Revitalization of Brandt's Creek - A Systems Approach Report

University of British Columbia - Okanagan

Group 2: Daisy Pullman, Gabrielle Heschuk, Sofia Bakhmutsky, Shaiyan Siddique, Kevin Auster & Em Isaak

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Dr. John Janmatt & Dr. KH MD Nahiduzzman

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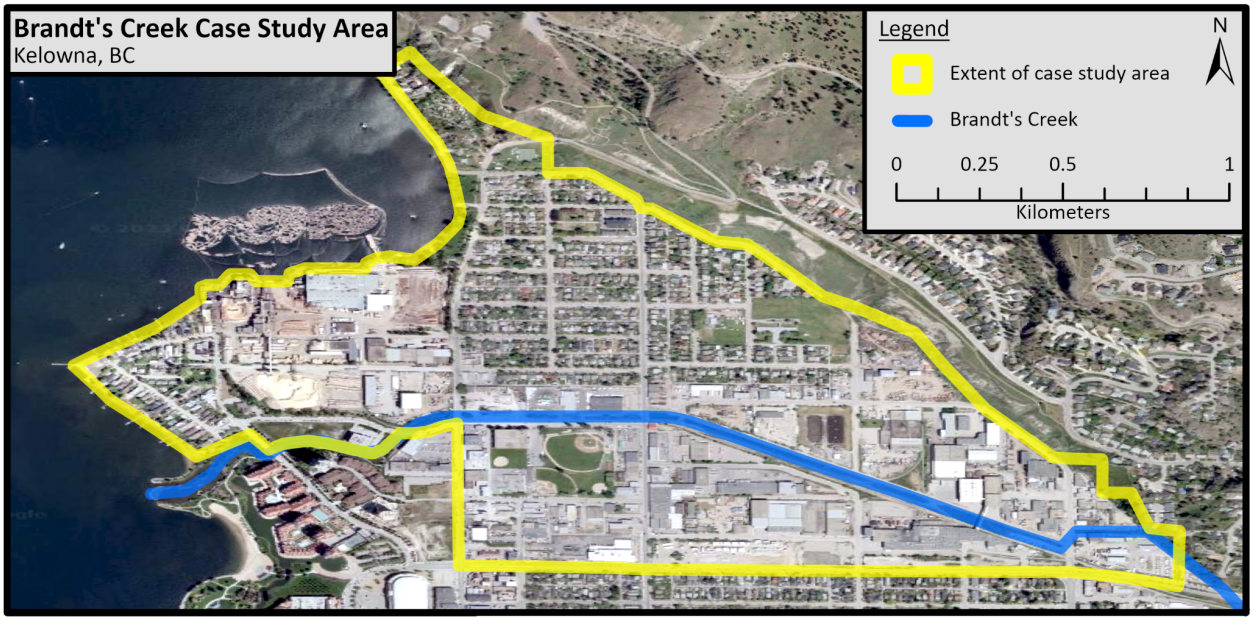
Reader's Note: We would like to acknowledge that this report was written on the Traditional, Unceded, and Ancestral Territory of the Syilx Okanagan Peoples.

Chapter 1.0 - Introduction

Brandt's Creek is located in the traditional, unceded, and ancestral territory of the Syilx Okanagan nation, in what is now known as Kelowna. The creek originates from the Glenmore neighbourhood before ultimately emptying into Okanagan Lake.

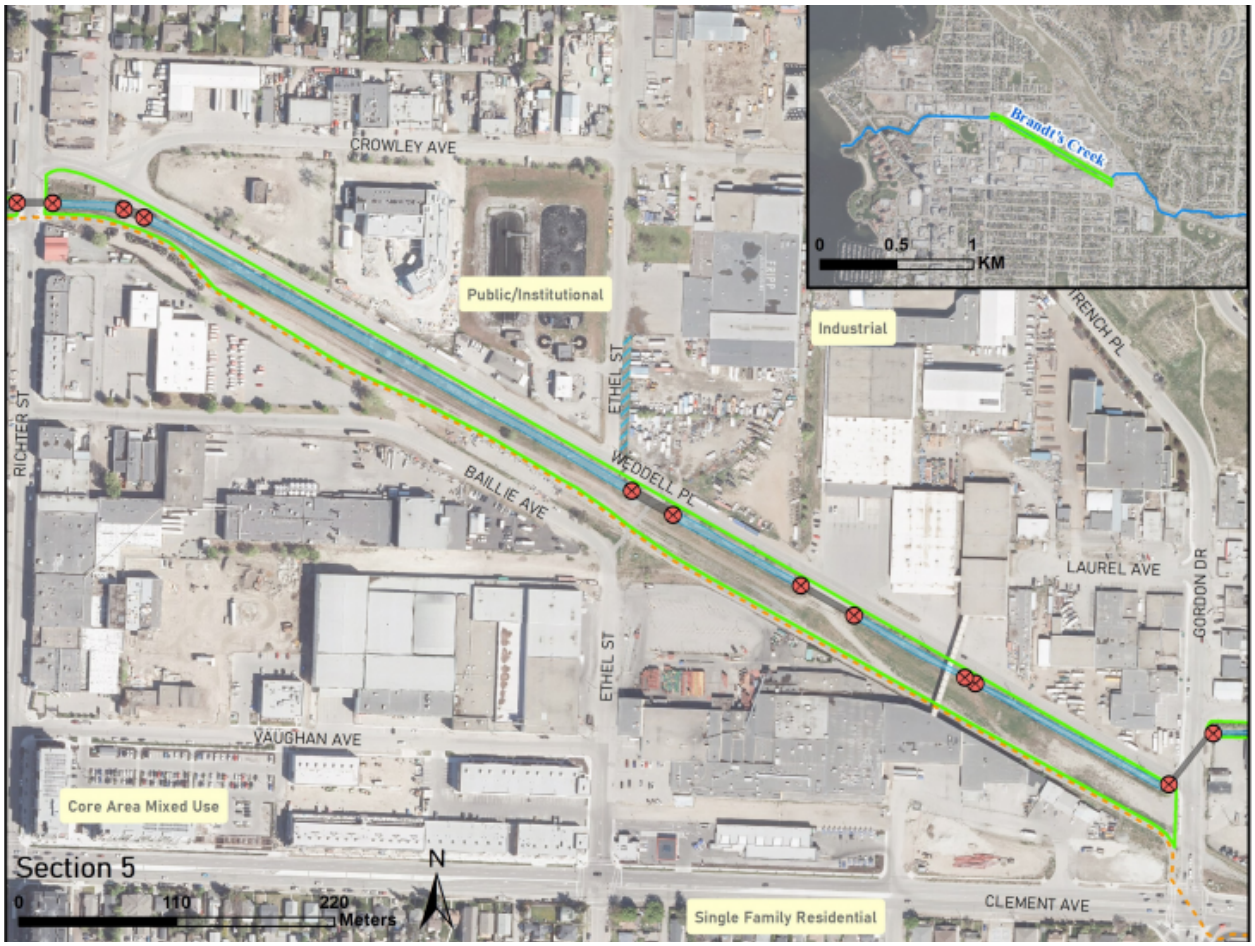
Figure 1.1 - Brandt's Creek Case Study Area



Note. The location of the Creek in relation to our study area.

This project is focused on a relatively small section of the creek, located in the North End of Kelowna's downtown in a semi-industrial neighbourhood that is also home to a growing brewery scene. The area is under significant pressure from gentrification, which risks displacing the significant unhoused community that lives alongside the creek in a city-approved campsite colloquially known as 'tent city'.

Figure 1.2 - Land Uses Near Brandt's Creek



Note. Proximity to mixed-use, residential, industrial, and public zones.

1.1 - History of the Landscape

Before European colonization, the Okanagan grasslands were "wide-open expanses where people, elk, horses, and sharp-tailed grouse freely roamed" (Blackstock and McAllister, 2004 p. 27). There was an abundance of wetland and riparian ecosystems at the valley bottom compared to today's more arid landscape (Lea, 2007, p. 6).

From early aerial photos, it seems the creek was initially a meandering waterway in a marshy landscape (Donald, 2023). However, as the City of Kelowna developed it began to be

channelised and routed underground (Donald, 2023; Thibeault, 2023)**.** European settlement began here in the mid-19th century, but it was with the official founding of the city in 1905 that sustained urbanization began, and the creek began to be managed to meet the needs of the growing human community.

From the mid-twentieth century, Kelowna's population grew rapidly: from only 13,000 in 1961 to over 60,000 in 1980 (Marsh, 2007). Kelowna was Canada's fastest-growing metropolitan area in 2021 and 2022 and is now the country's 20th largest city with a population of over 150,000 (McNaull, 2022). Downtown neighbourhoods like North End have witnessed some of the most intense development, housing over the decades a number of intensive industrial businesses including the Tolko Mill, the Sun Rype Factory, and Kelowna Winery, now named Sandhills (Thibeault, 2023; Lewis, 2023).

1.2 - Our Approach to this Report

As a group, we have decided to take what is known as a Systems Approach to our inquiry of Brandt's Creek. During one of the presentations provided by this class, we were visited by Dr. Lael Parrott who explains that the Systems Approach is a way to look at and define a landscape while keeping in mind all systems that weave in and throughout that landscape (2023). A Systems Approach allows us to take into account all the individual systems in our inquiry. In the context of this report, the systems within our landscape are: development, housing, community, water pollution and biodiversity. We felt that these systems best encompassed what Brandt's Creek is and how they fit into our chosen landscape.

