

Sustainability & Resilience in the Mission Creek Watershed

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Executive Summary

The importance of sustainability and resilience in ensuring that human interactions (resource extraction and/or use) are commensurable with the landscape's support/capabilities now and in the future cannot be over-emphasized. However, the ability to achieve this is usually constrained by multiple competing uses in the landscape, especially in human-dominated ones. The Mission Creek watershed situates itself in this quandary serving as a landscape of economic, cultural and ecological significance through its provision of a hub of activities and services to the people of Kelowna and surrounding communities as well as tourists. This report provides an exploration of select economic, cultural and ecological frameworks for the Mission Creek watershed using the lens of sustainability and resilience, and knowledge mobilization to identify challenges, successes and opportunities for development in this watershed.

In this report, we highlight some pertinent sustainability and resilience challenges that are faced in the protection and restoration of landscape functions within the City of Kelowna using the Mission Creek watershed as a case study. Some identified challenges include a limited legal and/or jurisdictional preview, socio-economic impetus, a legacy of historical disturbance, flora and fauna restoration, Indigenous community collaboration and inclusion, cost of restoration, impacts of climate change, and increasing population density. While these challenges persist in the Mission Creek watershed and to a larger extent the City of Kelowna, the City and its partners have in several ways achieved some successes that are worthy of notice. On successes, we highlight that the City of Kelowna's 2040 Official Community Plan holds a wealth of potential through its intentional inclusion of several mechanisms that empower the City to maintain the overarching properties for a sustainable and resilient community. However, these policies are not absolute and fall short in certain areas. Additionally, we highlight the Mission Creek Restoration Initiative

(MCRI) as one of the successes in this report. The MCRI which is a multi-phase, multi-stakeholder partnership formed in 2002 to restore natural functions to the lower reaches of Mission Creek provides an avenue to ensure a sustainable and resilient Creek upon its completion. The Mission Creek Greenway Regional Park, The Scenic Canyon Regional Park and the Environmental Education Center for the Okanagan are some of the successful programs being run in the watershed. Though some successes have been achieved, there is more room for improvement in achieving a sustainable and resilient Mission Creek watershed. We, therefore, highlight some successful collaborative models from other places that can be implemented to achieve this goal.

The s̓c̓e:l̓x̓w̓əy̓əm Foodland Corridor provides a poignant example of building ecological adaptive capacity within an urban context in a watershed largely dominated by human land uses. Like the Mission Creek watershed, this project faced many of the similar such as complex regulations, diverse values and objectives, and a legacy of historical disturbance. Their approach involved identifying contiguous parcels of land along the Salmon River that could be restored to improve landscape connectivity, habitat availability, and habitat diversity and subsequently developing and implementing a restoration plan. Also, another collaborative model that could be adopted in this watershed is the Columbia River Salmon Reintroduction Initiative (CRSRI). The CRSRI is an agreement between the syilx Okanagan, the Ktunaxa, the Secwepmec Indigenous Nations, and the Government of Canada and British Columbia to reintroduce culturally and ecologically important Pacific salmon into the Columbia River. It is important to note that these and other solutions highlighted in this report although viable and valuable for the watershed may be constrained by a limited budget, social barriers, and legislative barriers in their implementation. We recognize that solutions posted in this report are current to modern (2022) considerations, but, notably, the Mission Creek watershed must be continually and comprehensively monitored to

adapt this framework to the dynamic and increasing impacts of population growth, development, and extreme weather events resulting from climate change.

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List of Acronyms

ALC	Agricultural Land Commission
ALR	Agricultural Land Reserve
BC	British Columbia
CONC	Central Okanagan Naturalists' Club
CRIS	Community Recreation Initiatives Society
CRSRI	Columbia River Salmon Reintroduction Initiative
DFO	Fisheries and Oceans Canada
DRIPA	Declaration on the Rights of Indigenous Peoples Act
EECO	Environmental Education Center
FLNRO	Ministry of Forests, Lands, Natural Resource Operations
FNLMA	First Nations Lands Management Act
FOMC	Friends of Mission Creek Society
HADD	Harmful alteration, disruption, or destruction
IR	Indian Reserve
KM	Knowledge Mobilization
MCRI	Mission Creek Restoration Initiative
OBWB	Okanagan Basin Water Board
OCCP	Okanagan Collaborative Conservation Program
OCP	Official Community Plan
OKLRPI	Okanagan Lake Responsibility Planning Initiative
ONA	Okanagan Nation Alliance
RAPR	Riparian Areas Protection Regulation
RDCO	Regional District of Central Okanagan
SARA	Species at Risk Act
TEK	Traditional ecological knowledge
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
WFN	Westbank First Nation
WSA	Water Sustainability Act

Introduction

The Mission Creek watershed serves as one of the City of Kelowna’s most ecologically, economically, and culturally significant landscapes. It can be understood to be a microcosm of the greater socio-ecological state of watersheds within the region and used to illustrate and understand the complex systems that govern these hydro-social spaces. Within this context, understanding the sustainability and resiliency challenges that threaten the Mission Creek watershed will prove vitally significant to its sustenance. The overarching objective of this report is to explore the current state of sustainability and resilience within select ecological, economic, and cultural frameworks of the Mission Creek watershed and, through these, identify both successes achieved and opportunities for development.

1.0 Resiliency and Sustainability

1.1 Sustainability

Sustainability as a concept has gained enormous recognition with a long history that has evolved over time. Definitions of the term have varied from one scholar to another and one discipline to another. Despite the differences that are acknowledged in defining sustainability, it has evolved to include three critical dimensions that are acceptable by many and now form the basis of its definition. Embedded in most definitions of sustainability are economic development, social equity, and environmental justice. As a result, the three pillars of sustainability are Environmental, Social, and Economic sustainability. Sustainability may therefore be defined as “the process of living within the limits of available physical, natural and social resources in ways that allow the living systems in which humans are embedded to thrive in perpetuity” (University of Alberta Office of Sustainability, 2010). Another definition of the term sustainability is “the

integration of environmental health, social equity, and economic vitality in order to create thriving, healthy, diverse and resilient communities for this generation and generations to come” (UCLA Sustainability, 2022).

From these definitions and perspectives, sustainability entails recognition of how the three pillars are interconnected, an acknowledgment of complexity, and it requires a systems approach to ensure a balance of the critical dimensions. In a similar light, Giovannoni and Fabietti (2013) introduce a concept of integrated sustainability which implies realizing the potential of the key (economic, social, environmental) dimensions simultaneously coupled with the management of trade-offs, synergies, and tensions between these dimensions. They further state that in managing the tensions of sustainability, vital roles can be performed by ad hoc government structures, reporting systems, management, business models, and measurements, which could be deliberately designed according to an integrated system (Giovannoni and Fabietti 2013).

1.2 Resiliency

Notwithstanding the depth of papers and decades of work discussing resilience and sustainability, either broadly or specifically tailored to a system, both words are usually interchangeably used (Marchese et al., 2018; Resilience and sustainability, 2019). While sustainability encompasses how the present generations can meet their needs (economic, social, and environmental) without compromising the future generation’s ability to meet theirs, resiliency looks at a system’s preparedness for threats, ability to absorb impacts and to recover and adapt after disturbances and/or disruptive events (Pacific Council on International Policy, 2017). The resilience of a system can be considered based on its structural dimension, functional dimension, and/or a combination of both dimensions. While the overall resilience is important and informs

the sustainability of a system's structure and/or function, the details and context matter. Resilience is the ability to recover/adapt from a disturbance/significant alteration (e.g., dyking & channelization) that could have been prevented or alleviated with sustainability practices (Sustainability Degrees, 2022). The resilience of a system is augmented by sustainability practices, and both serve as the key objective of healthy development.

Situating these definitions in the context of Mission Creek, we envision a sustainable and resilient Mission Creek as one where the “demands for the use of resources in the Mission Creek watershed does not overwhelm the ability of the Mission Creek watershed to supply/provide these demands.” Given the hub of activities that takes place in this watershed, it will be the ability of the watershed to be able to support all the myriad of activities and functions in the present and for future generations without any adverse effect on its structure and function now and in the future.

2.0 Mission Creek Overview

Mission Creek is a culturally and ecologically significant aquatic corridor situated in the south-central portion of Kelowna (Figure 1). The Creek originates northwest from the City of Kelowna in the Graystokes Provincial Park and flows south eastwardly for approximately 71 km before discharging to Okanagan Lake near the terminus of Cook Road in the heart of Kelowna (RDCO, 2021). The entirety of the Mission Creek watershed, defined as the area of land topographically draining to Mission Creek, encompasses approximately 850 sq km, only 5% of which (50 km²) overlaps with the municipal boundary (Figure 1; RDCO, 2022). The vast majority of the watershed is therefore situated outside of the City of Kelowna and falls under the purview of the Regional District of Central Okanagan (RDCO) and the provincial government (see Section 2.1 for a detailed review of the regulatory and jurisdictional context).

The Mission Creek watershed is characteristic of many watersheds throughout the Columbia-Okanagan basin. The upstream reaches are defined by a high-gradient channel surrounded by precipitous slopes (Westrek Geotechnical Services, 2000). Towards the confluence of Mission Creek and Okanagan Lake, the Creek exhibits a low gradient meandering morphology. Elevations throughout the watershed vary from approximately 340 m at the Okanagan Lake confluence to 1880 m in the headwaters (Westrek Geotechnical Services, 2000). Most of the topographical variability is restricted to the portions outside of the municipal boundary; within the City limits, the watershed is generally flat with a gentle eastward slope. The lack of a glacier to provide a sustained flow, together with low precipitation during the summer months, present a hydrologically dynamic system that is sensitive to periods of extreme flooding followed by very low flows.

The portion of the watershed overlapping the City of Kelowna is primarily dedicated to agricultural space (Figure 2). This is reflective of intentional manipulation of land use dating back to European colonization. Other land uses include interspersed rural-residential and suburban-residential areas, recreational use areas (e.g., golf courses, trail networks, playgrounds, and a bike skills park), and natural areas (Figure 2). At the mouth of the Creek, surrounding land uses are predominantly commercial and residential.

Underscoring its vital importance to the City of Kelowna, The Mission Creek watershed collects, filters, and delivers water to Okanagan Lake, which supplies a large proportion of municipal freshwater. Approximately 28% of the Okanagan Lake Basin comes from the Mission Creek watershed (OBWB, 2010). Additionally, Mission Creek is an essential source of irrigation water that supports agricultural activities in its surroundings, which is one of the most important economic sectors for the Okanagan region.

Since time immemorial, the syilx Okanagan People have been the custodians of Mission Creek and its interconnected land and waters. Through maintaining intrinsic relationships with, and dependence on, Mission Creek as a way of life, culture, and source of sustenance, the syilx People have ensured the sustainable use of its resources and ecosystems for millennia. In the centuries following European settlement, Mission Creek has been subject to significant alterations, which have concomitantly driven declines in ecosystem function and biodiversity. Mission Creek is now recognized as a “highly disturbed river system” (Burge, 2009, pg. 11), facing many pervasive challenges to its long-term vitality, including habitat degradation and declining channel stability.

Perhaps the most transformative of these alterations has been the gradual loss of habitat complexity caused by instream alterations and riparian habitat removal. Historically the Creek is understood to have exhibited a braided and meandering morphology with frequent periods of flooding into the surrounding terrestrial landscape. Since approximately the mid-1900s, however, the Creek was straightened, diked, and armored to accommodate an expanded agricultural land base and to abate flooding. Taylor et al. (2013) estimate that these technocratic modifications have removed at least 60% of the historical creek length. Concurrent with aquatic habitat homogenization, the surrounding riparian habitat has been incrementally removed and converted to softscapes (e.g., agricultural land, greenspaces) and built infrastructure (e.g., roads, residential/commercial developments).

While not a primary focus of this study, it is noted that alterations in the watershed headwaters (outside of the City boundaries) have also played a disproportionately large role in ecological degradation. Within the headwaters, forestry, water withdrawals, cattle grazing, and logging road construction are ubiquitous and exacerbated by pine beetle infestations, forest fires,

landslides, and climate change (Carter Consulting, 1997; Westrek Geotechnical Services, 2000). The collective impact of these human and climate-driven watershed alterations is challenging to estimate but is broadly implicated as contributing factors influencing the watershed conditions within the municipal boundaries.

Despite considerable alterations, the watershed continues to serve as an ecologically important area embedded within a rich social and cultural context. The remaining intact natural areas harbor a rich spectrum of wildlife, including many species of management concern. Of note, Mission Creek supports one of the most productive Kokanee salmon (*Oncorhynchus nerka*) spawning populations within the Columbian basin (BC Parks, 2022) and one of the last remaining populations of Western Screech Owl (*Megascops kennicottii macfarlanei*) in the Okanagan (Hobbs et al. 2006). Assemblages of black cottonwood/ douglas-fir – common snowberry – red-osier – dogwood riparian and interconnected marsh habitat throughout the watershed are also recognized provincially as a red-listed ecosystem (Ecoscape Environmental Consultants Ltd., 2015). From a social and cultural standpoint, we depend intimately on the Mission Creek watershed for a diversity of nature’s contributions to people, or ecosystem services, such as provisioning water, supporting agriculture, cattle grazing, recreation, and carbon sequestration (Taylor et al., 2013).

Serving as a “hub of activity” (Regional District of Central Okanagan, 2022) for the surrounding population, Mission Creek Regional Park hosts an Environmental Education Center (EECO), a Kokanee spawning channel, a children’s fishing pond, picnic shelters, washrooms facilities, and access to the Mission Creek Greenway (Regional District of Central Okanagan Mission Creek Regional Park, 2022). The Mission Creek Greenway currently consists of 18 km of trail from near Okanagan Lake to Hydraulic Creek along the Mission Creek riparian corridor (it will eventually total to 26 km upon Greenway project completion). Scenic Canyon Regional Park

also serves as a popular recreational center, encompassing 229 ha of Mission Creek watershed, and hosting picnic areas, viewpoints, and washroom facilities (Regional District of Central Okanagan Scenic Canyon Regional Park, 2022). Within the City of Kelowna portion of the Mission Creek watershed, many residential properties and housing developments border the Creek boundary. Also within City boundaries is the Mission Creek Recreation Park. Totalling 46.55ha of land, this parcel includes a community garden, softball field, soccer field, playground, and trail network (City of Kelowna, 2022).

Recognizing the importance of Mission Creek for a diversity of social-ecological values, the impetus and wherewithal to restore hydro-ecological processes (Gaboury, Hawkes, Mould, and Good, 2004) and reinvigorate cultural and recreational services has grown. However, there remain many challenges to achieving a sustainable and resilient system.

2.1 The Ownership & Jurisdictional Landscape of Mission Creek

A key sustainability challenge within the City of Kelowna and, indeed, more broadly, is satisfying human land use needs and resource demands without transgressing ecological limits of degradation (Dearing et al., 2014; O'Neill et al., 2018). The Mission Creek watershed captures this challenge well. It is, foremost, a finite space with limited resources that service a variety of human and ecological needs. This includes land use activities (e.g., agriculture, residential development, industrial sectors, and recreation), provisioning nature's contributions to humans (e.g., clean water, flood abatement, carbon storage), and providing opportunities for Kelowna's unique biodiversity and ecosystems to flourish (Figure 2; Taylor et al., 2013; Ecoscape Environmental Consultants Ltd., 2015). However, human uses of semi-natural areas, like the Mission Creek watershed, are often incommensurable with conservation priorities. Human activities like development,

agriculture, and recreation precipitate a phenomenal ecological toll, both through the direct loss of habitat as well as the alteration and fragmentation of those habitat patches that remain (Ekka et al., 2020; Fischer & Lindenmayer, 2007). Further compounding this challenge, the governance structure that manages our interactions with this space is poly-centric. There are five main interest groups that overlap the Mission Creek watershed: the province of British Columbia (BC), the federal government, the City of Kelowna, the RDCO, and the syilx Okanagan Nation.

The Greenway lies within Mission Creek Regional Park, Scenic Canyon Regional Park (RDCO), and City of Kelowna properties, and in the City of Kelowna portion, it is operated under agreement by the City and the RDCO as an extension of the Regional Park (Wiseman, 2022). In addition, the RDCO and municipality, the federal and provincial government have jurisdiction in the watershed, particularly relating to the governance of water, fish, and fish habitat (Government of BC, 2014; Government of Canada, 1985).

After a 1963 formal separation from the Okanagan Indian Band, the newly independent Westbank First Nation (WFN) took control of reserve lands (as designated by the Crown), including Indian Reserve (IR) 8 (Mission Creek Indian Reserve), 9, and 10 (Westbank First Nation, 2022). In 1974, the WFN surrendered 177.3 acres of IR 10 land for a 99-year lease of the Lakeridge Park residential development, and in 1982, due to a major land claim settlement with the federal and provincial governments, were also granted land reserve parcels 11 and 12 (Westbank First Nation, 2022). Of these three parcels on the City of Kelowna side of WFN territory, IR 8 and 12 directly encompass Mission Creek surface flows, and IR 11 exists within the greater watershed boundary (Figure 3). In total, Mission Creek 8, Medicine Hill 11, and Medicine Creek 12 total 1,180.2 ha (Statistics Canada, 2021).

Within the constitute of four jurisdictional bodies, navigating the governance structures of the Mission Creek watershed can be arduous and complex. Though not an uncommon scenario in British Columbia's watersheds, these multi-level, multi-jurisdictional structures can offer both challenge and opportunity. Fragmentation in monitoring activities and issue identification can lead to delayed or inadequate responses to ecosystem threats (Raymond, 2016), understanding that within a social-ecological systems (SES) approach to watershed ecology, one influence upon the systemic framework (biological, hydrological, or hydrosocial) has the capacity to affect the entire watershed network (Gonzalés and Parrott, 2012). Conversely, along with additional jurisdictional claims come additional responsibility and resource capacities. The collective oversight amongst the WFN, the RDCO, the City of Kelowna, and the Province presents a unique opportunity within the Mission Creek watershed for investment into conservation and restoration projects that have the potential to promote the sustainable governance of the water source for generations to come.

