

Re-establishing Reciprocal Relationships with the Land:

Designing Regenerative Developments on Six Nations
Reserve Through the Application of Haudenosaunee
Ecological Knowledge (HEK)

by

Taylor McGee

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Nom du candidat McGee, Taylor

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APPROVED/APPROUVÉ

Thesis Examiners/Examineurs de thèse:

Shannon Bassett
(Thesis Advisor / Directeur(trice) de thèse)

David Fortin
(Thesis Second Reader / Directeur(trice) de thèse deuxième)

Ted Krueger
(External Examiner / Examineur externe)

Brian Porter
(External Advisor/Conseiller externe)

Approved for the Faculty of Graduate Studies
Approuvé pour la Faculté des études supérieures

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ABSTRACT

This Thesis pursuit explores how Traditional Ecological Knowledge (TEK) can inform sustainable land management and architectural development strategies that perform reciprocally with the land, forming harmonious relations with the natural environment. Situated within the Six Nations of the Grand River Reserve located in southern Ontario, the Haudenosaunee will be the cultural focus of the study. For the Haudenosaunee, maintaining a respectful relationship with Mother Earth isn't just a lifestyle, it is a central component to their culture and identity, while serving as a necessity to achieving healthy minds, bodies and spirits. Although Six Nation's Reserves built environment has been influenced by settler culture and development. As a result, the environments aren't conducive to Haudenosaunee value systems and promotes a hyper-individualistic ownership of property that produces segregated communities while allocating hardly any land for communal or recreational use or nature preserves. Titled '*Re-establishing Reciprocal Relationships with the Land: Designing Regenerative Developments on Six Nations Reserve Through the Application of Haudenosaunee Ecological Knowledge (HEK)*,' this Thesis pursuit revolves around utilizing Haudenosaunee Ecological Knowledge (HEK) in modern applications to inform regenerative strategies for sustainable design that reinterprets Six Nations current westernized built environment that is based on a colonialist method of developing the land. Through more of a land-based approach, regenerative systems will take advantage of natural processes of the land while enhancing and remediating the ecological conditions, producing environments that form reciprocal relations with the land. This land-based learning approach also begins both to question, as well as to think and re-conceptualize the current Six Nations gridalinear, westernized landscapes to better align with Haudenosaunee perspectives.

The architectural vehicle for the exploration of employing HEK is through the design of a Land Based Learning Center with accompanying facilities of a Transitional Housing Center and the Elderly Care Facility. With the Land Based Learning Center serving as the programmatic anchor of the three architectures, the intent is to produce a regenerative development that achieves self-sufficiency and resiliency, centered around Haudenosaunee ways of keeping balance with Mother Earth in a contemporary context. In doing so, a new community development will be conceived that



maintains reciprocal relationships with the surrounding ecology of Six Nations while developing infrastructures that empower the local community and promote self-determination.

The intent of the Land Based learning center is to serve as a cultural and educational hub that operates both locally as well as across North America, serving as an outreach center for Six Nations community members both on and off reserve, as well as North American Indigenous people and enlightened mainstream individuals. The Center's goal is to actively preserve and rekindle Six Nations connections with traditional values, teachings and ceremonies surrounding ecological knowledge and skill sets of harvesting and cultivating the land, while reinforcing the significance of traditional knowledge in a contemporary context. The facility provides social, educational, and therapeutic programming that reinforce the significance of maintaining close and respectful relationships with Mother Earth as a necessity to achieving healthy minds, bodies and spirits. In addition, the facility provides consultation services to home owners, builders, and developers both on and off the reserve as well as Six Nations Council on how traditional teachings and HEK can be reinforced in a contemporary context to inform sustainable land management and regenerative development strategies. Overall, the development of the Land Based Learning Center with accompanying housing facilities will inform Six Nations members and broader society on how to perform reciprocal relations with the land while actively reaching to increase the number of Six Nations members living on reserve by providing affordable housing for displaced Indigenous members.



27,276

Six Nations Members



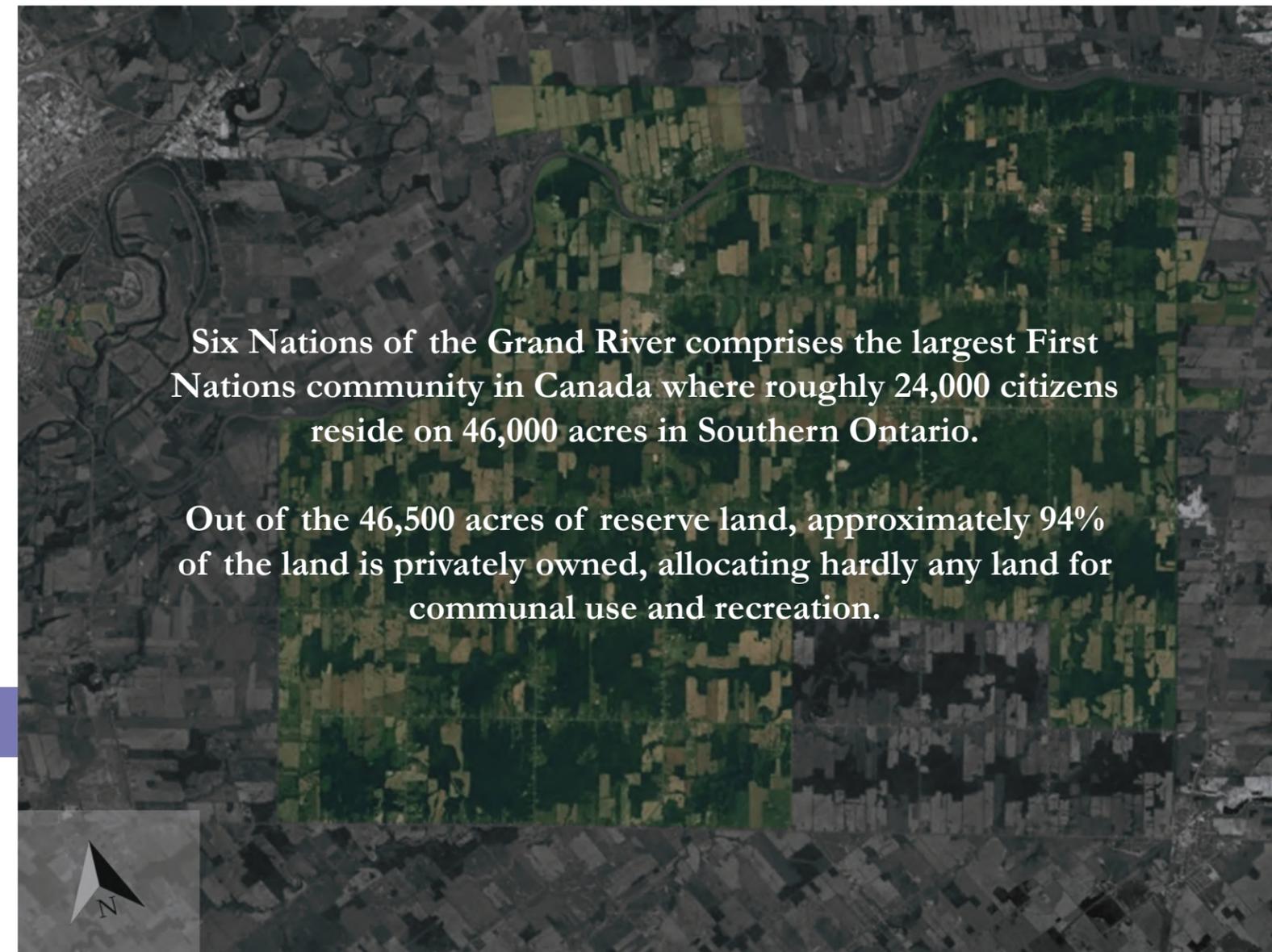
12,848

Living on Reserve



14,428

Living off Reserve



Six Nations of the Grand River comprises the largest First Nations community in Canada where roughly 24,000 citizens reside on 46,000 acres in Southern Ontario.

Out of the 46,500 acres of reserve land, approximately 94% of the land is privately owned, allocating hardly any land for communal use and recreation.

KEYWORDS

Traditional ecological knowledge (TEK), Haudenosaunee Ecological Knowledge (HEK), Scientific Ecological Knowledge (SEK), Indigenous Knowledge (IK), Regenerative Design and Developments, Systems Thinking, Stewardship, Reciprocity, Sustainability, Longhouse, Village, Haudenosaunee, Six Nations, Six Nations of the Grand River, Retrofitting the Reserve.

Figure 1: Aerial photo of Six Nations Reserve demonstrating how the landscape has been divided as a result of the hyper individualistic ownership of property that faces Six Nations. Infographics of members living on and off reserve.

ARCHITECTURAL METHODOLOGY

The goal of the Thesis is to develop an architectural methodology towards implementing regenerative design strategies on Six Nations Reserve that have been informed by HEK - Haudenosaunee ecological perspectives. It is to also provide a framework of sustainable building approaches that can be utilized as a tool for the Haudenosaunee to redefine the colonialist impositions facing the reserve through re-establishing reciprocal relationships with Mother Earth. Through engaging with public officials located on Six Nations Reserve while conducting comprehensive research, a strong understanding of Haudenosaunee Ecological Knowledge (HEK) has been gathered. This methodology has been informed through interdisciplinary research at the intersection of urban design, ecological design, architecture, and ecological knowledge. Further, knowledge regarding HEK has been gathered through design research and conducting interviews with community members from Six Nations surrounding oral histories, traditions, agricultural practices, philosophies, the cycle of ceremonies and harvests, wampum treaties, and the traditional social structures of the Haudenosaunee. The architectural vehicle for the exploration of redefining Six Nations westernized built environment through employing HEK, is through the development of a regenerative facility on a vacant lot located in the heavily developed village of Ohsweken. Here, the development of the Land Based Learning Center and the accompanying facilities of the Transitional Housing Center and the Elderly Care Facility will demonstrate how HEK can inform regenerative design strategies that reinterpret the current suburbanized environment of Ohsweken to align more with a Haudenosaunee way of life.

The intent of the Thesis is that the architectural methodology can be utilized as an informative guide towards land remediation and communal land reclamation efforts throughout the Reserve, while prompting institutions, developers and community members located on Six Nations reserve to question the concept of *land ownership*. The project engages with a privately owned parcel of land located in Ohsweken, demonstrating how regenerative design strategies can be implemented within the reserve. The hope is that the project can serve as a catalyst for sustainable interventions and blossom design strategies throughout the reserve that works towards restitching communal lands back into the social fabric of Six Nations.

The architectural vehicle for the exploration of employing HEK is through the development of a regenerative facility in the form of a Land Based Learning Center with accompanying housing facilities on a vacant lot located in the heavily developed village of Ohsweken.



Figure 2: Aerial photo of the village of Ohsweken demonstrating how the surrounding built environments have been influenced by colonialist developments reflecting a suburban model while showcasing the vacant lot highlighted in green.

RESEARCH QUESTION

This Thesis poses the following questions:

Can the development of the Land Based Learning Center and the accompanying facilities of the Transitional Housing Center and the Elderly Care Facility demonstrate how HEK can inform regenerative environmental and infrastructural design strategies that perform reciprocally with the land to reinterpret Ohsweken's suburbanized environment?

Furthermore, can the study serve as an initiative to reclaim communal lands, provoking institutions, developers and community members to question the concept of land ownership by informing them how communal lands can be reclaimed through methods of remediation and regenerative design that re-establish reciprocal relations with Mother Earth, diminishing the hyper-individualistic society facing Six Nations?

This design Thesis will attempt to both address and answer these questions.

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Second Reader	David Fortin
External Advisor	Brian Porter

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PREFACE

Born and raised in Sudbury Ontario, I developed a strong appreciation for the natural environment, adopting a northern lifestyle which entailed spending most of my youth and spare time in the outdoors. Being exposed to the practices of hunting and fishing from a young age, it was through these lived experiences in the outdoors with my grandfather, father and uncles where I received my greatest teachings and fondest memories. They taught me how to behave in nature, how to respect wildlife, and how to live sensibly with the land. These humbling experiences had profound effects on my development, both personally and professionally, where I developed a strong appreciation for the natural environment, influencing my pursuit of architectural education and practice. This appreciation for the natural environment was carried throughout my architectural studies and professional practice, where I became fascinated in exploring architectural designs that translate the inherent connections that humans have with nature and the interdependent nature of this relationship into architectural manifestations and sustainable design.

This appreciation for the land directed myself to pursue the Indigenous Design Studio offered in 2018 during the first phase of the Masters Program at the McEwen School of Architecture at Laurentian University. The studio course provided the opportunity to learn how to utilize architecture as a collaborative tool that can engage with Indigenous communities. Here, students were asked to produce cultural infrastructures that are reflective of the cultural values and traditional principles held by a community while ameliorating their current environments to best serve the community's needs. The studio design was centered around addressing the political conflicts surrounding the relocation of the MoCreebec Eeyoud Nation from Moose Factory Island onto identified sites of interest provided by the MoCreebec Eeyoud Nation that were located further up the river on Moosonee. After experiencing the culture and its historical, social and spatial context, the design objective of the course was to collectively design a new community layout with an

individual design component that focused on developing a highly resolved architectural building that was informed by Indigenous principles. The goal was to develop a community and design solutions that were appropriate and complimentary to the historical context of the MoCreebec Eeyoud Nation while also responding to the local ecology, potential means of access and potential developments. Addressing and engaging with the following themes: the expression of Indigenous art, emerging industries, future agriculture space, notions of sovereignty, migration and displacement, education, land-based initiatives, health and wellbeing, community and the use of technology. The highly resolved architectural building that I produced as part of the individual component of the assignment was a Cree Cultural Harvesting Centre which focused on food sovereignty addressing food security in the north while preserving and celebrating traditional Cree practices surrounding the harvesting and cultivation of food. The studio course furthered my passion for maintaining harmonious relationships with the land, while allowing myself the opportunity to learn more about my Métis heritage.

After the completion of the Indigenous studio, I had the opportunity of securing an eight-month cooperative placement within the architecture firm Two Row Architect, an Indigenous owned and operated architecture firm located on the Six Nations of the Grand River First Nations Reserve. Here, I had the opportunity to work alongside Brian Porter. This experience furthered my passion for sustainable architectures that place an importance on working with the land respectively, which furthered my understanding on the collaborative nature architecture must engage while serving Indigenous communities. These experiences have led and navigated my trajectory and path to my Thesis pursuit which seeks to learn from Indigenous cultures, as well as utilizing Traditional Ecological Knowledge (TEK) in architectural planning to re-establish deep-rooted connections and intimate relationships with the land in order to form self-sustainable and resilient community design.

Part 1 | Historical-Interpretive
Research



Chapter 1 | Introduction



1.1 INTRODUCTION

Before colonialism took place between the late 1400s and the 1800s, when European countries settled the Americas,¹ Indigenous communities had developed detailed economic, political, and social ideologies through thousands of years of close interaction with the land.² Through these lived experiences, distinctive codes of conduct were produced that guided how humanity was supposed to relate with one another, the animals, and the land.³ Responsibilities were assigned to every human and non-human entity to maintain peaceful internal and external relations to the land, acting as stewards of the land.⁴ This led to Indigenous communities having a profound understanding of the natural environment, serving as the first ecologists living in perfect harmony with nature.⁵ This holistic and sensible outlook on life and the weight of this knowledge has been devalued, misunderstood, and forgotten in western culture. North American landscapes have since been developed in ignorance to natural ecological conditions of the land, attempting to control all natural forces, manipulating them to be deemed more *efficient* and *predictable*.⁶ This cultural ignorance that plagues western civilization portrays humanity to be at the top of a hierarchical pyramid, where the natural environment and its offspring are viewed as resources that can be manipulated and controlled as needed. This has progressed in a loss of knowledge and understanding of the land and how to read it, diminishing our understanding of the complexities of the land and how to work with it rather than against it. As a consequence, our built environments have been segregated from the natural environment, resulting in catastrophic environmental effects and alterations.⁷

WHAT IS SUSTAINABILITY?

Compared to Indigenous sciences, knowledge systems, and traditional practices of working with the land, western sciences surrounding ecological knowledge systems have been less successful in devising sustainable solutions towards environmental applications.⁸ The concept of sustainability and the understanding of the significance of sustainable development didn't gain traction in western culture and science until the 1980s with the United Nations establishing the World Commission on Environment and Development (WCED) in 1983. In 1987, the WCED published the influential report, 'Our Common Future,' which vaguely defined the term sustainable development, embarking the task of



Figure 3: Aerial photo of the urbanization of Toronto, Ontario Canada

addressing environmental concerns through western approaches to infrastructural development and planning.⁹ Throughout western progressions of devising environmental solutions, sustainability has been vaguely comprehended, providing several definitions of its pertaining fundamental principles of environmental efficiency, social equity, and cultural diversity. As a result, the term ‘sustainability’ has been misappropriated while failing to address and comprehend the underlying environmental problems itself. Rather, sustainability has been interpreted and situated in architectural designs as a means of defining a building’s ‘Eco-efficiency,’ where a hyper-focus is placed on the performative aspects of the infrastructures while neglecting a designs capability of addressing worldview issues.¹⁰ Therefore, producing architectural interventions with cliché methods of resolution, where a romanticized perception of sustainable architecture now consists in the production of technological and passive systems to portray a visual aesthetic of ‘green’ design.¹¹ With the introduction of LEED certification in Canada in 2003, these design issues were exacerbated with the guidelines for the



green building certification ratings being sought after strictly for its branding. This generated competitions between architectural projects to achieve the highest LEED classifications for environmental efficiency.¹² This resulted in architectural solutions that focused more on eco-aesthetics than environmental systems themselves. It also failed to provide holistic design solutions that address a buildings beneficial contribution to its surrounding environment. As a result, sustainability has endured a reorientation of architectural visual expression, rather than reinterpreting new holistic models of ecological design.¹³ If principles of green architecture are to provide substantial benefits to a building’s performance and surrounding environment, it must be specifically crafted to its unique locale. In this manner, moral judgments are to guide its application, producing green values that are contextualized within the social, cultural, environmental, and ecological conditions of a specific community and site.

Ethically appropriate models of environmental applications can be informed through traditional teachings and knowledge systems corresponding to specific cultures and communities. These understandings can guide holistic models of sustainable design from Traditional Ecological Knowledge (TEK) of Indigenous people that has been derived from deep rooted and complex understandings of natural environments of culturally specific locales.

Toronto, the capital of the province of Ontario, located roughly an hour north of Six Nations of the Grand River Reserve, is a perfect example of how North American landscapes have been developed in ignorance to natural ecological conditions through means of urbanization and suburbanization as demonstrated in figure 3 and figure 4. With that being said, Toronto is starting to look at natural and ecological ways of recovering its landscapes, with such notable projects and agencies as “Waterfront Toronto” and The Don Mouth Naturalization and Port Lands Flood Protection Project (DMNP). In this manner, Toronto is moving towards a more sustainable future by learning from its mistakes and undoing its previous infrastructures.

Figure 4: Aerial photo of the rapid suburbanization of Toronto, Ontario Canada



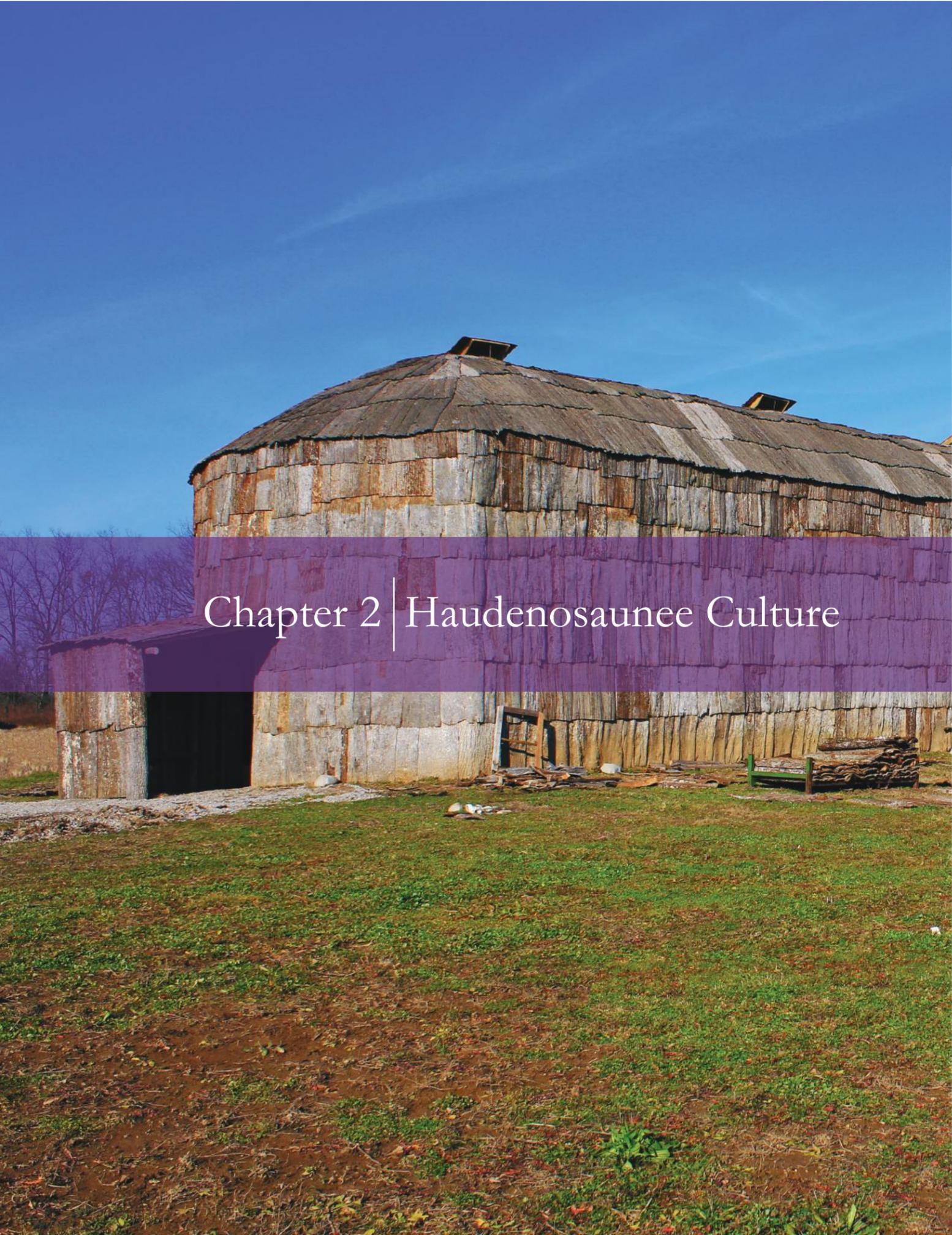
WHAT IS TRADITIONAL ECOLOGICAL KNOWLEDGE?

TEK of Indigenous people – refers to the knowledge, practice and beliefs concerning the interrelationships between living entities and their relationships to physical environments.¹⁴ TEK is based on a millennium of lived experiences of close interaction with the land, providing profound understandings of specific locales.¹⁵ It is therefore a knowledge-base derived from an Indigenous epistemology that every aspect of life is interconnected – a web of life – in which Indigenous people are spiritually and materially intertwined with their environment. The knowledge system of TEK has much in common with scientific ecological knowledge (SEK) in that both knowledge systems are derived from systematic observations of nature. TEK parallels western science in complexity and its multifaceted depth of understanding of natural phenomena and relationships among ecosystems. This knowledge system, however, is misunderstood, devalued, and seen as subordinate to western sciences in mainstream approaches.¹⁶ With that being said, traditional ecological knowledge can rival that of western science as a body of empirical information offering holistic ways of understanding the environment. Here, nature is viewed subjectively with observations of the natural environment tending to be qualitative rather than quantitative.¹⁷ Further, observations have been established through intimate relations of the land over long periods of time, where survival and harvesting success was inextricably linked to ecological understandings of specific locales. Additionally, Indigenous understandings of natural environments are intertwined with culture through social and spiritual values. These provide comprehensive knowledge systems based on specific ecologies that supersede the empirical limits of western sciences. TEK, therefore, offers long-term perspectives and understandings of the natural environment that western sciences lack, based on the quantitative, short-term assessments of the land.¹⁸ TEK can also serve as a source of new biological insights which can inform new models for sustainable development, while also promoting the inclusivity of western communities and Indigenous communities, promoting relationships of coexistence and successful partnerships.¹⁹

This Thesis will explore how TEK and HEK can be applied in a contemporary context through relationships of coexistence with Scientific Ecological Knowledge (SEK). Here, traditional principles

of maintaining reciprocal relations with the land can guide and enhance modern technologies and sciences to create an ecological interface of architectural solutions. Incorporating Indigenous principles of respect, responsibility and reciprocity can both guide, as well as enrich ethically appropriate environmental applications of sustainable design and development.

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- 1 “Early History.” The Canada Guide. Accessed October 1, 2019. <http://www.thecanadaguide.com/history/early-history/>.
 - 2 Hendry, Joy. SCIENCE and SUSTAINABILITY : Learning from Indigenous Wisdom. New York: Palgrave Macmillan, 2014. Prologue.
 - 3 Belanger, Yale D. Ways Of Knowing: An Introduction to Native Studies in Canada. Third Editioned. Nelson: University of Lethbridge, 2017. Pg 2-3.
 - 4 Ibid. Pg 8.
 - 5 Ibid. Pg 7-8.
 - 6 (1990)(With Peggy V. Beck, Nia Francisco and Anna Walters) The Sacred: Ways of Knowledge, Sources of life. Flagstaff: Northland Press and Navajo Community College Press. Pg 47.
 - 7 Ibid. Pg 47.
 - 8 The Fortress, The River and the Garden – A New Metaphor for Cultivating Mutualistic Relationship Between Scientific and Traditional Ecological Knowledge. Kimmerer, Wall Robin. Pg 57.
 - 9 “Sustainability.” Climate Change: In Context. Encyclopedia.com, December 14, 2019.
 - 10 Cucuzzella, Carmela. 2015. “Is Sustainability Reorienting the Visual Expression of Architecture?”. Pg 86.
 - 11 Guy, Simon, and Graham Farmer. 2000. “Contested Constructions: The Competing Logics of Green Buildings and Ethics.” In Ethics and the Built Environment, edited by W. Fox, 73-87.
 - 12 Cucuzzella, Carmela. 2015. “Is Sustainability Reorienting the Visual Expression of Architecture?”. Pg 90.
 - 13 Ibid. Pg 87.
 - 14 BioScience. Vol. 52 No. 5. May 2002. Kimmerer, Wall Robin. “Weaving Traditional Ecological Knowledge into Biological Education: A Call to Action.” Pg 432.
 - 15 The Fortress, The River and the Garden – A New Metaphor for Cultivating Mutualistic Relationship Between Scientific and Traditional Ecological Knowledge. Kimmerer, Wall Robin. Pg 57.
 - 16 BioScience. Vol. 52 No. 5. May 2002. Kimmerer, Wall Robin. “Weaving Traditional Ecological Knowledge into Biological Education: A Call to Action.” Pg 433.
 - 17 Ibid. Pg 433.
 - 18 Ibid. Pg 433-434.
 - 19 The Fortress, The River and the Garden – A New Metaphor for Cultivating Mutualistic Relationship Between Scientific and Traditional Ecological Knowledge. Kimmerer, Wall Robin. Pg 59.



Chapter 2 | Haudenosaunee Culture

2.1 ETHICAL CONSIDERATION

Before the Thesis can begin to explore what Haudenosaunee Ecological Knowledge (HEK) is, and appreciate the fundamental teachings and instructions provided to the Haudenosaunee through cultural tradition – which instruct how members are to understand, appreciate, and interact with the complexities of the natural environment – it is essential to understand who the Haudenosaunee are and the cultural background of the united six Iroquois Nations. Once a general comprehension of Haudenosaunee culture and tradition is understood in its relation to historical context, insights into the culture will begin to reveal ecological understandings and environmental sciences inherent to their culture. With that being said, it is important to point out that I myself am not a knowledge holder of Haudenosaunee culture, nor do I claim to be one. Any information provided in this document has been compiled through performing comprehensive research through accessing Haudenosaunee nation websites; the Six Nations of the Grand River Development Corporation website and databases; Six Nations Polytechnic resources and website databases; additional online databases; through conducting first person engagements with working professionals in several departments located on Six Nations of the Grand River Reserve; through my experiences of working within the community of Six Nations Reserve at Two Row Architect for a cooperative placement; and through working and consulting with Brian Porter throughout the duration of the Thesis project. The information represented in the document surrounding Haudenosaunee culture and tradition have been generalized and only showcase a small insight into the complexities and specifics of the culture. The information surrounding Haudenosaunee culture and tradition should not be viewed as an absolute or completely accurate source. The comprehension of the culture reflects the time constraints associated with the specific Thesis pursuit, and should be referenced as such.



2.2 FORMATION OF THE IROQUOIS CONFEDERACY

The Haudenosaunee, commonly referred to as Iroquois or Six Nations, are members of an Iroquois Confederacy which unifies six different Iroquois Nations through a common council composed of clan and village chiefs.¹ The formation of the Iroquois Confederacy, self named Haudenosaunee (“People of the Longhouse”), originally consisted of Five Nations: Mohawk (“People of the Flint”), Oneida (“People of the Standing Stone”), Onondaga (“People of the Hills”), Cayuga (“People of the Great Swamp”), and Seneca (“People of the Great Hill”), forming the Iroquois League.²¹ The Iroquois nation of Tuscarora (“People of the Shirt”) later joined the confederation in 1722, establishing the confederacy known today as the Six Nations.²

This Confederacy between nations was united by the Great Law of Peace, which is considered both a political and cultural document/constitution, stipulating complex social and political structures, while serving as a basis for Haudenosaunee society in general.³ In accordance to Iroquois tradition, the formation of the confederacy is credited to ‘the Peacemaker’ (Dekanawidah) a Huron individual who was sent by the creator to spread the good mind.⁴ He is said to have persuaded an Onondaga living amongst Mohawks known as Hiawatha to advance ‘peace, civil authority, righteousness, and the great law’ as authorizations for the confederation.⁵ It is stated that the formation of the confederacy took place in pre-colonial context during a phase of blood feuds, known as the mourning wars. This lasted from the 15th century to the early 17th century where various groups constantly waged war on one another through acts of vengeance, creating a never ending cycle of violence.⁶ The Great Peacemaker and his disciple Hiawatha, having shared passions for ending the war and violence amongst the Haudenosaunee, spread the word of peace throughout the nations, eventually uniting the Five Nations.⁷ Unified through the Great Law of Peace, the constitution was comprised of 117 articles that were initially recorded and transmitted not in written language, but by means of wampum symbols that conveyed meaning.⁸ The exact date of when the Iroquois Confederacy was formed is unknown but it is speculated to have taken place between 1570-1600. For more information regarding the role of the Peacemaker in the formation of the Confederacy and culturally significant symbolism regarding

The Six Nations of the Iroquois Confederacy

HAUDENOSAUNEE

“People of the Longhouse”

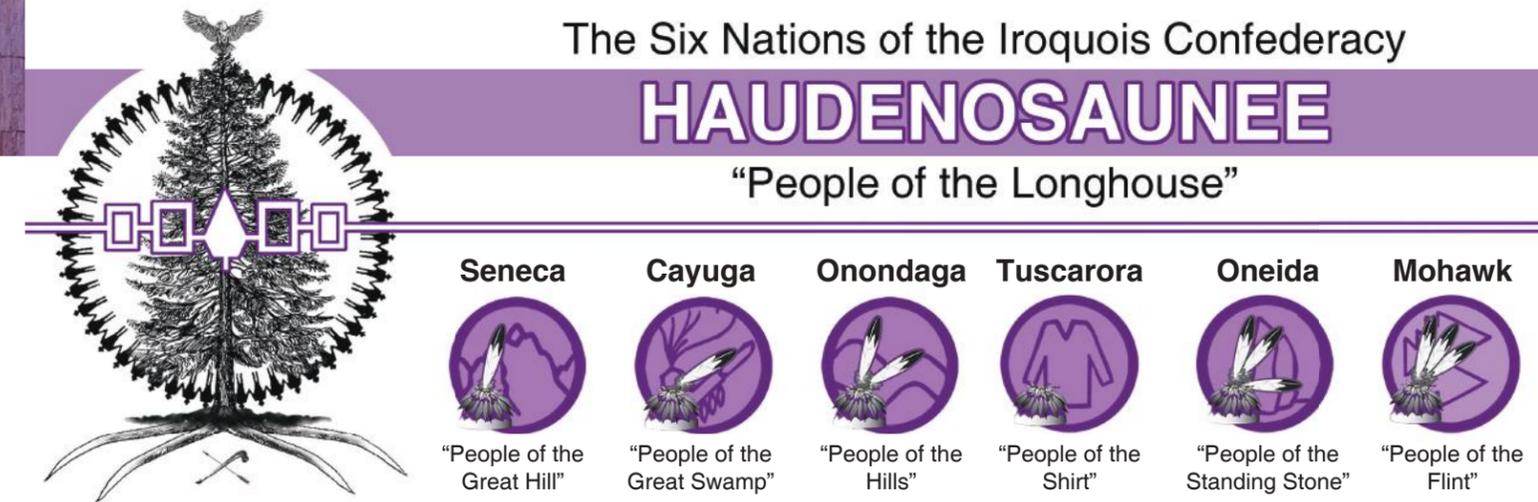


Figure 5: Diagram produced by the author representing the formation of the Iroquois Confederacy and the later Six Nations.

the formation of the League of Nations, refer to Appendix A: Formation of the Iroquois Confederacy.

The national wampum belt of the Haudenosaunee known as the Hiawatha Belt (represented in figure 6), named after the Peacemaker’s helper Hiawatha, is said to have been produced to commemorate the unity amongst the five nations.⁹ The belt is comprised of thirty eight rows¹⁰ of white and purple wampum beads produced from carved cubes of Quahog, a round shell.¹¹ The white wampum beads signify peace while the purple wampum beads signifies more serious political matters or relates messages.¹² The belt is comprised of five sections where five symbols relate to the traditional geographical settlements of the five nations while denoting different meanings towards each. The traditional lands of the Haudenosaunee stretched across New York State, starting from the approximate current day location of Albany, extending to what is now Rochester, continuing through the Finger Lakes.¹³ As depicted in the Hiawatha belt, the geographical positioning of the original five Iroquois nations had informed the generation of complex political structures that governed Haudenosaunee society. These political structures were inextricably linked to that of the social/political structures of the ‘Longhouse’ (the universal Iroquois vernacular) with the Peacemaker utilizing the symbolism of the Longhouse in the construction of the belt.¹⁴ The united settlements of the original five nations forming the Iroquois League were contextually framed through the imagining of an invisible Longhouse that stretched across the original Iroquois League territory. With the Mohawks being situated at the east and the

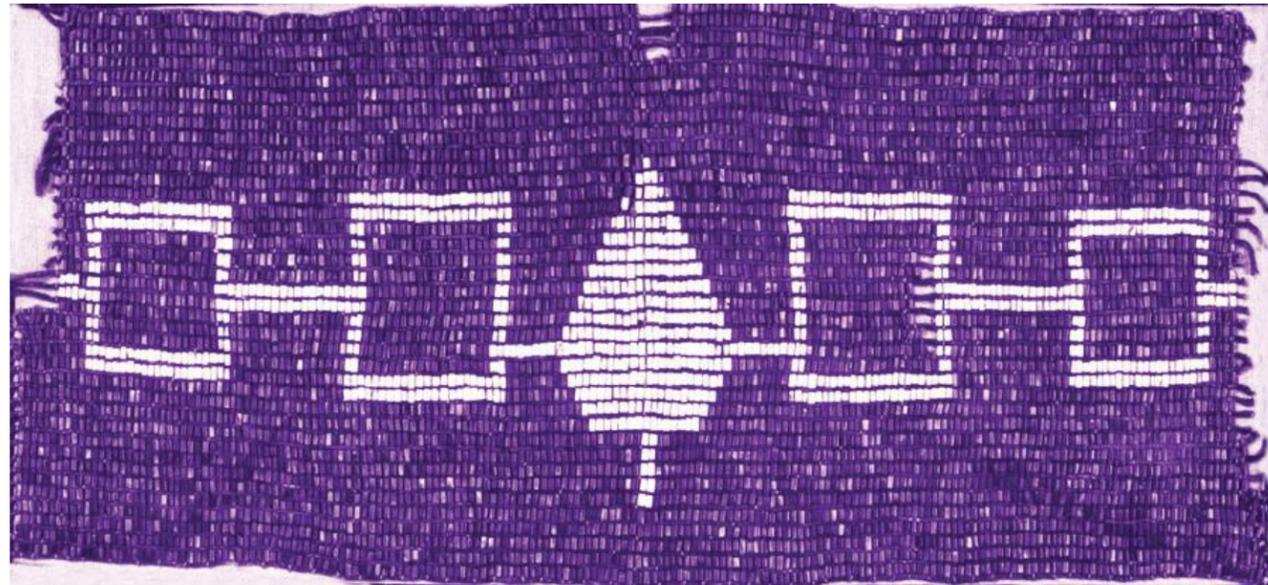


Figure 6: Picture of the national wampum belt of the Haudenosaunee known as the Hiawatha Belt.

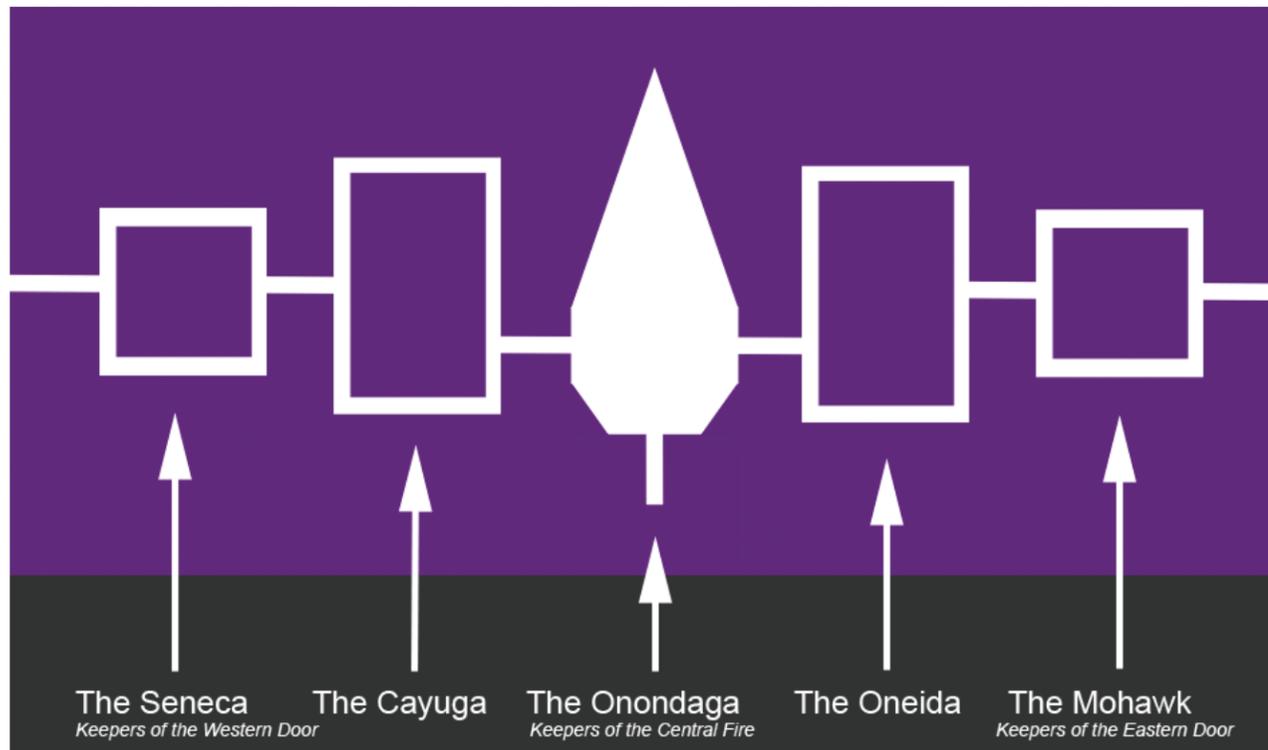


Figure 7: Graphic illustrating the flag of the Iroquois.

Seneca's at the West.¹⁵ The Peacekeeper named the Seneca Nation to the west, the 'Western Door Keepers,' and to the east, he named the Mohawk Nation the 'Keepers of the Eastern Door,' from which he named the Onondagas, the 'Firekeepers.'¹⁶ Today the Hiawatha Wampum Belt is represented in the flag of the Iroquois (represented in figure 7).¹⁷ For more information regarding the political structures that governed the formation of the Iroquois Confederacy, its representation in the Hiawatha belt, and how the social structures of the Longhouse are metaphorically personified in its formation, refer to Appendix A: Formation of the Iroquois Confederacy.

- 1 "Haudenosaunee (Iroquois)." The Canadian Encyclopedia.
- 2 Britannica, The Editors of Encyclopaedia. "Iroquois Confederacy." Encyclopædia Britannica.
- 3 Ibid.
- 4 "Haudenosaunee (Iroquois)." The Canadian Encyclopedia.
- 5 "Confederacy's Creation." Haudenosaunee Confederacy, January 23, 2019.
- 6 Britannica, The Editors of Encyclopaedia. "Iroquois Confederacy." Encyclopædia Britannica.
- 7 "Hiawatha." The Canadian Encyclopedia. Accessed December 16, 2019.
- 8 Ibid.
- 9 Ibid.
- 10 "Confederacy's Creation." Haudenosaunee Confederacy, January 23, 2019.
- 11 "Hiawatha Belt." Onondaga Nation, June 24, 2014.
- 12 "The Iroquois Flag." Iroquois Nationals Lacrosse, December 10, 2015.
- 13 "Mohawk Nation News." Gayanerekowa: The Great Law of Peace as Brought to the Confederacy of the Iroquois by Deganawida the Peacemaker, 1993, 1-189.
- 14 Ibid.
- 15 Ibid.
- 16 "Hiawatha Belt." Onondaga Nation, June 24, 2014.
- 17 Ibid.

2.3 THE LONGHOUSE

The Haudenosaunee lived in long cylindrical dwellings known as Longhouses which were bent wood structures sheathed with the bark of trees.¹ Eighteen foot tall wood structural members were embedded into the ground at three foot intervals from which the tops of the members were curved and lashed together with rope made from bark to form the roof.² The walls and roofs of the dwellings were then shingled with thick sheaths of bark that were stripped from elm trees and bound to the structural elements with twine made from wood fibers.³ The structures had an arterial passageway roughly ten to twelve feet wide that flowed through the center of the Longhouses which would be occupied by multiple fires.⁴ Door openings were located at either end of the arterial passageway with the doors themselves being constructed out of bark or hide.⁵ Often measuring around 20 feet in width and 200 feet in length, the Longhouses were cellular in growth,⁶ intended to accommodate large extended clan families (represented in figure 8).⁷ This was achieved by reconstructing the structures over time to be elongated in order to accommodate the growth of the family. In this manner, the Longhouses embodied the Haudenosaunee nation's values for a strong and interconnected community, serving as a distinctive form of communal housing.⁸ The Longhouses were compartmentalized into separate family living quarters by wood screens forming walls with a common doorway which connected each compartment back to the central passageway.⁹ Along either side of the central passageway were wooden structures forming stacked platforms consisting of sleeping quarters and storage.¹⁰ Each living compartment consisted of a low platform raised slightly off the

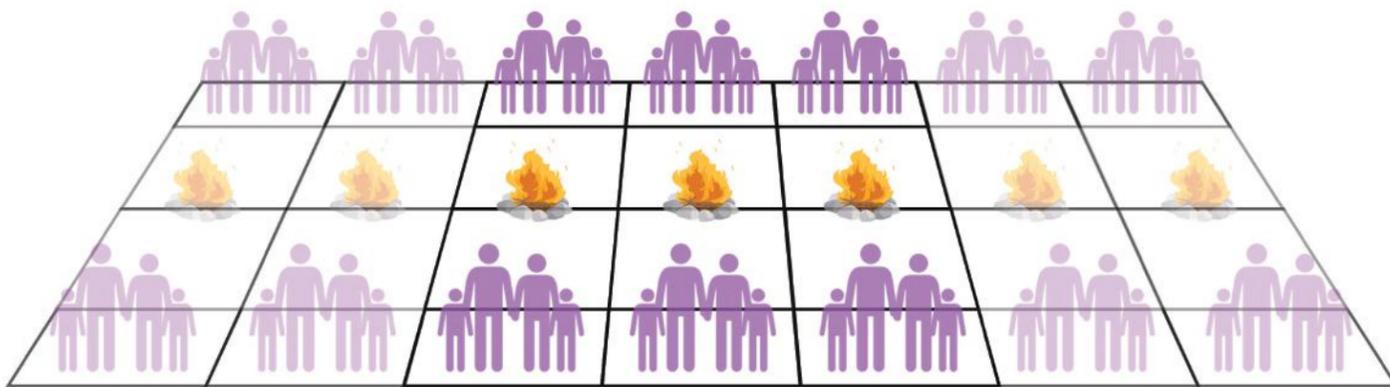


Figure 8: Graphic produced by author illustrating the cellular growth of the Longhouse serving as a form of communal housing.

ground covered with reed or corn husk mats and hides serving as the families bed and sitting area during the day.¹¹ Other platforms were suspended above the bed which served as storage space for provisions, clothes and other necessities.¹² The living compartments were to hold two families on either side of the Longhouse sharing a common fire pit.¹³ The only openings in the structure of the Longhouses, aside from the two door openings, were smoke holes set in the roof at intervals of around 20 feet to provide smoke ventilation.¹⁴ These openings could be sealed off with bark or hide hatches for shelter against unwelcoming weather conditions (Longhouse represented in figures 9, 10, 11, 12, & 13).

The Iroquois vernacular of the Longhouse can be seen as the first representation of Indigenous science and environmental understandings towards developing lands sustainably. Communal and densified in nature, the housing typologies minimized impacts on the natural environment, all the while serving their purpose as semi-permanent settlements in which the Longhouses were intended to be relocated once the farming lands and resources had been depleted.¹⁵ Allowing the natural environment of the previously developed lands to heal, replenish, and flourish with life while the community would develop elsewhere. The nation could then choose to return to the previously developed site years later once the land had been completely rejuvenated. This is unlike that of contemporary infrastructural developments which favor permanent structures that deplete natural resources and score the landscape, prohibiting the land a chance to heal and recover through ecological remediation.

- 1 YouTube. The People of the Longhouse. Film.
- 2 "Housing." Haudenosaunee Confederacy, April 17, 2018.
- 3 Ibid.
- 4 YouTube. The People of the Longhouse. Film.
- 5 "Housing." Haudenosaunee Confederacy, April 17, 2018.
- 6 Feedback from Brian Porter through Zoom meeting, November 8th, 2019.
- 7 "Housing." Haudenosaunee Confederacy, April 17, 2018.
- 8 Ibid.
- 9 Ibid.
- 10 YouTube. The People of the Longhouse. Film.
- 11 "Housing." Haudenosaunee Confederacy, April 17, 2018.
- 12 YouTube. The People of the Longhouse. Film.
- 13 "Housing." Haudenosaunee Confederacy, April 17, 2018.
- 14 Ibid.
- 15 Ibid.

Typological and Precedent Studies
The Longhouse on Six Nations

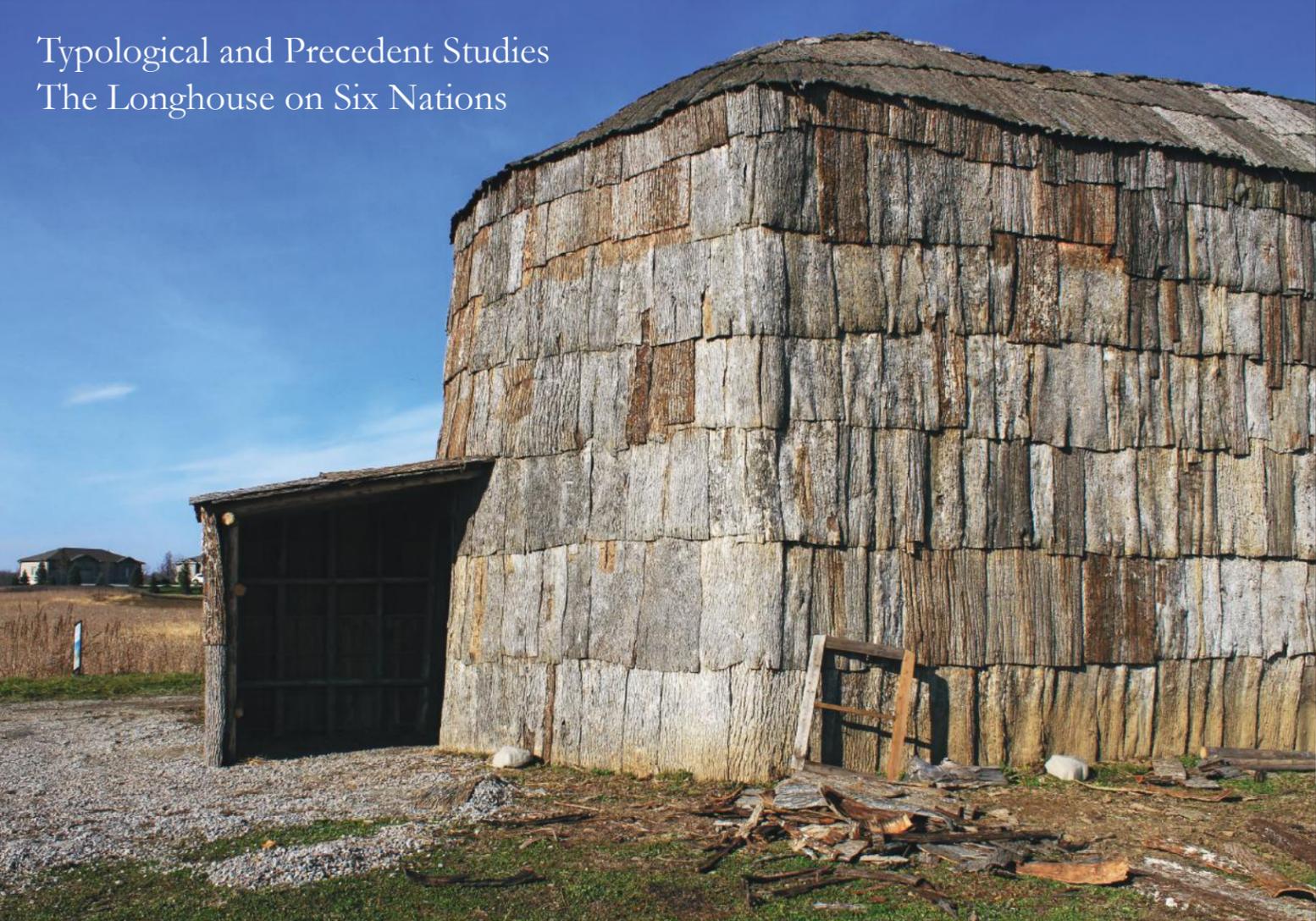


Figure 9: Photo taken by author of the Longhouse located at Kayanase on Six Nations.

Figure 11: Photo taken by author of the interior of the Longhouse located at Kayanase on Six Nations.

Figure 10: Photo taken by author of the Longhouse located at Kayanase on Six Nations.

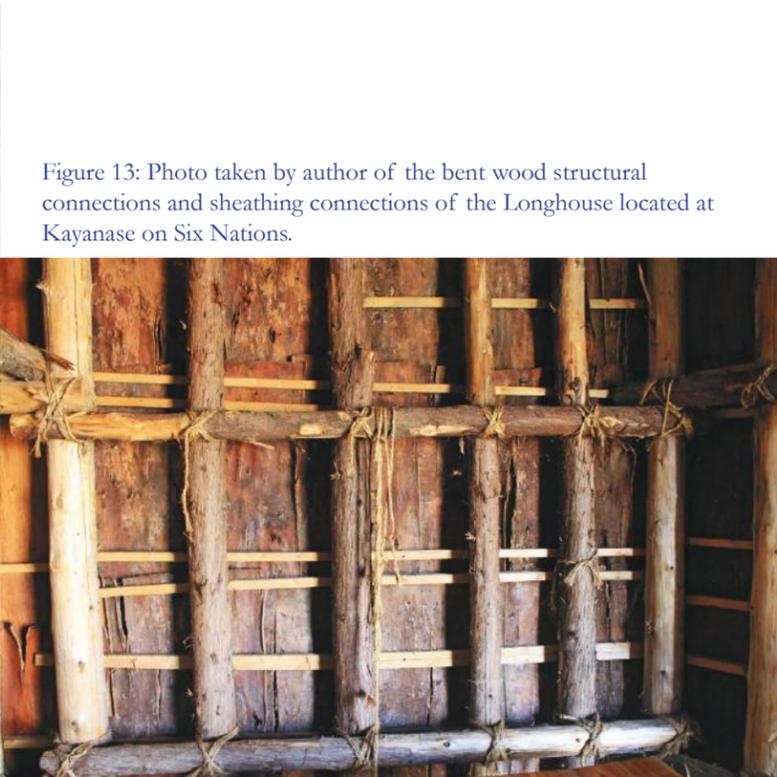


Figure 12: Photo taken by author of the Elm tree bark used to sheath the Longhouse located at Kayanase on Six Nations.

Figure 13: Photo taken by author of the bent wood structural connections and sheathing connections of the Longhouse located at Kayanase on Six Nations.

2.4 SOCIAL AND POLITICAL STRUCTURES OF THE LONGHOUSE AND VILLAGE

Furthering the notion of infrastructural densification as inherent of the communal housing vernacular of the Longhouse, this concept of minimal infrastructural imposition on the landscape extended to the formation, layout, and political/social structures of Iroquois villages. As previously stated, the Longhouse was intended to accommodate extended clan families, having multiple families living together under the same roof. Although, the nature of the living structures comprising the clan families within the Longhouses and the manner in which the Longhouses correlated with one another were based on complex social and political structures that informed the design of nation villages. Such complex social and political structures promoted interconnected communities while resulting in densified Haudenosaunee housing clusters or neighborhoods.