Chapter 2.0 - Development

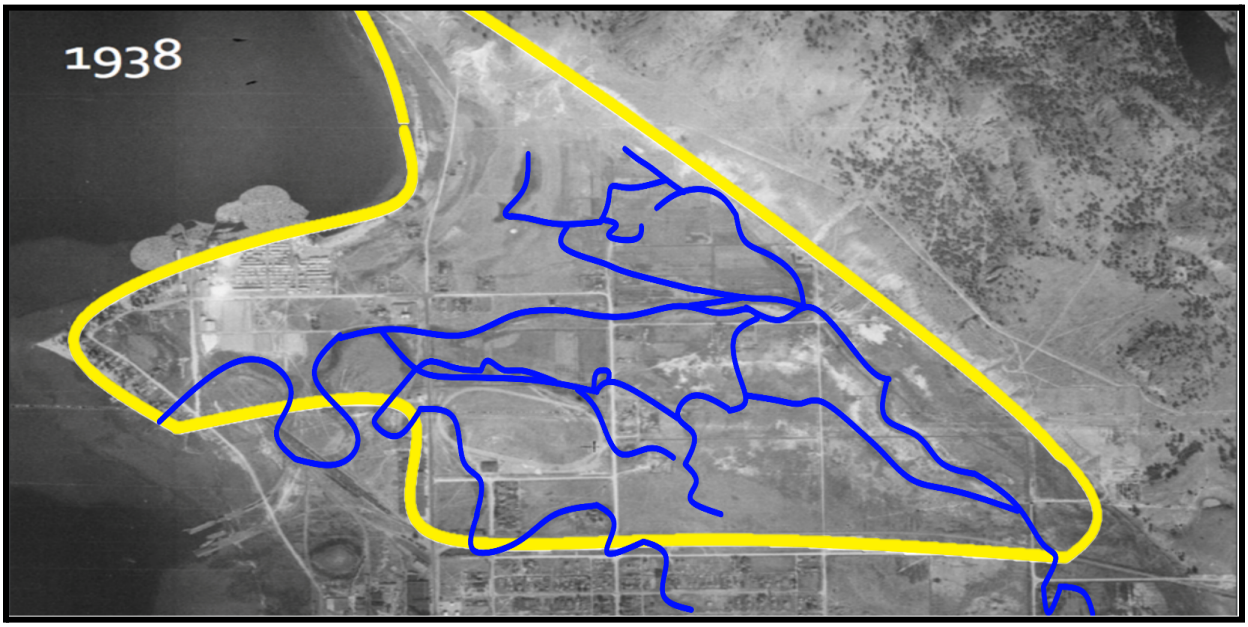
A meandering creek has the capacity to support and create diverse habitats for a wide range of plants and animal species. Meandering creeks also disperse nutrients along the creek and beyond its boundaries as well as control erosion and flooding potentials. The ability of a creek to meander relies heavily on its surrounding environment, especially the urban environment.

With the modification of a meandering creek in an attempt to channelize it, there are large impacts to the creek and the surrounding area. The part of Brandt's creek that this project is focusing on is a culvert that has seen intense modification and human involvement, and therefore is extremely vulnerable.

Figure 2.1 is a photo provided by Aaron Thibeault from the City of Kelowna of the area where Brandt's creek is located and was taken in 1938. As shown here there is evidence of multiple channels and streams and creeks within this area that allow the channels to navigate freely throughout the area. Figure 2.2 is a photo of this same area but in 2011 and the streams and channels that were in the previous photo are either hard to identify or have been removed completely. The removal and modification of the channels and streams and creek has created significant issues and will continue to increase the area's vulnerability to many climate change related issues, such as decreased availability of resources, reduced water usage, and increased impacts of flooding.

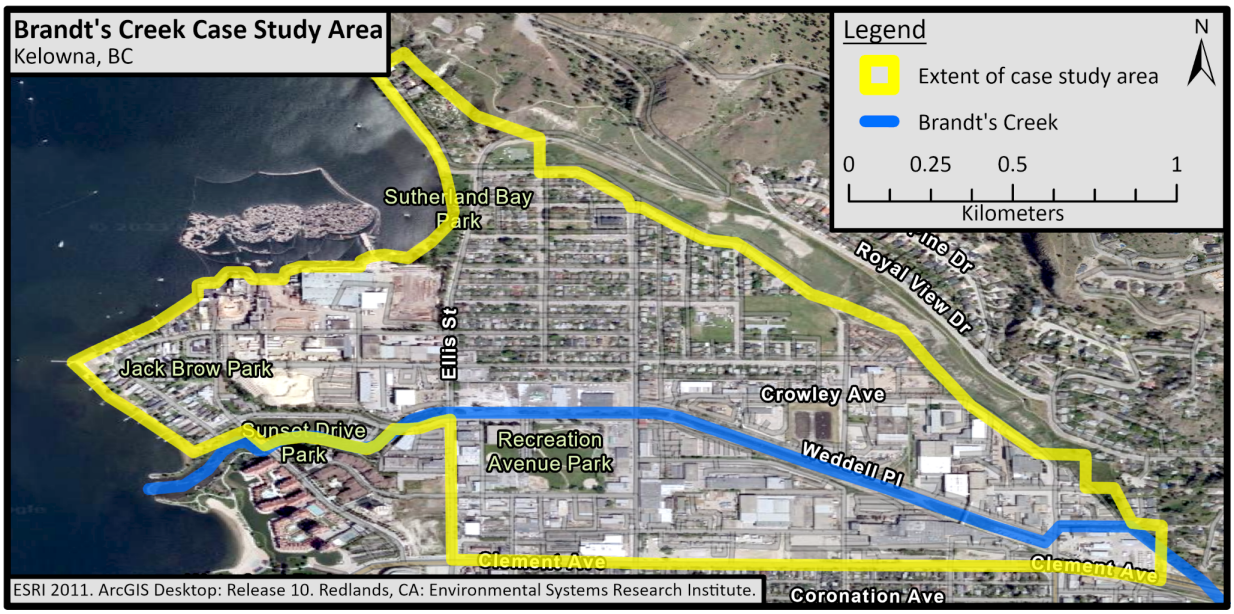
The "Channelization is the widening, deepening, and usually straightening of channels to

Figure 2.1 - Meandering of Brandt's Creek



Note. An aerial image of the Creek from 1938, before the land around it was developed.

Figure 2.2 - Channelization of Brandt's Creek



Note. A recent aerial image of the Creek and the developed land surrounding it.

increase their capacity to transport flood flows, and thus to decrease flooding of adjacent lands" (Schoof, 1980). Brandt's Creek has not only seen channelization but also intense modification with adverse urban development. The channelization of streams and its negative impacts is not a new idea in environmental literature, yet despite known environmental effects, urban development has only increased the modification and channelization of streams, rivers and creeks. "Humans have greatly modified rivers in order to exploit the natural resources they provide." (Poff, 2022) Some of the known negative impacts of modification include the spawning areas for fish are reduced if not removed completely by reducing the bends in a stream. Reducing the natural flora and fauna near the creek reduces nutrient availability. Channelization can also increase streamflow velocity which reduces algae ability to grow. This reduces other nutrients' ability to enter the channel and provide benefits to the channel. Channelization reduces fish cover and shelter which reduces fish populations further. Using the information from both Hans Schreier with his presentation on impervious surfaces to reduce floods as well as Aaron Thibeault with the development of the North End Neighborhood development plan there is a large potential for retrofitting the creek to bring back some of its natural features. The North End Development Plan is undergoing major urban development. There is potential for Brandt's Creek to continue to be modified as it is within the bounds of this plan. However, as Hans mentioned in his presentation about impervious surfaces increasing the negative impacts of climate change, there is a potential for green infrastructure development within these areas to reduce these impacts. Bringing back the creek's ability to meander would increase the overall sustainability of the creek in terms of its ability to support life, and decrease intense flooding episodes. At this moment, Brandt's creek is locked in by concrete on either side of the creek which is limiting its capacity to flow naturally and is also creating a higher potential for flooding as this is an

impervious surface. The North End development plan could consider increasing the area around the creek to be entirely consistent of soil, vegetation and flora and fauna.

The creek's natural ability to meander is reliant on increasing this area on either side of the creek that can support differences in water pressure and water amount. This would also improve the creek's ability to flow and meander naturally. The increase in natural flora and fauna would also promote and produce a diversity of nutrients to the creek that would support more life cycles. Some considerations of developing the area of Brandt's creek to include this expansion would be to ensure that there is at least 30 cm of topsoil on either side of the creek to ensure flood mitigation. Considering a swale near Brandt's creek could also be part of this development that allows for the collection of stormwater. Also considering increased vegetation and the planting of rain gardens near Brandt's creek would increase pervious surfaces that can ultimately control and manage stormwater. This approach considers how urban development planning can be used to enhance the natural environment rather than promoting increased modification of the creek. Urban development projects like the North End development Plan should consider the importance of a meandering stream and allow for the retrofitting of Brandt's Creek to allow for its natural ability to meander and support a diverse habitat and ecosystem.

2.1 - Mission Creek Example

Mission Creek is another creek that has seen intense modification and channelization and the inhabitants of this creek have experienced the repercussions of this. As discussed in regard to Brandt's creek, some of the advantages to de-channelization include, carbon sequestration, and this comes from enhancing the riparian zone in mission creek. Repairing spawning habitats to support the kokanee salmon and the rainbow trout. Another benefit of this restoration effort is its

anticipated chancement for stormwater capacity thus reducing flood risk immensely. Figure 2.1.1 shows a photo of Mission creek with the channelized creek and the restoration project's potential meandering.

Figure 2.1.1 - Potential Mission Creek Restoration

Note. A local example of restoring a creek to its natural flow.