3.0 Flora and Fauna Restoration

The Okanagan Valley in British Columbia is a Canadian biodiversity hotspot (Warman, et al., 2004), a region of high irreplaceability (Parrott, Kyle, Hayot-Sasson, Bouchard, & Cardille, 2019). It is part of the semi-arid North American Great Basin ecoregion, home to many endemic species and key for north-south migration due to the mountain ranges east and west of the valley (Parrott, Kyle, Hayot-Sasson, Bouchard, & Cardille, 2019). This aligns well with some of the goals of the 2040 OCP, that is trying to: retain native fauna (14.5.2), select the correct type of local fauna (14.2.3), critical area restoration (14.4.4), natural riparian areas & watercourses (14.4.3), riparian area restoration (14.5.6), and urban forest and habitat connectivity (14.2.7) (City of Kelowna, 2022). These objectives are reactive to what already happened. There are no preventive measures which is a fault, as it will only correct the wrongs done instead of

preventing them. The policies try to create areas to retain and restore both critical and non-critical areas while interconnecting them to make them stronger. Theoretically, this creates the environment for the recuperation of some of the affected areas.

Furthermore, the Okanagan contains around 30% of British Columbia's species at risk and several endangered and rare species (Warman, et al., 2004). The 2040 OCP wants to address this through the protection, management, enhancement, and restoration of habitats for species at risk (14.4.5) as defined by the Species at Risk Act (SARA) (City of Kelowna, 2022) (Government of Canada, 2022). Here the urban forest and habitat connectivity (14.2.7) can play an important role as it expands the current habitats for some of the smaller species on the list.

3.1 Challenges

The area faces several challenges, mainly from the urban development of Kelowna. Historically, urban development has been permitted immediately adjacent to Mission Creek, leading to a loss in habitat, structural changes to the Creek morphology, and the displacement of flora and fauna. Therefore, a key challenge will be creating a space big enough to be sustainable over the long run, in ecological terms, a big enough buffer to allow native flora and fauna to thrive through the entire extent of Mission Creek. It is especially challenging since a significant portion of the creek is neighbors by private homes mainly located alongside Creekside Road, Senger Road (end of the road), and the Greenway (part of the road). Most of the fauna is concentrated in Mission Creek Regional Park, which is mostly in the southern part of the Creek. The rest of it is concentrated towards the western borders of the City of Kelowna in what is known as Scenic Canyon Regional Park, which is mainly in an uninhabited area. The other areas are mainly bordered by the city itself or farming areas, leaving little to no area for

expansion, as shown in Figure 2. These areas serve a dual function, serving as recreational areas as well as habitats for the local flora and fauna.

Fauna has been greatly affected by this loss of habitat. This is especially true for Kokanee salmon, who migrate to Mission Creek to spawn. Some estimates suggest that the Mission Creek spawning population of Kokanee has dropped from 80,000 to 8,000 individuals over the past 25 years, which is largely attributed to a 90% reduction in available spawning habitat (Friends of Mission Creek Society, 2013). Significant changes in the natural flow of water have been done by creating the canal and destroying the natural habitats of many species. An assumption can be made that the local fauna will not be able to recover to the levels at the end of the 20th century due to human intervention; this applies to fish, birds, and other animals that considered Mission Creek an essential part of their habitat.

Other species are at risk, such as the Western Screech Owl, Grasshopper Sparrow, Western Painted Turtle, Black Cottonwood, White-throated Swifts, and Great Blue Heron, have also been affected by the habitat loss caused by the canalization of the creek (Mission Creek Restoration Initiative , 2020). The salmon, as well as the turtle, like shallow environments for their development, places such as lakeshores that in great part have been destroyed. Some of the birds that are affected depend on having enough places to nest and food to eat, which has been lost due to the decline in local fauna and insect life.

Another challenge is the invasive species in the area. If left untended, these species could become problematic to the local ecosystem, as has happened in other parts of the world. There are several invasive plant species observed in the region, such as Burdock, Canada thistle, Dalmatian Toadflax, Hoary cress, Jimson weed, Scentless chamomile, and several others, some of which are regionally or provincially noxious plants (Mission Creek Restoration Initiative,

2021). It is important to note that the number of invasive species has declined in the second half of the last decade. However, many high-risk toxic species remain. Many introduced species are also evidenced in the Mission Creek Restoration Initiative (MCRI) Grass Seed Mix, where only 10% of the fauna is native to the area, composed of slender wheatgrass (Mission Creek Restoration Initiative, 2021). While the introduced mix has proven effective at surviving and covering areas with complex growing conditions (Mission Creek Restoration Initiative, 2021), it does not mean they should remain. Here we have the dilemma of what definition of the environment to pick. The historical environment that existed comprised only of native species or something more suited for human taste, as proposed by Shellenberger. Perhaps survival of the fittest is what we prefer. However, this is a fine line to treat as it can be in direct contradiction with some of the other decisions made in the OCP.

3.2 Opportunities

Permaculture is the creation of closed loop systems where through mutually beneficial synergies, people and the environment can thrive together (Permaculture Research Institute, 2022). Using the permaculture ideals would allow for robust utilitarian development of the region, allowing both the ecosystem and human populations to thrive (Mollison & Slay, 2013). There are twelve principles that guide permaculture: 1) Observe and interact, 2) Catch and store energy, 3) Obtain a yield, 4) Apply self-regulation & accept feedback, 5) Use & value renewable resources & services, 6) Produce no waste, 7) Design from patterns to details, 8) Integrate rather than segregate, 9) Use small and slow solutions, 10) Use and value diversity, 11) Use edges & value the marginal, and 12) Creatively use and respond to change (Permaculture Principles, 2022). These principles can allow for the harmonious existence of both nature and people. It will

allow for the creation of multifunctional spaces that are beneficial for the environment yet functional and productive for the human population.

A good example of most of the points in permaculture can be Scenic Canyon Regional Park, which allows one to observe and interact with nature (a principle I), catches and stores energy through plants and trees (principle II), allows one to obtain a yield by allowing for the reproduction of both flora and fauna (principle III), it is self-regulated while at the same time feedback by the local community is created through boundaries and fire control (principle IV), it produces no waste as any dead animals or flora are composted naturally by the environment (principle VI), it contains and takes advantage of biodiversity (principle 10), and it uses the edges and values the marginal as in these region nature uses all the space it is allowed (principle 11).

A good example of these principles around the area in question are Mission Creek Greenway Regional Park, and Mission Creek Regional Park. These areas have multiple purposes, both from the human perspective and the ecological one. These areas can be further developed; the foremost opportunity lies along the Creek itself and the area south of it, which already provides water for the city and creates an environment for fish and entertainment. This can be further developed by creating more and/or larger interconnected parks, walkways, and beneficial land use, especially areas that belong to the natural way water flows in the area. By using the ground so that the environment can cope with it, floods should no longer destroy productive areas, but work in harmony with those effects as nature did for many years.

Farming native flora and fauna is a good option, for example, the restoration of grasslands and big native species that humans can consume, such as elk, antelope, and bison. Native fauna environments could also be restored in these areas, as it would allow for more

water, less erosion, and other benefits, but they can also be used to raise animals that humans can consume. It has been done in other areas of the world and could create several opportunities for farmers in areas afflicted by flooding.

Furthermore, the use of local plants for gardens, especially in those neighborhoods that border Mission Creek, could benefit the overall ecosystem. It would create a larger area for fauna and flora without necessarily being part of public lands. Local flora tends to be better adapted for local conditions, meaning it will help and support local fauna by providing food and shelter. Therefore, we create ornamental gardens for humans but healthy environments for the ecosystem.

This entire process can encompass and promote riparian areas and watercourses while creating a healthy environment for species at risk or overall affected species that can be consumed by the human population, such as Kokanee salmon or rainbow trout. A healthy riparian area has high biodiversity and production, and they act as filters for pollutants (Morissette & Donnelly, 2010). The Mission Creek Restoration Initiative started taking care of the lower 12km (Mission Creek Restoration Initiative, 2021). Still, this work must continue to help with the restoration and protection of riparian areas that, by their nature, serve multiple purposes for the environment and the human population. Perhaps some of the agricultural lands can be integrated into one of the parks or as a bigger buffer zone.

A good opportunity is to create a corridor along the lines of Mission Creek that connects to the Okanagan Connectivity Corridor that is recognized by the OCP and some other corridors in the area that are not recognized. This will give further protection to the site to allow flora and fauna to thrive as part of a more extensive ecosystem that connects the outside of the Kelowna city boundaries. This corridor could qualify for a faster expansion of flora and fauna into the

protected areas previously affected by a regulation less development, putting at risk this source that brings around 25% of the water into the Okanagan Lake (Friends of Mission Creek Society, 2013). The creation of this corridor could carry several economic benefits, such as increased expenditure on outdoor recreation but also an increased value for farmland, habitat, water, air quality, and waste treatment (Taylor & Sauer, 2013).

4.0 Maintaining Sustainable and Resilient Ecosystems in the Mission Creek Watershed

A central challenge in urban-interfacing ecosystems like Mission Creek is tactfully managing our interactions with our landscapes in a way that preserves ecological function while minimizing restrictions on human land use (Wu, 2014). The recent population growth in the City of Kelowna has made this challenge particularly poignant. As human populations continue to burgeon, we can expect increasing impetus to expand our urban footprint into the remaining softscapes (e.g., agricultural land) and semi-natural areas, as well as a growing dependence on the resources therein. A sustainability and resilience lens provides a useful heuristic to frame this challenge (Cumming, 2011). Circling to the definition of a sustainable system provided at the start of this report, we can broadly envision a sustainable watershed as one in which humanity and nature co-evolve without surpassing planetary bounds. While there are many intractable social, economic, and cultural factors that contribute to a sustainable watershed (Nemec et al., 2014), maintaining ecological function underpins most of these, particularly in consideration of our dependence on ecosystems for food, water, and other benefits (Wu, 2013). This section, therefore, considers how to maintain ecological function within urban-interfacing semi-natural systems like the Mission Creek watershed.

The scholarly community is generally in agreeance that threshold levels of ecological degradation exist that, if crossed, will result in fundamental alterations to the structure, identity, and function of a landscape (Andersen et al., 2009; Folke et al., 2010; Gunderson et al., 2017; Scheffer & Carpenter, 2003). While we cannot predict where these thresholds are, we can anticipate that there are structural and dynamic properties of an ecological landscape that improve adaptive capacity and, therefore, better position landscapes to adapt, transform, and persist despite human and climate driven alterations. There are three landscape properties strongly associated with maintaining adaptive capacity¹: (1) sufficient intact and quality habitat, (2) connectivity to facilitate the flow of resources, and (3) heterogeneity. These properties are described briefly hereafter.

Preserving intact, quality habitat. Simply put, to continue providing ecosystem services and to support biodiversity, there needs to be enough habitat left. As habitat is removed, degraded, or altered in support of human uses, the ability of the landscape and the flora and fauna it supports to ‘bounce back’ or persist following a disturbance decline (Bender et al., 1998; Lindenmayer et al., 2008). It is, therefore, not surprising that habitat loss has been directly implicated as a primary causal factor in global extinction trends (Brooks et al., 2002). Habitat loss is particularly challenging in urban interfacing areas, such as the City of Kelowna, where the leading edge of development incrementally encroaches into remaining habitat each year, leading to a decline in both the number and size of remaining habitat patches (Martinuzzi et al., 2015). Indeed, this was

¹ Landscapes resilience to climate change and human driven alterations is linked to ecological complexity (Bullock et al., 2021; Parrott & Meyer, 2012). Herein we have simplified this to the described three properties for brevity but acknowledge this is a topic with considerable nuance.

a trend highlighted by Mary Ann Olson-Russello with respect to the continued degradation of Okanagan Lake (personal communication, March 8, 2022).

Maintaining connectivity between habitat areas allows for the safe passage of wildlife and the flow of materials, information, and energy across a landscape (Taylor et al., 1993). Maintaining continuity is critically important for supporting adaptive capacity and is among the most widely recommended strategies for reducing the effects of climate change on biota (Heller & Zavaleta, 2009). Past studies suggest that if a landscape is functionally connected, it will be better positioned to respond to a range of future conditions and disturbances. For example, maintaining connectivity allows for the exchange of individual species among local populations, thereby supporting gene flow, recolonization following a localized extinction event, or adaptation in response to depleting resources (Beier et al., 2011; Fischer & Lindenmayer, 2007). In the Mission Creek watershed, this concept can be applied by conceptualizing the landscape as a series of habitat patches (i.e., intact natural areas) with an intervening matrix comprised of variable densities of human alteration (Latimer and Peatt, 2014). The permeability of this matrix to a variety of ecological flows is likely related to the level of modification; it can be hypothesized, for example, that agricultural fields are more permeable than intensely urbanized land. Nonetheless, aquatic and riparian corridors like Mission Creek may serve as important linkages between habitat patches across a matrix of urban land uses (Parrott et al., 2019).

Maintaining landscape diversity is akin to “not putting all your eggs in one basket.” We cannot predict what future conditions will be needed to adapt and respond to future change. Therefore, we can best position ecological systems to respond to a range of potential futures by emphasizing a heterogeneous landscape that encapsulates a range of ecological processes, demographic stochasticity, and genetic diversity (Carpenter et al., 2015; Elmqvist et al., 2003; Mori et al., 2013).

Within the Mission Creek watershed, landscape diversity may be achieved by supporting a mosaic of habitat types (e.g., forested, grassland, wetland assemblages), with diverse species compositions at different successional stages.

This brings us to a core sustainability challenge the City of Kelowna must grapple with: how to manage our interactions with the Mission Creek watershed in a way that maintains a sustainable, functioning ecosystem in support of the continued provisioning of ecosystem services and biodiversity. In the sub-sections that follow, we explore:

- (1) What policy successes can we point to that demonstrate a commitment to maintaining ecological function within the Mission Creek watershed while balancing the human use of this landscape? To address this, we look for verbiage that speaks to maintaining sufficient, connected, and diverse ecosystems, consistent with the ecological properties important for maintaining adaptive capacity and resilience (summarized above). We then explore where there are opportunities to expand on these policies by identifying key shortcomings.
- (2) What challenges remain that restrict or otherwise hinder the City in fully achieving a resilient, sustainable ecosystem embedded within an urban context? We then point to examples elsewhere that could be used to overcome some of these challenges.

4.1 Some Successes achieved in the Mission Creek watershed to build and maintain ecological adaptive capacity

Maintaining sufficient, diverse, and contiguous habitat requires a long-term vision. As such, the Official Community Plan is a critically important tool for supporting ecological adaptive capacity within the City of Kelowna. We can see the intentional inclusion of several mechanisms

that empower the City to maintain the overarching properties of a sustainable ecological system described in the previous section (Appendix A).

4.1.1.1 Maintaining sufficient habitat

Considerable emphasis has been placed on preserving existing riparian and aquatic habitats. For example, most of the Policies under Objective 14.5 (protect and restore environmentally sensitive areas from development impacts) have the verbiage that directly mandates riparian and/or aquatic features are protected from development, or where protection is not possible, that development adheres to the principle of “no net loss.” Where the Kelowna OCP stands out as particularly progressive is with the inclusion of mechanisms to protect habitat outside of proposed development processes (e.g., Objective 14.4). While operationally nebulous, the inclusion of Objective 14.4 (preserve and enhance biodiversity and landscape diversity, integrating and connecting ecological networks through the City) suggests an intentional effort to safeguard and restore habitat regardless of proposed land alterations and recognizes the role of local landowners in achieving this directive (e.g., Policy 14.4.7).

Several policies expand on abating encroachment into existing habitat areas by providing mechanisms to ensure their legal protection. For instance, Policy 14.4.7 and Policy 14.5.3 encourage landowners and developers to protect sensitive areas on private property and at the time of development, respectively (e.g., through covenants). It is important to highlight that covenants or other measures that restrict farming activities on Agricultural Land Reserve (ALR) land are typically not supported by the Agricultural Land Commission (ALC).

4.1.1.2 Maintaining connected habitat

In addition to protecting habitat, we can see some linkages to supporting a connected landscape interwoven with Objectives 14.4 and 14.5, albeit less implicit. Specifically, Policy 14.4.1, Policy 14.4.3, and Policy 14.5.11 have the verbiage that relates to the protection of ecological connectivity. It is noted that while Policy 14.4.2 Ecosystem Connectivity Corridors directly relates to maintaining a connected landscape, this policy does not have overlap with the Mission Creek watershed, and its overarching objective of maintaining safe passage for wildlife is somewhat incompatible with the Mission Creek aquatic/riparian corridor, which supports many recreational opportunities (personal communication, L. Parrott, March 13, 2022). For these reasons, it is not considered a suitable mechanism for maintaining a connected landscape in the Mission Creek watershed.

4.1.1.3 Maintaining diverse habitat

Ties to maintaining diverse habitats are weak. One could reason that Policy 14.4.1 Ecosystem Level Planning invertedly includes this as a sub-objective through its emphasis on “[ensuring] the function of environmentally sensitive areas” (City of Kelowna, 2022). It is also acknowledged that by meeting the intent and spirit of the other policies listed in Appendix A, diversity will be maintained inherently.