The family structures of the Haudenosaunee were primarily based on clan systems,¹ while social structures were based on matrilineal principles.² Every Longhouse consisted of a senior female and her husband from which the other members dwelling in the compartments of the Longhouse were to be of female lineage,³ descendants of the senior female, in exception for children and the men that married into the family. The husbands that married into the family were to belong to other matrilineages and were to move from their family's Longhouse into the Longhouse of their

wives.⁴ Several matrilineages formed the matrilineal clan where a Clan Mother would serve as the head of several Longhouses comprised in the matrilineage.⁵ This social/family structure not only served of symbolic and ceremonial importance, it also governed marriage patterns in which marriage between members of a clan was forbidden.⁶ Clans typically bore names of animals like that of Bear, Turtle, Wolf, Snipe, Deer or Hawk, and members of a clan were considered family, hence the forbidden marriage between clan members.⁷ Every community and/or village had their own respective sachems (supreme chiefs) and chiefs that governed their councils. Every nation's clans were represented by Clan Mothers that were entrusted with particular responsibilities such as overseeing the actions of the chief and appointing the chief's successor.⁸ Many Haudenosaunee people and communities still follow these traditional political and social structures, such as the case for Six Nations of the Grand River Reserve. Where community members identify with their clan and nation while looking towards the chiefs and their appointees, the Clan Mothers, for guidance.⁹

The manner in which these social and political structures manifested themselves in architectural relationships were densified Longhouse villages. The Haudenosaunee lived in year-round stockade villages of several hundred people, where a village could contain a few Longhouses to as many as 50,¹⁰ as represented in figure 14. The Haudenosaunee sustained themselves through advanced harvesting, cultivating, and hunting practices where everyone had a specific role to maintain within the community. The men's domain was out in the woods, hunting and gathering, whereas the female's domain was in the village, tending the crops, preparing meals, producing amenities, and caring for the young.¹¹ The social and family structures within the Longhouses and villages promoted a strong community, founded around healthy relations in which families and clan members nurtured and provided for one another. Children lived in the Longhouse where they were surrounded by their immediate family and extended family. The elders served as the wisdom keepers, mentoring the youth while passing down guidance, teachings, and wisdom.¹² The children referred to their mother and other females within the same lineage all as 'mother', showcasing the strong support system offered through the family structure.

Figure 14: Graphic illustrating traditional Haudenosaunee villages.





Additionally, the children referred to cousins and relatives within the same matrilineage all as ‘brothers’ and ‘sisters,’ demonstrating the healthy relations and bonds that were formed between clan systems.¹³ Haudenosaunee family structures today may still follow the matrilineal structures within clans, although it has embodied a more common nuclear family system as a result of colonialist influences and assimilation.¹⁴

Through developing densified villages, not only were the Haudenosaunee able to promote interconnected communities and healthy nurturing relationships between families, they were able to minimize land disturbances through the developments of their structures. Sharing lands through building densely allowed more land to be allocated towards agricultural, recreational and hunting practices while diminishing encroachments on the natural environment (represented in figure 15).

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- 1 “Family Structure.” Haudenosaunee Confederacy, April 17, 2018.
 - 2 “Haudenosaunee (Iroquois).” Haudenosaunee (Iroquois) | The Canadian Encyclopedia. Accessed December 3, 2019.
 - 3 YouTube. The People of the Longhouse. Film.
 - 4 “Haudenosaunee (Iroquois).” The Canadian Encyclopedia. Accessed December 3, 2019.
 - 5 “Family Structure.” Haudenosaunee Confederacy, April 17, 2018.
 - 6 “Haudenosaunee (Iroquois).” The Canadian Encyclopedia. Accessed December 3, 2019.
 - 7 Ibid.
 - 8 Ibid.
 - 9 Ibid.
 - 10 Ibid.
 - 11 YouTube. The People of the Longhouse. Film.
 - 12 Ibid.
 - 13 Ibid.
 - 14 “Family Structure.” Haudenosaunee Confederacy, April 17, 2018.

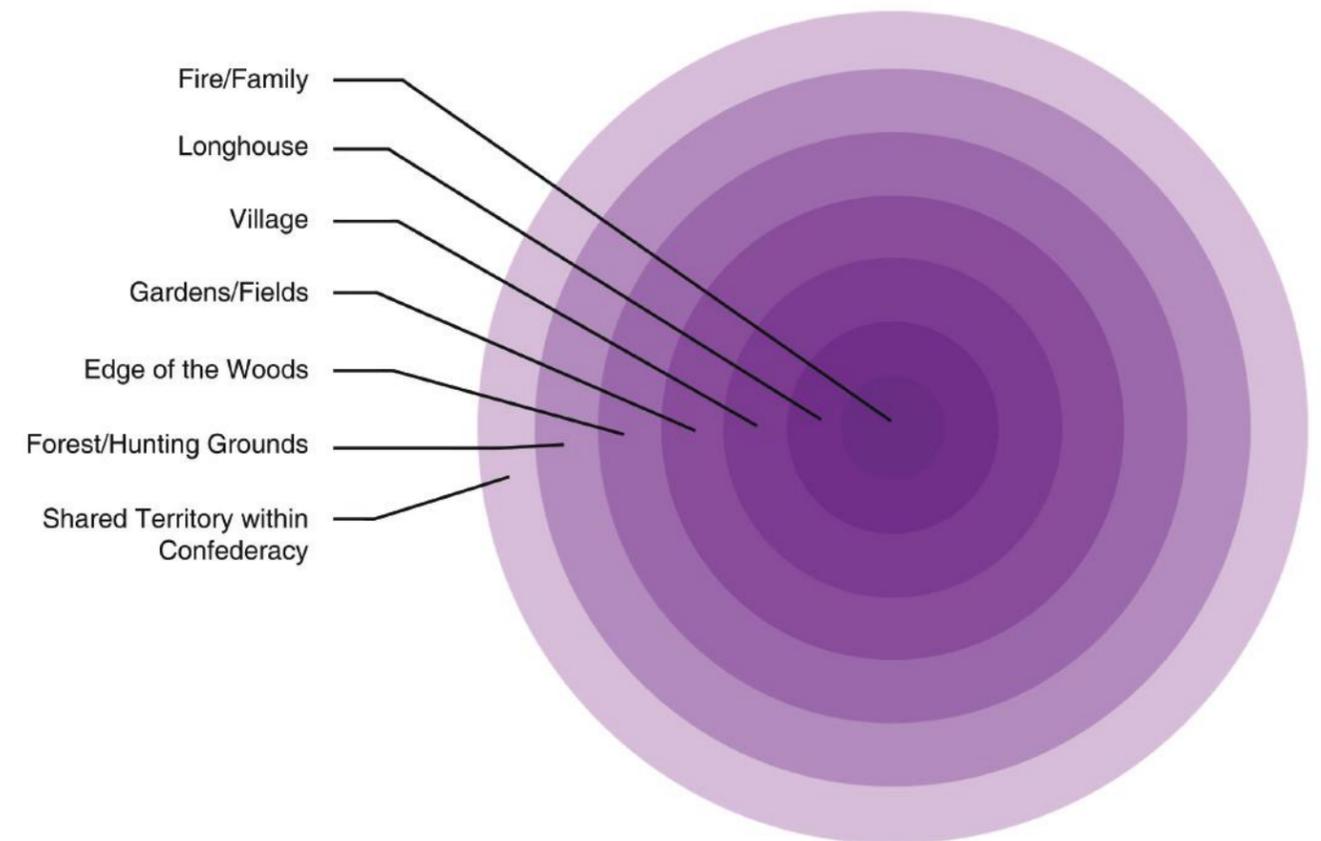


Figure 15: Diagram by author representing the social sphere of traditional Haudenosaunee villages. Graphic is an interpretation that was informed and derived from the following source:
 Susan M. Hill, Haudenosaunee Societal Spheres, in *The Clay We Are Made Of* (Winnipeg, Manitoba: University of Manitoba Press, 2017), 80.





2.5 HISTORICAL CONTEXT

After providing a brief background on the culture of the Haudenosaunee, it is now possible to vaguely comprehend the complexities of Haudenosaunee traditional practices. With that being said, before this Thesis is able to analyze ecological knowledge systems and practices inherent to the Haudenosaunee in a modern context, it is essential to understand the historical context of the culture. The current situations and conditions facing Haudenosaunee communities, including that of Six Nations of the Grand River Reserve are reflective of the historical events and political movements that have forced Indigenous communities to reside on contemporary Indigenous Reservations. In order to understand the culture in its contemporary context, it is essential to understand the cultural digression that the Haudenosaunee endured as a result of colonization, and how it has influenced their traditional knowledge systems and practices. Now, in an era of resurgence and reconciliation, Haudenosaunee communities are actively working towards rekindling connections with traditional teachings and practices through contemporary applications.

Throughout history, the Haudenosaunee played significant roles in the development of North America, both economically, politically and geographically. They were perceived as revered warriors that reigned over much of the central lowlands of North America. Their contributions and sacrifices given to the European conflicts of the North Americas between France and England, and the American revolution, however, have been sadly undermined and devalued. Sadly, throughout history, the Haudenosaunee fell victim to the oppressive forces of colonialism through attempted cultural assimilation, which has shaped and effected the people of the Haudenosaunee both physically, culturally, emotionally, spiritually, and environmentally. The current conditions that the Six Nations community are facing today are directly correlated to the mistrust and neglect of the Crown and other colonialist forces since the early 1500s. More information regarding the historical movements that the Haudenosaunee endured as a result of colonialism as well as the mistrust and neglect of the Crown throughout history can be found in Appendix A: Haudenosaunee Historical Context.



Chapter 3 | Haudenosaunee Ecological Knowledge (HEK)



3.1 HAUDENOSAUNEE ECOLOGICAL KNOWLEDGE (HEK)

The Thesis has provided a fairly comprehensive foundation on Haudenosaunee tradition in relation to its historical context, ecological knowledge systems and Indigenous sciences inherent of the culture – which lead to the Haudenosaunee having profound understandings of the natural environment and how to work with the land sustainably and reciprocally. We can now begin to analyze their community and traditions in a modern context. However, in order to embark this chapter, it is important to acknowledge that I myself am not producing the information presented on Traditional Ecological Knowledge (TEK) specific to the Haudenosaunee. Nor do I present myself as a knowledge carrier or holder of this information. Any and all information and understanding of the information has been derived from working with Indigenous professionals on Six Nations Reserve and their specific departments, as well as other Haudenosaunee reserve members and Haudenosaunee Nation websites. The main source of information for this paper regarding HEK has been informed through working members or documented information provided through Six Nations Polytechnic, which is a Haudenosaunee owned and controlled post-secondary institution at Six Nations of the Grand River First Nation Reserve. Comprehension of Haudenosaunee traditional teachings and practices was also derived from engagements with working professionals and resources offered at Kayanase, an ecological restoration and native plant and seed business based on Six Nations Reserve. The following working professionals had graciously allocated time out of their busy schedules to sit down with myself and discuss topics related to my Thesis in regard to Haudenosaunee Ecological Knowledge: Kerdo Deer, the ecotourism coordinator at Kayanase; Derek Sandy, a research assistant in the Indigenous Knowledge Centre at Six Nations Polytechnic; Phil Monture, Six Nations Lands Rights Consultant; and Brian Porter, the Principal Architect at Two Row Architect, an Indigenous owned and operated architecture firm located on Six Nations Reserve.

The cultural values, principles, and grounding philosophies of the Haudenosaunee are meant to guide its people on how to live their life in a manner that maintains and respects all aspects of creation. These philosophies, values and principles of the Haudenosaunee have been informed by traditional stories. Stories

which serve as sacred teachings, ideas, concepts and lived experiences that have been passed down through generations by means of oral transmission. These stories have provided the Haudenosaunee an understanding of how to behave as human beings on Mother Earth.¹ These stories and cultural understandings have endured knowledge provisions to overcome historical events to which Dan Longboat refers to as foundations of Haudenosaunee knowledge.² Throughout history, the Haudenosaunee have been faced with events and issues to which their culture, traditions and teachings have had to adapt and overcome, being renewed in reflection to current conditions. This has provided new knowledge and new teachings to the people of the Haudenosaunee. Throughout these renewals, there have been implicit values and principles that have remained within the teachings of the Haudenosaunee since creation, such as responsibility, respect, reciprocity, and relationships which have been embedded within a Haudenosaunee way of thinking.³ TEK, or more specifically, HEK is embedded within all of those teachings.

Four main topics of HEK will be discussed in this chapter. The first section will discuss the ecological understandings of Indigenous polyculture as understood through the Haudenosaunee with the utilization of the Three Sisters Garden. The next three topics will cover the three fundamental teachings of HEK that instruct/guide the Haudenosaunee on how to relate with the natural world and all of creation in a sustainable and reciprocal manner. These three teachings have been identified as the Thanksgiving Address, the Cycle of Ceremonies and Harvest, and the Dish with One Spoon Wampum Belt. I have tried to consolidate these four teachings into a cohesive and ethically appropriate manner that seeks to showcase the depth and complexity of an Indigenous worldview towards environmental understandings. Additionally, I will analyze how these fundamental principles, guidelines, teachings and practices could inform sustainable land management and architectural design strategies in a contemporary context.

1 Haudenosaunee Ecological Knowledge & the Dish with One Spoon. Conversations in Cultural Fluency Lecture Series #2. Six Nations Polytechnic, 2016. Dan Longboat.

2 Ibid.

3 Ibid.



3.2 POLY CULTURE

Polyculture: Agriculture that utilizes multiple crops in the same region, providing crop diversity in imitation of the diversity of natural ecosystems, in contrast to single crop farming, or monoculture.

Three Sisters Garden: A symbiotic planting technique involving corn, beans and squash.

Intercropping: A cropping practice involving growing two or more crops in close proximity.

Biodiversity: The variety of biological organism in the world or a particular habitat or ecosystem.

Before sustained contact with Europeans, the Haudenosaunee served as some of the first horticulturists with most of their diet consisting of maize.¹ They sustained themselves through advanced agricultural practices, refining skill sets that optimized the growth and cultivation of crops. Rather than cultivating the lands through a means of monoculture and competition of plants, like that of Europeans or westerners who were accustomed to atomized production of single species, the Haudenosaunee had a profound understanding of the biological capabilities of the plant species they were harvesting. This allowed them to establish cultivation methods through sustainable Indigenous *polyculture*.² This was exemplified through the merging of three crop species into an integrated agricultural practice through the planting of corn, beans, and squash to perform symbiotically, thus maximizing crop performances.³ The polyculture of the three plant species served as a more productive means of farming practice than if the plants were to have been individually farmed through methods of monoculture, fortifying the soil rather than depleting it.⁴ This practice was referred to as the *Three Sisters Garden* (represented in figure 16) and these three food groups were known as the Sustainers of Life, as it comprised the foundation of the Haudenosaunee traditional diet.⁵ For more information regarding Haudenosaunee horticultural and harvesting practices refer to Appendix A.2: Haudenosaunee Horticultural and Harvesting Practices.

The agricultural system of the Three Sisters Garden doesn't just focus on cultivating lands for sustainable food production, it utilizes *intercropping* to create beneficial relationships between crop species, generating sophisticated resource management systems.⁶ Here, the integrated crop species work together to not only fortify and enrich the soil, but provide natural pest control while increasing natural *biodiversity*.⁷ The method of growing the crops was communal, involving the men clearing the fields by removing the trees and brush while the women tended to the cultivation of the crop fields.⁸ After the fields were cleared, the grounds were hoed, scraping up the loose forest soils into piles serving as seed beds, to which the crops were then planted on their respective mounds.⁹ In the Three Sisters Garden, the corn is planted first due to its unique attributes serving as the pillar of the three plant species.¹⁰ Corn is among one of the most productive crop plants due to the strength of its stem,

its widely spaced leaves, and specialized C4 photosynthesis. This allows the plant species to support heavy yields, while allowing it to maximize sun exposure, and thus photosynthesis.¹¹ Beans, on the other hand, grow into vines which don't provide the stem strength required to grow upwards to gather a sufficient amount of sun exposure. Once the corn has grown 6 feet tall, the beans are planted, utilizing the sturdy stalk of the corn as a support system to spiral upward to obtain adequate sun exposure.¹² Additionally, the beans are a member of the legume family, having the ability to capture nitrogen from the air and manufacture protein which is stored in its leaves, roots and seeds from which it can then be released into the soil. Fertilizing the soil while nourishing the growth of the corn and squash.¹³ The squash grows closest to the ground out of the three species, providing a thick canopy of leaves that diffuse and block harsh sunlight, thus preventing the growth of harmful weeds while maintaining moist soils through diminishing water evaporation.¹⁴ In this manner, the Three Sisters use polyculture as a means of capitalizing on the unique attributes of each plant species to enrich one another, increasing crop yields through complimentary growth. This provides a nutritionally complete diet that wouldn't be attainable through the monoculture of one crop alone.¹⁵ Traditionally speaking, once the Haudenosaunee had finished cultivating the horticultural lands of the village and were seeking to relocate the community, the agricultural fields would

Figure 16: Diagram produced by author illustrating the Three Sisters Garden.

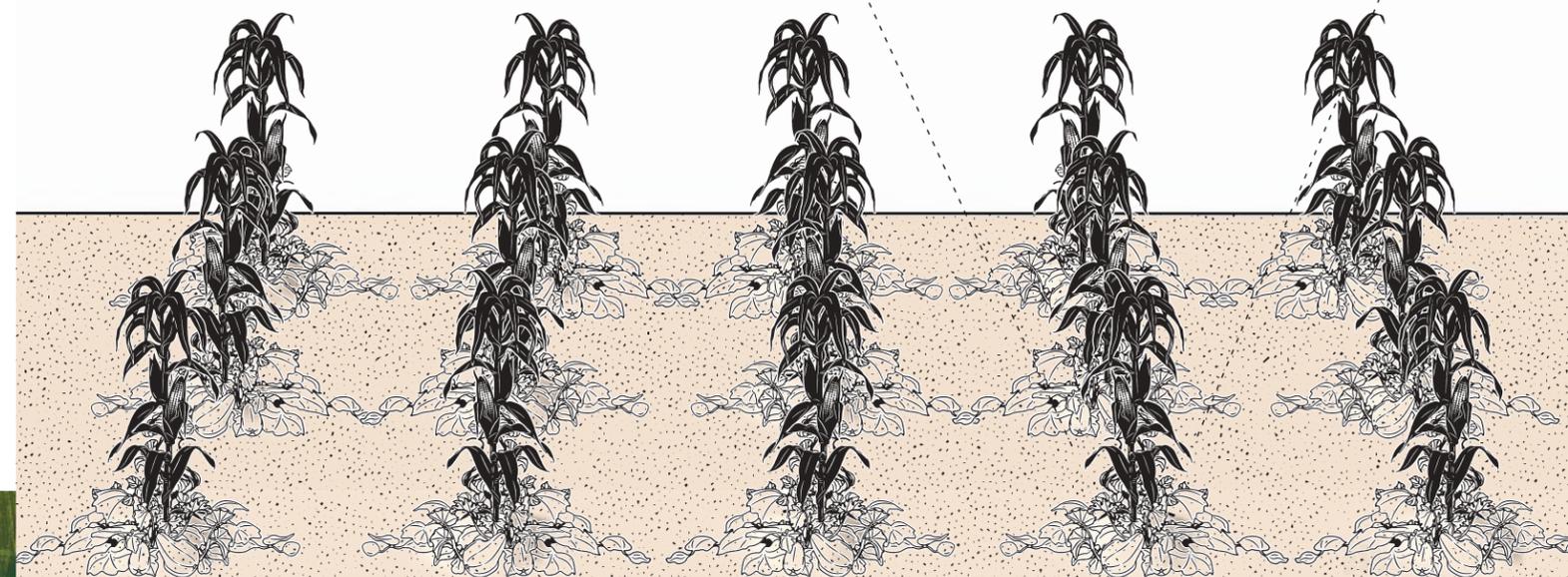
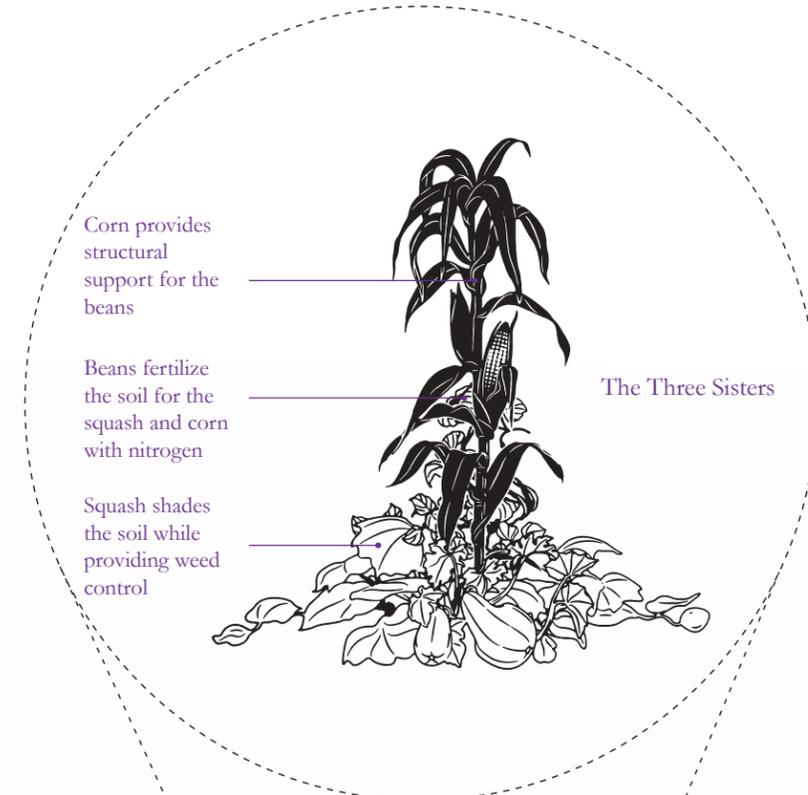
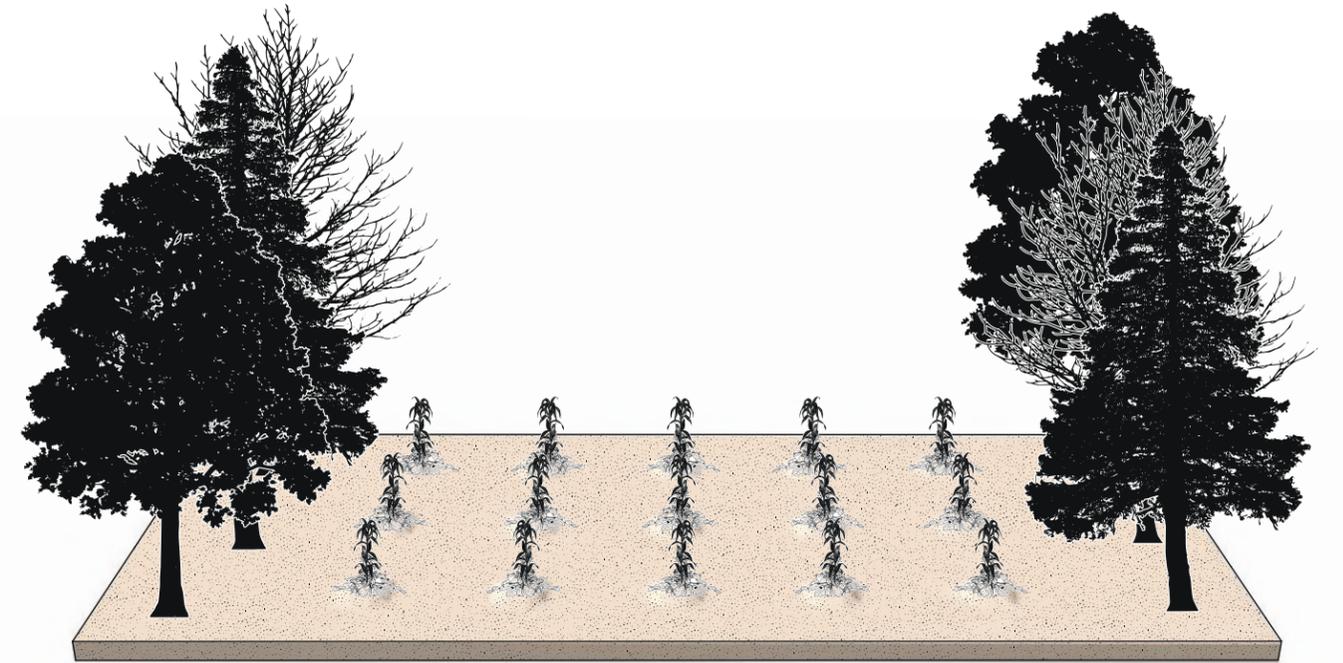


Figure 17: Diagram produced by author representing the Four Cycles of Cultivation for the Three Sisters Garden.



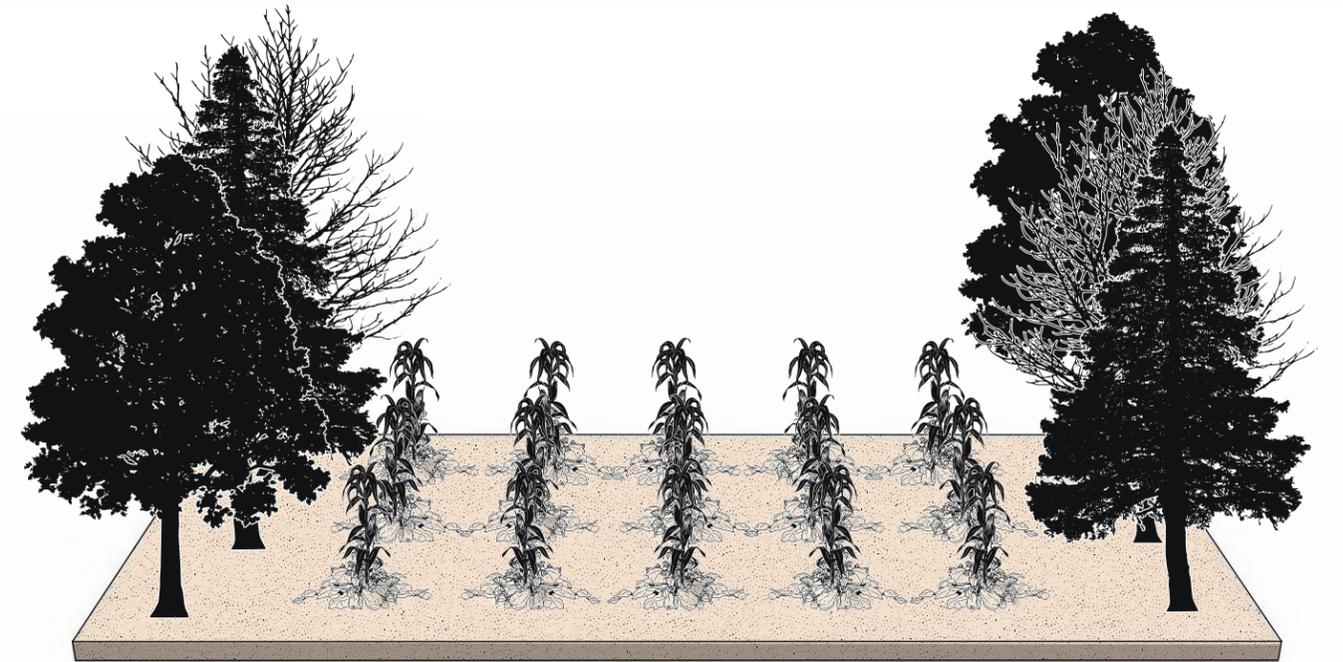
1. Forest patch located outside the village for plots of planting the Three Sisters Garden



3. Corn is planted first followed by squash, embarking the polycultural cultivation system



2. Forests are cleared and ground is scraped into mounds to prepare plots for the Three Sisters



4. Once corn has grown six feet tall the beans are planted, forming the Three Sisters Garden



Regenerative Agriculture:

Agriculture that functions in a manner that enhances its immediate physical and biological environment, which in turn brings greater dignity and welfare to the producing community.

Agroecology: The study of ecological processes applied to agricultural systems.

be cleared to allow nature to revegetate the lands back into mix-wood forests. The naturally fertilized soil from the use of the Three Sisters Garden would easily support the rejuvenation of an abundance of native biodiversity. Refer to figure 17 for a graphic representation of the four cultivation cycles the Haudenosaunee used for the Three Sisters Garden. The Haudenosaunee created several dishes and soups that incorporated corn, beans and squash together, such as the traditional dish which has become known as succotash. Preparing these traditional meals combining these three plant species not only enhanced the nutritional value of each, the complimentary amino acids of the Three Sisters form complete proteins.¹⁶

The symbiotic nature of the Three Sisters Garden is a perfect example of Haudenosaunee science, exemplifying how profound understandings of ecological systems can inform sustainable agriculture. Inherent of natural ecosystems are complex structures that involve communities of plant and animal species interacting with one another in close proximity. The diversity of species and the network of interactions contribute to the health, stability and longevity of the ecosystem as a whole.¹⁷ The crop diversity offered through the polycultural system of the Three Sisters is an imitation of the biological diversity found in natural ecosystems. This concept of letting nature do the work is the first strategy of regenerative design.¹⁸ Advanced variations of traditional Haudenosaunee agricultural themes can begin to inform systems thinking for *regenerative agriculture*.¹⁹ Here lies the potential for the reemergence of regenerative perspectives offered through Haudenosaunee tradition that could inform sustainable agricultural systems that are designed according to the general principles of natural ecosystems, forming *agroecosystems*. The significance of producing a regenerative agriculture that follows these guidelines would allow the production of sustainable and ethically appropriate food production for the community of Six Nations while working with the lands reciprocally. The benefits of utilizing the biological diversities offered through these agroecosystems would remediate the landscape, while providing enhancements to the physical and biological environments from which they were implemented.

In order to develop regenerative agricultural systems that have been informed through sciences of agroecology, there are a series of guidelines that one must follow. These intertwining guidelines consist of protecting and revitalizing the soil; planting for polycultural diversity; incorporating strategic pest control; utilizing interactive roles of animals; and integrating farming systems.²⁰ In addition, when developing a *guild*²¹ through the formation of agroecosystems, every member of the guild should support the needs of at least one other member. These needs consist of: pest control; microclimate control; providing nutrients; soil preparation; physical support; and processing and assimilation of materials.²² In order to develop a regenerative agricultural system for the Thesis project that achieves all these guidelines and supports all the previously stated guild needs, agricultural methods of agroforestry will be utilized, which is the sustainable practice of integrating crop farming with trees. The agroforestry system will be achieved through methods of *alley cropping* and *strip-cropping/intercropping*.²³ This system consists of the incorporation of plant and animal species into a comprehensive network of interactions to achieve a diverse ecosystem of sustainable production, layering the forest garden horizontally and vertically. The species structure of the agroforestry system would include a number of complimentary annual species consisting of perennial nut and fruit trees (both large trees and dwarf trees), shrubs, as well as forage and row crops. Terrestrial animals such as chickens and honey bees also form a critically important role serving as interactive components of the agricultural system.

The diversity of the crops provided in this system generate a comprehensive network of interactions that support and aid the success of other guild members, contributing to the health and stability of the ecosystem. The introduction of nut and fruit trees as well as tall shrubs provides microclimate control for forage and row crops such as the Three Sisters, as well as other lower growing plants. The trees shelter other growing mediums from the wind, fending off rain and snow, while the trees and tall shrubs provide shade for lower-growing medium. The root system of the larger plants consisting of the trees and shrubs also stabilize the soil while loosening the soil ground for better rainfall retention and germination of other plants providing soil preparation. The dense foliage of the taller plants contribute leaves as mulch and

Guild: a community of species devised by humans is referred to as a guild. Generally a guild is formed around a central species of plants or animals. In the case of the Three Sisters, the central species is corn.

Alley Cropping: Alley cropping is a sustainable agroforestry system utilized in temperate zones in which rows of trees are planted far enough apart to allow for row crops between the trees.

Strip Cropping / Intercropping: Methods of applying polyculture at larger scales through means of agroforestry by alternating rows of different crops.

Regenerative Agriculture - Agroecosystem

Figure 18: Graphic produced by author demonstrating the agro-ecologies within the proposed polycultural farming system.

- ① Canopy (Large Fruit & Nut Trees)
- ② Low Tree Layer (Dwarf Fruit & Nut Trees)
- ③ Shrub Layer (Berries)
- ④ Herbaceous Layer (Medicinal Herbs/Sweet Grass/Natural Prairies)
- ⑤ Forage and Row Crops (The Three Sisters Garden)
- ⑥ Ground Cover Crops (Strawberries, Legumes, Grasses & Grains, etc.)
- ⑦ Vertical Layer (Climbers & Vines)

Natural Habitat



The incorporation of a forested area into the agroecosystem allows for increased habitat of terrestrial animals such as birds, squirrels, chipmunks, butterflies, etc. These animals can help aid in natural pest control while also helping pollinate different species within the ecosystem and beyond, meanwhile contributing soil fertilization through manure.

Free Range Chickens

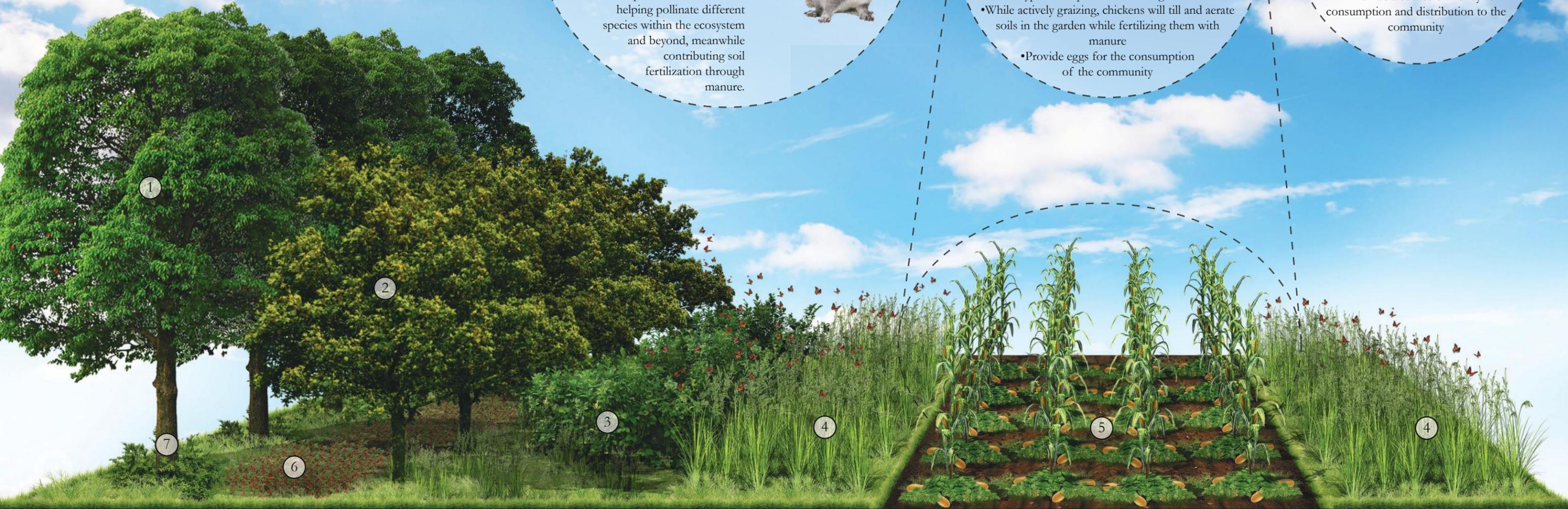


- Natural pest control consuming weeds, as well as byproducts produced in the gardens
- While actively grazing, chickens will till and aerate soils in the garden while fertilizing them with manure
- Provide eggs for the consumption of the community

Honey Bees



- Natural pollinators for the ecology of the agroecosystem, as well as the whole reserve
- Provide a source of honey for consumption and distribution to the community





compost that help fertilize the soils. The taller plants also offer physical supports for smaller plants, utilizing their trunks as poles or frames in which vines and other vegetation can grow. Through incorporating ground cover, crops and vines within the treed areas will provide opportunities for leguminous nitrogen fixing plants to fertilize the soils, providing nutrients to the ecosystem. The incorporation of a forested area into the ecosystem allows for increased habitat of terrestrial animals such as birds and squirrels. These animals can help aid in natural pest control while also helping pollinate different species within the ecosystem and beyond, while contributing soil fertilization through manure. In addition, certain animals prey on pests while certain plants repel pests that prey on other plants. By intermixing different plant species through methods of intercropping and strip cropping these can spread and diffuse, and thus reduce, the pest population affecting the ecosystem.²⁴ The addition of terrestrial animals in the form of free range chickens and honey bees also actively contribute to the ecosystem. The free range chickens actively graze the gardens, assimilating materials through the consumption of byproducts produced in the gardens while actively consuming weeds, serving as another form of natural pest control. While the chickens graze, they actively scratch the soil, tilling and aerating the soil while fertilizing it with manure. In addition, the chickens would in turn provide eggs for the consumption of the community. The honey bees, on the other hand, would serve as an additional layer of natural pollinators that would not only contribute to the pollination of the biodiversity within the agroecosystem, they would also contribute to the pollination of the surrounding ecology throughout the reserve. This would actively remediate and enhance the surrounding physical and biological conditions of Six Nation Reserve. This agroecosystem and the complex network of interactions that support the guild members within this polycultural system has been graphically demonstrated in figure 18.

To conclude, the regenerative perspectives offered through HEK and tradition as understood in this case through the polycultural system of the Three Sisters Garden can begin to inform sustainable and reciprocal land management strategies. These strategies actively aim to not only produce self-sustaining systems, but also systems that actively enhance and remediate surrounding ecological conditions of the reserve. These polycultural concepts can also extend to the

architectural profession, serving as frameworks or guidelines that can begin to inform passive and active building systems that work towards generating self-sustainable and resilient architectures that contribute to their surrounding ecologies, while enhancing natural site conditions.

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- 1 “Haudenosaunee (Iroquois).” Haudenosaunee (Iroquois) | The Canadian Encyclopedia. Accessed December 3, 2019.
 - 2 The Fortress, The River and the Garden – A New Metaphor for Cultivating Mutualistic Relationship Between Scientific and Traditional Ecological Knowledge. Kimmerer, Wall Robin. Pg 61.
 - 3 “Food And Hunting.” Haudenosaunee Confederacy, April 17, 2018.
 - 4 The Fortress, The River and the Garden – A New Metaphor for Cultivating Mutualistic Relationship Between Scientific and Traditional Ecological Knowledge. Kimmerer, Wall Robin. Pg 62.
 - 5 “The Interworking of the Three Sisters.” Oneida Indian Nation, January 18, 2018.
 - 6 Ibid. Pg 123.
 - 7 Ibid. Pg 126.
 - 8 “Food And Hunting.” Haudenosaunee Confederacy, April 17, 2018.
 - 9 YouTube. The People of the Longhouse. Film.
 - 10 The Fortress, The River and the Garden – A New Metaphor for Cultivating Mutualistic Relationship Between Scientific and Traditional Ecological Knowledge. Kimmerer, Wall Robin. Pg 64.
 - 11 Ibid. Pg 64.
 - 12 Ibid. Pg 66.
 - 13 Ibid. Pg 65.
 - 14 Ibid. Pg 69.
 - 15 Ibid. Pg 65.
 - 16 “The Interworking of the Three Sisters.” Oneida Indian Nation, January 18, 2018.
 - 17 Lyle, John Tillman. Regenerative Design for Sustainable Development. Pg 199.
 - 18 Ibid. Pg 192.
 - 19 Ibid. Pg 190.
 - 20 Ibid. Pg 194.
 - 21 Ibid. Pg 194.
 - 22 Ibid. Pg 199.
 - 23 Ibid. Pg 203.
 - 24 Ibid. Pg 199.





3.3 THANKSGIVING ADDRESS

Another instrumental teaching in Haudenosaunee culture that establishes how members are to relate to Mother Earth is the importance of expressing thanks to all of creation.¹ After talking to several public officials working on Six Nations Reserve on topics surrounding HEK, the teachings offered through the Thanksgiving Address continually surfaced. It is one of the most important parts of Haudenosaunee culture that can be easily conveyed to the outside world, serving as a sort of road map to Haudenosaunee relationships with nature.² After speaking with Kerdo, the ecotourism coordinator at Kayanase, he offered insight into the formation and significance of the Thanksgiving Address. He stated that the formation of the Thanksgiving Address dates back around the early 1800s, during a time when the Haudenosaunee were struggling to come to terms with their cultural and geographical displacement. The Thanksgiving Address consolidated Haudenosaunee traditional teachings dating back to the confederacy into a more modern context. They took the traditional teachings and distilled them into an oral address that resonated with the community's current conditions. This has been the way of the Haudenosaunee since sustained European contact, where traditional practices are constantly being adapted to match the current conditions of the community.

The Ganohonyohk (Thanksgiving Address) or otherwise known in English as the 'Opening Prayer' or the Greetings ("giving greetings to the natural world"), acts as a traditional thanksgiving that allows the Haudenosaunee to acknowledge and express gratitude towards each other, the earth, the animals, and the Creator.³ The teachings comprised in the Thanksgiving Address inform and guide the Haudenosaunee on how to respect all aspects of Mother Earth, expressing the interconnectedness and interdependency with nature, the earth, and human beings as defined through a Haudenosaunee worldview.⁴ It is a direction and also a summation of Haudenosaunee cosmology serving as a renewal, a continuation, great authority, great instruction, and good values.⁵ In order to understand HEK, it is essential to understand the interconnectivity of all aspects of creation and their relationship with humanity.⁶

The Thanksgiving Address is utilized in traditional Haudenosaunee culture, spoken during the openings and closings of important cultural events, ceremonies, meetings and gatherings.⁷

It is through these teachings and their cycle of ceremonies that give the Haudenosaunee the knowledge to be skilled agriculturalists and hunters, establishing deep rooted connections to the earth through the hunting of animals and the growing of foods for sustenance.⁸ Haudenosaunee culture and tradition identifies the Haudenosaunee as being stewards of the land to which they bear responsibility to uphold these reciprocal relationships. The Thanksgiving Address can be perceived as Indigenous science as it formats all of the elements comprised in an ecosystem, while relaying how the Haudenosaunee are to relate, respect and care for all these elements and their responsibility to uphold its perpetual care.⁹ By analysing the Ganohonyohk (Thanksgiving Address) a framework can be generated to guide architectural approaches to developing systems thinking, incorporate HEK of the Haudenosaunee and to inform creative and seamless architectural building solutions with nature. For more information and graphical clarity on the Ganohonyohk (Thanksgiving Address) refer to figure 19 on pages 58-59.

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- 1 Ecological Knowledge & the Dish with One Spoon - Conversation in Cultural Fluency #2. Conversations in Cultural Fluency: A Monthly Series of Webinars on Haudenosaunee Worldviews . Six Nations Polytechnic, 2016.
 - 2 Ibid.
 - 3 "Ohén:Ton Karihwatéhkwen - Thanksgiving Address in Haudenosaunee Culture." Engage for Change, October 24, 2019.
 - 4 "2019 Six Nations Community Plan," 2019. Pg 17.
 - 5 "Ohén:Ton Karihwatéhkwen - Thanksgiving Address in Haudenosaunee Culture." Engage for Change, October 24, 2019.
 - 6 Ecological Knowledge & the Dish with One Spoon - Conversation in Cultural Fluency #2. Conversations in Cultural Fluency: A Monthly Series of Webinars on Haudenosaunee Worldviews . Six Nations Polytechnic, 2016.
 - 7 "Ohén:Ton Karihwatéhkwen - Thanksgiving Address in Haudenosaunee Culture." Engage for Change, October 24, 2019.
 - 8 "2019 Six Nations Community Plan," 2019. Pg 17.
 - 9 "Ohén:Ton Karihwatéhkwen - Thanksgiving Address in Haudenosaunee Culture." Engage for Change, October 24, 2019.

Figure 19: Graphic produced by the author on pages 60-61 depicting the address and teachings offered through The Ganohonyohk (Thanksgiving Address - Greetings to the Natural World) - Ohen:ton Karihwatehkwen (Words Before All Else). It illustrates all the aspects of Creation that the Thanksgiving Address acknowledges. It is important to point out that this representation of the Thanksgiving Address has been shortened and many specific references to the culture of Six Nations have been generalized.

**Onkwehshon:'a
The People**



**Iethi'nistenha Ohontsia
The Earth Mother**



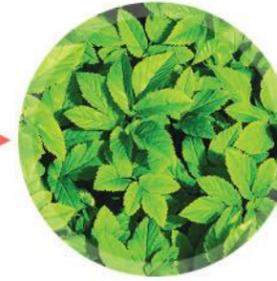
**Ohneka'shon:'a
The Waters**



**Kenstionshon:'a
The Fish**



**Tsi Shonkwaienth:w
The Plants**



**Kaien'thohshera
The Food Plants**



Today we have gathered and we see that the cycles of life continue. We have been given the duty and responsibility to live in balance and harmony with each other and all living things. So now, we bring our minds together as one as we give our greetings and our thanks to one another as people.

We are all thankful to our Mother, the Earth, for she gives us all that we need for life. She supports our feet as we walk about upon her. It gives us joy that she continues to care for us as she has from the beginning of time. To our mother, we send our greetings and our thanks.

We give thanks to all the waters of the world for quenching our thirst and providing us with strength. Water is life. We know its power in many forms — waterfalls and rain, mists and streams, rivers and oceans. With one mind, we send our greetings and our thanks to the spirit of Water.

We turn our minds to the all the Fish life in the water. They were instructed to cleanse and purify the water. They also give themselves to us as food. We are grateful that we can still find pure water. So, we turn now to the Fish and send our greetings and our thanks.

Now we turn toward the Plants. As far as the eye can see, the Plants grow, working many wonders. They sustain many life forms. With our minds gathered together, we give our thanks and look forward to seeing Plant life continue for many generations to come.

With one mind, we turn to honor and thank all the Food Plants we harvest from the garden. Since the beginning of time, the grains, vegetables, beans and berries have helped the people survive. Many other living things draw strength from them too. We gather all the Plant Foods together as one and send them our greetings and our thanks.

Now our minds are one.

**Ononhkwa'ashon:'a
The Medicine Herbs**



**Kontirio
The Animals**



**Okwire'shon:'a
The Trees**



**Otsi'ten'okon:a
The Birds**



**Owera'shon:'a
The Four Winds**



**Ratiwe:ras
The Thunderers**



Now we turn to all the Medicine herbs of the world. From the beginning they were instructed to take away sickness. They are always waiting and ready to heal us. We are happy there are still among us those special few who remember how to use these plants for healing. With one mind we send our greetings and our thanks to the Medicines, and to the keepers of the Medicines.

We gather our minds together to send our greetings and our thanks to all the Animal life in the world. They have many things to teach us as people. We are honored by them when they give up their lives so we may use their bodies as food for our people. We see them near our homes and in the deep forests. We are glad they are still here and we pray that this will always be so.

We now turn our thoughts to the Trees. The Earth has many families of Trees who have their own instructions and uses. Some provide us with shelter and shade, others with fruit, beauty and other useful things. Many people of the world use a Tree as a symbol of peace and strength. With one mind, we send our greetings and our thanks to the Tree life.

We put our minds together as one and thank all the Birds who move and fly about over our heads. The Creator gave them beautiful songs. Each day they remind us to enjoy and appreciate life. The Eagle was chosen to be their leader. To all the Birds — from the smallest to the largest — we send our joyful greetings and our thanks.

We are all thankful to the powers we know as the Four Winds. We hear their voices in the moving air as they refresh us and purify the air we breathe. They help us to bring the change of seasons. From the four directions they come, bringing us messages and giving us strength. With one mind, we send our greetings and our thanks to the Four Winds.

Now we turn to the west where our grandfathers, the Thunderers live. With lightning and thundering voices, they bring with them the water that renews life. We are thankful that they keep those evil things made by Okwiseres underground. We bring our minds together as one to send our greetings and our thanks to our Grandfathers, the Thunderers.

Now our minds are one.

**Kionhkehnehhkha Karahwa
The Sun**



**Ahsonthennehhkha Karahkwa
Grandmother Moon**



**Otsistanohkwa'shon:'a
The Stars**



**Shonkwaia'tison Raonkwe'ta'shon:'a
The Enlightened Teacher**



**Shonkwaia'tison
The Creator**



**Sakarihwaho:ton
Closing Words**



We now send greetings and thanks to our eldest Brother, the Sun. Each day without fail he travels the sky from east to west, bringing the light of a new day. He is the source of all the fires of life. With one mind, we send our greetings and our thanks to our Brother, the Sun.

We put our minds together and give thanks to our oldest Grandmother, the Moon, who lights the night-time sky. She is the leader of woman all over the world, and she governs the movement of the ocean tides. By her changing face we measure time, and it is the Moon who watches over the arrival of children here on Earth. With one mind, we send our greetings and our thanks to our Grandmother, the Moon.

We give our thanks to the Stars who are spread across the sky like jewelry. We see them in the night, helping the Moon to light the darkness and bringing dew to the gardens and growing things. When we travel at night, they guide us home. With our minds gathered together as one, we send our greetings and our thanks for the Stars.

We gather our minds together to greet and thanks the Enlightened Teacher who have come to help the people throughout the ages. When we forget how to live in harmony, they remind us of the way we were instructed to live as people. With one mind, we send our greetings and our thanks to these caring teachers.

Now we turn our thoughts to the Creator, or Great Spirit, and send our greetings and our thanks for all the gifts of Creation. Everything we need to live a good life is here on this Mother Earth. For all the love that is around us, we gather our minds together as one and send our choicest words of greetings and thanks to the Creator.

We have now arrived at the place where we end our words. Of all the things we have named, it was not our intention to leave anything out. If something has been forgotten, we leave it to each individual to send their greetings and their thanks in their own way.

Now our minds are one.

And now our minds are one.



3.4 CYCLE OF CEREMONIES AND HARVESTS

Through keen observations of natural phenomenon and thoughtful contemplation on the understanding of natural events derived from experiences of living off the land, the Haudenosaunee had refined their own earth sciences that allowed them to understand how the earth worked and the mechanics and chemistry of it.¹ Haudenosaunee ancestors studied Mother Earth and the cycles of nature in order to derive how to live with the land sustainably. Looking towards nature as a model for how to behave, the Haudenosaunee had derived a lifestyle that was in tune with the cycles of the land, while developing an annual cycle of ceremonies.² There are 13 ceremonies that are performed throughout the year following seasonal changes while representing the 13 moons throughout the year.³ Every month there is a ceremony or harvest that takes place, connecting the Haudenosaunee to nature through reciprocal relations, while allowing them to live with and follow the natural cycles of the land.⁴ The ceremonies serve as a way to express thanks to the people, the natural world, the spirit world, and the creator.⁵ These ceremonies are still being conducted by the Haudenosaunee in Longhouses today.⁶ These cycle of ceremonies and harvests performed throughout the year, following the seasons in relation to the 13 moons is graphically represented in figure 20.

Kerdo Deer and Derek Sandy were major contributors to the information provided surrounding this topic, providing valuable insight into the cycle of ceremonies and harvests performed throughout the year by the Haudenosaunee. It is important to point out that these ceremonies and practices vary between Longhouses, communities, and from family to family, and the teachings surrounding the ceremonies and harvests may vary in the same way as well. With that being said, Kerdo and Derek made it apparent that the information they provided shouldn't be considered as an authoritative representation of all Haudenosaunee people. As in the ways of the Haudenosaunee, the power of knowledge belongs to all and all are responsible for its survival/loss. In that respect, Kerdo Deer had provided insight into the practices as done by the Onondaga Longhouse of Six Nations, and Derek Sandy provided insight into the practices as followed by the Cayuga nation. I have tried to consolidate this information, in addition to information that was collected through conducting comprehensive online/

secondary source research, in an ethically appropriate manner. With that being said, the knowledge represented here illustrates my general comprehension of the ceremonies and harvests practiced by the Haudenosaunee and isn't to be regarded as a authoritative representation of the cycle of ceremonies and harvests performed by the Haudenosaunee.

With that being said, Kerdo clarified that in general, as long as the four main ceremonies are completed at each Mid Winter, this should suffice. Traditionally, the midwinter ceremony should be started by the end of the first moon phase after the winter Solstice, although these traditional practices have been adapted overtime to accommodate and reflect the current community. Shifting the ceremonies back one moon cycle to avoid interfering with families who celebrate Christmas holidays. Kerdo also clarified that as a consequence of colonization, there is no current existence of an official seed library owned by Six Nations. In addition to this, it is not known what restoration practices were used, if any. It may be reasonable to assume many plants were encouraged or certain habitats intentionally enhanced. Furthermore, the concept of reciprocity is celebrated by the community in their ceremonies and individually through planting, gathering food/medicines, hunting, fishing, and enjoying freedom to roam. Again, how individuals show this can be highly variable based on community, nation, clan or family.

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- 1 Ecological Knowledge & the Dish with One Spoon - Conversation in Cultural Fluency #2. Conversations in Cultural Fluency: A Monthly Series of Webinars on Haudenosaunee Worldviews . Six Nations Polytechnic, 2016.
 - 2 Ibid.
 - 3 "Ceremonies." Haudenosaunee Confederacy, April 17, 2018.
 - 4 Ecological Knowledge & the Dish with One Spoon - Conversation in Cultural Fluency #2. Conversations in Cultural Fluency: A Monthly Series of Webinars on Haudenosaunee Worldviews . Six Nations Polytechnic, 2016.
 - 5 "Ceremonies." Haudenosaunee Confederacy, April 17, 2018.
 - 6 "Ceremonies." Onondaga Nation, March 20, 2014.



Mother Earth, each other, and all aspects of creation. It taught the Haudenosaunee to only take exactly what is needed for the sustenance and care of your family in life. It also taught the Haudenosaunee to always leave something in the dish of nature for future generations, other people and all of creation, while always making sure that the dish is clean and healthy.²

The Dish With One Spoon wampum belt is in many ways a representation of ecology,³ where the limits of the dish (nature) are understood, as well as the sustainable relationships that are to be formed between humanity and all aspects of life that work towards maintaining and sustaining the natural environment. In this manner, systems ecology and symbology can be utilized to analyze foodsheds, watersheds and sewersheds, while addressing food, water, and energy sovereignty in a Dish With One Spoon perspective.⁴ Where philosophies surrounding respect, reciprocity, responsibility and relationships can begin to inform systems thinking for regenerative design.