According to the Mission creek restoration initiative resort, the initiative has received around 500,000 dollars in compensation from various city and provincial projects. In terms of attempting to provide tangible and related solutions, it can be assumed that a similar amount of funding would be needed for Brandt's Creek in order to reverse the damages of heavy modification and for de-channelization efforts. Some of the higher costs for the project were in

regard to land restoration that includes dyke removal and reconstruction (*Mission Creek a Background on Stream Restoration, 2011*).

Another aspect of this project was its heavy volunteer commitment, as the many volunteers that are committed to the sustainability of mission creek are what has driven the project immensely. This is something that Brandt's Creek could benefit from. Education and providing information about the creek and its potential benefit to the community could increase community care and perhaps drive volunteer efforts in restoration for the creek. This will lead into the next section regarding the development of the North End regarding the urban landscape surrounding the creek and ensuring it is conducive to positive human interactions with the creek. Creating an environment that is appreciated by humans could increase empathy for the creek and promote action. Just like Brandt's creek, the naturalizing and de-channelization of mission creek requires an interdisciplinary undertaking. One important aspect to consider moving forward is that, de-channelization and naturalizations of creek is not an impossible undertaking, the Okanagan River Restoration initiative was a great example of how de-modification is possible. The river saw a restoration of a 1.2km section to allow for meandering and naturalization of the stream in an attempt to bring back natural flora and fauna and an array of other benefits as discussed that comes with de-channelizing a stream (*Mission Creek a Background on Stream Restoration, 2011*).

Chapter 3.0 - Housing

Our Brandt's Creek urban renewal proposal also includes developing various housing options, including affordable and luxury housing, which will be offered in varying degrees of density. Our housing proposal has three goals: 1) to provide housing without gentrifying the existing community, 2) to facilitate social cohesion between people from different socioeconomic backgrounds by diversifying housing options, and 3) to provide sanctuary for the homeless population.

Kelowna's social, economic, and environmental conditions are best characterized by a trend favoring neoliberal ideals (Marten, 2009), which means our Brandt's Creek renewal proposal for housing must account for neoliberal obstacles. We identified three: 1) class monopoly rent and gentrification, 2) the prioritization of free-market principles and economic growth over social welfare programs, and 3) the prioritization of individualism over community-building.

3.1 - Literature Review of Neoliberalism and its Implications on Housing

To understand how to approach residential development in our Brandt's Creek renewal proposal, it is essential to consult current social, economic, and environmental conditions in Canada that affect housing. Marten (2009) argues that housing outcomes are a product of economic and political motivations and that there has been a notable ongoing shift to neoliberalism ideals. Neoliberalism is an economic and political ideology emphasizing the importance of free markets, individualism, and minimal government intervention (Harvey, 2005).

Since the 1980s, many cities worldwide have adopted neoliberal policies, significantly impacting their social, economic, and environmental conditions (Brenner & Theodore, 2002).

The federal government has restructured its financial responsibilities in Canada and transferred many tasks to provinces and municipalities following a neoliberal economic and political strategy (Marten, 2009). This has resulted in cities being given new funding obligations while funding sources are removed. This compels cities to implement innovative and business-oriented strategies to overcome financial shortcomings. Harvey (1989) argues that the role of local governments has changed from managing the city's economy and infrastructure to actively attracting investment capital to their area (p. 125). This has led to competition between cities to implement local policies prioritizing the appeal for investment, exports, tourism, and affluent residents (Aguiar et al., 2005, p. 125). Therefore, municipalities must accept opportunities that ensure funding, regardless of whether they offer only temporary benefits or result in additional financial commitments for the public to cover maintenance and repair expenses over the long term. Overall, cities in Canada have adopted a development strategy that caters to neoliberalism, which has implications for a city's interconnected social, economic, and environmental conditions.

Socially, neoliberalism has led to increased inequality and social fragmentation in cities (Peck & Tickell, 2002). The emphasis on individualism and free markets has created a winner-takes-all environment where those with the most resources and skills can thrive while others struggle. One way this transpires in a city is through class monopoly rent, also known as the mobilization of property for value enhancement. The commodification of private property is reinforced by protective legal mechanisms, such as those that usher away the presence of homeless people (Anderson et al., 2022). This has resulted in the concentration of wealth and

power in the hands of a few while many others have been left behind. For instance, the erosion of public housing programs and class monopoly rent have left low-income people without affordable housing options, resulting in increased homelessness and the spatial concentration of poverty in cities (Roy, 2009).

Economically, neoliberalism has encouraged the growth of the service sector at the expense of manufacturing and other productive industries (Heynen, Kaika, & Swyngedouw, 2006). According to Siu and Jaimovich (2018), this has created low-wage jobs with little job security, making it difficult for many people to afford homes or rental units. This leads to an increased need for affordable housing. Additionally, the deregulation of financial markets has led to increased financial speculation and instability, negatively impacting many cities' economies. For instance, this instability can artificially inflate housing prices, further contributing to the difficulty for people to afford a place to live. From here, the resulting housing crisis creates a domino effect where instability in the real estate market and the broader economy is exacerbated (Vale, 2017).

Environmentally, neoliberalism contributes to environmental degradation and the exploitation of natural resources for profit. This is because neoliberal policies have encouraged the privatization of public resources, which has led to the conversion of public lands into private properties for real estate development (Lees, 2014). For instance, the neoliberal policies adopted in India since the 1990s have allowed private developers to acquire public land for real estate development, leading to environmental degradation, biodiversity loss, and indigenous communities' displacement (Roy, 2009). Moreover, the neoliberal emphasis on economic growth and profit has often come at the expense of sustainable development and environmental protection (Marcuse, 2018). The deregulation of the real estate market, in particular, has led to

the growth of unsustainable practices, such as building on ecologically sensitive areas, without regard for the environmental impact. This has resulted in increased pollution and environmental degradation in many cities.

3.2 - Implementing our Housing Plan

3.2.1 - Addressing Gentrification

Providing new housing in urban areas while avoiding gentrification can be challenging. Gentrification refers to a process where investment in a neighborhood increases property values, rents, and property taxes, ultimately leading to the displacement of low-income residents. One way to address this issue is through Community Land Trusts (CLTs). These non-profit organizations hold land in trust for the community, protecting the land from speculative real estate practices and providing affordable housing to low-income families. Ensuring housing remains affordable long-term, CLTs can help prevent gentrification (Barnett, 2016). For instance, the Champlain Housing Trust in Burlington, Vermont, has successfully implemented CLTs to provide affordable housing.

Another policy that can help prevent gentrification is Inclusionary Zoning (IZ), which requires developers to include affordable units in new developments (Ramakrishnan, 2019), ensuring a mix of housing types and prices in a neighborhood. Montgomery County, Maryland, is an example of IZ successfully implementing over 12,000 affordable housing units (Rusk, 2006). Carvalho's (2021) research suggests that implementing inclusionary zoning in a neoliberal context has limitations. Therefore, to make it effective, several solutions should be considered: 1) Tailoring policies to local market conditions, which means taking into account the unique economic realities of each city or region when designing policies. For instance, land costs,

construction costs, and demand for housing vary in different places. Policymakers must consider these factors when implementing inclusionary zoning policies to make them feasible and practical. 2) Providing incentives to developers can encourage them to include affordable units in their developments. Incentives such as density bonuses or tax breaks can reduce the costs of creating affordable units. This option can be more appealing to developers who may not be able to include affordable units in their developments. 3) Allowing developers to pay into an affordable housing fund instead of requiring them to include affordable units in their developments is another solution. This option can be helpful for developers who may not have the capacity to create affordable units within their projects. 4) Monitoring the effectiveness of policies is crucial to ensure they are achieving their goals. Policymakers should collect data on the impact of inclusionary zoning policies on housing affordability and adjust the policies as needed to make them more effective. Overall, these solutions can help make inclusionary zoning policies effective in promoting affordable housing. Policymakers must balance promoting market-based solutions and affordable housing to achieve the desired results.

Policies like CLTs and IZ can help provide new housing while preventing gentrification and displacement of low-income residents.