4.1.2 Where these policies fall short

Despite several notable examples where the OCP deliberately includes mechanisms to support a sustainable landscape, short fallings remain. Perhaps most notably, the OCP relies strongly on the principle of no net loss as a putative solution to maintaining sufficient habitat in a development-centric context. In Canada, Fisheries and Oceans Canada (DFO) have been instrumental in driving the adoption of the principle of “no net loss” and affiliated frameworks

(e.g., habitat compensation and habitat banking), particularly to abate eroding fisheries resources precipitated by development in or proximal to fish habitat (Fisheries and Oceans Canada, 2019; Harper & Quigley, 2005). Under this principle, proposed development projects that cannot avoid the harmful alteration, disruption, or destruction (HADD) of fish habitats are required to compensate for harm by constructing habitats of equal or greater value. Typically, this involves constructing spawning channels, wetlands, or vegetating degraded riparian areas that total to an area more than the area disturbed (e.g., two times the amount of habitat created to habitat lost).

In practice, it is increasingly clear habitat compensation cannot be treated as a panacea for maintaining ecological adaptive capacity (Bull et al., 2013). Most alarmingly, the vast majority of habitat compensation projects outright fail, owing to designs that inadequately contemplate the ecological conditions of the region (e.g., selecting plants poorly adapted to the climate), extensive invasive species colonization, and inadequate monitoring and interventions (Quigley & Harper, 2006). In the lower Fraser River, for example, two-thirds of habitat compensation areas were found to have failed (Lievesley et al., 2016). There does not appear to be mechanisms in the OCP – or indeed, more broadly in provincial or federal regulations – for compliance and reinforcement when compensation projects fail to establish. Perhaps most critically, though, supporting development under the guise of a ‘net benefit’ to the environment through habitat compensation is not befitting to the mindset shift needed to transition from a community that promotes the economic capacity to one that supports adaptive capacity.

The second major shortfaling we wish to highlight is the project-by-project or parcel-by-parcel nature of most of the Policies and Objectives in the OCP. All of Objective 14.5 is triggered by proposed development projects submitted to the City of Kelowna. Although this does readily provide funding for restoration initiatives (i.e., from developers), it does challenge the temporal

and spatial cohesion of efforts, as well as the underlying motivation and purpose. The Mission Creek habitat bank is a reassuring step towards ensuring that restoration funds are allocated in a way that contributes to a collective vision in contrast to haphazard compensation projects linked to development (Policy 14.6.3 and 14.6.4). While Objective 14.4 includes mechanisms for ecosystem level management irrespective of development, the verbiage is constructively ambiguous; it is challenging to discern the mechanisms by which this Objective is triggered and where funding may come from to implement stewardship and preservation programs. It will be interesting to monitor how this policy is implemented over time.

As a final major shortfalling of the ecological mechanisms within the Kelowna OCP, it is important to highlight that the policies and objectives in the OCP that relate to building ecological adaptive capacity are not inherently protective. Unless a legal mechanism is used to mandate protection – like a covenant - the OCP merely provides the overarching direction and vision for managing our interactions with semi-natural areas. It remains the purview of elected City officials to either approve or deny projects that are in contravention of these policies.

4.2 Some challenges the City of Kelowna still faces to protect and restore ecological function within an urban context

As the preceding section highlights, the City’s OCP provides many mechanisms that support achieving the vision of a sustainable watershed wherein ecological function is preserved while minimizing restrictions on human use of this area. However, the City continues to be confronted with many challenges that limit the implementation of more progressive measures. In this section, we review a few of the most striking of these challenges and look towards ecological land use models used elsewhere to offer potential solutions.

4.2.1 Limited Legal Purview

The first challenge facing the City in protecting and restoring functional ecosystems is one of a legal and jurisdictional nature: the majority of the land and resources within the Mission Creek watershed are not under the City of Kelowna's purview. While the municipality can set overarching priorities through the OCP, provincial and federal regulatory mechanisms are highly restrictive, particularly for establishing ecological protection and restoration priorities.

4.2.1.1 Aquatic and riparian habitat protection and restoration

There are two statutes that regulate nearly all activities within the aquatic footprint of the creek extending to approximately 30 m landward: the provincial *Water Sustainability Act* (WSA) and the federal *Fisheries Act* (Government of BC, 2014; Government of Canada, 1985). The WSA is arguably the most influential of these in defining the range of activities permissible within Mission Creek, as all water in British Columbia is owned – or rather safeguarded – by the province. In addition to acting on their responsibility to safeguard water through an arduous licensing system for withdrawals, the WSA also prohibits any changes in and about a stream without prior authorization (Government of British Columbia, 2022). Synergistic with the WSA, the federal *Fisheries Act* provides protection to all fish and fish habitats by prohibiting the harmful alteration, disruption, or destruction of fish habitat and prohibiting the death of a fish by means other than fishing (Government of Canada, 1985).

Under these two pieces of legislation, effectively, all activities that may change the structure or function of Mission Creek, even temporarily, are regulated. It is important to note that there is no implicit distinction drawn in the legislation between destructive processes (e.g., development in or near a stream) versus restorative works (e.g., removing dikes or other structures,

naturalizing creek meanders, riparian restoration planting). Often, navigating these regulatory requirements poses an insurmountable financial barrier to well-meaning restoration efforts. Indeed, laborious authorization processes under the WSA and *Fisheries Act* can take several years to complete and require considerable costs to retain qualified professionals. It is also important to highlight that, while the WSA and *Fisheries Act* lead to the protection of habitat, the spirit, and intent of these regulatory mechanisms are not motivated from an altruistic place. Fish and water are viewed as resources for our continued use under these laws, a point that has been the subject of considerable controversy, particularly as it relates to Indigenous rights and title.

A third noteworthy piece of provincial legislation that influences activities within the 30 m buffer around the aquatic area is the Riparian Areas Protection Regulation (RAPR) (Government of BC, 2021). The intent and spirit of the RAPR are to “protect fish habitat by maintaining functional riparian buffers between human development and aquatic features” (Government of BC, 2021). This is achieved by prescribing minimum buffers (generally varying from 10 m to 30 m depending on the width of the creek) that must be wholly protected from development (Ministry of Forests, Lands, Natural Resource Operations and Rural Development 2019). Specific to Mission Creek, the City of Kelowna has elected to exceed the minimum buffer requirements under the RAPR for the portion of Mission Creek upstream of Gordon Drive through measures required under the Natural Environmental Development Permit Area (Chapter 21, City of Kelowna, 2022). The legislation only applies to residential, commercial, or industrial development; the vast majority of the activities around Mission Creek, however, are recreational (e.g., trails and affiliated amenities) or agricultural and are thus exempt from this critical legislation. Also, the legislation is triggered by proposed new developments; it does not apply to existing infrastructure within the protected streamside buffer, which is considered “grandfathered” in place (FLNRORD, 2019).

4.2.1.2 Upland habitat protection and restoration

Outside of the 30 m buffer surrounding Mission Creek, the majority of the land falls within BC's Agricultural Land Reserve. Established under the provincial *Agricultural Land Commissions Act* and administered by the agricultural land commission, the intent of the ALR is to protect farmland in BC (Government of BC, 2002). Removing land from the ALR is not permitted under most circumstances (and isn't usually desirable from a socio-economic perspective). Ecological objectives, particularly restoration efforts that seek to return agricultural land to a semi-natural state, restrict the farmable area and are therefore unlikely to be permitted. It is important to highlight that while the ALR/ALC may restrict restoration works within the ALR, these lands are also protected from conversions to higher density anthropogenic uses. As such, land within the ALR may provide important 'softscapes' that maintain some ecological functions, such as provisioning ecosystem services and harboring biodiversity (Loewen, 2020). Therefore, the ALR/ALC may serve as an important regulatory mechanism for creating spaces that support both human and ecological purposes.

While other environmental regulatory mechanisms may also come into play during certain activities, we feel the aforementioned status captures the challenge of maintaining functional ecosystems within an urban context well. The jurisdictional landscape in the Mission Creek watershed is complex, particularly for the land with the most potential to maintain and enhance ecological adaptive capacities, such as the intertwined riparian and aquatic areas and low-density human areas like agricultural land. As the preceding paragraphs highlight, these multi-jurisdictional regulations serve as important mechanisms to protect habitat but also constrain more aggressive directives and restoration work in some cases.

4.2.2 Socio-Economic Impetus

Compounding challenges related to navigating the regulatory landscape, the City of Kelowna is also challenged with appeasing the diverse constituents to whom the City is politically accountable (Imperial et al., 2016). A diverse number of people from disparate settings and social-economic backgrounds collide within the Mission Creek watershed. This includes the landowners, business owners, recreationists, non-governmental organizations (NGOs), other municipalities, and academics who are either affected by a problem (or its solution), studying a problem, or politically accountable for a problem. Challenges related to preserving a functional ecological system embedded within a socio-economic context are, therefore, deeply interwoven with challenges related to integrating epistemologies, worldviews, values, and priorities (Bodin & Tengö, 2012; Raymond et al., 2010; Tengö et al., 2014). It is for these reasons that land and resource management is often conceptualized as a “wicked problem” wherein tractable, salient solutions that appease all parties and achieve a balance between conservation and development are unlikely (Defries & Nagendra, 2017). Specific to the objectives of maintaining the ecological function, while the importance of protecting habitat may seem obvious to some, it is an objective incommensurable with many other social and economic priorities. Further challenging this, Kelowna is, at present, a highly conservative region that places considerable emphasis on development, urban expansion, and increased productive capacity.

Ecosystem services may serve as a powerful metaphor to bridge socio-economic directives with ecological protection, particularly when a clear link can be drawn to the financial burden of eroding ecosystem function (Daily et al., 2009). The Mission Creek watershed provides many examples of this, such as costs associated with replacing flood damaged infrastructure, managing stormwater, water treatment, and ecotourism (expanded on in Section 5 of this report).

4.2.3 A legacy of historical disturbance

The final challenge the City must overcome to maintain ecological adaptive capacity is a legacy of historical land use conversions that have highly constrained opportunities available now. Since European settlement in what is now called Kelowna, ecosystems have been removed and replaced by human land uses at an alarming rate. For instance, estimates suggest that as much as 81% of open wetland habitat, 74% of ponderosa pine woodland, and 93% of grasslands have been lost since 1800 (Lea, 2008). As the availability and connectivity of habitat have declined, so too has biodiversity. Many species that historically frequented the Mission Creek watershed are now recognized as endangered, threatened, or of special concern under the Federal *Species at Risk Act* or provincially designated as red or blue listed (BC Conservation Data Centre, 2022). It is exceptionally unlikely that anthropogenic land uses will be returned to their formerly natural state. As such, we are already significantly constrained in the opportunities remaining to maintain connected, functional ecosystems that can support adaptive capacity.

Even where there is the motivation and wherewithal, restoration is not a panacea. While sobering, restoration efforts are often not successful in achieving their purported goals (Bernhardt & Palmer, 2011). Ecosystems that are lost are oftentimes not replaceable, as the genetic diversity, soil properties, biodiversity, and unique microclimates that the ecosystem once supported are also lost – we cannot ‘restore’ extinction. To avoid further constraining future opportunities, we should proceed with the assumption that the intact natural areas remaining in Mission Creek harbor critically important species assemblages and genetics that should be maintained to build adaptive capacity. While we cannot undo historic habitat loss, we can abate further encroachment into these critically important remaining areas.

4.3 s̓c̓e:łx̓w̓əy̓əm Foodland Corridor: An example of building ecological adaptive capacity within an urban context

The recent s̓c̓e:łx̓w̓əy̓əm Foodlands Corridor project (hereafter Foodlands) completed on the unceded territory of Kwantlen First Nation near Langley, BC, provides a poignant example of how ecological adaptive capacity can be improved in a watershed largely dominated by human land uses (Rivershed Society of BC, 2021). Completed in spring 2022, the overarching objective of Foodlands was to restore and protect contiguous swaths of land for the purpose of simultaneously supporting ecological functioning while improving Indigenous food sovereignty. The project was prompted by increasing concern by Kwantlen First Nation that traditional food sources were eroding with increased land disturbance, which was concomitantly constraining opportunities to transfer knowledge across generations and participate in important cultural practices. Their approach involved identifying contiguous parcels of land along the Salmon River that could be restored to improve landscape connectivity, habitat availability, and habitat diversity and subsequently developing and implementing a restoration plan.

This project faced many of the similar challenges we have highlighted for the Mission Creek watershed, including complex regulatory considerations (most of the land falls within the ALR/ALC), diverse values and objectives, and a legacy of historical disturbance. There were several creative strategies employed by the Foodlands team to overcome these challenges, which may have applicability to the Mission Creek watershed.

4.3.1 Overcoming legislative barriers

Similar to the Mission Creek watershed, the Foodlands corridor is largely situated within the ALR. Restoration works, therefore, had to align with the spirit and intent of the ALR/ALC.

This challenge was embraced wholly as an opportunity by acknowledging and building on the diverse food systems a landscape can support, particularly once semi-restored. This includes land-based food production (i.e., farming) and food harvest (e.g., gathering and trapping), as well as aquatic-based food systems like fishing. Working alongside Kwantlen First Nation elders and knowledge holders, restoration directives were identified that support nutritious and ecologically/culturally appropriate plant assemblages that are sustainable and restore food sovereignty for Kwantlen First Nation. To overcome regulatory requirements imposed by the federal and provincial governments, these agencies were engaged early and frequently to help expedite permitting processes (note that the project was also funded by the Provincial government under the Healthy Watershed Initiative).

4.3.2 Overcoming socio-economic barriers

Foremost, the s̓c̓e:l̓x̓w̓əy̓əm Foodland corridor represents a highly collaborative initiative between not-for-profit groups (Rivershed Society and the Langley Environmental Partners Society), consultancies, government, private landowners, and Seyem Qwantlen (the business subsidiary of Kwantlen First Nation). The respect embedded into every step of the Foodlands corridor project, from inception to completion, is a testament to the importance placed on meaningful collaboration. Examples of this include the intentionality with which different knowledge systems were intertwined to define restoration directives and the upfront and meaningful discussions with landowners to ensure restoration works on their land would be synergistic with their aesthetic priorities and intended use of the land. Also, in recognition of ephemeral, limited, and sporadic funds, the Foodlands corridor was delineated into many different parcels and projects that collectively contribute to a contiguous swath of restored habitat. This will allow for continued efforts that provide spatial continuity across years and funding agencies.

4.3.3 Overcoming a legacy of historical disturbance

This was perhaps the most challenging barrier to overcome, as the Foodlands corridor is embedded within a rural-residential and agricultural context. The project overcame this challenge by thinking in terms of ‘multifunctionality’ – that is, designing restoration sites to complement, not compete with, other land uses in the areas. Examples of this are touched on above, like conceptualizing aesthetic and agricultural values in addition to ecological.

Foodlands provided a mechanism for improving ecological adaptive capacity by promoting connected and diverse habitat swaths without eroding human uses of these lands. The abundance of low-density land uses (e.g., agricultural, rural-residential) proximal to Mission Creek are well-suited for a similar type of project. In moving towards sustainable landscape solutions, we recommend the City of Kelowna identify aptly positioned parcels of land that may also support multifunctional uses.

5.0 Natural Capital and Ecosystem Services

According to Taylor, Wilson, and Sauer (2013), “[n]atural capital refers to the value of the earth’s land, water, atmosphere, living organisms, and all formations of the earth’s biosphere (i.e., nature).” Natural ecosystems provide human beings with essential goods and services, many of which benefit and are valued by humans. People often define ecosystem services as benefits that they receive from ecological systems, either directly or indirectly (Millennium Ecosystem Assessment, 2005). For instance, watersheds capture, filter, and store water; trees absorb air pollution; and trees, plants, and soils store and regulate carbon emissions (Taylor et al., 2013).

Ecosystems exist in relation to one another rather than in isolation. For this reason, location and spatial relations are important aspects of the financial valuation of ecosystem services (Gallay et al., 2021). An ecosystem's ability to provide services based on its biophysical properties, social conditions, and ecological functions is termed service capacity. Service capacity is a function of natural and human-caused changes over time and space (Varga, 2019). The value of ecosystems and their services has multiple dimensions (Costanza, 2017). In terms of value, there are three domains: ecological (biophysical), sociocultural, and economic.

5.1 What Ecosystem Services Mean to the Economy

It is growingly recognized that quantifying ecosystem services is a productive way to account for the value of ecosystems. A global study has estimated the value of the world's ecosystem goods and services (\$16-54 trillion/year, with an average of \$33 trillion/year) to be worth more than the value of the entire global economy (\$18 trillion in the year of the study) (Costanza, R. et al. 1987). Environmental conservation/restoration must be a top priority because of the value that nature offers.

As Mission Creek plays a critical role in Kelowna and the greater Okanagan Valley, its restoration may result in significant enhancements in the ecosystem services provided by the creek. Such enhancements can have a direct impact on quality of life, including water quality, whereas in other cases, they can have an indirect impact (for example, wildlife habitat). The Mission Creek ecosystem is also known for providing important habitats for a variety of species. For instance, a large stand of black cottonwood trees (over 100 years old) can be found in Mission Creek, representing a rare ecosystem in the Okanagan (Gaboury et al. 2004).

To quantify the value of ecosystem services in a practical way, it is necessary to focus on a specific area with its specific properties that interact/interrelate with surrounding ecosystems and how this value is impacted by changes in the use of the area and/or the surrounding ecosystems (Nelson, 2009).

5.2 Quantified Value of Services Provided by the Mission Creek Ecosystem

In 2013, Amy Taylor, Sara Wilson, and Greg Sauer conducted a quantification study in the lower portion of Mission Creek. Their study included valuations of the following ecosystem services: farmland, habitat, recreation and tourism, water supply, forest carbon storage and sequestration, wetland carbon storage, grassland carbon storage, air filtration by forests, flood protection (water regulation), and waste treatment by wetlands. Considering the limited scope of this report, we will only focus on the quantification of ecosystem services regarding water supply and flood protection (water regulation).