- 1 Haudenosaunee Ecological Knowledge & the Dish with One Spoon. Conversations in Cultural Fluency Lecture Series #2. Six Nations Polytechnic, 2016. Dan Longboat.
- 2 Ibid. Rich Hill.
- 3 Lumiflux Media. "Neil Patterson Jr. – The Ecology and History of Onondaga Lake @ Skā-Noñh – Great Law of Peace Center on 08/02/16." Vimeo, December 5, 2019.
- 4 Haudenosaunee Ecological Knowledge & the Dish with One Spoon. Conversations in Cultural Fluency Lecture Series #2. Six Nations Polytechnic, 2016. Neil Patterson Jr.

3.6 TWO ROW METHODOLOGY FOR COEXISTENCE OF KNOWLEDGE SYSTEMS

As previously stated, the Haudenosaunee had refined their own earth sciences that allowed them to understand how the earth worked and the mechanics and chemistry of it. By analyzing the concept of polyculture as understood through the Three Sisters Garden, the concept of the Thanksgiving Address, the Cycle of Ceremonies and Harvests, and the Dish With One Spoon wampum belt, a framework can be generated to guide architectural approaches towards systems thinking. With that being said, if Haudenosaunee ecological knowledge is to inform systems thinking, guiding and enhancing modern technologies and sciences to create sustainable architectural building solutions, it is essential to understand the ethical manner in which the two knowledge systems of Indigenous Ecological Knowledge and Western Ecological Knowledge are to be applied. This has been represented through the metaphor of the Two Row Wampum.

The Two Row Wampum belt was created in 1613 as a treaty documenting an agreement between the Dutch and the Haudenosaunee people, stipulating how they were to treat one another and live together¹ (represented in figure 23). The white ground of the belt symbolically represents the River of Life to which we all travel, whereas the two parallel purple bands running its length represents both parties traveling the River of Life in their respective



Figure 22: Graphic illustrating The Dish With One Spoon.



boats. With one band representing the path of the canoe of the First People, where the other band represents the ship of the newcomers. The three beads that separate the two purple bands symbolizes the principles of peace, the Good Mind, and strength to indicate that both parties will travel together in peace and friendship.² The purple paths of the people do not cross, representing how they are to travel through life respecting each others ways and not attempting to steer the other vessel.³ The Two Row wampum belt is a model based on sovereignty and mutual respect, with an understanding that the fates of the canoe and the ship are linked.⁴

The metaphor of the Two Row Wampum calls for coexistence and neutrality, serving as a model of autonomy. Although, it also encompasses the responsibility of environmental stewardship surrounding issues of shared concern.⁵ In this manner, the Two Row concept can be extended as a guiding principle in natural resource planning and ecological design, while serving as a model for healthy relationships between knowledge systems. Rather than perceiving productive relationships between knowledge systems as an “integration” or “blending,” which would result in the loss of individual identity to the homogeneous whole; the Two Row concept recognizes the inherent sovereignty of each epistemology and worldview.⁶ This demonstrates how the two knowledge systems can coexist and enrich one another in a healthy manner that maintains their unique identities as represented in figure 24.

1 “Two Row Wampum – Guswenta.” Onondaga Nation – People of the Hills, June 24, 2014.
 2 The Fortress, The River and the Garden – A New Metaphor for Cultivating Mutualistic Relationship Between Scientific and Traditional Ecological Knowledge. Kimmerer, Wall Robin. Pg 59.
 3 “Two Row Wampum – Guswenta.” Onondaga Nation – People of the Hills, June 24, 2014.
 4 The Fortress, The River and the Garden – A New Metaphor for Cultivating Mutualistic Relationship Between Scientific and Traditional Ecological Knowledge. Kimmerer, Wall Robin. Pg 59.
 5 Ibid.
 6 Ibid.

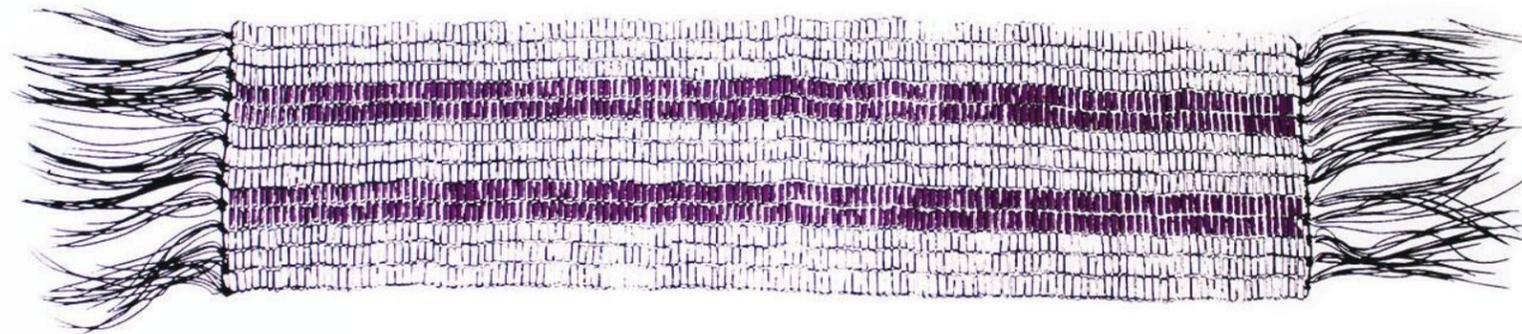


Figure 23: Picture of the Two Row Wampum Belt.

Traditional Ecological Knowledge (TEK)

-Haudenosaunee Ecological Knowledge - Indigenous Worldview - Indigenous Science - knowledge is aquired through holistic thinking, direct observation of natural phenomenon, contemplation of natural events, experiential learning, learning from elders, storytelling and ceremonies.

Environmental Stewardship

Shared concerns for the health and maintenance of the natural environment

Western Ecological Knowledge (WEK)

-Modern Sciences - Modern Technologies - Western Worldview - Western Science - knowledge is aquired through linear thinking, analytical and reductionist methods, objectivity, inductive reasoning, deductive reasoning

Figure 24: Graphic produced by author representing the Two Row methodology for coexistence of knowledge systems.



3.8 CHAPTER CONCLUSION

As an extension of the Thesis project, a finely crafted object/artifact was supposed to be designed and built that supported the Thesis direction. With the object serving as a physical embodiment of the Thesis methodology, the object was to parallel into the deliverable requirements of two other masters courses, that of Fabrication 2 instructed by Randal Kober and Material Culture instructed by Thomas Strickland. Since the Thesis revolves around utilizing Haudenosaunee ecological knowledge (HEK) in modern applications to inform sustainable architectural developments and land management strategies, the object was to metaphorically and symbolically embody what HEK is by personifying the three fundamental teachings of HEK that instruct/guide the Haudenosaunee on how to relate with the natural world and all of creation in a sustainable and reciprocal manner. These three fundamental teachings which have been identified are the Thanksgiving Address, the Cycle of Ceremonies and Harvest, and the Dish with One Spoon Wampum Belt, and have been encapsulated into the design of an object in a cohesive and ethically appropriate manner. Due to the COVID-19 virus outbreak that occurred during the final stretch of the Thesis pursuit, Laurentian University had to officially close its doors, resulting in the inability to complete the desired project. For more information regarding the object, graphics demonstrating its design proposal, as well as construction progress that had been made on the artifact, refer to Appendix B: Haudenosaunee Ecological Knowledge (HEK) Artifact.

As demonstrated throughout this chapter, as a consequence of colonization, the Haudenosaunee have endured a loss of cultural knowledge. Certain teachings and traditional practices surrounding sustainable land management as practiced in traditional Haudenosaunee lifestyles have been eroded and lost to time. Subsequently, there is no current existence of an official Haudenosaunee seed library owned by Six Nations that could inform sustainable land management strategies or landscape remediation. In addition to this, Kerdo Deer had informed myself that it isn't known what restoration practices were traditionally used by the Haudenosaunee, if any at all. Though it may be reasonable to assume many plants were encouraged and certain habitats were intentionally enhanced. In general, in terms of sustainable land management strategies, it was understood that the land would heal itself when left alone.

Although there has been a cultural loss of knowledge throughout history, the Haudenosaunee are in an era of reconciliation and are actively trying to rekindle lost connections to their traditions. Even though there is no concrete Haudenosaunee seed library or definitive traditional land remediation strategies available at this time, the foundational teachings and instructions provided to the Haudenosaunee through cultural tradition can be utilized as instructions that can guide and enhance modern technologies and land remediation strategies. In doing so, it is possible to produce regenerative architectural developments that perform reciprocally with the land. Although, before we can begin to explore how Haudenosaunee Ecological Knowledge can inform regenerative design strategies and how these sustainable systems will begin to take form following nature's processes, it is essential to gather a comprehensive understanding of the current conditions and issues facing Six Nations Reserve. If regenerative developments are to be designed on the reserve informed through traditional knowledge systems, it is imperative to align the architectural intentions of the facilities with Six Nations envisioned direction of future developments. In doing so, this will allow the production of developments that are not only sustainably designed, but address the needs and desires of the community. In turn, providing infrastructures that empower the community while allowing Six Nations to support themselves in perpetuity.



Chapter 4 | Contemporary Context



4.1 SIX NATIONS OF THE GRAND RIVER RESERVE

Haudenosaunee communities have been planning sustainably with the land since the time of creation. The Haudenosaunee have an understanding that there are responsibilities that every individual is to uphold for the safety and wellbeing of each other and Mother Earth. This enabled past Haudenosaunee communities to be carefully planned to be self-governing, sustainable, and connected through healthy families and community relations.¹ Collectively, the Haudenosaunee have maintained this knowledge of planning healthy communities even through the pressures of colonization and displacement. With continuous efforts of reconciliation, the Haudenosaunee are actively revitalizing their culture and languages, returning to traditional teaching and wisdom of their past in a contemporary context.² Although the community is actively reaching to share, preserve and promote Haudenosaunee culture, teachings, and languages, there is still room to grow in this period of resurgence.³ With this being said, the planning and design of Six Nations built environment still doesn't adequately reflect the culture, values and needs of the Haudenosaunee.

For Haudenosaunee people, maintaining a respectful relationship with Mother Earth isn't just a lifestyle, it is a central component to their culture and identity, while serving as a necessity to achieving healthy minds, bodies and spirits.⁴ The teachings offered through the Ganq̄h̄onȳq̄hk (Thanksgiving Address) provided the Haudenosaunee the knowledge to know how to respect and acknowledge all aspects of creation. While their cycle of ceremonies and harvests instructs how the Haudenosaunee are to relate to Mother Earth, connecting them to nature through reciprocal relations through the foods and medicines they grow throughout the year, following the cycles of nature.⁵ Traditionally, the Haudenosaunee had utilized every part of a plant or animal for food, tools, and clothing producing little to no waste.⁶ As a consequence of colonization, the Haudenosaunee have endured a cultural shift which has deviated from traditional value systems and principles, heavily influenced by western value systems. As a result, the Haudenosaunee of Six Nation's relationship with mother earth is at risk due to contemporary habits.⁷



Figure 25: Graphic produced by author illustrating the statistics of Six Nations members living on and off reserve. Graphic reinterpreted from page five of the community plan (SNGRDV).
 “2019 Six Nations Community Plan,” 2019. Pg 5.

Due to colonization, external forces have hindered Haudenosaunee culture and practices. Further, the expectations and lifestyles of a modern world tend to distance the Haudenosaunee from their identity.⁸ This has resulted in very few members that hold traditional knowledge of Haudenosaunee principles and their applications. The few that do have become very protective of it. Additionally, relationships have become based on individual possession and personal benefit, encouraging hyper-individualistic ownership of property while favoring individualistic living systems. This has segregated the community and diminished safety throughout the reserve while eliminating opportunities for communally owned lands.⁹ This has resulted in a deviation from the principles and values as reflected in Haudenosaunee tradition that prioritized strong, interconnected, and nurturing communities that bore a responsibility to nurture Mother Earth for future generations.¹⁰

As a result of colonization, the Haudenosaunee have endured a loss of culture, which subsequently lead to a loss of understanding on how to maintain reciprocal relations with Mother Earth.¹¹ As a consequence, community members and visitors tend to pollute the lands, rather than managing the waste responsibly, leading to yard, property, and infrastructural neglect of maintenance and care. To make matters worse, there are no regulations or standards to hold businesses and individuals accountable for the proper disposal of waste.¹² In addition, a growing culture of consumption has proliferated which is littering the natural environments through the production of waste, impeding on Haudenosaunee ways of keeping balance with Mother Earth.¹³ As a consequence of consumerism, business development is a fundamental driver in the community while larger house construction is favored, resulting in the destruction of ecosystems and wildlife habitat. Businesses are profiting from

“Today, our community is coined ‘The Lungs of Ontario’ by our neighbors for the amount of healthy Carolinian forest and wetlands we have. Visible from space, our patch of green is a representation of how we value Mother Earth. However, our relationship with Mother Earth is at risk because of our current habits.”¹⁴

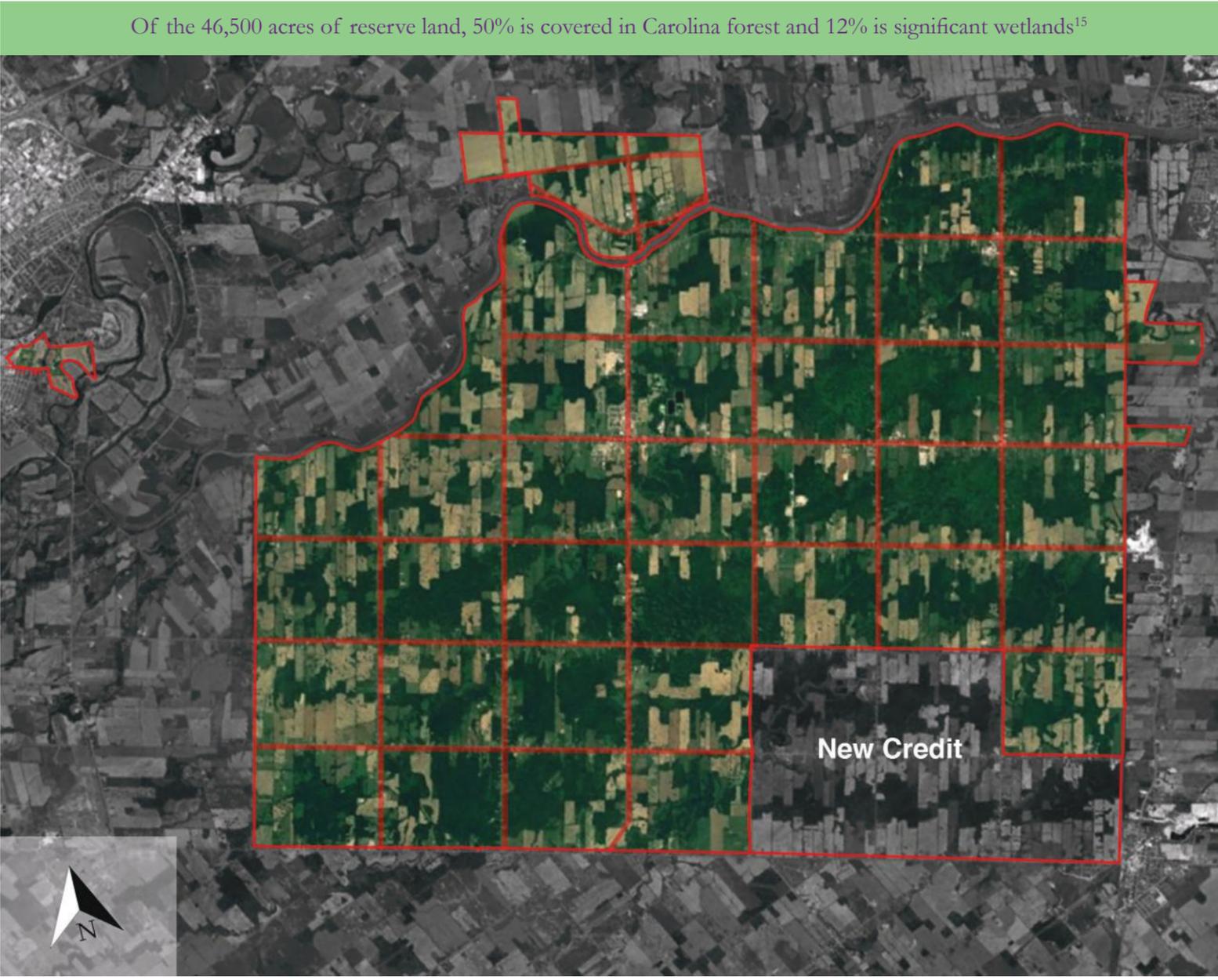


Figure 26: Graphic produced by author demonstrating the boundaries of Six Nations of the Grand River Reserve through aerial imagery. Diagram is composed of imagery gathered from Google Earth.



Six Nations water, without giving anything back to the community. Meanwhile, members can't drink their own water resources. Six Nations also doesn't currently have any standards to hold people and businesses accountable for the restoration of streams, wetlands, forests and fields that have been disturbed through developments.¹⁶

Currently, very few individuals within the community have cultural knowledge surrounding hunting and farming and there is a lack of sharing of cultural knowledge on Six Nations. Farming is also seen in the eyes of the community as an unreliable profession and newer generations are losing interest in these practices. The land that is being utilized for agricultural purposes are used for short-term profit, typically the growing of tobacco, rather than nutritious and healthy foods that could be recirculated back to the community. Additionally, concerns have been raised on the use of pesticides, herbicides and fertilizers that are being utilized by farmers without regulation. As well, the health of the forests and waters are suffering due to infrastructural developments which are also consuming agricultural lands thus impacting the ability to produce and harvest food, fish, and game. As a result, cultural knowledge on harvesting and cultivating is diminishing, while the number of community members accessing food banks is increasing.¹⁷ Overall, a lack of food sovereignty and food security.

The Six Nations of the Grand River community have voiced a desire to change their ways to make their actions match their principles. These principles are based on a strong respect for Mother

Earth and the understanding that Haudenosaunee survival and success depends on the wellbeing of Mother Earth.¹⁸ In addition, funding initiatives for infrastructural developments usually consist of focusing on basic needs such as housing, water, etc, leaving cultural values and their incorporation into the project scope out of the question.¹⁹ More work is needed to rekindle connections with Haudenosaunee teachings and values from the past in a contemporary context in which the principles that are intended to guide the Haudenosaunee can in turn guide future developments, such as utilizing Haudenosaunee guiding values and principles of maintaining balance with Mother Earth.

1 "2019 Six Nations Community Plan," 2019. Pg 4.
 2 Ibid.
 3 Ibid. Pg 27.
 4 Ibid. Pg 17.
 5 Ibid.
 6 Ibid.
 7 Ibid.
 8 Ibid. Pg 29.
 9 Ibid. Pg 61.
 10 Ibid. Pg 17.
 11 Ibid. Pg 23.
 12 Ibid.
 13 Ibid. 17.
 14 Ibid.
 15 Ibid. Pg 16.
 16 Ibid. Pg 19.
 17 Ibid. Pg 21.
 18 Ibid. Pg 17.
 19 Ibid. Pg 29.





4.2 COMMUNITY VALUES AND VISION

Due to the prescribed time constraints of the Masters of Architecture Thesis offered through Laurentian University's Architecture program, community engagement with Six Nations members wasn't feasible. This can be primarily attributed to the fact that Research Ethics Board approval was required for any engagement with non-working professionals, i.e. community members, pertaining to the field of interest/study. Therefore, in order to derive any comprehension of the values, vision, direction and necessities advocated by the Six Nations community, it was necessary to interview working professionals located on the reserve and to gather existing documentation on the topic. Thankfully, a comprehensive community plan had been released in 2019 just prior to embarking the Thesis pursuit, serving as a guiding document for a sustainable Six Nations future that has been formed through the community's voices. Through engaging with public officials working on Six Nations of the Grand River Reserve and analyzing the community plan, I have been able to derive an architectural framework of Six Nations community priorities that will guide and inform the programmatic design of the architecture.

Located on the Six Nations of the Grand River Reserve is the 'Six Nations of the Grand River Development Corporation (SNGRDC)', which is committed to managing the economic interests of the Six Nations Community in a manner that reflects the community's vision and values.¹ The corporation stipulates guiding principles for business decisions that are reflective of Six Nations cultural values and community vision, both on and off the reserve.² In 2019, the SNGRDC produced a comprehensive Community Plan, the 2019 Six Nations Community Plan, serving as a living document representing the values, vision and direction of the Six Nations community.³ The information recorded throughout the document was gathered through community consultations and engagements at several scales from 2018-2019, comprised as a planning tool that is to serve as a guide for future developments in order to achieve social, economical and environmental sustainability.⁴ The cultural values and principles recorded throughout the document have been distilled to address concerns surrounding or relating to Haudenosaunee Ecological Knowledge and its application in a contemporary context.

Based on the feedback received from community engagements, the Community Plan had been broken down into eight interconnected priorities that had emerged through the voices of the community.⁵ The eight priorities of the plan are as follows: *Mother Earth, Culture, Governance, Community, Built Environment, Employment and Education, Wealth and Economy, and Well-being.*⁶ The eight priorities of the plan were conceptually framed and strategically organized through the metaphor of the Great Tree of Peace, serving as a symbol of unity amongst the six nations of the Haudenosaunee confederacy.⁷ The Community Plan utilizes the metaphor of unification specific to the Tree of Peace to symbolically represent the harmonious relations and interconnected nature of the eight priorities, that when properly orchestrated, can unite the Six Nations community through prosperous developments progressing towards a sustainable future.⁸ Figure 27 metaphorically represents the symbolism of the 'Tree of Peace, which I will refer to as the 'Governing Tree of Development Strategies,' formulating an interconnected framework of the eight community plan priorities and their respective positioning based on the significance given by Six Nations members. This illustrated metaphor is to guide the decision making of any community development proposals or design strategies moving forward throughout the Thesis progression, as the basis of this framework should inform the design of the regenerative developments. The community plan outlined 34 community goals that had been subcategorized into the 8 community priorities.⁹ For the purpose of this Thesis only a selection of the community goals have been analyzed that relate to the scope of work and the respective qualities found through regenerative design. Overall, 24 identified community goals will be explored in relation to the respective 8 community priorities (represented in figure 28).

Today, the Haudenosaunee hold the Great Law of Peace in the hearts of the community, although the way in which the community behaves and relates with one another and Mother Earth isn't always reflective of Haudenosaunee teachings.¹⁴ The Haudenosaunee of Six Nations voices their responsibility to be stewards of the land and keepers of Mother Earth. In order to rebuild reciprocal relationships with Mother Earth, they must collectively return to these responsibilities.¹⁵ Community visions



Situated atop the tree is Well-being, acting as the fundamental overarching goal which is to increase or benefit the overall Well-being of the community through community development.
WELL-BEING

Culture is situated at the core of all the priorities, acting as the integral trunk of the symbolic tree. Since Culture is the integral and central core that constitutes what it means to be Haudenosaunee Six Nations, it should be at the core of all development and design decisions for the community.
CULTURE

The branches, serving as protection and shelter as represented in the symbolism of the Great Tree of Peace, metaphorically represents the interconnected nature of the economy, employment, education and their essential connections to Haudenosaunee culture. These priorities are reflective of the Six Nations community. In order to achieve self-sufficiency and sustainability, Employment, Education, Wealth, and Economy must be fundamental drivers for Six Nations community development.
EMPLOYMENT & EDUCATION
WEALTH & ECONOMY

The roots symbolically serve as the foundation of the community plan, grounding all of the other priorities. In order to obtain a healthy well-being, healthy relations are to be established with Mother Earth. Governance is to be organized by strong and accountable leadership, communities are to be safe and connected and sufficient infrastructures and housing should form the built environment.
MOTHER EARTH - GOVERNANCE
- COMMUNITY - BUILT ENVIRONMENT

towards future developments involve exploring new modes of clean energy production and innovative waste management solutions in hopes of a more sustainable built environment. By centering Haudenosaunee best practices in a modern context, communities can begin to be designed with increased self-sufficiency in terms of food, water and energy production, paving paths towards self-determination that re-establish intimate relations with the land while designing for seven generations in the future.¹⁶

“Our Vision for the future is that... ‘Six Nations is a community with a strong and respectful relationship with Mother Earth. We protect Her to provide for us and future generations. We limit our impact and enhance the natural systems around us.’”¹⁷

By the community collectively being better stewards of the land and its resources, the health of the forests, waters and soils will be better maintained, which will allow them to generate their own food sources and support themselves in perpetuity. It would allow the opportunity to increase land-based learning initiatives through having intact ecosystems, providing education systems that can work towards empowering new generations to live up to the Haudenosaunee identity of being protectors of the earth. With cleaner waters and maintained healthy resources, less complex infrastructures will be needed to filtrate water and manage environmental systems, while diminishing dependency on outside regulations and enforcements. Educating the community on sustainable waste management initiatives will promote self-reliance, empowering them to manage their own lands without having to rely on outside affiliations which will provide economic and employment opportunities, thus building a collective spirit of participation and personal accountability.¹⁸ Furthermore, better maintained and sustained environments will promote healthier lifestyles while promoting more recreational opportunities to explore and enjoy the natural environment.¹⁹ The community also advocated certain responsibilities that every member and development process should uphold on the reserve, consisting of: the responsibility to plant trees in order to recover lost lands given to construction or developments; properly assessing property for environmental assets such as streams, wetlands, medicines, species

Figure 27: Graphic produced by author demonstrating the Governing Tree of Development Strategies. Graphic and text reinterpreted from page six of the community plan (SNGRDV). “2019 Six Nations Community Plan,” 2019. Pg 6.

at risk; surveying land to address land and neighboring issues; as well as planting non-invasive trees and shrubs on unused parts of property.²⁰

Additional responsibilities that the community advocated every individual should live up to consisted of: obtaining food from local growers and hunters as much as possible; converting portions of lawns into vegetable gardens and composts; educating the community on sustainable hunting and fishing practices; educating the community on the ceremonies that allow the Haudenosaunee to understand practices of planting and harvesting; sharing traditional meals with the community and family members; as well as volunteering for food banks and other food initiatives.²¹ By living up to these community responsibilities and developing food systems of sustainable production and equitable access, not only can stronger, reciprocal relationships be formed with the land, skill sets of harvesting and cultivating can be reinforced, deepening community understandings of Haudenosaunee ceremonies and traditions surrounding these practices.²² Additionally, a growing food production sector can create healthy, fulfilling job opportunities that connect people with nature, economically sustaining Six Nations in a manner that is harmonious with the natural environment. By integrating gardening and food production systems into infrastructural designs, a built environment can be generated that recognizes and celebrates Haudenosaunee skill sets of being horticulturists. This would not only celebrate Haudenosaunee culture, it would increase community knowledge of traditional diets and subsequently promote healthier nutritional diets, alleviating health related issues and concerns facing the community. In addition to this, integrating food production systems into the built environment would promote more community interaction and engagements over the preparation of meals.²³ The growing and harvesting of own foods would also lessen dependency on the purchasing of bought foods, reducing waste from packaging while reducing the intake of unhealthy, processed bought foods.²⁴ Overall, this integration of food production into infrastructural design would promote self-reliance while achieving food security and sovereignty through affordable and culturally appropriate foods.²⁵

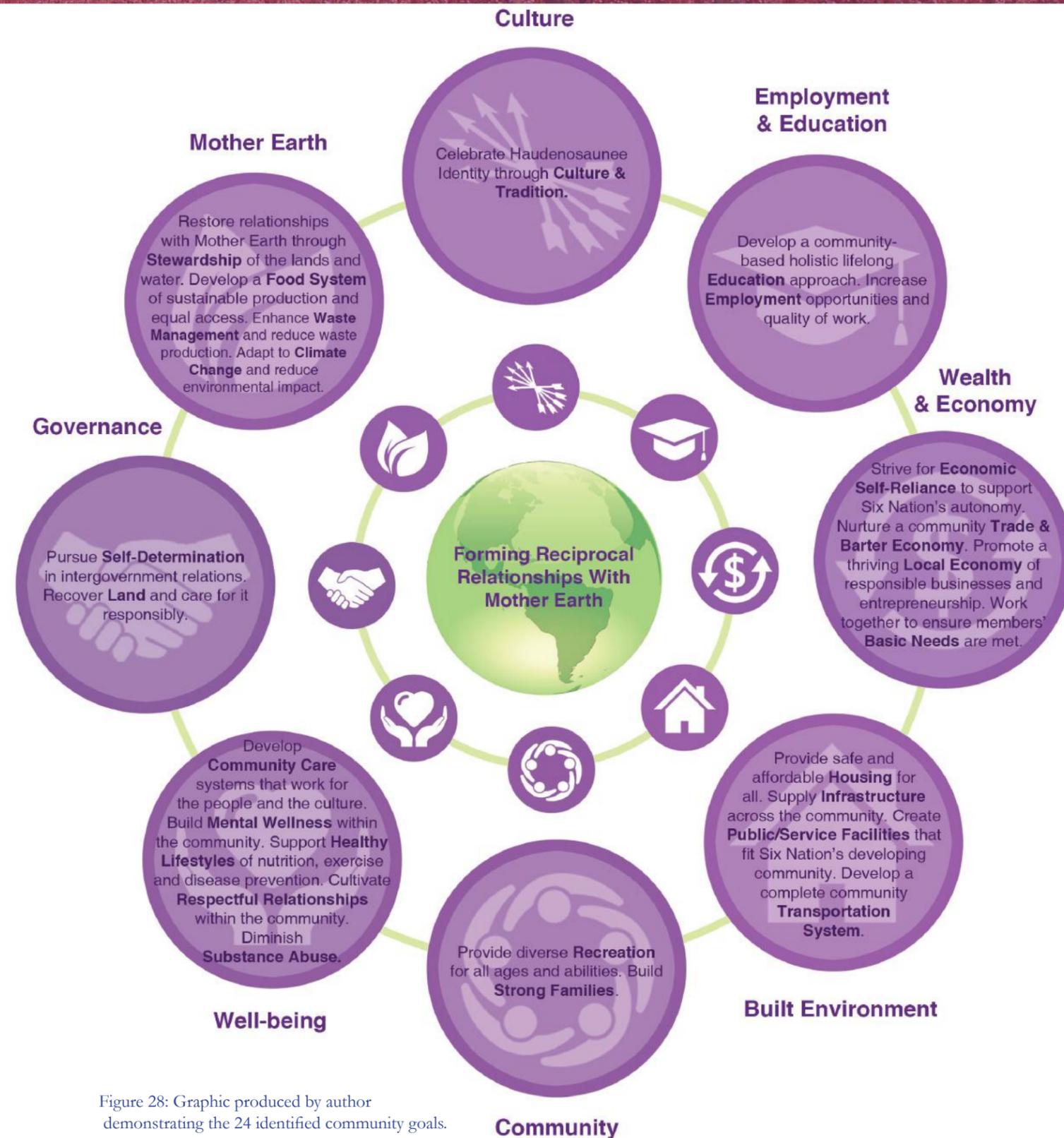


Figure 28: Graphic produced by author demonstrating the 24 identified community goals.



Currently there are initiatives set in place to develop dedicated food banks throughout the reserve, while seeking to expand the number of community gardens throughout Six Nations. Well deserved strategic planning is needed to address these concerns through holistic design approaches that restructure building regulations and reformat current infrastructural initiatives to produce more sustainable built environments that favor resiliency and community prosperity. Future community aspirations consist of developing multipurpose farm resource centers, developing agricultural education and training programs, developing a community wild food share which distributes foods gathered by local hunters throughout the community, and the generation of a Haudenosaunee seed library.²⁶

The community also advocated concerns of addressing climate change in future infrastructural developments and planning. Due to climatic changes, Haudenosaunee relationships with Mother Earth are constantly changing in order to adapt to new environmental conditions, affecting the knowledge of when to plant, hunt and harvest. Increased risks of environmental disasters will need to be reflective in the designs of future architectures in order to address concerns of flooding which damage infrastructures and houses. Additionally, the community's ability to help mitigate environmental impacts that lead to exacerbated effects of climate change, extend beyond their lands and community. The forests and wetlands contained within the reserve act as 'The Lungs of Ontario,' and serve an important role in fighting climate change. Furthermore, these natural habitats and biodiversities are being encroached upon through business and housing developments.²⁷ By developing infrastructures that are able to combat environmental disasters, producing less greenhouse gas emissions and reducing energy consumption and costs, sustainable built environments can begin to emerge that address concerns of climate change. The community advocated responsibilities that members should take to actively participate in reducing carbon footprints, and taking preventative measures against environmental disasters. These include: planting trees to reduce soil erosion; building infrastructures outside of flood zones; considering low-emissions choices; and developing eco-homes.²⁸ By taking initiatives in this manner, the Haudenosaunee

can begin to serve as leaders in their role as environmental stewards, informing broader society that has now begun to acknowledge their responsibilities to environmental sustainability. New environmental management efforts addressing concerns of climate change will not only provide new employment opportunities, but will also strengthen the community's ability to supply for one another. Ultimately, this will increase community resilience and infrastructural resiliency to environmental changes and disasters. Developing green energies will not only provide the availability for job opportunities, but will diminish reliance on outside dependencies, increasing self-sufficiency and resiliency. Additionally, tackling climate change today will reinforce traditional teachings of planning for seven generations, producing cleaner and healthier environments that will mitigate natural disasters for future generations. These strategies will also protect and preserve traditional ceremonies that are dependent on weather and seasons.²⁹ Currently, there are initiatives set in place to expand environmental stewardship outside of the reserve to the Carolinian zones which are currently being carried out through Kayanase's ecosystem restoration program.³⁰ Future community goals and visions are to develop a green infrastructure plan that requires new infrastructures to utilize natural technologies (i.e. wetlands, rain gardens, bioswales), while developing a community solar farm and to install electric vehicle charging stations.³¹

Traditional teachings contain many solutions to today's challenges, such as the harvesting, growing and consuming of foods, which is central to Haudenosaunee culture. By analyzing the culture in a contemporary context that is reflective of current ways of living, housing challenges can be solved through social living patterns. Traditionally, families were intentionally living together, nurturing one another through the sharing of resources and knowledge. These traditional social patterns could inform the design of stronger modern communities where families and clans support one another, promoting more respectful relationships while encouraging a reciprocal economy.³² Traditional Haudenosaunee communities brought families and clan systems together through the interconnected social structures of the Longhouses, expanding to accommodate larger families as the nation(s) grew. This generated strong, interconnected families that nurtured healthy relations as the



community learned to live together.³³ However, Six Nation’s current built environment exacerbates physical, mental and emotional isolation, while, at the same time, promoting overcrowding in areas, creating unsafe and unhealthy living environments. The nature of the individualistic living systems that prioritize segregated properties promotes an atmosphere where violence and illness can fester.³⁴ As well, current economic conditions and housing options have created economic disparity in the community, where some members are financially thriving, and others are struggling to receive access to basic needs.³⁵ The community advocates for built environments that promote stronger, interconnected families and communities, reflecting past living structures in a contemporary context. The community also vocalized a desire to increase access to affordable housing options with design variability, advocating for communal living options while addressing homelessness on the reserve. The community also seeks to integrate the natural habitat into the built environment, rooting the Haudenosaunee with Mother Earth.³⁶ In addition, the Six Nations community wishes to utilize housing densification and increased access to affordable housing as a means to increase the portion of members living on reserve rather than the living off reserve.³⁷

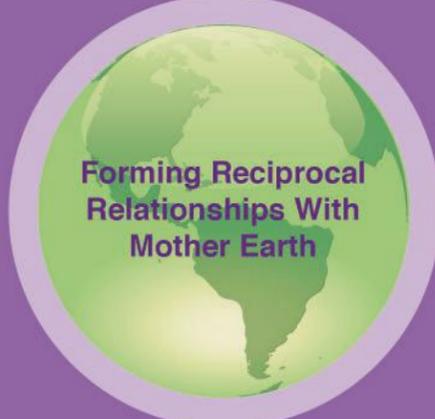
Currently on Six Nations, there are initiatives working towards providing resources that promote the sharing of culture such as the Traditional Medicine Committee. As well, initiatives are set in place that currently work towards reviewing and modifying the organization’s policies to support culture, such as integrating practices of the Ganq̄h̄onȳq̄hk (Thanksgiving Address).³⁸ Future community goals consist of constructing an Indigenous Knowledge Center that would preserve traditional teachings, while also reaching to generate funding capabilities to support cultural knowledge holders.³⁹ Demonstrated in figure 29 are all of the community goals in relation to the eight community priorities that have been distilled in relation to forming reciprocal relations with Mother Earth in a contemporary context. These goals are all interrelated within the overarching goal of producing a regenerative development on Six Nations Reserve, prioritizing the community goals into three categories of significance. The prevalence of each goal is radiated

from the core of the diagram to depict its relevancy to achieving reciprocal relations with the land.

Now that the contemporary conditions facing Six Nations Reserve has been analyzed, and a comprehension has been gathered of the communities’ visions towards future developments, new modes of clean energy production, innovative waste management solutions, sustainable methods of clean water production and filtration, and food systems of sustainable production and equitable access can begin to be explored in hopes of developing a more sustainable built environment. By centering Haudenosaunee best practices in a modern context, regenerative strategies can begin to be explored that address the communities vision while performing reciprocal relations with the natural environment.

1	“Ohsweken.” Six Nations of the Grand River Development Corporation, September 4, 2019.	34	Ibid. Pg 62-63.
2	Ibid.	35	Ibid. Pg 37.
3	Ibid.	36	Ibid. Pg 63.
4	Ibid.	37	Ibid. Pg 25.
5	“2019 Six Nations Community Plan,” 2019. Pg 6.	38	Ibid. Pg 29.
6	Ibid.	39	Ibid. Pg 29-31.
7	“Symbols.” Haudenosaunee Confederacy, October 4, 2019.		
8	“2019 Six Nations Community Plan,” 2019. Pg 6.		
9	Ibid. Pg 14.		
10	Ibid. Pg 37.		
11	“Haudenosaunee (Iroquois).” Haudenosaunee (Iroquois) The Canadian Encyclopedia.		
12	“2019 Six Nations Community Plan,” 2019. Pg 37.		
13	Ibid.		
14	Ibid. Pg 37.		
15	Ibid. Pg 17.		
16	Ibid.		
17	Ibid.		
18	Ibid. Pg 22.		
19	Ibid. Pg 18.		
20	Ibid.		
21	Ibid. Pg 20.		
22	Ibid. Pg 21.		
23	Ibid. Pg 20.		
24	Ibid. Pg 22.		
25	Ibid. Pg 21.		
26	Ibid.		
27	Ibid. Pg 25.		
28	Ibid. Pg 24.		

Figure 29: Graphic produced by author demonstrating the community goals in relation to the eight community priorities that have been distilled to relate to forming reciprocal relations with Mother Earth in a contemporary context from pages 88-89. These goals are all interrelated within the overarching goal of producing a regenerative development on Six Nations Reserve, prioritizing the community goals into three categories of significance. The prevalence of each goal is radiated from the core of the diagram to depict its relevancy to achieving reciprocal relations with the land.



Mental Wellness

Mental health is becoming more of a concern amongst the youth where technology can promote feelings of loneliness and depression. Promote programs and resources dedicated towards addressing mental health. Rekindling relationships with Mother Earth can rejuvenate the mind.



Self-Determination

Promoting self-reliance through achieving food, water and energy security and sovereignty, diminishing reliances on outside dependences. While asserting land care practices that reflect Haudenosaunee principles.



Culture & Tradition

Increasing food knowledge surrounding traditional diets while deepening the communities understandings of ceremonies and traditions surrounding harvesting and cultivation practices.



Substance Abuse

Support services and facilities are needed to address and alleviate mental health and addictions associated with drug and alcohol abuse. Turning towards traditional medicines can diminish addictions to medication and drug use while strengthening relationships with Mother Earth.



Trade & Barter Economy

Fixated on western ideals of wealth and consumerism, individualising the community while eroding language and culture. More knowledge on practical and traditional skills is needed that can promote reciprocal trade to sustain the community locally.



Education

Increase land-based learning initiatives through having intact ecosystems, providing education systems that work towards empowering new generations to live up to the Haudenosaunee identity of being protectors of the earth.



Respectful Relationships

Densifying residential developments while integrating complimentary social programs into the design can create stronger and healthier relationships between families and public services. Teachings offered in the Thanksgiving Address can guide how members should respect each other and Mother Earth.



Local Economy

More businesses are needed to support the economy other than gas and cigarettes that align with community values. Food systems can generate local businesses providing nutritious and affordable foods while employing traditional teachings in its application.



Land

Coordinate developments to utilize the land to its highest standard, reinforcing our responsibilities to the land as Haudenosaunee people. To avoid replicating urbanization, a strategy for densifying infrastructural developments that reflects the community and culture is needed.



Stewardship

By the community collectively being better stewards of the land and its resources, the health of the forests, waters and soils will be better maintained allowing the community to take greater cultural pride of identifying as stewards of the earth.



Economic Self-Reliance

A growing food production sector can create healthy, fulfilling job opportunities that connect people with nature, economically sustaining Six Nations in a manner that is harmonious with the natural environment.



Waste Management

The community must take more responsibility with the managing and recycling of waste, disposing of materials properly. By educating the community on sustainable waste management initiatives will promote self-reliance.



Food System

By developing food systems of sustainable production and equitable access, not only can stronger, reciprocal relationships be formed with the land, skillsets of harvesting and cultivating can be reinforced.



Infrastructure

Provide access to clean drinking water, sustainable and affordable energy systems, reliable technology and responsible wastewater systems. With cleaner waters and maintained healthy resources, less complex infrastructure will be needed to filtrate water and manage environmental systems.



Strong Families

Proposing social housing patterns where families are intentionally living together. In this manner a stronger community can be achieved where families and clans support one another, promoting more respectful relationships while encouraging a reciprocal economy.



Climate Change

Develop infrastructures that are able to combat environmental disasters, producing less green house gas emissions and reducing energy consumption and cost while developing green energies.



Infrastructure

Better maintained and sustained environments will promote more recreational opportunities to explore and enjoy the natural environment. Allocation of communal lands is needed towards the development of park and trail development.



Basic Needs

Designing infrastructures that provide adequate access to healthy and affordable resources while addressing concerns of poverty and wealth inequity facing the community. More collaborative initiatives are needed that provide opportunities for the community to work together to ensure everyone's basic needs are met.



Housing

Members prioritize individualistic living based on consumerism resulting in segregated communities. Utilizing the metaphor of the longhouse in a contemporary context, communal living can be promoted with an emphasis on environmentally friendly house construction. Provide more housing availability, variety and affordability while addressing homelessness.



Public Service Facilities

Through holistic planning, facilities can be designed to reflect the unique community, integrating complimentary services within the same facilities to provide diverse spaces through infrastructure densification. While increasing accessibility for the elders and the disabled.



Employment

Through environmental management efforts that address concerns of climate change, new employment opportunities can be produced while strengthening the community's ability to supply for one another.



Healthy Lifestyles

Better maintained and sustained environments will promote healthier lifestyles. Chronic disease issues can be resolved by developing a food system based on traditional nutritious diets.



Recreation



Transportation System

Due to the rural setting of the reserve, escape from abuse or violence can be challenging. Additionally, roads are deemed unsafe to walk and bike. Promoting densification can allocate lands towards safe walking trails, while minimizing travel distances and reducing dependancy on vehicular traffic.



Community Care

Youth and elderly care is insufficient due to inadequate facilities as well as overworked and underpaid staff. Implimenting the Haudenosaunee Wellness Model can provide communal care through traditional teachings. Encouraging land based learning can allow the community to heal through connections with Mother Earth.



Chapter 5 | Regenerative Design

5.1 INTRODUCING REGENERATIVE DESIGN

Throughout the past century or so, the global landscape has been scoured by humanity's relationships with nature, reorganizing natural systems to facilitate the artificial system of one-way-flows as reflected in our built environments.¹ In doing so, built environments have been produced that neglect the complex relationship structures and synergies inherent of natural ecosystems that form sustainable and renewable processes. In turn, humanity has developed infrastructural systems that completely contradict the earth's core operating systems, replacing nature's endless cycling and recycling of materials with a one-way throughput system. Unlike nature's regenerative processes of recycling material flows, the one-way system is degenerative, devouring its own source of sustenance over time and eventually devouring the landscape on which it depends.² The first law of thermodynamics states that "energy and materials cannot be created or destroyed, only transformed from one state to another."³ Therefore, one-way throughput systems don't perform sustainably, as the energy and materials used within its processes aren't recirculated or self-renewing, underutilizing the capacity for materials and energy to be transformed into further states of usable capacity. In utilizing the Indigenous principle of reciprocity to inform sustainable environmental design, active and passive systems composing building ecologies can be designed to be cyclical in nature, forming mutually beneficial relationships that not only enhance each others' performances but enhance the health and stability of the surrounding natural ecology of the site. Furthermore, in order to produce sustainable architectural developments, the systems composing the infrastructural and environmental design of the site are to be continuously self-renewing or regenerative in their operation.⁴

In nature, the core life-support processes consist of energy, water, shelter, biotic production, and waste assimilation and they are inextricably interrelated.⁵ Through analyzing their commonalities and interactions, the human landscape can be reshaped and redesigned to take advantage of their synergies, developing systems that follow nature's processes. Although, the ability to generate sustainable environments that perform reciprocally with the land doesn't require the utilization of technology alone, as humanities behavior and relationships with nature need to change considerably.



In order to achieve this, Haudenosaunee Ecological Knowledge (HEK) and the fundamental instructions provided through Haudenosaunee culture and tradition have been utilized as a moral compass that can guide and enhance the application of modern sciences and technologies to offer enormous design potential. Here HEK and TEK can inform regenerative systems of sustainable design for their intended application on Six Nations of the Grand River Reserve. This section will provide a handbook of regenerative design principles and strategies that can be utilized as a tool for the Haudenosaunee to redefine the colonialist impositions facing the reserve through re-establishing reciprocal relationships with Mother Earth. As previously stated, the intent of the Thesis is to extend further than its initial scope, prompting institutions, developers and community members located on Six Nations reserve to question the concept of *land ownership*. With that being said, this chapter of this Thesis is intended to serve as an educational handbook that could be utilized as a community tool to inform Six Nations home owners, builders, and developers on how these sustainable land management and architectural development strategies can be implemented throughout the reserve, forming reciprocal relations with Mother Earth. Therefore, the writing style of this section is to serve as an explanatory/informative text that is geared for its potential application as a community tool for retrofitting the reserve.

Furthermore, this chapter explores an architectural methodology for designing human habitats that perform reciprocally with the landscape. For both natural and man-made environments to flourish, it is essential for human habitats to be designed harmoniously with nature in a manner that not only works with natural ecological conditions, but also enhances the physical and biological conditions of the natural environment. In order to do this, the natural environment needs to be analyzed as an informative guide from which modern society has much to learn from the ecological structures, systems and ecosystemic orders inherent to natural processes that can begin to inform systems thinking for regenerative design. Regenerative design, as defined by John Tillman Lyle, consists of “replacing the present linear system of throughput flows with cyclical flows at sources, consumption, and sinks.”⁶ Furthermore, regenerative systems continuously replace energy and materials used in its operation through its own functional

process, resembling the cyclical relations formed in nature.⁷ As is in nature and that of passive and active systems forming regenerative processes, energy is replaced by incoming solar radiation whereas materials are replaced by the process of recycling and reusing.

The overall intention of regenerative systems are to make full use of the ecological processes taking place on the site, while enhancing these conditions to form a more complete system than nature herself is able to produce. In this manner, the architecture and developed lands become an extension of the natural environment, continuing the ecological functions of the land they displace. The following chapter will outline regenerative design strategies for achieving architectures that perform reciprocally with nature by analyzing four different regenerative categories which will inform the regenerative design of this Thesis project: that of the Hydrological Cycle, Solar Energy, Food Production, and Waste Management. With that being said, this Thesis project engages with a privately owned parcel of land located in Ohsweken which will serve as a demonstration of how these regenerative design strategies can be implemented within the reserve. Therefore, this section will demonstrate how these four regenerative categories can inform sustainable land management and architectural development strategies throughout the reserve through their environmental and infrastructural design integration within the proposed architectural development on the vacant lot located in Ohsweken. The format of this section of this Thesis document is intended to be linked to the design section of the document. The design section will demonstrate how the proposed development on the Ohsweken site is regeneratively designed, while this chapter will demonstrate how each of the four regenerative categories and their strategies are manifesting themselves in the projects design in a cyclical and reciprocal manner.

1 Lyle, John Tillman. Regenerative Design for Sustainable Development. Pg 4.
2 Ibid. Pg 5.
3 Ibid. Pg 10.
4 Ibid. Pg 10.
5 Ibid. Pg X
6 Ibid. Pg 10
7 Ibid. Pg 10



5.2 REGENERATIVE STRATEGIES

HYDROLOGICAL CYCLE

In order to address these regenerative strategies and their interrelationships, one must first understand how these systems are informed and enriched by the ecological processes of the landscape. The first manner in which these strategies are applied, informing infrastructural placement, is through the analysis of nature's hydrological cycling. The hydrological cycle is concerned with the movement and flow of water above and below the earth's surface, and subsequently, is the fundamental instrument that defines landscape ecology and biological processes around the globe. In order to produce a regenerative development, water-related practices and technologies must be integrated within processes of the hydrological cycle in a manner that mitigates stormwater runoff, maintains water chemistry, and protects overall watershed quality.¹

1. RIPARIAN BUFFER

The first step to approaching regenerative design is to carefully craft the infrastructural development to landforms, soils, plants and biological processes of the site, rooting the infrastructure to the topography. A perfect example of this is to establish *Riparian Buffers* which consists of preserving or remediating a strip of land along the banks of a river or stream that supports a rich biodiversity of plant and animal life, offering diverse ecosystem services.² Riparian buffers are an inexpensive and simplistic method of working with natural ecological systems, protecting and enhancing water quality through the utilization of native plant species, while establishing safe development boundaries that lie outside of flood lines. Riparian zones of native plant species have several environmental benefits including the mitigation of stormwater runoff. According to the 'University of Arkansas Low Impact Development Manual,' between roughly 50 to 85 percent of stormwater pollutant loads can be naturally filtered through the establishment of 100 to 300 foot vegetated riparian buffer.³ Additionally, these established buffers prevent soil erosion, structurally stabilizing banks and shorelines, while the polyculture of native tree and shrub species can maintain adequate soil moisture and nutrients to support aquatic and terrestrial habitat life.⁴ For this Thesis project, the remediation of riparian zones serve as a fundamental driver of the



Riparian Buffer

Figure 30: Graphic produced by author illustrating how the remediation of riparian zones are fundamental drivers of the environmental and infrastructural design of this Thesis project.



Remediated
Riparian zone

environmental and the infrastructural design. Through performing rigorous site analysis on the Ohsweken site, it was determined that a creek, known as McKenzie Creek, intersected the northwest edge of the site within an existing forested area. In order to design the proposed development to perform reciprocally with the site's natural hydrological cycles, it was essential to establish a riparian buffer from McKenzie Creek's shoreline that would work towards preserving the natural infiltration region of the creek that supports a variety of habitat. The flood line extents of the creek formed the riparian buffer limits. This strategy would remediate and improve the site's environmental and biological conditions. Figure 30 illustrates how a riparian buffer was implemented in the proposed design development of the Ohsweken site.



Pervious Paving:

- Consists of permeable materials or composition of materials that allow water to pass through its surface.
- Consists of a subsurface base of coarse aggregate or soil.
- Reduces and distributes stormwater volume while removing sediments and other pollutants.

Infiltration Basin:

- A shallow impression in the land consisting of highly permeable soils that supports a diversity of wetland plants.
- The system is designed to temporarily detain and infiltrate stormwater runoff, improving the water quality by mitigating contaminants and pollutants as it passes through the soil medium and dense vegetation.

Cistern:

- A large tank that can be utilized for residential or commercial applications for harvesting and storing rainwater runoff either from roofs or other impermeable surfaces.
- The tanks can either be situated on-grade, below-grade, or within the basement of buildings.
- Reduces rainwater runoff volume while providing future use of the collected rainwater for landscape irrigation or greywater applications if additional filtration systems are implemented.

2. PARKING GARDENS

As demonstrated, preventing soil erosion and stormwater runoff are significantly important qualities to maintaining the health of local biodiversities and watershed quality. One of the main ecological issues surrounding the current designs of human environments are the vast expanses of space dedicated towards impervious paving surfaces, especially that of parking lots. There is no reason why parking lots have been designed with such neglect to aesthetic quality and ecological performances. Parking lots can serve as a site for design and ecological potential, having the opportunity of being perceived as stormwater gardens that integrate landscape design with stormwater filtration and retention capabilities.

For this Thesis project, the parking lot design will serve as an integral component to the overall success of the regenerative systems composing the site, contributing to food, energy, and waste production systems while integrating natural hydrological processes into infrastructural design. In order to achieve this, in the design proposal the parking lots will be configured around central vegetated parking islands that will retain, infiltrate, and collect stormwater runoff through the utilization of *Pervious Paving*⁵ materials and *Infiltration Basins*.⁶ The impervious asphalt surfaces forming the driving aisles will be strategically angled to direct stormwater runoff towards the center of the vegetated parking island and the perimeter of the parking lot. The pervious paving materials composing the parking spaces themselves bordering the vegetated parking island and the perimeter of the parking lot would consist of grass concrete and turf pavers which would allow the stormwater to percolate through the hard surfaces, infiltrating and distributing stormwater volume.⁷ The stormwater would then be conveyed through the pervious parking space materials into the central infiltration basin, temporarily detaining and infiltrating the stormwater runoff.⁸ The central vegetated island composing the infiltration basin would serve as a large treatment meadow, eliminating rainwater runoff contaminants as infiltration occurs. This integration of stormwater mitigation would not only beautify the parking lots through organic design and increased biodiversity in the form of grasses, wetland shrubs, and trees, it would provide increased habitat for terrestrial animals while purifying water table quality. In addition to this, as stormwater runoff is detained and infiltrated within the infiltration

basin, portions of it can be harvested and stored in an underground *Cistern*⁹ for future irrigation or greywater uses. This will provide a sustainable water collection system that serves as an efficient source of water for agricultural and domestic applications while mitigating rainwater runoff. The harvested water would provide opportunities for it to be recycled and recirculated throughout other infrastructural systems that will eventually lead to its infiltration back into groundwater supply, producing systems that perform reciprocally with the natural hydrological cycle.

