowing it to percolate into the soil rather than contributing to urban runoff. Additionally, rainwater harvesting systems, including cisterns and drip irrigation, will be integrated to maximize water efficiency, providing a self-sustaining irrigation source for food production and habitat restoration.

Biodiversity enhancement will play a key role in reintroducing native plants and creating pollinator habitats, fostering ecological resilience and strengthening local ecosystems. By incorporating native flowering species, hedgerows, and multi-layered plantings, the site will serve as a refuge for pollinators, birds, and beneficial insects, improving local biodiversity and supporting natural pest control. Food forests and perennial polycultures will be designed to mimic natural ecosystems, creating long-term, self-sustaining agricultural zones that require minimal intervention.

Climate adaptation measures, such as windbreaks, shade structures, and solar optimization, will help regulate temperature fluctuations and protect crops from environmental stressors. Additionally, community accessibility will be prioritized by designing clear pathways and integrating the site with Swift Waters Elementary and the adjacent Brock Trail, ensuring seamless connections for students and the broader public.

By addressing these physical and environmental factors, the site's redevelopment will remain ecologically responsible, functionally resilient, and educationally enriching. This model will serve as a precedent for integrating outdoor learning with regenerative land use, demonstrating how urban spaces can be transformed into productive, biodiverse, and community-centered landscapes that prioritize ecological health and social engagement.

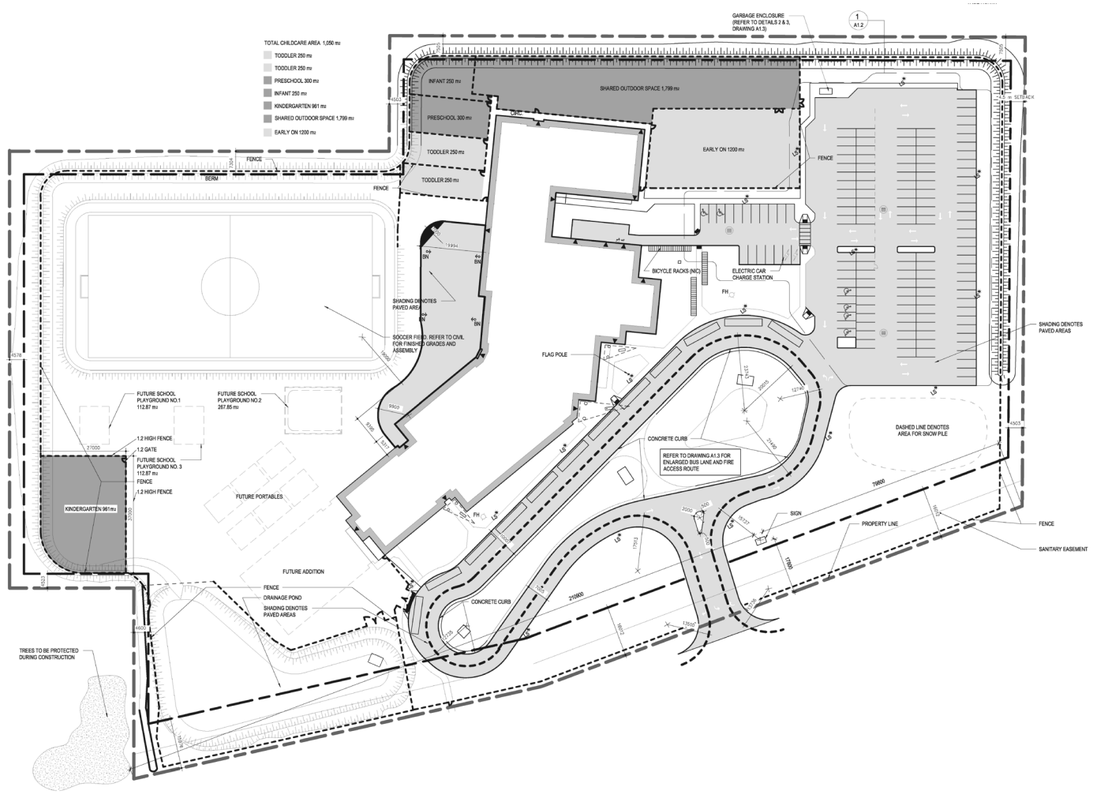


Figure 4. 29 Site plan of Swift Waters Elementary School, Architecture 49, 2022

4.5 Relationship with Swift Waters Elementary School

The proximity of Swift Waters Elementary School to the proposed urban learning farm presents a valuable opportunity to extend the school's learning environment beyond the classroom. Situated directly adjacent to the former Phillips Cables site, the farm offers students direct access to an evolving landscape that supports hands-on engagement with ecological systems, food production, and environmental stewardship. This connection transforms an underutilized site into an interactive space that complements the school's existing curriculum while fostering a deeper relationship between students and the land.

The physical adjacency of the school and farm allows for regular interaction, reinforcing outdoor learning as an integral part of students' daily experiences. Unlike traditional schoolyard green spaces, the farm is designed as a dynamic environment where students can participate in seasonal planting, observe ecological processes, and engage in long-term projects that evolve over time. Safe and structured access points will be necessary to facilitate movement between the school and farm, ensuring ease of integration while maintaining security and supervision.

Beyond its immediate function as an educational resource, the farm is positioned along the Brock Trail, a well-used pedestrian and cycling corridor that connects various parts of the community. This location enhances visibility and accessibility, opening opportunities for broader community engagement. The site has the potential to host public workshops, school-community collaborations, and intergenerational learning experiences that bring together students, educators, and community residents. By strengthening the link between Swift Waters Elementary School and the surrounding community, the farm fosters a shared sense of environmental responsibility and place-based learning.

Rather than existing as an isolated project, the urban learning farm serves as an extension of the school's educational framework, offering a living landscape that evolves alongside its students. Its design considers both immediate and long-term engagement, ensuring that future generations benefit from its presence. This relationship exemplifies how underutilized urban land can be repurposed into a productive, educationally rich space that supports both student learning and broader community participation.

4.6 Opportunities and Constraints

The site's proximity to Swift Waters Elementary School provides a unique advantage, allowing students to seamlessly engage in outdoor learning. This direct access supports curriculum-based experiences in agriculture, ecology, and environmental science, reinforcing experiential education. Additionally, historical soil surveys classify the site as Farmington loam, a well-draining and stone-free soil type. While contamination must be addressed, this classification suggests that the land was once well-suited for agriculture, providing a strong foundation for soil restoration efforts.

The site also demonstrates ecological regeneration potential, as early successional plant species have begun establishing, signaling that the land can support biodiversity restoration. With strategic reforestation and habitat planning, the urban learning farm can enhance soil stabilization and improve connectivity between local ecosystems. Furthermore, the site's adjacency to the Brock Trail, a well-used pedestrian and cycling corridor, creates opportunities for community engagement and public access. Future integration with the trail could strengthen ties between the school, the urban learning farm, and the surrounding neighborhoods, making the space an inclusive and accessible resource.

The site's microclimate presents advantages for both energy and agricultural planning. Consistent westerly winds provide opportunities for windbreak planning, while ample sunlight exposure supports solar energy capture and seasonally optimized crop production. These environmental factors can be strategically harnessed to enhance resilience and productivity.

Despite these advantages, the site presents several challenges that must be addressed to ensure its long-term viability. Soil contamination from industrial residues, including petroleum compounds (PAHs, BTEX), heavy metals, and PCBs, necessitates remediation before agricultural use can proceed. While phytoremediation and soil amendments offer sustainable solutions, these processes require time, meaning that certain areas may remain unsuitable for cultivation in the short term. Simultaneously, compacted soil and drainage issues pose concerns for water management, as industrial activity has likely reduced soil permeability, increasing runoff and erosion risks. Implementing bioswales, rain gardens, and soil aeration will be essential to improving infiltration, restoring soil structure, and mitigating hydrological challenges across the site.

Beyond soil conditions, wind exposure presents another constraint that must be considered in site design. Persistent westerly winds, while beneficial for passive cooling, may negatively impact delicate crops and contribute to soil erosion. Without intervention, these conditions could compromise plant stability and reduce growing success. To address this, strategic windbreak placement will be necessary to diffuse wind intensity, protect crops, and create sheltered microclimates that support plant growth.

In addition to these environmental factors, long-term maintenance and stewardship will be critical to ensuring the urban learning farm's continued success. Even after remediation, sustained efforts will be required to preserve soil health, manage invasive species, and maintain productive growing areas. The farm's viability will depend on structured management strategies, ongoing community participation, and institutional support from the school and broader stakeholders.

By addressing these constraints while capitalizing on the site's inherent strengths, the urban learning farm can be designed as a resilient, functional, and ecologically responsible landscape that integrates education, sustainability, and community engagement. Through thoughtful planning and strategic interventions, the site has the potential to become a thriving model for urban agriculture, ecological restoration, and experiential learning.

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Figure 5. 1 *Render showing school yard entrance to the Swift Waters Urban Learning Farm*

5.1 Introduction to the Urban Farm Design

The Swift Waters Urban learning farm is designed as a multifunctional space that integrates phased ecological restoration, sustainable agriculture, and outdoor learning. This chapter outlines the farm's design approach, beginning with strategies to restore soil health through phytoremediation, ensuring that the site is prepared for long-term agricultural use.

Following this, the overall site plan is introduced, detailing zoning strategies that define key areas for agriculture, ecological restoration, and outdoor education. The building design is then explored, highlighting teaching spaces, food production facilities, and market infrastructure that support both educational and community engagement goals. The chapter then examines key outdoor learning zones in greater detail, demonstrating how the site fosters hands-on, curriculum-aligned experiences. Finally, a selection of structural details is provided to illustrate the material and construction choices that reinforce sustainability and long-term adaptability.

Together, these elements establish the Swift Waters Urban learning farm as a resilient, educational, and ecologically restorative landscape, translating permaculture principles into a functional and integrated design.

5.2 Site Plan

The site plan for the Swift Waters Urban Learning Farm establishes a framework for integrating outdoor education, sustainable agriculture, and ecological restoration within a former brownfield. Designed around permaculture principles, the farm's layout facilitates efficient movement, optimizes sun exposure, and incorporates natural resource cycles. Organized into zones based on frequency of use and ecological function, high-traffic areas like outdoor classrooms and demonstration gardens are positioned for easy access from the adjacent school, while food forests and restoration zones extend outward, reinforcing a gradient of cultivation, conservation, and biodiversity. Site-specific conditions such as wind patterns, existing vegetation, and drainage inform the design, with bioswales, and windbreaks supporting soil regeneration and microclimate creation. Accessible pathways ensure safe, engaging circulation across the site for students and the broader community.

To further strengthen the relationship between indoor and outdoor learning, this thesis also proposes reorienting Swift Waters Elementary School to face the urban farm. Classrooms are positioned to frame views of gardens, orchards, and outdoor learning zones, maintaining a strong physical and visual connection. This reorganization embeds outdoor education into daily school life, allowing students to observe ecological processes, seasonal change, and community activity, deepening their engagement with the living landscape as part of their everyday experience.



Figure 5. 2 *Key Plan of Existing Site*

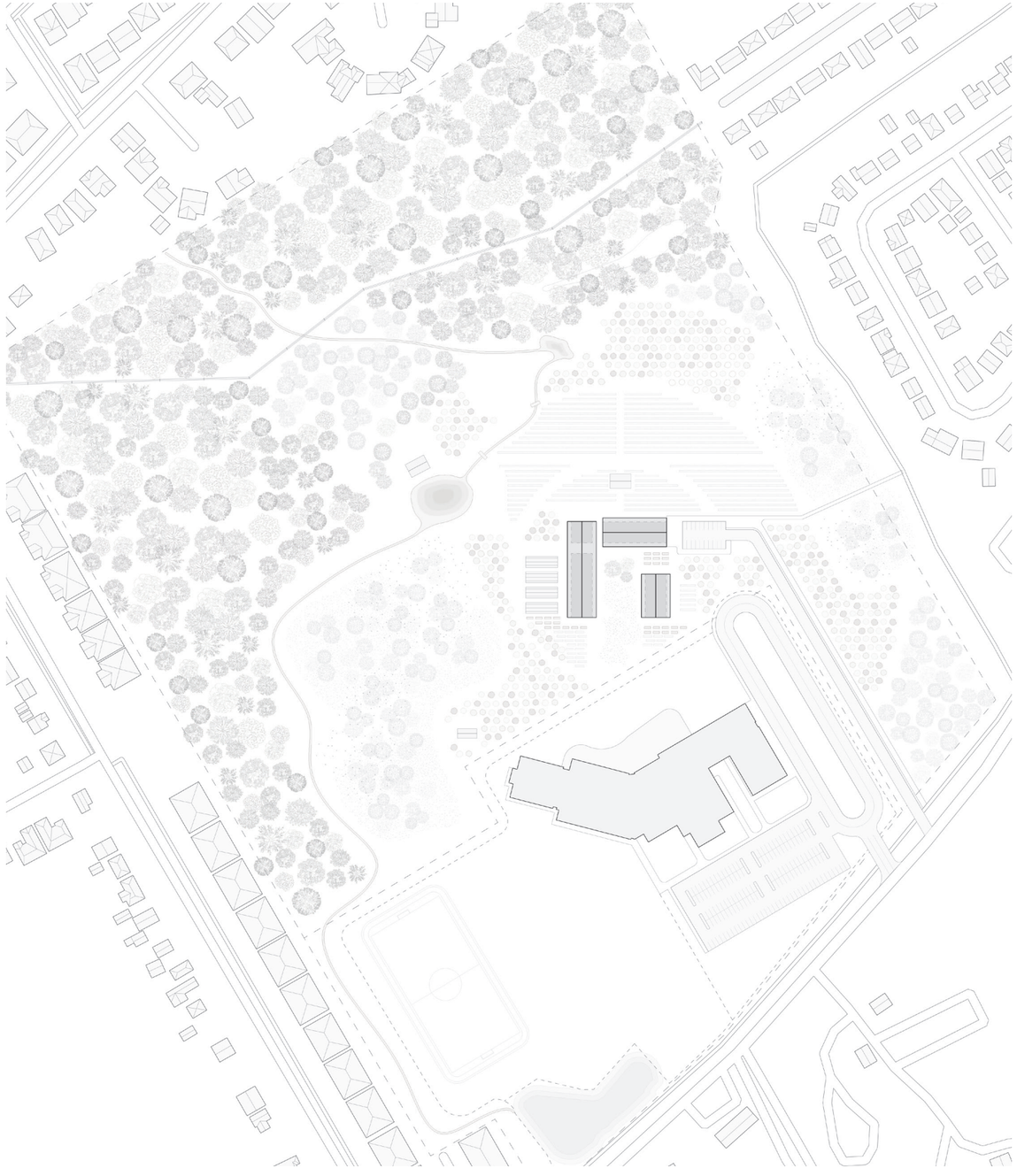


Figure 5. 3 *Site Plan Proposal for Swift Waters Urban Learning Farm*

5.3 Design Phasing and Remediation Strategy

The transformation of the former Phillips Cables brownfield site into an urban learning farm requires a phased approach to ensure that ecological restoration and site remediation occur alongside the development of educational and agricultural spaces. Given the site's industrial history and the presence of assumed soil contaminants, the first stage of intervention focuses on soil remediation through phytoremediation and regenerative land management techniques. This process not only restores soil health but also serves as an integral learning opportunity, allowing students to engage in real-world environmental restoration practices.

Phytoremediation—the use of plants to absorb, break down, or stabilize contaminants—serves as the primary remediation strategy for the site drawing on approaches outlined in *Phyto* by Kate Kennen and Niall Kirkwood.[115] This method is particularly suited for brownfields where traditional soil removal and replacement would be costly and disruptive.[116] The approach is guided by contamination assumptions outlined in Chapter 4, with specific plants selected based on their ability to target heavy metals, petroleum hydrocarbons, and persistent organic pollutants.

A review of the site's industrial history and soil testing methodology suggests that contamination is most concentrated in areas associated with manufacturing, storage, and transportation. While detailed soil analyses are limited, historical land use and typical pollutants linked to wire and cable production inform remediation strategies. The assumed contaminants across key industrial zones include heavy metals (lead, copper, zinc), petroleum hydrocarbons (PAHs, BTEX compounds), and polychlorinated biphenyls (PCBs). These contamination assumptions inform plant selection and site phasing, ensuring that phytoremediation efforts are targeted and ecologically effective.