5.2.1 The Value of Water

Water has value because of its numerous functions in human societies, such as drinking, food production, sanitation, energy production, forestry, and tourism. Taylor et al. (2013) reported that “the value of water supply from the Mission Creek watershed (46,785 hectares) is estimated to be between \$7.6 million and \$24.5 million/year or \$162.52/ha/year (domestic water use) and \$524/ha/year (total water use)”. Also, based on avoided water treatment costs thanks to the forest/wetland cover in the watershed, they assessed the economic value of water filtration to be \$2,127.76/ha/year. There is a mutual connection between decreased water quality or quantity and the degradation of ecosystems (BC Wildfire Service, 2021). Healthy ecosystems reduce stormwater runoff and flooding, provide fish and wildlife habitat, and increase property values.

Considering the critical role of water in quality of life, water quality and/or quantity is an important aspect of urban sustainability.

5.2.2 The Value of Flood Protection (Water Regulation)

Flooding can do extensive harm to people, houses, and businesses that are located in historical floodplain areas. Flood risk management strategies involve the enhancement and protection of natural areas, building flood control and erosion control structures, or alternative methods such as investing in green infrastructure. According to Taylor et al. (2013), “[n]atural capital such as forests, rivers, lakes, wetlands and permeable soils provide natural flood protection services for communities. For example, forests and wetlands collect and regulate water flow within watersheds by storing and slowing the release of water and thereby providing natural protection against flooding and erosion.” Taylor et al. (2013) estimated the value of water regulation/flood protection services delivered by forest covers in Mission Creek to be \$518,652 per year. Furthermore, they quantified the value of flood protection provided by wetlands and the stream to be an additional \$138,793 per year. Finally, they speculated that “[r]estoration efforts along Mission Creek could feasibly result in [...] a 2.4 percent increase in natural cover areas.”

5.3 The Benefits of Restoration of Mission Creek

The channelization of Mission Creek was intended for better flood protection and increased agricultural land use. However, it has resulted in a greater flood threat and a 75% loss in wetland/riparian areas (Gaboury, 2004). The restoration of Mission Creek is expected to reduce the annual risk of flooding during the spring freshet.

Restoration will also likely result in improvements to habitats for bird and amphibian species that rely on the stream's riparian zone. Specifically, it will allow important riparian vegetation such as wild rose, dogwood, willow, and cottonwood to regrow. Wildlife tree-dependent bird and bat species depend on these trees for nests, roosts, and foraging opportunities.

Restoring Mission Creek is aimed at improving aquatic habitat as well. Taylor et al. (2013) estimate that at appropriate flow rates, the capacity of Mission Creek is 308,000 spawning kokanee, 5,500 fall rainbow trout parr, and 57,000 rainbow fry. Furthermore, the restoration will improve carbon storage through the re-establishment of forests, tree cover, grasslands, and wetlands.

Taylor et al. (2013) also state that “a 10 to 20 meter widening of the channel, to a width of 40 to 50 meters between dikes, can result in bar formation, better pool and riffle definition, some substrate sorting to improve the quality and quantity of spawning gravels, and the creation of a few small vegetated islands.” Additionally, they argue that restoring the conditions prior to channelization “could result in numerous desirable habitat characteristics, including areas of shallow riffles and deep pools, discrete micro and macro-habitats where silt, sand, gravel, cobbles, and boulders have been sorted, increased instream cover, local velocity, and depth diversity, and reduced instream sedimentation and embeddedness.”

Agricultural lands adjacent to Mission Creek may also improve as a result of restoration. Due to dike setbacks and a high-water table in much of the agricultural land bordering Mission Creek, crop production becomes limited in these areas. Restoration can widen the stream cross-

section, which results in a lower water table and improves soil conditions in upland agricultural areas.

5.4 The Challenges of Restoration of Mission Creek

A list of challenges, goals, and recommendations facing the management of Mission Creek can be found in the *Mission Creek Regional Park Management Plan* published by the Regional District of Central Okanagan in 2021. A selective list of challenges, goals, and recommendations that are pertinent to the restoration project at Mission Creek is laid out in Table 1.

5.4.1 Costs of Restoration

MCRP's 20-year implementation plan prioritizes and provides estimates of costs in the form of actions by funding type: capital or operational. Capital funding items are assets that depreciate over time and have a defined life cycle, such as new bridges, buildings, kiosks, trails, and picnic shelters (Table 2).

Operational funding covers the day-to-day expenditures, such as salaries and items that don't meet a value threshold. These items do not depreciate over time and are consumable.

The *Mission Creek Regional Park Management Plan* lists the amount of funding required for MCRP activities as provided in table 3 and 4.

5.4.2 Wildfires, Water Quality, and Climate Change

Mission Creek originates near Big White Mountain within the southern interior of British Columbia. Creek waters travel rapidly through various bio-geographical areas to finally slow and

meander through benchlands in Kelowna and on to Okanagan Lake. Wildfires in the Big White Mountain area cause changes in water quality, with variable rates of recovery. Even small changes/disturbances in water quality can significantly impact aquatic ecology, resulting in greater algal production, increased aquatic invertebrate abundance, and shifts in invertebrate community structure.

Wildland fire management requires a balance between wildfire's benefits and risks (Zaksek & Arvai, 2004). In cases where wildfires may cause damage to human settlements or valuable timber resources, fires are aggressively extinguished (Boiffin, 2013). Firefighting constitutes an extremely costly dimension of Canada's forest management, including approximately \$400 to \$800 million spent on fire suppression, prevention, and prescribed burning (Gordon, G., 2014).

A few studies have suggested a connection between wildfires in Canada and climate change. For instance, climate change has been linked to a longer, more severe, and more expansive fire season (Flannigan et al., 2005; Gillett et al., 2004). In the past few decades, Canada has seen an increase in areas burned by wildfire as a direct result of climate change (Gillett et al., 2004). Furthermore, continued urban development into wildland interface zones (McCaffrey, 2004) and resistance to wildfire mitigation strategies such as prescribed fire (McCaffrey, 2004; McGee, 2007; Winter & Fried, 2000) may pose extra risks.

5.4.3 Crown Land Wildfire Risk Reduction

Provincial fuel management planning and treatment activities began in 2019. Crown Land Wildfire Risk Reduction is administered through the Ministry of Forests, Lands, Natural

Resource Operations, and Rural Development with an initial 2019/20 investment of up to \$20M per year through to 2021/22.

According to *Crown Land Wildfire Risk Reduction*, published by BC Wildfire Service, some of the most important aspects of the program include:

- Fuel management planning and treatment activities focus on provincial Crown land located around communities.
- Prescribed fire (including planning and operational treatments) and the development of a comprehensive provincial prescribed fire program.
- Operational projects funded by the CRI Crown Land WRR category will be contracted via BC Bid and will help to increase community resilience to wildfire, increase ecosystem resiliency and support local contractors in communities across the province.

5.5 How to Achieve a Sustainable/Resilient Future for Cities

There is no single solution to achieve urban sustainability. Natural and human-caused problems require different interventions from place to place. Considering the number of problems facing our natural ecosystems, planning and designing for the mid- and long-term future is difficult. For this reason, modern planning strategies should be adaptive, risk-based, and flexible to account for unexpected conditions or developments.

6.0 What is the Current State of Water Sustainability in Mission Creek Within the Lens of Indigenous Collaboration and Inclusion?

6.1 The Current Legal and Cultural Relationship Amongst the Province, the City of Kelowna, and the syilx Okanagan Nation in Mission Creek

To understand the modern political and ecological context of the Mission Creek watershed and the Indigenous/settler-culture structures that govern it, Canada's history of colonial engagement must first be established. As the historical picture of colonial era Crown and Indigenous Nations treaty negotiations never extended into western Canada, the lands of British Columbia, to this day, remain unceded and largely devoid of treaty definition (both historical and modern) (Sloan Morgan et al., 2018). For over a century, the centralized land seizure has been one means through which the province has utilized "lawfare," or the "effort to conquer and control Indigenous peoples by the coercive use of legal means" (Blomley, 2015, p.171). Without addressing the clear questions surrounding the legitimacy of colonial treaties, and the akin flaws of the modern treaty process (through the British Columbia Treaty Commission) (see Sloan Morgan et al., 2018), as it is beyond the scope of this report, the truth remains that the relational landscape amongst the provincial government and Indigenous Nations over land ownership is varied and highly contentious (Harris, 2008). Currently, treaty settlement lands in British Columbia make up only a total of 228,000 ha, or 0.2% of the provincial land base (British Columbia, 2011). Within this larger context, the land now known as the city of Kelowna sits upon the unceded territory of the Syilx Okanagan Nation (Terbasket, 2019). This territory encompasses the districts of eight-member communities over approximately 69,000 square kilometers (Okanagan Nation Alliance, 2017) on both sides of the 49th parallel (Good Water, 2018).

6.1.1 Water Resource “Ownership” in British Columbia

The Indian Reserve system within British Columbia (as well as the rest of Canada) was designed to hold the “temporary reserve” (Flanigan, 2019) in trust for the Indian Band to whom it had been assigned, with the intent to facilitate a progressive integration of Indigenous peoples into Canadian society (Harris, 2008). Possession was exclusive but did not entail “ownership” per se, as through the 1867 *Constitution Act*, “Parliament claims jurisdiction over Indians and lands reserved for the Indians” (Cameron, 2020, p.11). “Reserves are held by Her Majesty for the use and benefit of the respective bands for which they were set apart, and subject to this Act and the terms of any treaty or surrender, the Governor in Council may determine whether any purpose for which lands in reserve are used or are to be used is for the use and benefit of the band” (*Indian Act* 18(1), 1985). Despite the lack of legal right to the title for IR lands, Indigenous bands are the legal “possessors” (*Indian Act* 20(1), 1985) and caretakers of the land, responsible for its maintenance (including roads, bridges, ditches, and fences) at the expense of the band, and under the instruction and supervision of the [Crown-Indigenous Relations] Minister (*Indian Act* 34(2), 1985). Via the *First Nations Lands Management Act* (FNLMA) (1999) and through the *WFN Self Government Agreement* between the WFN and the Government of Canada, the WFN became a self-governing entity and has “full jurisdictional authority” over Westbank Lands and resources and exemption from the majority of *Indian Act* legislation (Westbank First Nation Land Registry, 2022).

While some jurisdictional clarity has been established on WFN reserve lands, the debate over water rights remains convoluted (Brandes et al., 2014). Legally, the province of British Columbia positions that “all water in British Columbia is owned by the [provincial] Crown on behalf of the residents of the province” (British Columbia Water Licensing & Rights, 2022). British Columbia freshwater resource distribution was established and continues to operate

through the Water Sustainability Act section 22 (2016) under a system of prior allocation, otherwise known as a “first-in-time, first-in-right” (FITFIR) system. Through this system, a water user in British Columbia must do so through a licensing paradigm (domestic, agricultural, industrial, conservation) that is prioritized upon “precedence of rights” (British Columbia Water Use During Scarcity, 2022). This means that earlier license holders will have priority access to “stream” water resources (defined as “(a) a natural watercourse, including a natural glacier course, or a natural body of water, whether or not the stream channel of the stream has been modified, or (b) a natural source of water resource in times of scarcity or drought; Water Sustainability Act, 2016). While oppositions surmount regarding the jurisdiction, possession, and ownership of water resources on a treaty, reserve, and Indigenous territorial lands in British Columbia, as interpreted through section 35 of the Canadian Constitution (Brandes and Curran, 2008) and the federal Crown systems designed to ensure the continuation of Indigenous activities and practices on the land (Harris, 2008; Syilx Water Declaration, 2014; Sam and Armstrong, 2013), the provincial position remains steadfast – all stream water resources remain under the full jurisdiction of the government of British Columbia. As of this month, there are 864 “current” licenses held for surface and groundwater in the Mission Creek watershed; of these, the WFN (inclusive of the Westbank Indian Band Development Co Ltd) is the holder of three (3) surface water licenses, totaling 4.54609 m³/day and 107,189.412 m³/year of water allotment.

6.1.3 Why is Mission Creek Culturally Significant to Syilx Communities?

While “Mission Creek” received its title in 1860 as an acknowledgment of the Catholic Oblate Mission (Mission Creek Restoration Initiative, 2022), which helped in laying the structural framework for 19th century European settlement, the watershed has been sustainably inhabited by the Syilx people since time immemorial (Armstrong, 1993). The syilx Okanagan Nation asserts

“inherent and implicit Aboriginal Title, Rights and Responsibilities to siwłk^w”(Syilx Okanagan Nation, 2014). The watershed plays important roles, both physically and culturally, and serves as a focal point for “syilx people to affirm deep connections with the sc’win, the land, the waters which are central to syilx traditional food systems, while continuing to revitalize our language, songs, and prayers, and thus the perpetuation of syilx culture” (Okanagan Nation Alliance, 2017). Syilx communities view watersheds as far more than mere extractive resources. The Syilx Okanagan Nation Siwłk^w Declaration describes this relationship as one characterized by respect and responsibility:

“syilx peoples assert that siwłk^w has the right to be recognized as a familial entity, a relation, and a being with a spirit who provides life for all living things. Siwłk^w must be treated with honor, respect, and reciprocity. We care for, protect, and honor our relationship and bond with siwłk^w through our syilx laws, customs, traditions, and practices. Siwłk^w is not a resource or a commodity.” (Syilx Okanagan Nation, 2014).

Prior to European settlement and the implementation of extractive resource frameworks, intensive agricultural practices, and development impacts in the Mission Creek watershed, the ecosystem supported robust populations of salmon and other aquatic species. Centralized management structures have caused a plethora of ecological stresses in the watershed, including riparian habitat decimation, impacts on water quality and quantity, and basin alteration and flooding (Mission Creek Restoration Initiative, 2022). Mission Creek serves as one of the last remaining places for threatened creek-spawning Kokanee salmon (BC Parks, 2022), and the revitalization of these endangered populations has served as an impetus for collaboration amongst the City, the province, and Syilx communities.

6.1.4 The Relationship Between Watershed Sustainability, Resilience, and Indigenous Land Stewardship

The University of Victoria’s POLIS Project on Ecological Governance suggests that “watersheds are the foundation of our prosperity and collective well-being” and that “developing a system in British Columbia that effectively manages and governs fresh water in the context of functioning and healthy watersheds will be a priority challenge for the coming decade” (Brandes et al., 2014 p.2). A growing body of research is emerging regarding the importance of acknowledging Indigenous sciences, knowledge, and practices in ecological governance frameworks while simultaneously situating Indigenous communities in leadership roles in restoration and conservation initiatives (Lukawiecki et al., 2019; Alexander et al., 2021; Blackstock, 2002; Barber, 2021; POLIS with Columbia Basin Trust, 2018; Fraser Basin Council, 2016; Alexander et al., 2021). As Indigenous communities, like the syilx Okanagan Nation, have long served as stewards of the land, cultivating “multifaceted social and governance mechanisms that provided equity and land sustainability for the community” (Good Water 2018, iii), these concepts are increasingly being recognized as alternatives to current forms of unsustainable practice (Barber, 2021). This trend has materialized into an increase in government (all levels) collaborations with Indigenous communities to “co-produce knowledge to inform policy and community-based solutions” (Climate Atlas of Canada, 2022).

In the case of Mission Creek, a better comprehension of syilx watershed sciences and practices can serve to greatly augment the knowledge base through which the ecosystem is understood and interacted with. A dualistic approach, inclusive of multiple ways of knowing, or

“two-eyed seeing”² (Wilson et al., 2019), has the capacity to “strengthen the evidence base for policy advice and decision-making” (Alexander et al., 2021, p.1) and offers a viable alternative to western modules of resource governance. Further, collaborative ecological governance has the capacity to facilitate pathways toward better, more egalitarian relationships with Indigenous communities and can help support both “reconciliation and self-determination” (Alexander et al., 2021, p.1). An increasing number of collaborative ecological initiatives throughout British Columbia explicitly recognize the essentiality that “First Nations are engaged, and Indigenous rights and interests are recognized and respected” (POLIS and Columbia Basin Trust 2018). Many of these initiatives stem from principles stated within the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and the subsequent Declaration on the Rights of Indigenous Peoples Act (DRIPA) (2019). Of specific poignance to Indigenous water, governance are articles 10 and 19 related to development, and 18 and 27 related to co-governance (United Nations, 2007). The City of Kelowna, as a Canadian municipality, has a legal responsibility to recognize UNDRIP legislation as of June 21, 2021, with the Royal Assent of Bill C-15, *An Act Representing the United Nations Declaration on the Rights of Indigenous Peoples* (Parliament of Canada, 2021). Further, the City’s engagement with UNDRIP legislation and the ethos of Indigenous collaboration will increase as DRIPA continues to become more established in structure and practice throughout the province. Current collaborative projects within the microcosm of the Mission Creek watershed provide a foundation from which to nurture collaborative ecological governance relationships with syilx Okanagan communities, though, as will be demonstrated, there is more that can be done.

² From Wilson et al. (2019), the concept of “two-eyed seeing” “was first articulated by Mi’kmaq Elder Albert Marshall in 2004”...and serves as an approach that “represents a call for the research community to see the strengths of Indigenous knowledge (one eye) on equal terms as the Western scientific knowledge (one eye), and to learn how to use both eyes to answer pressing research questions in more holistic ways.” (624)

6.2 Some Successes Achieved in the Mission Creek Watershed Through the Lens of Indigenous Community Collaboration and Inclusion

6.2.1 The City of Kelowna 2040 Official Community Plan

The City of Kelowna has demonstrated both intentionality and initiative in the cultivation of better ecological governance relationships with syilx Okanagan Nation representatives and agencies. An illustration of this can be found within select policy verbiage in the 2040 Official Community Plan, which for the purposes of this section, will be utilized as a framework through which to understand the ideologies and action commitments of the municipal government. Sections of the 2040 OCP that explicitly relate to collaboration with the syilx Okanagan Nation are noted in Appendix A (*note that in addition to those listed, there are two additional Objectives and Policies in the 2040 OCP that refer to the Syilx Okanagan Nation but have been assessed to be outside the scope of interest of this Report*). Perhaps the two most pertinent sections for the purposes of this lens of analysis within the Mission Creek watershed are Objective 13.4, relating to the provision of secure water sources with specific Policy mention of the syilx/Okanagan Water Declaration; and Objective 14.4, relating to the preservation and biodiversity of landscapes with specific Policy mention of collaboration amongst the RDCO, communities, First Nations and senior levels of governments towards the protection of viewsapes (City of Kelowna, 2022).