In addition to this, the parking lots will also be strategically designed to incorporate water retention and infiltration systems along the periphery of the impermeable surfaces in the form of percolation parks. These systems of percolation parks won't just serve as a means of mitigating and filtering stormwater runoff, they will strategically be positioned in a manner that directs runoff water into a specific water collection basin located on site. This will be achieved through using a combination of *Bioswales*¹⁰ and *Rain Gardens*.¹¹ The bioswales serve as gently sloped, vegetated channels providing bioretention capabilities that naturally treats stormwater runoff, mitigating pollution, while conveying stormwater runoff throughout the site. The function of the rain gardens, on the other hand, are planted depressions that don't provide a means of conveyance, but rather treats stormwater runoff as it is infiltrated into the growing medium. Rain gardens would be utilized along the edge of parking lots closest to infrastructures where the conveyance of water wouldn't be as feasible. Similarly to the design of the vegetated islands, the impervious asphalt forming the driving aisles would be angled to direct water to the periphery of the parking lot. The pervious materials of the parking spaces would then permeate stormwater runoff into the surrounding rain gardens and bioswales that would then infiltrate and convey runoff water throughout the site. The bioswales would then collectively work together to convey stormwater runoff into a retention pond located on site which will be discussed in more detail later on. For clarification on the design, implementation and functionality of the Parking Gardens in the proposed project, refer to figure 31.

Bioswale:

- An open, vegetated channel that mitigates stormwater runoff while serving as a conveyance system, as the channel is gently sloped to direct water flow back to the natural watershed.
- Incorporates a diversity of grasses, shrubs and trees to utilize bioretention as a means to mitigating pollutants from rainwater runoff.
- Located alongside roads, walkways, parking lots and buildings.

Rain Garden:

- Vegetated depressions that infiltrate stormwater runoff without having the capability to hold or direct the flow of the water.
- Utilizes a combination of plants and layers of organic sandy soil to filter out pollutants from stormwater runoff.
- Located along driveways, parking lots, and buildings.

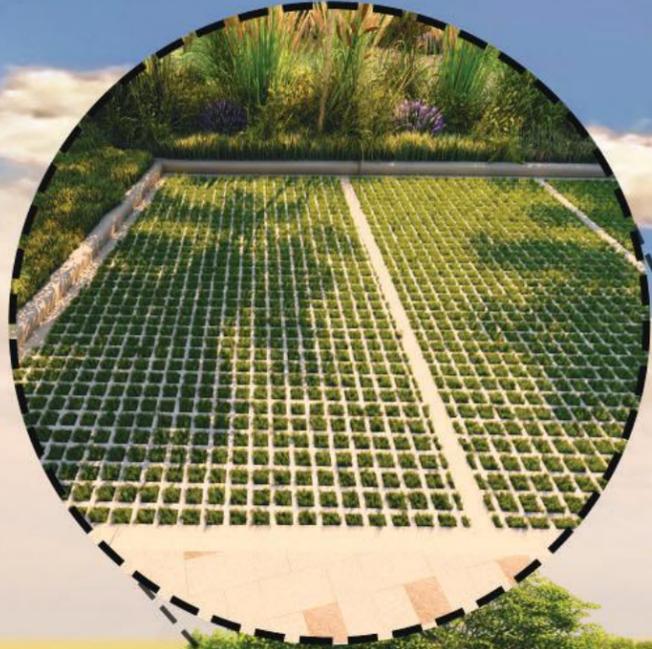


Parking Gardens

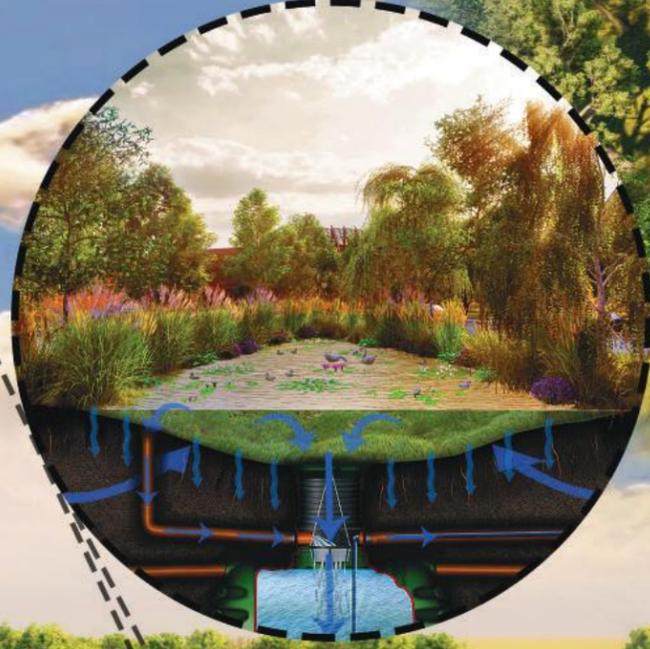
Parking Gardens

Figure 31: Graphic produced by author illustrating the design and functionality of the parking gardens which serve integral roles to the overall success of the regenerative systems.

Grass Concrete and Turf Pavers



Infiltration Basin



Bioswales/Rain Gardens



As stormwater runoff is detained and infiltrated within the infiltration basin, portions of it can be harvested and stored in an underground *Cistern* for future irrigation or greywater uses.

The stormwater harvested and stored in the underground *Cistern* will be utilized within the Facilities for greywater applications as well as internal agricultural applications conducted within the Land Based Learning Center. Additional collected stormwater will be utilized for agricultural irrigation throughout the agroecosystems located on the southern region of the site.



Brown Roof

3. Brown ROOFS

The second largest culprit that is responsible for increased rainwater runoff is the neglect of consideration given to pervious roof surfaces in built environments, favoring impervious surfaces usually consisting of asphalt/fiberglass shingles, membrane systems, or metal roofing. With that being said, there are many methods of which rainwater can be collected and mitigated through the use of impervious roofing materials. Although, the most environmentally sustainable and economically efficient roof systems incorporate natural vegetation and pervious materials into their composition to generate an infrastructural system that mimics natural energy flows and hydrological processes into its functionality. These roofing systems are referred to as vegetated roofs, green roofs or brown roofs, and are essentially garden ecologies that are installed atop of buildings. Generally, containing a foot or so of soil medium, intensive green/brown roofs have the capability to support a density and diversity of vegetation that can infiltrate and retain around 60 to 100 percent of the stormwater they receive.¹² In addition to this, the added soil medium and vegetation provides additional thermal insulation, reducing heating and cooling loads of a facility, while also shading the roof from solar radiation. In turn, actively working towards reducing the heat island effect of infrastructural environments, which will be discussed in further detail later on in this chapter.¹³

In the design proposal of the three facilities on the Ohswéken site, intensive brown roofs will be integrated into the infrastructural design of the architectures that will serve as a key component to the overall success of the regenerative development. The intensive green roofs will consist of native grasses and shrubs, providing several ecological benefits such as replacing the natural biodiversity and hydrological processes of the land that the infrastructural developments would be displacing.¹⁴ In addition, the intensive green roofs would provide the opportunity to reintroduce an endangered ecosystem to Canada, the native tallgrass prairies, back into the Grand River watershed region which once supported 243 square kilometers of grasslands between Brantford and Cambridge.¹⁵ Aside from the green roofs providing enhanced biodiversity and animal habitat, they have the capability of harvesting rainwater for future uses, where the left over stormwater that wasn't soaked up through

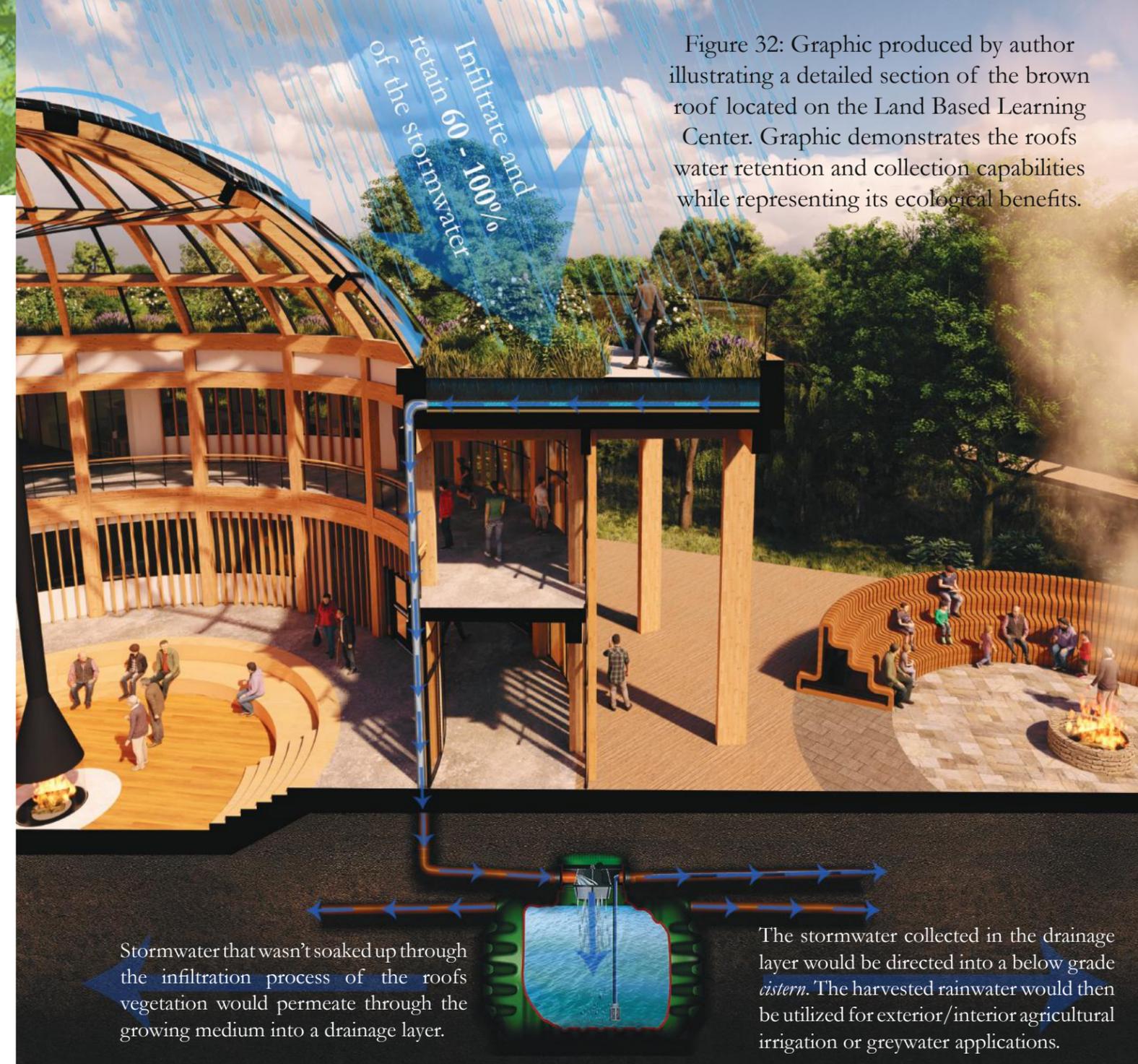


Figure 32: Graphic produced by author illustrating a detailed section of the brown roof located on the Land Based Learning Center. Graphic demonstrates the roofs water retention and collection capabilities while representing its ecological benefits.

Stormwater that wasn't soaked up through the infiltration process of the roofs vegetation would permeate through the growing medium into a drainage layer.

The stormwater collected in the drainage layer would be directed into a below grade cistern. The harvested rainwater would then be utilized for exterior/interior agricultural irrigation or greywater applications.

the infiltration process will be directed into a below grade cistern.¹⁶ Harvested rainwater would then be utilized for exterior/interior agricultural irrigation or greywater applications. Lastly, the green roofs would serve as garden ecologies, providing the opportunity to support communal park space and public gardens, while having the potential of yielding fruits and vegetables. Refer to figure 32 for a roof detail of the Land Based Learning Center illustrating how the intensive green roof system is being implemented into this project and its associated environmental and economical benefits.



Retention Pond:

- A constructed stormwater pond that is designed to retain a permanent pool of rainwater runoff.
- The system, usually constructed with a permanent pool depth of 4 feet, can support a rich biodiversity offering aquatic and terrestrial habitats if designed and monitored correctly.
- Filters the water by removing pollutants through the process of biological uptake and sedimentation.
- Proper aerators are essential to producing successful aquatic and terrestrial ecosystems, minimizing algae growth and stagnation of water.



Retention Pond



Constructed Wetland

4. RETENTION POND

In addition to the impervious surfaces of parking lots and rooftops, impervious wall surfaces also contribute to increased stormwater runoff. In order to collect additional stormwater runoff from walled surfaces and walking paths, bioswales will be integrated around the periphery of infrastructures to infiltrate and convey water throughout the site. Working in conjunction with the conveyance of stormwater runoff through the use of bioswales in the parking lot design, the bioswales integrated within the infrastructural designs will also collectively work together to convey stormwater runoff into the *Retention Pond*¹⁷ located on site. The retention pond, serving as a constructed stormwater pond, will retain a permanent pool of water through the continuous inflow of runoff water directed by the bioswales as well as the form of the landscape that would naturally curate water flow into the depression of the pond. The pond will further treat the retained stormwater runoff by removing pollutants through the biological uptake of aquatic and wetland plants and the process of sedimentation.¹⁸ The body of retained stormwater will also serve as a water source that can be actively recirculated into infrastructural applications for use of agricultural and landscape irrigation and/or greywater uses. In addition to this, the retention pond not only serves as a site of enhanced biodiversity, supporting aquatic and terrestrial habitat, it can be utilized for aquacultural practices to support local fish farming that will correlate with the internal aquaponic farming methods utilized within the facility which will be discussed later on in this chapter.

The last piece of the environmental design that works with the natural hydrological cycle deals with the infiltration of stormwater runoff back into the watershed. In order to maintain appropriate pool levels and to prevent flooding, the retention basin allows for overflow in case of severe weather or excessive rain. In order to allow for overflow, a constructed wetland¹⁹ serving as artificial marshes will be developed downstream of the retention pond that will infiltrate the overflow of runoff water. Further filtering the runoff water through its rich biofiltering capabilities, while providing extensive wildlife habitat, before the water is eventually infiltrated into groundwater resources or released back into the watershed through infiltration into the riparian zone of McKenzie

Creek. Refer to figure 33 for an illustration of the retention pond and constructed wetlands that are being implemented within the proposed Thesis development.

SOLAR ENERGY

Now that the regenerative strategies for designing with natural hydrological cycles have been discussed, the next set of regenerative design strategies that will be explored relates to the environmental significance of solar exposure and the utilization of solar radiation within architectural and environmental design. These regenerative design strategies will explore passive and active systems towards utilizing and mitigating solar energy. As it occurs in nature and henceforth in the human environment, the most important sustainable energy source is the sun, renewed daily and inexhaustible by humanity.²⁰ Solar energy, initially embodied within the earth's atmosphere in the form of solar radiation, can be channeled by a number of different means that can provide useful energy in multiple forms. The solar radiation that strikes the earth embodies four different energy transformations consisting of photosynthesis (energy locked into biomass), heat absorption (embodied thermal mass), reflection (solar heat reflected), and evaporation.²¹ By utilizing modern technologies in cohesion with natural processes, holistic, self-renewing, and self-sustaining energy systems can be developed that work with nature rather than against it. One of the main strategies for regenerative design, especially pertaining towards architectural form, is the notion that form guides energy flows.²² In this manner, the infrastructures and developed lands perform like microcosms of the earth's operating system, shaping energy flows by controlling the reflection, absorption, and release of solar energy and heat through various materials and shading devices, while controlling air movement in order to mediate building temperatures. Several design strategies have been developed to retain, utilize, and mitigate multiple forms of solar energy – some working in cohesion with one another – to produce very efficient methods of energy production and conservation.²³

Parking Gardens

Figure 33: Graphic produced by author illustrating a landscape section through the retention pond and constructed wetland. Showcases the infiltration process of the systems and their environmental benefits.

Aquaculture

Ponds contain aerators

The retention pond will utilize aquacultural practices to support fish farming of native species that will correlate with the internal aquaponic farming methods utilized within the Land Based Learning Center

Farming wastes and byproducts will be introduced into the retention pond as nutrients for plants and fish

The retention pond serves as a site of enhanced biodiversity supporting aquatic and terrestrial habitat. The free range chickens and additional wildlife habitat such as ducks, geese and blue herons could provide additional nutrients through their manure

Retention Pond & Constructed Wetland Detail

- 100-year flood line
- 50-year flood line
- 25-year flood line
- Normal Water Level
- 4' average depth (10' maximum)

Retention pond allows for stormwater overflow into the constructed wetlands that will naturally treat the overflow water before it is released into McKenzie Creeks Watershed.

The body of retained stormwater will serve as a water source that can be actively recirculated into infrastructural applications for use of agricultural and landscape irrigation and/or greywater uses.

Retention Pond Serving as a Constructed Stormwater Pond

Constructed Wetland Serving as an Artificial Marsh



1. CONTROLLING SOLAR EXPOSURE

To begin, the most efficient and commonly utilized methods of retaining solar energy in infrastructural and environmental design revolves around the basic principle of maximizing solar exposure. When developing building designs and landscape elements in a cohesive manner that takes into consideration the movement of the sun throughout the year, environments can be strategically oriented to take advantage of the natural heating and energy capabilities provided through solar radiation. The most efficient means of retaining solar energy and heat through infrastructural design consists of strategically placing glazing systems on south, east and west facades to maximize sun exposure, transmitting and trapping solar heat within buildings. Additionally, prioritizing building programs that require a significant amount of heating and lighting towards these solar exposed facades will take advantage of the passive heating, lighting, and energy retention capabilities provided by the sun. With this Thesis project heavily relying on agricultural food production through internal greenhouse operations, maximizing solar exposure to utilize its heat, energy and lighting capabilities in the form of solar radiation will heavily inform the design and layout of the facility. In conjunction to the strategic placements of glazing elements is the design strategy of implementing materials with high thermal mass properties that retain and store heat from solar radiation transmitted through the glazing. The utilization of dense materials with high heat-holding capacities provides endless design opportunities to maximize materiality to passively heat or cool internal and external building environments. With that being said, when orienting infrastructures to maximize solar exposure, cooling systems are just as important to the buildings overall success.

There are various design strategies for implementing passive and active cooling systems into a buildings' infrastructural, mechanical and landscape design. Aside from the utilization of natural vegetation, the next efficient cooling strategy that can be easily integrated into a buildings infrastructural design is the implementation of architectural shading devices. The design strategies and methods of achieving these systems are varied and provide architectural creativity and innovation. In addition to this, as previously mentioned a building form can guide energy flows and wind movements, and thus, can utilize building openings to direct

and enhance natural wind movements through facilities. Therefore, taking advantage of natural ecological wind flows over the landscape and utilizing it through naturally ventilated cooling strategies. For more information on these previously mentioned passive and active regenerative design strategies that will be incorporated into the facility, refer to Appendix C: Regenerative Strategies. For more clarification on how these systems have been integrated into the design of the Land Based Learning Facility, refer to figure 34.

2. PHOTOVOLTAIC SOLAR ENERGY

Another manner in which a building can control energy flows of the natural environment consist of methods in which solar radiation can be transformed into usable energy. This is achieved through the use of *photovoltaic cells* which use a semiconductor material, such as silicon, to absorb light and convert photons (particles of sunlight) into electricity.²⁴ Solar panels are usually mounted to be south-facing, although there are a variety of ways in which solar panels can be oriented for maximum solar exposure. Solar panels that are situated within glazing units are known as transparent solar panels and are usually utilized in large expanses of south-facing glazing systems. For transparent solar panels, only 60 percent of the light is absorbed by the panel, where the other 40 percent is transmitted through the panel.²⁵ The benefit of utilizing this solar panel system is that it is fairly translucent, providing clear views to the exterior environment of the facility while having the capability of passively shading the interior environment through diffused lighting, allowing only 40 percent of the suns radiation to penetrate into the building. Photovoltaic cells and panels overall can perform substantial energy performances and can be easily integrated into a buildings structure or other parts of the developed landscape.

In regards to the Thesis project, both solar panels and translucent solar panels will be utilized through different applications supplying most of the facilities required energy consumption. Solar panels will be situated atop of the roof surfaces of the infrastructures, whereas the transparent solar panels will be incorporated into the large expanses of glazing systems forming wall and roof surfaces of the prescribed greenhouse facilities. The implementation of the transparent solar panels will not only make



Photovoltaic Solar Energy



Figure 34: Section cut through the Land Based Learning Center to demonstrate how the facility has been designed to maximize and mitigating solar exposure for internal climate control.



As illustrated, the infrastructure is designed to perform like microcosms of the earth's operating system, shaping energy flows by controlling the reflection, absorption, and release of solar energy and heat through various materials and shading devices, while controlling air movement in order to mediate building temperatures. The Center prioritizes greenhouse operations and large glazing systems along the southern facade, maximizing solar exposure and heat gain potential for the growing operations of the facility. The utilization of transparent photovoltaic (PV) glass within the glazing systems not only obtains solar energy while allowing the transmittance of solar radiation, the transparent solar panels diffuse harsh sunlight, allowing roughly 40 percent of the light hitting the panels to be transmitted inside the building. In addition, a wood slat shading system was integrated along the southern facade, passively shading and cooling the building

during summer months while allowing the sun in winter months to shine through and passively heat the facility. The Center also utilizes the predominant westward winds on the Ohsweken site to passively cool the building through cross-ventilation strategies in order to reduce excessive heat gain brought on by the transmittance of solar radiation within the greenhouse, internal courtyard and ceremonial space of the building. In placing window inlets closer to the ground and window outlets higher above the ground, the induced airflow brought on through the cross-ventilation will utilize stack effect to help move warm air out of the building. The introduction of green/brown roofs also provides additional thermal insulation through the added soil and growing medium, while the vegetation shades the facility by absorbing the solar radiation hitting the roof, reducing heating and cooling loads of the facility while mitigating the heat island effect of the developed environment.



use of the required amount of glazing for sufficient greenhouse production; it will transmit solar radiation in the form of diffused lighting, protecting the vegetation from intense solar exposure that could be harmful for plant growth. Overall, the energy produced by the solar panels will power most of the facilities needs consisting of interior/exterior lighting and mechanical equipment consisting of fans, pumps, air-conditioning units, ventilation systems, etc. This energy will also power the pumps, aerators, and filtration equipment

needed for the retention pond and to distribute stormwater collected in cisterns for irrigation and domestic greywater uses. Refer to figure 35 for clarification regarding the implementation of transparent solar panels into the design of the Thesis project.

3. SHELTERING ROLES OF PLANTS

Now that this notion of controlling energy flows has been discussed, the moderation of thermal gain brought on through solar radiation is equally as important in the process of maximizing sun exposure. As previously mentioned, the most environmentally and economically efficient passive shading strategies that can be easily implemented within infrastructural and environmental designs consist of the *Sheltering Roles of Plants*. Due to the fact that infrastructures usually consist of materials with high thermal mass properties (metal, bricks, concrete, masonry, and paved surfaces) human habitats usually tend to be several degrees warmer than that of vegetated areas.²⁶ This has come to be known as the heat island effect and vegetation can drastically mitigate this heat gain.²⁷ For instance, strategically planting deciduous trees around an infrastructures south, east and west facades can passively cool the building during the summer months with its thick canopy of foliage shading the building. Meanwhile in the wintertime, when the trees leaves have fallen, sun rays are able to penetrate through the branches of the tree to passively heat the building.²⁸ A tree with a full canopy of leaves is able to mitigate between 60 and 90 percent of all solar radiation striking the tree, whereas a deciduous tree in the wintertime only reflects between 25 to 50 percent of the solar radiation.²⁹ Therefore, the cooling capacity of trees are quite considerable, reducing the infrastructures dependency on mechanical cooling systems, thus reducing energy consumption. One large tree is able to provide the same cooling effects than that of 10 room-sized air conditioning units that are operating for 20 hours a day.³⁰ In addition to this, the utilization of trees are able to shield off harsh winds and undesirable weather conditions, retain additional rainwater, fertilize soils, and provide better air quality. Altogether, providing a natural system that allows the building to follow the cycles of nature while contributing to the surrounding ecology of the site.



Sheltering Roles of Plants

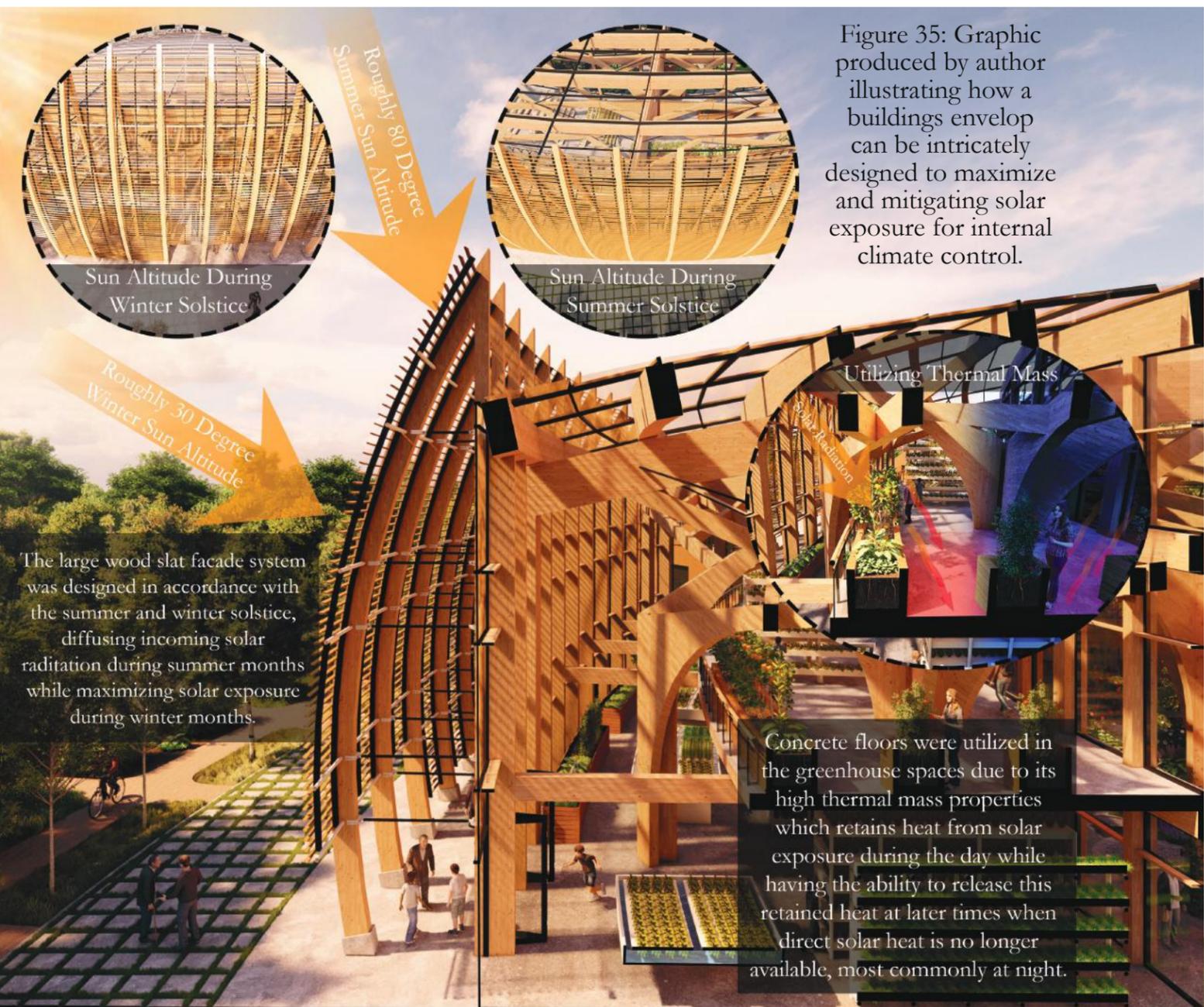


Figure 35: Graphic produced by author illustrating how a buildings envelop can be intricately designed to maximize and mitigating solar exposure for internal climate control.

The large wood slat facade system was designed in accordance with the summer and winter solstice, diffusing incoming solar radiation during summer months while maximizing solar exposure during winter months.

Concrete floors were utilized in the greenhouse spaces due to its high thermal mass properties which retains heat from solar exposure during the day while having the ability to release this retained heat at later times when direct solar heat is no longer available, most commonly at night.



For the design of the Thesis project, trees will be strategically planted within the bioswales located around the periphery of infrastructures providing a dense canopied protection layer around their south, east, and west facades. Not only will the trees serve as a passive cooling strategy, the additional retention of water provided through the trees thick canopy will supply additional rainwater runoff into the water conveyance system of the bioswales, infiltrating water into the overall hydrological cycle of the site. In addition to this, the passive shading capabilities of trees can actively work towards mitigating the heat island effect of paved surfaces including parking lots. Working in unison with the biodiversity offered through the bioretention devices of the infiltration basins and bioswales, trees will perform a crucial role in the overall success of the proposed sustainable parking lot designs. Trees will be strategically placed in a manner where their mature canopy coverage is at least 50 percent of the paved surfaces in order to actively shade incoming solar radiation, thus reducing the parking lots overall heat island effect.³¹ Refer to figure 36 for clarification on how the sheltering roles of plants are forming integral cooling components to the success of the facility design and parking garden designs.

REGENERATIVE FOOD PRODUCTION

As demonstrated thus far, regenerative strategies are informed and enriched by the ecological processes of the landscape, specifically pertaining towards passive and active systems that are interrelated with natural hydrological cycles and solar exposure. The merit of these two ecological processes is the embodiment of agricultural practices, which in this case will consist of regenerative agricultural systems. In current built environments, agriculture serves as the greatest polluter of water, constantly leaching chemicals into water bodies and groundwater sources through prevailing irrigation practices.³² Although, as previously mentioned in chapter 3, the reemergence of regenerative perspectives offered through Haudenosaunee tradition in contemporary applications can inform sustainable agricultural practices that mimic the diversity and complexity of natural ecosystems to inform polycultural systems. As



Section Showing the Sheltering Roles of Plants in the Summer



Section Showing the Sheltering Roles of Plants in the Winter

Figure 36: Detailed sections through the restaurant and rentable space/event space of the Land Based Learning Center produced by the author demonstrating how the sheltering roles of plants are forming integral cooling components to the success of the facility design and parking garden designs.



Regenerative Agriculture - Agroecosystem

- ① Canopy (Large Fruit & Nut Trees)
- ② Low Tree Layer (Dwarf Fruit & Nut Trees)
- ③ Shrub Layer (Berries)
- ④ Herbaceous Layer (Medicinal Herbs/Sweet Grass/Natural Prairies)
- ⑤ Forage and Row Crops (The Three Sisters Garden)
- ⑥ Ground Cover Crops (Strawberries, Legumes, Grasses & Grains, etc.)
- ⑦ Vertical Layer (Climbers & Vines)

Natural Habitat



The incorporation of a forested area into the agroecosystem allows for increased habitat of terrestrial animals such as birds, squirrels, chipmunks, butterflies, etc. These animals can help aid in natural pest control while also helping pollinate different species within the ecosystem and beyond, meanwhile contributing soil fertilization through manure.

Free Range Chickens



- Natural pest control consuming weeds, as well as byproducts produced in the gardens
- While actively grazing, chickens will till and aerate soils in the garden while fertilizing them with manure
- Provide eggs for the consumption of the community

Honey Bees



- Natural pollinators for the ecology of the agroecosystem, as well as the whole reserve
- Provide a source of honey for consumption and distribution to the community

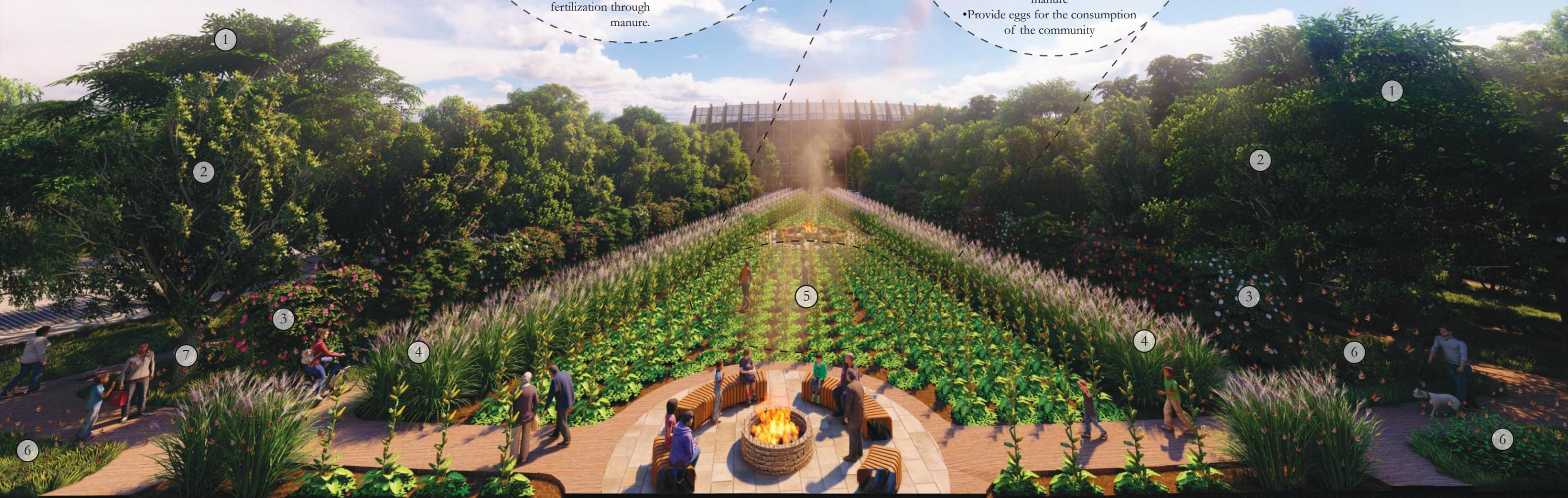


Figure 37: Graphic produced by author illustrating the agroecosystem design of the agricultural landscapes to the southern regions of the Ohsweken site that mimic the diversity and complexity of natural ecosystems that have been informed by the concept of Polyculture as understood through the Three Sisters Garden.



Xeriscape:

- Water conserving landscapes that consist of a multispecies mix of native grasses that are specifically accustomed to a regions climatic conditions.
- Provide a stable plant community that requires minimal maintenance with little to no irrigation due to their drought-resistant nature.



Agroecosystem



Xeriscape



Aquaculture

previously stated, the agricultural practices that are to transpire in the surrounding landscape consist of agroecosystems, remediating the site by enhancing the physical and biological environments from which they were implemented. Refer to figure 37 for insight on the landscape design of the agroecosystems that are incorporated into the Thesis project. In addition to this, the surrounding landscape that hasn't been designated as agricultural lands will extend this concept of polyculture to the vegetated landscapes of *Xeriscapes*.³³ Instead of implementing industrialized lawns that consist of the monoculture of turf grasses which require intensive maintenance, irrigation, pest control, chemical fertilizers, and herbicides, the polyculture of native plant species and native prairies will be implemented throughout the site providing enhanced biodiversity through the use of xeriscapes. Not only do they require minimal maintenance, they have significant economic and environmental benefits providing on-site infiltration as well as the potential for additional food production.³⁴ In addition to these methods of agricultural production, methods of aquaculture will also be utilized on site for aquatic food harvesting while enhancing land biodiversity. The polyculture principles applied to crops is also applied to aquaculture do to its ability of supporting an active food chain consisting of multiple species that occupy the full depth of the pond, producing large amounts of high protein biomass that can be harvested. Due to their high-efficiency spread throughout the pond, fish ponds are extremely productive, having great waste assimilation capacities.³⁵ This symbiotic relationship between the interaction of species consists of microorganisms consuming the waste materials which are then consumed by larger microorganisms and small fish, which are then consumed by larger fish that are harvested for human consumption.³⁶

1. AQUACULTURE

The fish farming and fish pond will be situated within the retention pond located on site, taking advantage of the stored rainwater source while increasing its biodiversity and usable capacity for human consumption. Farming wastes and byproducts will be introduced into the retention pond as nutrients for plants and fish, while the free range chickens and additional wildlife habitat such as ducks and geese could provide additional nutrients through manure. For clarity on the integrated system design of aquaculture

within the retention pond, refer to figure 32. In addition to these exterior farming methods, as previously discussed, interior agricultural systems will be conducted within the greenhouse facility on site. This green house facility located within the Land Based Learning Center will not only have soil based growing medium that will support agroecosystems, they will also incorporate indoor agriculture systems that utilize modern technologies that enhance farming capabilities consisting of aquaponics.

2. AQUAPONICS

Aquaponic growing systems are the combination of aquaculture and hydroponics, which is a closed loop system that doesn't require soil but rather utilizes water and other additives to supply nutrients to grow produce. The concept of polyculture can yet again be extended to aquaponics which utilize these two agricultural systems in a symbiotic manner, forming a closed loop system in which water is cycled between grow beds and fish tanks. The vegetated grow beds producing fruits and vegetables filter the water cycled in the system for the fish, from which the fish in turn provide fertilizer for the plants through their manure.³⁷ This Provides high-protein yields of biomass that can be consumed by humans year round in the indoor environments in the form of fish, vegetables and fruits. In addition, the exterior fish pond located within the landscape works in tandem with the aquaponic system, providing mature fish native to the region that can then be circulated into the indoor farming system. Overall, the agricultural systems would be sustainable and regeneratively designed, with the irrigation requirements for all systems being provided through the stormwater collection systems, while their energy consumption would be supplemented by the on site solar panels and anaerobic digesters. Refer to figure 38 for a system diagram of the aquaponic systems that will be utilized in the Thesis project.

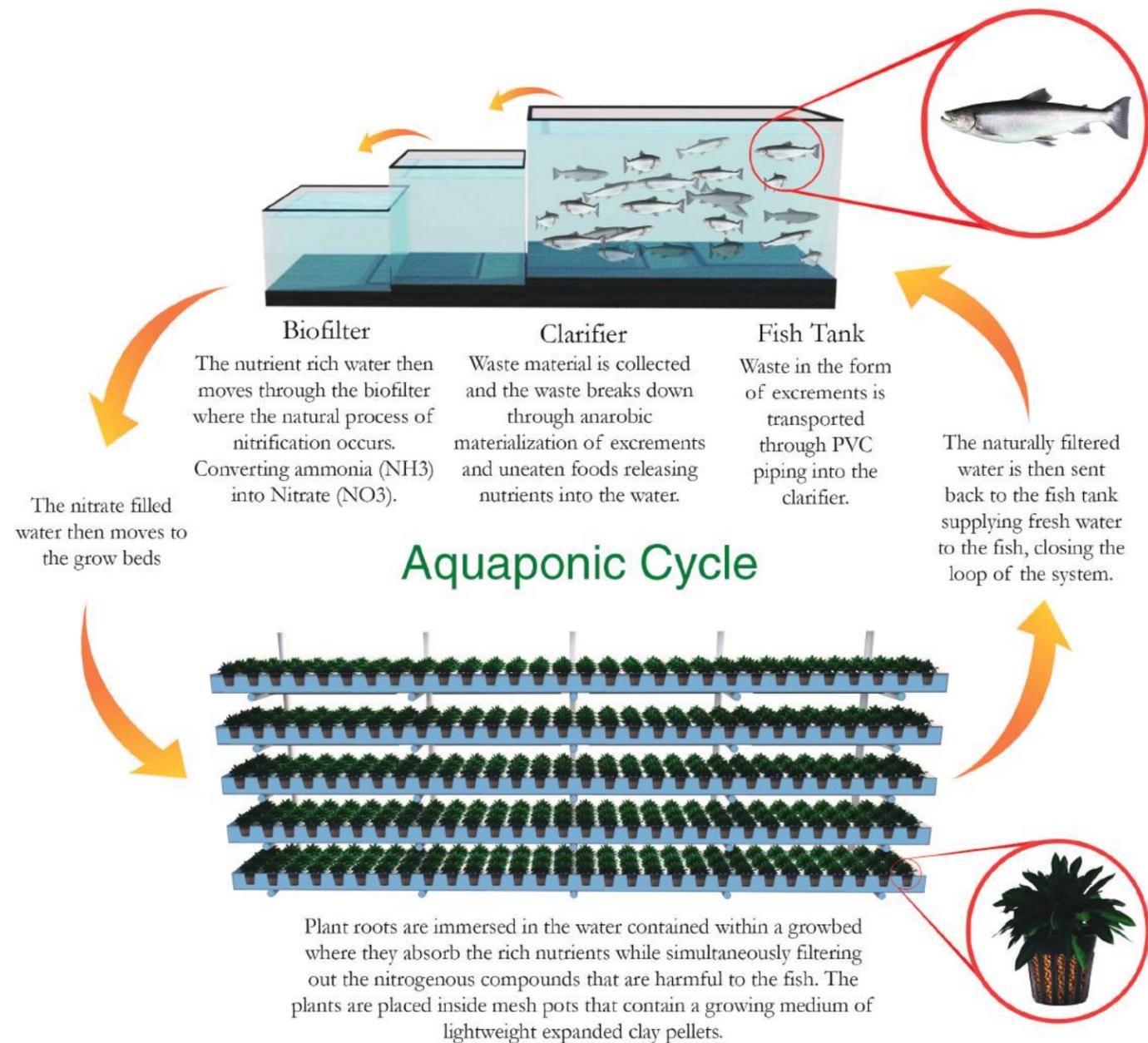


Figure 38: Graphic produced by author illustrating the aquaponic system that will be utilized within the greenhouse facility of the Land Based Learning Center.

WASTE MANAGEMENT

The last integral component that closes the loop to the functioning success of the regenerative systems deals with waste management and treatment. In contemporary society, sewage discharge is a prevailing concern, polluting waterways around the world.³⁸ Although, modern technologies have advanced systems of biomass conversion that transfer waste into usable capacities that can work reciprocally with the landscape and other regenerative systems. Methods of biomass conversion work towards extracting the solar energy embedded within biomass to convert it into different states of gaseous, liquid, or solid materials that can then be utilized for different energy capacities such as heat, electricity, fertilizer, or fuel.³⁹ There are many different systems and methods of application available for biomass conversion, although, an *Anaerobic Digestion* system will be utilized in the Thesis project. The process of *Anaerobic Digestion* consists of using acid-forming bacteria to break down organic materials, converting them into fatty acids, alcohols, and aldehydes.⁴⁰ This acid is then further broken down by methane-forming bacteria, converting the acids into a biogas consisting of a gaseous mixture of 65 percent methane, 35 percent carbon dioxide, and traces of hydrogen, nitrogen, and hydrogen sulfide.⁴¹ This biogas can then be utilized for combustible fuel serving as a heat source for infrastructural applications as the conversion process of biogas generates heat, and electricity for infrastructures.⁴² In addition to this, the left over organic materials are further digested, breaking down the organic matter into a liquid known as digestate, which consists of all the distilled rich nutrients producing a liquid rich fertilizer. The anaerobic digestion system is able to break down most waste materials, consisting of crop wastes and farming byproducts, livestock wastes, food wastes or kitchen scraps, and waste water.⁴³ For its implementation into the Thesis project, the waste foods and waste water produced within the facilities, as well as crop wastes and farming byproducts produced in the interior and exterior agricultural systems will be directed into the anaerobic digesters. Converting the wastes into heat and electricity that can then be recirculated into the facilities and regenerative systems, while producing rich fertilizers that can be recirculated



Anaerobic Digester

back into the agricultural systems as nutrients. The only waste materials that hasn't been mentioned is the disposal or conversion of human sewage, which has the capabilities of being recirculated into the anaerobic digestion system, and thus, recycled into the overall regenerative system. Although, due to the controversial topic pertaining the recirculation of human sewage biomass into closed loop systems of agriculture and food production, it hasn't been explored in detail. Overall, the anaerobic digester follows nature's processes of biomass conversion, breaking down common wastes to produce sustainable energy in the form of heat, electricity and fertilizers, forming a closed loop, regenerative system. Refer to figure 39 for a systems diagram for the underground anaerobic digester that will be incorporated into the Thesis project.

For more clarification regarding the integration of the defined regenerative systems/strategies into the proposed Thesis development and how they operate in relation to one another, refer to figure 40. For more clarification on how the regenerative systems serve as an extension to the natural hydrological processes of the site, refer to figure 41. For more clarification on how these four categories of regenerative design (consisting of the Hydrological Cycle, Solar Energy, Food Production, and Waste Management) perform symbiotically with one another to perform a regenerative, closed loop system, refer to figure 40.

1 Lyle, John Tillman. Regenerative Design for Sustainable Development. Pg 152.
 2 "Low Impact Development: a Design Manual for Urban Areas," 2010. Pg 36.
 3 Ibid. Pg 180.
 4 Ibid.
 5 Ibid. Pg 172.
 6 Ibid. Pg 184.
 7 Ibid. Pg 172.
 8 Ibid. Pg 184.
 9 Ibid. Pg 158.
 10 Ibid. Pg 182.
 11 Ibid. Pg 178.
 12 Ibid. Pg 51.
 13 Lyle, John Tillman. Regenerative Design for Sustainable Development. Pg 115-116.
 14 Lyle, John Tillman. Regenerative Design for Sustainable Development. Pg 115-116.
 15 "Grasslands." Grand River Conservation Authority.
 16 "Low Impact Development: a Design Manual for Urban Areas," 2010. Pg 171.
 17 "Low Impact Development: a Design Manual for Urban Areas," 2010. Pg 160.
 18 Ibid. Pg 160.
 19 Ibid. Pg 186.

20 Lyle, John Tillman. Regenerative Design for Sustainable Development. Pg 54.
 21 Ibid.
 22 Ibid. Pg 105.
 23 Ibid. Pg 53.
 24 Ibid. Pg 64.
 25 "Transparent Solar Panels." United Kingdom. Accessed March 22, 2020.
 26 Ibid. Pg 101-102.
 27 Ibid.
 28 Ibid.
 29 Ibid.
 30 Ibid. Pg 103.
 31 "Low Impact Development: a Design Manual for Urban Areas," 2010. Pg 62.
 32 Lyle, John Tillman. Regenerative Design for Sustainable Development. Pg 146.
 33 "Low Impact Development: a Design Manual for Urban Areas," 2010. Pg 67.
 34 Ibid. Pg 67.
 35 Lyle, John Tillman. Regenerative Design for Sustainable Development. Pg 208.
 36 Ibid. Pg 208.
 37 North, Darren. "What Is Aquaponics and How Does It Work?" The Permaculture Research Institute, May 29, 2016.
 38 Lyle, John Tillman. Regenerative Design for Sustainable Development. Pg 147.
 39 Ibid. Pg 60.
 40 Ibid. Pg 61.
 41 Ibid.
 42 Ibid.
 43 Ibid.

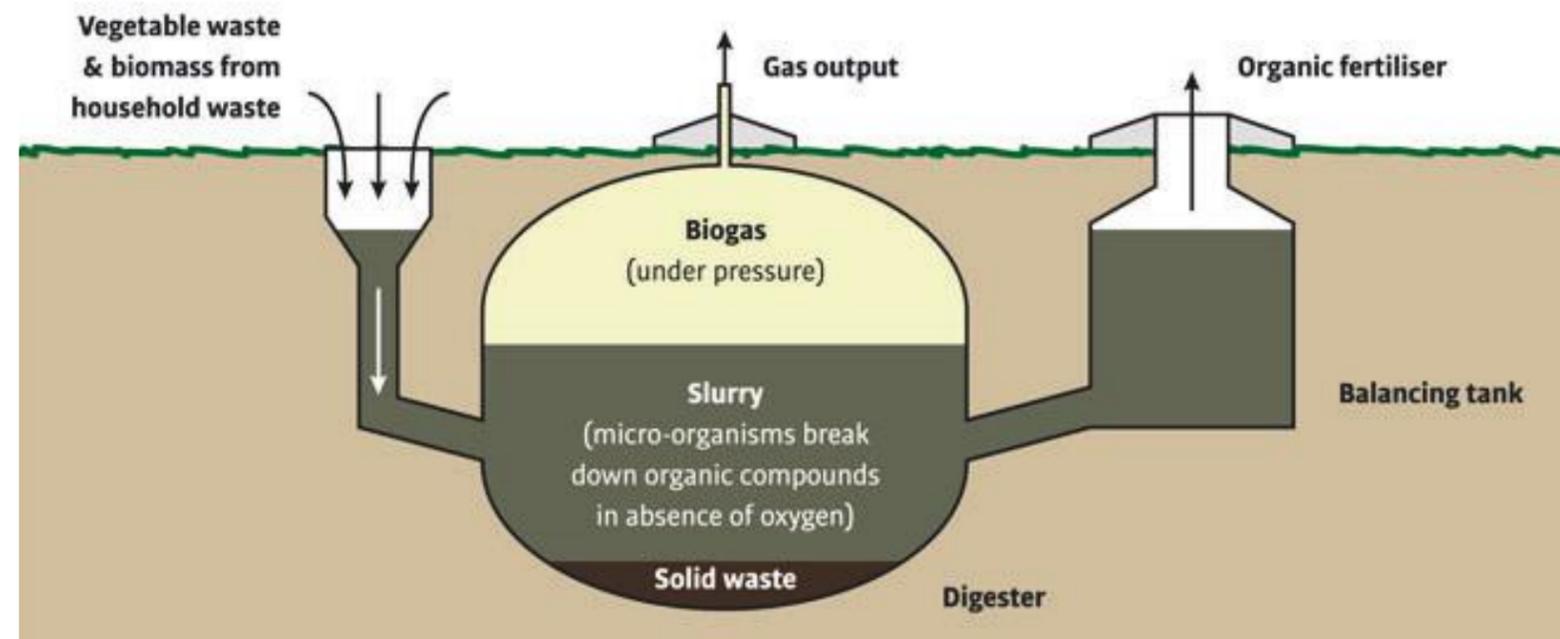


Figure 39: Graphic illustrating a systems diagram of an underground anaerobic digester that will be utilized within the Thesis project.

Figure 40: Graphic produced by author demonstrating the integration of the defined regenerative systems/strategies into the proposed Thesis development and how they operate in relation to one another.



- Riparian Buffer

- Parking Gardens

- Brown Roofs

- Retention Pond

- Constructed Wetland

- Photovoltaic Solar Energy

- Sheltering Roles of Plants

- Agroecosystem

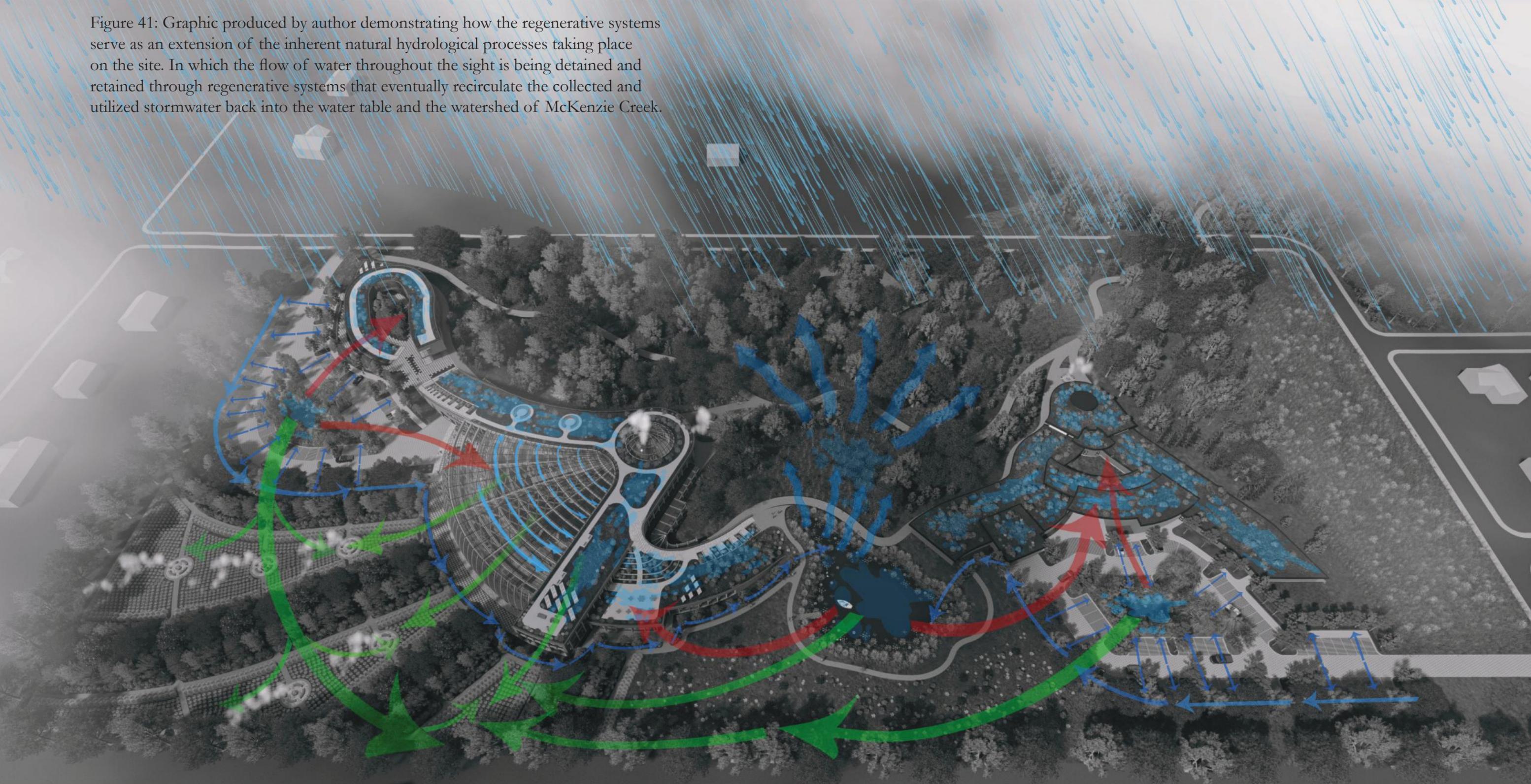

Two Anaerobic Digester's are to be located at the ends of the Land Based Learning Center underneath the sloped, walkable brown roof. This would provide ease of access to the waste management systems from inside the center and from atop the brown roofs, allowing two centrally located waste management systems that would manage the agricultural wastes and household wastes of all the facilities and agricultural applications on the site.