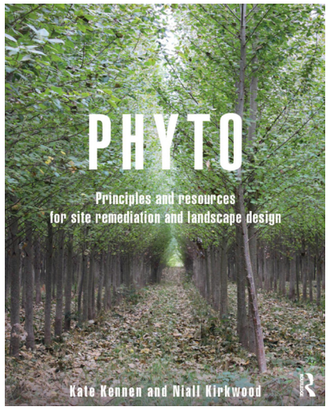


Figure 5. 4 *Image of PHYTO Cover*

Types of Phytoremediation Mechanisms

Phytodegradation (*Phytotransformation*): This process occurs when plants uptake contaminants and metabolize them into non-toxic or less harmful byproducts.[117] Organic pollutants, such as petroleum hydrocarbons, can be broken down within plant tissues or in the rhizosphere, effectively reducing contamination over time. Some plant species use photosynthesis to further degrade contaminants, incorporating biproducts into their biological processes.[118] Phytodegradation is a preferred method for remediating organic compounds because it eliminates contaminants rather than simply containing them.[119]

Rhizodegradation (*Plant-Assisted Bioremediation*): Unlike phytodegradation, where the plant itself breaks down contaminants, rhizodegradation relies on the plant's root exudates to stimulate microbial activity in the soil.[120] These exudates provide nutrients and carbon sources that support microbial populations capable of breaking down hydrocarbons and other organic pollutants. The presence of plant roots creates a more hospitable environment for beneficial bacteria and fungi, accelerating the biodegradation of contaminants.[121] This method is particularly effective in remediating petroleum-based compounds such as PAHs and BTEX, as microbial activity naturally breaks them down into harmless substances.

Phytovolatilization: In this process, plants absorb contaminants through their roots and release them into the atmosphere as a gas through transpiration.[122] This mechanism is commonly used for contaminants that exist in liquid or gaseous states, such as certain hydrocarbons and volatile organic compounds (VOCs).[123] While this method does not eliminate contaminants from the environment, it removes them from soil and groundwater, allowing for dispersion at low concentrations that do not pose significant environmental risks.

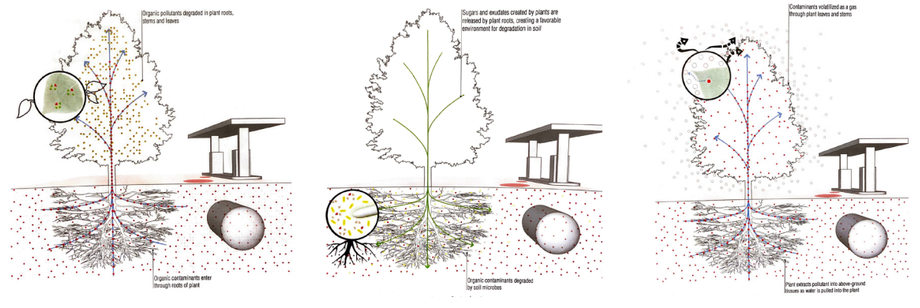


Figure 5. 5 *Diagrams showing premeditation techniques, ordered from right to left (Phytodegredation, Rhizodegradation, Phytovolatization)*

Phytoextraction: Also known as phytoaccumulation, this process involves plants absorbing contaminants from the soil and storing them in above-ground tissues, such as leaves and stems.[124] While effective for heavy metals—such as lead, copper, and zinc—this method does not degrade the contaminants but rather isolates them within the plant structure.[125] To prevent the metals from re-entering the environment, the contaminated plant material must be harvested and safely disposed of or processed.

Phytostabilization (*Phytoimmobilization*): Rather than extracting contaminants, phytostabilization prevents their movement through soil or groundwater by binding them in place.[126] Plants in this process reduce the bioavailability of contaminants by releasing chemicals that alter the form of pollutants, making them less mobile and less likely to leach into surrounding ecosystems. Additionally, plant roots stabilize the soil, reducing erosion and preventing contaminants from spreading. This method is particularly useful for sites with heavy metal contamination, as it prevents toxins from migrating off-site while allowing the land to recover.[127]

Phytometabolism (*Phytotransformation of Nutrients*): This process refers to the natural cycling of essential nutrients such as nitrogen (N), phosphorus (P), and potassium (K) within plants.[128] While not a direct remediation method for pollutants, phytometabolism enhances soil fertility and structure, supporting the long-term restoration of degraded land.[129] By fostering healthier soil conditions, this mechanism helps sustain productive agriculture and ecosystem function over time.

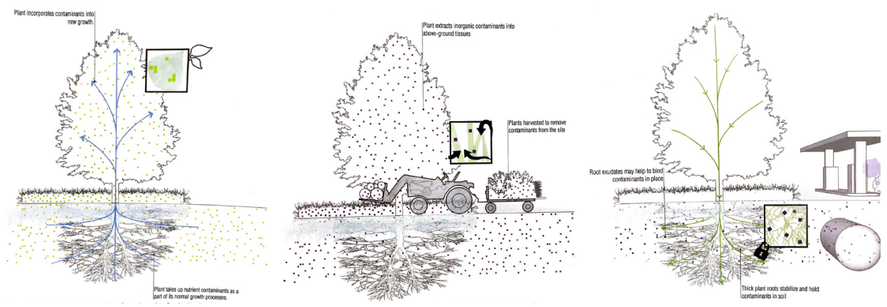


Figure 5. 6 *Digrams showing premeditation techniques, ordered from right to left (Phytoextraction, Phytostabilization, Phytometabolism)*

Applying Phytoremediation to the Urban Learning Farm Site

With the historical presence of petroleum compounds, heavy metals, and persistent organic pollutants (POPs) across the former Phillips Cables site, phytoremediation is employed as a site-specific remediation strategy. The contamination is unevenly distributed, with different pollutants concentrated in storage areas, manufacturing zones, transport corridors, electrical storage areas, and waste disposal sites. Addressing each contamination type requires careful plant selection, ensuring that species thrive in the local 6A hardiness zone while effectively remediating the soil through mechanisms suited to each contaminant type.[130]

Since BTEX compounds and PAHs are dominant in storage and transport areas, phytoremediation strategies will focus on phytovolatilization, phytodegradation, and rhizodegradation. Selected plants will be capable of breaking down hydrocarbons into less harmful compounds or stimulating microbial activity in the rhizosphere to facilitate biodegradation. These approaches ensure that petroleum residues do not persist in the soil but are instead converted into byproducts that support soil health.

In manufacturing and processing areas, where lead, zinc, and copper are expected, phytoremediation efforts will focus on phytoextraction, phytometabolism, and phytostabilization. Since zinc can be absorbed and stored within plant tissues, phytoextraction will be applied in designated areas where biomass harvesting can safely remove contamination. Copper and lead, however, require stabilization techniques, as these metals are less bioavailable to plants and can persist in the soil. Phytostabilization species will be introduced to bind these metals in place, reducing their mobility and preventing leaching into groundwater.

The former transformer and electrical storage areas, where PCBs may still be present, will be stabilized using deep-rooted vegetation that limits soil disturbance and prevents the spread of contaminants. Because PCBs are chemically stable and resistant to degradation, phytoremediation will focus on long-term phytostabilization, containing pollutants while simultaneously improving soil structure and preventing erosion.

Phytoremediation is an incremental process, requiring multiple growing seasons before measurable improvements in soil health can be observed. Given this, the remediation strategy will be staged in phases, with designated areas undergoing initial planting before being integrated into productive agricultural and educational uses. Permanent phytoremediation zones will be established in highly contaminated areas where remediation is expected to take longer, while transitional zones will incorporate species that can be later replaced with agricultural crops once contaminants reach safe levels.

Selection of Remediation Plants

The effectiveness of phytoremediation depends on selecting regionally adapted plant species that target specific contaminants while thriving in the 6A hardiness zone. The identified plants serve different remediation functions, including phytoextraction, phytodegradation, phytovolatilization, and phytostabilization, ensuring a comprehensive approach to soil restoration across the site.

BTEX Remediation

BTEX compounds (benzene, toluene, ethylbenzene, and xylene) are commonly found in storage and loading zones, transport corridors, and former industrial areas, where fuel spills and petroleum residues have accumulated.[131] These species will be planted along transport pathways and storage areas, where they will intercept petroleum-based contaminants, improve air and soil quality, and prevent further leaching of hydrocarbons into groundwater. The following trees have been selected for their ability to uptake and degrade BTEX pollutants while also contributing to canopy cover, soil stabilization, and biodiversity enhancement[132]:

- Norway Maple (*Acer platanoides*)
- Hackberry Tree (*Celtis occidentalis*)
- Honey Locust (*Gleditsia triacanthos*)
- Eastern Red Cedar (*Juniperus virginiana*)
- Jack Pine (*Pinus banksiana*)
- Bur Oak (*Quercus macrocarpa*)



Figure 5. 7 Images of plant species used for BTEX remediation, ordered right to left (Norway Maple, Hackberry Tree, Honey Locust, Eastern Red Cedar, Jack Pine, Bur Oak)

PAH Remediation

Polycyclic aromatic hydrocarbons (PAHs) are another class of petroleum-based contaminants, often found in rail corridors, industrial processing areas, and asphalt-laden zones.[133] These pollutants require phytodegradation and rhizodegradation, with plant species that stimulate microbial activity and accelerate hydrocarbon breakdown in the root zone.[134] A diverse mix of grasses, herbaceous plants, and trees will be used to remediate PAH-contaminated areas, balancing fast-growing cover crops with long-term stabilizing vegetation. These plants will be concentrated in former industrial workspaces, rail corridors, and paved surfaces, where they will absorb and degrade PAHs while contributing to habitat restoration.[135]

- Native Grasses and Sedges: Big Bluestem (*Andropogon gerardii*), Side Oats Grass (*Bouteloua curtipendula*), Buffalo Grass (*Buchloe dactyloides*), Blue Grama (*Bouteloua gracilis*), Oval Hedged Sedge (*Carex scoparia*), Bottlebrush Grass (*Elymus hystrix*), Red Fescue (*Festuca rubra*), and Indian Grass (*Sorghastrum nutans*).
- Wildflowers and Herbaceous Plants: Sticky Geranium (*Geranium viscosissimum*), Sunflowers (*Helianthus annuus*), Switchgrass (*Panicum virgatum*), Little Bluestem (*Schizachyrium scoparium*), Goldenrod *(Solidago spp.*), and Clover (*Trifolium spp.*).
- Trees and Shrubs: European White Birch (*Betula pendula*), Eastern Redbud (*Cercis canadensis*), Green Ash (*Fraxinus pennsylvanica*), and Willow (*Salix spp.*).



Figure 5. 8 Images of plant species used for PAH remediation ordered right to left (Buffalo Grass, Sticky Geranium, White Birtch, Oval Hedges Sedge, Sunflower, Green Ash)

Heavy Metal Remediation (Zn, Cu, Pb)

Heavy metals, including zinc (Zn), copper (Cu), and lead (Pb), persist in the soil and do not degrade over time.[136] Therefore, remediation efforts rely on phytoextraction (for Zn and Cu) and phytostabilization (for Pb). Zinc and copper can be absorbed and stored in plant tissues, allowing for periodic biomass harvesting to remove contaminants from the site. Lead, however, must be stabilized in place using deep-rooted plants that bind it within the soil matrix, preventing it from becoming bioavailable. These species will be introduced in manufacturing and metal-processing areas, as well as waste disposal sites, where they will prevent the spread of contamination while gradually restoring soil health.[137]

- Red Fescue (*Festuca rubra*)
- Horseweed (*Conyza canadensis*)
- Sunflower (*Helianthus annuus*)
- Willow (*Salix spp.*)
- White Poplar (*Populus alba*)



Figure 5. 9 Images of plant species used for heavy metals remediation ordered right to left (Red Fescue, Horseweed, Sunflower, Willow, White Poplar)

PCB Remediation

Polychlorinated biphenyls (PCBs), found in former transformer storage areas and scrap disposal zones, present a significant challenge due to their chemical stability and persistence in the environment.[138] Phytostabilization and phytovolatilization are the most effective remediation strategies, preventing leaching while slowly breaking down contaminants into less harmful compounds.[139] These plants will be established in designated remediation areas, where their deep root systems and high biomass production will help contain and gradually process PCB residues over multiple growing seasons.[140]

- Groundcovers & Herbaceous Plants: Zucchini (*Cucurbita pepo*), Pumpkin (*Cucurbita maxima*), Queen Anne's Lace (*Daucus carota*), and Goldenrod (*Solidago spp.*).
- Woody Shrubs & Trees: Osage Orange (*Maclura pomifera*), and Red Mulberry Tree (*Morus rubra*).

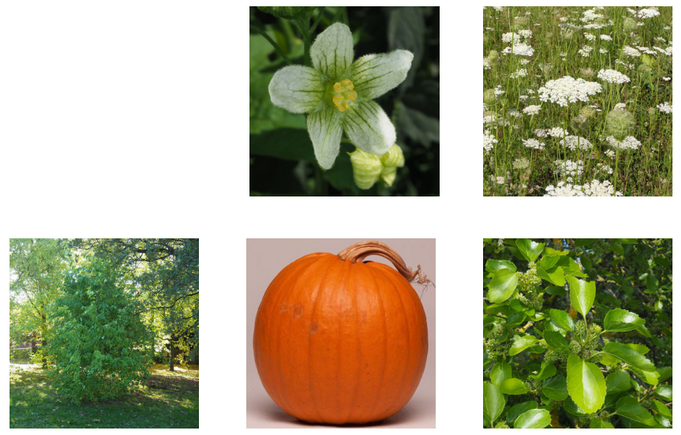


Figure 5. 10 Images of plant species used for PCB remediation ordered right to left (Zucchini, Queen Anne's Lace, Osage Orange, Pumpkin, Red Mulberry Tree)

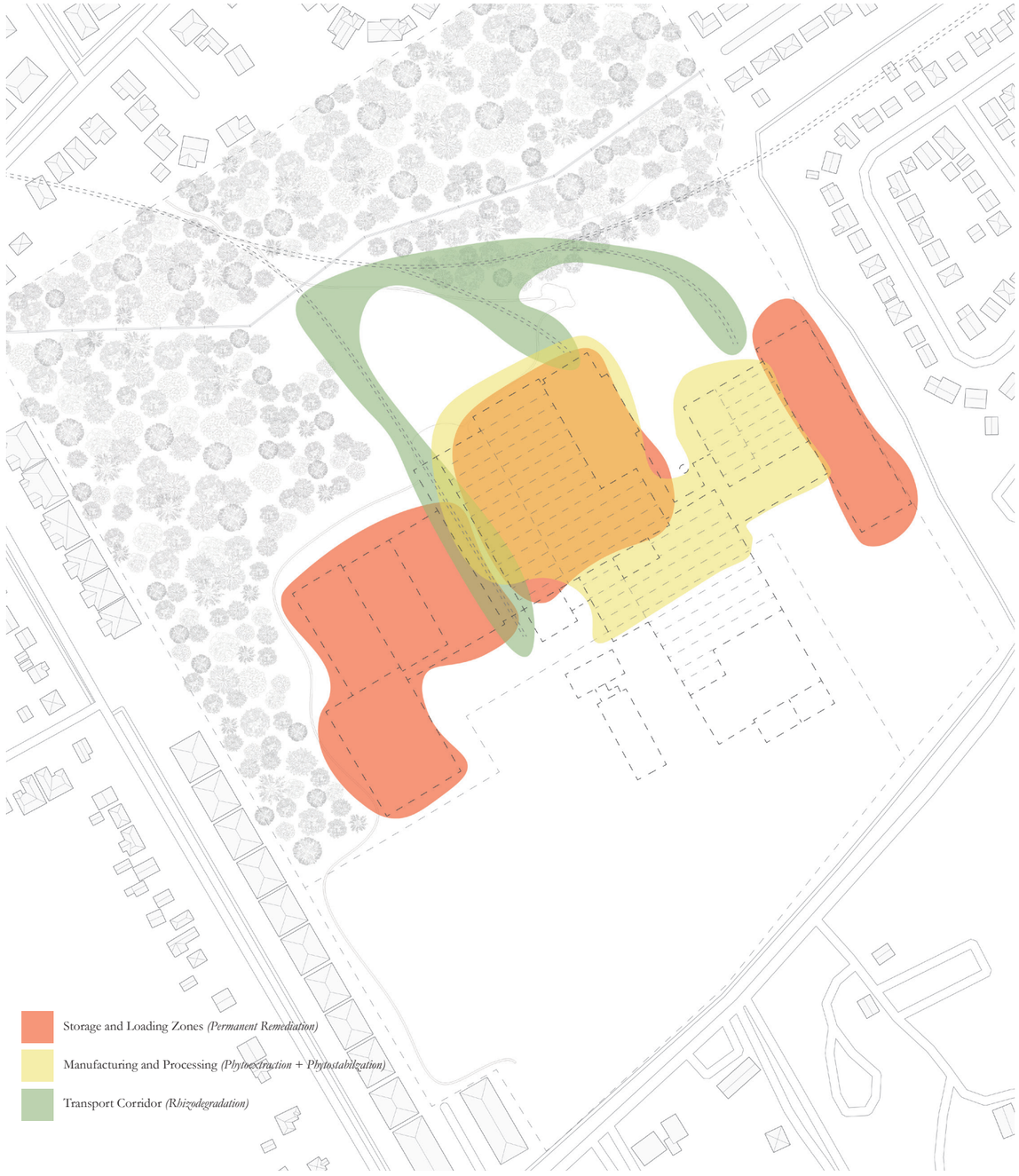


Figure 5. 11 Phytoremediation planting zones plan

Phytoremediation Planting Strategy by Contamination Zone

Phytoremediation on the Swift Waters Urban Learning Farm is spatially tailored to address distinct contamination zones left by industrial activity. The planting strategy prioritizes targeted soil remediation while supporting broader ecological functions, ensuring the site transitions from a brownfield to a productive landscape. The storage and loading zones, identified as the most highly contaminated areas due to their likely exposure to petroleum hydrocarbons (PAHs, BTEX compounds) and polychlorinated biphenyls (PCBs), will remain dedicated remediation zones. Given the persistence of these contaminants in the soil, phytoremediation efforts in these areas will focus on stabilization and long-term degradation rather than immediate extraction. Deep-rooted grasses and fast-growing pioneer species will initiate decontamination by enhancing microbial activity, accelerating the natural breakdown of petroleum residues.[141] Tree plantings with high transpiration rates will support phytovolatilization, gradually releasing volatile compounds into the atmosphere at safe levels.[142] Additionally, strategic buffer zones along transport pathways will help contain residual contamination and prevent leaching into adjacent soils.