The inclusion of a reference to UNDRIP and the Truth and Reconciliation Commission's 94 Calls to Action demonstrates an important commitment from the City, as illustrated through this document, to forging better relationships with syilx Okanagan Nation communities. This is further supported by the repeated use of the word "collaboration" in regard to issues of culture, food security, parks, water, and governance which all have underlying ecological connotations.

6.2.3 The Mission Creek Restoration Initiative

Emerging from this context, the Mission Creek Restoration Initiative stands as a reflection of this accumulative policy framework and its practical intentionality. The MCRI is a “multi-phase, multi-stakeholder partnership formed in 2002 to restore natural functions to the lower reaches of Mission Creek...” (Mission Creek Restoration Initiative Project Partners, 2022). The MCRI is funded by the City of Kelowna, the RDCO, the Province of British Columbia, the Okanagan Basin Water Board, and a variety of foundations and societies. The project partners provincial (Ministry of Forests, Lands, Natural Resource Operations - FLNRO) and federal agencies (DFO) along with the City of Kelowna, the Okanagan Nation Alliance (ONA), and the WFN, as well as NGOs like the Friends of Mission Creek Society (FOMC) and the Central Okanagan Land Trust in a collaborative effort to restore and protect the shared watershed (Mission Creek Restoration Initiative Project Partners, 2022). The Project has completed Phase 1: *Construction*, where the ONA’s role is centralized in environmental & archaeological monitoring (Mission Creek Restoration Initiative Project Phase 1, 2022). Though monitoring work is ongoing, the ONA produced the Mission Creek Restoration Initiative Effectiveness Monitoring, 2016-2019 report in February of 2020, detailing ONA Fisheries Department activities, data, and conclusions. As stated within the document, the ONA participates in this collaboration in order to “continue to document the successes and challenges of these projects as part of the larger vision of Okanagan Nation Elders in healing the watershed and *kł cp̓əlk stím* - ‘cause to come back” (Yuan, B. et al., 2020). Through this collaboration, the Project was able to employ best practices in fish and wildlife habitat monitoring while simultaneously recognizing the knowledge base and skill set of the *syilx* Okanagan Nation. The collaboration stands as a basis from which positive relationships can be

nurtured amongst the City and syilx communities, facilitating future commitments and a more egalitarian understanding of resource governance.

6.3 Some Challenges the City of Kelowna Still Faces Within the Mission Creek Watershed Through the Lens of Indigenous Community Collaboration and Inclusion

Despite the saturation of verbiage in the City of Kelowna's 2040 OCP relating to syilx Okanagan Nation collaboration and recognition of syilx knowledge, value systems, and cultural ideologies, only one single corresponding action is defined (Section 16.1 – *Implementation Actions*). Further, this Action #5, to “Partner with stakeholders to develop an Okanagan Lake Management Plan,” does not actually correlate directly to the Objective (14.4) within this chapter, *Natural Environment* (14), that explicitly mentions partnerships with the syilx Okanagan Nation and its representative agencies. Additionally, the use of the term “stakeholders,” if it was, in fact, used to reference the syilx Nation, is problematic as it holds connotations of a reduced status when, in fact, syilx communities should be recognized as sovereign Nations and decision-making authorities in matters of ecological governance as per UNDRIP/DRIPA verbiage. Though other connections could possibly be drawn amongst Objectives, Policies, and their corresponding Actions, they are not explicit, and the Plan fails, overall, to broadly define meaningful activity through which syilx Okanagan community collaboration can be promoted. On a similar thread, the Mission Creek Restoration Initiative, while facilitating collaboration with the ONA and the WFN, notably fails to situate those communities in distinct leadership roles or employ Indigenous frameworks that could more centrally address syilx cultural considerations. Despite the Creek's meander directly through WFN IR 8 boundaries and the City's acknowledgment of placement within “unceded syilx lands” (City of Kelowna, 2022 Community Histories), the MCRI thus far has only included limited aspects of ONA involvement, specifically relating to monitoring

activities. In this light, this project could certainly be woven into a much richer, more robust fabric with the inclusion of syilx leadership, cultural ideologies, and full engagement.

6.4 Collaborative Models to Look Towards

Cultivating an overarching framework of guiding verbiage amongst UNDRIP/DRIPA and the 2040 OCP, it stands to assert that much intentionality exists behind the push for nuanced ecological governance relationships with Indigenous communities and the City of Kelowna. The deficiency, however, as is so often the case with policy, lies in the practical application and fulfillment of those principles. Looking to examples of initiatives that have found success in this arena of Indigenous-centered collaborative watershed governance can be a helpful foundation from which to shape future project initiatives within the Mission Creek watershed. Some watershed-based organizations and programs have made significant intentions to centralize Indigenous communities (knowledge and ideologies) while dismantling entrenched and restrictive colonized frameworks (see POLIS, 2018; Wilson, 2019; Wilson, 2018; Hunter et al., 2014; Palmer, 2021).

5.4.1 The Columbia River Salmon Reintroduction Initiative (CRSRI)

One prime example of this can be found in the Columbia River Salmon Reintroduction Initiative (CRSRI). The CRSRI is an agreement between the syilx Okanagan, the Ktunaxa, the Secwepmec Indigenous Nations, and the Government of Canada and British Columbia to reintroduce culturally and ecologically important Pacific salmon into the Columbia River. The three-year initiative is funded by contributions from the Government of Canada, British Columbia, and the Columbia Basin Trust, with a total of \$2.25 million dollars (Syilx Nation et al., 2020). The initiative is guided by a Strategic Direction Framework, which prioritizes the role of Indigenous communities through its intention to “build the capacity of Indigenous Nations to support their

leadership and involvement in the salmon reintroduction initiative” and “celebrate salmon among Indigenous Nations, including through ceremonial releases, to support their cultural, spiritual, and livelihood connections” (Syilx Nation et al. 2020, p. 5). The Initiative identifies Indigenous Leadership as its first Shared Principle for collaboration and decision-making (Syilx Nation et al., 2021) and references the United Nations Declaration on the Rights of Indigenous Peoples as a guiding framework in its 2019 Letter of Agreement (Syilx Nation et al., 2019). Unlike other structures which systemically marginalize and constrict Indigenous engagement and influence, the CRSI is “governed through an innovative organizational structure that is Indigenous-led, includes an Indigenous coordination mechanism, guiding principles for collaboration and decision-making, and is supported by an impartial Secretariat” (Syilx Nation et al., 2020 p.4). Notable for its meritorious centralization of Indigenous practice and leadership, this multi-jurisdictional collaborative model utilizes a cost-sharing structure amongst multiple levels of government that serves to relieve some economic burden off of solitary governments who seek to prioritize such initiatives but may have restricted means through which to do so.

6.4.2 The kłúsxńítkw (Okanagan Lake) Responsibility Planning Initiative (OKLRPI)

As a means for the facilitation of an initiative like the CRSRI, the development of the kłúsxńítkw (Okanagan Lake) Responsibility Planning Initiative (OKLRPI) is currently underway. The OKLRPI is a consensus-based pilot project that intends to “implement a syilx Water Responsibility Planning Methodology...to bolster protection measures for siwłkw (water) and land and address the cumulative impacts threatening the long-term viability of ecosystems to provide clean drinking water, habitat for fish and wildlife, erosion and flood control, and climate change mitigation” (Okanagan Nation Alliance Okanagan Lake Responsibility Planning Initiative, 2022). The project incorporates a “syilx-led process, bringing the voices of Elders, youth, knowledge

holders, hunters, fishers, and harvesters to articulate and share the Syilx values associated with Okanagan Lake Stewardship” (Okanagan Collaborative Conservation Program, 2022). Further illustrating the centrality of syilx leadership, the project “prioritizes the participation of syilx Traditional Ecological and Cultural Knowledge keepers” (Healthy Watersheds Initiative, 2022) and utilizes a planning process which ensures watershed “solutions are embedded with syilx Okanagan water laws, principles, and practices that value water and the environment as the foundation for stability” (Okanagan Basin Water Board, 2022). The newly established process aims to “undertake the development of the klúšxnítkw (Okanagan Lake) Responsibility Action Plan” (Okanagan Collaborative Conservation Program, 2022) throughout 2022, coordinated through the ONA, the Okanagan Collaborative Conservation Program (OCCP), the RDCO, the Provincial Government (FLNRO), and UBC Okanagan. It currently boasts support from “Mayors and Councils” (Okanagan Nation Alliance Okanagan Lake Responsibility Planning Initiative, 2022) of Okanagan Lake bordering municipalities. Though the level of commitment from the City of Kelowna to the OKLRPI remains to be seen, if a project within this umbrella of framework could be initiated in the Mission Creek watershed, a diversity of ecological and hydro-social goals could be simultaneously achieved. Meaningful engagement with this project could allow the City of Kelowna to cultivate ecological governance structures within the Mission Creek watershed, in which syilx Okanagan representation is more centralized, and significant steps are taken towards the cultivation of better relationships through shared ecologies.

7.0 Tourism and Recreation

7.1 What are tourism and recreation?

Tourism and recreation are widely used synonymously. Tourism and recreation have been defined in so many ways by different scholars. For the purpose of this report, tourism is defined as “the

business of attracting and serving the needs of people traveling and staying outside their home communities for business or pleasure” (Westcott, 2016, p.8), whereas recreation “is considered as an activity through which leisure may be experienced and enjoyed but it is also seen as a social institution” (Cushman and Laaidler, 1990). Kelowna is well known as a destination for tourism and recreational activities in the Okanagan region.

7.2 Sustainable tourism and recreation in Kelowna & Mission Creek watershed

Tourists may visit Kelowna for several reasons, including visiting the lush vineyards and orchards, the Okanagan Lake (Tourism Kelowna, 2022a), wineries, and the tourist attractions in the Mission Creek watershed. In the spirit of sustainability, Tourism Kelowna asks that all visitors explore Kelowna sustainably. On their website, it states:

“In order to ensure Kelowna remains beautiful, we ask you to respect and care for the land, the people, and our way of life during your stay. Take time to learn about the deep roots of the Indigenous culture of the syilx Okanagan People who have been on these lands for thousands of years. Reduce your carbon footprint by exploring businesses that have committed to sustainable business practices. And make sure when you are exploring nature to pack it in and pack it out, leaving no trace behind” (Tourism Kelowna, 2022a).

This declaration shows the commitment of Kelowna towards sustainability in the tourism industry for Kelowna and the need for tourists and/or visitors to reduce their footprint/impact on the environment. One place where this declaration strongly applies, given the history of human impact on the watershed, is the Mission Creek watershed. The Mission Creek watershed is greatly important for both recreation and tourism purposes. Mission Creek provides recreational services to the people of Kelowna and surrounding communities and tourist attractions to visitors and

tourists from all destinations (Taylor et al., 2013). The Creek embodies several geologic features and archeological sites remaining along its shores and is worthy of notice to tourists, such as the Gallagher Canyon and the Layercake Mountain (BC Parks, 2022; Friends of Mission Creek Society, 2013; RDCO, 2021). The Mission Creek Regional Park, located in the Mission Creek watershed, is one of the highest used parks in the region, receiving more than 1000 users each day (City of Kelowna, 2022a) and hence regarded as a flagship park for the Regional District of Central Okanagan Parks Service (Taylor et al., 2013).

7.3 Importance of tourism and recreation to the city of Kelowna and its populace

The visitation of tourists from all walks of life to the beautiful and unique Okanagan landscape, notably Kelowna and its surrounding areas, contributes immensely to the economic growth and development in the region. The region's tourism and recreation industry contribute to the local, regional, and provincial economy and beyond. This economic growth and development are realized and manifested through different businesses operating and trading goods and services to the local populace and non-local tourists (Figure 4). Kelowna and, by extension, the greater Kelowna area serves as a hub for an extensive recreation range of outdoor attractions, entertainment, and arts to its populace and visitors all year round (Westcott, 2016; WFN, 2019; InterVISTAS, 2020).

The tourism and recreation industry equally serves the region and its tourists with aesthetics, outdoor recreation, science and education, and culture and arts. Tourists enjoy and appreciate the beautiful scenery, sounds, and breath of nature performing outdoor activities in natural ecosystems. There are also opportunities for learning and research activities in these

ecosystems where tourists can experience the natural environment through film, books, art, folklore, and cultural symbols (Taylor et al., 2013; Westcott, 2016).

7.4 Resilience and sustainability challenges

Tourism and recreation amount of use, activity type and distribution of use

Tourism and recreation activities, despite their importance and benefits to the local and regional economy, have the propensity to impact the environment in negative ways. Some of the negative impacts of tourism and recreation include trampling on soil and vegetation, effect on aquatic systems (activities such as swimming) and wildlife, and to an extent, air quality (through transportation) (Monz et al., 2013). A conceptual framework of the ecological impacts that outdoor recreation poses to the natural environment has been proposed. The conceptual model is detailed and applicable in a North American setting and hence applicable to the Mission Creek watershed as well (Figure 5). Research conducted in the spring of 2000 on the impact of recreational activities on water quality in the Lamby, Kelowna, and Mission Creek watersheds indicated that recreation has a significant impact on the water quality (high levels of color, maximum summer temperatures, total organic and inorganic carbon, fecal and total coliforms) in the watersheds (Phippen, 2001). Park use may cause degradation in portions of the Mission Creek watershed. Areas of the watershed requiring restoration and/or redevelopment are marked by higher density trails (RDCO, 2021).

7.5 Impacts of Climate Change

Climate change effects like prolonged drought, landslides, flooding, wildfires, and establishment of invasive species increase, and extreme temperatures increase the vulnerability of

the tourism sector to uncertainty and risk (RDCO, 2021). With climate change exacerbating extreme weather events, the risk of flood and wildfire increases in the Kelowna region. These occurrences lead to the destruction of properties disrupting the community, productivity, and resources from other sectors of the economy (City of Kelowna, 2017). An example is the 2017 flood event that impacted the City's tourism and economic activity when access was limited to Okanagan lake, and parks and beaches closed with a loss of about \$10.7 million worth of damages recorded. As a result of the upsurge in lake levels at the time, residents and tourists were highly impacted by the closure of vital recreational and commuting paths for several months. Additionally, programs like the Canada Day fireworks attracting over 60,000 residents, were deferred due to the flooding of recreational parks and beaches (City of Kelowna, 2017).

Increasing population density

The expansion of populations, especially in urban areas and increasing urban density, may lead to an increase in user conflict in recreational areas and activities, an increase in pressure on core habitat areas within the Mission creek watershed, and an increase in park & infrastructure maintenance requirements (RDCO, 2021). With increasing densities comes increasing pressures and responsibilities if the watershed is to be managed sustainably. Where sustainable management of the watershed means managing the watershed to meet the demands for its usage and its ability to supply these demands, the goals and decisions for management may be impacted by competing use and/or increasing demand for usage.

7.5.1 Successes achieved

Mission Creek Greenway Regional Park & Scenic Canyon Regional Park

The Mission Creek Greenway is currently a 16.5 kilometer stretch of trail that is adjacent to Mission Creek (Figure 6). Upon completion, the Greenway will be 26 kilometers in length from the shore of Okanagan Lake to Mission Creek Falls (Friends of Mission Creek Society, 2013). It is considered one of the important areas of Mission Creek for the city of Kelowna. Many tourism and outdoor recreational activities are carried out in the Greenway of Mission Creek and Scenic Canyon, which shows the significance of Mission Creek to the people of Kelowna and other surrounding communities. These activities include but are not limited to running, walking, and cycling aimed at recreation and/or commuting, horseback riding, and bird watching (Taylor et al., 2013; Friends of Mission Creek Society, 2013). Greenway users per day in 2007 averaged approximately 1,450.4, which is attributed to its ability to provide residents and visitors with recreational (network of easy trails for hikers, cyclists, runners, walkers, and equestrians) and tourist attractions (Tourism Kelowna, 2022b; Taylor et al., 2013; Friends of Mission Creek Society, 2013).

The regional park embodies the Mission Creek mountain bike skills park. This Park is a 3.4 hectare site located at 1960 Hollywood Road South, accessible via the Mission Creek Greenway. The Park provides a space to practice skills as a rider or just to watch and catch a glimpse of more advanced riders. It was established in partnership with top riders of the sport and the City of Kelowna (City of Kelowna, 2022b; International Education Newsletter, 2020). Additionally, the regional park has an accessible playground for children, and it is wheelchair accessible as well. This ensures that people from all walks of life are able to use the park for tourist attractions and/or recreational activities (Taylor et al., 2013; Friends of Mission Creek Society, 2013).

7.6 Environmental Education Center for the Okanagan (EECO)

The Environmental Education Center for the Central Okanagan is situated in Mission Creek Regional Park and provides recreational and educational programs to local school children in Kelowna and surrounding communities and the general public (Taylor et al., 2013; RDCO, 2022). The EECO has a wealth of data and fun displays on environmental themes such as water, Okanagan flora and fauna, and local ecosystems (Friends of Mission Creek Society, 2013). Currently, the EECO runs a sign out discovery backpack - Kokanee, birds, bats, geology, trees, and pond study; seasonally rotating exhibitions; park staff for assistance and answering of questions; and programs and activities for all ages (RDCO, 2022). The EECO, through the organization of programs like the Kokanee Salmon Exhibit, Kokanee Salmon Festival, Hike for Hospice, Juvenile Diabetes Research Foundation, Prostate Canada Foundation, and Plan Okanagan, received an estimated 25,000 visitors in 2012 to view exhibited displays and/or enjoy some time in the greenway or park (Taylor et al., 2013). The EECO's fundraising events bookings that occurred on the greenway served as a source of funds for the RDCO. An amount of \$1700 was paid to the RDCO in 2012 from proceeds due to bookings for fundraising that took place (Taylor et al., 2013).