3.2.2 - Facilitating Social Cohesion

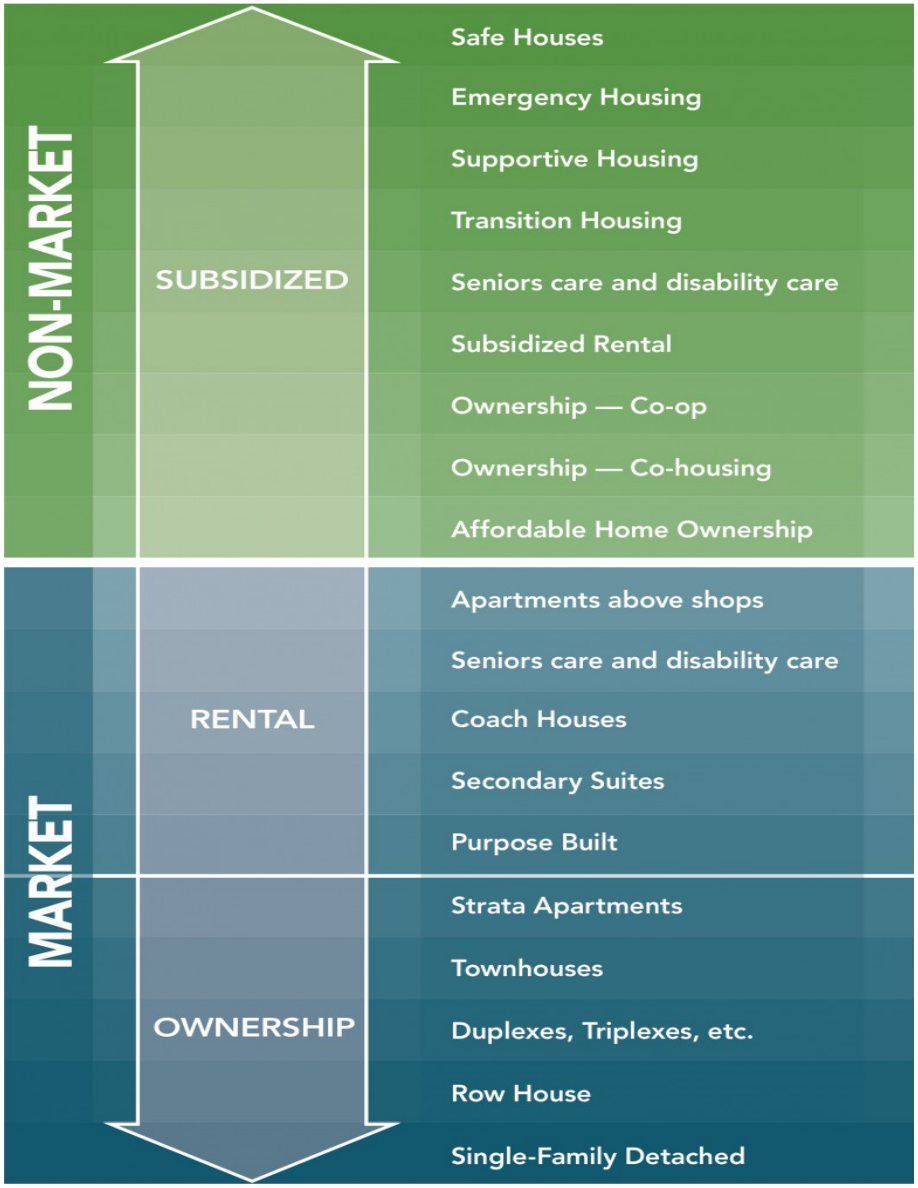
To facilitate social cohesion between people from different socioeconomic backgrounds, we recommend adopting the housing continuum strategy currently implemented in the District of North Vancouver (2016). The housing continuum framework recognizes various housing options for a community's diverse needs. As seen in Figure 3.2.2.1, this continuum promotes different

housing choices, from emergency shelters and transitional housing to affordable rental units and market-priced homes.

The housing continuum contributes to a vibrant, inclusive, diverse, and well-functioning community in several ways. First, it allows people to live in a home that suits their needs and financial situation, which can help promote stability, security, and overall well-being. For example, seniors may benefit from affordable housing options that cater to their unique needs, while young professionals may prefer market-priced housing options in urban centers. Second, diverse housing options can promote economic growth by attracting and retaining various businesses and workers. Affordable housing can help ensure lower-income workers can live close to their jobs, reducing commute times and improving productivity. Market-priced housing can attract higher-income earners, who may contribute to the local economy through spending and investments. Third, a continuum of housing options can promote social integration and diversity by bringing together people from different backgrounds and income levels. This can help to build stronger and more resilient communities, as people from diverse backgrounds can learn from each other, share resources, and work together to solve problems. The housing continuum also involves five critical actions for its implementation: 1) increasing the supply of affordable housing, which can be achieved through partnerships with non-profit housing providers, using incentives for developers, and creating new affordable housing units, 2) ensuring a mix of housing types and tenures, which means providing a range of housing options, from emergency shelters and transitional housing to rental and homeownership opportunities, 3) encouraging the redevelopment of underutilized sites for affordable housing, which involves identifying sites that could be used for affordable housing, such as vacant or underutilized buildings, and working with developers to redevelop these sites, 4) promoting housing

affordability through policies and programs, which includes implementing policies that promote affordable housing, such as inclusionary zoning and density bonusing, and offering programs to support low-income residents in accessing affordable housing, and 5) fostering partnerships and

Figure 3.2.2.1 - Housing Continuum



Note. A diagram of non-market and market housing options outlined by the District of North Vancouver (2016).

collaborating with community partners, such as non-profit organizations and developers, to create affordable housing solutions that meet the community's needs.

Overall, the housing continuum is essential for promoting various housing options that can contribute to a vibrant, inclusive, diverse, and well-functioning community. By recognizing that people have different needs and financial situations, communities can work to create a more equitable and sustainable housing landscape that supports the health and well-being of all its residents.

3.2.3 - Providing Sanctuary for the Unhoused Population

In addition to the housing continuum, the continuum of care already offered by Turning Points Collaborative (Sproing Creative, 2023) in Kelowna and the JohnHoward Society of Okanagan & Kootenay (2021) are initiatives that can be replicated in this renewal of Brandt's Creek. The care continuum consists of five services: 1) outreach programs designed to reach out and offer support to homeless people, 2) providing temporary shelter free of charge for those facing barriers to housing or experiencing homelessness, 3) providing short to long-term housing options depending on the nature of clientele's housing, economic, and health circumstances, 4) providing addiction recovery services, and 5) providing education and employment services. The resources needed to provide these services for the vulnerable population residing in the Brandt's Creek area can be made available by our other proposed solutions for addressing gentrification and facilitating social cohesion, such as IZ, which can contribute to an affordable housing fund and CTLs, which help keep land and housing affordable by protecting land from market speculation. Additionally, funds from British Columbia (BC) Housing is another potential source of funding for these care services.

3.3 - Conclusion

Our Brandt's Creek urban renewal proposal aims to provide diverse housing options, including affordable and luxury housing, while avoiding gentrification and promoting social cohesion among people from different socioeconomic backgrounds. However, our proposal must address obstacles posed by neoliberalism, including class monopoly rent, prioritization of free-market principles, and individualism over community-building. To overcome these obstacles, we suggest using CLTs to address gentrification and prioritize affordable housing. Additionally, we recommend promoting social cohesion by creating mixed-income housing developments, providing amenities that encourage community building, and managing the homeless population's needs through supportive housing. The housing proposal also considers environmental sustainability by prioritizing green building practices and creating public spaces that promote ecological awareness. Overall, our Brandt's Creek urban renewal proposal seeks diverse housing options while promoting social, economic, and environmental sustainability.

Chapter 4.0 - The Unhoused Population

This next section centers around the community of folks who live right next to Brandt's Creek. This is a community of unhoused folks who live in a designated outdoor camping space (Munro, 2023). For the purpose of this report, we would like to acknowledge that none of us writing this report are experts in homelessness, however we want to give dignity and humanity to the very vulnerable community that lives next to Brandt's Creek. This portion of the report will also not include any photos because the designated outdoor camping area is someone's home and that would be a violation of privacy. There is not a lot of information provided on the community living there due to their precarious living situations, therefore this portion of the report is comprised of news articles and government reports, that potentially do not reflect the entirety of this community's context.

To begin, there are approximately 1000 unhoused folks in the Central Okanagan area which covers Vernon all the way to Penticton, British Columbia (Seymour, 2023). In Kelowna, there are 400 visibly unhoused folks, however this number is just a guess (Seymour, 2022). The designated outdoor area near Brandt's Creek is locally known as "tent city" which at the time that the research for this report began which was January 2023, it was estimated that there were 60-100 folks living there (Munro, 2023). The space was only meant to hold 40 – 50 people and so overcrowding is becoming an increasing issue (Munro, 2023). As of April 24th, 2023, there was an article published on April 14th, 2023, that outlined the mandatory 'spring cleaning' that folks living at Tent City were required to do (Gelineau). When the above article was published mid-April, there are now 150 folks living in Tent City and the number is expected to grow as the weather increases in temperature (Gelineau, 2023).

It is estimated that by next winter 2024 there will be 100 more unhoused people living in Kelowna, this number is expected to grow due to the rising cost of living and inflation (White, 2023). Due to the touristic nature of Kelowna and somewhat temperate weather, there is a national push for folks from all over Canada to move to Kelowna as it is one of the fastest growing cities in the country (MacNaull, 2022). Kelowna had a goal that by 2024, homelessness would be brought to net zero, however, it is now estimated that the population of unhoused folks could double due to the push for more Canadians to move into the Central Okanagan area (Wheeler, 2020). This information comes from a report that further outlines how 8000 households in the Central Okanagan area are spending between 30 and 50% household income on rent which makes them susceptible to falling into poverty and potentially ending up unhoused (Munro, 2023). The research done on the unhoused community of Kelowna shows how this community is inexplicably tied to Brandt's Creek, meaning that nothing related to the creek can occur without taking into account the folks that live near it.

4.1 - COVID-19 Implications

To give some information regarding the Canadian context of houselessness, in cities like Calgary and Edmonton there was a decrease in houselessness pre-pandemic, however, the context surrounding the pandemic has increased chronic houselessness by 46% (Seymour, 2022). This report further explains how despite there being help wanted signs all over the Central Okanagan area, the hourly wage being offered by businesses is not enough to cover rent and the cost-of-living within the Central Okanagan area (Seymour, 2022). Between the lasting effects of the pandemic and rising housing costs has greatly affected the unhoused community (Seymour, 2022). Pre-pandemic there were approximately 200 beds for unhoused folks in shelters across Kelowna but because of social distancing guidelines throughout the pandemic, the number of

beds had to greatly decrease in order to prevent the spread of COVID-19 (Wheeler, 2020). COVID-19 has affected every person and so it is no surprise that the unhoused folks have also been implicated by the pandemic, arguably at a much deeper and harmful rate than some folks due to the lack of resources for folks living in precarious living situations.