In contrast, the manufacturing and processing areas, where heavy metals such as lead, copper, and zinc have accumulated from industrial waste and wire coating processes, will require a different remediation approach. Because heavy metals do not degrade naturally, phytoremediation in these areas will rely on controlled extraction and stabilization techniques. Phytoextraction species will be planted in rotation, allowing for periodic biomass harvesting to remove accumulated metals and prevent recontamination.[143] Phytostabilization efforts will focus on deep-rooted plants that chemically immobilize contaminants, preventing their migration into groundwater.[144]

Transport corridors, including former rail and trucking areas, represent transition zones with a mix of hydrocarbon and heavy metal contamination. These spaces will function as ecological buffers, filtering pollutants before they spread into lower-contamination areas. Mixed-species plantings will be established to capture contaminants while simultaneously supporting broader ecological restoration. Rhizosphere-enhancing vegetation will promote microbial remediation, breaking down hydrocarbon residues while improving soil aeration.[145] Stabilizing tree and shrub belts will serve as windbreaks, mitigating airborne contaminant spread and reinforcing soil structure.

Each phytoremediation strategy is implemented in phases to allow for progressive soil restoration while ensuring minimal disruption to future site functions. Initial plantings will establish remediation species in high-contamination areas, anchoring soil and initiating pollutant uptake. Adaptive monitoring will inform planting adjustments and targeted biomass removal where necessary. In the long term, once contaminants reach safe levels, areas outside of the permanently designated remediation zones can transition into productive agricultural and educational landscapes. By mapping phytoremediation to site-specific contamination conditions, this strategy not only facilitates soil recovery but also reinforces habitat resilience, making the farm a dynamic model of ecological restoration in practice.

5.4 Zone Breakdown: A Permaculture Approach

The spatial organization of the Swift Waters Urban Learning Farm is structured using permaculture zoning principles, where land use intensity is determined by frequency of human interaction, ecological function, and the regenerative capacity of the site. This method ensures that remediation efforts, agricultural productivity, and learning spaces are seamlessly integrated, allowing the farm to operate as a dynamic, evolving system.

Zone 1: Core Activity & Learning Hub (Most Frequently Used)

At the core of the site, this zone serves as the primary area for daily activity, including education, community engagement, and farm management. It encompasses built structures, gathering spaces, and intensively managed growing areas such as raised beds, herb gardens, and polytunnel production. This zone is designed for frequent human interaction, supporting outdoor classrooms, hands-on workshops, and demonstration plots that showcase sustainable growing practices.

Zone 2: Intensive Agricultural Production & Transition Areas

Expanding outward from the learning hub, Zone 2 hosts productive agricultural spaces, including rotational cropping systems utilizing companion planting strategies. These areas require regular but not constant attention, balancing food production with soil regeneration. This zone also includes transition areas where phytoremediation is underway, allowing for the gradual integration of agricultural activities as contaminants are remediated.

Zone 3: Agroforestry & Orchards (Less Frequent Maintenance, Ongoing Ecological Function

This zone integrates remediation species and food-producing trees and shrubs, creating a long-term productive landscape while continuing soil regeneration through deep-rooted species. It includes fruit and nut orchards, and windbreaks. The design prioritizes low-maintenance, resilient plant systems that require seasonal care rather than daily intervention.

Zone 4: Remediation & Ecological Buffer Zones (Minimal Human Interaction, Passive Restoration) - This zone is primarily designated for long-term phytoremediation, targeting the most contaminated areas of the site—particularly storage and loading zones where PAHs, BTEX, and PCBs persist in the soil. Due to the high level of contamination, this area will remain in continuous remediation rather than transitioning to agricultural production. Deep-rooted trees, native grasses, and mycoremediation species will work to stabilize and break down contaminants, gradually restoring soil health. These areas also function as wildlife corridors and habitat zones, reinforcing ecological connectivity with adjacent forested areas.

Zone 5: Wild & Unmanaged Zones (Naturalized Landscape, Ecological Succession)

At the periphery of the site, Zone 5 remains largely untouched, allowing for natural regeneration and ecosystem self-regulation. This area serves as a buffer between the urban farm and the surrounding environment, supporting native plant communities, pollinator habitat, and stormwater absorption. It plays a key role in biodiversity conservation and soil-building, ensuring the site remains ecologically balanced over time.

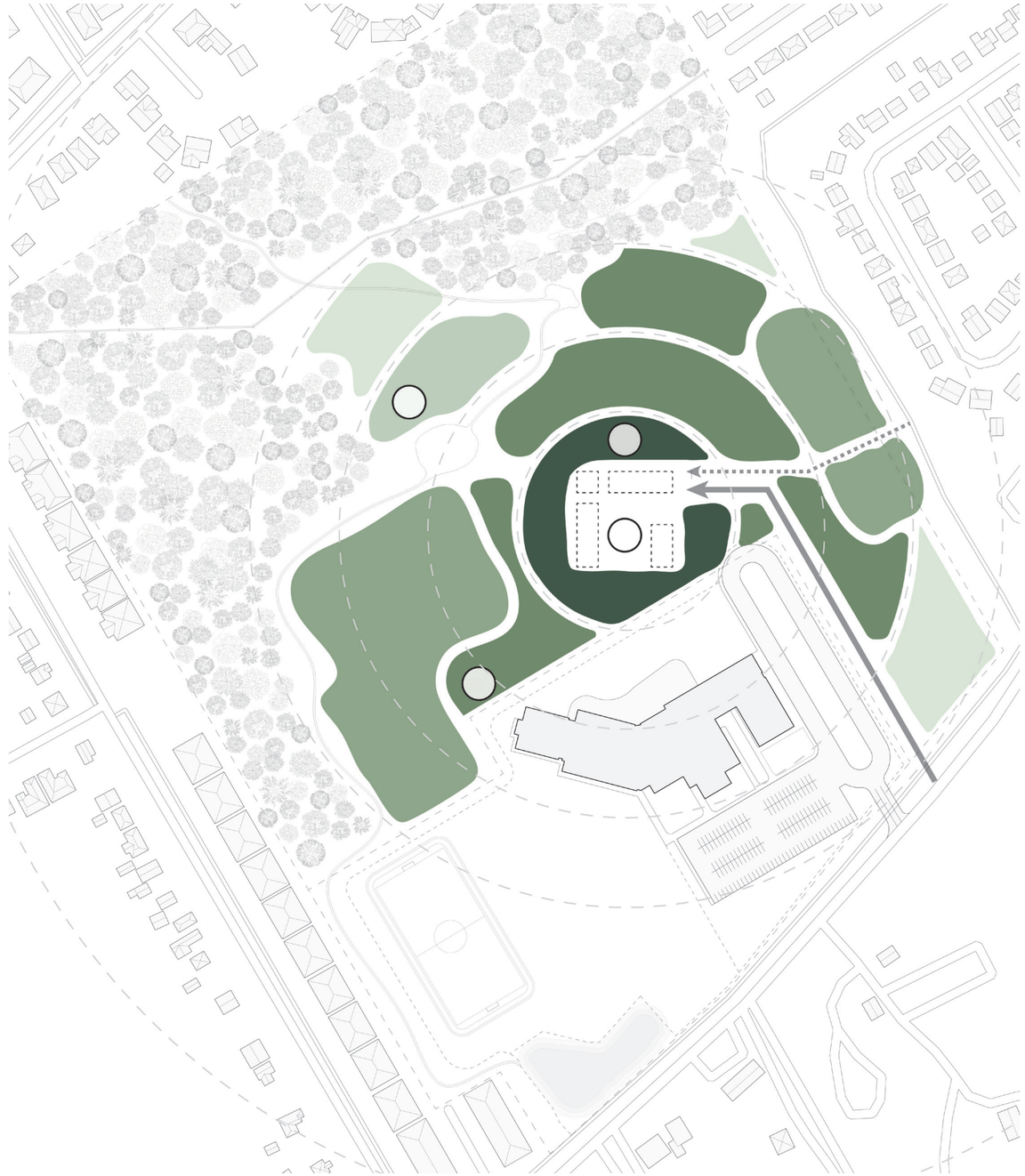


Figure 5. 12 *Site Plan Zoning*

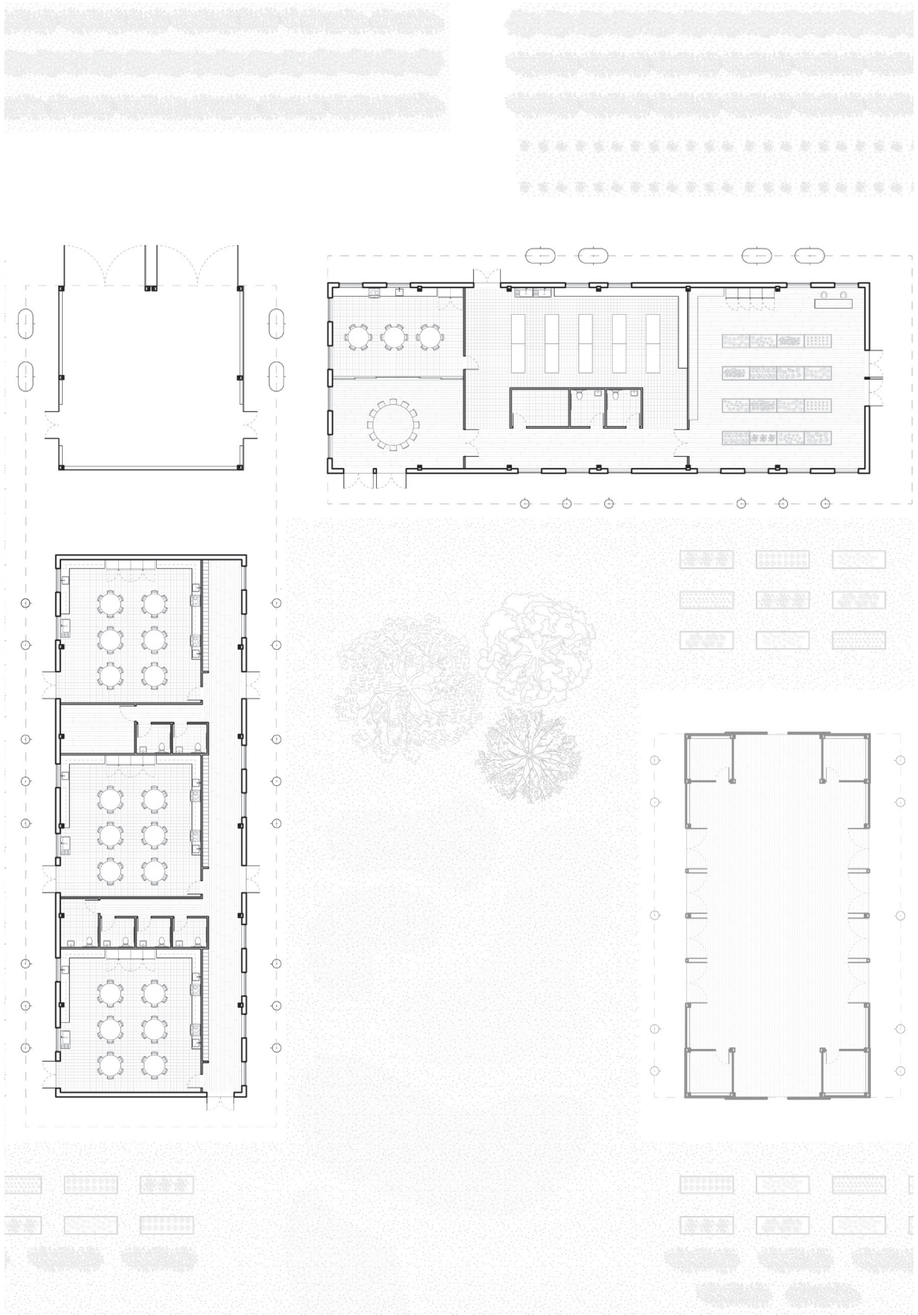


Figure 5. 13 Floor Plans of Zone 1 Buildings

5.5 Building Design

The architectural design of the Swift Waters Urban Learning Farm integrates flexible, functional spaces that support both educational programming and community engagement. The built environment is designed to be adaptable, fostering experiential learning while reinforcing the farm's broader goals of sustainability and environmental stewardship. Three key structures form the core of the project: the **Teaching Kitchen**, the **Teaching Pavilion**, and the **Public Building**. Each is positioned strategically within the site to ensure efficient circulation, accessibility, and integration with outdoor learning environments.

Teaching Kitchen

The Teaching Kitchen serves as a central hub for food literacy and hands-on culinary education. Designed for both structured lessons and informal workshops, the space includes communal tables, food preparation stations, and storage for farm-grown produce. Its adjacency to productive growing spaces strengthens the connection between cultivation, nutrition, and sustainable cooking practices. This space is intended to host activities such as farm-to-table workshops, student-led food preparation, and educational demonstrations that highlight the intersection of agriculture, ecology, and culinary arts.

Teaching Pavilion

The Teaching Pavilion provides a flexible, open-air learning environment designed for workshops, seasonal programming, and group activities. As a covered but unenclosed space, it offers protection from the elements while maintaining a strong connection to the surrounding farm landscape. The pavilion's adaptable layout supports a variety of uses, from hands-on agricultural lessons to outdoor lectures, reinforcing the farm's role as a dynamic educational space. The structure encourages fluid engagement with the site, allowing students and visitors to interact with the land while benefiting from a shaded and sheltered setting.

Public Building

The Public Building serves as a multi-purpose facility that supports both educational and community functions. Designed to accommodate larger gatherings, discussions, and farm-based activities, it acts as an interface between the farm and the broader community. The space is programmed to host events such as community meetings, farm-to-market sales, and interdisciplinary learning sessions, creating a bridge between student-led initiatives and public engagement. Positioned to transition between cultivated farm plots and structured learning zones, the building fosters interaction between students, educators, and visitors.

Additionally, Zone 1 includes a Barn Structure, which provides essential storage for tools, equipment, and materials used across the farm. Though not intended for programmed learning activities, the barn plays a critical supporting role in the daily operations of the site. Its proximity to both the productive growing areas and teaching spaces ensures efficient access for students, staff, and volunteers, reinforcing the functional backbone of the farm while contributing to the overall rhythm and organization of Zone 1.