7.6.1 Kokanee salmon habitat restoration and annual events

The Mission Creek Annual Kokanee stream spawning equally provides a recreational and tourist attraction for the residents and visitors/tourists in Kelowna (Taylor et al., 2013). The Mission Creek is an ecologically important ecosystem and habitat that serves as an important habitation for the at-risk Interior species of the creek-spawning Kokanee Salmon (BC Parks, 2022). Currently, this provides and serves as a tourism and recreational opportunity for residents and

tourists to view the spawning activity of the fish population in the watershed. The species saw a decline from 700,000 to 1.2 million fish spawning in the creek per year in the 1950s to about only 30,00 fishes spawning per year by 1996 (BC Parks, 2022). However, this has further declined to 8,000 over the past 25 years (Friends of Mission Creek Society, 2013). This drastic reduction in fish spawning in the Creek is attributed to about a 90% reduction in spawning habitat availability resulting from channelization after heavy dyking within city limits (BC Park, 2022; Friends of Mission Creek Society, 2013; de Vries, 2016). Efforts to increase habitat for spawning began in 1988 when a 1 km spawning channel was built and is still active today across the creek from the EECO (Friends of Mission Creek Society, 2013). Currently, shore spawning stands at about 51% of the total Kokanee salmon produced yearly, with measures being implemented (such as the Mission Creek Restoration Initiative) in the channeled part of Mission Creek to improve and restore the Kokanee salmon spawning habitats along the creek (BC Parks, 2022).

The Mission Creek Dyke Setback and Restoration Initiative comprises setting back the existing dykes, widening sections, re-establishment the flood plain, building rifle pools for fish, and reconstructing a more natural and meandering course for the creek. This will, in turn, improve kokanee and trout spawning success, augment the riparian habitat, and increase Kelowna's flood protection (Friends of Mission Creek Society, 2013; de Vries, 2016). The need to restore the habitat for the fish species requires a concerted effort to educate the populace on the fish species and their importance, as such the institution of the Annual Kokanee festival. This festival draws people from all walks of life to Mission Creek to learn about the importance of the fish species. Residents and tourists equally end up enjoying other attractions and exhibitions or recreational activities that may be available, which contributes to the tourism and recreation potential of Mission Creek.

7.6.2 Tourism Kelowna's Biosphere Adhesion Program

Several businesses have made a commitment to the Biosphere Adhesion Program, where they are committed to incorporating business practices that will ensure the protection and restoration of environmental and social impacts of sustainability (Tourism Kelowna, 2022a). These businesses, which provide goods and services such as food, transportation, and accommodation, offer memorable experiences and comfort for tourists seeking to reduce environmental footprints as well as making Kelowna more sustainable.

7.6.2.1 What more can be done in the Mission Creek watershed?

7.6.2.1.1 Research on impacts of tourism and recreation on the Mission Creek watershed and the development of appropriate management prescriptions

The resultant ecological impacts from outdoor recreation/nature-based tourism activities have generally been categorized as a curvilinear use–impact relationship in an effort to capture management strategies to minimize impacts (Monz et al., 2013). However, to fully capture vegetation responses and other ecosystem effects/impacts of tourism and recreation (such as in the Mission Creek watershed) would require the exploration of linear, exponential, and step-function models of research to comprehensively capture ecosystem responses that will enable the proposal of alternative sustainable management strategies (Monz et al., 2013). To properly inform management decisions on the impact of tourism and recreation in the watershed, research is recommended to assess the influence of the industry on the ecosystem (flora, fauna, water, etc.). Other aspects to consider are visitor/tourist behavior, trail design, degree of site maintenance, and environmental durability (Monz et al., 2013). Research, although very important, costs a lot of money, and this may serve as the biggest constraint to its implementation. However, this brings to

light the “pay now or pay later” principle. How much are we willing to sacrifice (pay now) to mitigate or prevent the adverse effects of ecosystem degradation (much more costly in the future).

7.6.2.1.2 Investment in Green infrastructure

“Green infrastructure describes the various ways a city can manage lands at a city, neighborhood, and site scale to reduce runoff and limit the amount of water that ends up in the city’s stormwater infrastructure” (City of Kelowna, 2017). Improvement in the quality of water, increases in groundwater recharge, provision of recreational amenity to the city, community, or site, which enhances resilience in major flood events, is some of the major benefits associated with green infrastructure (City of Kelowna, 2017). With the occurrence and vulnerability of Mission creek to flooding, investment in green infrastructure serves as a viable solution for the management of the watershed against floods. Investment in green infrastructure for the Mission Creek watershed should involve the development of “natural” parks or urban creeks that act as confinement ponds during main flood events (City of Kelowna, 2017). There may be an opportunity to do this in the Sutherland hills restoration area and the Cottonwood conservation area of the park, which are not as developed as the other areas of the park. However, a consultation is needed to determine its suitability for these areas and the identification of other more suitable areas. Some limitations worthy of note continue to be funding, competing uses, and community perceptions of the importance of conservation (RDCO, 2021).

7.6.2.1.3 Collaborate with the First Nations to boost tourism and recreation through the increase of Indigenous knowledge

There are opportunities for a more deliberate inclusion of Indigenous knowledge and presence in the Mission Creek watershed in the tourism and recreation sector. Several activities

could be implemented to boost tourism through the use of Indigenous knowledge and presence, such as the provision of materials and resources that will enable people (residents and tourists) to learn the indigenous names for the flora, fauna, and places in the watershed. The establishment of a placed-based network for indigenous storytelling where the park serves as the storytelling hub. Together with the Westbank First Nation, work to integrate Syilx Indigenous places of traditional ecological knowledge (TEK) and cultural value significance to ensure continuous conservation and ecological protection (RDCO, 2021).

8.0 Knowledge Mobilization and education for the sustainability of the Mission Creek watershed

8.1 What Is Knowledge Mobilization?

Knowledge Mobilization (KM) is the process of creating, assimilating, disseminating, and applying knowledge within an organization or community to create a particular value (Bennet & Bennet, 2008). In other words, KM refers to the creation and development, translation, distribution, and application or utilization of knowledge to mobilize or influence a group of people into taking individual and collective action to meet a common goal and/or solve a specific problem.

KM has been recognized as a crucial aspect in the development of plans and strategies to achieve environmental sustainability, sustainable development (De Marchi & Grandinetti, 2013), and climate action (McKenzie, 2021). To mitigate the “dangerous” human interventions to the climate system and to prevent future risks, it is necessary to educate and create public awareness, as well as to allow public access to information and public engagement (UNFCCC, 1992, Article 6). Effective strategies to communicate, distribute and implement knowledge should be developed, taking into consideration the community (or systems) boundaries, the different people involved - including academics, owners and directives, partners, managers, employers, clients, and other

interested parties-, the multi-structure and networks, and the interactions that exist within the organizations (Bennet & Bennet, 2008). KM plans should also be developed based on a context-specific approach.

8.2 Education strategy on Mission Creek

In the context of the Mission Creek watershed, different tactics have been used to promote the conservation and preservation of the natural habitats, including the biodiversity and ecological resources found in the Mission Creek Greenway, as well as to create awareness about the socio-cultural, historical, and ecological value of that natural area. The main responsible for the educational programs, the content, and advertising campaigns, is the EECO, which is part of the Regional District of the Central Okanagan Parks Department and is located at the Mission Creek Regional Park. In addition, the FOMC and the MCRI are strong contributors to the education events and initiatives that support the conservation and rehabilitation of the Greenway, also in collaboration with different governments, such as the City of Kelowna and the Westbank First Nation, and other community-based organizations, for example, the ONA, the Central Okanagan Naturalists' Club (CONC), the Okanagan Basin Water Board (OBWB), or the Community Recreation Initiatives Society (CRIS).

The EECO holds an ongoing educational program throughout the year that consists of seasonal exhibits, guided tours, and other cultural events and activities held in different Regional Parks across and around the Okanagan Valley. These recreational initiatives are focused on environmental education regarding the Okanagan flora and fauna, as well as the conservation of other valuable ecological resources, such as water. The activities can be carried out for school tours and visits, as well as for the general public, including people of all ages and diverse abilities (with the support from CRIS). The activities are adapted so that anyone can engage with the natural

ecosystems found in the Okanagan region and, at the same time, learn about the historical, social, and ecological value of these ecosystems.

In addition, annual events, such as Kokanee Salmon Festival and Kokanee Fun Run, were being hosted, on the one hand, to educate people about the salmon life cycle and the importance of this species in the natural ecosystem, and on the other hand, to inform about the attempts to preserve and rehabilitate Mission Creek in addition to raising funds to support the restoration and enhancements of the Greenway (Fiends of Mission Creek, 2022).

Virtual projects have been carried out to advertise and engage with the residents of the Okanagan Valley and to create awareness about the conservation of biodiversity and restoration of the Mission Creek Greenway. One example is the Mission Creek Greenway Biodiversity Challenge (June-December 2020), launched by the CONC in collaboration with the FOMC and the RDCO, which purpose was to encourage the general public to go over the Mission Creek Greenway and capture any type of biodiversity (flora and fauna) found along the Corridor and submit it through the digital platforms iNaturalist and eBird. The bio inventory and the project interaction statistics can be found on the project's profile on the iNaturalist website (CONC, 2020). Another digital campaign created by the Mission Creek Restoration Initiative is the 2021 documentary film, created to communicate the progress of the restoration project as well as the next phases and expected results. Most importantly, Mission Creek's historical and cultural value was presented in this film from the perspectives of Syilx Okanagan People.

Both projects were advertised on the websites and social media profiles of FOMC, CONC, and the MCRI. However, there is no public data that shows the success of public engagement, in terms of impressions and interactions, of the social media efforts. Additionally, it is important to note that the RDCO offers a periodical e-newsletter that is used to communicate relevant

information and updates on the upcoming events and activities hosted by the EECO. The newsletter is sent weekly via email, and people can subscribe to it by registering on the website of the RDCO Park Department. However, this communication effort is still unilateral and impersonal since it does not allow for a response or personalized messaging.

Visitors to the Mission Creek Greenway (or Mission Creek Regional Park and Scenic Canyon Regional Park), including people who are unaware of the educational resources and programs that are available, are also able to find interpretive signs all along the Greenway that explain the various geological, historical, and environmental features, including information about flora and fauna, invasive species, and about some of the conservation awareness campaigns (i.e., the Stream of Dreams campaign). Furthermore, the EECO office is available and open on a wide schedule for the general public and also offers visitations and appointments to speak about environmental education and conservation projects.

8.3 Recommendations on a Knowledge Mobilization strategy

The RDCO, in collaboration with the FOMC and the MCRI -and in cooperation with other organizations and entities-have developed an important strategy in terms of environmental education about Mission Creek's natural ecosystem. However, the communication still appears to lack focus in regard to the current and future challenges that the City of Kelowna is facing, and which also affect the state and the sustainability of the Mission Creek watershed. The challenges and risks are related to the constant increase in population density, historical changes in land uses, and the effects of climate change.

Due to the complexity of the relationships (including the *cause-effect* implications) between the human and the ecological systems, The Mission Creek Greenway requires an effective KM strategy that involves (1) further research on the environmental, social, and economic

challenges and implications that the Mission Creek watershed is currently facing, (2) a strong collaboration and constant communication among the different parties involved, such as government entities, research centers, landowners, partners and sponsors, park managers, Friends of parks, NGOs, industries, residents and visitors, and (3) public awareness and engagement, policy development, restoration, mitigation and adaptive management strategies that contribute to the resiliency of the watershed when facing the consequences of the alterations to the ecosystem caused by the increased population density as well as the extreme changes in the climate of the Okanagan region. It is also essential to develop and implement a complete resiliency strategy that involves the ancestral and traditional ecological knowledge of the Syilx Peoples in regards to the conservation and rehabilitation of the Okanagan endemic species, as well as the restoration of its natural habitats to enable and preserve the functions and services provided by the Mission Creek Greenway's ecosystems.

From an environmental dimension, it is important to put focus on the education and communication strategies, in addition to the direct human interventions to the environment of Mission Creek, on implementing tactics that address the indirect impacts from the social and economic activities to the long-term sustainability of the watershed. Therefore, education and communication efforts should also include useful and reliable information that facilitates the application of specific practices or *calls to action* to reduce the overall human ecological footprint.

For example, because transportation is Kelowna's main source of greenhouse gas emissions (Kelowna's Community Climate Action Plan, 2012), it would be relevant to educate and foment different means of transportation to reach the parks that are low-carbon emissions, such as e-scooters or e-bikes, so enabling different types parking stations would encourage the park's visitors to reduce the use of gas vehicles as their main mode of transportation. Other

examples would be educated on waste management, not only to avoid the direct contamination of Mission Creek's natural habitats but also to educate the public on the importance of proper waste management by simply enabling the visitors with ways to sort and dispose of the types of solid wastes generated at the parks (i.e., organic wastes such as food scraps or pet manure, or plastic bottles, cans, and other recyclable materials). Although, this would require an investment in infrastructure and coordination and plan development with the Regional Waste Reduction Office from the RDCO to collect and distribute the waste to the different recycling and composting facilities.

Applying and educating on different climate actions would provide long-term environmental benefits due to a change of behavior and awareness from the residents and visitors, which can be reflected in a considerable reduction of greenhouse gas emissions from the use of alternate means of transportation, as well as the properly treated solid waste generated in and out of the Regional Parks.

Moreover, from a social perspective, it is essential to support activities that not only include Indigenous knowledge but that are also fully coordinated and hosted by the Syilx Okanagan Nation in order to promote first-hand perspectives and TEK in regards to the cultural and ecological value and services of the Mission Creek.

Furthermore, it is important to consider a broader landscape of the community in the development and implementation of effective knowledge mobilization strategies. Currently, the educational programs are mainly directed at families and schools, which means primarily to children and adults. Therefore, there is a need to develop a more diverse and inclusive educational and recreational program by designing specific initiatives taking into consideration different social aspects, such as age, ethnicity, gender, diverse abilities, and other social identities. Planning and

carrying out communication and educational initiatives that is directed to a specific socio-demographic audience, would not only increase interest and awareness, but also public participation and engagement from Kelowna's current residents. One example of how to engage the youth to contribute to the sustainability goals would be designing and coordinating programs directed to teens and young adults, such as different volunteer programs (which are currently available), but also by implementing internships and co-op programs for students at different levels (i.e., high school, undergraduate, and graduate students) and different disciplines could enable students to learn about environmental, socio-economic, and cultural preservation and resiliency, but also to contribute to the production and distribution of knowledge in regards to the sustainability challenges of Mission Creek, as to the City of Kelowna.

Lastly, it is important to invest and design specific communication efforts to engage the private industry into the sustainability strategies, so periodical networking campaigns could be an effective to build and strengthen alliances, partnerships, and sponsorships with industry-based organizations (e.g., the Kelowna Chamber of Commerce or Tourism Kelowna Society). Having a strong network based on communication, collaboration and transparency will help to secure and raise funds not only for restoration and mitigation initiatives for the Mission Creek watershed, but also to support further research and educational campaigns.

9.0 Conclusion

Due to its ecological, economic, and cultural significance to the City of Kelowna, the cultivation of strategies and practices towards augmenting principles of sustainability and resiliency in the Mission Creek watershed must be prioritized in both policy and social consciousness. In order to facilitate this, a clear understanding of challenges to these ideologies, as well as the opportunities they represent, must be established. This has been the overarching goal of this report. The report

is intended to be utilized as a tool for reference for students, researchers, municipal staff, and other interest groups in order to better understand the dynamic and complex socio-ecological landscape of the Mission Creek watershed. The solutions posted in this text are current to modern (2022) considerations, but it is notable that the watershed must be continually and comprehensively monitored in order to adapt this framework to the dynamic and increasing impacts of population growth, development, and extreme weather events resulting from climate change.