- Xeriscape

- Aquaculture

- Anaerobic Digester


Figure 41: Graphic produced by author demonstrating how the regenerative systems serve as an extension of the inherent natural hydrological processes taking place on the site. In which the flow of water throughout the sight is being detained and retained through regenerative systems that eventually recirculate the collected and utilized stormwater back into the water table and the watershed of McKenzie Creek.



Represents the Curated Flow of Stormwater Throughout the Site from Collection to Infiltration

Represents the Stormwater that has Been Collected Being Utilized for Grey Water Applications

Represents the Collected Stormwater Being Utilized for Irrigation Throughout the Agroecosystems

Illustrates the Curated Flow of the Stormwater Infiltrating Back into McKenzie Creeks Watershed

Represents the Detention, Retention and Collection of Stormwater for its Infiltration into Groundwater Supply or its Utilization for Interior/Exterior Agricultural Irrigation and Greywater Applications.

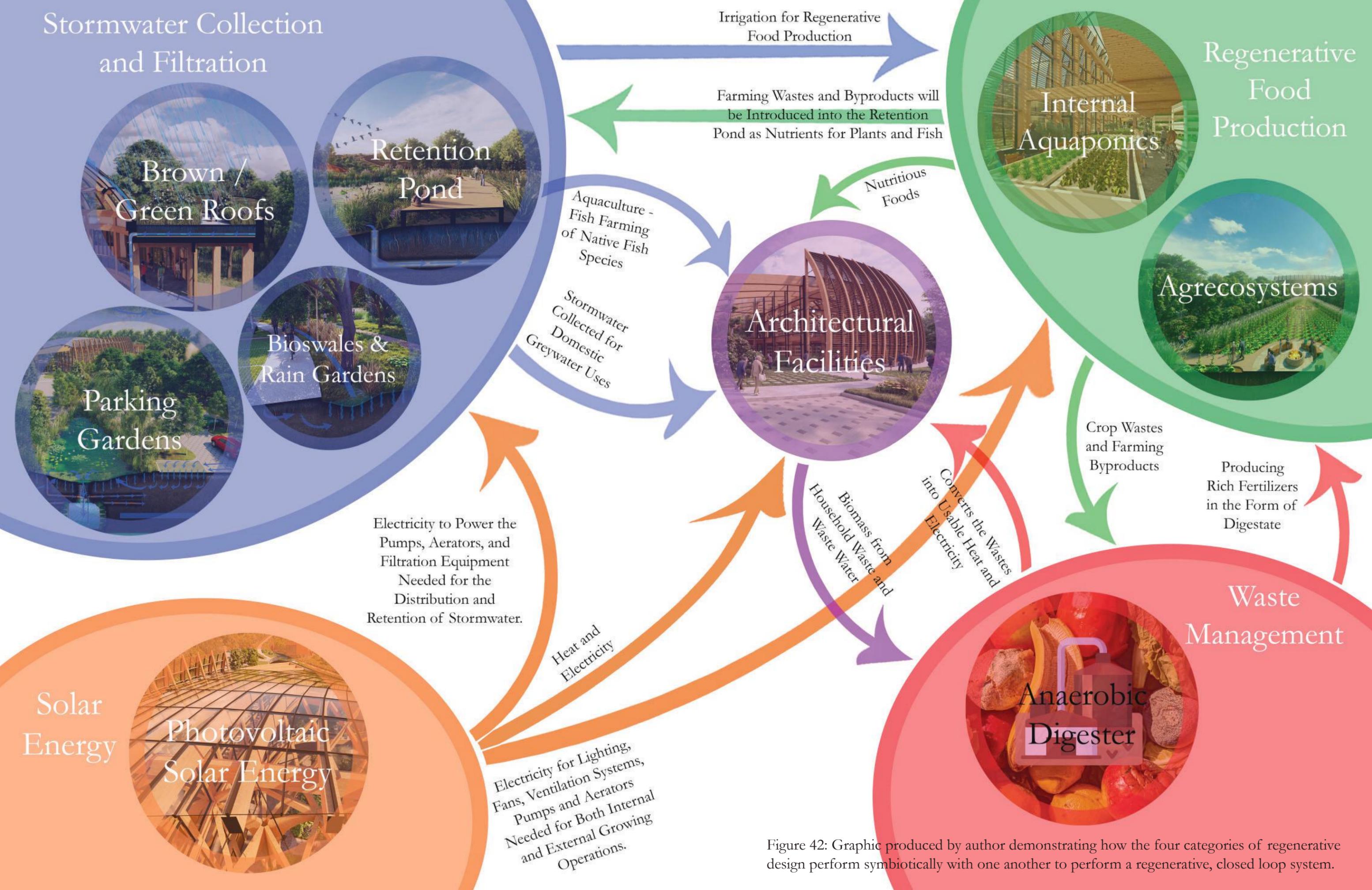
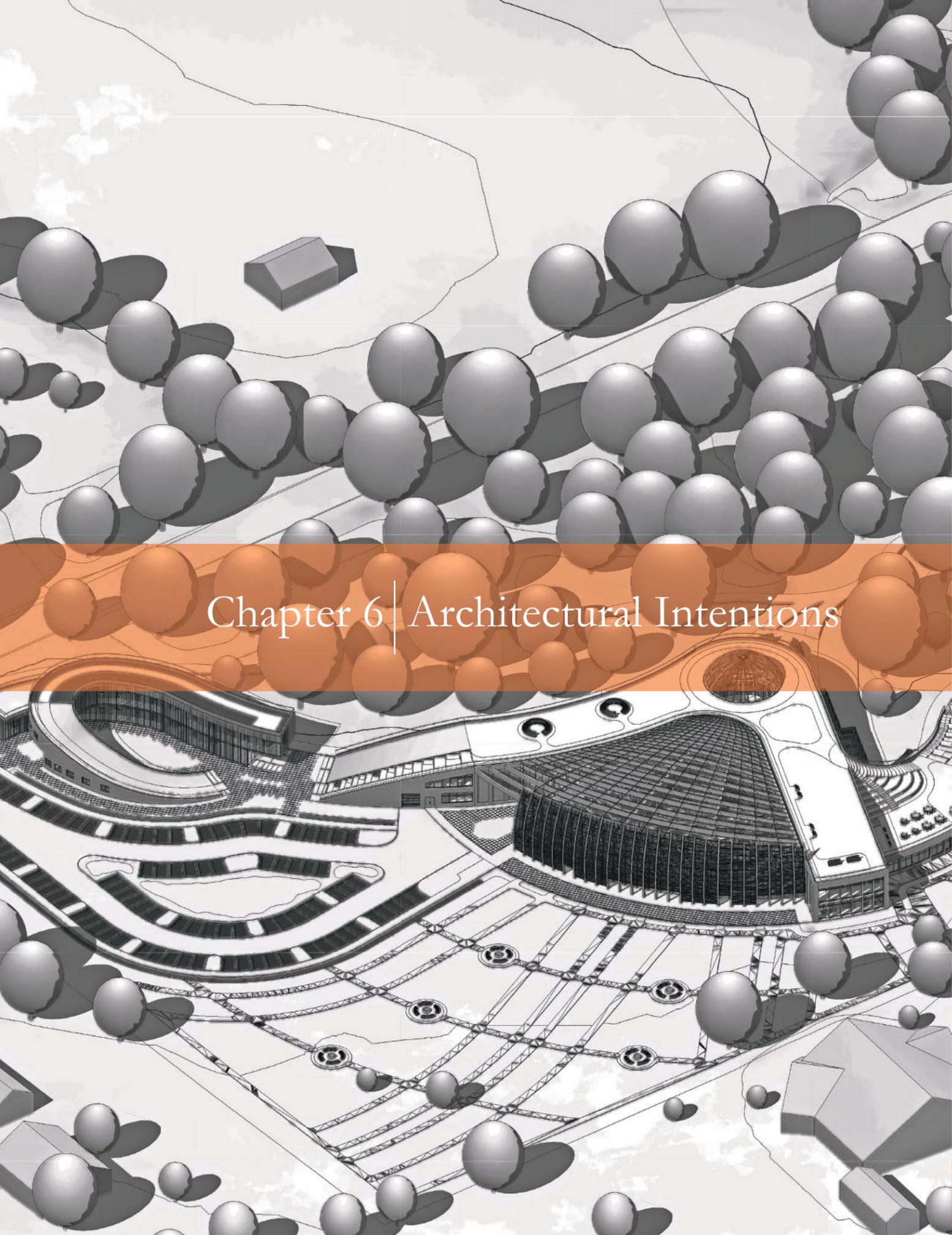


Figure 42: Graphic produced by author demonstrating how the four categories of regenerative design perform symbiotically with one another to perform a regenerative, closed loop system.

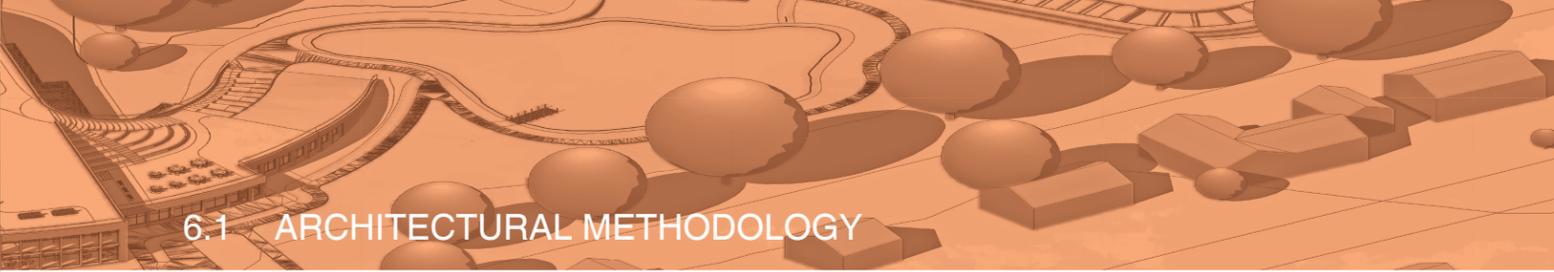


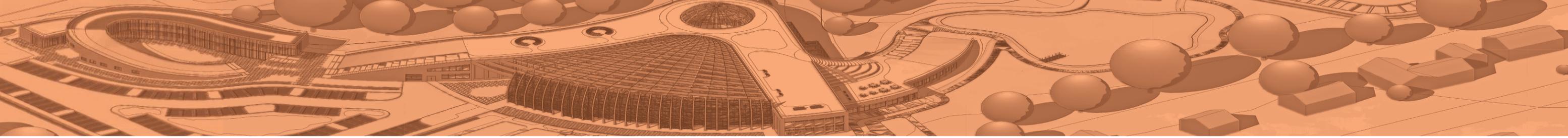
Chapter 6 | Architectural Intentions

6.1 ARCHITECTURAL METHODOLOGY

As demonstrated thus far, through engaging with public officials located on Six Nations Reserve, while conducting comprehensive research, a strong understanding of Haudenosaunee Ecological Knowledge (HEK) has been gathered. Likewise, contemporary conditions facing Six Nations Reserve have also been analyzed, and a comprehension has been gathered of the communities visions towards future developments, consisting of new modes of clean energy production, innovative waste management solutions, sustainable methods of clean water production and filtration, and food systems of sustainable production and equitable access. It has also become apparent that Six Nations Reserves' westernized built environment isn't conducive to Haudenosaunee value systems, promoting a hyper-individualistic ownership of property that produces segregated communities, while allocating hardly any land for communal or recreational use or nature preserves. As a result, relationships have become based on individual possession and personal benefit, promoting a consumerist society that favors individualistic living systems. Which has resulted in a deviation from principles and values as reflected in Haudenosaunee tradition that prioritized strong, interconnected, and nurturing communities that bore a responsibility to nurture Mother Earth for future generations. Although, the Six Nations of the Grand River community have voiced a desire to change their ways to make their actions match their principles. Principles that are based on a strong respect for Mother Earth and the understanding that Haudenosaunee survival and success depends on the wellbeing of Mother Earth. As demonstrated, centering Haudenosaunee best practices in a modern context has informed regenerative strategies for environmental and infrastructural design that addresses the communities vision while performing reciprocal relations with the natural environment. This breadth of comprehensive research has generated a methodology that has been informed through interdisciplinary research at the intersection of urban design, environmental design, architecture, and ecological knowledge.

This architectural methodology is to demonstrate how TEK and HEK can be applied in modern applications to inform regenerative strategies for sustainable design that reinterprets Six Nations westernized built environment. These regenerative systems



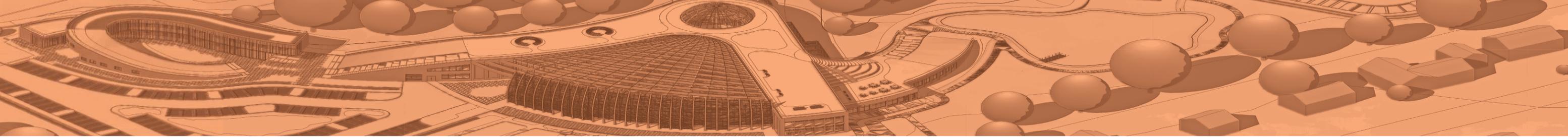


take advantage of natural processes of the land while enhancing and remediating ecological conditions, producing environments that form reciprocal relations with the landscape while reenvisioning Six Nations gridalinear, westernized landscapes to align with Haudenosaunee perspectives. By developing infrastructures and landscapes that are in tune with natural hydrological cycles, sun movements and exposure, natural ecological conditions, and natural wind movements/patterns, the intent is to produce a regenerative development that achieves self-sufficiency and resiliency, centered around Haudenosaunee ways of keeping balance with Mother Earth in a contemporary context. In doing so, a new community development will be conceived that maintains reciprocal relationships with the surrounding ecology of Six Nations while developing infrastructures that empower the local community and promote self-determination.

With that being said, the developments' main priority is to be regeneratively designed with the sole focus of sustaining the infrastructure(s), its programs, and its occupants through renewable resources and energies. These will consist of regenerative design principles surrounding the necessities of everyday life such as shelter, water, food, and waste processing. This will be achieved through implementing new methods of clean energy production and conservation, consisting of renewable systems such as the implementation of solar panels and the utilization of biogasses. In addition to this, architectural form will shape energy flows, controlling the reflection, absorption, and release of solar energy and heat through various materials and shading devices, while controlling air movement in order to mediate building temperatures. Applications of innovative waste management systems will be integrated into the development such as the use of an anaerobic digester. Food systems of sustainable production and equitable access will be provided through the greenhouse facility as well as land based applications through the utilization of agricultural systems such as agroecosystems, xeriscapes, aquaculture, and aquaponics. Sustainable water filtration and collection systems will be utilized that work with the natural hydrological cycles, infiltrating and mitigating rainwater runoff through establishing riparian buffers, vegetated roofs, rain gardens, bioswales, infiltration basins, retention ponds, constructed

wetlands, and cisterns. By educating and providing the community of Six Nations with sustainable and renewable systems of energy production, water collection and filtration, food production and waste management will provide economic and employment opportunities while empowering the community to manage their own lands and support themselves in perpetuity. At the same time, developing stronger reciprocal relationships with the land, reinforcing skill sets of harvesting and cultivating of the land in a contemporary context. This will hopefully result in the community having deeper understandings of Haudenosaunee ceremonies and traditions surrounding these practices, while allowing the community to take greater pride in identifying as stewards of the earth.

Additionally, current housing challenges can be solved through analyzing Haudenosaunee culture in a manner that reflects traditional social living patterns in a contemporary context. An architectural metaphor has been drawn from the social structures of the Longhouses and traditional villages in a contemporary context. Traditionally, families were intentionally living together, nurturing one another through the sharing of resources and knowledge. By utilizing traditional living structures as an architectural framework, a stronger community can be achieved where families and clans can support one another, promoting more respectful relationships while encouraging a reciprocal economy. This architectural framework is also supported and informed by the community's feedback as derived from the Community Plan, where their priorities were concerned with housing densification and stronger, interconnected families and communities. Therefore, the proposed structures programmatic layouts, density, and composition will prioritize the densification of infrastructures. This will minimize ecological displacement while allocating more lands towards agricultural, recreational, cultural and natural use. In doing so, will create the opportunity for the design integration of communal trails and parks, promoting healthier lifestyles and stronger communities. In addition, densifying living structures reintroduces cultural principles found in traditional ways of life which prioritized the spirit of togetherness and unified communities as metaphorically represented in the Longhouse. By densifying living structures through means of cohousing and multipurpose structures will also allow the potential for supportive



social programming to be integrated into community developments. Consequently, this will result in more supportive infrastructures that contribute to the mental wellness of its occupants and community care of Six Nations, while reinforcing and celebrating Haudenosaunee culture. Two methods of architectural densification were initially examined through the means of a conceptual typological study that proposed two architectural interventions. One method consisted of developing densified infrastructural clusters like that of an eco-village, where the other promoted the production of large multipurpose facilities (refer to figure 43). For the proposed Thesis project, the architectural intervention for infrastructural densification will consist of developing multipurpose facilities. In addition, a periphery Thesis intention is to provide the community of Six Nations with affordable and environmentally friendly housing options with design variability, providing communal living options that address homelessness and needed elderly care on the reserve. In doing so, the Thesis proposes a built environment that is integrated with natural environments while seeking to increase the number of Six Nations members living on the reserve.

In addition to these guidelines, HEK surrounding land management will inform the manner in which the sites are developed. This will involve utilizing the sites inherent natural qualities to dictate

and determine what lands are suitable for certain programmatic developments (i.e., infrastructure, agriculture, natural preservation, land remediation, park space and trails). Such development strategies will incorporate principles of HEK to inform architectural master planning approaches which will consist of properly assessing environmental conditions (i.e. streams, rivers, creeks, wetlands, medicinal plants, species at risk, flood zones, and invasive plants) while utilizing unused parts of property for purposes of land remediation that will not only enhance the surrounding environment but will recover vegetation lost or displaced due to construction and development.

Furthermore, the intent of the Thesis is that the architectural methodology can be utilized as an informative guide towards land remediation and communal land reclamation efforts throughout the reserve, instilling institutions, developers and community members located on Six Nations reserve to question the concept of *land ownership*. Since the project engages with a privately owned parcel of land located in Ohsweken, the project will demonstrate how these regenerative design strategies can be implemented within the reserve. This methodology can begin to inform how lands can and should be developed throughout Six Nations Reserve, reinterpreting the colonialist impositions facing the built environment and retrofitting the reserve through a Haudenosaunee perspective. The hope is that the project can serve as a catalyst for sustainable interventions, blossoming design strategies throughout the reserve that works towards diminishing the hyper-individualistic ownership of property facing Six Nations by restitching communal lands back into the social fabric of the reserve. In this manner, the architectural methodology and specifically Chapter 5 of the Thesis can be utilized as a road map towards implementing sustainable development strategies throughout Six Nations reserve that have been informed through HEK. In time, these concepts and ecological perspectives could not only instill pride back into the community as identifying as stewards of the land, Six Nations could serve as world class leaders in ecological remediation/preservation and self-determination. Eventually informing broader society of these ecological perspectives by reclaiming treaty lands through ecological remediation efforts throughout the Grand River watershed region.

Infrastructural Clusters: Eco-village

Multipurpose Facility

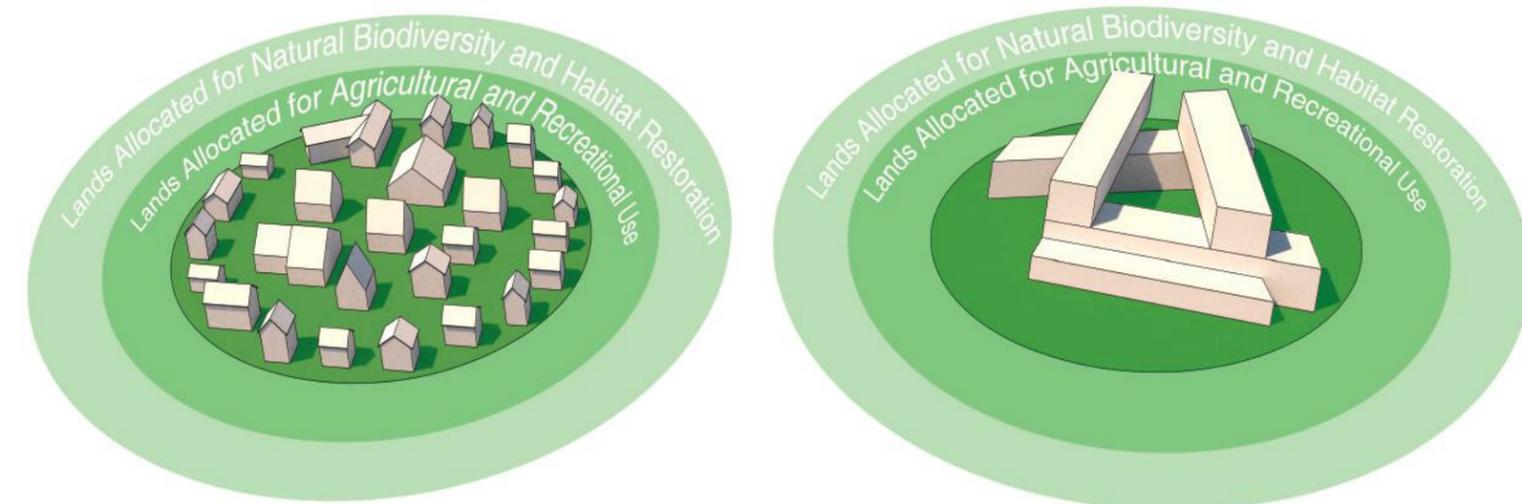


Figure 43: Graphic produced by author representing the initially proposed methods of infrastructural densification.



Chapter 7 | Site Proposals

7.1 SITE ANALYSIS

Initially, throughout the pursuit of the Thesis, two sites were considered that could demonstrate how the defined regenerative strategies could be implemented within Six Nations Reserves' built environment. Both sites provided viable opportunities to test the architectural methodology offering two different modes and scales of architectural intervention. Both sites required completely different design approaches offering different architectural programming and functionality while being specifically crafted to the unique qualities of each site. Both architectural interventions were to analyze how multipurpose infrastructural developments could be regeneratively designed. The architectural vehicles for this Thesis exploration of retrofitting the colonialist impositions of Six Nations' built environment through employing HEK in modern applications, was through the development of Land Based Learning Centers with accompanying facilities. These Cultural Centers would serve as communal hubs and learning facilities that would not only preserve, reconcile and rekindle traditional teachings and values surrounding Haudenosaunee skill sets of harvesting and cultivating the land, they would serve as educational centers that would reinforce traditional teachings in a contemporary context to inform community members of sustainable land management and development strategies. Furthermore, both architectural design proposals addressed food sovereignty, generating food systems of sustainable production and equitable access that would deepen community understandings of Haudenosaunee ceremonies and traditions surrounding these practices.

The first site that was considered was situated in a more heavily developed area where a specific vacant lot located in the village of Ohsweken would be analyzed. The other site was located in a large portion of nearly untouched land located along the shoreline of the Grand River to which I referred to as the Riverfront site (represented in figure 44). Both sites are privately owned properties, with the Ohsweken site being owned by an individual Six Nations member whereas the Riverfront site is owned by several Six Nations members. Since there are hardly any communally owned lands located on Six Nations reserve, the selection of the sites being located on privately owned properties was intentional. The intent of Thesis as previously stated is to extend further than its initial scope, instilling institutions,



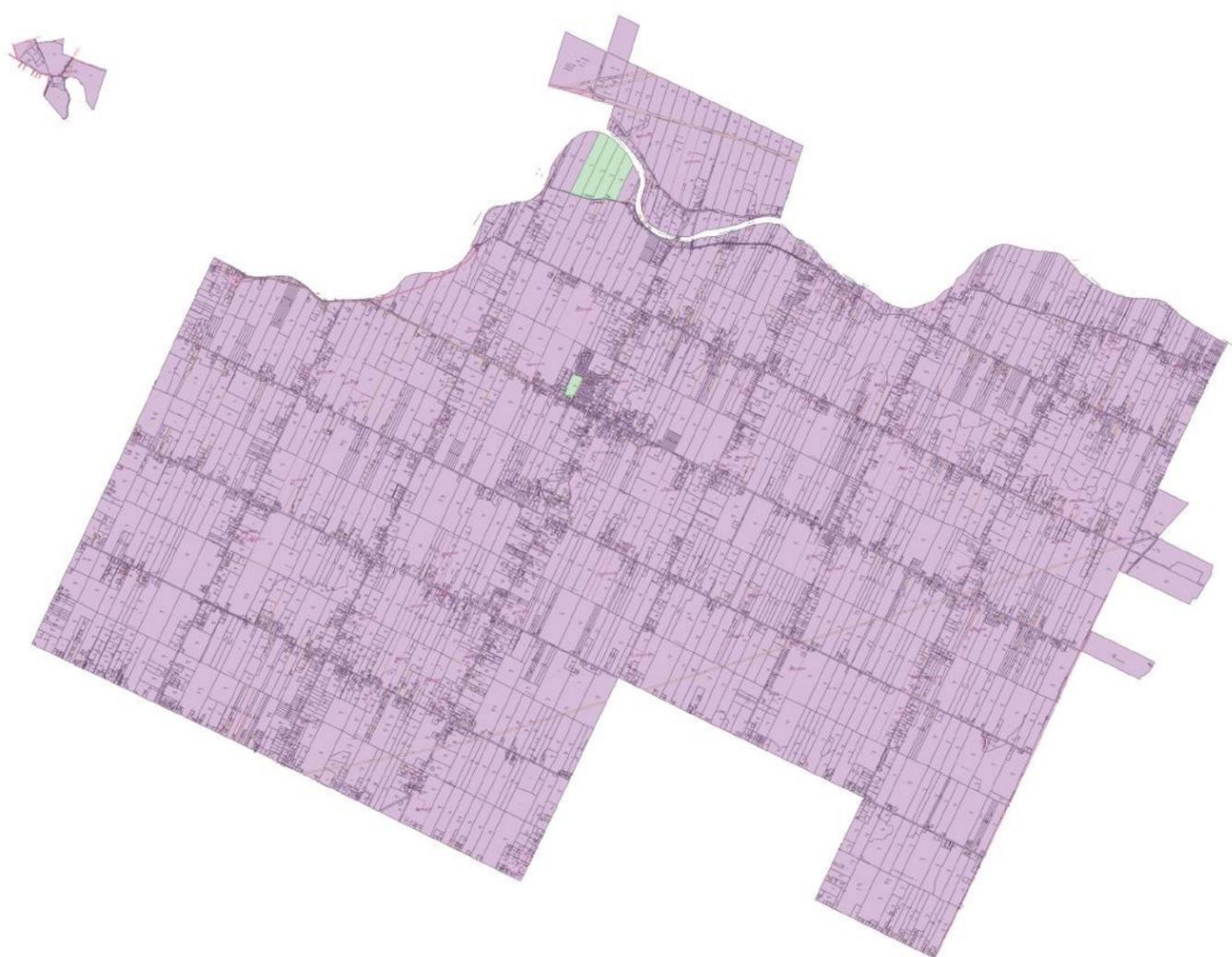


Figure 45: Graphic produced by author demonstrating how the two sites will serve as seeds of sustainable interventions that will blossom future design strategies throughout the reserve.

Ohswegen Site

Riverfront Site

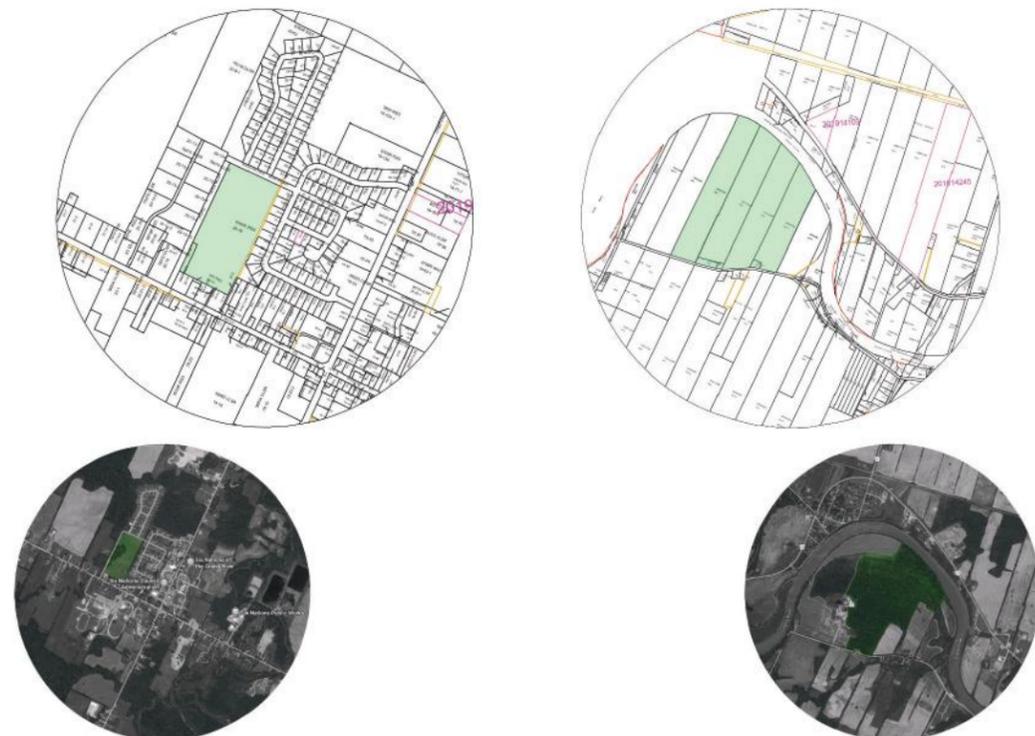


Figure 44: Graphic produced by author demonstrating the two identified sites in relation to one another on Six Nations reserve.

developers, organizations and community members located on Six Nations reserve to question the concept of *land ownership*. Serving as a westernized concept, the hyper-individualistic ownership of property that faces Six Nations is reflective of the consumerist culture that faces the community as a consequence of colonization. Traditional Haudenosaunee ways of life and living structures were fundamentally grounded around communal living structures, the sharing of lands, and interconnected families and communities. The individualism that faces Six Nations contradicts several fundamental teachings and principles of Haudenosaunee culture, including the concepts and principles offered through the teachings of the Dish With One Spoon Wampum Belt. The initial Thesis intent was that the development of both sites would serve as sustainable catalysts that would plant seeds of sustainable interventions, blossoming design strategies throughout the reserve, working towards reclaiming communal lands and restitching them into the social fabric of Six Nations. The architectural methodology would then be utilized as a road map that would inform how lands can be remediated and developed through reciprocal relations throughout the reserve through a series of nested scales (represented in figure 45).



The riverfront site is situated in a more rural setting with little to no infrastructural developments. The lands that have been selected are completely forested aside from a few crop fields along its periphery, consisting of a wide variety of biodiversity. Working with this site would provide the opportunity to explore how HEK could inform the development of seemingly virgin lands in a sustainable and reciprocal manner. Since the site is located in a very rural setting with an abundance of natural biodiversity with connections to the shoreline and little to no infrastructural developments or amenities surrounding the area, the implementation of a public facility such as a Haudenosaunee Harvesting Center surrounding land management and horticultural and hunting practices would serve to be beneficial in this region. This facility would provide the opportunities for a large scale multipurpose farm resource center that would provide agricultural and harvesting education and training programs. While developing a community wild food share which would distribute foods gathered by local hunters, fishermen, and forest gatherers throughout the community. This would provide a facility that would demonstrate how HEK can inform regenerative strategies towards environmental design and maintenance at large scale applications.

With the size of the site, large portions of land could be allocated towards regenerative agricultural and aquacultural practices as well as internal greenhouse farming applications such as aquaponics, agroecosystems and soil based farming. To approach the development of a site of this scale and nature, a rigorous site analysis would need to be conducted to determine the ecological conditions of the site that would be more conducive for certain applications. This environmental analysis would inform which regions of the site would be best suited for either agricultural practices, greenhouse applications, or nature preserves and landscape remediation, nestling the design within the hydrological cycles and ecological conditions of the region. Through preliminary site analysis, it was determined that the sites vegetation was mostly composed of deciduous forests and regions of treed swamps (represented in figure 46). To develop the site in a manner that worked with the natural ecosystem and hydrological cycles, the treed swamped regions would be left undeveloped, preserving the natural infiltration and mitigation properties of the wetland plants, while remediating the site through

re-establishing native plant species. Additionally, with the site being located alongside the waterfront of the Grand River, it was determined through preliminary site analysis that the regulatory floodplain of the Grand River covered the majority of the site (represented in figure 47). Therefore, allocating a riparian buffer for purposes of ecological preservation and remediation would serve as a fundamental driver of the project. By establishing a riparian buffer within the extents of the regulatory floodplain of the Grand River would either advocate for the situation of infrastructural developments outside of flood zones or would demonstrate the manner in which infrastructures can be designed within flood zones to accommodate water level rise (i.e. elevating infrastructures on stilts/concrete piles). In addition, it would provide the opportunity to explore how the reintroduction of native plant species into the watershed region could mitigate the volume of water displaced during floods, providing natural floodplain control. In doing so, the land within the riparian buffer would not only serve its purpose for ecological preservation and remediation, it would provide the opportunity to re-establish a public front to the riverside, providing communal lands along the river that could be utilized for recreational, cultural or natural occupancy. By establishing communal and natural lands/park spaces within the riparian buffer could hopefully evoke community members, institutions and developers to begin allocating riparian buffers along the shoreline of the Grand River. In this manner, members could collectively begin working towards reclaiming the public front to the shoreline throughout the reserve, actively restitching communal lands back into the social fabric of Six Nations. Overall, the site would exemplify how HEK could inform land remediation and preservation practices of native species through developing landscape environments reciprocally with the land. All the while providing a site and facility that would actively contribute to the development of a comprehensive Haudenosaunee seed library.

However, due to the complexity and multifaceted nature of the Thesis, it was only feasible to test the architectural methodology on one site. The site that was selected to move forward throughout the Thesis progression was the Ohsweken site, as it was determined that the social programming provided through a Haudenosaunee Cultural



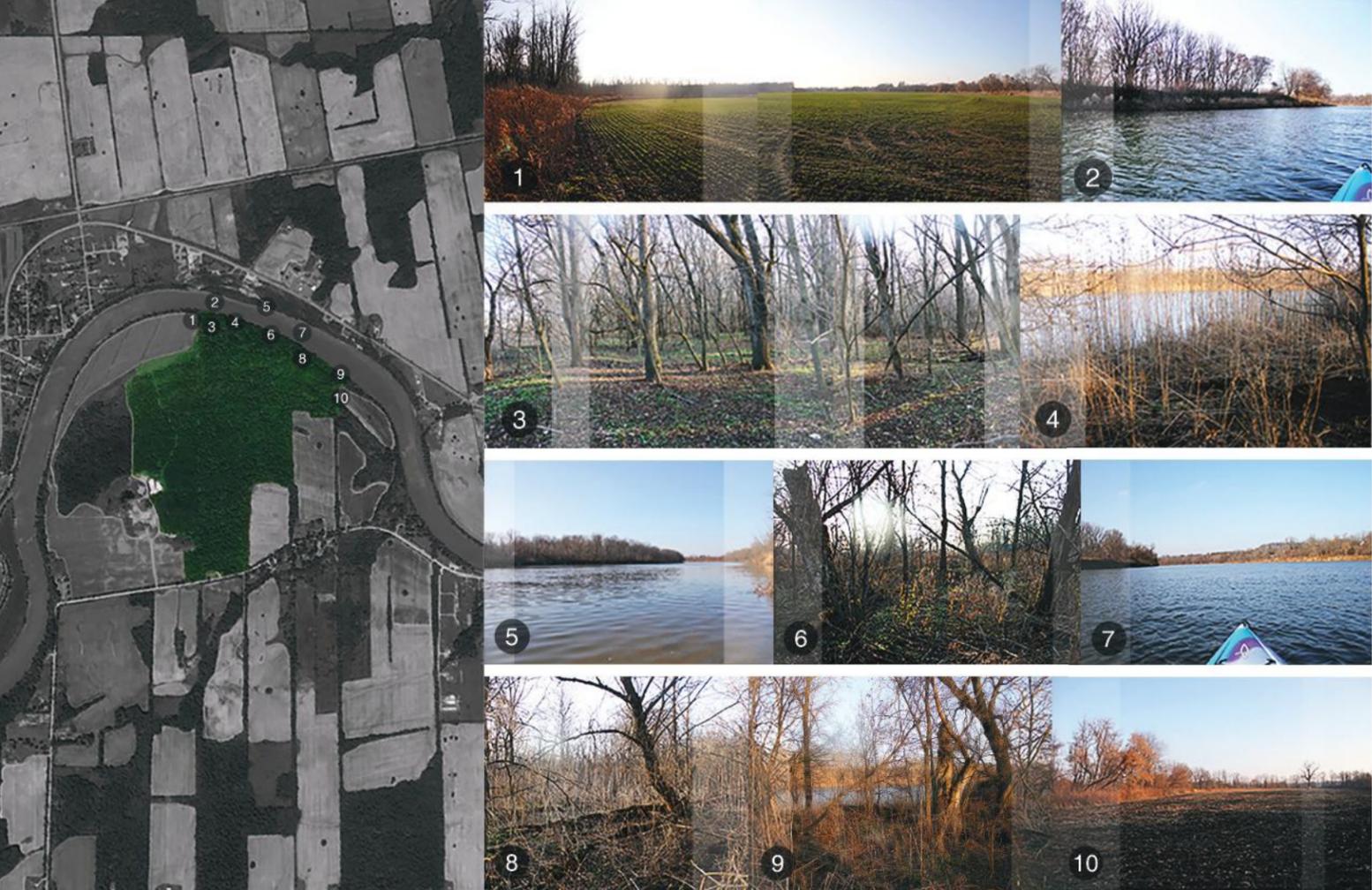


Figure 46: Graphic produced by author illustrating the photographic site analysis of the Riverfront site.

Center would serve to be more beneficial to the community if it was situated in a central location on the reserve. With the intended facility design of the project revolving around utilizing, preserving, and celebrating Haudenosaunee tradition and culture through the integration of social/support programming that would address Haudenosaunee healing and wellness, food systems of sustainable production and equitable access, traditional medicinal remedies and nutritional dietary supplements, youth and elderly support groups and workshops, and regenerative building consultation and education programs, the site for the development would be better suited in a more heavily developed region with increased public access to the facilities, such as the location of the Ohsweken site.

Riverfront Site Analysis

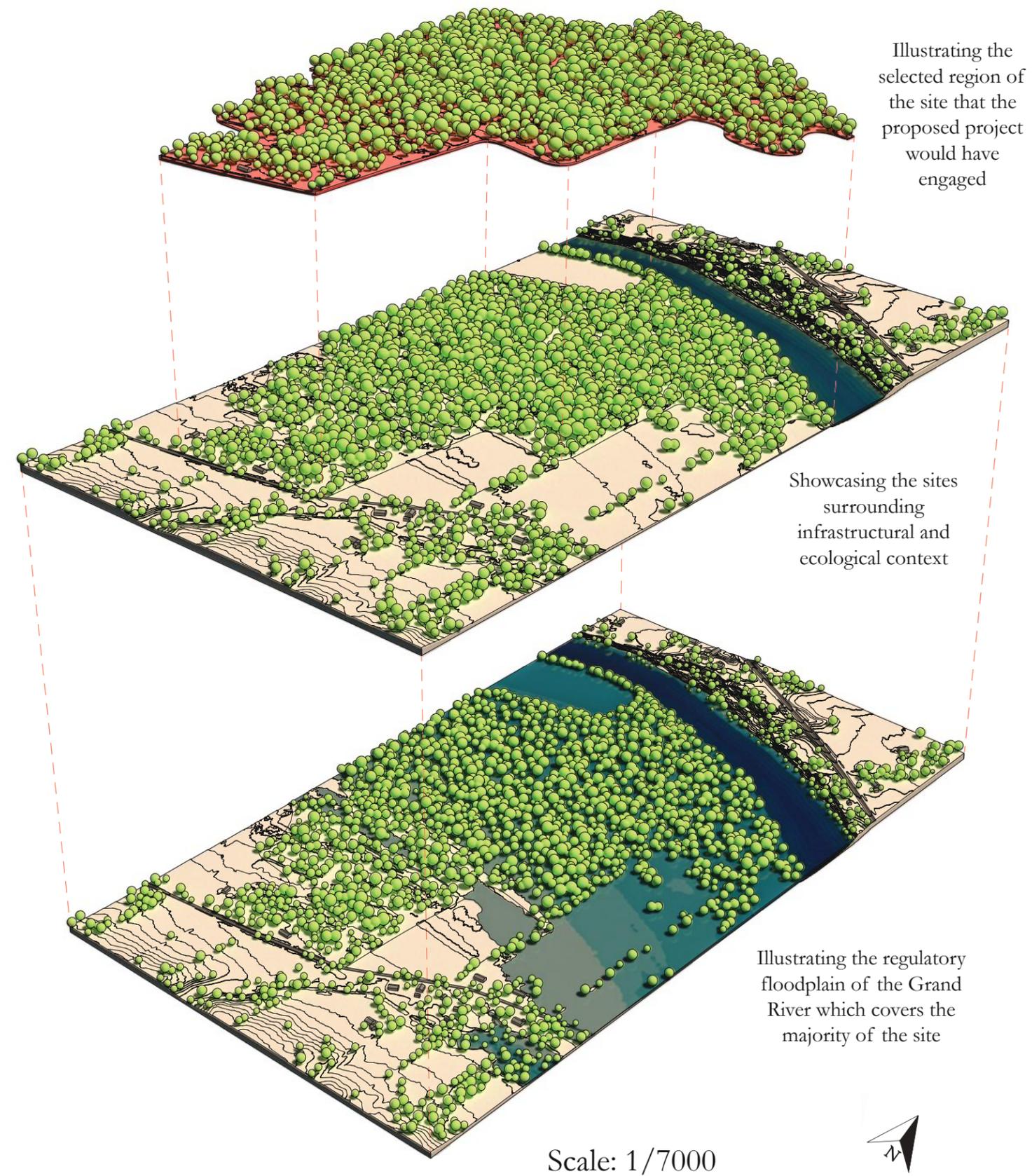


Figure 47: Graphic produced by author illustrating the preliminary site analysis of the Riverfront site showcasing surrounding site context and the regulatory floodplain of the Grand River.



7.3 OHSWEKEN SITE

The vacant lot located in Ohsweken holds the potential to showcase how regenerative strategies informed through Haudenosaunee ecological perspectives could inform sustainable environmental and infrastructural design, forming reciprocal relations with Mother Earth that would radically contradict the heavily developed, westernized landscape of the region. Located in an economical booming sector in Six Nations, where the region has recently seen a large increase in infrastructural developments, the site is surrounded by housing grids that resemble subdivision layouts as reflected in western residential developments (represented in figure 48). With several amenities nearby, the site would serve as a prime location to apply the architectural methodology through the intervention of a multipurpose cultural center with accommodating housing facilities.

ESTABLISHING A RIPARIAN BUFFER

In order to develop the site reciprocally with the land, it was imperative to perform a rigorous site analysis to determine inherent ecological conditions specific to the site. With the land already being cleared due to previous developments, with small shrubs, grasses, and a small deciduous forested area remaining (represented in figure 49), methods of ecological preservation and remediation would serve as the fundamental driver of the project. Methods of ecological remediation and preservation would then inform the location, density and layout of the architectures. Through the site analysis, it was determined that along the northwest edge of the site within the existing forested area was a creek, known as McKenzie Creek, that intersected the site. Through further exploration, it became clear that McKenzie Creek carved its way throughout the entirety of the reserve supporting a wide variety of biodiversity, including several of the many wetlands contained on Six Nations (represented in figure 50). In order to develop a facility that performed reciprocally with the sites ecological conditions, the infrastructures would have to extend and enhance the natural hydrological cycles of the region.

The first obvious solution was to establish a riparian buffer from McKenzie Creeks shoreline that would work towards preserving the natural infiltration region of the creek which supports a variety of habitat. Although, in order to define the limits of the riparian

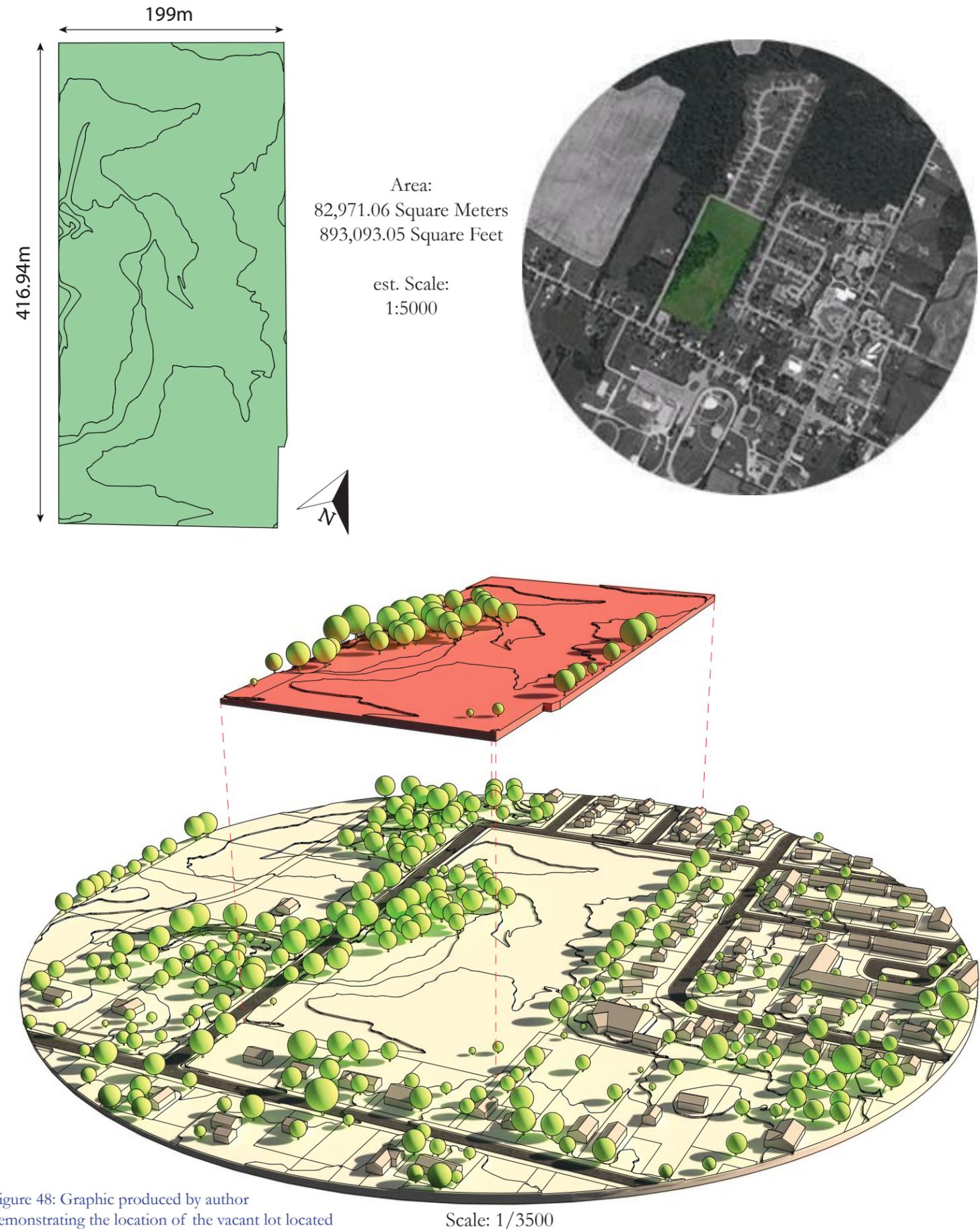
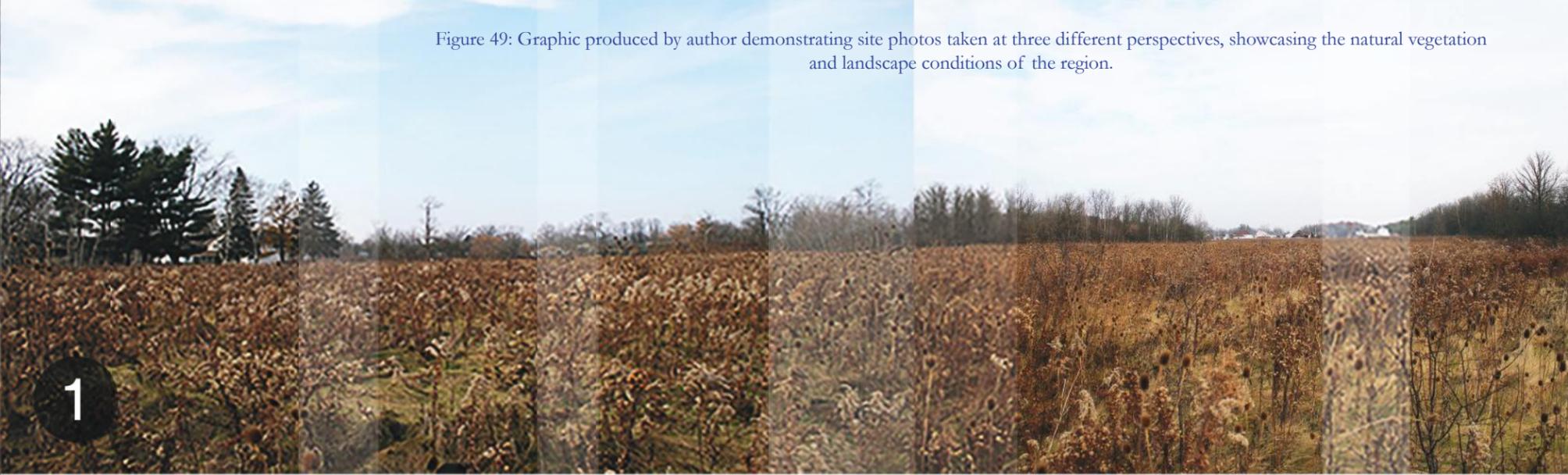


Figure 48: Graphic produced by author demonstrating the location of the vacant lot located in Ohsweken while providing surrounding suburban context.



Figure 49: Graphic produced by author demonstrating site photos taken at three different perspectives, showcasing the natural vegetation and landscape conditions of the region.



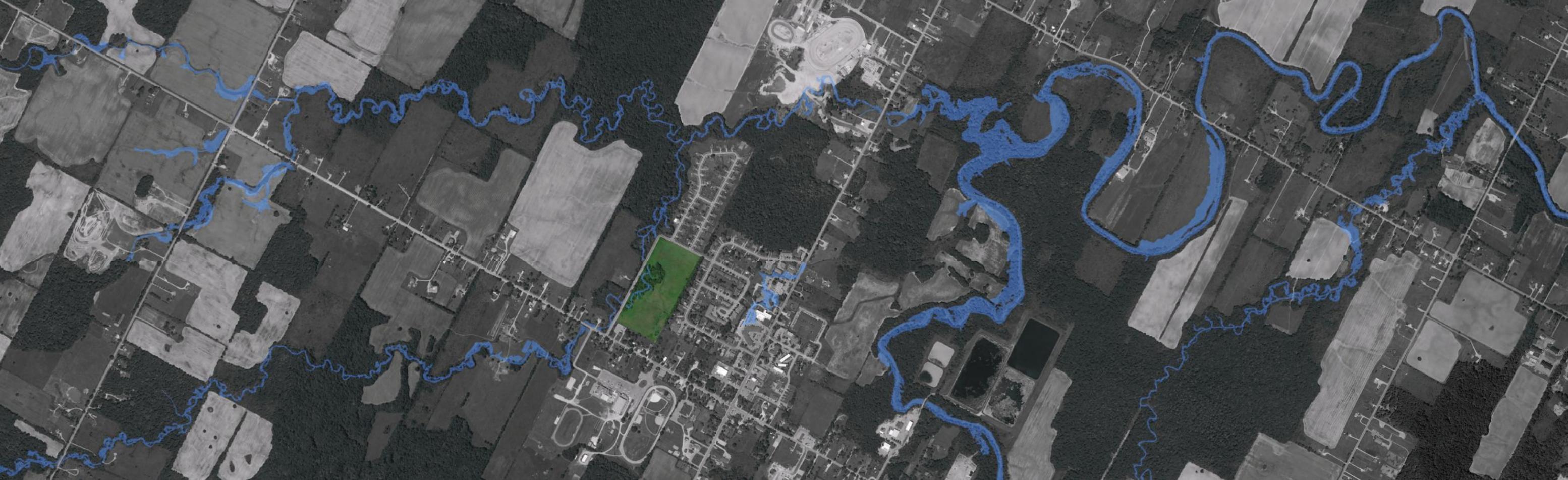


Figure 50: Graphic produced by author illustrating how McKenzie Creek flows throughout the entirety of the reserve supporting a wide variety of biodiversity, including several of the many wetlands contained on Six Nations.

buffer, proper site analysis was to be performed on the creeks water flows, determining the flood line setbacks which would then inform the bordering regions for ecological preservation and remediation (refer to figure 51 for an illustration of the extents of the flood zones of McKenzie Creek).