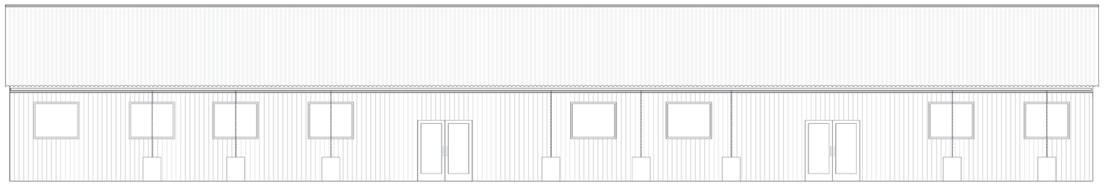


Figure 5. 14 *Teaching Kitchen East Elevation, 1:200*

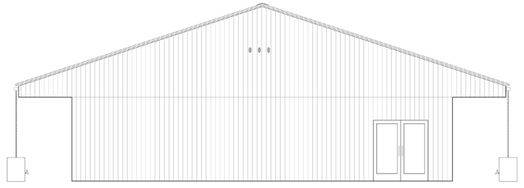


Figure 5. 15 *Teaching Kitchen South Elevation, 1:200*

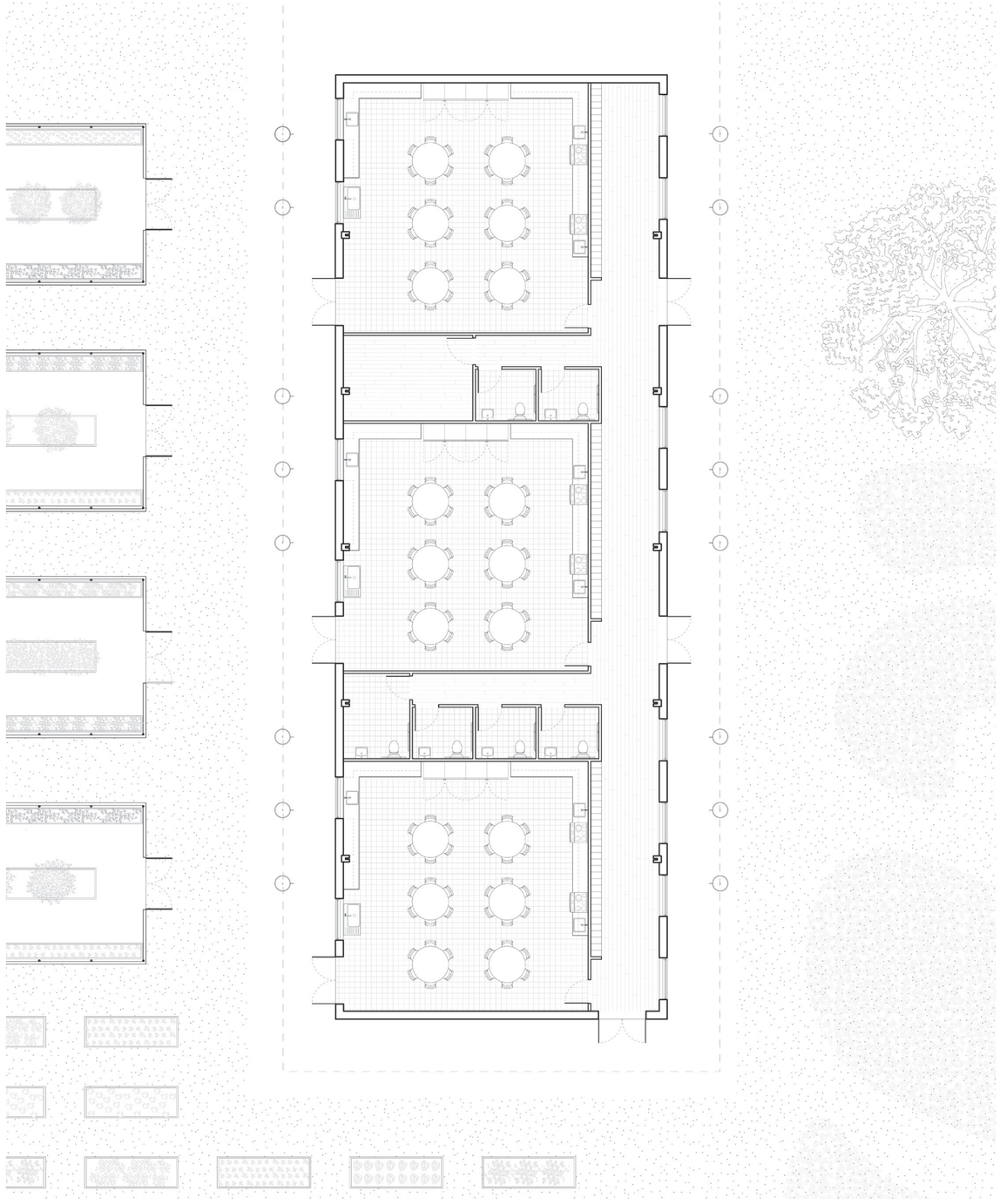


Figure 5. 16 *Teaching Kitchen Plan, 1:200*



Figure 5. 17 *Render of Teaching Kitchen Interior*

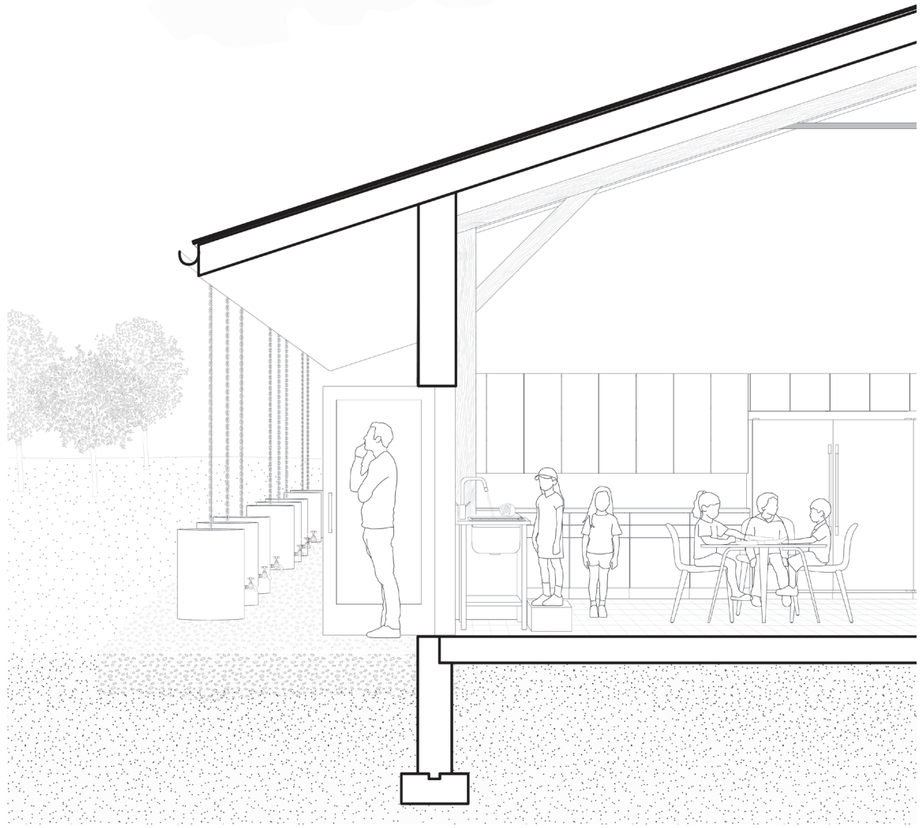


Figure 5. 18 *Teaching Kitchen section perspective illustrating reimagined Health and Physical Education OEC D2.1 "Farm to Table" Grade 6*

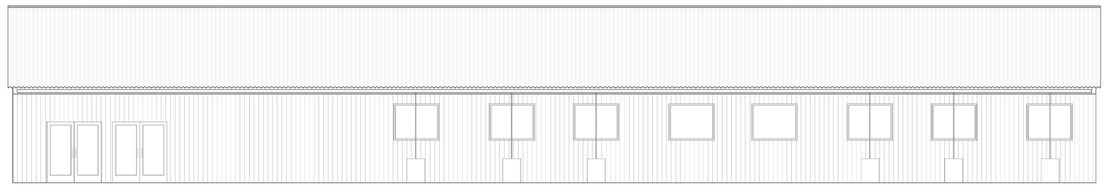


Figure 5. 19 *Pubic Building North Elevation, 1:200*

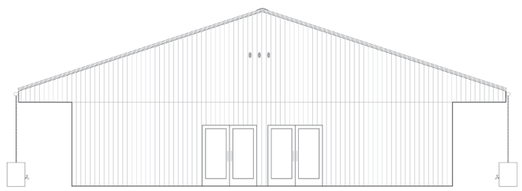


Figure 5. 20 *Public Building East Elevation, 1:200*

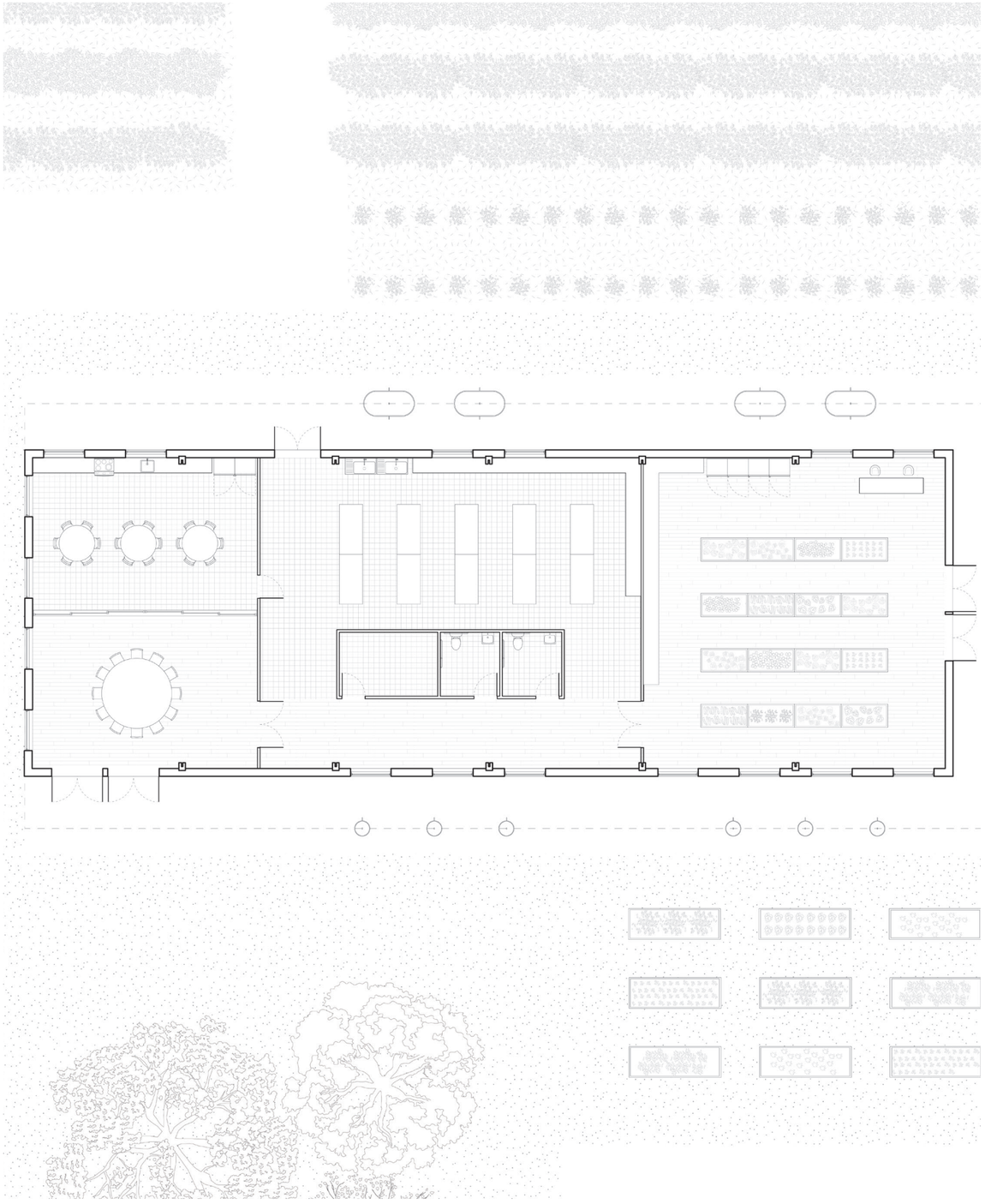


Figure 5. 21 *Public Building Plan 1:200*



Figure 5. 22 *Render of Public Building Exterior*



Figure 5. 23 *Public Building section perspective*



Figure 5. 24 *Teaching Pavilion West Elevation, 1:200*

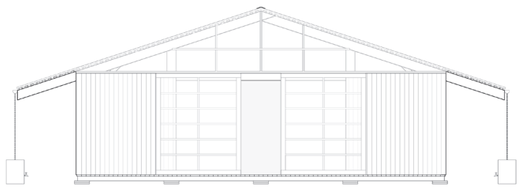


Figure 5. 25 *Teaching Pavilion South Elevation, 1:200*

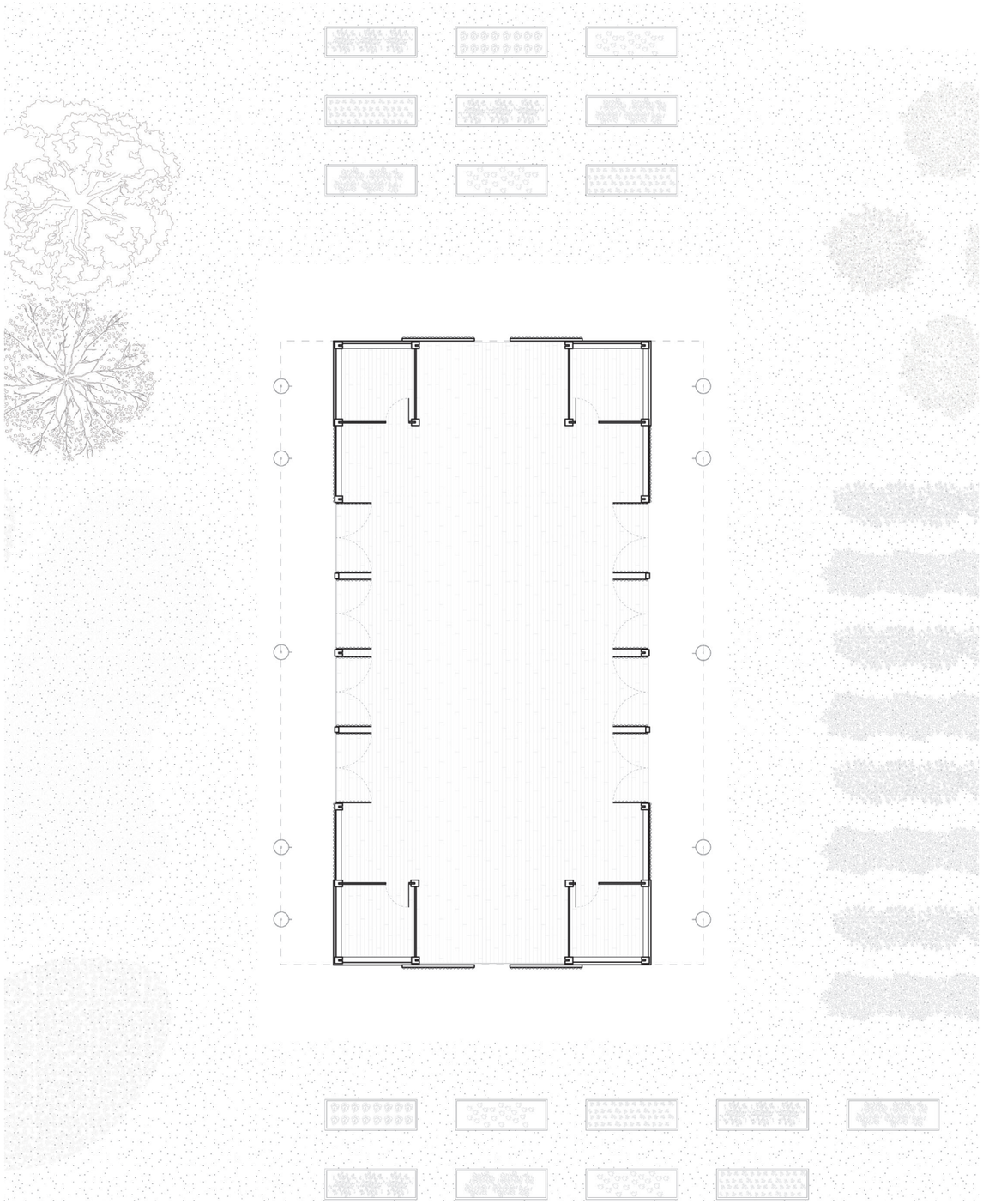


Figure 5. 26 *Teaching Pavilion Plan 1:200*



Figure 5. 27 *Render of Teaching Pavilion Interior*



Figure 5. 28 *Teaching Pavilion section perspective illustrating reimagined OE20.5 "Sorting Farm Discoveries" Kindergarten*

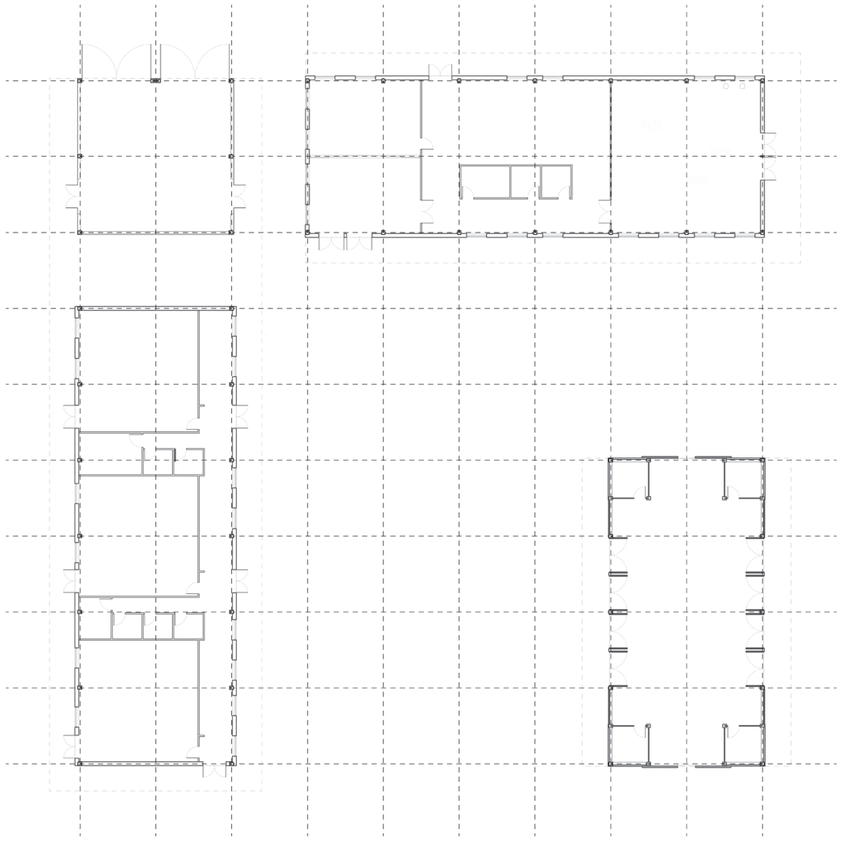


Figure 5. 29 Zone 1 Building Grid System

5.6 Structure Design

Following the development of building form and program in the previous section, this portion of the thesis shifts focus toward the structural and envelope strategies of the buildings within Zone 1. The intent was not only to design spatially functional and pedagogically responsive architecture, but also to consider how construction methods and material assemblies could reinforce the project's broader goals of sustainability, replicability, and integration with the broader site systems.