Bibliography

- Alexander, S. M., Provencher, J. F., Henri, D. A., Nanayakkara, L., Taylor, J. J., Berberi, A., Lloren, J. I., Johnson, J. T., Ballard, M., & Cooke, S. J. (2021). Bridging Indigenous and Western Sciences in Freshwater Research, Monitoring, and Management in Canada. *Ecological Solutions and Evidence*, 2(3). <https://doi.org/10.1002/2688-8319.12085>
- Andersen, T., Carstensen, J., Hernández-García, E., & Duarte, C. M. (2009). Ecological thresholds and regime shifts: approaches to identification. *Trends in Ecology and Evolution*, 24(1), 49–57. <https://doi.org/10.1016/j.tree.2008.07.014>
- Armstrong, J. C. (1993). *We Get our Living Like Milk from the Land*. Penticton, BC:Theytus Books.
- Barber, M. (2021). Co-Creating a Vision for Conservation in the Okanagan. *Vancouver Foundation*. Retrieved March 14, 2022 from <https://www.vancouverfoundation.ca/whats-new/co-creating-vision-conservation-okanagan>.
- BC Conservation Data Centre. (2022). BC Species and ecosystems explorer. *BC Ministry of Environment, Victoria, BC*. Retrieved March 13, 2022, from <http://a100.gov.bc.ca/pub/eswp/>
- BC Parks (2022). Mission Creek. Retrieved March 14, 2022, from https://bcparks.ca/heritage_rivers_program/bc_rivers/mission_creek.html. Accessed on March 25, 2022.
- BC Wildfire Service. (2021, June 2). *Crown Land Wildfire Risk Reduction*. Province of British Columbia. Retrieved April 3, 2022, from <https://www2.gov.bc.ca/gov/content/safety/wildfire-status/prevention/funding-for-wildfire-prevention/crip/wrr>
- Beier, P., Spencer, W., Baldwin, R. F., & McRae, B. H. (2011). Toward best practices for developing regional connectivity maps. *Conservation Biology*, 25(5), 879–892. <https://doi.org/10.1111/j.1523-1739.2011.01716.x>
- Bender, D. J., Contreras, T. A., & Fahrig, L. (1998). Habitat loss and population decline: A meta-analysis of the patch size effect. *Ecology*, 79, 517–533. [https://doi.org/10.1890/0012-9658\(1998\)079\[0517:HLAPDA\]2.0.CO;2](https://doi.org/10.1890/0012-9658(1998)079[0517:HLAPDA]2.0.CO;2)
- Bennet, A., & Bennet, D. (2008). Moving from knowledge to wisdom, from ordinary consciousness to extraordinary consciousness. *VINE. Very Informal Newsletter on Library Automation*, 38(1), 7-15. doi:10.1108/03055720810870842.
- Bernhardt, E. S., & Palmer, M. A. (2011). River restoration: The fuzzy logic of repairing reaches to reverse catchment scale degradation. *Ecological Applications* (Vol. 21, Issue 6).
- Blackstock, M. (2002). Water-based Ecology: A First Nations' Proposal to Repair the Definition of a Forest Ecosystem. *BC Journal of Ecosystems and Management*, 2(1). Retrieved from <https://go.exlibris.link/9dW41VZQ>

- Blomley, N. (2014). The ties that blind: Making fee simple in the British Columbia Treaty process. *Transactions of the Institute of British Geographers*, 40(2), 168–179. <https://doi.org/10.1111/tran.12058>
- Bodin, Ö., & Tengö, M. (2012). Disentangling intangible social-ecological systems. *Global Environmental Change*, 22(2), 430–439. <https://doi.org/10.1016/j.gloenvcha.2012.01.005>
- Boiffin, J., & Munson, A. D. (2013). Three large fire years threaten resilience of closed crown black spruce forests in eastern Canada. *Ecosphere*, 4(5), 1–20. <https://doi.org/10.1890/es13-00038.1>
- Brandes, O. M., O’Riordan, T., O’Riordan, J. & Brandes, L. (2014). A Blueprint for Watershed Governance in British Columbia. University of Victoria.
- British Columbia. (2011). Crown Land: Indicators & Statistics Report, Retrieved April 3, 2022, from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/crown_land_indicators__statistics_report.pdf.
- British Columbia. (2022). Water Licensing & Rights. Retrieved March 10, 2022, from <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights#:~:text=All%20water%20in%20British%20Columbia,the%20residents%20of%20the%20province.>
- British Columbia. (2022). Water Use During Scarcity. Retrieved March 10, 2022, from <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights/water-licences-approvals/water-use-during-scarcity.>
- Brooks, T. M., Mittermeier, R. A., Mittermeier, C. G., Fonseca, G. A. B., Rylands, A. B., Konstant, W. R., Flick, P., Pilgrim, J., Oldfield, S., Magin, G., & Hilton-Taylor, C. (2002). Habitat Loss and Extinction in the Hotspots of Biodiversity. *Conservation Biology*, 16(4), 909–923. <https://doi.org/10.1046/j.1523-1739.2002.00530.x>
- Bull, J. W., Suttle, B. K., Gordon, A., Singh, N. J., & Milner-Gulland, E. J. (2013). Review Biodiversity offsets in theory and practice. *Oryx*, 47(3), 369–380. <https://doi.org/10.1017/S003060531200172X>
- Bullock, J. M., Fuentes-Montemayor, E., McCarthy, B., Park, K., Hails, R. S., Woodcock, B. A., Watts, K., Corstanje, R., & Harris, J. (2021). Future restoration should enhance ecological complexity and emergent properties at multiple scales. *Ecography*. <https://doi.org/10.1111/ECOG.05780>
- Burge, L. (2009). Analysis of Sedimentation and Sediment Migration Strategies for Mission Creek. Prepared by: Burge Ecohydraulics. Prepared for: the City of Kelowna Environment Division. Retrieved April 3, 2022, from [Mission Sedimentation 1238541520666_7e6b0c07cf3119b7bc2ab4df9a7e6828e989e54c4a554a80d951c1b684cbf1cb.pdf \(gov.bc.ca\)](https://www2.gov.bc.ca/assets/gov/land-use-planning/building-construction/mission-sedimentation/1238541520666_7e6b0c07cf3119b7bc2ab4df9a7e6828e989e54c4a554a80d951c1b684cbf1cb.pdf)
- Cameron, A., Graben, S. & Napoleon, V. (2020). Creating Indigenous Property: Power, Rights, and Relationships. University of Toronto Press. <https://go.exlibris.link/lSLftyk9>.

- Carpenter, S. R., Brock, W. A., Folke, C., van Nes, E. H., & Scheffere, M. (2015). Allowing variance may enlarge the safe operating space for exploited ecosystems. *Source*, 112(46), 14384–14389. <https://doi.org/10.2307/26466458>
- Carter Consulting. (1997). Access management strategy for the Mission Creek Watershed Volume 2 of 2. Prepared for: Penticton Forest District. Retrieved April 3, 2022, from [mission_ams_vol2_1997_1170460257540_d23ac148394a4f868ed18df1ae5c4f24.pdf \(gov.bc.ca\)](https://www2.gov.bc.ca/gov/content/spe/spe_collections/mission_ams_vol2_1997_1170460257540_d23ac148394a4f868ed18df1ae5c4f24.pdf)
- Central Okanagan Naturalists Club (2020). Mission Creek Greenway Biodiversity Challenge. Retrieved April 3, 2022, from <http://okanagannature.org/Mission%20Creek%20Greenway%20Biodiversity%20Challenge.pdf>
- City of Kelowna (2017). A Changing Climate Special Edition Community Trends Report 2017. Retrieved March 22, 2022, from https://www.kelowna.ca/sites/files/1/docs/business/2017_community_trends_report_.pdf
- City of Kelowna (2018). Kelowna’s Community Climate Action Plan. Retrieved April 3, 2022, from https://www.kelowna.ca/sites/files/1/docs/community/community_climate_action_plan_june_2018_final.pdf
- City of Kelowna. (2019). Water in Kelowna. Retrieved March 10 from <https://kelownapublishing.escribemeetings.com/filestream.ashx?DocumentId=21815.>
- City of Kelowna. (2022). 2040 Official Community Plan. Retrieved March 10, 2022, from <https://www.kelowna.ca/our-community/planning-projects/2040-official-community-plan/ch-9-equitable-community>.
- City of Kelowna (2022b). Mission Creek Mountain Bike Skills Park. Retrieved March 10, 2022, from <https://www.kelowna.ca/parks-recreation/parks-beaches/parks-beaches-listing/mission-creek-mountain-bike-skills-park>. (Accessed March 21, 2022)
- City of Kelowna. (2022). Mission Creek Recreation Park. Retrieved March 10, 2022, from <https://www.kelowna.ca/parks-recreation/parks-beaches/parks-beaches-listing/mission-recreation-park>.
- City of Kelowna (2022a). Parks and recreation: Regional and provincial parks. Retrieved March 10, 2022, from <https://www.kelowna.ca/parks-recreation/parks-beaches/regional-provincial-parks>.
- Climate Atlas of Canada. (2022). Collaborative Research on Climate Change Bridging Cultures. Retrieved March 16, 2022, from <https://climateatlas.ca/indigenous-knowledges-and-climate-change>.
- Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R. G., Sutton, P., & van den Belt, M. (1997). The value of the world's ecosystem services and Natural Capital. *Nature*, 387(6630), 253–260. <https://doi.org/10.1038/387253a0>

- Costanza, R., de Groot, R., Braat, L., Kubiszewski, I., Fioramonti, L., Sutton, P., Farber, S., & Grasso, M. (2017). Twenty Years of ecosystem services: How far have we come and how far do we still need to go? *Ecosystem Services*, 28, 1–16. <https://doi.org/10.1016/j.ecoser.2017.09.008>
- Cumming, G. S. (2011). Spatial resilience: Integrating landscape ecology, resilience, and sustainability. *Landscape Ecology*, 26(7), 899–909. <https://doi.org/10.1007/S10980-011-9623-1/TABLES/1>
- Daily, C. G., Polasky, S., Goldstein, J., Kareiva, P. M., Mooney, H. A., Pejchar, L., Ricketts, T. H., Salzman, J., & Shallenberger, R. (2009). Ecosystem services in decision making: time to deliver. *Frontiers in Ecological Environment*, 7(1), 21–28. <https://doi.org/10.1890/080025>
- Cushman, G., & Laidler, A. (1990). Recreation, leisure and social policy. Retrieved from https://researcharchive.lincoln.ac.nz/bitstream/handle/10182/1431/prt_op_4.pdf?sequence=1. Accessed March 22, 2022.
- De Marchi, V. and Grandinetti, R., 2013. Knowledge strategies for environmental innovations: the case of Italian manufacturing firms. *Journal of Knowledge Management*, 17(4), pp. 569-82.
- De Vries, J. (2016). Phase One Construction Fact Sheet. Mission Creek restoration Initiative. Retrieved March 26, 2022, from <https://www.missioncreek.ca/restoration-project/phase-one-construction-fact-sheet/>.
- Dearing, J. A., Wang, R., Zhang, K., Dyke, J. G., Haberl, H., Hossain, M. S., Langdon, P. G., Lenton, T. M., Raworth, K., Brown, S., Carstensen, J., Cole, M. J., Cornell, S. E., Dawson, T. P., Doncaster, C. P., Eigenbrod, F., Flörke, M., Jeffers, E., Mackay, A. W., ... Poppy, G. M. (2014). Safe and just operating spaces for regional social-ecological systems. *Global Environmental Change*, 28(1), 227–238. <https://doi.org/10.1016/J.GLOENVCHA.2014.06.012>
- Defries, R., & Nagendra, H. (2017). Ecosystem management as a wicked problem. *Science*, 356(6335), 265–270. https://doi.org/10.1126/SCIENCE.AAL1950/ASSET/01B7768B-F1CF-48E3-8520-95D11FEF7FBF/ASSETS/GRAPHIC/356_265_F2.JPEG
- Ecoscope Environmental Consultants Ltd. (2015). Mission Creek Restoration Initiative (MCRI) Monitoring Report. MCRI Partnership Project. File No. 14-1257. Prepared for: MCRI Partnership Project. Retrieved April 3, 2022, from <https://www.missioncreek.ca/wp-content/uploads/2018/06/MCRI-FINAL-NOV-2015-web.pdf>
- Ekka, A., Pande, S., Jiang, Y., & Zaag, P. van der. (2020). Anthropogenic modifications and river ecosystem services: A landscape perspective. *Water (Switzerland)*, 12(10), 1–21. <https://doi.org/10.3390/w12102706>
- Elmqvist, T., Folke, C., Nyström, M., Peterson, G., Bengtsson, J., Walker, B. and Norberg, J. (2003), Response diversity, ecosystem change, and resilience. *Frontiers in Ecology and the Environment*, 1, 488-494. [https://doi.org/10.1890/1540-9295\(2003\)001\[0488:RDECAR\]2.0.CO;2](https://doi.org/10.1890/1540-9295(2003)001[0488:RDECAR]2.0.CO;2)

- Fischer, J., & Lindenmayer, D. B. (2007). Landscape modification and habitat fragmentation: A synthesis. *Global Ecology and Biogeography*, *16*, 265–280. <https://doi.org/10.1111/j.1466-8238.2006.00287.x>
- Fisheries and Oceans Canada. (2019). Policy for applying measures to offset adverse effects on fish and fish habitat under the *Fisheries Act*. Fish and Fish Habitat Protection Program, Fisheries and Oceans Canada. Retrieved April 3, 2022, from <https://waves-vagues.dfo-mpo.gc.ca/Library/40939698.pdf>
- Flanagan, T. (2019). Property Rights and Prosperity: A Case Study of Westbank First Nation. Retrieved April 3, 2022, from <https://www.fraserinstitute.org/sites/default/files/property-rights-and-prosperity-case-study-westbank-first-nation.pdf>.
- Flannigan, M.M., Cantin, A.S., de Groot, W.D., Wotton, M., Newberry, A., and Gowman, L.M. (2013). Global wildland fire severity in the 21st century. *Forest Ecology and Management*, *294*, 54-61. doi.org/10.1016/j.foreco.2012.10.022.
- Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*, *15*(4). <https://doi.org/10.5751/ES-03610-150420>
- Fraser Basin Council. (2016). Guidance for Collaborative Watershed Governance in BC: Discussion Paper. Retrieved March 10, 2022, from https://www.fraserbasin.bc.ca/_Library/Water_BCWF/fbc-bcwf-guidance_for_watershed_governance-june_30-2016.pdf.
- Friends of Mission Creek Society. (2013). Friends of Mission Creek Society Website. Retrieved March 25, 2022, from <https://www.missioncreekfriends.ca/en/index.html>
- Gaboury, M. & Slaney, P. (2003). Mission Creek habitat restoration feasibility. Prepared for Ministry of Water, Land and Air Protection, Penticton, BC.
- Gaboury, M.N., V.C. Hawkes, S. Mould, and J. Good. (2004). Mission Creek Habitat Restoration: Detailed feasibility studies. Prepared by: LGL Limited Environmental Research Associates and Mould Engineering, for: Ministry of water, land, and air protection, Penticton, BC. Retrieved March 10, 2022, from <https://www.missioncreek.ca/wp-content/uploads/2014/05/2004-Mission-Creek-Habitat-Restoration-Detailed-Feasibility-Studies.pdf?msclkid=ba7114e7b14711eca491c010017653ea>
- Gallay, I., Olah, B., Gallayová, Z., & Lepeška, T. (2021). Monetary valuation of flood protection ecosystem service based on hydrological modelling and avoided damage costs. an example from the čierny Hron River basin, Slovakia. *Water*, *13*(2), 198. <https://doi.org/10.3390/w13020198>
- Gillett, N. P. (2004). Detecting the effect of climate change on Canadian Forest fires. *Geophysical Research Letters*, *31*(18). <https://doi.org/10.1029/2004gl020876>
- Giovannoni, E., & Fabietti, G. (2013). What is sustainability? A review of the concept and its applications. *Integrated reporting*, 21-40.

- Gonzalès, R., & Parrott, L. (2012). Network Theory in the Assessment of the Sustainability of Social-Ecological Systems: Network theory for social-ecological system analysis. *Geography Compass*, 6(2), 76-88. <https://doi.org/10.1111/j.1749-8198.2011.00470.x>.
- Good Water, D. (2018). Okanagan Syilx Historical and Contemporary Salmon Distribution: Underpinning Social and Governance Structures. Retrieved March 10, 2022, from <https://open.library.ubc.ca/collections/24/items/1.0365707>.
- Gordon, G..2014. Workforce Demographic Issues in Canada's Wildland Fire Management Agencies. Report to the Wildland Fire Management Working Group, Canadian Council of Forest Ministers. 50pp.
- Government of Canada. (1985). Fisheries Act [R.S.C., 1985, c. F-14]. Obtained from Justice Laws Website: <https://laws.justice.gc.ca/eng/acts/f-14/index.html>
- Government of British Columbia. (1998). Ministry of Environment - Okanagan Region. Retrieved March 25, 2022, from https://www.env.gov.bc.ca/okanagan/esd/atlas/riparian_wetland.html
- Government of BC. (2002). Agricultural Land Commission Act [SBC 2002]. Victoria, BC. Retrieved March 25, 2022, from https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/02036_01#section20
- Government of Canada. (2002). Species at Risk Act [S.C. 2002, c. 29]. Environment Canada. Retrieved March 25, 2022, from <http://www.laws.justice.gc.ca>
- Government of BC. (2014). Water Sustainability Act [SBC 2014]. Victoria, BC. Retrieved March 25, 2022, from <https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/14015>
- Government of BC. (2021). Riparian Areas Protection Regulation [BC. Reg. 11/2021]. Retrieved March 10, 2022, from <https://canlii.ca/t/55391>
- Government of Canada. (2022, March 4). Government of Canada. Retrieved March 25, 2022, from <https://www.canada.ca/en/environment-climate-change/services/environmental-enforcement/acts-regulations/about-species-at-risk-act.html>
- Gunderson, L., Cosens, B. A., Chaffin, B. C., Arnold, C. A. T., Fremier, A. K., Garmestani, A. S., Craig, R. K., Gosnell, H., Birge, H. E., Allen, C. R., Benson, M. H., Morrison, R. R., Stone, M. C., Hamm, J. A., Nemec, K., Schlager, E., & Llewellyn, D. (2017). Regime shifts and panarchies in regional scale social-ecological water systems. *Ecology and Society*, 22(1). <https://doi.org/10.5751/ES-08879-220131>
- Harper, D. J., & Quigley, J. T. (2005). No Net Loss of Fish Habitat: A Review and Analysis of Habitat Compensation in Canada. *Environmental Management*, 36(3), 343–355. <https://doi.org/10.1007/s00267-004-0114-x>
- Harris, D. C. (2008). *Landing native fisheries: Indian reserves and fishing rights in British Columbia, 1849-1925*. UBC Press.