Analysis of the flood line setbacks of McKenzie Creek were performed, determining 2 year, 5 year, 10 year, 25 year, 50 year and 100 year flood line zones as well as the flood line extents of the creek which was gathered through accessing the Grand River Conservation Authority (GRCA) Websites GIS data and resources (Refer to figure 52 for the flood line analysis of McKenzie Creek). In order to determine a sufficient riparian zone that would allocate enough land to compensate for potential floods, utilizing native biodiversity to infiltrate storm water runoff and creek overflow water, the largest speculated flood line setback was utilized. By establishing the riparian buffer will not only provide methods of remediation, it will improve upon environmental and biological conditions of the site.



Scale: 1/3500

Figure 51: A site perspective produced by the author illustrating the flood lines of McKenzie Creek and its impact on the selected Ohsweken site.

2 year flood line

5 year flood line

10 year flood line

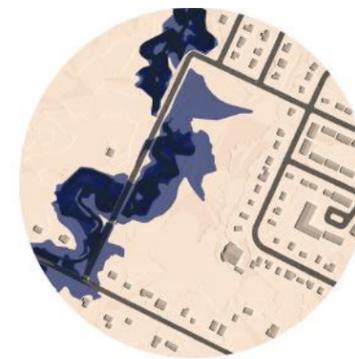
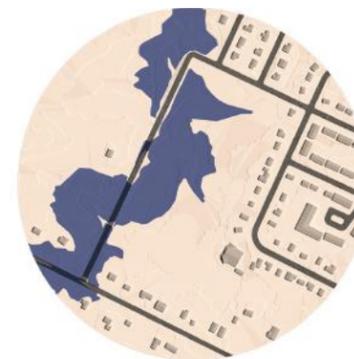
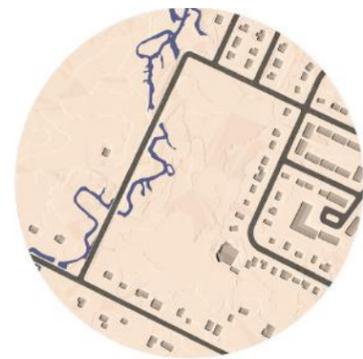
25 year flood line

50 year flood line

100 year flood line

Flood Line Extents

All Flood Lines

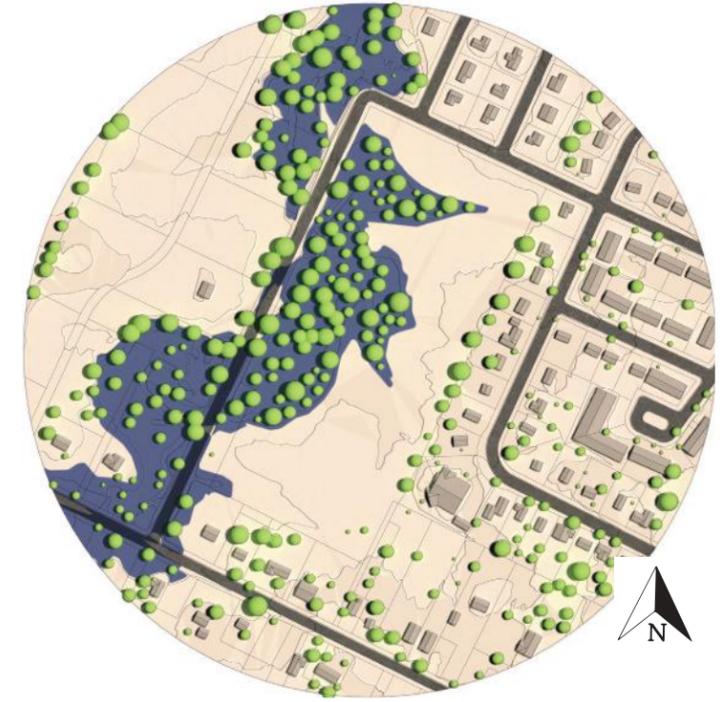
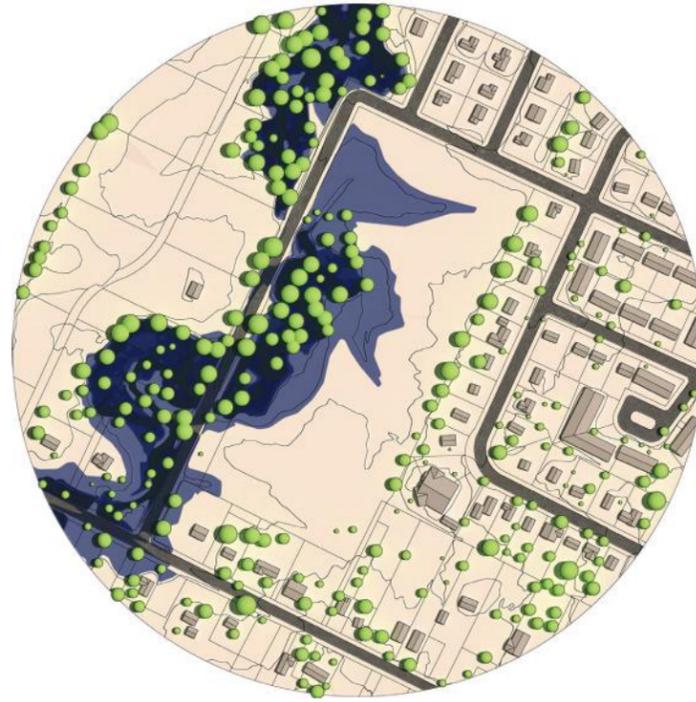


est. Scale 1:14,000

Current Site Conditions with no Flood Lines Depicted

Current Site Conditions with all Flood Line Extents

Land Remediation within the Riparian Buffer



est. Scale 1:7000

est. Scale 1:7000

est. Scale 1:7000

Figure 52: The diagrams located along the top of the two pages showcase the flood zones of McKenzie Creek, illustrating 2 - 100 year flood line setbacks of the creek. The diagram to the left showcases all the flood line extents while illustrating the current forested region. Whereas the graphic to the right showcases the remediation of the landscape, allowing the natural habitat to regrow and reclaim the extents of the riparian buffer. This would enhance the sites physical and biological conditions by allowing the natural habitat to reclaim this portion of the site occupied within the flood zones. This would present the opportunity to remove invasive plant species and reintroduce native vegetation back into this region. Additionally, this newly established riparian buffer would form a nature preserve boundary serving as a definitive barrier that infrastructural design will have to abide by.

Thus providing more lands for natural habitat as well as communal park space and recreational areas. For more information regarding the details and benefits of the established riparian buffer that was implemented into the site design, refer to Chapter 5: Regenerative Design, section 5.2.

SOLAR AND WIND ANALYSIS

Integrated within the site analysis was the conduction of a wind study and a solar study (represented in figure 53). Through performing this study, it was determined where the predominant wind directions and solar exposures were in relation to the site, informing infrastructural orientation to maximize solar heat gain. In

addition, informing where natural and man made passive and active shading strategies could be implemented and the placements of inlet and outlet wall openings to curate natural wind flows for passive cooling systems. The solar studies and wind studies informed which areas would be better suited for agricultural lands and which lands would be best suited for infrastructural development. Similarly to the agroecosystems that are to be intricately designed that block harsh winds while maximizing sun exposure, infrastructures should be mindful of utilizing inherent site qualities to help inform their situation.

Site Analysis

Figure 53: Graphic produced by author illustrating the Ohsweken site analysis showcasing predominant wind directions and solar exposure throughout the year.

Predominant wind direction on Six Nations of the Grand River First Nations Reserve is from the west throughout the year.



Scale: 1/3500

Solar exposure denoting maximum sun exposure and minimum sun exposure throughout the year

Honed in Site Plan Scale: 1/1500

With the maximum solar exposure on the site coming from the south, situating agricultural fields along the southern region made the most sense, whereas situating infrastructural development along the edge of the flood line setbacks of McKenzie Creek would provide protection from predominant westward winds. Thus utilizing the existing and eventual remediated forest canopy as wind cover. This also provided the opportunity to nestle the infrastructures into the surrounding landscape, where the architecture mimics the rhythm of McKenzie Creek throughout its design of the three facilities (represented in figure 54).



Figure 54: Graphic produced by author illustrating the flood line extents of McKenzie Creek and how the design of the three facilities are nestled into the surrounding landscape, conforming to the established boundary of the riparian buffer.



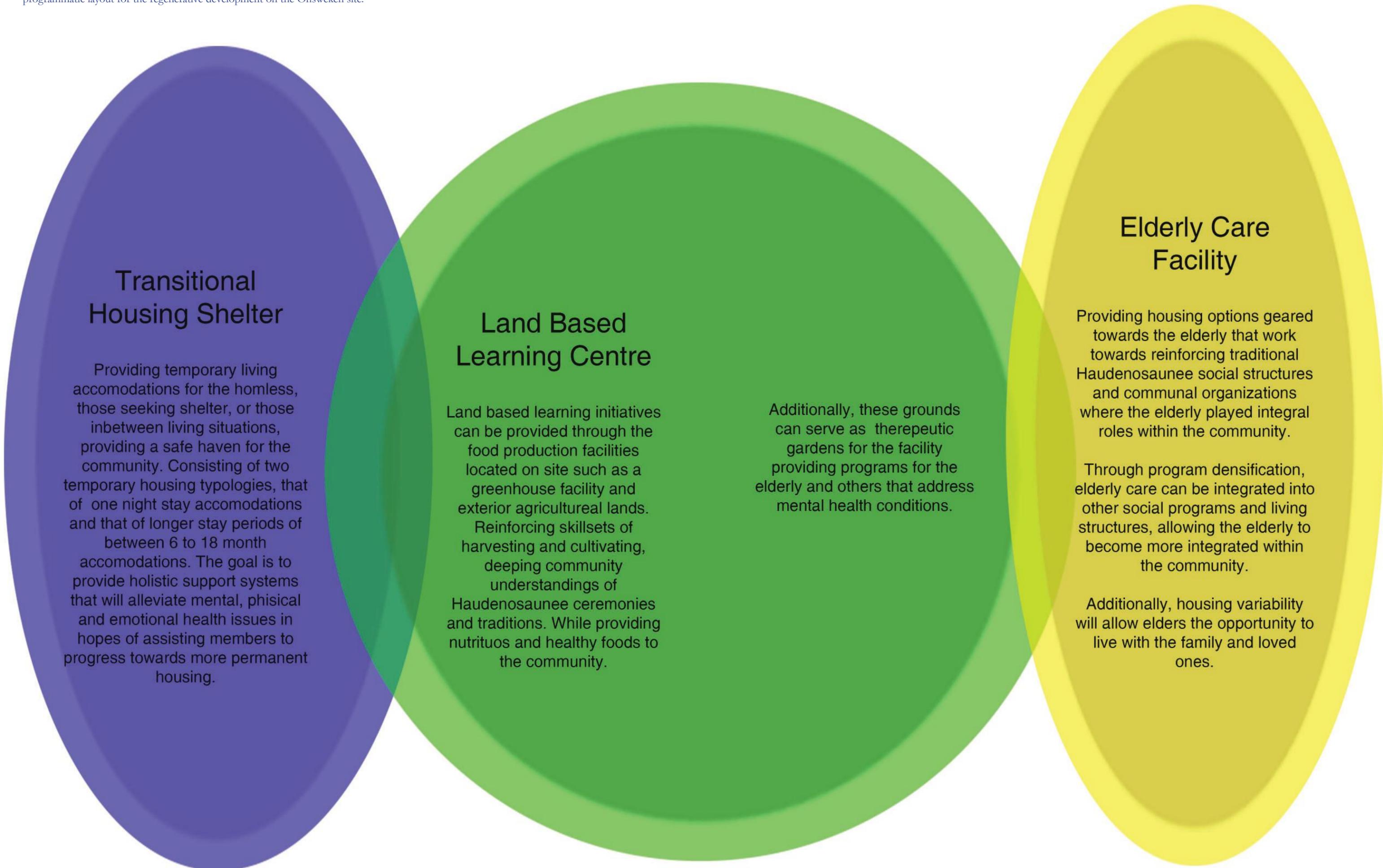
Chapter 8 | Design Proposal

8.1 ARCHITECTURAL PROGRAMMING

The architectural vehicle for the exploration of employing HEK on the Ohsweken site will be through the development of a Land Based Learning Center with accompanying facilities of a Transitional Housing Center and an Elderly Care Facility (represented in figure 55). With the Land Based Learning Center serving as the programmatic anchor of the three architectures, the intent is that this facility will serve as a central community hub from which the two other accompanying architectures will benefit from its social, educational, and therapeutic programming. The intent of the Land Based learning center is to serve as a cultural and educational hub that operates both locally as well as across North America, serving as an outreach center for Six Nations community members both on and off reserve as well as North American Indigenous people and enlightened mainstream individuals. The Centers' goal is to actively preserve and rekindle Six Nations' connections with traditional values, teachings and ceremonies surrounding ecological knowledge and skill sets of harvesting and cultivating the land, while reinforcing the significance of traditional knowledge in a contemporary context. The facility provides social, educational, and therapeutic programming that reinforce the significance of maintaining close and respectful relationships with Mother Earth as a necessity to achieving healthy minds, bodies and spirits. In addition, the facility provides consultation services to home owners, builders, and developers both on and off the reserve as well as Six Nations Council, on how traditional teachings and HEK can be reinforced in a contemporary context to inform sustainable land management and regenerative development strategies. Overall, the development of the Land Based Learning Center with accompanying housing facilities will inform Six Nations members and broader society on how to perform reciprocal relations with the land, while actively reaching to increase the number of Six Nations members living on reserve, by providing affordable housing for displaced Indigenous members. With that in mind, the Thesis's driving force is the Land Based Learning Center that will challenge/prove the architectural methodology. The other two facilities are intended to be phased into the master planning of the site design at a later date.

The reason for the architectural intervention consisting of a multipurpose cultural center in the form of the Land Based

Figure 55: Graphic produced by author demonstrating the architectural programmatic layout for the regenerative development on the Ohsweken site.





Learning Center with accompanying housing facilities is to advocate infrastructural densification and strong, interconnected communities. The introduction of an Elderly Care Facility and a Transitional Housing Facility would not only supply the affordable and sustainable housing demands advocated by the community, it would also involve and engage all age groups which would reintroduce cultural principles found in traditional ways of life in a contemporary context. This would reaffirm and instill the spirit of togetherness and unified communities as metaphorically represented in the Longhouse back into Six Nations' social fabric, where families and clan structures could nurture and support one another. In this manner, the facility will accompany several social programs and housing options targeting all age demographics to develop housing variability that seeks to address the economic disparity facing Six Nations. In addition, the infrastructures are intended to be cooperative in nature, in which the housing facilities are intended to benefit, enrich and support the programming offered through the Land Based Learning Center. This would not only strengthen community interactions and connections between the elderly and the youth demographics of Six Nations, it would also preserve traditional knowledge, practices and values that would be sustained through their shared interactions with the landscape and the center's programs. Yet again, reinforcing traditional values and living structures back into the community of Six Nations in a contemporary context as elders traditionally served integral roles within the community, acting as knowledge carriers and care takers of the youth. As such, they would pass down oral traditions and practices to the younger generations. In designing these infrastructures to perform symbiotically with one another, the intent is that a new community development will be conceived that maintains reciprocal relationships with the surrounding ecology of Six Nations while developing infrastructures that empower the local community and promote self-determination and self-sufficiency. This would also demonstrate how HEK can inform regenerative design strategies that reinterpret the current suburbanized environment of Ohsweken to align more with a Haudenosaunee way of life.

In order to address issues of Indigenous housing, it is important to acknowledge that one of the main issues facing

infrastructural developments on reserves, is the non-involvement of the community throughout the structures development. After having the opportunity to discuss with Gail Obediah, a property manager in the housing department involved with rental units on Six Nations, she expressed how imperative it was for the construction management of housing developments to be controlled by departments situated on Six Nations reserve. In this manner, more internal control will be offered for the construction companies to ensure the financing of the project will be managed in a way that is reflective of the community. In order for this project to be developed in this manner, where the community would be actively involved with the project, it will be programmatically designed to be developed in phases. As the site would gain more recognition and involvement from the community and the demand for housing increases, the scale of the infrastructures and the programming offered in the facilities including the Land Based Learning Center, could be retrofitted and reformatted to provide flexible architectures that would expand with the growing and changing needs of the community. This will also symbolically representing the cellular growth of the Longhouses, which were structurally redesigned and expanded to meet the growing demand of the community. Refer to figure 56 for an infrastructural phasing diagram that illustrates how the two accompanying housing facilities will be introduced into the project at a later date as the community sees fit.

To conclude, the Land Based Learning Center would produce food systems of sustainable production and equitable access through multipurpose greenhouse farming centers and traditional horticultural harvesting practices. The facility will provide accommodations for Haudenosaunee knowledge keepers on these practices, providing a facility that not only produces affordable and culturally appropriate foods, but reinforcing Haudenosaunee traditional harvesting and cultivating practices in a contemporary context. This will provide educational programs surrounding land based learning systems that would deepen community understandings of Haudenosaunee ceremonies and traditions surrounding these practices.

8.2 DESIGN NARRATIVE

OPTIMIZING WIND AND SOLAR ENERGY

With the Land Based Learning Center serving as the programmatic anchor of the three facilities, it was strategically rooted within the center of the site to serve as the central hub of the development. The facility itself was nestled into a bend along the boundary of the riparian buffer, creating an interesting condition where the infrastructure could serve as a mediator between the agricultural regions of the site and the remediated lands of the riparian zone. The intent was to situate more intimate programming along the edge of the restored forest line while radiating the social/communal programming of the center out into the agricultural lands facing the southern regions of the site. In this manner, the center would not only conform its programming to the ecological design of the site, its form fanned outward towards the southern exposure, acting as a sort of sun dial that would prioritize agricultural programs towards the southern facade.

As previously mentioned, building forms can be designed to guide solar energy flows and wind movements, and thus, can take advantage of natural ecological functions to maximize sustainable performances. With the project heavily relying on agricultural food production through internal greenhouse operations, maximizing solar exposure to utilize its heat, energy and lighting capabilities of solar radiation heavily informed the design and layout of the facility. In order to take advantage of the sun's heat, energy and lighting capabilities, the southern facade was composed of a large shell shaped glazing system that fanned outwards from east to west in order to maximize the solar exposure of the site. Not only allowing the facade to utilize the sun's radiation for passive heating strategies and vegetation growth, photovoltaic cells were embedded within the glazing system in the form of transparent solar panels to retain and utilize solar energy for electricity. This not only served as a sustainable source of energy, the utilization of the transparent solar panels provided diffused lighting for the internal agricultural programs of the facility, creating safer growing environments for the vegetation. In the process of optimizing solar exposure, it was equally important to be able to control and mitigate solar radiation and excessive heat gain. Since most greenhouse facilities utilize opaque glass/plastic panels or semi-transparent facade systems to provide indirect, diffused lighting within the building, the design of the facade needed to diffuse the incoming solar radiation in a similar fashion to provide a controlled interior environment. Since the facility was to serve as a cultural and educational hub that provided sustainable food growing operations as well as therapeutic environments, maintaining clear views to the surrounding landscape was preferable in order to achieve beautiful vistas. To achieve this, a large wood slat facade system was incorporated onto the exterior of the southern facade, providing an exterior trellised walkway that offered tranquil environments within the exterior and interior spaces of the building. The structural facade system would not only serve as a mediator between the interior and exterior growing operations, the architectural style of the facade pays homage to the layouts of traditional Haudenosaunee villages in which wooden palisades encircled the villages. The palisades acted as a protective barrier against weather and wildlife, serving as a mediator between the exterior and interior environments of the village and the exterior agricultural fields and harvesting grounds. For graphical

Figure 56: Infrastructural Phasing Diagram

With the Land Based Learning Center serving as the programmatic anchor of the three architectures, the intent is that the other two accompanying facilities of a Transitional Housing Center and an Elderly Care Facility will be phased in over time as the site gains more recognition.

- Transitional Housing Facility
- Elderly Care Facility

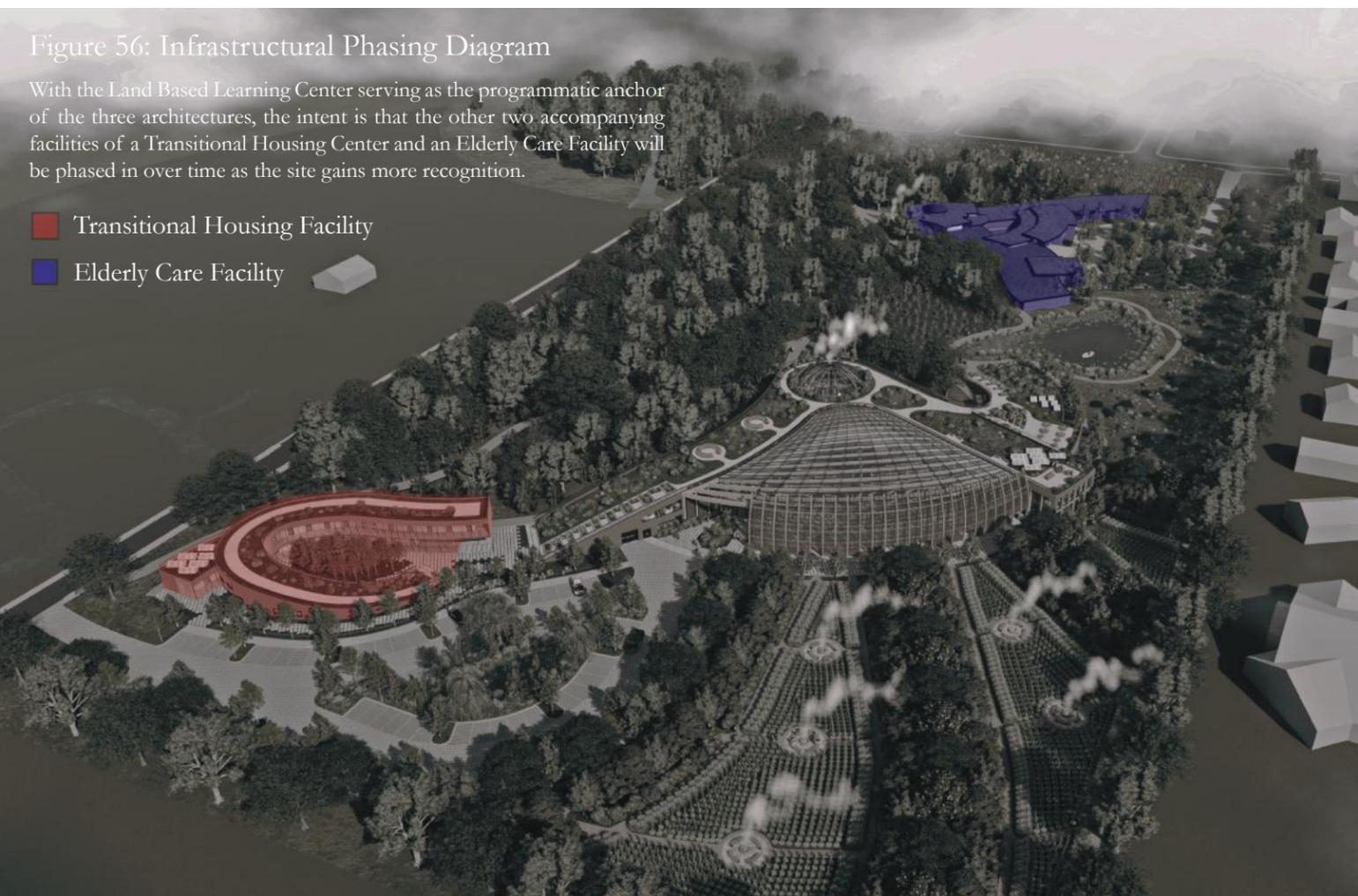




Figure 57: Render produced by author of the entrance of the Land Based Learning Center that demonstrates the integration of the structural wood slat shading system along the southern glazing facade.

clarity on the design and incorporation of the shading facade and glazing system within the southern facade and greenhouse design, refer to figure 57. For further clarification on the sustainable system integration of the glazing system, transparent solar panels and the shading facade, refer back to Chapter 5: Regenerative Design under the regenerative category **Solar Energy**.

LAND BASED LEARNING

Another essential key to the facilities design was to try and blur the lines between the natural environment and the built environment, in which the facilities programming extends into the surrounding landscape. In this manner, the facility not only provides educational programs within the building surrounding the preservation and application of traditional knowledge, it also echoes these teachings and values throughout the site's landscape. In which the landscape personifies how HEK can inform sustainable land management and development strategies while also showcasing traditional skill sets of harvesting and cultivating the land. In doing so, the landscape serves as educational and therapeutic gardens that allow members/visitors to learn from nature and the curated landscape through hands on applications, actively rekindling and reinforcing traditional teachings in a contemporary context. In addition to this, the site itself will also personifies a reinterpreted



Ohsweken built environment, demonstrating how HEK can inform sustainable land management and development strategies for their implementation throughout the reserve, educating and communicating regenerative design strategies to the community through their interactions with the site.

Not only is the surrounding landscape intended to accommodate agricultural lands and natural landscape preservations, the site accommodates the availability for public walking trails and public lands for the community to enjoy for both recreational and educational purposes. Traditional teachings and practices surrounding medicinal plants, horticultural and harvesting practices, and living with the cycles of the land will resonate throughout the landscape. This would advocate for healthier lifestyle practices through the consumption of culturally appropriate foods and rekindled connections with Mother Earth. For graphical clarification of how the programming of the facility is echoed throughout the sites landscape design of the agricultural lands, the riparian buffer, parking gardens, remediated landscapes, walking trails and recreational parks, refer to figure 58.

BUILDING PROGRAMMATIC LAYOUT

The programmatic design of the facility radiates outward from the internal courtyard serving as the central component of the facility as represented in Figure 59 on page 166 and 167. The therapeutic and medicinal gardens forming the internal courtyard serve as an extension to the educational programming of the facility, where the garden itself serves as a physical manifestation of how the Haudenosaunee live with the cycles of the land through their Cycles of Ceremonies and Harvests that are performed throughout the year following the seasons and lunar cycles. The garden loosely represents the lunar cycles around its perimeter by depicting the 13 new moons that occur throughout the year in the form of 13 circular walkway entrances that are constructed out of stone interlocking. Each of the pathway entries lead into 13 individual walkways that meander throughout the garden. Three small circles separate each of the 13 new moons, or paved walkway entries, representing the moons transformations between every new moon consisting of the first quarter moon, full moon and last quarter moon. These small series of circles have been depicted through white and black stones

Site Plan

Scale: 1/3500

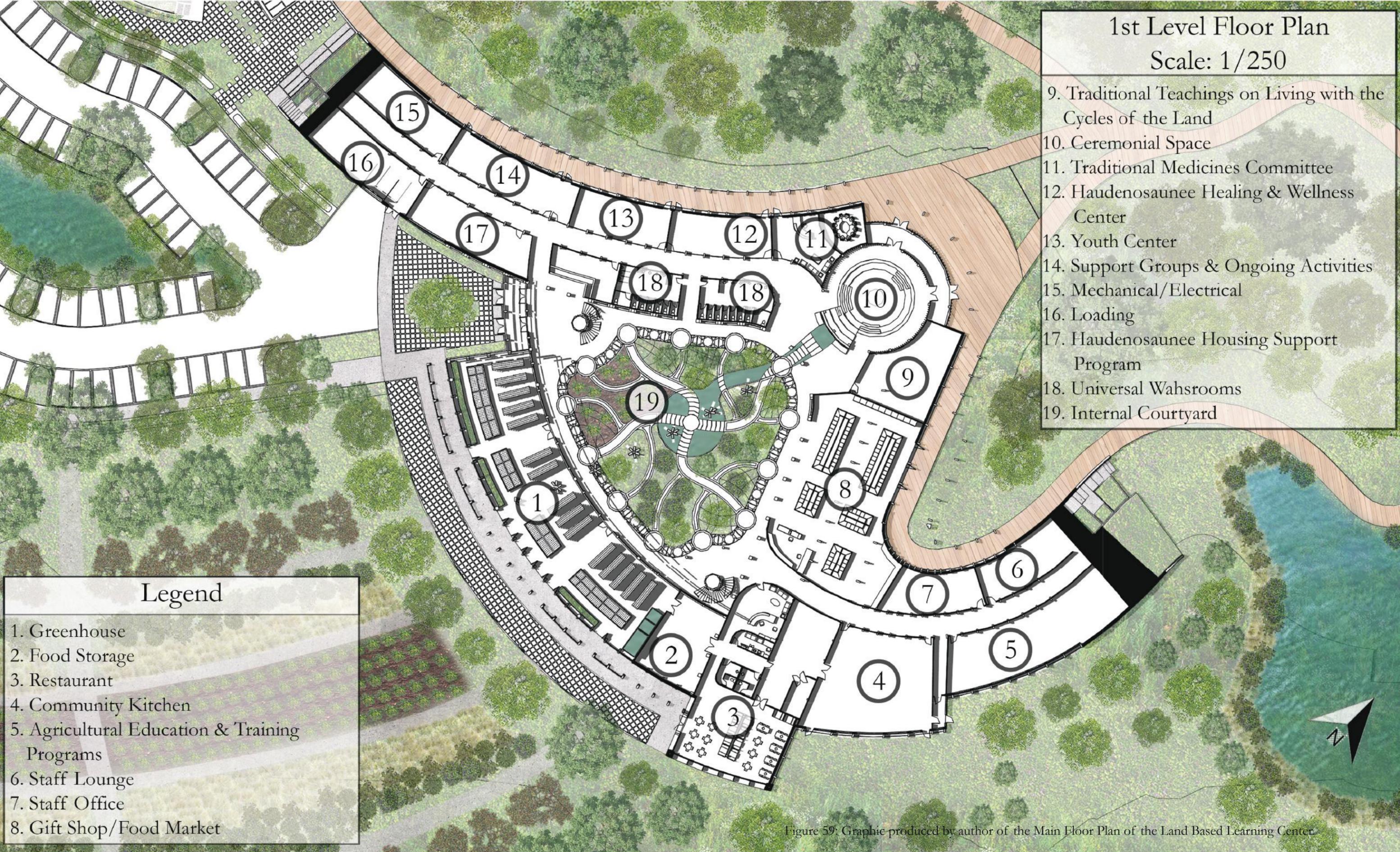


Figure 58: Site plan produced by author illustrating McKenzie Creek in relation to the site design while to demonstrating how the facility is contextualized within its surrounding environment.



(gravel) as well as growing medium. The overall garden has then been divided into four sections through four main walking paths, dividing the garden into four growing regions that are to represent the four seasons of the year. It is intended that specific medicinal herbs, plants, trees and crops will be grown in these quadrants that specifically relate to the four seasons and their associated ceremonies. For additional clarity or recollection surrounding the Cycles of Ceremonies and Harvests that are understood by the Haudenosaunee and performed throughout the year following the seasons and the lunar cycles, refer to Chapter 3: Haudenosaunee Ecological Knowledge section 3.4 Cycle of Ceremonies and Harvests.

Another integral component to the courtyard design is the fish pond that intersects the walkways and vegetated regions of the garden. The introduction of the fish pond provides the community with first hand interactions and experiences of the larger harvesting systems that are utilized on site and in the facility in the form of aquaponics and aquaculture. This would not only serve as an educational component to the facility but the sound of running and falling water has profound therapeutic effects which would add to the therapeutic qualities of the space. The inflow of water into the pond is directed by a water wall and supported green walls which form sound and privacy barriers for the ceremonial space. The intent of the internal courtyard is to serve as an interactive educational component of the facility that supports and reinforces the teachings offered throughout the facility. In doing so, the courtyard will serve as educational and therapeutic gardens that rekindle and reinforce these teachings in a contemporary context through first hand experiences and engagements with their applications, allowing members to learn from nature through hands on interactions. For graphical clarity of the design of the internal courtyard and the layout of the therapeutic and medicinal gardens, refer to Figure 60, 61 and 62.



1st Level Floor Plan

Scale: 1/250

- 9. Traditional Teachings on Living with the Cycles of the Land
- 10. Ceremonial Space
- 11. Traditional Medicines Committee
- 12. Haudenosaunee Healing & Wellness Center
- 13. Youth Center
- 14. Support Groups & Ongoing Activities
- 15. Mechanical/Electrical
- 16. Loading
- 17. Haudenosaunee Housing Support Program
- 18. Universal Wahsrooms
- 19. Internal Courtyard

Legend

- 1. Greenhouse
- 2. Food Storage
- 3. Restaurant
- 4. Community Kitchen
- 5. Agricultural Education & Training Programs
- 6. Staff Lounge
- 7. Staff Office
- 8. Gift Shop/Food Market

Figure 59: Graphic produced by author of the Main Floor Plan of the Land Based Learning Center.

Figure 60: Graphic produced by author illustrating the internal courtyard design and layout of the therapeutic and medicinal gardens.



Perspective View
of the Winter Section

Perspective View
of the Fall Section

Figure 61: Graphic produced by author demonstrating how the internal gardens serve as a physical manifestation of how the Haudenosaunee live with the cycles of the land through their Cycles of Ceremonies and Harvests that are performed throughout the year following the seasons and lunar cycles.

The overall garden has then been divided into four sections through four main walking paths, dividing the garden into four growing regions that are to represent the four seasons of the year. It is intended that specific medicinal herbs, plants, trees and crops will be grown in these quadrants that specifically relate to the four seasons and their associated ceremonies.

Perspective View
of the Spring Section

Perspective View
of the Summer Section





Figure 62: Render produced by author of a perspective view of the internal courtyard design and the layout of the therapeutic and medicinal gardens. View looking south towards the greenhouse facility.



The intention of the internal courtyard wasn't just to serve as a botanical garden providing the community of Six Nations with year round access to therapeutic and educational gardens. The gardens contribute to the overall success and functionality of the greenhouse facility and exterior agricultural applications. Fruits, vegetables, seedlings and saplings are all intended to be grown and distributed from the internal courtyard, providing additional greenhouse operations. The internal courtyard would aid in the germination of seedlings and the transplanting of saplings. During winter months or spring preparation periods, seedlings and saplings grown in the greenhouse facility could be transplanted into the large soil based growing medium provided in the internal courtyard to help aid in their germination before they could then be transplanted into the exterior agricultural lands or distributed to community members and visitors through the on site Food Market. The seedlings and saplings of the plants could utilize the layout/design of the internal courtyard to inform when the plants are to be planted, seedlings to be germinated, and saplings to be transplanted and distributed in a manner that follows with the cycles of the land and corresponds to special occasions, holidays, harvests and ceremonies.

GREENHOUSE OPERATIONS

The sizing of the greenhouse facility, the internal courtyard and the corresponding programming that is intertwined with the overall functionality of the center was informed by two current greenhouse facilities operating on Six Nations reserve. The first one that was analyzed was Kayanase, an ecological restoration and native plant and seed business based on Six Nations Reserve. Roughly a six minute drive from the Ohsweken site is Kayanase's roughly 55,000 square foot greenhouse featuring a retractable roof.¹ Dedicated to improving the health of Mother Earth using science-based approaches and Traditional Ecological knowledge, Kayanase has been dedicated to restoring Mother Earth holistically through the collection of native seeds and the progression of a native seed library.² While offering a full range of services for ecological restoration that promote conservation of natural biodiversity and habitat protection.³ The second greenhouse facility that was analyzed was a currently operating community based social enterprise, 'Our Sustenance', which is a greenhouse facility that is supported by a number of community organizations.⁴ Only a six minute drive from

the Ohsweken Site, the 'Our Sustenance' is currently operating out of a 12,000 square foot facility, allowing them to produce more than 30 types of vegetables and fruits out of their greenhouse.⁵ The facility also holds a 'Garden Cafe' that utilizes healthy and nutritious fruits and vegetables grown on site to produce healthy and culturally appropriate meals, with the goal of educating the community on healthier meal plans. In addition to this, the site also has their own poultry farm and honey production through incorporating on site bee hives. The poultry farm can house up to 150 layer chickens which are able to produce 250 eggs a week that can either be incorporated in meals or sold to community members in the cafe.⁶ The honey collected in the bee hives are also sold in the cafe, where the bees help bring pollinators into Six Nations environment.

'Our Sustenance's' mission statement is to help the community restore its independence with nature and strive towards self-determination, self-sufficiency and food sovereignty.⁷ With the current Six Nations community advocating for food systems of sustainable production and equitable access - as informed through the 2019 Six Nations Community Plan - the desire and demand of implementing a new, larger greenhouse facility through a Land Based Learning Center seemed warranted to help achieve these goals. Utilizing 'Our Sustenance's' 12,000 square foot greenhouse facility and Kayanase's 55,000 square foot greenhouse facility as a size reference, the Thesis's proposed Land Based Learning Center utilizes 6,000 square feet of growing space within the greenhouses main floor and roughly 3,000 square feet of greenhouse space in the second floor, with the addition of a food storage room. In addition, the Center's internal courtyard occupies roughly 12,300 square feet, with roughly an additional 7,800 square feet of therapeutic and medicinal gardens dedicated to the second level of the facility. Overall, the Land Based Learning Center provides a rough total of 9,000 square feet of dedicated food production in the greenhouse facility and roughly 20,000 square feet of interior educational and therapeutic medicinal gardens that actively produce fruits and vegetables. The greenhouse growing applications consist of aquaponics and soil based farming as referenced and explained in Chapter 5: Regenerative Design under the regenerative category **Regenerative Food Production**. For graphical clarity on the design and layout of the greenhouse facility refer to Figure 63.





Similarly to that of ‘Our Sustenance’s’ greenhouse facility, the Thesis’s Land Based Learning Center will also recirculate the healthy and nutritious foods grown within the greenhouse facility, the internal courtyard and the second level gardens into an on site Restaurant, Community Kitchen and a Farmers Market. The Restaurant and Community Kitchen will work in tandem with one another to produce affordable, healthy and culturally appropriate meals for the community of Six Nations while educating members of healthier meal plans and the nutritional benefit of consuming traditional diets. The Community Kitchen will also provide home economics and food preparation and cooking classes where meals produced can either be distributed to the families taking the lessons or to the community through the Farmers Market and restaurant. Likewise to that of the ‘Our Sustenance’s’ greenhouse operations, the site development of Ohsweken utilizes free range chickens and honey bees into the overall success of the restaurant, community kitchen, farmers market, land based agricultural applications, as well as the overall environmental success of the site. As previously mentioned in Chapter 3: Haudenosaunee Ecological Knowledge (HEK) in section 3.2 Polyculture, the concept of Indigenous polyculture as understood through the symbiotic relationships formed in Three Sisters Garden can inform sustainable agricultural systems that are designed according to the general principles of natural ecosystems, forming agroecosystems. The agricultural lands that have been situated in the southern region of the site for maximum solar exposure will be composed of complex biodiversities to form agroecosystems that would remediate the landscape while providing enhancements to the physical and biological environment. Terrestrial animals such as chickens and honey bees form a critically important role in the agroecosystem serving as interactive components of the agricultural system. The honey harvested from the bee hives and the eggs produced by the free range chickens would be utilized in the Restaurant, Community Kitchen and Farmers Market for the production, consumption and distribution of nutritious and locally resourced meals and food. For more information and graphical clarity on the design of the agroecosystems and their implementation in the southern region of the site, refer to Chapter 5: Regenerative Design under the regenerative category [Regenerative Food Production](#).



Figure 63: Render produced by author illustrating a perspective of the greenhouse on the first floor of the Land Based Learning Center showcasing the aquaponic systems and the soil based agricultural systems being utilized.

The remaining programs offered throughout the main floor of the facility consisting of an Agricultural Education and Training Program, Traditional Teachings on Living with the Cycles of the Land, Traditional Medicines Committee, Haudenosaunee Healing and Wellness Center, Youth Center, Support Groups and Ongoing Activities, and a Haudenosaunee Housing Support Program, would all collectively work towards enriching the curation, preservation, reconciliation and revitalization of traditional Haudenosaunee knowledge and practices while informing and educating the community of their intended applications in Six Nations reserve in a contemporary context. In providing accommodations for Haudenosaunee elders and knowledge keepers surrounding these programs, opportunities would arise for the sharing of knowledge that would guide and inform the manner in which HEK can inform sustainable land management and sustainable development strategies, while reaffirming traditional values and skill sets of harvesting and cultivating the land in a manner that is conducive to the current conditions of Six Nations reserve. Based on the emotionally sensitive nature of several of these programs, they have been situated along the periphery of the building affronting the remediated landscape of the riparian buffer. This allowed for more intimate, private and secluded settings that would be best suited for



their implementation while allowing them to have the capability of extending their teachings and therapeutic programming throughout the facility or into the riparian buffer and extended landscaping.

In addition to the programming offered on the main floor, the social, educational and therapeutic programming offered throughout the facility surrounding the preservation and application of Traditional Ecological Knowledge (TEK) in a contemporary context is echoed into the programming on the second level of the building. These programs consist of a second level greenhouse facility, a Regenerative Building and Design Resource Center, a Haudenosaunee Seed Library, Traditional Language Preservation and a Library Resource Center with accompanying offices, conference rooms and rentable space/event space. These programs collectively work towards enriching the curation, preservation, reconciliation and revitalization of traditional Haudenosaunee knowledge and practices in a contemporary context. While also providing consultation services to home owners, builders, and developers both on and off the reserve as well as Six Nations Council on how traditional teachings and HEK can be reinforced in a contemporary context to inform sustainable land management and regenerative development strategies. In addition, the therapeutic and medicinal gardens offered in the interior courtyard are intended to extend onto the perimeter of the second floor, overlooking the main floor, to provide more secluded and intimate settings that would work in tandem with the nature of the educational and therapeutic programming throughout the second floor and main floor. Overall, the center provides visitors and community members a diversity of social, educational and therapeutic programs and unique environments that promote cross pollination of traditional teachings and engagements through several departments and committees throughout the facility. For more information and graphical clarification on the layout and design of the second level of the Land Based Learning Center refer to figure 64.

Furthering this notion of multipurpose programmable spaces that privilege the sharing of knowledge, stories, traditions and teachings while providing more intimate and private settings, the ceremonial space serves as the cultural anchor of the facility. The space has been strategically designed to be nestled within

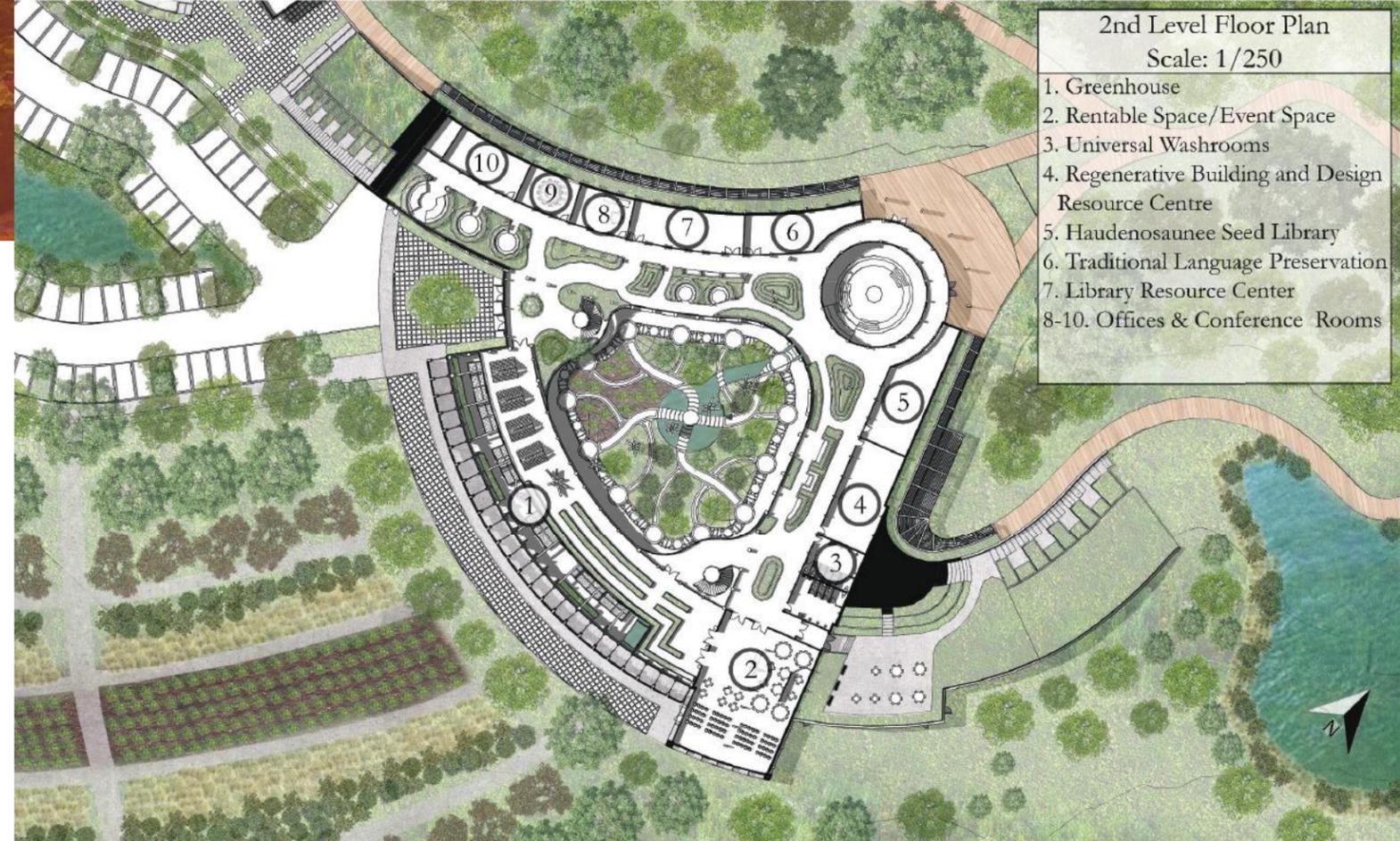


Figure 64: Second floor plan of the Land Based Learning Facility produced by author.

a crevice of the riparian buffer boundary to provide a more intimate and stand alone space that provided the opportunity of extending its teachings into the remediated landscape. The intent is that the ceremonial space would serve as a meeting place for knowledge carriers to provide a cross-pollination of knowledge and engagements around several departments and committees. The ceremonial space consists of a circular amphitheater surrounding a central gathering space with a concealed fireplace that prioritizes the notion of inclusivity and equality through the sharing of knowledge, restricting any form of hierarchy. The space is open to the second level providing a double height space with a large glass domed skylight to provide an open atmosphere with lots of natural sunlight. This also provides viewing opportunities from the second floor to overlook the ceremonial space and partake in the cultural, educational and communal events taking place. The interior and exterior walls bordering the circular space are constructed out of large glass panels that provide a feeling of transparency into the surrounding landscape and bordering offices. Large wood slat facade systems are then positioned along the interior and exterior walls to portray the feeling of being submerged within a treed area while providing privacy from the exterior landscape and surrounding offices. For graphical clarity of the design and layout of the space refer Figure 65.



One of the main reasons that the ceremonial space was positioned in the corner of the riparian buffer zone was to provide the space with the ability to extend its events, ceremonies, education, teachings and gatherings back into the facilities therapeutic and educational gardens and surrounding programs offered on both levels, or to extend into the surrounding landscape. With that being said, the roof overhangs the exterior facade of the ceremonial space affording the riparian zone providing a covered patio to allow for program extension. Within the covered patio region is an extended ceremonial space with additional cascaded circular seating surrounding an exterior fireplace to allow for larger gatherings and events for exterior program extension. In addition, several boardwalks that permeate throughout the site and remediated landscape also converge at this point, providing program extensions into the tranquil environments of the remediated lands and the rest of the curated landscape. Refer to figure 66 for an exterior view of the ceremonial space from the boardwalks located within the forested region of the riparian buffer.

Figure 65: Render produced by author illustrating a perspective of the ceremonial space.



ROOFTOP ECOLOGIES

To further this notion of extending the facilities programming into the surrounding landscape, the teachings and values consolidated through the programming of the center is intended to be echoed throughout the rooftop design. Intensive brown roofs are to be integrated into the infrastructural design of the facility which will serve as a key component to the overall success of the regenerative development. The intensive green roof will consist of native grasses and shrubs, providing several ecological benefits such as replacing the natural biodiversity and hydrological processes of the land that the infrastructural developments would be displacing.⁸ The green roofs will also serve as a garden ecology, providing the opportunity to support communal park space and public gardens, while having the potential of yielding fruits and vegetables. Overall, the vegetated roof will personify how HEK can inform sustainable land management and development strategies while also showcasing traditional skill sets of harvesting and cultivating the land. In this manner, the rooftop serves as educational and therapeutic gardens that allow members/visitors to learn from nature and the curated rooftop ecology through hands on applications, actively rekindling and reinforcing traditional teachings in a contemporary context. For more information on the critical roles that vegetated roofs play in the overall design on the regenerative development, refer to Chapter 5: Regenerative Design under the regenerative category Hydrological Cycle category under the subcategory 3. Green Roofs. For graphical clarification of the design of the rooftop ecology, refer to figure 67.

STRUCTURAL DESIGN AND MATERIALITY

Another integral component to regenerative design that plays an overall significance towards designing a facility that performs reciprocally and sustainably with the land, while furthering the notion of controlling energy flows, is regarding the concept of embedded energy. All material utilized in buildings and construction processes require energy in its manufacturing, shaping, treating, and shipping.⁹ The general rule of thumb is that materials drawn from natural resources require less processing and are usually less energy-intensive, especially if the materials are locally resourced. The other aspect to consider is whether the materials are renewable or non-renewable. When considering regenerative design, energy is to be



Figure 66: Render produced by author illustrating an exterior perspective of the ceremonial space from the boardwalks intersecting the riparian buffer.

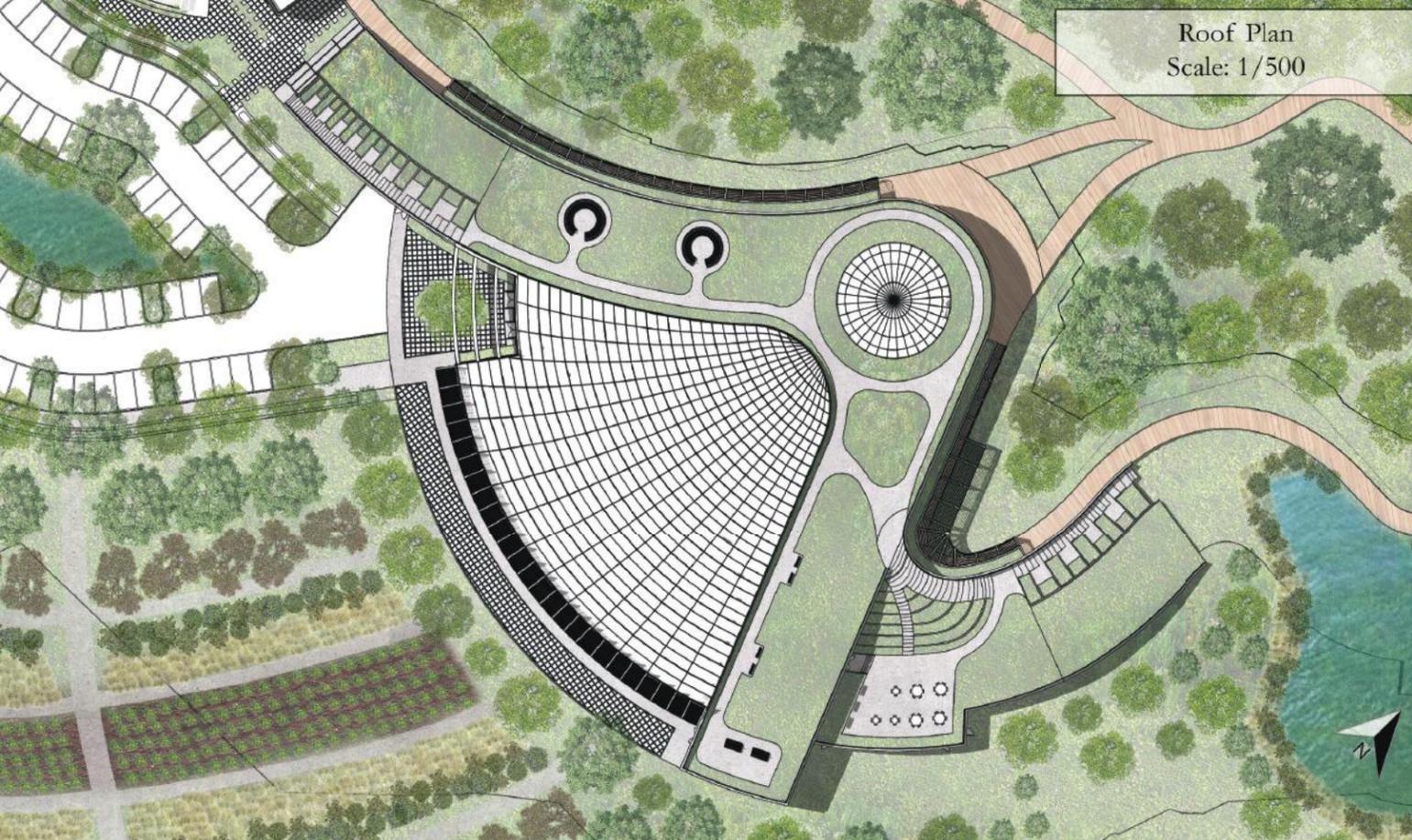


Figure 67: Roof plan produced by author illustrating the design of the rooftop ecology forming the vegetated roof.

recirculated and recycled, and these principles should be carried through the selection of a buildings materiality. In this manner, the embodied energy of the materials can be recirculated into another useful capacity at a later date, providing an architecture that is not only regenerative in its functionality but composition as well.