4.2 - Local Help

Due to this report being looked at from a systems perspective, there will be information provided that look into the local, provincial, and national implications of houselessness within Canada. Currently in British Columbia, the provincial government defines houselessness as folks living unhoused for 30 or more days (British Columbia Government, 2009). This policy provides an interesting perspective because it was written in 2009 which now seems quite dated and as well does not take into account folks living in other unstable forms of housing like living in their car, couch surfing and any other precarious living situations.

In January 2023, a pilot project emerged which came in the creation of 27 insulated shelters (Peters). The shelters are shaped like a burrito, sleeping bag only with more room. They were given out on a first come, first serve basis (Peters, 2023). Folks who tried the shelters said they were not that different from tents and overall were not that much warmer even though the intention was to provide a warm shelter to unhoused folks in the winter (Peters, 2023).

One local organization that does a lot of work with the unhoused community is Kelowna Gospel Mission. Kelowna Gospel Mission is a religious charity that has been around for 40 years, their goal is to give humanity and dignity back to the unhoused community (2020, 2021). They often provide humanity and dignity through warm meals, coffee and conversation (Kelowna Gospel Mission, 2020, 2021).

4.3 - National Help

In 2018, the Canadian government invested 22 billion dollars into the Opportunity For All policy which was meant to lift 650, 000 Canadians out of poverty (Statistics Canada, 2018). There was no further information on this policy and if it ever saw any of its implementations through, which could be due to the pandemic.

4.4 - Conclusions

Through our research of Brandt's Creek, it is clear that no revitalization efforts can be made without proper acknowledgement and inclusion of the unhoused community living near the creek. Folks who are unhoused are often not seen or heard and it is our belief that ethically, the city of Kelowna cannot change anything regarding Brandt's Creek without first taking into account the folks that live there. It is our hope that Kelowna will see this project from a systems perspective, in that the unhoused community is a large part of that system.

Chapter 5.0 - Water Pollution in Brandt's Creek

5.1 - Urban and Agricultural Pollution

Water quality can be a challenging issue to address, especially in an area where many small sources contribute to overall pollution. In Kelowna, many relatively small creeks and streams flow through the city, outflowing into Okanagan Lake. Brandt's Creek in particular flows through industrial and agricultural lands, immediately depositing into a constructed marsh before emptying into the lake. Maintaining water quality in Brandt's Creek requires action within three areas: its upper watersheds (Glenmore area), agricultural/industrial areas (North End district of Kelowna), and urban developed areas (stormwater drainage which joins Brandt's Creek underground and via culverts). Healthy riparian ecosystems are vital to water quality in upper watersheds, and mitigation of extreme runoff from streets and agricultural lands is important in lower areas of the watershed.

According to the Okanagan Basin Water Board 2020-2024 Strategic Plan, addressing water pollution is one of the main goals for the near future of Kelowna's watershed (OBWB, 2020). Main concerns stem from increased demand and strain on stormwater drainage systems due to rapid development and population increase in the city of Kelowna. Emerging contaminants and their role in the stormwater system is one point where more research is required, since stormwater and Brandt's Creek drain untreated immediately into the Okanagan Lake - the primary drinking water source and ecological necessity of the valley. Stormwater drainage systems are put under most stress during severe and frequent rainfall events, which are likely to be seen more often due to climate change impacts.

Unlike in natural water systems, urban landscapes disrupt the natural flow of surface water. Soil and vegetation in natural environments allow rain and melted snow to permeate through the soil into the groundwater reservoir. The process allows for natural filtration and cleaning of surface waters; bacteria, plants, and soil cleaning the water in a natural way. Heavily industrialized landscapes abundant in concrete and cement block this natural flow of water, thus preventing the ecosystem service of water cleansing to occur naturally. The phenomenon of surface water pollution caused by urban runoff systems and stormwater drainage has been studied since the mid twentieth century (Müller et al., 2020). Early studies identified total suspended solids (TSS), trace metals, and nutrients (nitrates and phosphates) as common pollutants in urban systems (Horkeby and Malmquist, 1977; Laxen and Harrison, 1977). In addition, heavily modified landscapes (i.e., cement surfaces, sloped roofs, etc.) introduce foreign pollutants such as oil, chemicals, and debris which become concentrated as water collects and gathers in drains, ditches, and over paved surfaces, much like the system of Brandt's Creek and Okanagan Lake in Kelowna's North End district. Urban water pollutants include lawn fertilizers which can contribute to eutrophication and algal blooms. Chemicals from car washes, waste sites, and manufacturing also contribute to water pollution. Neighborhood streets are nonpoint sources of pollution as vehicle exhaust, automotive chemicals, and other tracked-in elements (tire residues from a cement plant for example) deposit on the road over time and during a rain event are quickly flushed into drainage systems.

Mitigation of water pollution in urban systems is important, but also can be challenging to address at the individual level. Action is required at the broader scale, coming from city planning and bylaw officials. In residential planning, it is important to be thoughtful of limiting concrete coverage as much as possible, directing rain gutters over green space, for example. Any

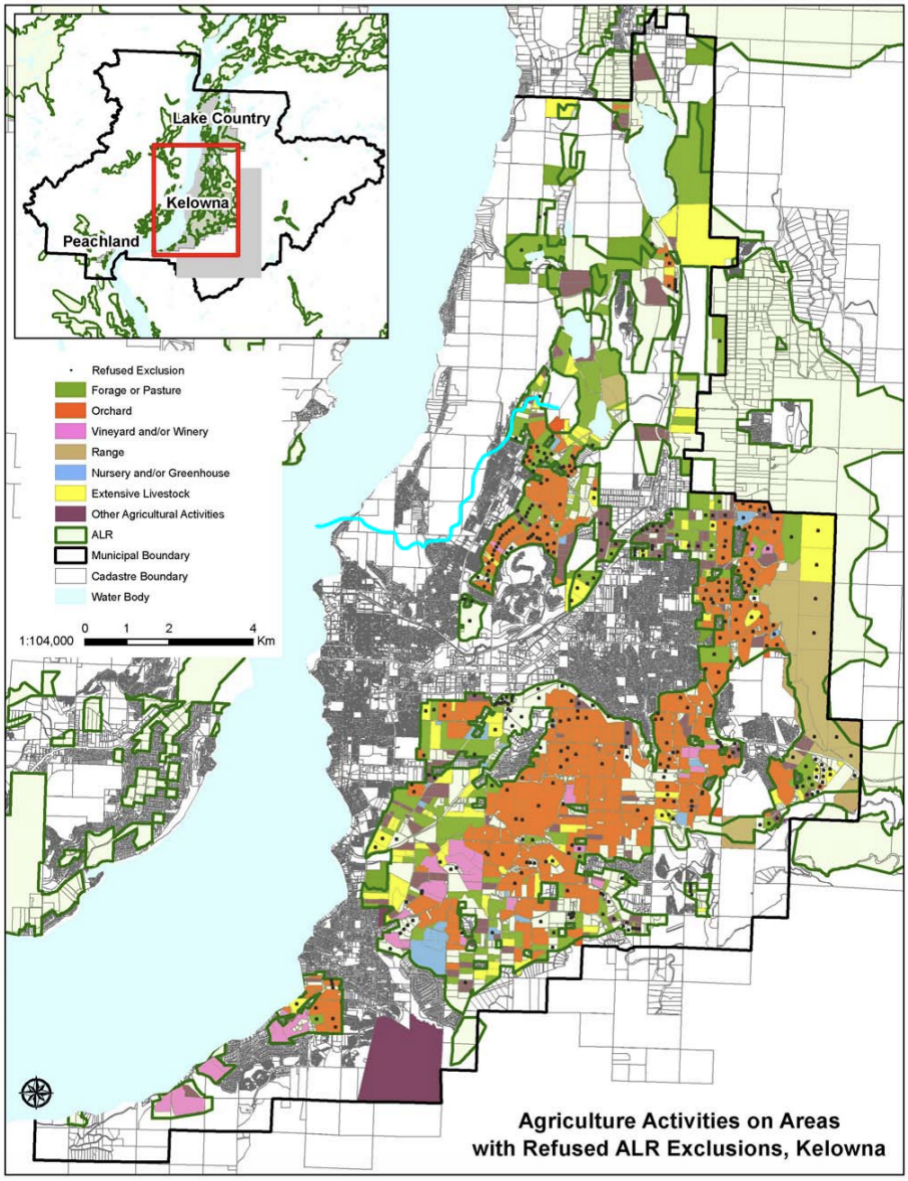
stored household chemicals, fuels/oil should be inspected to prevent leaks. Careful planning of densification in neighborhoods is required to avoid complete coverage of land area into carriage homes. This is currently relevant to the North End redevelopment plan in Kelowna as elaborated to our course by Dr. Hans Schreier. The choice of garden plants also can have an impact; native species generally require less pesticides and fertilization maintenance than traditional lawns and also help to reduce water runoff from the surface with their deeper root systems (Government of British Columbia, n.d.).

Another common use of land in the area of Brandt's Creek watershed is agriculture, especially in the upper portion of the watershed in the Glenmore area (Figure 5.1.1). A significant portion of Kelowna's land base is agricultural, with 55% of land base zoned for agriculture, and almost 40% of the city in the Agricultural Land Reserve (ALR). The crops that are produced in the Okanagan distinguish Kelowna from the rest of the province, Canada, and increasingly, the world. The Okanagan is notable as one of only three major fruit growing regions and one of only two grape growing regions of Canada.