The following sections outline the structural design and envelope considerations of the Zone 1 buildings, emphasizing how construction logic and material choices were used to express the project's core values through built form.

Grid System

The buildings within Zone 1 are organized around a consistent grid, reinforcing the idea of a unified system—even within the architectural expression. This grid functions as both a spatial and structural framework, supporting modularity, ease of construction, and visual cohesion across the diverse program types.

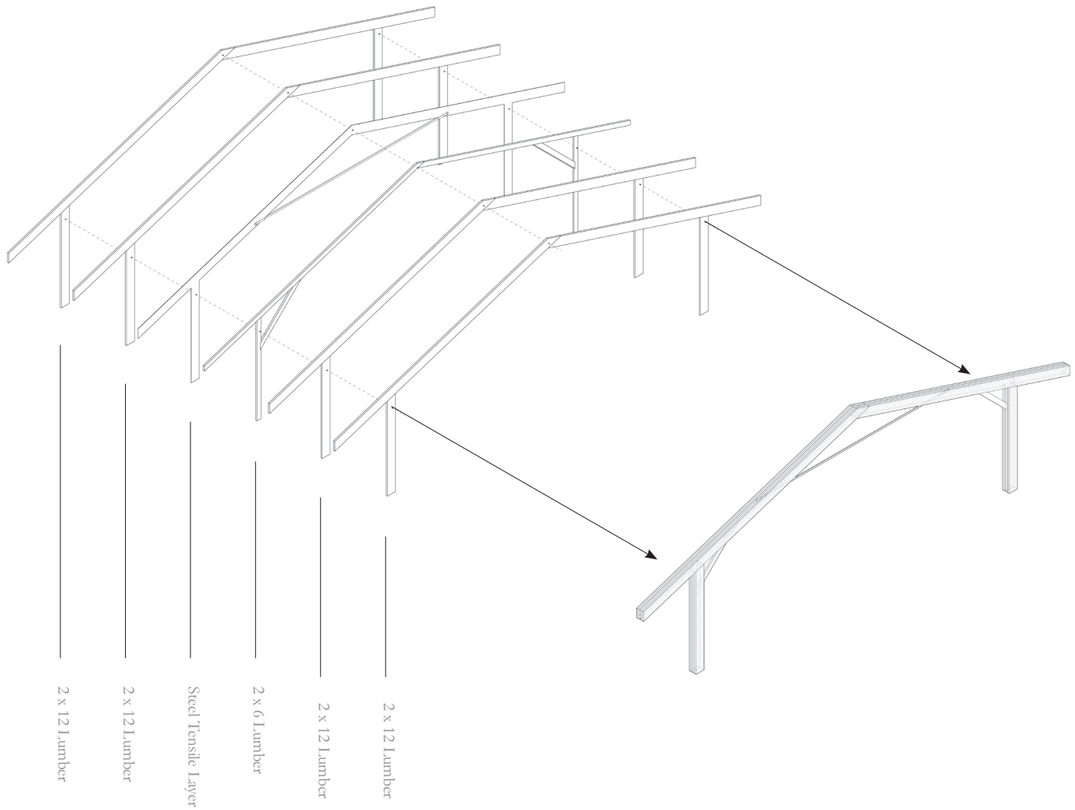


Figure 5. 30 *Composite Truss Unit Diagram*

Composite Truss Unit

All three structures share a custom composite wood truss system, developed by layering dimensional lumber with a central steel tensile member. The assembly consists of six components: two outer pairs of 2x12" lumber, a central 2x6", and a ¼" steel plate, all fastened with pairs of 1" bolts spaced 24" o.c.. This robust construction strategy allows the trusses to span generously while maintaining structural clarity and repetitive efficiency. Designed with standard materials and simple fabrication methods, the system prioritizes constructibility, material availability, and long-term durability—reinforcing the project's commitment to practical, expressive, and replicable design.

Teaching Pavilion

The Teaching Pavilion is an open-air structure with exposed composite wood trusses, which provide both structural support and visual rhythm. A wood decking floor elevates the space slightly, creating a clear threshold while supporting drainage. A translucent polycarbonate roof shelters the pavilion while allowing natural light to filter through.

Operable polycarbonate doors offer optional enclosure without disrupting the visual connection to the surrounding farm. Whether open or closed, the pavilion maintains its transparency and openness, reinforcing its role as a flexible learning space that blurs the boundary between built structure and landscape.

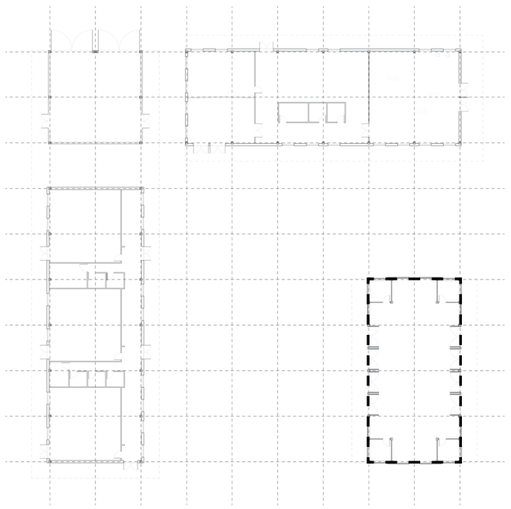


Figure 5. 31 Key Plan of Teaching Pavilion Structure Location

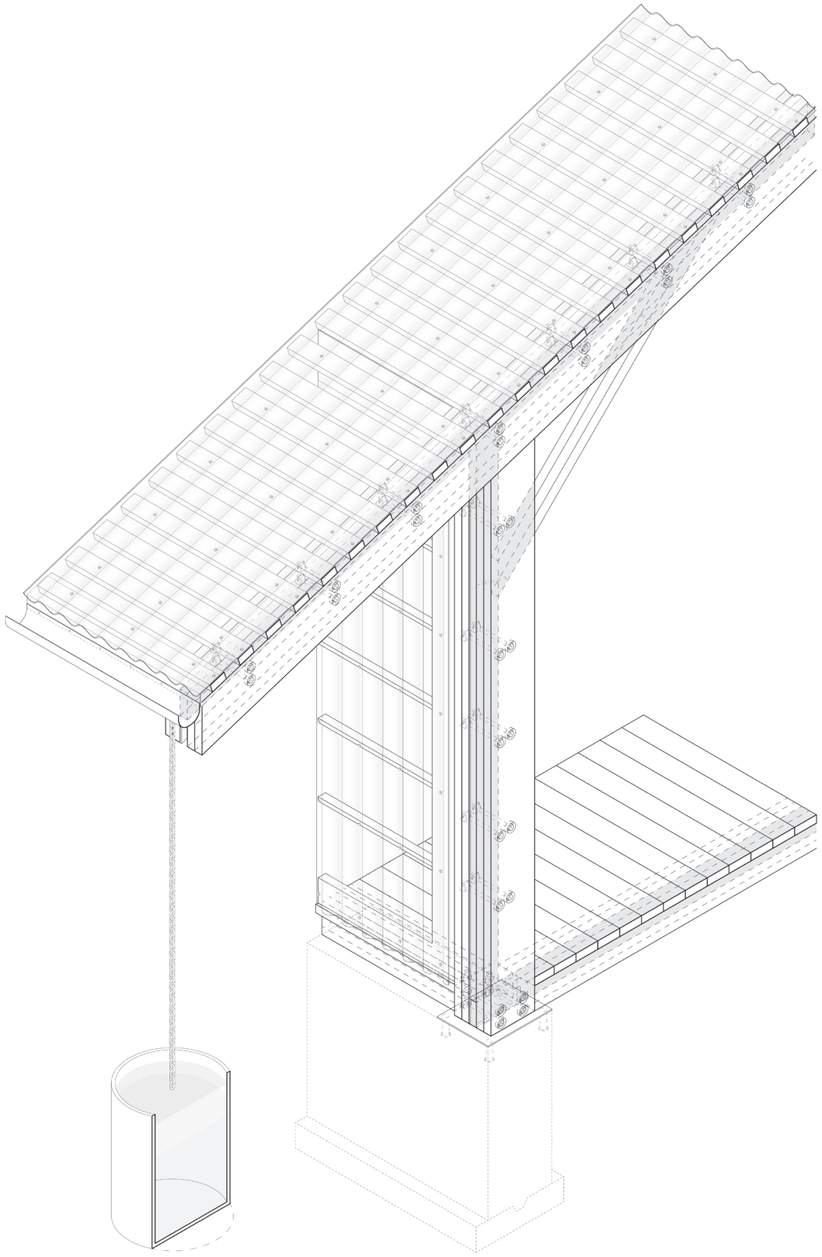


Figure 5. 32 Teaching Pavilion Isometric Construction Diagram

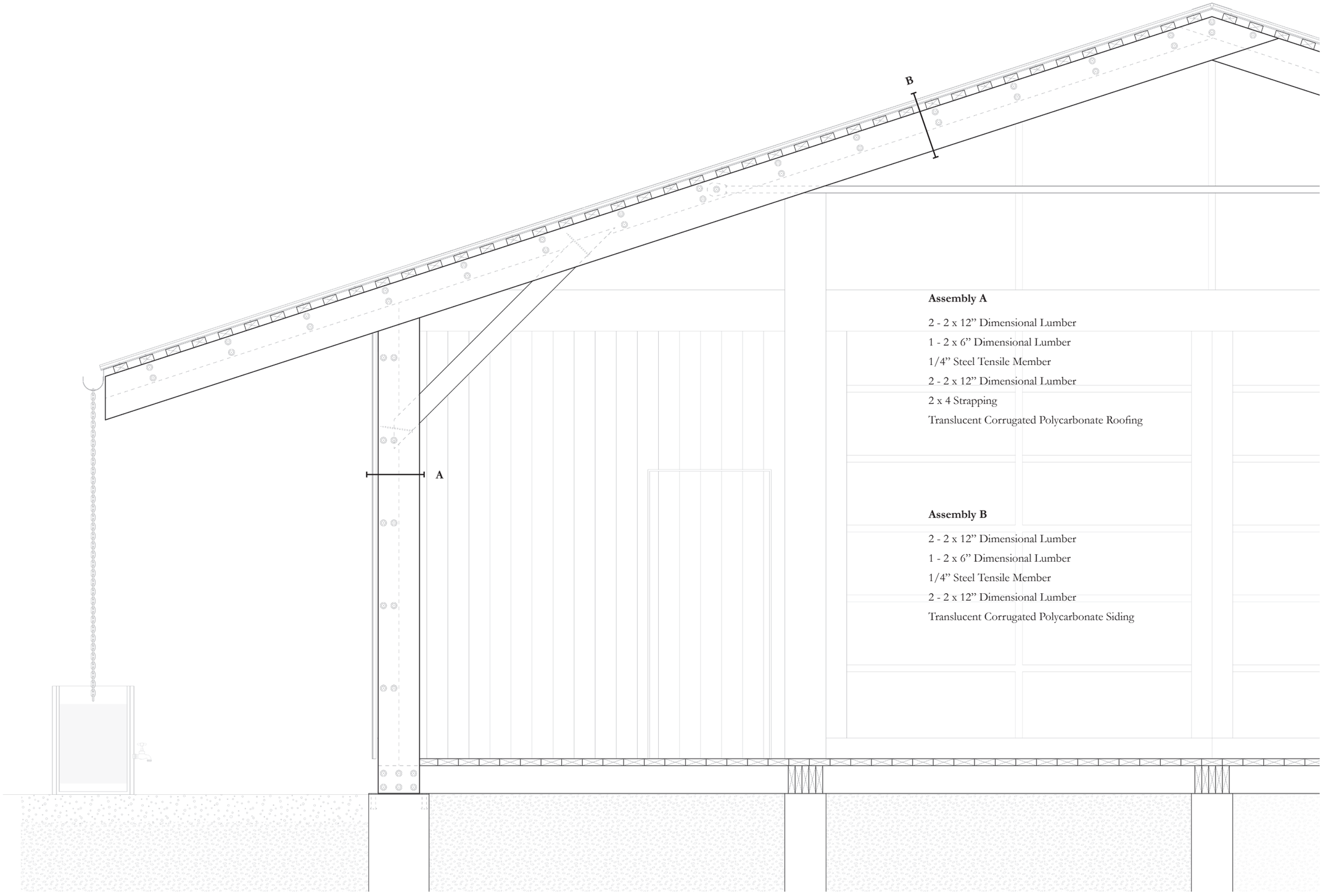


Figure 5. 33 Teaching Pavilion Section of Wall Assemblies

Teaching Kitchen and Public Building

The Teaching Kitchen and Public Building are fully enclosed, but their structure remains partially visible. By offsetting the enclosure layers 6 inches outward, portions of the composite truss system are exposed along the interior, offering a glimpse into the building's construction. This subtle reveal reinforces the farm's broader ethos of transparency, legibility, and learning through making—encouraging users to engage with how the space is built as much as how it is used.