For this reason, the architectures in the proposed development on the Ohsweken site are to be composed of natural materiality both in their structure as well as their facades as much as possible. Furthermore, the structure of the Land Based Learning Center consists of prefabricated glulam beams and columns that support CLT (Cross Laminated Timber) floor plates with concrete toppings and CLT roof plates that support vegetated roof systems. Exterior walls consist of standard 2 x 6" wood stud assemblies with exterior cedar cladding, where interior walls consist of standard 2 x 6" wood stud assemblies with gypsum wall finishes. Furthering this notion of natural materiality for exterior cladding, Elm tree bark is being proposed as exterior wall cladding around the ceremonial space of the Land Based Learning Center, reinforcing traditional knowledge of building systems utilized in Longhouse construction in a contemporary context. Additionally, the structural wood systems utilized within the internal courtyard space and greenhouse facility consist of custom glulam structures that have been designed



to resemble the shape of trees. The structural glulam columns have been designed to portray tree canopies, spreading out the load of the large glazing system and the supporting glulam beam structure through a fanning/weaving of glulam beams. The intent is that the organic design of the structure would provide unique shading opportunities that would portray the atmospheric qualities of being submerged underneath a forest canopy. With the integration of trees, agriculture and additional vegetation within these spaces, these atmospheric qualities will be heightened with the intention of creating beautiful, therapeutic and unique internal environments for the enjoyment of the community and visitors within the botanical gardens. For further graphical clarification of the custom glulam column structure and the unique atmospheric qualities achieved within the internal courtyard, refer to figure 68.

To conclude, the Land Based Learning Center serves as a cultural and educational hub that operates both locally as well as across North America, serving as an outreach center for Six Nations community members, both on and off reserve as well as North American Indigenous people and enlightened mainstream individuals. The Center provides social, educational, and therapeutic programming that actively preserves and rekindles Six Nations connections with traditional values, teachings and ceremonies surrounding ecological knowledge and skill sets of harvesting and cultivating the land, while reinforcing the significance of traditional knowledge in a contemporary context. In addition, the facility provides consultation services to home owners, builders, and developers both on and off the reserve as well as Six Nations Council on how traditional teachings and HEK can be reinforced in a contemporary context to inform sustainable land management and regenerative development strategies.

- 1 Kayanase. "Restoring Mother Earth." Website. Retrieved June 27, 2020.
- 2 Ibid.
- 3 Ibid.
- 4 Our Sustenance. Website. Retrieved December 19, 2018.
- 5 Ibid.
- 6 Ibid.
- 7 Ibid.
- 8 Lyle, John Tillman. Regenerative Design for Sustainable Development. Pg 115-116.
- 9 Ibid. Pg 119.



Figure 68: Render produced by author showcasing a perspective of the internal courtyard.

Render showcases the custom design of the glulam structural columns that have been designed to portray trees to convey the feeling of being immersed under a forest canopy.



Chapter 9 | Conclusion and Next Steps Forward

9.1 CONCLUSION

To distill this document, this Thesis has demonstrated how Haudenosaunee Ecological Knowledge (HEK) and the fundamental instructions provided through Haudenosaunee culture and tradition can be utilized as a moral compass to guide and enhance the application of modern sciences and technologies to offer enormous design potential. Where HEK and TEK have informed regenerative systems of sustainable design for their intended application on Six Nations of the Grand River Reserve. With the proposed development engaging with a privately owned parcel of land located in Ohsweken, the project has demonstrated how the defined four regenerative categories consisting of the Hydrological Cycle, Solar Energy, Food Production, and Waste Management with their corresponding design strategies, can be implemented within Six Nations reserve. The architectural methodology as defined in the Thesis is intended to be utilized as an informative guide towards land remediation and communal land reclamation efforts throughout the reserve, instilling institutions, developers and community members located on Six Nations reserve to question the concept of *land ownership*. The architectural vehicle for the exploration of employing the architectural methodology has been through the development of a Land Based Learning Center with accompanying housing facilities of a Transitional Housing Center and an Elderly Care Facility on the Ohsweken site. The intent of the Thesis is that the methodology and specifically Chapter 5: Regenerative Design can begin to inform how lands can and should be developed throughout Six Nations reserve, reinterpreting the colonialist impositions facing the built environment and retrofitting the reserve through a Haudenosaunee perspective. With chapter 5 of this Thesis serving as an educational handbook that could be utilized as a community tool to inform Six Nations home owners, builders, and developers on how these sustainable land management and architectural development strategies can be implemented throughout the reserve, forming reciprocal relations with Mother Earth.

The hope is that the project can serve as a catalyst for sustainable interventions, blossoming design strategies throughout the reserve that works towards diminishing the hyper-individualistic ownership of property facing Six Nations by restitching communal lands back into the social fabric of the reserve. This is being speculatively proposed through utilizing McKenzie Creek as the



architectural vehicle for land remediation and reclamation efforts throughout the reserve. As demonstrated within the proposed development on the Ohsweken site, a riparian buffer was established from McKenzie Creeks shoreline to preserve the natural infiltration region of the creek through methods of ecological remediation and preservation. Not only would this improve upon environmental and biological conditions of the site, it would reclaim nature preserves and communal lands from privately owned property. In this manner, the hope is that the project can serve as a catalyst for sustainable interventions, blossoming design strategies throughout the reserve

that works towards diminishing the hyper-individualistic ownership of property facing Six Nations by restitching communal lands back into the social fabric of the reserve by establishing riparian buffers from McKenzie Creeks shoreline as represented in figure 69. Furthermore, the proposed boardwalk that permeates the established riparian buffer on the Ohsweken site could hypothetically serve as a program extension of the Land Based Learning Center throughout the reserve, where the communal walking trails could extend throughout the reclaimed riparian buffers along McKenzie Creek as represented in figure 70. In this manner, these reclaimed lands could serve as an extension of the educational and therapeutic landscape that has been speculatively established on the Ohsweken site. In time, these concepts and ecological perspectives could not only instill pride back into the community as identifying as stewards of the land, Six Nations could serve as world class leaders in ecological remediation/preservation and self-determination. Eventually informing broader society of these ecological perspectives by reclaiming treaty lands through ecological remediation and preservation efforts throughout the Grand River watershed region as illustrated in figure 71.

Figure 70: Graphic produced by author illustrating how the boardwalk permeating the Ohsweken site could serve as a program extension of the Land Based Learning Center throughout reclaimed riparian buffers along McKenzie Creek.



Figure 69: Graphic produced by author illustrating how communal lands can be restitched back into the social fabric of Six Nations reserve through ecological remediation and preservation efforts along McKenzie Creeks shoreline by establishing riparian buffers.



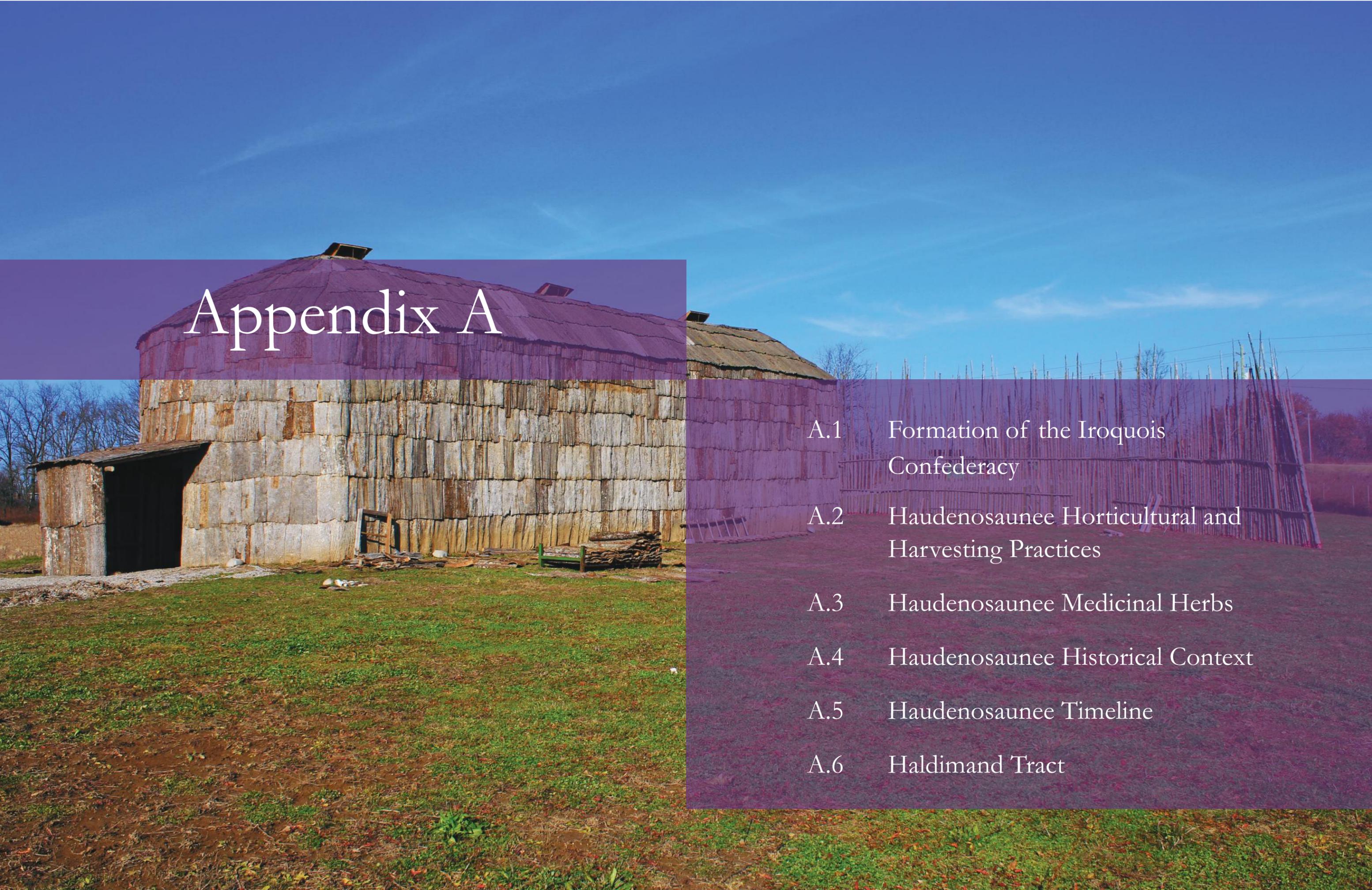


Figure 71: Graphic produced by author illustrating how these ecological perspectives could extend beyond the reserve by reclaiming treaty lands through ecological remediation and preservation efforts throughout the Grand River watershed region, informing broader society of sustainable land management and development strategies.

9.2 NEXT STEPS FORWARD

This Thesis project not only advocated for establishing holistic architectural models for sustainable land management and development strategies, the project seeks to reaffirm the significance of developing communities to be self-sufficient and resilient. As mentioned in the document, throughout history Haudenosaunee communities have had profound understandings of the natural environment and how to work with the land sustainably and reciprocally. Henceforth, traditional Haudenosaunee villages were strategically designed to perform sustainably and reciprocally with the land in a manner that allowed them to achieve self-sustainability. With my architectural academic year and thus my Thesis project being interrupted with the Covid-19 pandemic, where communities were swiftly overrun by the infectious disease resulting in panic buying, depleting shelves and store inventory, the significance of food security and self-sufficiency couldn't be more apparent. By looking towards Indigenous communities for ecological and moral insight into how to develop and manage lands reciprocally, modern environments and communities could begin to be developed in a manner that achieves self-sufficiency. As demonstrated in this Thesis, HEK and the fundamental instructions provided through Haudenosaunee culture and tradition can be utilized as a moral compass that can guide and enhance the application of modern sciences and technologies to inform regenerative design strategies for their intended application on Six Nations of the Grand River Reserve. In doing so, new community developments or retrofits can be conceived that maintain reciprocal relationships with the surrounding ecology of Six Nations while developing infrastructures that empower the local community and promote self-determination.

As I embark my Architectural Internship with the architecture firm Two Row Architect located on Six Nations reserve, I hope that this research and my architectural interests of designing regenerative developments that perform reciprocally with the land will translate themselves into future architectural endeavors. Ideally, the research and time dedicated to this proposed project will extend further than the pursuit of academia alone and translate itself into real world applications. Here I hope that Six Nations community members can benefit from the information and the provocative ideas provided within this document to allow them to begin retrofitting the reserve in a manner that aligns with the communities needs, vision and values.



Appendix A

- A.1 Formation of the Iroquois Confederacy
- A.2 Haudenosaunee Horticultural and Harvesting Practices
- A.3 Haudenosaunee Medicinal Herbs
- A.4 Haudenosaunee Historical Context
- A.5 Haudenosaunee Timeline
- A.6 Haldimand Tract

A.1 FORMATION OF THE IROQUOIS CONFEDERACY

To symbolize the unity of the five nations, it is stated that the Peacemaker chose a white pine tree to be planted in Onondaga territory known as the ‘Tree of Peace’ as its pine needles always grow in clusters of five.¹ He then instructed the leaders of the original five nations to bury their weapons of war beneath the tree, signifying peace amongst the nations.² The leaders were then directed to take shelter beneath the branches of the tree of peace where the Peacemaker set forth a method for the Haudenosaunee to conduct meetings concerning decisions. A council fire was ignited below the tree setting forth where the nation leaders were to meet in Onondaga territory to discuss issues concerning the confederacy.³ The Peacemaker then appointed a governance system, in which an entrusted committee of eight to fourteen members were selected from each of the five nations.⁴ Comprising a governance system of 50 supreme chiefs or peace chiefs (sachems) that collectively represented each nation and their respective clans. Complex political structures were formulated from which unanimous decisions were required amongst all the chiefs for the approval of decisions. The Great Law of Peace was intended to extend beyond the unity of the five Iroquois nations, in which the symbology of the Tree of Peace personifies. The roots of the tree known as the Great White Roots stretched out in four directions reaching north, south, east and west. The Peacemaker stated that anyone was able to follow the Great White Roots to seek haven underneath the shade of the tree of peace as long as they were to abide to the Great Law of Peace.⁵

As previously mentioned in chapter 2, the Peacemaker is also said to have utilized the symbolism of the ‘Longhouse’ in the construction of the belt.⁶ Utilizing the Iroquois vernacular and its pertaining social structures that stipulated Iroquois society to be metaphorically personified through the formation of the League of Nations.⁷ The united settlements of the original five nations forming the Iroquois League were contextually framed through the imagining of an invisible Longhouse that stretched across the original Iroquois League territory. Stretching across New York State starting from the approximate current day location of Albany, extending to what is now Rochester, continuing through the finger lakes, with the ends of the Longhouse being conceptually occupied by the Mohawks at the east and the Seneca’s at the West.⁸ The Peacemaker named the

The Six Nations of the Iroquois Confederacy

HAUDENOSAUNEE

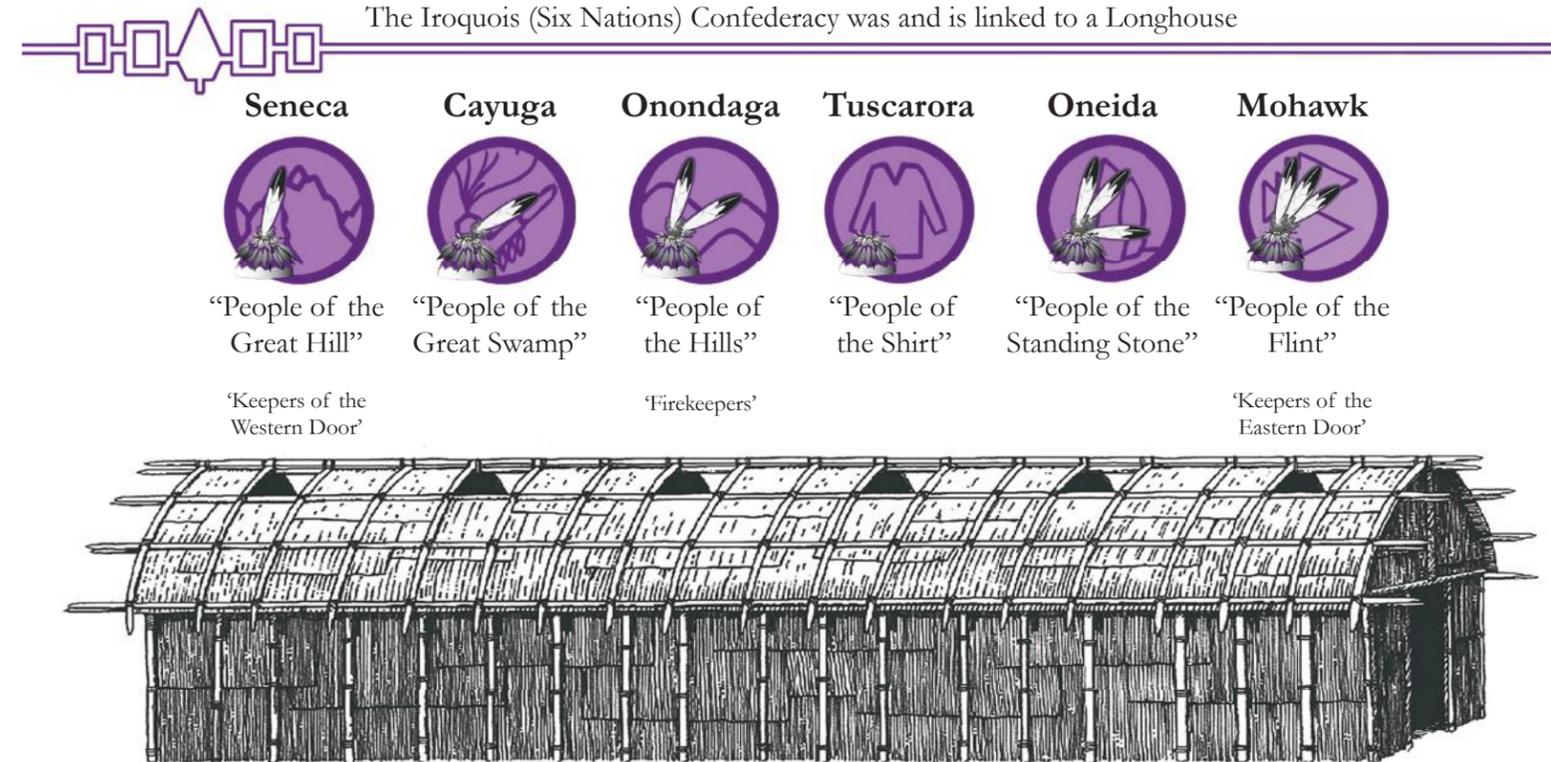


Figure 72: Diagram produced by author illustrating how the Iroquois (Six Nations) Confederacy was and is linked to a Longhouse.

Seneca Nation to the west, the ‘Western Door Keepers,’ and to the east, he named the Mohawk Nation the ‘Keepers of the Eastern Door,’ from which he named the Onondagas, the ‘Firekeepers.’⁹ The intent of the metaphysical Longhouse metaphorically uniting the League of nations was perceived as a Lodge to which several families were to live. As the families grew through the unification of other nations, the Longhouse would extend from east to west, from where the sun rises in the east and to where the sun sets in the west.¹⁰ The Iroquois League being contextually framed through the imagining of an invisible Longhouse while the confederacy being personified through the social and political structures of the Iroquois vernacular as represented through the Hiawatha belt is illustrated in figure 72.

The political structures and governance systems of the Haudenosaunee that were generated through the formation of the Confederacy and the fundamental instructions/teachings provided through the unification of the 5 nations as metaphorically represented in the symbolism of the Great Tree of Peace were finely

depicted in the Hiawatha belt. The center symbol of the wampum belt is that of a white beaded tree representing Onondaga, serving as the heart of the belt, from which a continuous white beaded line extends on either side connecting two white beaded squares situated on either side of the tree. The symbol of the tree signifies the Tree of Peace, demonstrating that the Great Law of Peace is situated within the heart of Five Nations, geographically and metaphysically, from which the council fire is to burn at the center in Onondaga, serving as the capital of the Haudenosaunee, while representing that the loyalty to the Great Law of Peace is in the hearts of all Iroquois League members.¹¹ The first white square on the far left represents the Seneca Nation, where the inner square on the left closest to the heart represents the Cayuga Nation.¹² The white square farthest to the right represents the Mohawk Nation, where the inner square to the right closest to the heart represents the Oneida Nation.¹³ The white beaded line that connects all the symbols together not only symbolically represents the unification of the Five Nations to the heart of the Great Law of Peace, but extends from each side of the squares – from the Seneca and Mohawk Nations – representing a path of peace that other nations are welcome to travel, joining the Iroquois Confederacy and taking shelter underneath the Great Tree of Peace.¹⁴

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- 1 “Haudenosaunee (Iroquois).” Haudenosaunee (Iroquois) | The Canadian Encyclopedia.
 - 2 “Symbols.” Haudenosaunee Confederacy, October 4, 2019.
 - 3 “Hiawatha Belt.” Onondaga Nation, June 24, 2014.
 - 4 Ibid.
 - 5 Britannica, The Editors of Encyclopædia. “Iroquois Confederacy.” Encyclopædia Britannica.
 - 6 Ibid.
 - 7 “Hiawatha Belt.” Onondaga Nation, June 24, 2014.
 - 8 Ibid.
 - 9 “Hiawatha Belt.” Onondaga Nation, June 24, 2014.
 - 10 YouTube. The People of the Longhouse. Film.
 - 11 “Wampum.” Haudenosaunee Confederacy, April 17, 2018.
 - 12 Ibid.
 - 13 “The Iroquois Flag.” Iroquois Nationals Lacrosse, December 10, 2015.
 - 14 Ibid.

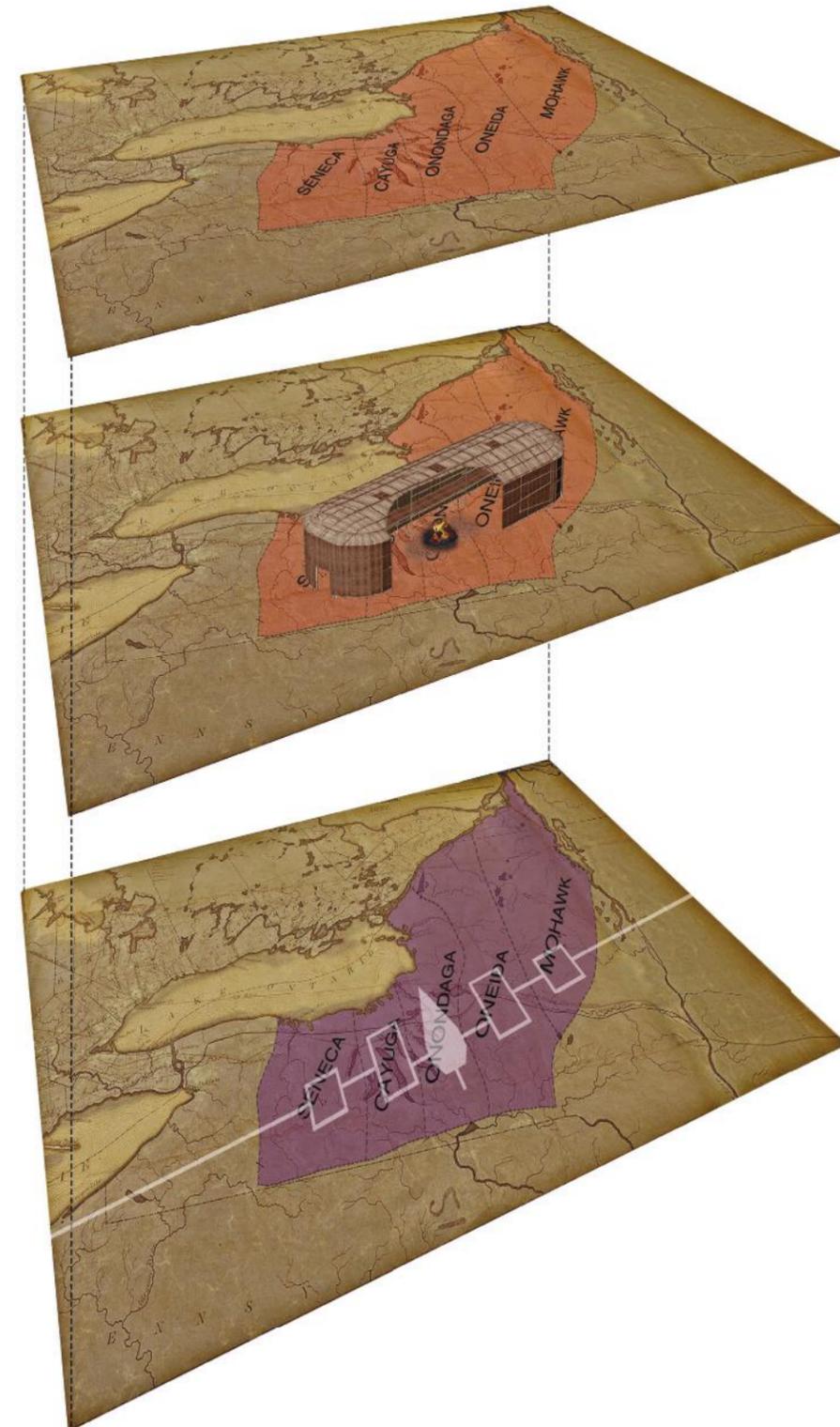


Figure 73: Graphic produced by author illustrating how the confederation was metaphorically linked to the Longhouse while demonstrating how the Hiawatha Belt was geographically linked to the original five nations.



A.2 HAUDENOSAUNEE HORTICULTURAL AND HARVESTING PRACTICES

In addition to the polyculture of corn, squash and beans, the Haudenosaunee's profound understandings of the biological capabilities of native plant species extended further than that of the Three Sisters Garden. Refining traditional medicines that recognized the medicinal and healing properties of specific plants, herbs, and berries, recognizing which natural medicines would alleviate certain illnesses. Unlike western medicines which are primarily meant to heal the physical attributes of the body, traditional medicines provided a more holistic approach to wellness. Seeking long term treatments through full restoration and healing of the body, mind and spirit. Skilled in the use and practice of medicinal remedies, Haudenosaunee healers had several methods and practices to cure the sick and care for the injured. Believing that sicknesses were brought on through spiritual causes as much as natural, the Haudenosaunee employed dances, ceremonies, sacred instruments, secret societies and medicine societies that were associated with their natural medicines. The Haudenosaunee still utilize traditional medicines today in association with a series of ceremonies and dances that are performed throughout the year, celebrating the seasons.¹ The four main sacred medicines that are still utilized by the Haudenosaunee are Tobacco, Sage, Cedar, and Sweetgrass, although it is important to point out that the teachings and practices associated with these medicines vary from nation to nation.² For more information regarding the four main medicinal herbs, refer to Appendix A.3: Haudenosaunee Medicinal Herbs.

In addition to agricultural methods of food procurement, foods were often gathered from the forests by the men and women consisting of berries, mushrooms, roots, shoots, nuts and certain barks which were incorporated into soups. Specific nuts that were harvested consisted of hickory, walnut, butternut, hazelnut, beechnut,

chestnut and acorns.³ Another important process to Haudenosaunee agricultural practices was seed preparation in which seeds were often soaked in 'medicine' before they were to be planted.⁴ The medicines often consisted of *Phragmites communis* (common reed) or *Hystrix patula* (bottle brush grass) that were believed to aid in the germination of the seeds. The corn and seeds would be soaked with the medicines which served to be beneficial when planting on the elevated soil mounds.⁵ After sustained contact with Europeans, new crops were introduced to the Haudenosaunee which began being incorporated into their horticultural practices. These crop species consisted of sunflowers, artichokes, beets, carrots, peas, onions, turnips, cabbages, peaches and apples.⁶

Another aspect of Haudenosaunee lifestyle and harvesting practices was the sustainable practice of hunting and the harvesting of animals. Hunting was one of the main methods of food procurement for the Haudenosaunee which consisting of hunting, trapping and fishing practices throughout their traditional territory.⁷ Deer were the most sought after animal for hunting in which every aspect of the animal was utilized from its venison for consumption, its hides for clothing, and antler and bones for tools.⁸ Although, animals such as bear, beaver, rabbit, muskrat, squirrels, ducks, geese, partridge, owl, quail and woodcock were hunted and utilized for various foods, clothing and tools.⁹ In terms of trapping, snares were constructed out of hemp that was tied onto bent saplings which would recoil upwards and immobilize the animal.¹⁰ Fishing was also an integral aspect of traditional Haudenosaunee diets, where the Haudenosaunee would fish bass, trout, whitefish, sturgeon and perch out of the nearby lakes and rivers through the use of nets, spears¹¹ and stockade gates.¹² These fishing activities served as communal events that took place primarily during the fall and spring



spawning seasons. The Haudenosaunee had ceremonial practices to celebrate the plentiful catches, such as that of the Fish Dance as well as others, which were intended to give thanks to the Creator for the provisions.¹³ Although traditional hunting and fishing practices have nearly disappeared, the traditional ceremonies and dances that were based around hunting and harvesting are still utilized today where the Haudenosaunee will give thanks to the Creator.¹⁴

As previously mentioned, traditional hunting and fishing practices have nearly disappeared as a consequence of colonization, and with it, the traditional lifestyles of the Haudenosaunee. The Haudenosaunee, as well as many other Indigenous communities, were displaced off of traditional lands and forced to reside on allocated treaty lands serving as Indigenous reservations. These reservations confined Indigenous communities to segregated portions of land throughout North America, situating communities and cultures within different landscapes and environments that often weren't conducive to Indigenous traditional lifestyles and practices. Forcing the communities to adapt certain cultural practices and ways of life that were more conducive to their new settings. Six Nations of the Grand River Reserve was no exception, in which the poor soil composition consisting of the allocated treaty lands – consisting of mostly silts and clays¹⁵ – proved challenging to develop agricultural lands and carry over traditional horticultural practices. In addition, influence from settler migration forced lands to become unsuitable for hunting, harvesting or agricultural practices, forcing the Haudenosaunee to find alternate means of support. This resulted in Six Nations adapting their traditional diets, seeking sustenance from European food and beef production systems while surrendering lands to the Crown to raise funds for perpetual care and maintenance of their lands.¹⁶ Although, with that being said, since then, terrestrial and aquatic biological life

has rebound, allowing Six Nations members to actively pursue methods of self reliance and self-sufficiency through harvesting practices. According to Kerdo Deer, the ecotourism coordinator at Kayanase located on Six Nations Reserve, there are many Six Nations members that currently rely solely on natural resources for sustenance obtained through hunting and fishing, with the Grand River now having profound fishing. Hunting practices usually taking place off the reserve through means of controlled hunts, usually to obtain wild deer. Although, Kerdo spoke of an unspoken rule that is exercised throughout the Six Nations community, in which the deer located on the reserve are left for the youth as a means for them to refine their hunting practices. In any case, Kerdo stated that the community actively tries to recirculate foods harvested by means of hunting and fishing to the rest of the Six Nations community within the longhouses situated on the reserve.¹⁷

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- 1 “Medicine.” Haudenosaunee Confederacy, April 17, 2018.
 - 2 “The Medicines.” Our Sustenance, December 19, 2018.
 - 3 “Food And Hunting.” Haudenosaunee Confederacy, April 17, 2018.
 - 4 Ibid.
 - 5 Ibid.
 - 6 Ibid.
 - 7 “Food And Hunting.” Haudenosaunee Confederacy, April 17, 2018.
 - 8 Ibid.
 - 9 Ibid.
 - 10 Ibid.
 - 11 Ibid.
 - 12 “Fishing for Life.” Oneida Indian Nation, January 25, 2018.
 - 13 Ibid.
 - 14 Ibid.
 - 15 Feedback from meeting conducted with Six Nations Lands Rights Consultant, Phil Monture.
 - 16 “Six Miles Deep - Land Rights of the Six Nations of the Grand River,” Pg 5.
 - 17 Feedback from meeting conducted with ecotourism coordinator Kerdo Deer at Kayanase located on Six Nations Reserve.

A.3 HAUDENOSAUNEE MEDICINAL HERBS

As mentioned in Chapter 2: Haudenosaunee Horticultural and Harvesting Practices, the four main sacred medicines that are utilized by the Haudenosaunee are Tobacco, Sage, Cedar, and Sweetgrass. Aside from their medicinal properties, it is believed through Haudenosaunee tradition that these four medicines were given to Indigenous people as a means of communicating with the creator and the spirit world. With tobacco serving as the first plant to be received, followed by that of sage, cedar, and sweetgrass. Some traditions associate the medicines with the four directions, with tobacco being situated in the east, sage in the west, cedar in the north, and sweetgrass in the south. Although these associated directions differ from Indigenous communities and nations.¹ The following text will describe the unique cultural practices and planting techniques associated with each of the medicinal herbs as utilized by the Haudenosaunee.

Tobacco

The Haudenosaunee use Traditional Tobacco as a way to convey honesty and respect behind the words they speak and their actions towards people and the spirit world. Utilized in ceremonies, in prayer, when knowledge is shared, when a question is asked or a request is made, it is believed that tobacco will travel ahead of the words to convey honesty and respect behind their intentions.² It can also be gifted between individuals to serve as an ultimate form of respect. Traditionally, the Haudenosaunee had grown *Nicotiana Rustica* as the original form of tobacco, however, there are over ten plants that are related to Sacred Tobacco and are utilized in the same manner and considered to be as sacred. With that being said, commercialized tobacco that is mass produced and laced with chemicals is not made from traditional tobacco and is not considered to be sacred.³

When planting tobacco it is important to make sure organic growing methods are utilized and to seed the tobacco plants in a greenhouse due to their extremely small seeds. This can be done through use of hydroponics or aquaponics by utilizing a float

management system where seeds are planted in segmented floating trays on top of water. In addition to this, seeds can be grown through soil-based applications where they can be planted on the ground or in a grow bed.⁴ Figure 74 illustrates what Traditional Tobacco looks like as used by the Haudenosaunee.

Sage

Sage is often utilized amongst the Haudenosaunee and many other Indigenous communities for smudging, either in ceremonies, or to cleanse spaces and sacred items as it is believed to be a potent cleanser, releasing troubles from the mind and removing negative energies.⁵ Sage is also widely used for its medicinal properties having several applications, such as its use of healing wounds being an antiseptic. Containing several vitamins and minerals, it is very healthful and is viewed as a medicine that can cure all ills. Due to this, it is known to be beneficial for the kidneys, stomach, liver, spleen, and reproductive organs. Such beneficial vitamins and minerals contained in sage consist of: high amounts of potassium, calcium, Vitamin B1 and Zinc; moderate amounts of magnesium, iron, vitamin A and B, sodium and niacin; with small amounts of manganese, silicon, phosphorus, sulphur, sodium and vitamin C.⁶

When planting sage, avoid generating environments with high humidity while utilizing well drained soils to avoid the development of root rot which forms in wet soils. The herb also requires ample sunlight exposure as it is an upright perennial subshrub growing up to four feet tall and two feet wide.⁷ Refer to figure 75 for a representation of what sage looks like.

Cedar

Cedar trees are integral to North American ecosystems supporting a vast amount of biodiversity consisting of over 40 wildlife species, providing ample protection to animals year round underneath its coniferous canopy.⁸ Aside from its ecological attributes, cedar is culturally significant to the Haudenosaunee,

Figure 74: Photograph of Traditional Tobacco.



Figure 75: Photograph of Sacred Sage.

Figure 76: Photograph of Sacred Cedar.





Figure 77: Photograph of Braided Sweetgrass.

often being used to purify homes, as well as its branches being used in ceremonies as a form of protection and on the floors of sweet lodges. Cedar is also utilized for its valuable medicinal properties, in which cedar baths have proven to be useful for healing and cleansing purposes.

When planting cedar trees it is important to be mindful of the vast root systems inherent of trees that could cause damage to nearby infrastructures, while locating them outside of flood zones that are prone to consistent flooding. In addition, cedar trees should be located a minimum of three feet away from water's edge while being situated in well-drained soils in areas that receive adequate sunlight. Cedar seeds should be planted in 6-8 inch diameter wholes spaced a minimum of 5 feet apart while any grasses, ferns and weeds should be removed from the area before planting the seedlings as they will rob the plant of moisture, nutrients and sunlight.⁹ Refer to figure 76 for a representation of what Sacred Cedar looks like.

Sweetgrass

Sweetgrass is viewed by the Haudenosaunee as the sacred hair of Mother Earth with the herb having a sweet aroma that tends to remind individuals of the gentle love that Mother Earth provides. Being used for smudging, the aroma of sweetgrass has calming effects when utilized in healing circles, while often being used to represent teachings of kindness. Sweetgrass is also utilized in craft making where it is often braided. The plant, consisting of three to four blades, is split up into individual blades and braided together from which it is then dried as represented in figure 77. The sweetgrass braids can be dried either in the sun, or by joining multiple braids together into one string, spacing each braid roughly 1-foot apart, and then hanging the sweetgrass from the ceiling.¹⁰

Sweetgrass should be planted in rich, moist soil with full sun exposure, and should be planted in a manner that is mindful of

the plants horizontally growing root stems called rhizomes. Since sweetgrass is infertile, it should be planted from root plugs (a stem or two with sweetgrass frizzy rhizome) in shaded pots for a few weeks until new roots have developed before they can be transplanted into the garden with a minimum of 1-foot spacings between each plant.¹¹ Refer to figure 78 for a representation of what Sacred Sweetgrass looks like.

- 1 "The Medicines." Our Sustenance, December 19, 2018.
- 2 Ibid.
- 3 Ibid.
- 4 Ibid.
- 5 Ibid.
- 6 Ibid.
- 7 Ibid.
- 8 Ibid.
- 9 Ibid.
- 10 Ibid.
- 11 Ibid.



Figure 78: Photograph of Sacred Sweetgrass.

TIMELINE

Historical Evolution of the HAUDENOSAUNEE

CREATION 4000 BCE to 500-600 CE 1000 1497 1543 1570 1613 1600s 1628 1639 1640 1642 1646 1650 1651

PRECONTACT

Era Before European Contact

Archeological evidence places Haudenosaunee in their traditional territory, current-day New York state, approximately between the dates of 4000 BCE and that of 500-600 CE.¹

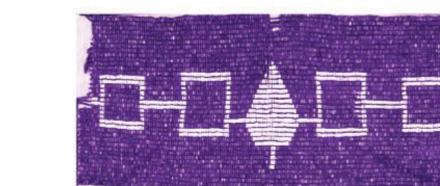
John Cabot's

European expeditions followed the Norse approaching northeastern America in the late 15th century with John Cabot's expeditions of 1497 serving as the first known voyage to mainland North America backed by hard evidence.³



It is stated that the first explorations of the Americas by Europeans was initiated by the Norse in the late 10th century along the East Coast of Canada.²

First Explorations

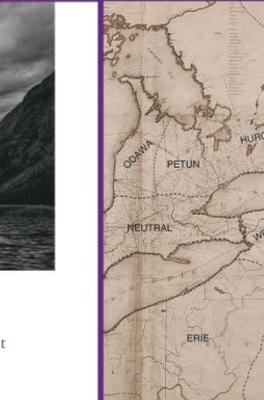
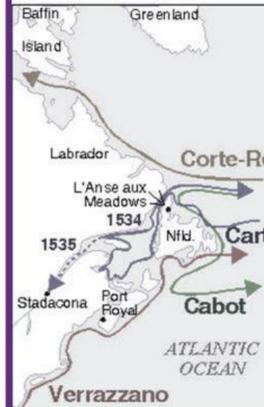


Formation of the Iroquois Confederacy

Jacques Cartier



Sustained European contact wasn't sustained until Jacques Cartier's exploration in 1543 which led to persistent explorations by the British and the French over the next three centuries,⁴ with the Dutch embarking on later explorations in the early 1600s.⁵

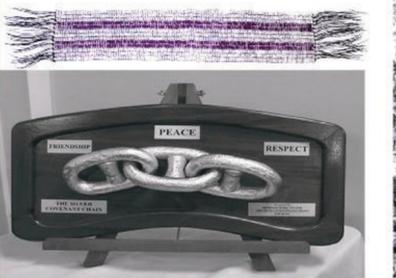


The exact date of when the Iroquois Confederacy was formed is unknown but it is speculated to have taken place between 1570-1600. The Iroquois Confederacy originally consisted of five different Iroquois nations: Mohawk, Oneida, Onondaga, Cayuga, and Seneca, were unified through a common council collectively united by the Great Law of Peace. These original members formed the Haudenosaunee or otherwise known as the Iroquois League.⁶

Formation of the Iroquois Confederacy

Two Row Wampum

In 1613 the Haudenosaunee met with Dutch settlers in order to determine their intentions and as to how they were to treat each other and live together.⁷ It was determined through the meeting that both people are to respect the ways of one another and to not interfere with the other. Three principals were agreed upon by both parties to make the treaty last: the first principal was friendship, where both the Haudenosaunee and their white brothers will live in friendship; the second principal was peace, in which there will be peace between the people; and the third principal was forever, stating that the peace treaty will last forever.⁸ The Silver Covenant Chain of Friendship and the Two Row Wampum Belt were produced to commemorate the meeting.



The exact date of when the Iroquois Confederacy was formed is unknown but it is speculated to have taken place between 1570-1600. The Iroquois Confederacy originally consisted of five different Iroquois nations: Mohawk, Oneida, Onondaga, Cayuga, and Seneca, were unified through a common council collectively united by the Great Law of Peace. These original members formed the Haudenosaunee or otherwise known as the Iroquois League.⁶

Formation of the Iroquois Confederacy

Iroquois Wars

The Haudenosaunee economy soon became interdependent with the European fur trade. With the depletion of local beaver populations and the procurement of firearms, the Haudenosaunee began asserting their military strength, waging wars on outlying tribal enemies in order to procure more hunting and trapping grounds.¹⁰ This embarked the Iroquois Wars, otherwise known as the Beaver wars, waging from 1628 to early 1800s, displacing many First Nations.¹¹

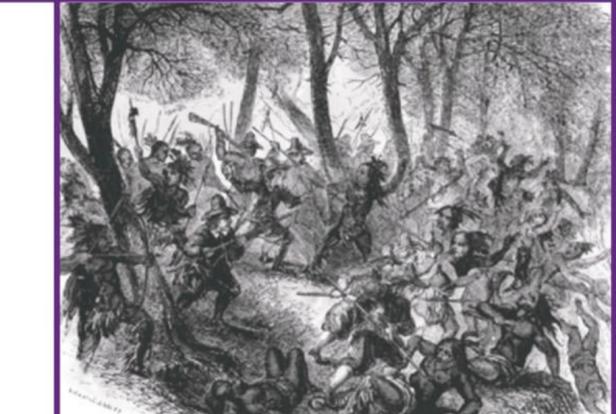
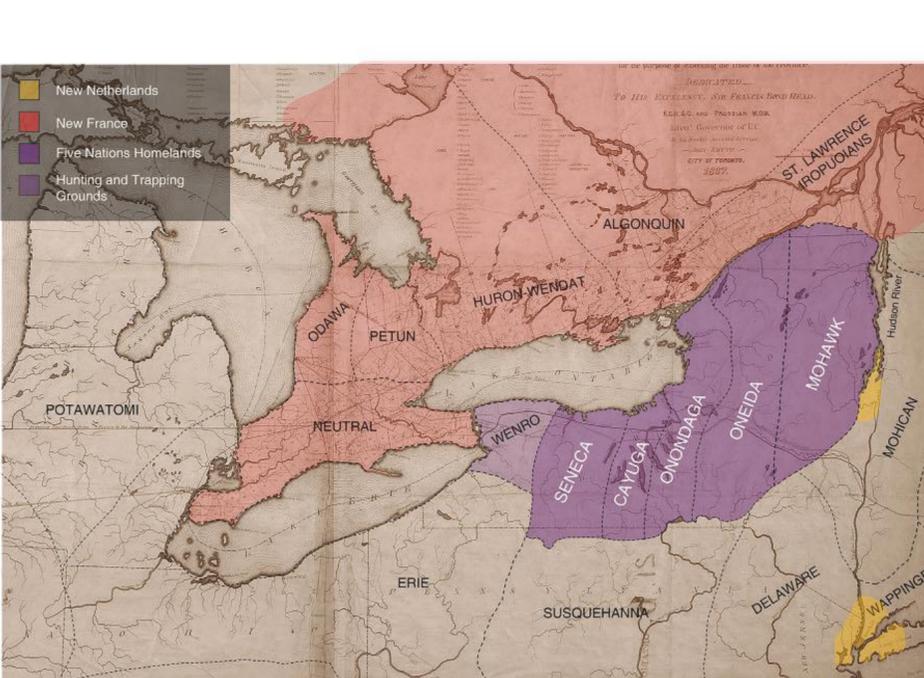


Throughout the 1600s, exploration began to be sought after for commercial or resource based interests where European and French settlements began to form throughout the Americas where trading outposts were established with the First peoples. The most substantial trade market being the 'fur trade' which resulted in wars over resources in which the Haudenosaunee embarked on campaigns to conquer or scatter neighboring Indigenous communities.⁹

The Fur Trade

In 1628, The Haudenosaunee had pushed the Mohicans east, from which further conquests were conducted by the Mohawks against the Algonquin in 1630, raiding their settlements located in the Ojttawa Valley.¹²

Mohican Tribal Wars



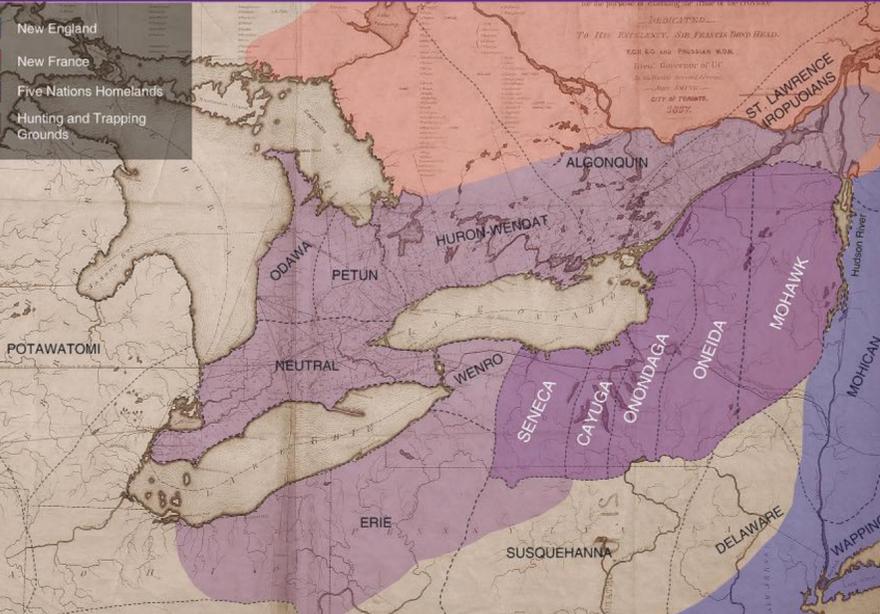
The Haudenosaunee then procured the traditional lands of the Wenrohronon (Wenro) nation in 1639 after the allied Neutral nation withdrew its support and protection from Iroquois attacks, dispersing roughly 600 Wenrohronon to seek refuge with the Huron and the Neutral.¹³

Wenrohronon (Wenro)



By the early 1640s the Mohawk and Oneida were attacking the settlements of New France and subsequently, due to affiliation with the French settlers, Algonquin tribes were raided throughout the St. Lawrence Valley.¹⁴

St. Lawrence Valley

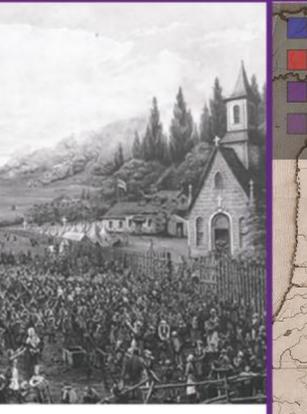
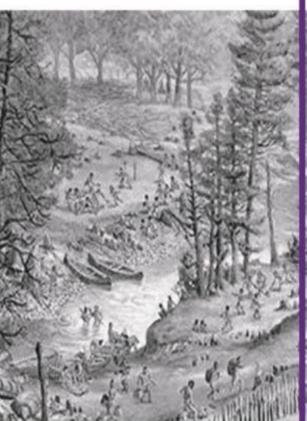


In the year 1642, the French began ceasing the raids made by the Iroquois through the production of fortified settlements as far up the river as Montreal, while prohibiting firearms trades with the Mohawk and arming their allied Huron-Wendat and Algonquin Nations.¹⁵

French Ceases Iroquois Raids

Huron-Wendat

Embarked in 1642, the Seneca's began dispersing the Huron-Wendat nation located north of Lake Ontario in order to gain more hunting and trading grounds.¹⁶ They began raiding small isolated Wendat villages, Pusing the Huron-Wendat further and further north, back to their homeland referred to as Huronia.¹⁷

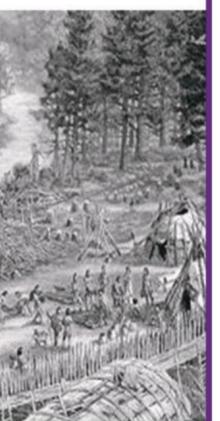


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French Ceases Iroquois Raids

Huron-Wendat

From 1642 to 1646 the Haudenosaunee had dispersed the Algonquians from the Ottoway Valley while continuously raiding Huron-Wendat Villages.¹⁸



In the year 1642, the French began ceasing the raids made by the Iroquois through the production of fortified settlements as far up the river as Montreal, while prohibiting firearms trades with the Mohawk and arming their allied Huron-Wendat and Algonquin Nations.¹⁵

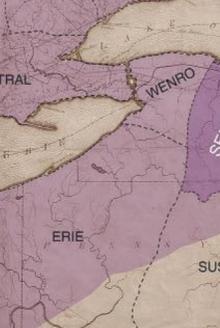
French Ceases Iroquois Raids

Petun Displacement

This resulted in the displacement of 500 Huron-Wendat people from the Georgian Bay region, from which they sought refuge from the French near the Quebec city region, as well as refuge from the Neutrals,²¹ and the Petun nation.²² In the winter of 1649-1650, the Haudenosaunee campaigned the surrounding Nipising (Nibising) and Petun nations, permanently displacing the Petun nation.²³

Huron-Wendat

This progressed to the eventual destruction of the Huron-Wendat homeland in 1649-1650 where 1000 Mohawk members¹⁹ armed with Dutch firearms attacked the two main settlements being the 'Bear' and the 'Cord Makers.'²⁰



French Ceases Iroquois Raids

Mohican and Abenaki

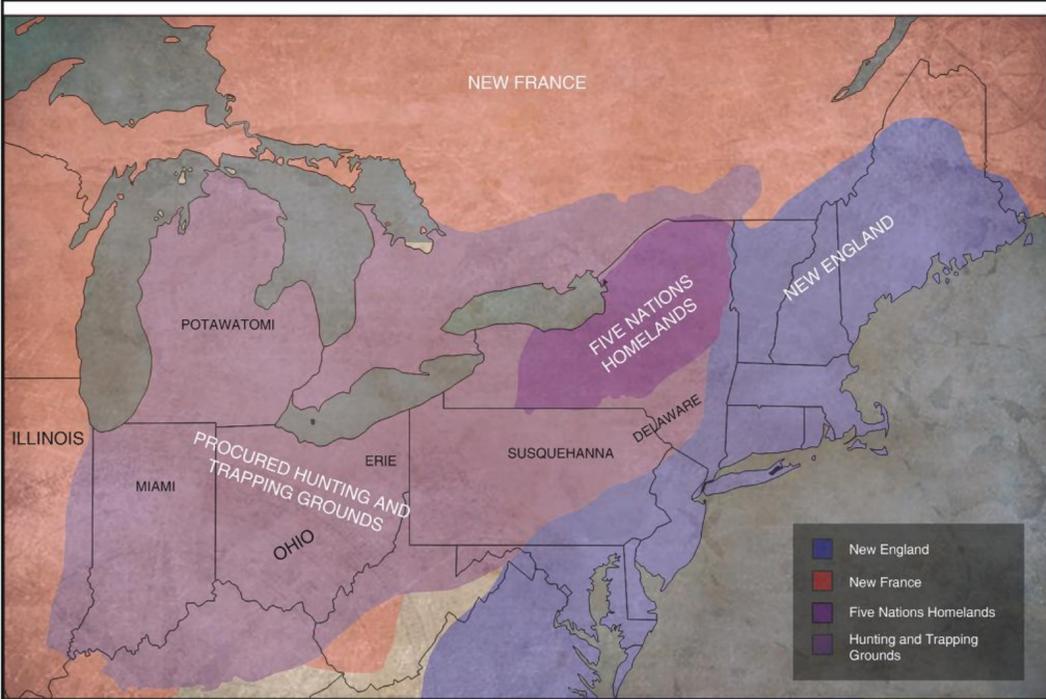
With the Huron-Wendat nation and Neutral nation effectively destroyed, dispersed, and absorbed, the Haudenosaunee focused their efforts of conquest on the Mohican and Abenaki (Wabanaki) nations.²⁶

The Neutral Nation

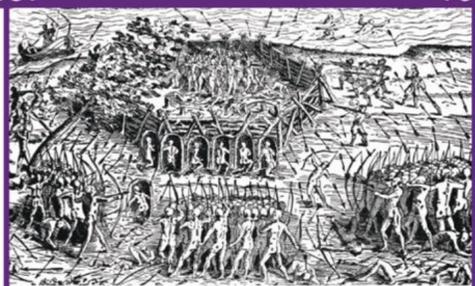
The Neutrals were dispersed and absorbed by the Seneca's in 1651 along with the Huron-Wendat people who sought refuge with them.²⁴ Throughout the duration of the war and after its conclusion, roughly 3,000 Huron-Wendat members had joined the Haudenosaunee.²⁵



Mohican Tribal Wars



1657 1660 1665 1667

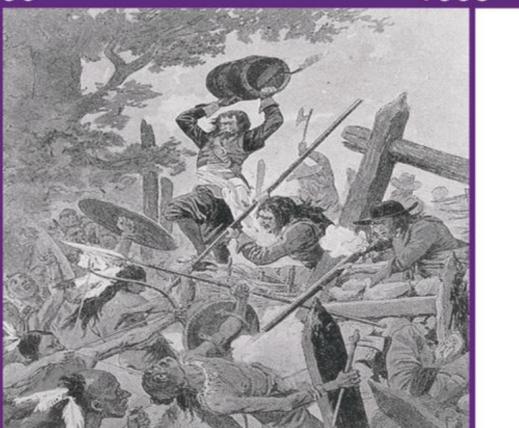


By 1657, the Erie Nation had been completely absorbed by the Haudenosaunee after consistent focussed attacks since 1653.²⁹