Orchard crop agriculture can negatively impact water quality because of the use of harsh chemicals on plants which can be washed away easily during rain events directly into creeks in the upper watershed. Fruit production typically uses a great deal of pesticides as compared to other types of crop production such as cereals or horticultural crops. Surface runoff is the main way fruit production activity contributes to surface water pollution issues (USEPA, 2002). Although to a lesser extent in the Okanagan, broad acre farming contributes to water pollution as it disturbs topsoil leading to soil erosion, adding influx of sediment loading into waterways. Sediment loading (or TSS) is another one of the main types of water pollution associated with crop production. Animal agriculture can also contribute to water pollution via excessive nitrogen

loading from manure and overgrazed soils.

Figure 5.1.1 - Brandt's Creek and its Proximity to Agricultural Lands



Note: Brandt's Creek is highlighted to show how it is adjacent to many Glenmore area farms.

Mitigation of these problems is a major challenge for the large scale agriculture industry. Excessive use of chemicals (fertilizers and crop protection products) has become synonymous

with agricultural activity, especially in the Okanagan where the extremely high value crops (cherries, stone fruit, wine grapes, etc.) are heavily chemically treated in order to guarantee yields. A more mindful usage of chemicals is necessary - implementing best management practices such as the 4 R's. The 4 R's is the principle of on-farm stewardship to balance the use of chemicals at the right source, right place, right time, and right rate (Fertilizer Canada, n.d.). Soil erosion can be limited by following no-till practices, and proper grazing management for animals. Much like the challenges in city and urban planning, the costs of implementing more sustainable agriculture practices which cause less harm to the surface water are more prohibitive and often possible only for farm holders with significantly more land area or capital than average.

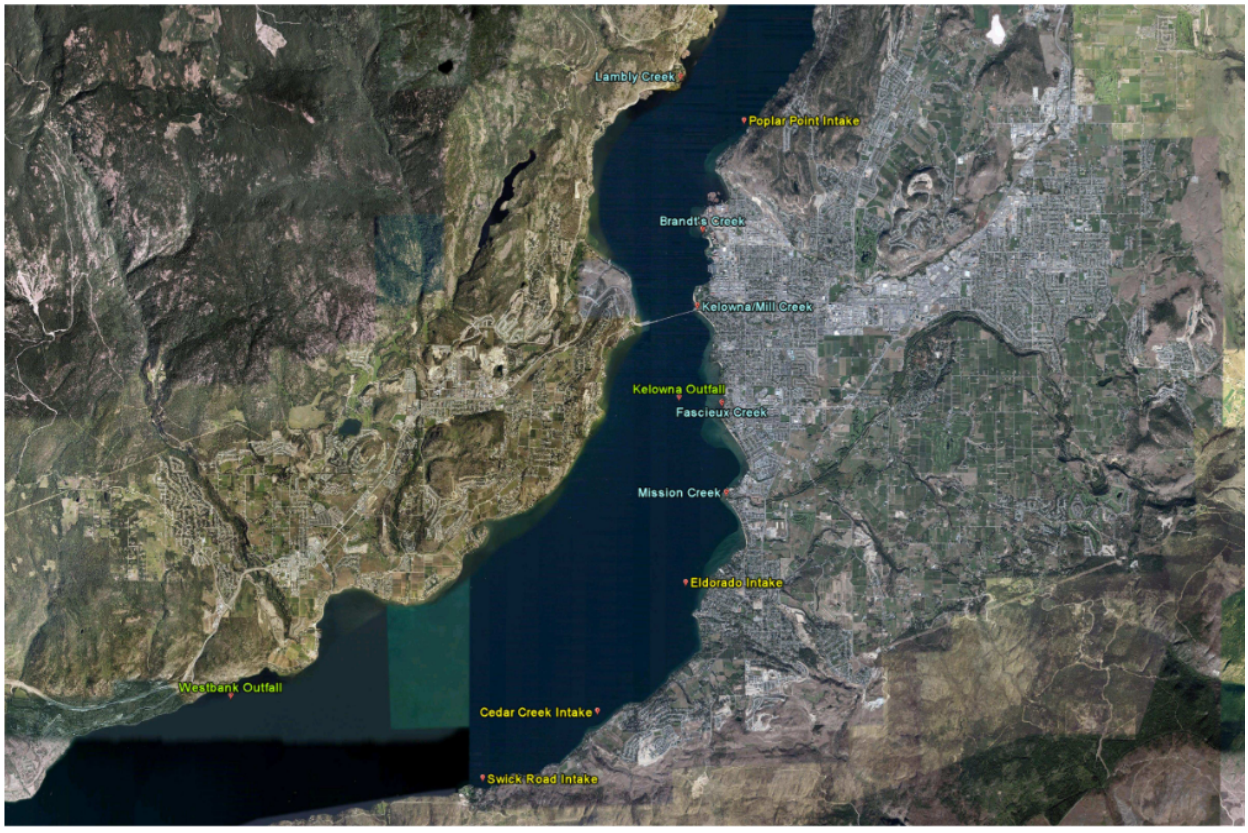
5.2 - Industrial Pollution

Urbanization is universally associated with a range of environmentally problematic characteristics, including higher population densities and higher concentration of economic and industrial activities, which consequently results in higher waste generation within a smaller, confined area. To complicate things further, impervious surfaces, a common feature of urbanization, enables the build up of urban pollutants such as oils from vehicles and other chemicals over the course of weeks and months. These concentrated pollutants are then readily washed into urban waterbodies in the event of rain or flooding, a phenomenon known as “first flush” (Maniquiz-Redillas et al., 2022) which causes severe harm to the ecosystem of the waterbody.

Storm water, industrial and agricultural runoff are major concerns for any urban waterbody (Müller et al., 2020), and the same is true for Brandt’s Creek (EBA, 2011). The case

of Brandt's Creek is particularly interesting and concerning, since this creek receives agricultural runoffs upstream, which in turn flows downstream and mixes with industrial pollutants (BC Ministry of Environment, 1990) and stormwater, exacerbating the pollutant load of its stream. Furthermore, the pollution of Brandt's Creek not only deteriorates the water of the creek itself, but has also been identified as a major source of pollution for the lake Okanagan due to the geographic landscape of the region (EBA, 2011). The five creeks flowing through the jurisdiction of the City of Kelowna contribute more than a third of the inflow of the lake (EBA, 2011).

Figure 5.2.1 - Outfall Locations of the Major Creeks in Kelowna



Note. (EBA, 2011)

Industrial pollution, in particular, is a major concern for Brandt's Creek due to its proximity to multiple large industries in downtown Kelowna. The proximity of Brandt's Creek to the city's North End industrial area appears to be a longstanding source of mutual nuisance for both the creek and the industry owners, as opined by Mr. Aaron Thibeault, a planner working for the City of Kelowna's North End Plan (NEP) which covers the area of the creek (Thibeault, 2023). Brandt's Creek is a low flow creek (EBA, 2011), which limits its usability as a source of water for the industries and agriculture compared to the larger creeks such as Mission creek. As a result, industries have used it for a long time to dispose of their wastes. According to Mr. Thibeault, the creek's poor prospects and value as a source of water may have also been the major driver behind the channelization of many of its segments, with the aim being to put it away from sight or get it out of the way for industrial and residential development.

In fact, based on the aerial footage of the area across the span of nearly 7 decades, Mr. Thibeault believes that the creek may have already been relegated to serve the function of an industrial sewer by the year 1938. This would not be surprising, given that in the context of the colonial mentality of the past, the value of a natural feature such as Brandt's Creek depended solely on its ability to provide anthropocentric utility such as water for irrigation or power generation.

Unconfirmed accounts of the water of Brandt's Creek turning red with pollution from a grape processing factory and the stories of deer getting drunk on the water from the creek all give traction to the sordid history of its mistreatment. According to the 2011 Drinking Water Source Protection Report by the City of Kelowna, along with storm water and agricultural runoff, partially treated industrial wastewater from the Brandt's Creek Trade Waste Treatment Plant, which receives wastes from the SunRype and other manufacturing plants, was also being

discharged into the creek in copious quantities (EBA, 2011). It was reported that nearly 73,000 cubic metres of high-phosphorus and high coliform laden industrial wastewater were released in Brandt's Creek back in 2002 alone (EBA, 2011).

More recently, in the 2017 City of Kelowna Tradewaste Treatment Annual Report, it was mentioned that while still being authorized to discharge its effluent into Brandt's Creek, the

Figure 5.2.2 - The Sun-Rype Factory

Note. A significant contributor to Kelowna's economy, and has been operating adjacent to Brandt's Creek for more than half a century (WesternGrocer, 2021).

the entirety of the effluent from the treatment plant is now being sent to the Kelowna Wastewater Treatment Facility (WWTF) for advanced treatment (Gosselin, 2018). However, a noticeable improvement in the water of the creek could not be seen as late as 2021, with the water of Brandt's Creek consistently ranking worst amongst all the five creeks of the area across all 10 measured parameters, as reported in the 2021 Annual Drinking Water and Filtration Deferral Report (Hoppe, 2022). In this regard, the first flush phenomenon was identified as being a major contributor to Brandt's Creek's pollution in recent times (Hoppe, 2022). The report highlighted

Figure 5.2.3 - Brandt's Creek Trade Waste Treatment Plant

Note. A facility responsible for discharging wastewater, notably from industrial uses, among other things (InfoNews, 2015).

that the highest concentration of suspended solids, E. Coli, turbidity and other contaminants were

observed in Brandt's Creek during the first flush events between March and October (Hoppe, 2022).