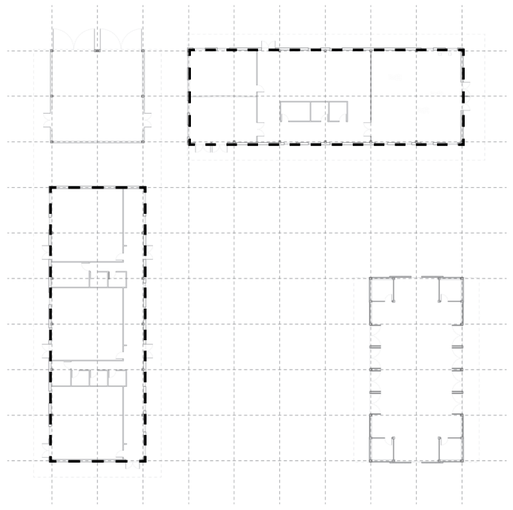


Figure 5. 34 *Key Plan of Teaching Kitchen & Public Structure Location*

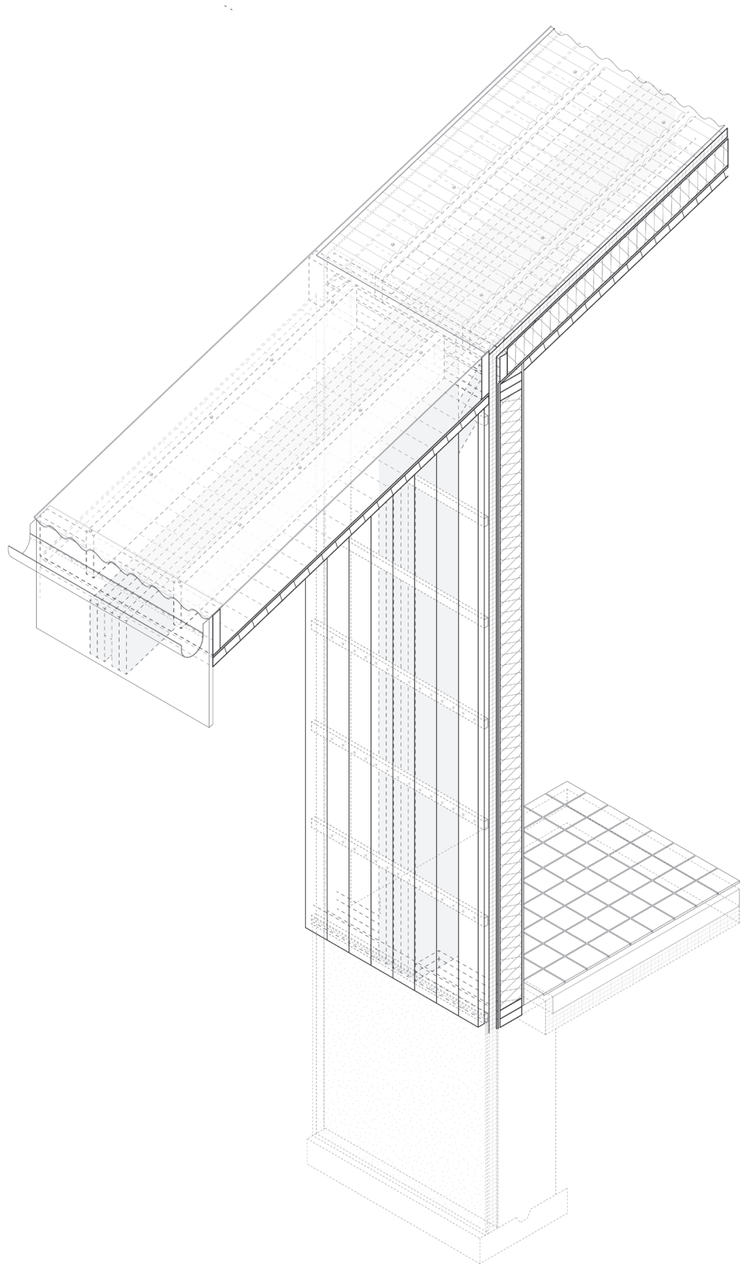
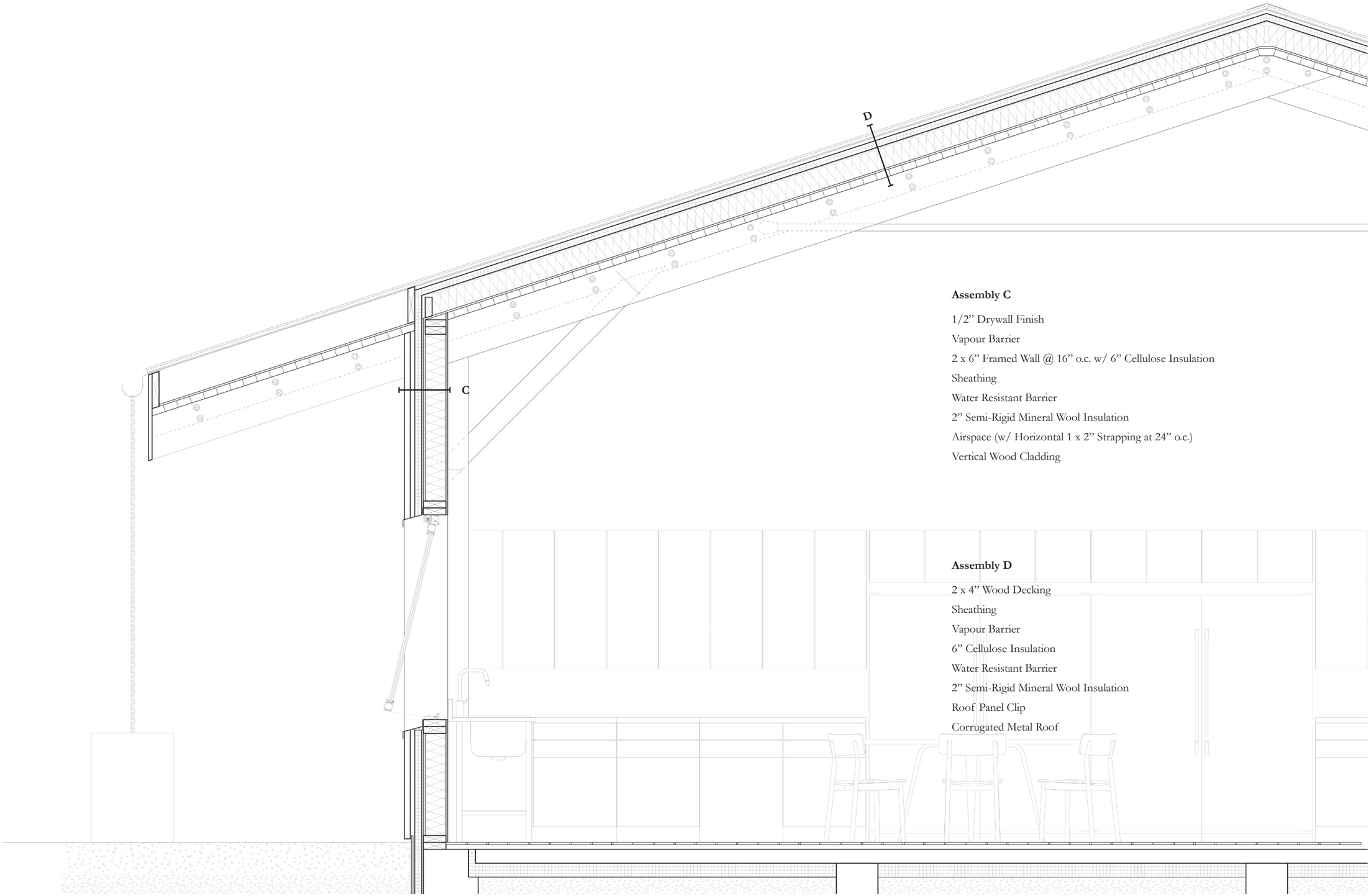


Figure 5. 35 *Teaching Kitchen Isometric Construction Diagram*



Assembly C

1/2” Drywall Finish
Vapour Barrier
2 x 6” Framed Wall @ 16” o.c. w/ 6” Cellulose Insulation
Sheathing
Water Resistant Barrier
2” Semi-Rigid Mineral Wool Insulation
Airspace (w/ Horizontal 1 x 2” Strapping at 24” o.c.)
Vertical Wood Cladding

Assembly D

2 x 4” Wood Decking
Sheathing
Vapour Barrier
6” Cellulose Insulation
Water Resistant Barrier
2” Semi-Rigid Mineral Wool Insulation
Roof Panel Clip
Corrugated Metal Roof

Figure 5. 36 Teaching Kitchen Section of Wall Assemblies

5.7 Key Outdoor Educational Spaces

Pond Learning Zone

The Pond Learning Zone transforms an existing low-lying area of the site—where water naturally pools—into a deeper, ecologically rich pond that functions as a thriving aquatic ecosystem. By enhancing and populating this space with native aquatic vegetation and supporting biodiversity, the pond becomes an educational tool for studying water cycles, habitat restoration, and ecosystem interdependencies.

Adjacent to the pond is an open-air shade structure, designed to mirror the architectural language of the Teaching Pavilion for continuity across the site. This sheltered space provides a comfortable setting for outdoor learning, allowing students and visitors to engage with the pond's ecology in a shaded environment.

Situated on the northwest side of the site, the Pond Learning Zone is uniquely positioned at the intersection of two contrasting ecosystems: a natural forest and a permaculture-inspired crop forest populated with fruit trees. This rich layering of landscapes makes the zone an immersive and dynamic learning environment, offering opportunities to observe how water, soil, and plant life interact across different ecological conditions.

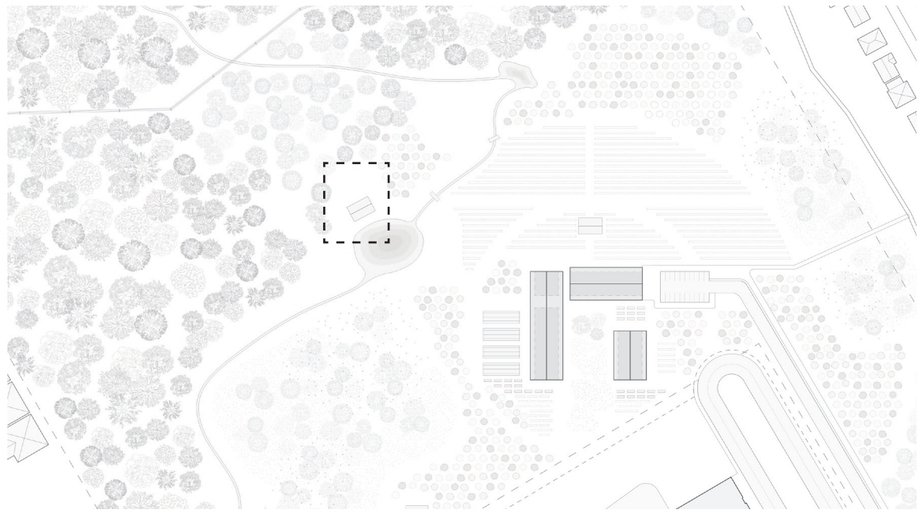


Figure 5. 37 Key Plan of Pond Learning Zone

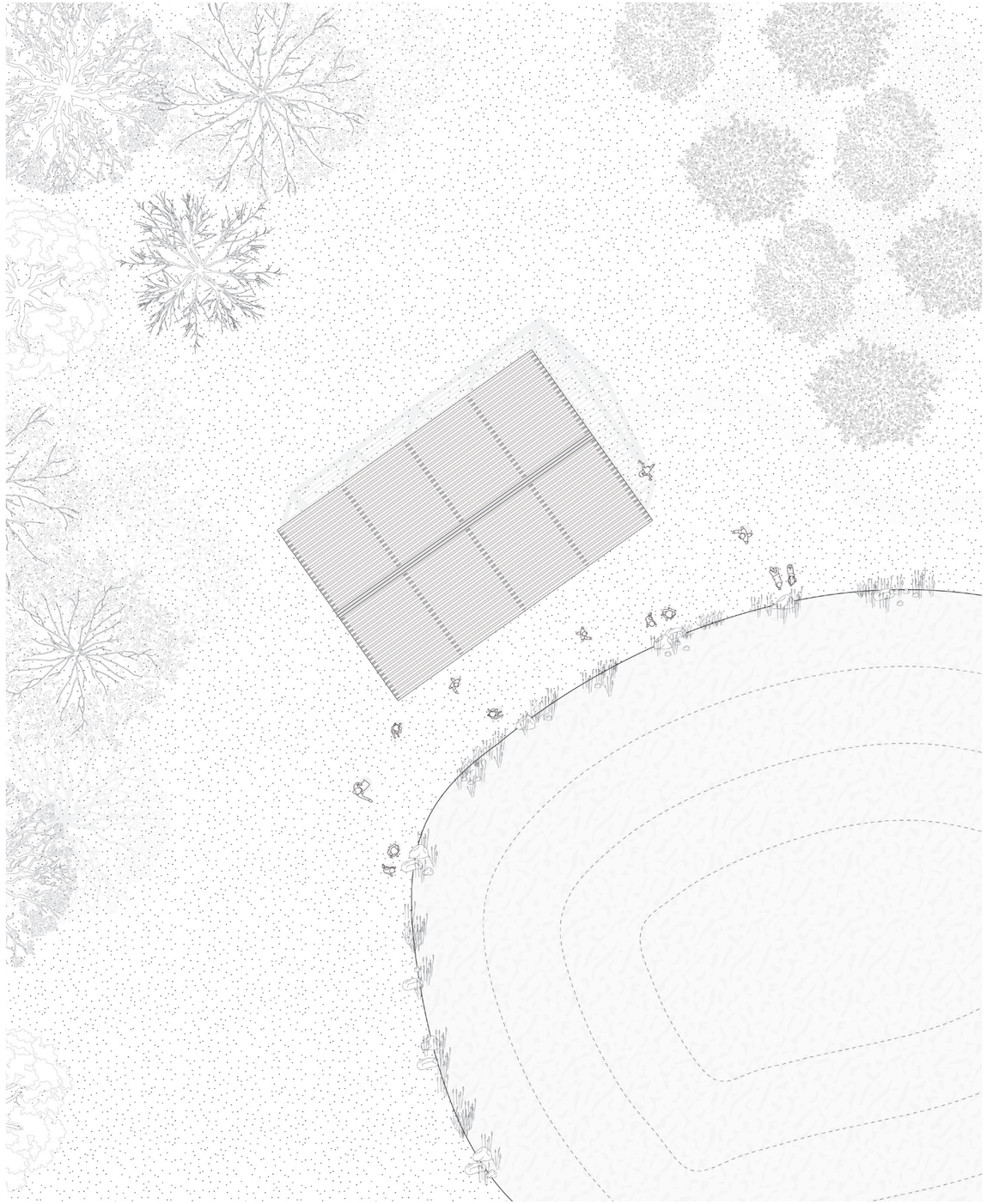


Figure 5. 38 Pond Learning Zone Plan

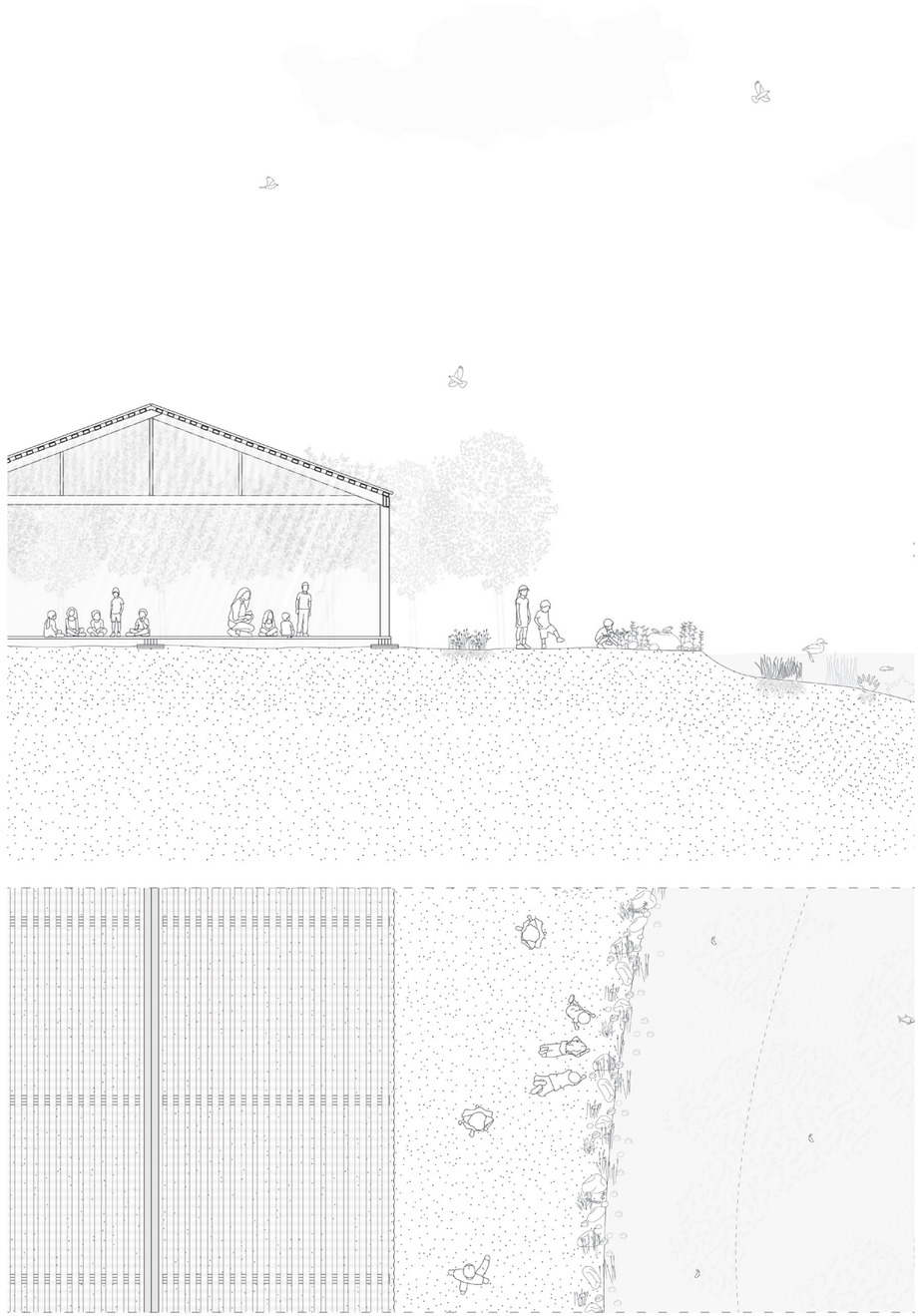


Figure 5. 39 *Pond Learning Zone illustrating reimagined Science and Technology B2.2 "Connections in Nature" Grade 6*



Figure 5. 40 *Render of Pond Learning Zone*

Compost Zone

Located near the west wing of Swift Waters Elementary School, the Compost Zone is embedded within a grove of the permaculture-inspired orchard, creating a direct link between soil health, plant growth, and student engagement. This space functions as a hands-on learning opportunity where students can actively participate in composting their daily food scraps, observing the transformation of organic waste into nutrient-rich soil that supports the learning farm.