Erie Nation Absorbed

In 1656-1657 the Haudenosaunee set forth an ultimatum for peaceful relations with the French on the grounds that the remaining Huron-Wendat nations that settled near Quebec were to join their confederacy.²⁷ This resulted with the Huron-Wendat 'Rock' nation joining Onondaga and some of the remaining 'Bear' nation joining the Mohawk.²⁸

Peace Negotiations with the French



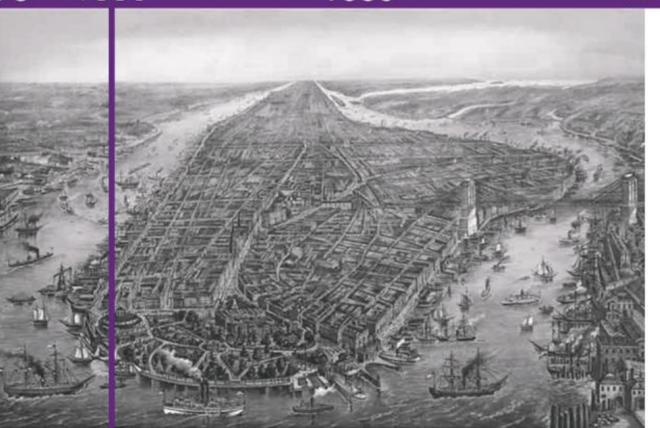
From the dates of 1659-1660, Haudenosaunee frequently raided French settlements along the St. Lawrence River, culminating with the Battle of Long Sault in which a five day battle ensued between the French colonial militia with their Huron and Algonquin allies, against the Iroquois Confederacy. This battle renewed past hostilities with the French.³⁰

Battle of Long Sault



In June 1665, France had sent 1100 troops known as the Carignan-Salieres Regiment to combat the devastating attacks from the Haudenosaunee on their French Canadian settlements.³¹ After a series of strategized raids and the production of several French fortified developments, the Carignan-Salieres Regiment invaded Mohawk territory in september 1666 and burned down a deserted village and the surrounding crops.³²

Carignan-Salieres Regiment



The Iroquois League remained firmly tied to trading interests in Albany, New York, although French Expansion to the west from 1670 to 1680 began cutting off the Haudenosaunee confederacy from new hunting grounds, hindering the success of New York's fur trade.³⁶ Due to previous treaty engagements made between the Haudenosaunee and the French, as long as England and France remained at peace there was little that could be done from the Iroquois to address this situation.³⁷

French Expansion to the West

Petun Displacement
By 1675, the Haudenosaunee had successfully conquered the Susquehannock nation, absorbing the nations members and forcing them to settle in Oneida territory.³⁴ The Iroquois nation then expanded westward into Ohio Valley, where they fought the Illinois and Miami nation.³⁵

Iroquois War Path
In May 1689, France and England declared war, to which the English of New York informed their Haudenosaunee allies of the news as soon as they got word, encouraging them on a war path.³⁸ On August 5th, 1689, 1,500 Haudenosaunee warriors heavily attacked the French village of Lachine.³⁹

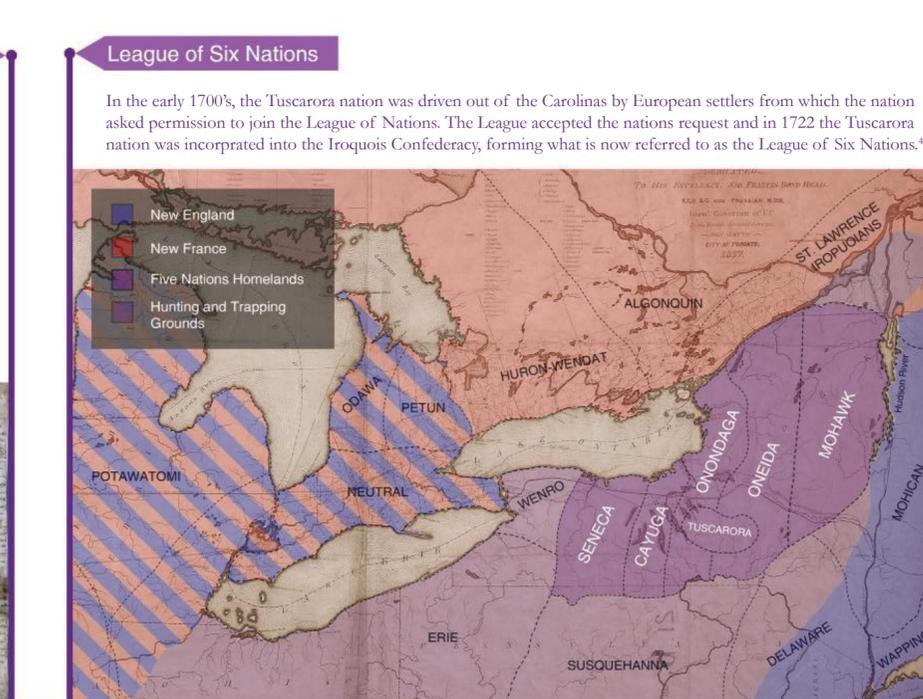
1675 1680 1689 1690

Troupes de la Marine
In response to the attack of the village of Lachine, in December of 1690, France established eighty independent companies consisting of roughly one hundred men each, known as the Troupes de la Marine,⁴⁰ and with their aid, the French settlers eventually forced the Haudenosaunee to make peace.⁴¹

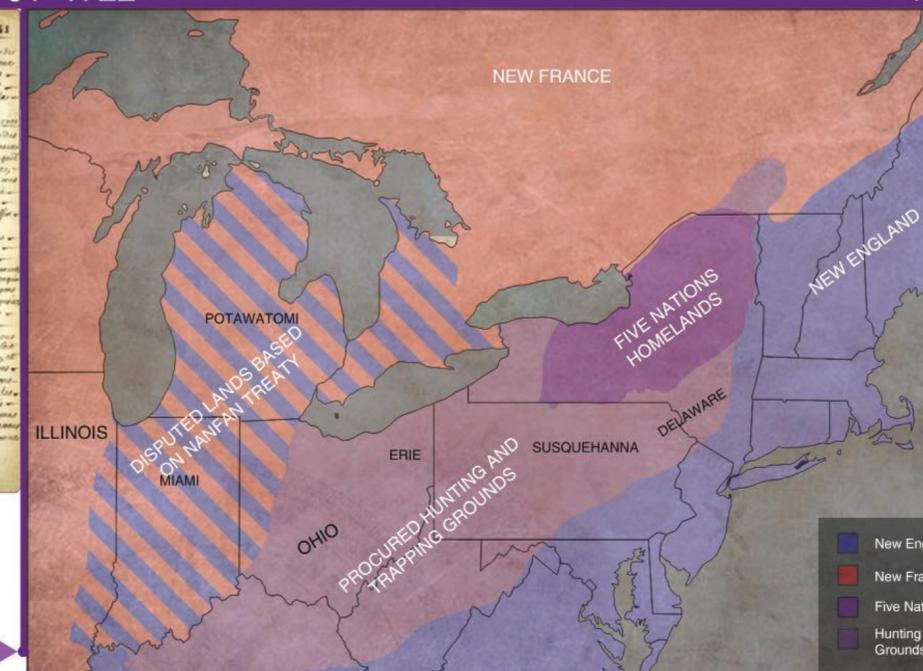
1690

Nanfan Treaty
Earlier that year, prior to the conference at Montreal where the 'Peace of Montreal' was signed, the 'Nanfan Treaty' was signed in Albany, New York. It was an agreement made between the representatives of the Iroquois Confederacy and John Nanfan, the acting colonial governor of New York, on behalf of the crown. Through the treaty, the Haudenosaunee decided their hunting grounds, occupying the great lakes region, to the Crown in exchange for British protection and continued rights to hunt and fish throughout the territory.⁴³

1701 1722

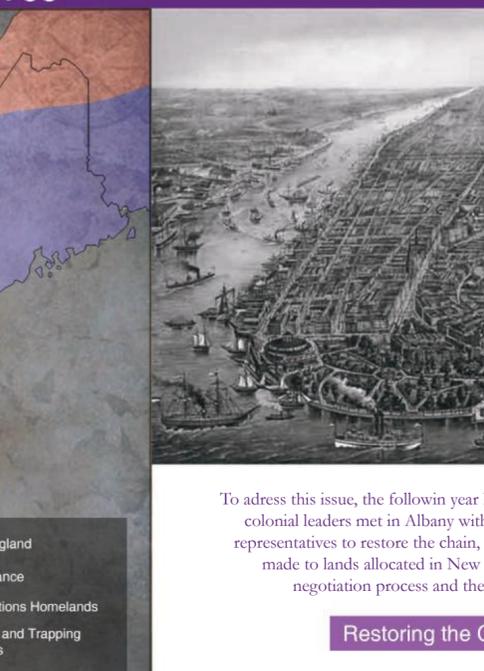


1701 1722



The Covenant Chain Broken
In June 1753, the Mohawk had formally announced that the Covenant Chain was broken due to wrongful encroachment and seizure of Haudenosaunee lands by colonials and the rest of the Iroquois Confederacy was to be informed. Around 1750, colonial populations starting growing and expanding exponentially, from which the Europeans started to expand westward, encroaching on First Nations lands. It was claimed that through intricate swindling, roughly 800,000 acres of Mohawk land had been taken, which had now cause the termination of the Haudenosaunee brotherhood with New York.⁴⁵

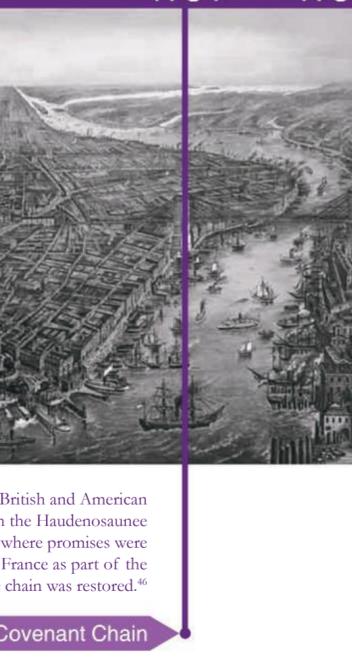
1753



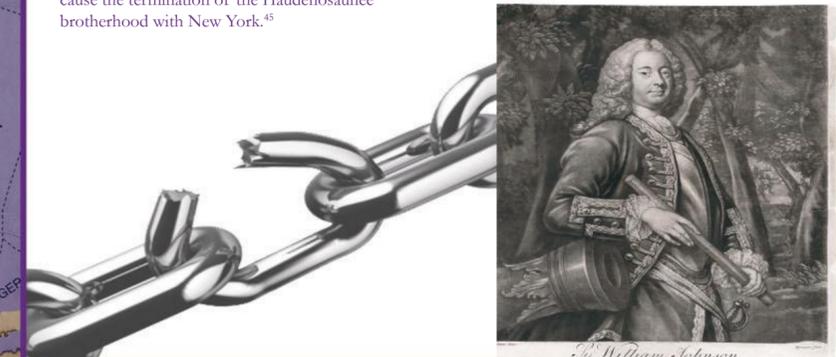
To address this issue, the following year British and American colonial leaders met in Albany with the Haudenosaunee representatives to restore the chain, where promises were made to lands allocated in New France as part of the negotiation process and the chain was restored.⁴⁶

Indian Department
With increased tensions between England and France on the brink of the Seven Year's War, in 1755, the British being desperate for military assistance, created the first Indian Department as a means to strengthen alliances with the Haudenosaunee while addressing concerns of colonial fraud and abuses against Indigenous people and their lands along the colonial frontier. The document also served as further retribution towards the first peoples of the land for their property and homeland losses, further restoring the Covenant Chain.⁴⁷

1754 1755



Restoring the Covenant Chain



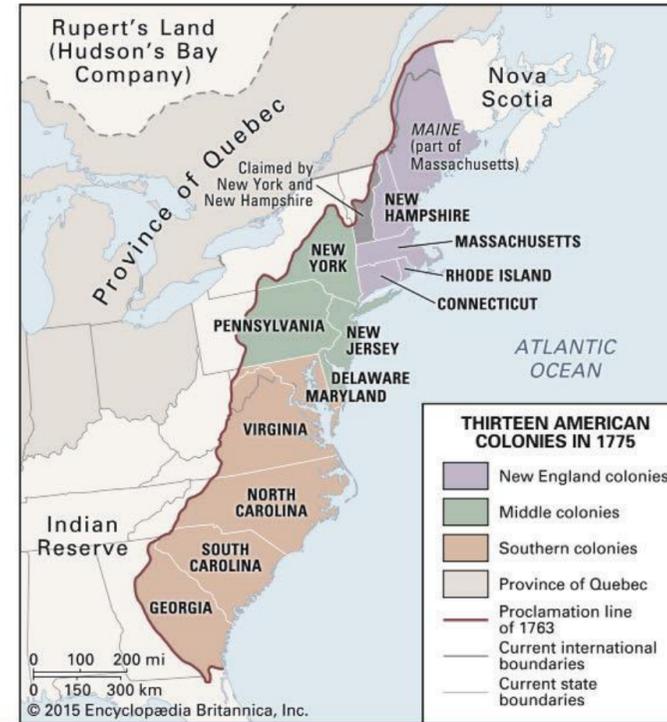
Troupes de la Marine

From 1756-1763 embarked the Seven Year's War, serving as the first global war that was fought in Europe, India, America and at sea, where in North America, the imperial rivals Britain and France struggled for supremacy.⁴⁸ Based on previous arrangements and agreements made between the British and the Haudenosaunee, the Iroquois Confederacy allied with Britain throughout the war.⁴⁹



The Royal Proclamation

Produced in 1763, The Royal Proclamation issued by King George III presented how the North American territories surrendered by France and Britain were to be governed while determining where the colonies were to be situated within a firm western boundary, allocating treaty lands for Indigenous inhabited regions of Canada.⁵⁴ This established boundary defined that all the lands to the west were to become "Indian Territories" where there could be no trade or settlement without the approval of the Crown and permission from the Indian Department.⁵⁵ The Royal Proclamation served as the first public recognition of First Nations rights to lands and title.⁵⁶



The Treaty of Paris

The Treaty of Paris in 1763 not only ended the war between France, Britain and Spain globally, it ended the phase of European conflict in North America, resulting in France formally surrendering North America to the British and withdrawing from the continent.⁵² Britain now served as the primary European power throughout much of North America, controlling all valuable commercial fur trade.⁵³

Loss of Ancestral Lands

Throughout the war the colonists made it a regular habit of raiding and burning the Iroquois land, and as a result, the Haudenosaunee lost much of their ancestral homelands in upper New York, with the Mohawk losing most of their homes to neighboring settlers, and several Seneca, Onondaga and Cayuga towns were burned in 1779.⁶¹



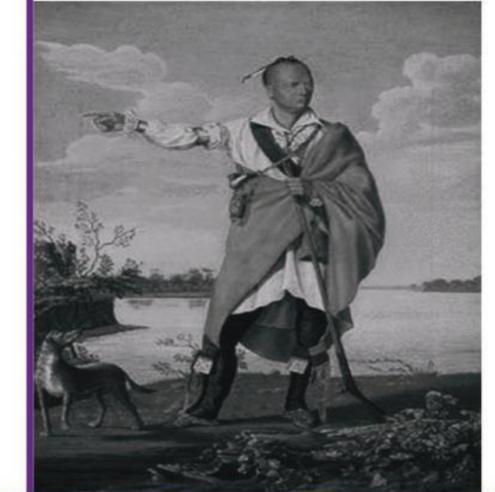
The Treaty of Paris

The Treaty of Paris signed in 1783 marked the end of the Revolutionary War, formally recognizing the United States of America establishing the definitive boundaries between the newly-independent American colonies and the remaining British territories in North America. The treaty also ignored the holdings of land by Native Americans and subsequently, the treaty's between First Nations and Americans weren't so much treaty's as they were a series of official requests to vacate their ancestral homeland or else. After the war the Haudenosaunee were so weakened that they were forced to accept.⁶²



Joseph Brant (Thayendagea)

In light of the designated land treaty, Joseph Brant (Thayendagea), a Mohawk leader, lead many Haudenosaunee members to form settlements in the valley of the Grand River, present day Southwestern Ontario.⁶⁴ The granted tract of land extended for 10 km on both sides of the Grand River, originating from Joseph Brant's settlement source, equating to a total of 950,000 acres of land.⁶⁵



1756

1759

1763

1774

1775 1777

1779

1783

1784

1828



Victory on the Plains of Abraham in 1759 had placed the city of Quebec under British rule.⁵⁰ In 1760 a treaty was signed that guaranteed the people of New France immunity from deprivation or maltreatment; the continued enjoyment of property rights; the right to freedom of religion; and the right to carry on the fur trade as equals to British.⁵¹

Quebec Under British Rule



Through the late 1700s disputes over taxes and other colonial administration had led to significant dissatisfaction of the British imperial rule. The 13 American colonies felt they weren't being represented in the British government.⁵⁷ Frustrations exacerbated with the passing of the British Parliament of the Quebec Act in 1774 which greatly enlarged Quebec's territory to include the unsettled lands of Ohio valley while guaranteeing religious freedom for Roman Catholic and restoring the French civil law within the colony of Quebec.⁵⁸

Quebec Act of 1774



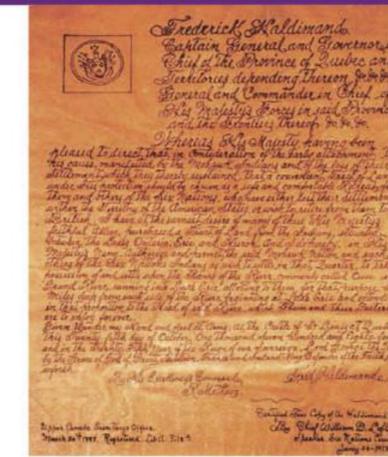
These disputes eventually sparked the American Revolutionary War lasting from 1775-1783 in which 13 of Great Britain's North American colonies fought and won political independence.⁵⁹

American Revolutionary War



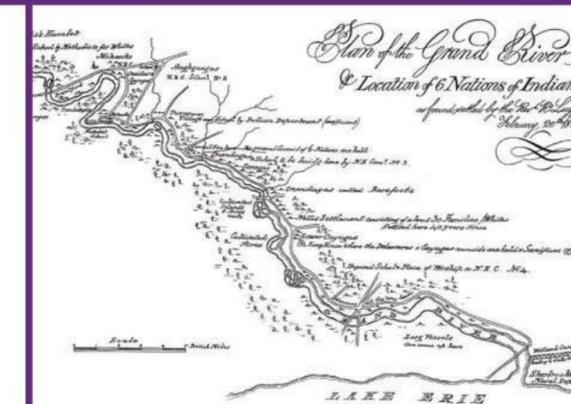
The Haudenosaunee wanted to remain neutral throughout the war having no interest in getting involved with more European conflicts. Although they soon realized that they would have to be at the good graces of the eventual winner and the Iroquois Confederacy was torn. In 1777 the Haudenosaunee joined the conflict with the Seneca, Cayuga, Onondaga and Mohawk nations supporting the loyalists and the British throughout the war, where the Tuscarora and Oneida nations supported the American cause. This split division between the Iroquois throughout the war often lead to Iroquois members fighting other Iroquois members, which hadn't happened since before the formation of the Iroquois confederacy in 1570.⁶⁰

Division Amongst the Haudenosaunee



The Haudenosaunee, as a result, were forced to split up, moving throughout the Americas to settle on different land treaties and reserves. One of these treaties was the Haldimand Proclamation, also known as the Haldimand Grant or Haldimand Tract, which granted a tract of land located in southern Ontario for the Haudenosaunee Six Nations. On October 25th, 1784, a British governor by the name Sir Frederick Haldimand secured a granted tract of land on the Grand river for the Haudenosaunee as compensation for their contributions and sacrifices given to the American Revolutionary War.⁶³

The Haldimand Tract



Location of original Haudenosaunee settlements along the Grand River in 1828.⁶⁶

Original Settlements Along the Grand River

A.5 HAUDENOSAUNN TIMELINE

The timeline that has been produced is a comprehensive overview of the Haudenosunee and their historical evolution. Acknowledging the precolonial era, the timeline begins at the time of creation and moves throughout history, depicting when first contact with Europeans began in the early 15th century to the formation of the Iroquois Confederacy at around 1570. Moving forwards until the formation of the Haldimand Treaty where the Haudenosunee of Six Nations resided on current day lands of Six Nations of the Grand River Reserve. Refer to figure 79 to view the historical timeline of the Haudenosunee that was produced.

Figure 79: Graphic produced by author illustrating the historical timeline of the Haudenosunee from pages 208-213.

TIMELINE CITATIONS

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A.6 HALDIMAND TRACT

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The tract of land that was granted to the Haudenosaunee by the British Governor Sir Frederick Haldimand in 1784 was known as the Haldimand Tract. Located in Southern Ontario within the Grand River watershed, the granted land was to serve as compensation for the Haudenosaunee’s contribution and sacrifices given to the American Revolution.¹ This tract of land extended for 10 km on both sides of the Grand River, originating from Joseph Brant’s selected settlement source.² It wasn’t long before settlers migrated into Six Nations territory, making the land unsuitable for hunting, harvesting or agricultural practices, forcing Six Nations to find alternate means of support. As a result, through the urging of the Crown, Six Nations surrendered lands to the Crown to raise funds for perpetual care and maintenance of their lands.³ Since 1784, the Haldimand Tract has resulted in consistent disputes between the Crown and the Haudenosaunee, disputing land rights and negotiations on tract agreements made between both parties.⁴ In many ways, the Crown failed to uphold its legal duties and responsibilities to respect and honor the treaty for the benefit of Six Nations, resulting in the dispossession of most their lands.⁵

Today, the Six Nations of the Grand River Reserve comprises the largest First Nations community in Canada where roughly 24,000 citizens reside on 46,500 acres of land in Southern Ontario, reflecting only 4.9 percent of the agreed 950,000 acres of land granted through the Haldimand Treaty.⁶ Additionally, the lands that fall within Six Nations of the Grand River Reserves current boundaries have been parceled and divided throughout history as a consequence of colonialist influences of the Crowns governance and control of the lands. Resulting in a consumerist culture and a hyper-individualistic land ownership society where a vast majority of the reserves lands are individually owned by Six Nation residents. Out of the 46,500 acres of reserve land, currently 94% of the land is under Certificate of Possession, privately owned by Six Nations members.⁷ Allocating hardly any land for communal or recreational use or nature preserves. While producing segregated communities which fundamentally contradicts Haudenosaunee traditional principles and values surrounding social structures that promoted a spirit of togetherness and inclusivity that achieved strong, nurturing communities and families. In addition to this,



SIX NATIONS HALDIMAND TRACT

...**"Six Miles deep from each side of the River beginning at Lake Erie and extending in the proportion to the Head of said River, which Them and Their Posterity are to enjoy forever"...**



connections to the land and land based learning/practicing initiatives have become limited based on the segregated, individuality of the landscape.

- 1 "Haldimand Proclamation." Haldimand Proclamation | The Canadian Encyclopedia.
- 2 "LAND RIGHTS - A GLOBAL SOLUTION FOR THE SIX NATIONS OF THE GRAND RIVER," 2015. Pg 7.
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- 4 "Haldimand Proclamation." Haldimand Proclamation | The Canadian Encyclopedia.
- 5 "Six Miles Deep - Land Rights of the Six Nations of the Grand River," Pg 5.
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- 7 "2019 Six Nations Community Plan," 2019. Pg 17

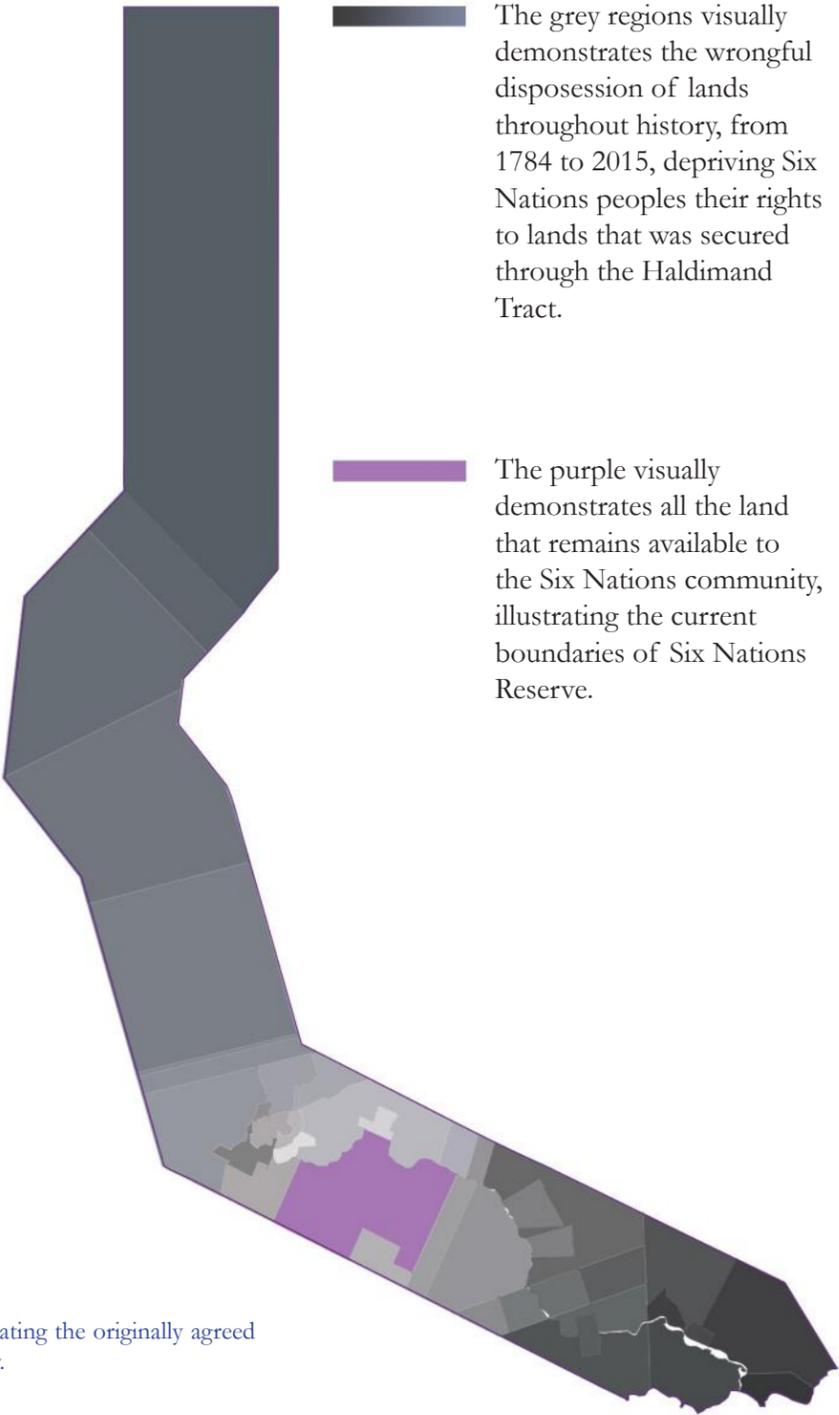


Figure 80: Graphic produced by author demonstrating the originally agreed upon lands secured through the Haldimand Treaty.



Appendix B

B.1 Haudenosaunee Ecological Knowledge (HEK) Artifact



B.1 HAUDENOSAUNEE ECOLOGICAL KNOWLEDGE (HEK) ARTIFACT

The artifact is to metaphorically and symbolically embody what Haudenosaunee Ecological Knowledge (HEK) is by personifying the three fundamental teachings of HEK that instruct/guide the Haudenosaunee on how to relate with the natural world and all of creation in a sustainable and reciprocal manner. These three teachings have been identified as the Thanksgiving Address, the Cycle of Ceremonies and Harvests, and the Dish with One Spoon Wampum Belt. I have tried to encapsulate these teachings into the object in a cohesive and ethically appropriate manner.

The object itself was intended to be constructed out of natural materiality consisting of culturally appropriate woods to form a hollow wooden sphere imbued with cultural meanings and teachings that have been portrayed through intricate engravings and paintings. The hollow wooden sphere has been divided into two halves/bowls that are suspended away from one another, supported by a wooden dowel. The object is shaped like a sphere to symbolically represent a Haudenosaunee worldview towards perceiving the natural environment, where the natural environment (or turtle island) is represented in the center of the sphere. Abstract ties can be made to sky world and underworld where the bottom half of the sphere represents Mother Earth/Turtle Island as well as the underworld, where the upper half represents sky world.

On the exterior of the upper half of the sphere, 13 moons have been engraved into the wooden bowl depicting the Haudenosaunee and Anishinaabe lunar calendar. On the exterior of the bottom bowl forming the bottom half of the sphere, the four seasons (Spring, Summer, Fall and Winter) have been illustrated through intricate paintings of the seasonal changes. Directly below this band of seasonal changes was supposed to be a series of written engravings depicting the cycle of ceremonies and harvests that occur throughout the year following the seasons. The 13 moons, the four seasons, and the depicted ceremonies and harvests correlate with one another to depict how the Haudenosaunee live with and follow the cycles of nature through their cycle of ceremonies and harvests. To continue the metaphorical representation of how Haudenosaunee tradition was and is linked to the cycles of the land, while furthering the symbolic ties made to sky world through the upper half of the

sphere/bowl, the constellation of Pleiades has been engraved on the underside of the bowl. Representing the cosmos while illustrating how astrology was utilized by the Haudenosaunee as a seasonal gauge to situate themselves in relation to their cycle of ceremonies and harvests.

Located in the bottom half of the sphere/dish, the natural environment, or rather Turtle Island, has been depicted in an Arnold Jacobs (a Haudenosaunee artist) sort of way where the north American continent has been abstractly represented as a turtle surrounded by water. The wooden ring surrounding turtle island was intended to have a series of paintings that would depict all the aspects of creation as acknowledged through the Thanksgiving Address, demonstrating a sort of roadmap of ecology as understood through Haudenosaunee relationships with nature. Additionally, the bottom half of the sphere/bowl symbolically represents the teachings consolidated within the Dish With One Spoon wampum belt. As already previously discussed in the Thesis paper, the philosophy behind the Dish With One Spoon wampum is that the dish metaphorically represents the extent of the natural environment where everyone has equal rights to take from the dish of nature with the spoon. You are only to take exactly what is needed for the sustenance and care of yourself and family in life, while always making sure to leave something in the dish of nature for future generations, other people, and all of creation. One is to also always make sure the dish (nature) is clean and healthy. The bottom half of the sphere/bowl metaphorically represents the dish of nature, with turtle island being situated within the center of the bowl, representing the extents of creation.

The last aspect of the artifact that bears cultural significance and importance is the symbology of the base. The base was intended to be constructed out of white pine to depict a stump containing four roots pointing in the four directions (north, south, east and west). This wooden base was intended to symbolically represent The Great Tree of Peace and the four white roots. The Great Tree of Peace serves as a foundational symbol of Haudenosaunee culture, representing the unification of the six Iroquois nations forming the confederation.

Cycle of Ceremonies and Harvests



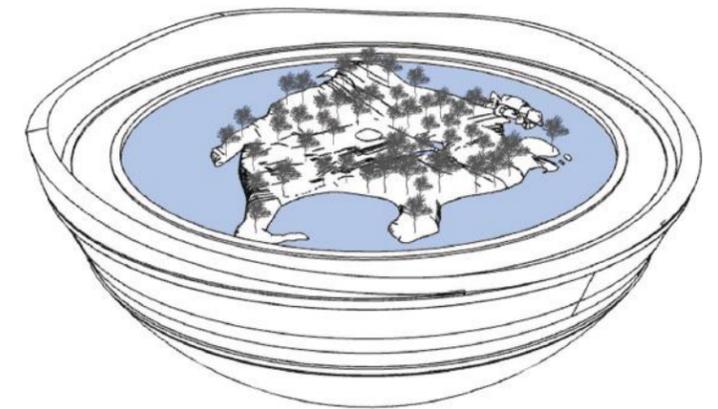
Dish With One Spoon Wampum Belt



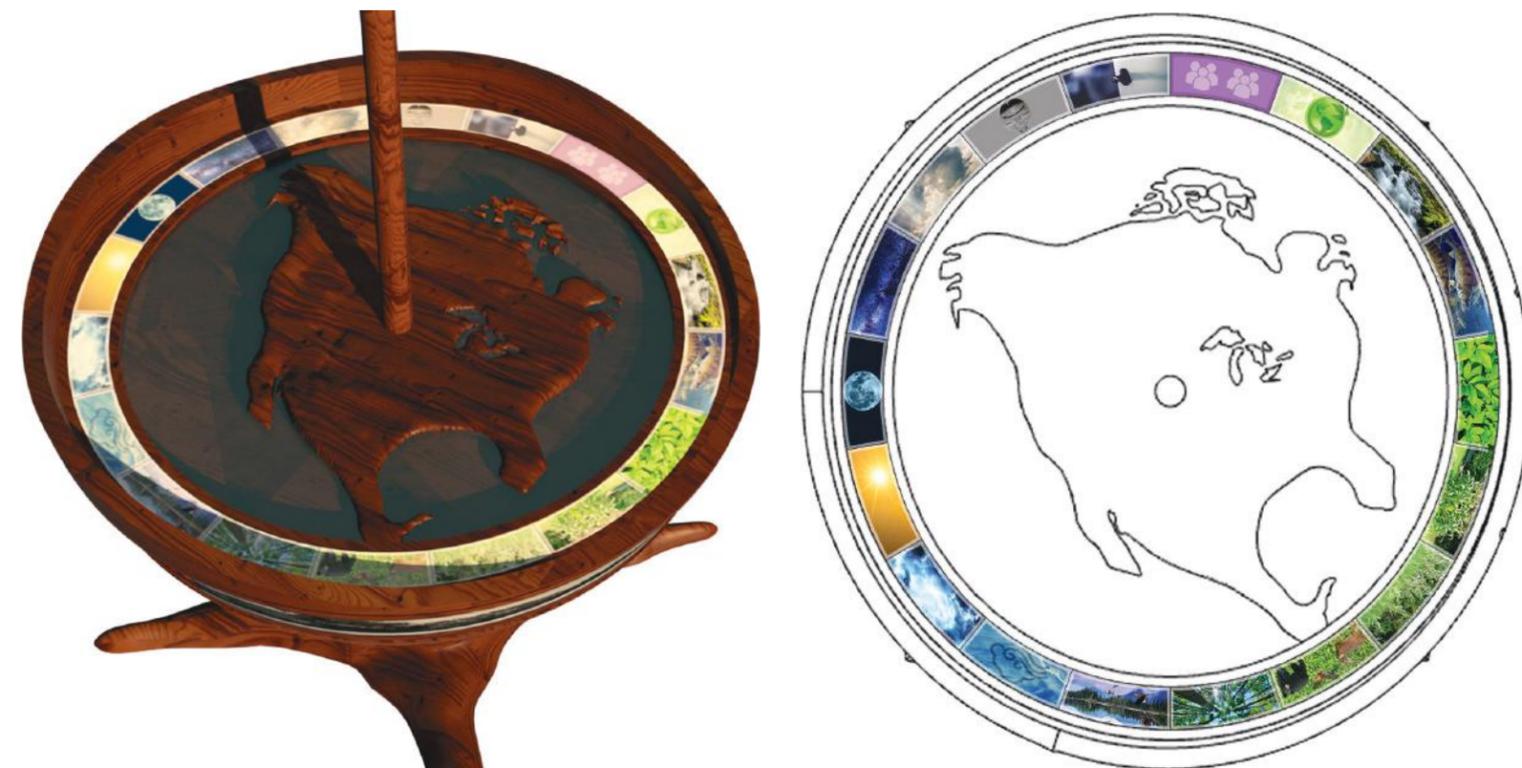
fwampumbelt Photos images pics. Accessed December 17, 2019. <https://instagram-dm.com/hashtag/wampumbelt>.



Haudenosaunee Ecological Knowledge & the Dish with One Spoon. Conversations in Cultural Fluency Lecture Series #2. Six Nations Polytechnic, 2016. <https://www.youtube.com/watch?v=e5szQHeQ9FM>.



The Thanksgiving Address



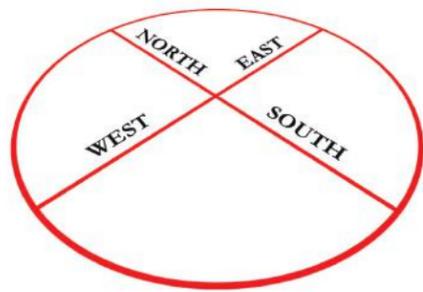
Depicting Constellations



Pleiades (The Seven Sisters)

Constellations will be depicted on the underside of the top bowl that have cultural significance in relation to the cycle of ceremonies and harvests. While serving as identifiers that allow/allowed the Haudenosaunee and Anishnawbe to determine the phases of the lunar cycles by the situation of certain constellations.

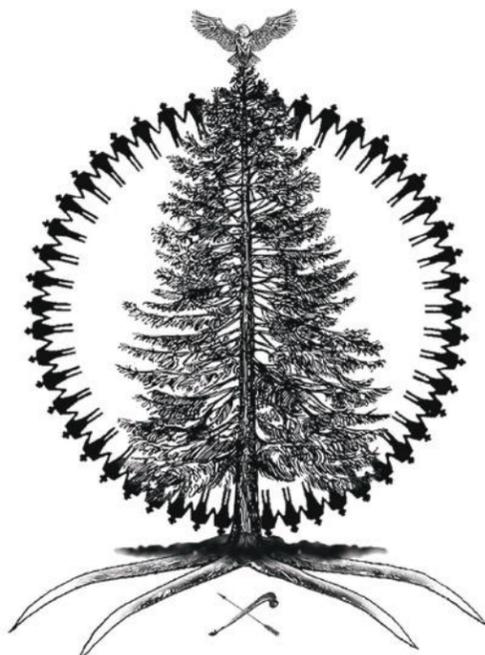
Significance of Base



The Four Directions



Model Base Made From a Harvested Pine Tree Stump with Natural or Crafted Roots Pointing in the Four Directions. Symbolic of the Great Tree of Peace

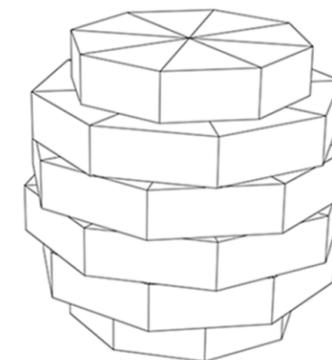
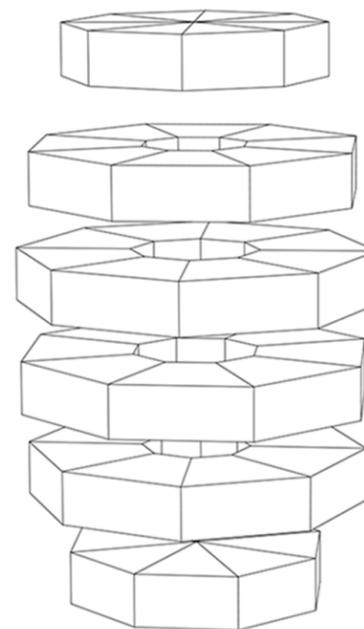


The Great Tree of Peace

Construction Progress

4" DIAMETER SPHERE

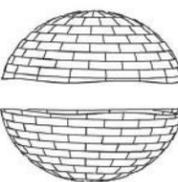
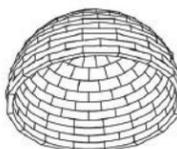
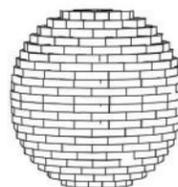
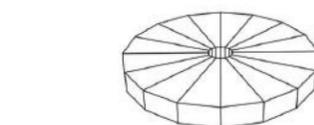
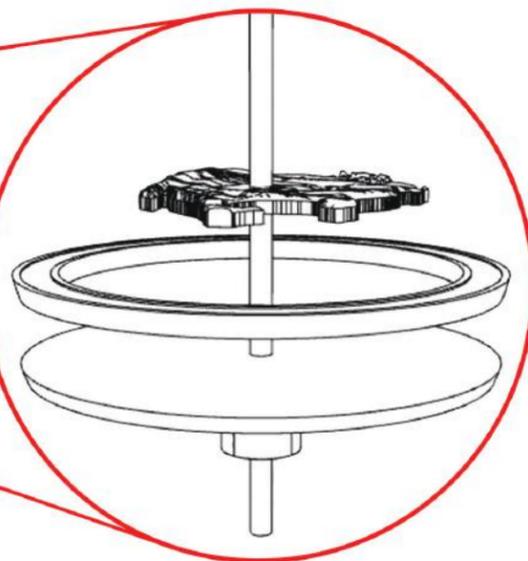
COMPRISED OF
6 RINGS



Spheres were comprised of wooden rings that were constructed through laminating eight wooden wedges, alternating different softwood/hardwood materialities. Each ring was glued through the use of hose clamps.



Construction Detail



Test Sphere 1:
Hardwood Sphere
Comprised of Birch and Maple



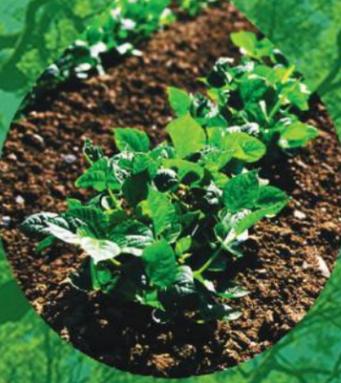
Test Sphere 2:
Softwood Sphere
Comprised of Cedar and Pine

Two test spheres with a diameter of 4-inches were produced testing the success of the intended lamination process for the final sphere while also exploring the use of different softwood and hardwood materialities. Both spheres were a success.

For the intended final production of the large scale sphere at a diameter of 12-inches, the materiality was going to consist of the hardwood laminations being that of birch and maple. Not only did these materials work better on the lathe, the coloration variances between the hardwoods is less busy than that of the softwoods.



Appendix C



C.1 Regenerative Strategies

Solar radiation is retained in nature through methods of assimilation and distribution of energy by materials with varied heat-holding capacities. The most common ways solar heat is retained and used to control temperatures of interior spaces through direct solar exposure are methods of *Passive* and *Active* systems of *Solar Space Heating*. There are two different approaches towards achieving solar space heating systems, consisting of either an active or passive system.¹ *Passive Space Heating* requires orienting the building form to maximize sun exposure while trapping incoming solar radiation through strategically placed glazing that works towards retaining as much solar radiation and thus heat as possible. These glazed portions of the building usually form sunspaces or greenhouses and typically contain a sizable amount of glazing on walled and/or roofed surfaces.² The second piece of the system is the utilization of certain materials with high heat-absorption capacities in locations that are in direct exposure to solar radiation. Once solar radiation has been transmitted through the glazing, it can significantly warm a building. Although, the challenge with this system is to find a way in which this gained solar heat can be stored and utilized at a later date. Utilizing materials with high heat-absorption capacities, otherwise known as “thermal mass,” have the ability to absorb large amounts of heat rapidly while releasing it slowly.³ Therefore, when materials with high thermal mass properties are utilized in a sunspace or greenhouse in direct exposure to solar radiation, they are able to retain large amounts of heat while having the ability to release it at later times when direct solar heat is no longer available, most commonly at night. Providing an energy efficient heat source to help moderate internal temperatures during cool night temperatures or times when sun exposure isn’t adequately providing enough heat. High density materials such as brick, stone, concrete, and water have high heat-absorption capacities and work well for these applications.⁴ In order for the passive space heating system to work efficiently, it is said that a ratio of thermal mass surfaces (both floor and wall materiality) to transparent surfaces should be around 3 to 1.⁵ Endless variations of this arrangement are available offering design variability and architectural innovation.

Active Space Heating on the other hand, requires circulating a heat-transport medium consisting of air, water, or antifreeze solution through solar collector panels situated on the roof.⁶

The solar collectors that are exposed to solar radiation heat up the transport medium as it flows through the panels. The heated transport medium is then transferred into a storage tank within the facility from which the heated medium can then be circulated throughout the building at a later time once solar radiation is no longer available, providing heat to the interior spaces.⁷ Active systems such as this require fans, pumps, and other mechanical operations for circulating the transport medium or air throughout the system.⁸

When it comes to utilizing solar radiation, control is key. There are times when heat gain should be maximized (usually during winter months) and other times it should be minimized (usually during the summer months) in order to control a building’s internal temperature. The next efficient cooling strategy that can be easily integrated into a building’s infrastructural design is the implementation of architectural shading devices. In analyzing the sun’s movement throughout the year, it can be determined that the sun passes significantly lower on the horizon during winter months than that of summer months due to the earth’s movement around the sun. During summer months, the earth’s north pole is tilted closer to the sun which is known as the summer solstice, whereas during winter months the north pole is tilted away from the sun, which is known as the winter solstice.⁹ Through understanding the sun’s directional changes throughout the year, shading devices consisting of fixed overhangs and other shading elements can be designed to take the summer and winter solstices into consideration, actively/passively shading the structure during summer months while allowing sun to shine through during winter months.¹⁰ There are several architectural shading strategies that consist of both active and passive systems. Passive systems consist of developing overhangs over window openings or extending roof overhangs, while additional shading fins or screens can be added to the interior or exterior of glazed surfaces. In addition, shading elements can be designed to be introduced during summer months while having the capability of being removed during winter months providing more control. Movable shading fins or systems can provide even more responsive control, having the capability to follow the movement of the sun throughout the day and year.¹¹ In this manner, the building’s shading system can respond to its environment, changing with the

Solar radiation is retained in nature through methods of assimilation and distribution of energy by materials with varied heat-holding capacities. The most common ways solar heat is retained and used to control temperatures of interior spaces through direct solar exposure are methods of *Passive* and *Active* systems of *Solar Space Heating*. There are two different approaches towards achieving solar space heating systems, consisting of either an active or passive system.¹ *Passive Space Heating* requires orienting the building form to maximize sun exposure while trapping incoming solar radiation through strategically placed glazing that works towards retaining as much solar radiation and thus heat as possible. These glazed portions of the building usually form sunspaces or greenhouses and typically contain a sizable amount of glazing on walled and/or roofed surfaces.² The second piece of the system is the utilization of certain materials with high heat-absorption capacities in locations that are in direct exposure to solar radiation. Once solar radiation has been transmitted through the glazing, it can significantly warm a building. Although, the challenge with this system is to find a way in which this gained solar heat can be stored and utilized at a later date. Utilizing materials with high heat-absorption capacities, otherwise known as “thermal mass,” have the ability to absorb large amounts of heat rapidly while releasing it slowly.³ Therefore, when materials with high thermal mass properties are utilized in a sunspace or greenhouse in direct exposure to solar radiation, they are able to retain large amounts of heat while having the ability to release it at later times when direct solar heat is no longer available, most commonly at night. Providing an energy efficient heat source to help moderate internal temperatures during cool night temperatures or times when sun exposure isn’t adequately providing enough heat. High density materials such as brick, stone, concrete, and water have high heat-absorption capacities and work well for these applications.⁴ In order for the passive space heating system to work efficiently, it is said that a ratio of thermal mass surfaces (both floor and wall materiality) to transparent surfaces should be around 3 to 1.⁵ Endless variations of this arrangement are available offering design variability and architectural innovation.

Active Space Heating on the other hand, requires circulating a heat-transport medium consisting of air, water, or antifreeze solution through solar collector panels situated on the roof.⁶

The solar collectors that are exposed to solar radiation heat up the transport medium as it flows through the panels. The heated transport medium is then transferred into a storage tank within the facility from which the heated medium can then be circulated throughout the building at a later time once solar radiation is no longer available, providing heat to the interior spaces.⁷ Active systems such as this require fans, pumps, and other mechanical operations for circulating the transport medium or air throughout the system.⁸

When it comes to utilizing solar radiation, control is key. There are times when heat gain should be maximized (usually during winter months) and other times it should be minimized (usually during the summer months) in order to control a building’s internal temperature. The next efficient cooling strategy that can be easily integrated into a building’s infrastructural design is the implementation of architectural shading devices. In analyzing the sun’s movement throughout the year, it can be determined that the sun passes significantly lower on the horizon during winter months than that of summer months due to the earth’s movement around the sun. During summer months, the earth’s north pole is tilted closer to the sun which is known as the summer solstice, whereas during winter months the north pole is tilted away from the sun, which is known as the winter solstice.⁹ Through understanding the sun’s directional changes throughout the year, shading devices consisting of fixed overhangs and other shading elements can be designed to take the summer and winter solstices into consideration, actively/passively shading the structure during summer months while allowing sun to shine through during winter months.¹⁰ There are several architectural shading strategies that consist of both active and passive systems. Passive systems consist of developing overhangs over window openings or extending roof overhangs, while additional shading fins or screens can be added to the interior or exterior of glazed surfaces. In addition, shading elements can be designed to be introduced during summer months while having the capability of being removed during winter months providing more control. Movable shading fins or systems can provide even more responsive control, having the capability to follow the movement of the sun throughout the day and year.¹¹ In this manner, the building’s shading system can respond to its environment, changing with the



seasons like that of a tree canopy.

Furthering this notion of controlling energy flows to passively and actively cool internal building environments, the controlled movement of air and natural winds can provide an array of sustainable and efficient cooling methods. Strategically placing openings in a structure can induce air movement by generating pressure and temperature differences from interior to exterior environments, forcing air movement that can be controlled throughout the building, hence heating and cooling the facility.¹² The most common method of controlling air movement through interior environments is through cross-ventilation, which consists of creating openings on opposite sides of a building to generate pressure differences that induces air movement through them. This pressure difference is generated by the build up of pressure on the windward side of the building relative to the low-pressure area on the lee-ward side of the building.¹³ There are multiple variations of these systems and methods of application, although there are some general principles that determine the directional flow of the air movement.¹⁴ For instance, the locations of the inlets and outlets are more important than their sizing, as this will determine the airflow direction throughout the facility. In conjunction with this statement, the other integral principal surrounding air movement is the fact that warm air rises. By situating inlets close to the ground while locating the outlets higher up in the structure will direct air movement that coincides with the natural temperature differences of air, forcing the air to rise through its movement. The greater the difference in height between the inlet and outlet and the larger the temperature difference will increase the speed of the air movement.¹⁵ This principal of temperature differences forcing vertical air movement is known as 'stack effect' and can inform more efficient airflow systems such as that of Heat Chimneys. A heat chimney consists of incorporating a vertical expanse of space (a tall vertical shaft) that will induce a flow of warm air upward to the outlet opening, creating a continuous flow of air drawing cool air from the space at its base. South facing glazing is usually incorporated into the outlet opening of this system in order to heat the upper air and induce more rapid air movement.¹⁶ Multiple variations of these systems and their integration with one another can be incorporated into an infrastructures design, utilizing inherent principles of air movement

and the natural winds on site to produce efficient, sustainable, and passive cooling systems.

Furthering this strategy of controlling the heat balance of a building through utilizing natural processes, the natural thermal properties of earth and soil mediums can inform building relationships with the land to generate efficient and sustainable heating and cooling strategies. For instance, buildings can be designed to take advantage of the earths natural heating/cooling systems by integrating buildings within the ground to form earth-sheltered structures, utilizing the earth as a sort of thermal governor.¹⁷ By embedding buildings within the ground or backfilling earth to submerge portions of infrastructures, the architecture can take advantage of the fact that the earth maintains a constant temperature of around 12 to 15 degrees Celsius a few feet below ground level.¹⁸ In this manner, the earth could passively cool the building by absorbing additional heat given off by the facility through thermal conduction during summer months, while the ground would transmit embodied heat to the facility during winter months.¹⁹ In addition, the earth also serves as an added protection layer and insulation layer, fending off harsh climates and temperature extremes, which would serve well in southern Ontario.

Another important aspect that plays a significant importance in a buildings overall functioning success is the consideration given to ventilation systems and air quality control. It is vitally important for an infrastructure to continuously flush indoor air out of the facility in order to reduce indoor pollution levels. The previously mentioned ventilation devices that achieved passive methods of airflow movements throughout a facility can accomplish this efficiently. Although, their processing efficiency is contingent on climatic conditions, as during cold climates it is virtually impossible for these passive systems to work in an economically efficient manner that maintains adequate room temperatures.²⁰ Therefore, additional mechanical ventilation systems are required to efficiently control air movement while moderating internal temperatures. By thinking of the building again as a microcosm of the earth, another passive ventilation strategy can be implemented. The introduction of natures air processors in the form of plants can be utilized to passively control the air quality of internal environments just as





they moderate the air quality in landscape ecosystems.²¹ Providing better air quality while also providing green space for interior environments, having the potential of designing botanical gardens.

The last strategy for regenerative design that plays an overall significance towards designing a facility that performs reciprocally and sustainably with the land, while furthering the notion of controlling energy flows, is regarding the concept of embedded energy. All material utilized in buildings and construction processes require energy in its manufacturing, shaping, treating, and shipping.²² The term for a materials consumption of overall energy is referred to as ‘embedded energy,’ and it varies for every materiality and their different manufacturing processes. The general rule of thumb is that materials drawn from natural resources require less processing and are usually less energy-intensive, especially if the materials are locally resourced. Materials such as wood, adobe brick, and rammed earth walls, for instance, require less energy to produce than materials such as steel, glass, concrete, and plastic, which require a more intensive manufacturing process.²³ The other aspect to consider is whether the materials are renewable or non-renewable. When considering regenerative design, energy is to be recirculated and recycled, and these principles should be carried through the selection of a building's materiality. In this manner, the embodied energy of the materials can be recirculated into another useful capacity at a later date, providing an architecture that is not only regenerative in its functionality but composition as well.

- 17 Ibid. Pg 105-106.
- 18 Ibid.
- 19 Ibid.
- 20 Ibid. Pg 116.
- 21 Ibid.
- 22 Ibid. Pg 119.
- 23 Ibid. Pg 61.

1 Lyle, John Tillman. Regenerative Design for Sustainable Development. Pg 60.
2 Ibid. Pg 105.
3 Ibid. Pg 107.
4 Ibid.
5 Ibid.
6 Ibid. Pg 60.
7 Ibid.
8 Ibid.
9 Ibid. Pg 108.
10 Ibid.
11 Ibid.
12 Ibid.
13 Ibid.
14 Ibid.
15 Ibid.
16 Ibid. Pg 112.



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