While Brandt's Creek has been held in very low regard throughout most of the history of the expansion and development of Kelowna city, mass awareness regarding water pollution and its threat to the city's water supply was raised by the Okanagan basin study of 1972 (Foweraker & Le Breton, 1972). It is estimated that this is around the time when mitigative measures had started to be implemented, as evident by the appearance of structures resembling pollutant settling ponds in the aerial image of the creek's lake Okanagan outflow point by 1985.

Due to the increased level of awareness and education regarding pollution and environmental sustainability amongst the mass population over the last few decades, the sustainability of the creeks of Kelowna is a much more serious policy topic at this time. As opined by Mr. Thibeault, despite financial constraints, there exists a genuine care and concern within the Kelowna city council and the policymakers to protect and improve the creeks and the overall environmental quality of the city. Accordingly, a range of measures have already been taken to protect and improve the water quality and pollution situation of Brandt's Creek and the other creeks, such as measurement of water quality at the mouths of the creeks, first flush analysis, as well general water quality measurement at regular intervals five times every month (Hoppe, 2022). In order to obtain a holistic picture of the overall health of the water flowing through these creeks, a wide variety of parameters are examined in these monthly quality tests, including but not limited to ammonia content, chloride content, water conductivity, apparent and true colour analysis, dissolved oxygen and E. Coli load, etc.

Although extensive data is being collected on the water quality of the creeks by investing public funds, no clear indication could be found with regards to the purpose, if any, that this data

is serving to improve the water quality of the creeks. Effective utilization of such data to make informed decisions regarding the water quality and sustainability of Brandt's Creek is of paramount importance and should be considered as a starting point by the stakeholders.

Innovative techniques and concepts which protect and prioritize ecosystem health and services need to be chosen over synthetic alternatives. Implementing the concept of green infrastructure at the private and public level, such as through green driveways and swales along the roads can significantly minimize the stormwater and first flush pollution load by improving

Figure 5.2.4 - Urban Green Infrastructure

(a.) Green Driveway **(b.) Green Swales**

Note. Examples of private and public uses of urban green infrastructure with (a.) a green driveway (Dalley, 2017) and (b.) green swales along a road (susDrain, 2023).

groundwater infiltration (US EPA, 2022). This will also facilitate percolation and recharging of the groundwater table, which is a very important consideration for a dry region such as the Okanagan (Environment Canada, 1992). In this regard, case studies of success stories employing a mixture of socio-economic sustainability policy measures at the city level, such as that of the New York City watershed program (Appleton, 2002), may prove to be especially inspiring.

While attention is finally being paid to the creek's water pollution, it is important not to forget that the North End industrial zone also contributes to significant air pollution in the area, particularly the heavy industries such as the ready mix concrete industry. According to Mr. Raymond Lewis, spokesperson for the Kelowna Downtown Knox Mountain Neighbourhood Association, the Kelowna ready-mix concrete factory has been a source of fugitive air pollution in the area for an extended period of time, affecting not just the environment, flora and fauna, but also causing significant harm to the health of the residents of the surrounding areas (Lewis, 2023). The best way to manage the overall environmental situation in the North End industrial area would involve an integrated, holistic management plan which can allow the industries to grow while addressing the needs of the local communities and the ecosystem at the same time.

Chapter 6.0 - Biodiversity in Brandt's Creek

The Okanagan contains a complex and rich "mosaic of intermixed ecosystems" (Lea, 2007, p. 5). This attracts a diverse mixture of plants and animals, many of which are endangered and some of which are not found anywhere else in the world (Wagner, 2008, p. 24). Around 60% of the Canadian Okanagan has been classified as "very high or high conservation ranking", and the region has some of the highest concentrations of species and habitats in Canada (OCCP and SOSCP, 2014).

The Okanagan valley is also a "critical pinch point" for north-south species migration (Parrott et al, 2019, p. 205). Wildlife moving from the Columbia Basin in the US to the BC interior grasslands traverse the valley bottom (Ibid.). However, this vital wildlife connectivity is under substantial threat from the accelerated development taking place across the Okanagan. Population growth is exploding in municipalities like Kelowna, and as a result wildlife movement is impeded by the growth of urban settlements and infrastructure such as roads at low elevations.

The planet is in the midst of the sixth mass extinction event (Cowie et al., 2022). Global extinction rates have reached between 50 to 1000 times the stable, natural "background level" of extinction (Heise, 2016, p. 21). Unlike the previous five mass extinction events, this time it is human activity that is driving the process. Habitat loss, anthropogenic climate change, pollution, declining landscape connectivity. The ways in which humans are contributing to a massive decline in biodiversity globally are numerous, and inextricably tied to neoliberal capitalist structures, and especially in contexts like Canada, colonial logics extraction and expansion.

In this context of unprecedented species loss, biodiversity 'hotspots' like the Okanagan are increasingly precious and in need of active protection (OCCP and SOSCP, 2014). Urbanization is not going to be undone, so how can we work with urban landscape to facilitate the protection of biodiversity? Working with existing natural resources like Brandt's Creek is an important first step.

6.1 - Concerns

Even a cursory survey of the creek, particularly our study section along Weddell Place, reveals a number of significant biodiversity concerns. We have highlighted some of the most pressing below.

6.1.1 - Invasive Species

The difference between native and non-native species is often overstated, it is not as simple as native 'good' vs. non-native 'bad'. Non-native species have been found integrating with ecosystems and supporting native species surprisingly often (Goodenough, 2010). However negative interactions of course also occur, and in Brandt's Creek there are number of invasive species that are cause for concern. The *Siberian Elm*, for example, is an extremely fast-growing deciduous tree that outcompetes native species to a dangerous extent. It can be found growing all along the creek (Donald, 2023). Similarly *Watercress* is growing in the creek; this plant multiplies rapidly and can quickly choke-up a narrow waterway such as Brandt's Creek (Ibid.). Watercress has to be cleared from the creek regularly to keep the water flowing, and therefore represents a significant issue (Ecoscape, 2007). The risk of these species is not that they are non-native, but that they are threatening the survival of other species, and impeding the water flow with potentially deleterious impacts on other aquatic life.

6.1.2 - Channelization

As discussed in previous chapters, Brandt's Creek has been significantly channelized and 'improved' to such an extent that it no longer resembles the meandering waterway it once was. Channelization creates a number of biodiversity issues. In particular, the lack of meandering and straightened waterway deprives fish of cover habitat and places to rest out of the flow of the water (Lorenz, 2016).

6.1.3 - Pollution

As discussed in previous chapters, Brandt's Creek has worryingly high levels of pollution and we identified a number of sources including agriculture and industry. As well as a threat to human health (especially when one considers that the creek feeds into Okanagan Lake, a popular swimming spot), this polluted water threatens other species' health. It is well established in the scientific literature that pollution has a catastrophic impact on aquatic life with cascading effects through the food chain (Liboiron, 2021).

6.1.4 - Lack of Cover

A 2007 habitat inventory reported that Brandt's Creek as a whole was devoid of riparian shrub and tree cover along 63% of its banks (Ecoscape, 2007). We would speculate that this number would be even higher in our study section, as upstream in Glenmore the creek is surrounded by much more greenery. An absence of riparian cover leaves aquatic species more exposed to predators, as well as the impacts of extreme weather events (Ibid.).

6.2 - Opportunities

6.2.1 - Rotary Marsh

Walking just a few minutes downstream from our study section of Brandt's Creek and you reach what appears to be a completely different waterway. Along Sunset Drive Trail and into Rotary Marsh the creek meanders and is significantly greener. Rotary Marsh is also home to a significant number of bird species. This difference is the result of restoration projects in the 1990s. It gives us a model, literally using the same creek, of what our study section of Brandt's Creek *could* look like with the right care and restoration efforts. Having an example, and a successful one at that, to use as a model will be a powerful tool in persuading stakeholders of the potential the rest of the creek holds as a biodiversity sanctuary.

6.2.2 - History

Another example that we can use to both design our restoration efforts and demonstrate to stakeholders the potential value of the creek is to look at its history (Thiebault, 2023). As discussed in previous chapters, we know Brandt's Creek was once a far more substantial waterway, meandering across the landscape. It has the potential to be restored to something closer to its original state, while working within the limitations of the now urbanized downtown.

6.2.3 - Existing Biodiversity

Even though our study section of the creek is in a poor state as a habitat, it continues to attract a diversity of species. Mule deer congregate in the area, fish can be found in the waters, and muskrats have been spotted (Lewis, 2023). If the creek is already supporting so much life in its current state, then it is exciting to imagine the haven for biodiversity it could become with the right care.

6.2.4 - Connections

The Mule Deer that are often found at Brandt's Creek are thought to come down from Knox Mountain, just a couple kilometres away (Lewis, 2023). This is promising as it hints at the creek's potential as a wildlife corridor. As well as Knox Mountain, the creek also connects to Okanagan Lake, another important habitat, as well as the aforementioned Rotary Marsh wetlands sanctuary. There is, therefore, significant potential with the right restoration efforts for the creek to act as a wildlife corridor through downtown Kelowna, connecting important habitats. As discussed above, landscape connectivity is both essential and under threat in the Okanagan, and even smaller corridors like the creek will be essential in facilitating species movement.

6.3 - Recommendations

6.3.1 - De-channelization

De-channelizing the creek and allowing it to meander will have enormous benefits for the biodiversity health of the creek. It would create more habitat for riparian and aquatic species, as well as reducing erosion and thus protecting plants growing alongside the creek. How this dechannelization could be accomplished is discussed in section 2.0.

6.3.2 - Daylighting

Significant segments of the creek have been routed underground. Daylighting these parts of the waterway (bringing them back aboveground) will allow the creek to function as a fully connected wildlife corridor.