Designed for frequent interaction, the Compost Zone encourages students to develop an awareness of waste cycles, decomposition processes, and the role of microbes in soil regeneration. By placing the composting system within an accessible and ecologically rich setting, the space reinforces the fundamental principles of closed-loop systems and regenerative agriculture. It serves as both an educational tool and an essential component of the farm's sustainability strategy, demonstrating how small, everyday actions contribute to a healthier environment.

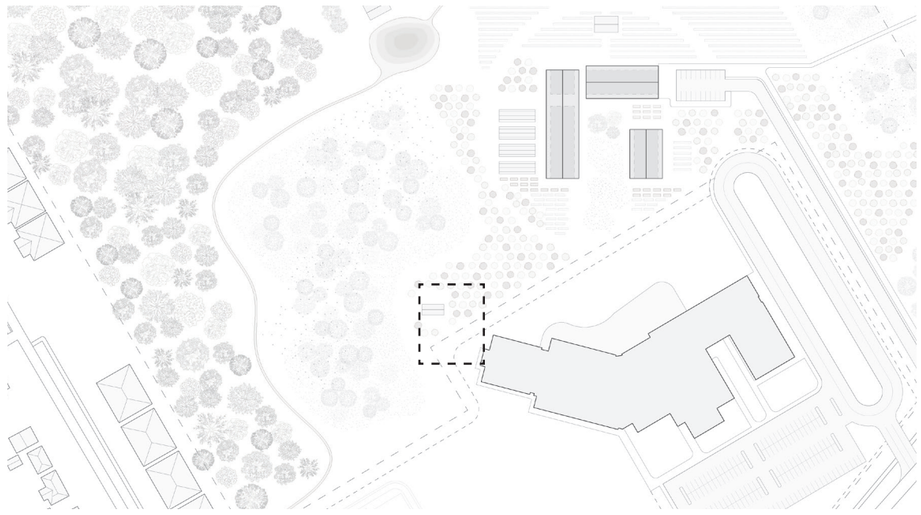


Figure 5. 41 *Key Plan of Composting Learning Zone*

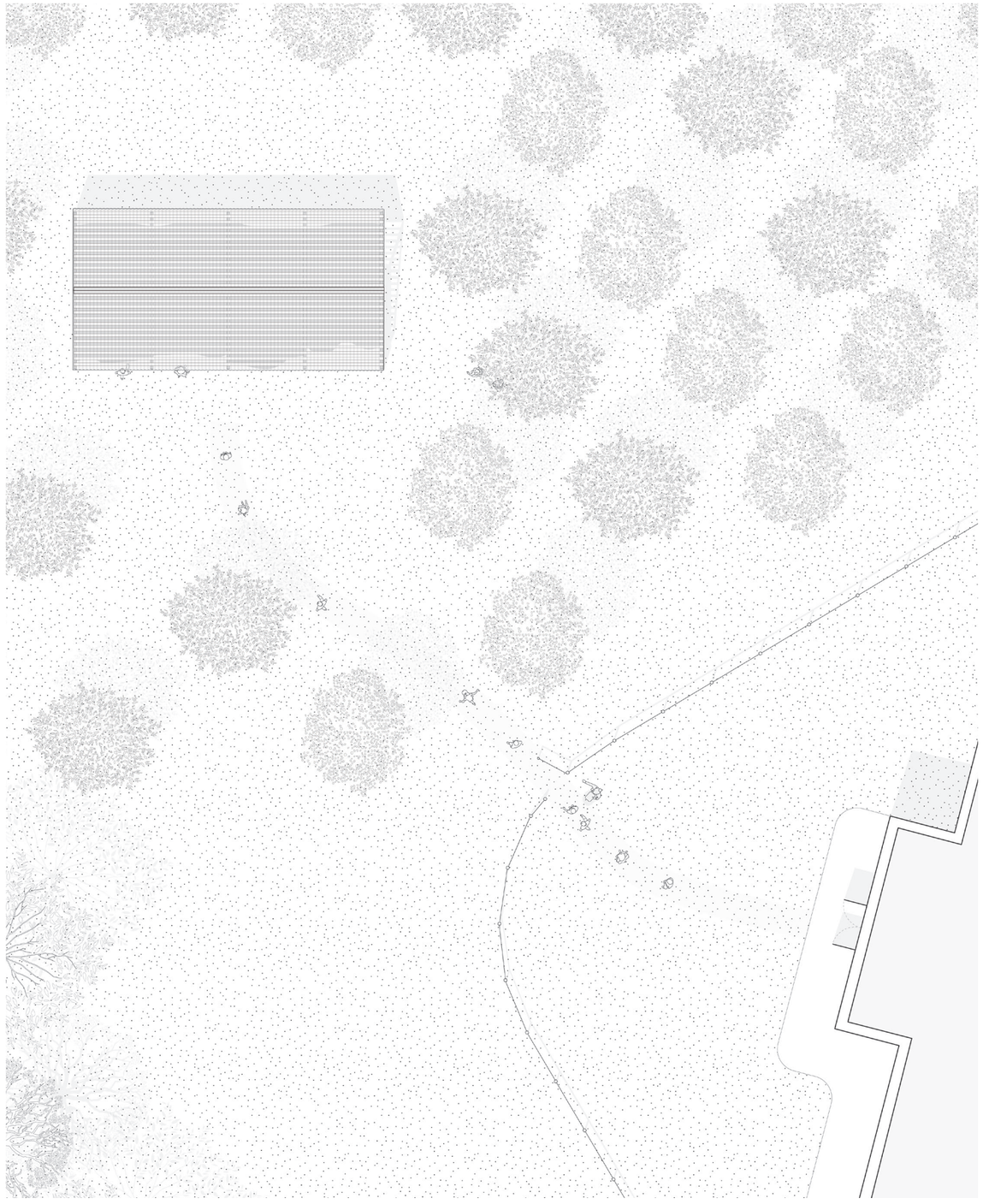


Figure 5. 42 *Compost Learning Zone Plan*

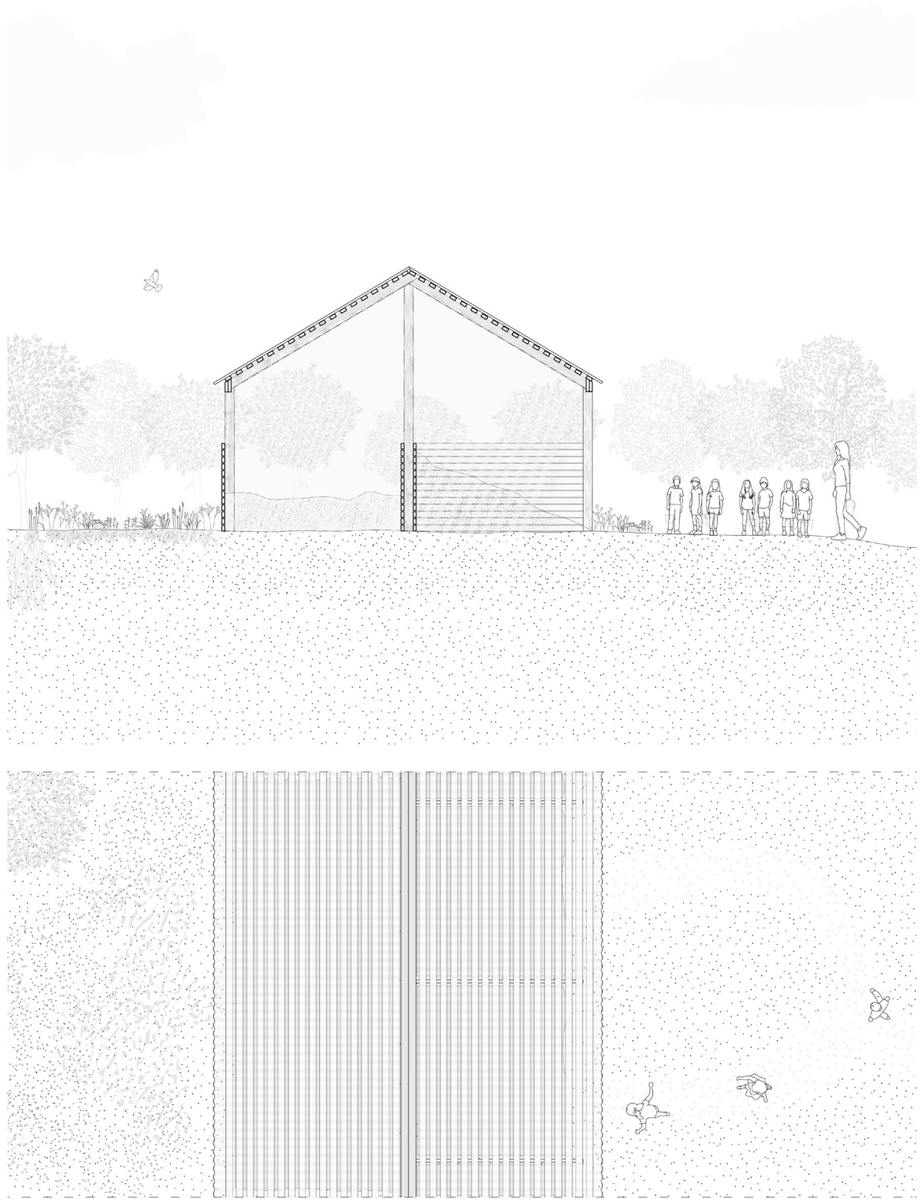


Figure 5. 43 *Compost Learning Zone illustrating reimagined Science and Technology B1.2 Grade 1*



Figure 5. 44 *Render of Compost Learning Zone*

Garden Learning Zone

Located in the open courtyard space between all the buildings, the Garden Learning Zone functions as both an educational and sensory environment. Designed to foster curiosity and engagement, the garden features a diverse mix of pollinator plants, flowers, and small trees, creating a dynamic testing ground for companion planting and food forest principles.

Beyond its role as a learning space, the Garden Learning Zone is intended to be immersive, surrounding students and visitors with an array of colors, textures, scents, and sounds. The presence of small animals and pollinating insects—drawn to the variety of plant life—enriches the sensory experience, reinforcing ecological interconnections in a tangible way. This space invites exploration, observation, and experimentation, making it a vital component of the farm's broader mission to integrate science, ecology, and play into the learning process.

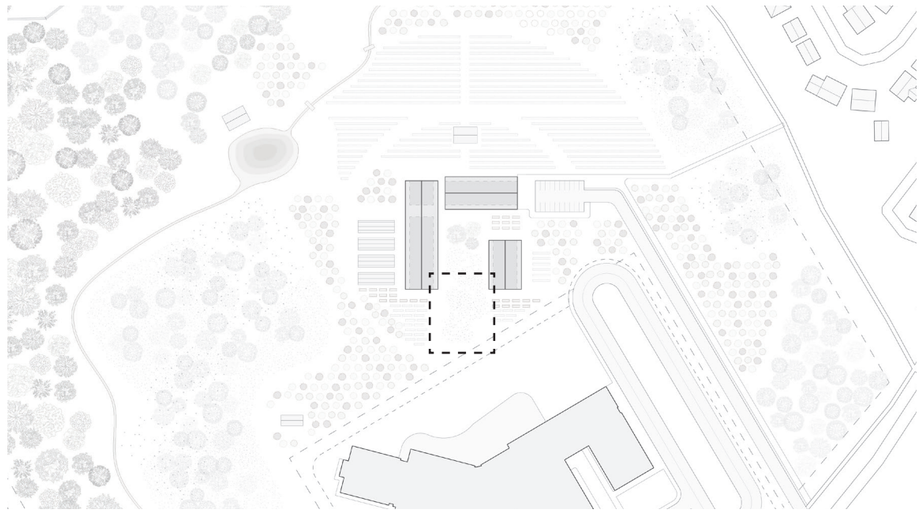


Figure 5. 45 *Key Plan of Garden Learning Zone*

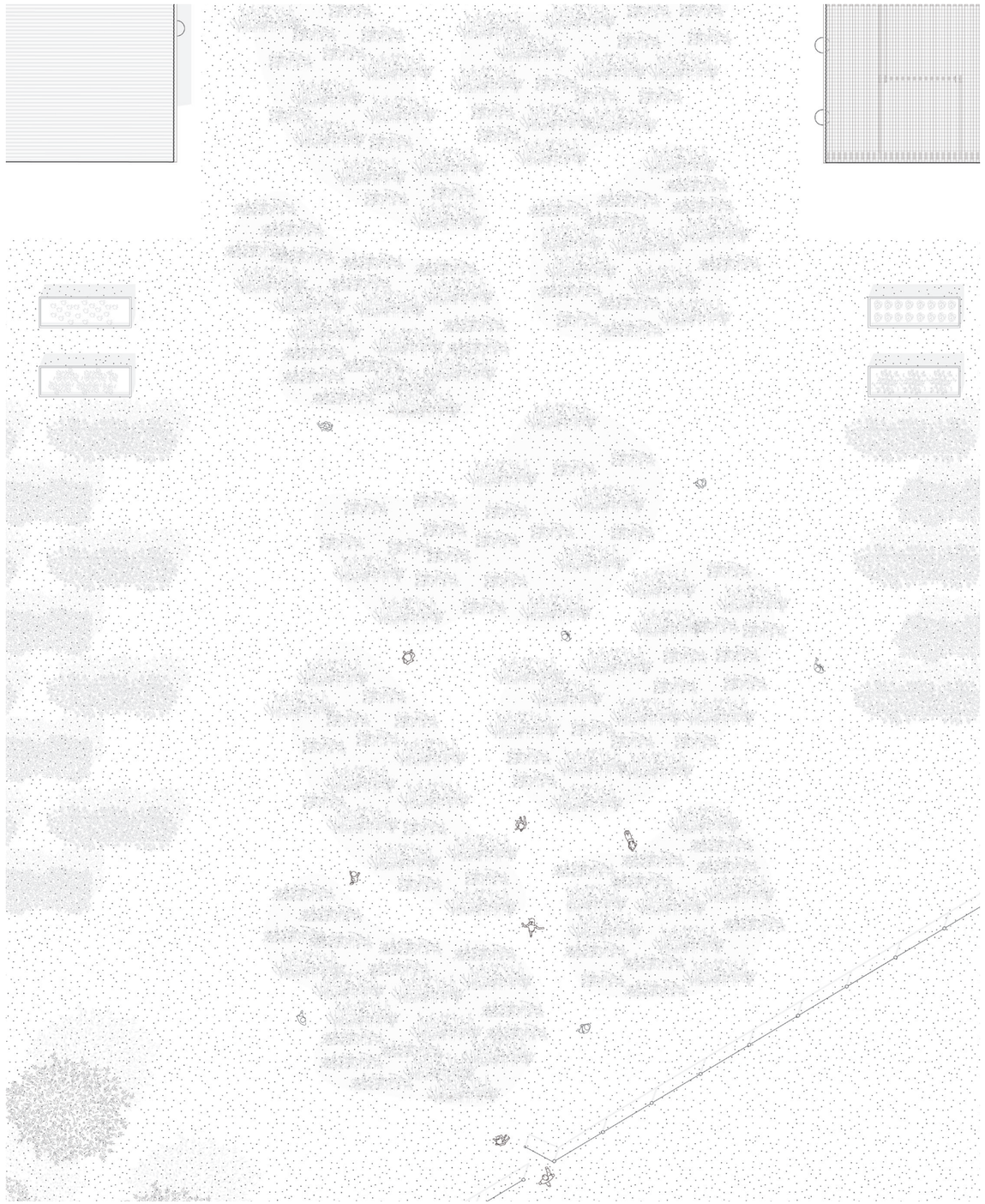


Figure 5. 46 *Garden Learning Zone Plan*

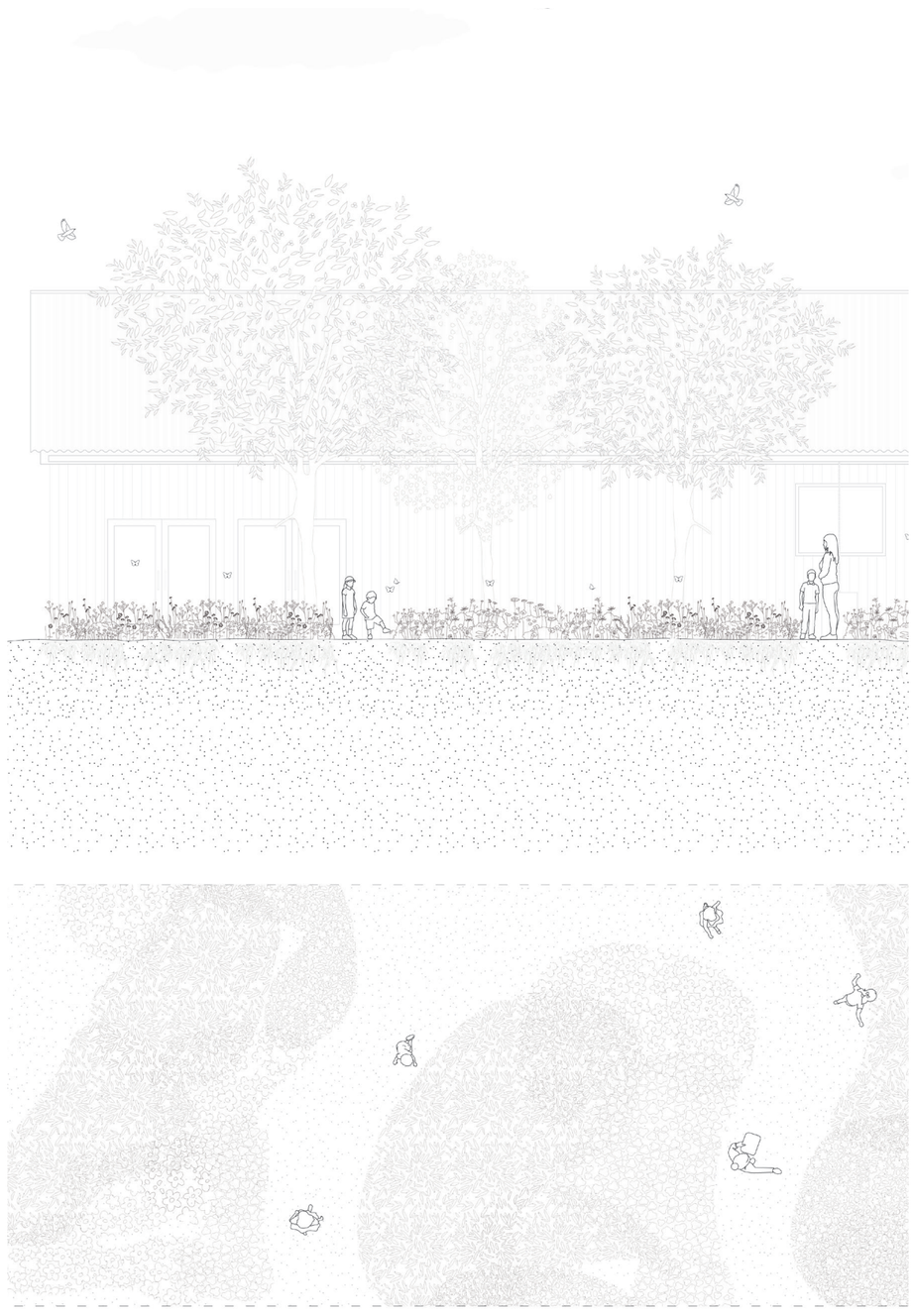


Figure 5. 47 *Garden Learning Zone illustrating reimagined OE29.1 for Kindergarten*



Figure 5. 48 *Render of Garden learning Zone*

Orchard Learning Zone

Located at the center of the farm fields, the Orchard Learning Zone offers students an immersive space for observing and engaging with local food systems. Populated with a mix of fruit and nut trees, and berry shrubs, the orchard supports lessons in agroecology, seasonal change, and long-term plant care.

Designed for less frequent but purposeful interaction, the zone encourages students to participate in planting, pruning, harvesting, and observing ecological relationships over time. The layering of canopy, understory, and ground-level plantings demonstrates principles of permaculture and supports biodiversity, reinforcing connections between food systems and environmental stewardship. Similar to the Pond Learning Zone, an open air shade structure is also provided in this learning zone, to facilitate teaching activities.

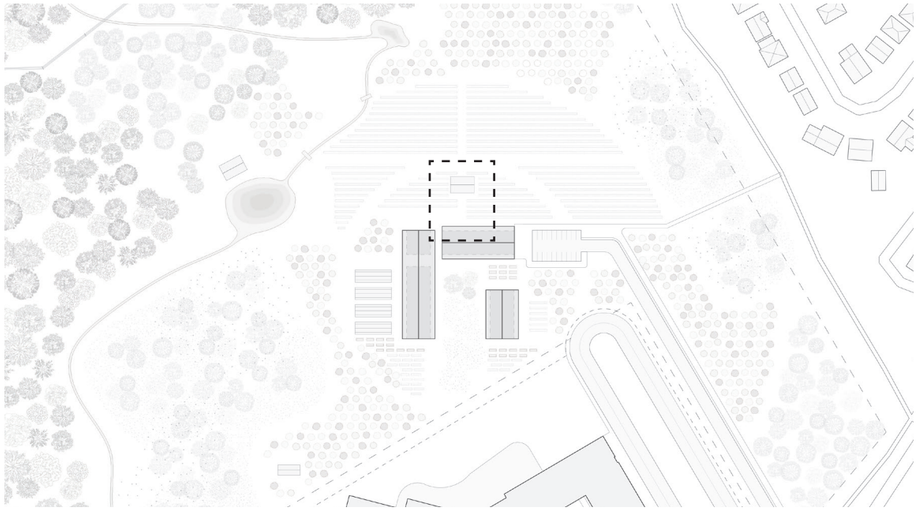


Figure 5. 49 *Key Plan of Orchard Learning Zone*

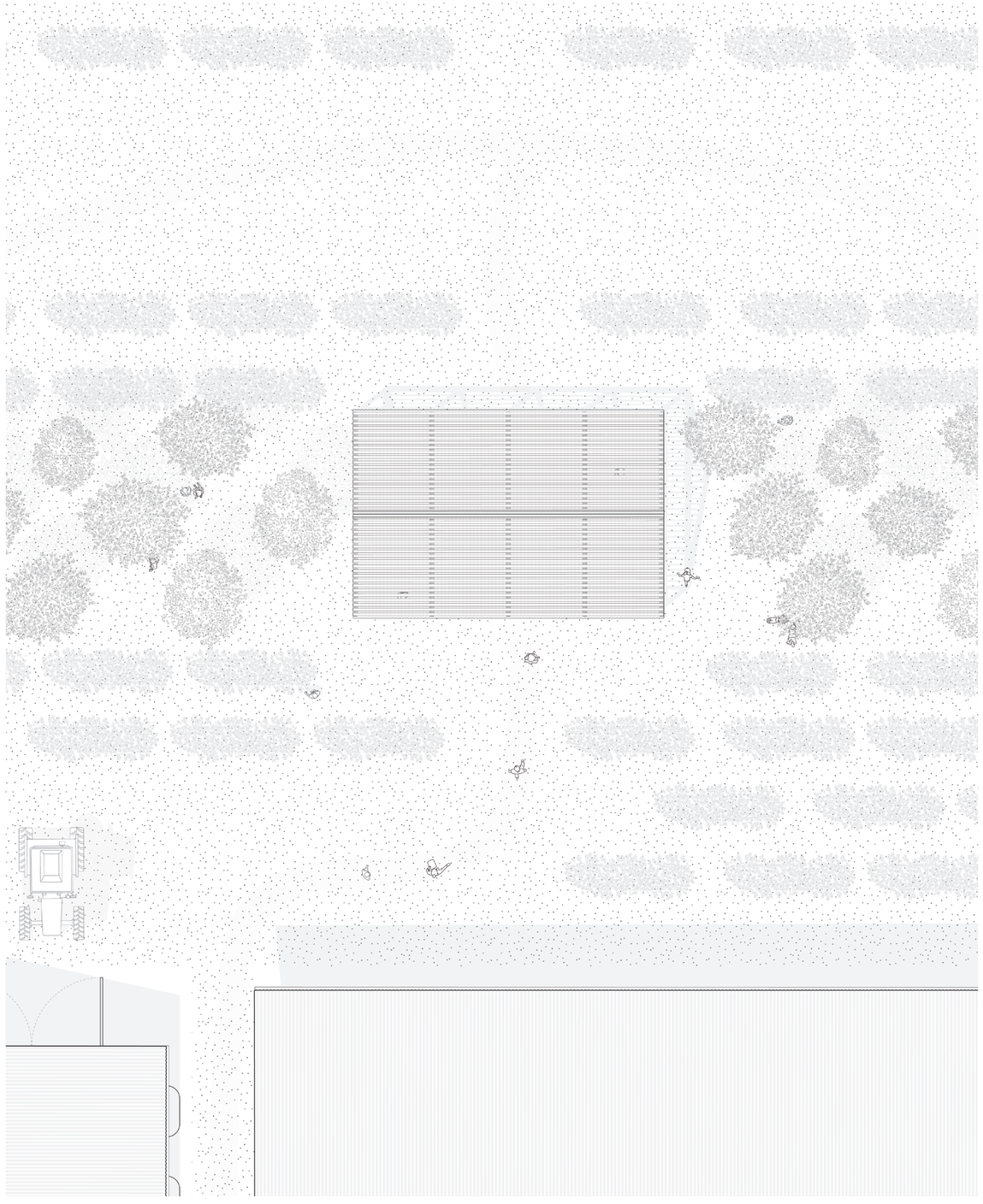


Figure 5. 50 *Orchard Learning Zone Plan*

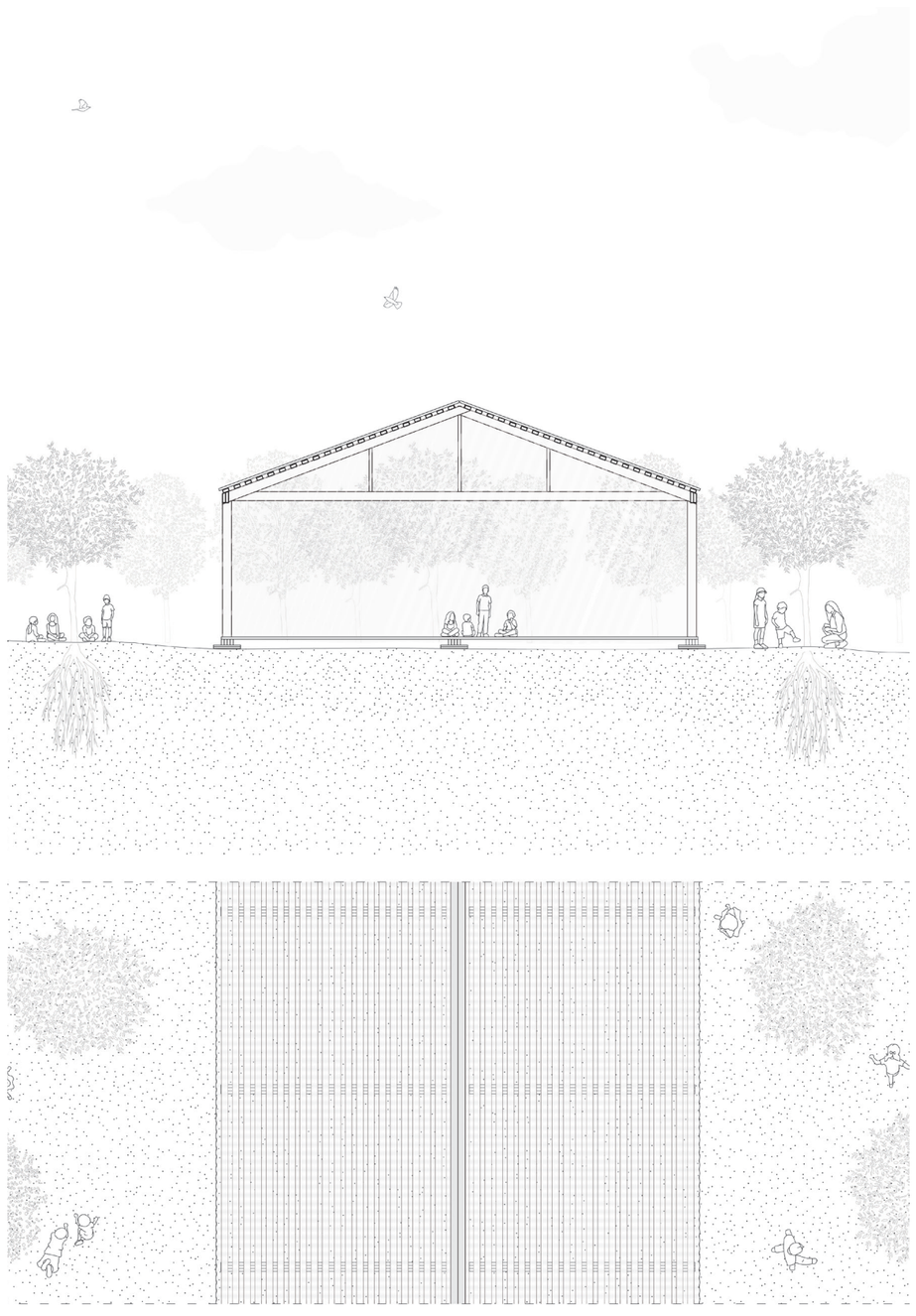


Figure 5. 51 *Orchard Learning Zone illustrating reimagined Health and Physical Education D2.1 Grade 1*



Figure 5. 52 *Render of Orchard Learning Zone*

Endnotes

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05 Conclusion

| Reflection, Adaptation, and Future Potential

This thesis has explored the integration of outdoor pedagogy and permaculture principles into educational landscapes through the design of the Swift Waters Urban Learning Farm. Situated on a post-industrial brownfield adjacent to Swift Waters Elementary School, the project responds to the growing disconnect between children and the natural world by offering an immersive, place-based model of education. The farm serves as both a teaching environment and a regenerative landscape, transforming contaminated land into a living classroom rooted in sustainability and community care.

The research and design process has highlighted the essential role schools can play in cultivating ecological awareness and environmental responsibility. When outdoor learning is embedded within formal curricula, students develop a more intuitive understanding of food systems, ecological relationships, and resource cycles. These hands-on experiences not only reinforce academic learning but also cultivate a lasting sense of care, responsibility, and curiosity about the world around them.

A central theme of this work is the power of learning rooted in place. Grounding education in the specific ecological and cultural context of Brockville allows students to see the relevance of their actions and understand their interconnectedness with local systems. Rather than studying nature in the abstract, students observe plant cycles, harvest food, and manage soil—activities that anchor learning in the rhythms of the land. This approach fosters not only ecological literacy but also a deepened connection to community and environment.

The Swift Waters Urban Learning Farm also illustrates how school-based projects can extend beyond their educational function to serve the broader public. Its location along the Brock Trail creates opportunities for visibility, accessibility, and engagement, positioning the farm as a shared space for public workshops, intergenerational learning, and local food distribution. In this way, the project reinforces the idea of schools as civic institutions—places where education, health, and sustainability intersect.

As a prototype, the farm offers a replicable model for transforming underused urban land into dynamic outdoor learning environments. While tailored to the Brockville site, the project's foundational principles—experiential learning, permaculture zoning, regenerative agriculture, and community collaboration—can be adapted to various educational and ecological contexts. Successful replication depends on thoughtful site analysis, curriculum alignment, and long-term stewardship, but the core framework is flexible and scalable.

Adaptability is a defining feature of the model. As curriculum priorities evolve and environmental challenges intensify, the farm must remain responsive—both in design and programming. Planting strategies may shift with climate patterns; pedagogical approaches will change with new educational standards. Outdoor learning environments, unlike static classrooms, are shaped by seasonality, growth, and renewal. Designing for this dynamism ensures that the farm continues to serve students and community members long into the future.

Sustained community involvement will be key to the project's longevity. The farm's success relies not only on infrastructure but on relationships—with educators, students, families, and local organizations committed to shared care and programming. By cultivating partnerships and encouraging co-stewardship, the farm moves beyond the schoolyard, becoming a node in a broader network of food, learning, and ecological action. Simple, low-maintenance strategies—like perennial planting, compost systems, and rainwater harvesting—enhance the site's ability to thrive with limited resources.

Beyond education, the project contributes to broader goals of ecological regeneration and climate resilience. Through soil remediation, pollinator support, and closed-loop systems, the farm actively restores ecological function while demonstrating sustainable land use practices. The transformation of a contaminated site into a productive, educational landscape challenges assumptions about post-industrial land and affirms the potential of design to heal both ecosystems and communities.

Looking ahead, the Swift Waters Urban Learning Farm signals a broader opportunity: to rethink the role of education in preparing students for a changing world. In a time of environmental crisis, teaching sustainability cannot remain theoretical. Students need the tools, spaces, and opportunities to engage with complex systems in tangible ways. The farm demonstrates that this is not only possible—it is profoundly impactful. By engaging with land, food, and ecological processes firsthand, students build the knowledge and habits necessary for a more sustainable future.

In sum, this project offers a compelling vision for integrating education, ecology, and community resilience. Through thoughtful design and responsive programming, the Swift Waters Urban Learning Farm transforms an overlooked site into a meaningful space for learning, restoration, and civic participation. Its strength lies not only in its physical form, but in its capacity to evolve, adapt, and remain rooted in the needs of both people and place. As schools and communities look to the future, this model affirms that education—when grounded in care and connected to the land—can be a powerful force for lasting change.

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