6.3.3 - Tree Planting

Planting of native riparian shrubs and trees along Brandt's Creek will provide a number of benefits. It would provide greater cover for fish species; shade the water and lower the temperatures (essential for aquatic life health, particularly during the extreme heat events that are becoming increasingly common with the changing climate); provide habitat and food for birds; and provide food and shade to other visitors to the creek like deer. The invasive watercress discussed above thrives in the sunlight, so improved riparian cover would also help to manage its spread (Ecoscape, 2007).

6.3.4 - Pollution Control

In previous chapters we identified a number of strategies for pollution control at the source, these would undoubtedly benefit the biodiversity health of the creek. There is also a potential for a positive feedback loop: strategies to improve biodiversity can also help manage pollution. Meandering the creek would slow the water flow, allowing pollutants to settle and more aquatic plants would help to filter and purify the water before it enters the lake. As the pollution decreases, biodiversity in the area should increase, and so on.

Chapter 7.0 - Conclusion

In conclusion, by applying a systems approach to our analysis of the sustainability and resilience of Brandt's Creek, we have been able to develop a multi-layered analysis of the challenges and opportunities the creek presents. The systems we investigated included development, housing, community, pollution, and biodiversity. By looking at the entire picture, we were able to present recommendations that take consider and cater to these different, intersecting, systems.

Our group was significantly strengthened by the interdisciplinary experience among us. The different aspects of sustainability and resiliency that were required to properly assess and create an action plan provided a solution where our different disciplines were highlighted. Approaching the sustainability and resilience of Brandt's Creek from an interdisciplinary perspective provided the necessary background to apply a systems approach. From here, the project utilized the information shared from the various guest presentations. This enhanced the project's interdisciplinary approach which was implemented in the project. For example, using Aaron Thibeault's information regarding the City of Kelowna's North End Development Plan, the group was able to create more tangible and realistic solutions based on the city's plans.

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Reflections on Reflections

Daisy
Individual Reflection
Before approaching this project I understood resilience and sustainability to be primarily related to ecology. Developing our proposal for Brandt's Creek, working with such an interdisciplinary group, and hearing from such a diversity of guest speakers significantly changed this perspective. I now understand sustainability and resilience to be multifaceted concepts that encapsulate not only ecology and the natural environment, but the built environment, human communities, and cultural dimensions. I found the systems approach outlined by guest speaker Professor Parrott to be particularly transformative for my understanding of the key concepts of sustainability and resilience.

Reflection on Reflections
It is great to see that many of us shared similar experiences in terms of valuing the interdisciplinary experiences within the group. I definitely agree that this strengthened our group, and allowed us to analyse the 'problem' of Brandt's Creek from a diversity of perspectives. While it was initially challenging to collaborate across such different disciplines, I found the process of working to align our expectations and methods rewarding and a great experience for future interdisciplinary collaborations.

Shaiyan
- *Individual reflection*

Being an environmental management major, coming into this course I already had some idea about the concept of resilience and sustainability from my undergraduate training. I believe this course helped me to significantly refine and mature those ideas. One of the aspects of this course that I particularly liked and found useful and interesting was the emphasis on knowledge mobilization. While academics across the world work tirelessly to innovate and generate knowledge, the reality is that there exists a disconnect between academia and the other branches of society such as government, industry, the general public and so on, with the latter components struggling to keep up. The focus should therefore be to emphasize the mobilization of knowledge to ensure that it contributes to the actual improvement of society.

Regarding the sustainability and resilience of Brandt's creek, I believe I now have a better idea about the seriousness of the crisis that the creek is facing, as well as the overarching role and linkage of this creek to water security in the Okanagan region. I also believe that I have a clearer idea about the urgency needed to address the pollution and sustainability issues of Brandt's creek, given the population growth rate, densification and physical expansion of the City of Kelowna. Honest effort from all stakeholders will be needed to make real change to the situation of the creek, and the

efforts of both of the groups in this class will be considered successful if our work brings about some positive changes to the status quo of the creek, no matter how miniscule.

- *Reflection on all other reflections*

One of the aspects of this class that I enjoyed was the diversity of the students, in terms of both cultural as well as disciplinary backgrounds. We all brought forward our unique perspectives to the concepts of resilience and sustainability, and the class facilitated a refreshing knowledge exchange. Over the course of 12 invited speaker sessions, we have got the opportunity to explore each other's perspectives on distinct issues and connect across a variety of concepts. For me personally, the most interesting discussions included those involving the importance of indigenous knowledge traversing the disciplinary boundaries of the sciences and the arts. Thanks to these discussions, I have learned to look at many of the sustainability issues with a nuanced approach compared to the black and white contrasting approach of my natural science background.

Sofia
Individual Reflection:
My final reflection of the IGS 585 Project is an overall view of how the course material, guest speakers, and term project tied together. The nature of sustainability is highly interdisciplinary, and this became very clear to me throughout the term and especially in the project. Each person in the group brought their own strength and academic/professional background forward to address a certain topic of the report. The problems highlighted to address in the Brandt's Creek project showed me how there is no simple solution and all aspects of the system must be considered to find an appropriate action plan. Dr. Hans Schreier spoke to many urban planning issues which I found particularly helpful in my contribution to this project.

Reflection on other reflections:
I see many commonalities between how I interpreted the project, and course as a whole when I read the reflections from my groupmates. I believe we all had a similar experience going through this project with our distinct academic and professional backgrounds giving a certain lens with which we each viewed the issues surrounding Brandt's Creek. I have learned a lot from working in such an interdisciplinary group, and seeing how no discipline is more important or relevant to the issue, all were necessary and required to even begin to tackle a problem as large as the revitalization of Brandt's Creek which we have only begun to address.

Kevin

Individual reflection:

Before working on this project, I already understood what resiliency and sustainability entailed from my courses in urban planning and concentration in sustainability. Urban planning is one of those disciplines that is in itself interdisciplinary. A planner is responsible for working through the complexities of city design and regulation, which has a stake in all human processes taking place within a planner's jurisdiction, and therefore, a planner must be able to understand how social, economic, and environmental processes are all interconnected to plan resilient and sustainable cities.

My main takeaway from this project is being able to think from a systems approach to make a proposal that aligns with sustainable and resilient practices. After working on this project, my overall perspective on resiliency and sustainability remained the same; however, learning how to approach a redevelopment plan for Brandt's Creek and hearing from our guest speakers has been an excellent opportunity to enrich my understanding of these concepts from the point of view of people with disciplinary backgrounds different from mine. Learning these new perspectives is helpful because it introduces nuance to my preconceived understanding of these concepts, which I can integrate with my prior knowledge and become more well-rounded.

Reflection on all other reflections:

Reading my peers' reflection was exciting for me because each provides their perspective from a discipline other than mine. Yet, many times I found myself easily relating to others' reflections and gained some perspective on how people from different backgrounds can approach the same problem from multiple angles. Over the course of this term, learning from the perspectives of others has contributed to my capacity to be more nuanced in the work I do.

Gaby

Individual reflection:
This project provided the ability to work on a sustainability issue that was tangible and locally specific. My research project is about regenerative tourism and one of the main components that it relies on is implementing strategies that are local, tangible and specific to the community. Similarly to working on the sustainability of Brandt's creek, it was interesting to relate how small the project initially seemed considering the size of the creek that we were concerned with in comparison to other creeks. While at first

Brandt's creek seemed small and the sustainability issues surrounding the creek could be tangible, local and specific, this project showed the true complexities of working on a project such as this. There were many aspects to consider when it came to what was affecting the creek, what was the creek affecting and how can we tangibly make it more sustainable. This is where the variety of disciplines within the group came out. It was also the point where we got the chance to look back and continue to reflect and use the teachings from the various guest speakers to understand how to approach this complex project. I really appreciated how all the guest speakers were able to provide a different perspective on approaching the sustainability of Brandt's creek. My perspective on resiliency and sustainability towards Brandt's creek is the sheer complexity that even a small creek can bring when it comes to sustainability. There are many factors and disciplines that need to be taken into account.

My reflection on the other reflections:

Like my peers mentioned in their reflections, the importance of working within an interdisciplinary team was highlighted within this project. It was the different approaches to solving sustainability that we were able to come up with the idea of doing a system's approach when it came to this project. While we perhaps had different ideas about which aspect of sustainability to focus on in terms of importance, due to our disciplinary backgrounds, we could all agree that a systems approach that encompasses all disciplines and opinions would be the most effective and realistic in terms of implementation.

Em

I have been thinking about what this reflection might look like for a while now and I have come to the conclusion that Dr. Parrott's presentation on systems approach was the most impactful learning in this semester. Once we began our project on Brandt's Creek, it became clear that there are so many systems at play with the creek because it is in the city, flows through public and private property, goes through residential and industrial areas and so many other systems as well. The systems approach just made the most sense with the various topics we wanted to cover. Another aspect I would like to reflect on throughout this project was the vast array of disciplines that my group comes from. There were a few of us from different kinds of tourism backgrounds, environmental science and urban planning. For the most part, our group came from different places in the world which allowed everyone to bring in their own unique perspective. I feel quite thankful for my fellow group members for the opportunity to work with them as they are all very unique and outstanding individuals.

My reflection on the other reflections:

Like many of the above reflections, it seems like everyone really related to our diverse backgrounds and the different perspectives we brought into this project. I think from reading everyone's reflections we all came into this project with some foundational knowledge of sustainability, resiliency and knowledge mobilization. Even with this foundational knowledge, all of us had something to learn from one another and also had something to share and contribute. As well, all of us seemed to have learned a lot about the systems approach and we will be taking this knowledge into future endeavours.