- Healthy Watersheds Initiative. (2022). Okanagan Lake Responsibility Planning Initiative and Restoration Project. Retrieved March 16, 2022, from <https://healthywatersheds.ca/project/okanagan-lake-responsibility-planning-initiative-and-restoration-project/>.
- Heller, N. E., & Zavaleta, E. S. (2009). Biodiversity management in the face of climate change: A review of 22 years of recommendations. *Biological Conservation*, 142(1), 14–32. <https://doi.org/10.1016/j.biocon.2008.10.006>
- Hobbs, J., B. Sawicz, I. Spendlow, and R. Noble. (2006). Okanagan and Thompson-Nicola Regions western screech-owl (*Megascops kennicottii macfarlanei*) inventory – 2006. Prepared for: Ministry of Environment, Penticton, BC. Retrieved March 16, 2022, from https://www.env.gov.bc.ca/wildlife/wsi/reports/4217_WSI_4217_RPT1.PDF
- Hunter, R., Brandes, O. M., Moore, M.-L., & Brandes, L. (2014). The Cowichan Watershed Board: An Evolution of Collaborative Watershed Governance. Retrieved March 16, 2022, from https://poliswaterproject.org/files/2017/06/CWBCaseStudy_WebFINAL_0.pdf.
- Imperial, M. T., Ospina, S., Johnston, E., O’Leary, R., Thomsen, J., Williams, P., & Johnson, S. (2016). Understanding leadership in a world of shared problems: Advancing network governance in large landscape conservation. In *Frontiers in Ecology and the Environment* (Vol. 14, Issue 3, pp. 126–134). Wiley Blackwell. <https://doi.org/10.1002/fee.1248>
- International Education Newsletter, 2020. Family Activities at Home & Outdoors <http://www.international.sd23.bc.ca/students/Student%20Forms/Central%20Okanagan%20May%202020%20Newsletter.pdf>. Accessed (March 21, 2022)
- InterVISTAS (2020). 2018 Economic Impact of Tourism in the Greater Kelowna Area. Retrieved March 26, 2022, from https://assets.simpleviewinc.com/simpleview/image/upload/v1/clients/kelowna/Tourism_Kelowna_Economic_Impact_of_Tourism_Industry_2018_FINAL_22Sep2020_24db9ad2-b5d2-4b46-b1d7-1cc49a5f19e5.pdf
- Joseph Henry, Washington, DC
- Kelowna Capital News. (2021). Portion of Kelowna's Mission Creek Greenway Closed for Flood Repairs. Retrieved March 18, 2022, from https://www.google.com/search?q=kelowna+capital+news,+mission+creek+watershed&rlz=1C1SQJL_enCA847CA847&sxsrf=APq-WBtbHh2w6A1H83Z8Df2tWxMI7tuZcg:1647728756517&source=lnms&tbm=isch&sa=X&ved=2ahUKEwiont_5m9P2AhWfIjQIHT21B1QQ_AUoA3oECAEQBQ&biw=1745&bih=800&dpr=1.1#imgrc=991Z3QZfnaE0_M.
- Latimer, S., and A. Peatt. (2014). Designing and Implementing Ecosystem Connectivity in the Okanagan. Prepared for the Okanagan Collaborative Conservation Program. Retrieved March 18, 2022, from <https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=42389>

- Lea, T. (2008). Historical (pre-settlement) ecosystems of the Okanagan valley and lower Similkameen valley of British Columbia—pre-European contact to the present. *Davidsonia*, 19, 3-36.
- Lievesley, M., D. Stewart, R. Knight, and B. Manon. (2016). Marsh and riparian habitat compensation in the Fraser River Estuary: a guide for managers and practitioners. Retrieved March 18, 2022, from https://cmnbc.ca/wp-content/uploads/2018/11/Lievesley-et-al-2016_Marsh-riparian-habitat-compensation-in-the-Fraser-River-Estuary.pdf
- Lindenmayer, D., Hobbs, R. J., Montague-Drake, R., Alexandra, J., Bennett, A., Burgman, M., Cale, P., Calhoun, A., Cramer, V., Cullen, P., Driscoll, D., Fahrig, L., Fischer, J., Franklin, J., Haila, Y., Hunter, M., Gibbons, P., Lake, S., Luck, G., ... Zavaleta, E. (2008). A checklist for ecological management of landscapes for conservation. *Ecology Letters*, 11(1), 78–91. <https://doi.org/10.1111/j.1461-0248.2007.01114.x>
- Loewen, T.M. (2020). Integrating ecosystem services and biodiversity in landscape management for multifunctional agroecosystems: A case study in the Okanagan Valley, British Columbia. University of British Columbia. Retrieved March 18, 2022, from <http://open.library.ubc.ca/collections/ubctheses/24/items/1.0389751>
- Lukawiecki, J., Gagnon, R., Dokis, C., Walters, D., & Molot, L. (2021). Meaningful engagement with indigenous peoples: A case study of Ontario's Great Lakes Protection Act. *International Journal of Water Resources Development*, 37(4), 603-618. doi.org/10.1080/07900627.2019.1681261.
- Lussier, R. (2016). Responding to the #1 Threat to Your Water Supply. *Journal of the New England Water Works Association*, 130(1), 25. <https://go.exlibris.link/qxwpK4Lt>.
- Marchese, D., Reynolds, E., Bates, M. E., Morgan, H., Clark, S. S., & Linkov, I. (2018). Resilience and sustainability: Similarities and differences in environmental management applications. *Science of the Total Environment*, 613, 1275-1283.
- Martinuzzi, S., Withey, J. C., Pidgeon, A. M., Plantinga, A. J., Mckerrow, A. J., Williams, S. G., Helmers, D. P., & Radeloff, V. C. (2015). Future land-use scenarios and the loss of wildlife habitats in the southeastern United States. *Ecological Applications*, 25(1).
- McCaffrey, S. (2004). Thinking of wildfire as a natural hazard. *Society & Natural Resources*, 17(6): 509-516.
- McGee, T.K. (2007). Urban residents' approval of management measures to mitigate wildland-urban interface fire risks in Edmonton, Canada. *Landscape and Urban Planning*. 82(4): 247-256.
- Mileti, D.S. (1999), *Disasters by Design: A Reassessment of Natural Hazards in the United States*. Washington, DC: Joseph Henry.
- Millennium Ecosystem Assessment. (2005). *Ecosystems and Human Well-being: Synthesis*. Washington, DC: Island Press.
- Ministry of Forests, Lands, Natural Resource Operations and Rural Development. (2019). *Riparian Areas Protection Regulation Technical Assessment Manual v.1.1*. Prepared by: Fish and Aquatic

Habitat Branch. Retrieved March 18, 2022, from https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/fish-fish-habitat/riparian-areas-regulations/rapr_assessment_methods_manual_for_web_11.pdf

- Mission Creek Restoration Initiative (MCRI). (2011). *Mission Creek: A Background on Stream Restoration. Mission Creek Stream Restoration*. Retrieved March 25, 2022, from <https://msnucleus.org/watersheds/mission/restoration.html>
- Mission Creek Restoration Initiative (MCRI). (2020). *Species at Risk*. Retrieved from Mission Creek Restoration Initiative, Retrieved March 18, 2022, from <https://www.missioncreek.ca/species-at-risk/>
- Mission Creek Restoration Initiative (MCRI). (2021). *Invasive Plant Strategy*. Kelowna: Mission Creek Restoration Initiative.
- Mission Creek Restoration Initiative (MCRI). (2022a). *Early Users*. Retrieved March 14 from <https://www.missioncreek.ca/illustrated-history/>.
- Mission Creek Restoration Initiative (MCRI). (2022b). *Environmental & Archaeological Monitoring*. Retrieved March 16 from <https://www.missioncreek.ca/restoration-project/phase-one-construction-fact-sheet/>.
- Mission Creek Restoration Initiative (MCRI). (2022c). *Project Partners*. Retrieved March 16 from <https://www.missioncreek.ca/about-us/>.
- Mitchell, T. (2019). Realizing Indigenous Rights in the Context of Extractive Imperialism: Canada's Shifting and Fledgling Progress Towards the Implementation of UNDRIP. *International Journal of Critical Indigenous Studies*, 12(1), 46-59. <https://doi.org/10.5204/ijcis.v12i1.1140>.
- Mollison, B., & Slay, R. M. (2013). *Introduction to Permaculture*, 2nd Edition. Tasmania: Tagari Publications.
- Monz, C. A., Pickering, C. M., & Hadwen, W. L. (2013). Recent advances in recreation ecology and the implications of different relationships between recreation use and ecological impacts. *Frontiers in Ecology and the Environment*, 11(8), 441-446.
- Mori, A. S., Furukawa, T., & Sasaki, T. (2013). Response diversity determines the resilience of ecosystems to environmental change. *Biological Reviews*, 88, 349–364. <https://doi.org/10.1111/brv.12004>
- Morissette, J., & Donnelly, M. (2010). *Riparian Areas: Challenges and Opportunities for Conservation and Sustainable Forest Management*. Alberta: Knowledge Exchange and Technology Extension Program, Sustainable Forest Management Network.
- Nelson, E., Mendoza, G., Regetz, J., Polasky, S., Tallis, H., Cameron, D. R., Chan, K. M. A., Daily, G. C., Goldstein, J., Kareiva, P. M., Lonsdorf, E., Naidoo, R., Ricketts, T. H., & Shaw, M. R. (2009). Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at Landscape Scales. *Frontiers in Ecology and the Environment*, 7(1), 4–11. <https://doi.org/10.1890/080023>

- Nemec, K. T., Chan, J., Hoffman, C., Spanbauer, T. L., Hamm, J. A., Allen, C. R., Hefley, T., Pan, D., & Shrestha, P. (2014). Assessing resilience in stressed watersheds. *Ecology and Society*, 19(1). <https://doi.org/10.5751/ES-06156-190134>
- Okanagan Basin Water Board. (2022). Lake Responsibility Planning Process. Retrieved March 16, 2022, from https://www.obwb.ca/wcqi_project/lake-responsibility-planning-process/.
- Okanagan Collaborative Conservation Program. (2022). Okanagan Lake Responsibility Planning Initiative Retrieved March 16, 2022, from <https://okcp.ca/projects/current-projects/753-klusxnitk-okanagan-lake-responsibility-planning-initiative>.
- Okanagan Nation Alliance. (2017a). Okanagan Nation Committed to Restore sc'win (Sockeye Salmon) to their Natural Habitat, the Okanagan Watershed. Retrieved March 14, 2022, from <https://www.syilx.org/okanagan-nation-committed-to-restore-scwin-sockeye-salmon-to-their-natural-habitat-the-okanagan-watershed/>.
- Okanagan Nation Alliance. (2017b). Territory. Retrieved March 9, 2022, from <https://www.syilx.org/about-us/syilx-nation/territory/>.
- Okanagan Nation Alliance. (2022). Okanagan Lake Responsibility Planning Initiative. Retrieved March 20, 2022, from <https://www.syilx.org/projects/k%C9%ACusxnitk%CA%B7-okanagan-lake-responsibility-planning-initiative/>.
- ONeill, D. W., Fanning, A. L., Lamb, W. F., & Steinberger, J. K. (2018). A good life for all within planetary boundaries. *Nature Sustainability*. <https://doi.org/10.1038/s41893-018-0021-4>
- Pacific Council on International Policy (2017). Resilience Versus Sustainability: The United States' Water Future. Retrieved March 22, 2022, from <https://www.pacificcouncil.org/activities/resilience-vs-sustainability-united-states-environmental-future#:~:text=While%20sustainability%20looks%20at%20how,and%20adapt%20after%20disruptive%20events>.
- Palmer, J. (2021). Water wisdom: The indigenous scientists walking in Two worlds. *Eos*, 102. <https://doi.org/10.1029/2021eo210597>
- Parliament of Canada. (2021). Statutes of Canada 2021 Chapter 14: An Act Respecting the United Nations Declaration on the Rights of Indigenous Peoples. Ottawa, Canada. Retrieved March 20, 2022, from <https://parl.ca/DocumentViewer/en/43-2/bill/C-15/royal-assent>.
- Parrott, L., & Meyer, W. S. (2012). Future landscapes: Managing within complexity. *Frontiers in Ecology and the Environment*, 10(7), 382–389. <https://doi.org/10.1890/110082>
- Parrott, L., Kyle, C., Hayot-Sasson, V., Bouchard, C., & Cardille, J. A. (2019). Planning for ecological connectivity across scales of governance in a multifunctional regional landscape. *Ecosystems and People*, 15(1), 204–213. <https://doi.org/10.1080/26395916.2019.1649726>
- Permaculture Principles. (2022, March 4). *Permacultur Principles*. Retrieved March 22, 2022, from <https://permacultureprinciples.com/principles/>

- Permaculture Research Institute. (2022). What is Permaculture? Retrieved March 22, 2022, <https://www.permaculturenews.org/what-is-permaculture/>
- Phippen, B. (2001). The Effects of Recreation on Drinking Water Quality Within the Lambly, Kelowna and Mission Creek Watersheds Kelowna, BC 2000. BWP Consulting. Kelowna, BC. Retrieved March 22, 2022, from <http://www.llbc.leg.bc.ca/public/PubDocs/bcdocs/361643/recreatdrink.pdf>
- POLIS with Columbia Basin Trust (2018). Community Engagement in Watershed Governance: Case Studies and Insights from the Upper Columbia River Basin. Columbia Basin Trust. Retrieved March 10, 2022, from https://poliswaterproject.org/files/2018/06/2018-06_CommunityEngagmentinWatershedGovernance_FINAL.pdf
- Quigley, J. T., & Harper, D. J. (2006). Effectiveness of Fish Habitat Compensation in Canada in Achieving No Net Loss. *Environmental Management*, 37(3), 351–366. <https://doi.org/10.1007/s00267-004-0263-y>
- Rae, R. (2005). *The state of fish and fish habitat in the Okanagan and Similkameen Basins*. Victoria: BC Ministry of Water Land & Air Protection.
- Raymond, C. M., Fazey, I., Reed, M. S., Stringer, L. C., Robinson, G. M., & Evely, A. C. (2010). Integrating local and scientific knowledge for environmental management. *Journal of Environmental Management*, 91(8), 1766–1777. <https://doi.org/10.1016/j.jenvman.2010.03.023>
- Regional District of Central Okanagan (RDCO) (2021). *Mission Creek Regional Management Plan*. Retrieved March 22, 2022, from https://www.rdco.com/en/parks-and-trails/resources/Documents/21-10-29_MissionCreekMP-Final_compressed.pdf
- Regional District of Central Okanagan (RDCO) (2022). *Parks and Trails: Environmental Education Centre for the Okanagan*. Retrieved March 25, 2022, from <https://www.rdco.com/en/parks-and-trails/environmental-education-centre-for-the-okanagan.aspx>.
- Regional District of Central Okanagan (RDCO) (2022). *RDCO Main Map [Geographical Information System v2.17c]*. Retrieved March 22, 2022, from https://www.rdcogis.com/GIS_App_public/index.html
- Regional District of Central Okanagan (RDCO) (2021). *RDCO Streams [shapefile]*. Retrieved March 22, 2022, from <https://gis-rdco.hub.arcgis.com/datasets/RDCO::rdco-streams/about>
- Regional District of Central Okanagan (RDCO) (2022a). *Mission Creek Regional Park*. Retrieved March 22, 2022, from <https://storymaps.arcgis.com/stories/2c6bc9536e2044cea9baae199fe47f02>
- Regional District of Central Okanagan (RDCO) (2022b). *Scenic Canyon Regional Park*. Retrieved March 10, 2022, from <https://storymaps.arcgis.com/stories/b54dffc016a4a11afebb9f46f7c4728>.
- Resilience and sustainability. (2019). *Nature Sustainability*, 2(4), 249–249. <https://doi.org/10.1038/s41893-019-0284-4>
- Rivershed Society of BC. (2021). Foodlands Corridor Restoration Program. Retrieved March 22, 2022, from <https://rivershed.com/restore/foodlands-corridor-restoration-program/>

- Sam, M., & Armstrong, J. (2013). Indigenous Water Governance and Resistance: A Syilx Perspective. In W. John Richard (Ed.), *The Social Life of Water* (1 ed., pp. 239-254). Berghahn Books. <https://go.exlibris.link/vV4LIJ6Z>.
- Sandink, D. (2009). *Handbook for Reducing Basement Flooding. Institute for Catastrophic Loss Reduction*. Retrieved March 22, 2022, from <https://www.iclr.org/wp-content/uploads/PDFS/handbook-for-reducing-basement-flooding.pdf>
- Scheffer, M., & Carpenter, S. R. (2003). Catastrophic regime shifts in ecosystems: Linking theory to observation. *Trends in Ecology and Evolution*, 18(12), 648–656. <https://doi.org/10.1016/j.tree.2003.09.002>
- Sloan Morgan, V., Castleden, H., & Huu-ay-aht First, N. (2018). “This Is Going to Affect Our Lives”: Exploring Huu-ay-aht First Nations, the Government of Canada and British Columbia’s New Relationship Through the Implementation of the Maa-nulth Treaty. *Canadian Journal of Law and Society*, 33(3), 309-334. <https://doi.org/10.1017/cls.2018.23>.
- Statistics Canada. (2021). Reserves/Settlements/Villages. Retrieved March 10, 2022, from https://fnppn.aadnc-aandc.gc.ca/fnp/Main/Search/FNReserves.aspx?BAND_NUMBER=601&lang=eng.
- Sustainability Degrees (2022). Sustainability vs. Resilience: Why Bouncing Back is the Way of the Future. Retrieved March 22, 2022, from <https://www.sustainabilitydegrees.com/blog/sustainability-vs-resilience-why-bouncing-back-is-the-way-of-the-future/>
- Syilx Nation, K. N., Secwepmec Nation, Government of Canada, Government of British Columbia. (2019). Letter of Agreement. Retrieved March 9, 2022, from https://columbiariversalmon.ca/wp-content/uploads/LOA-Signed_Aug-27-2019.pdf
- Syilx Nation, K. N., Secwepmec Nation, Government of Canada, Government of British Columbia. (2020). Annual Report 2019-2020. Retrieved March 9, 2022, from <https://www.syilx.org/wp/wp-content/uploads/2020/07/2019-20-ANNUAL-REPORT-Columbia-River-Salmon-Reintroduction-Initiative-Final-for-distribution.pdf>
- Syilx Okanagan Nation. (2014). Okanagan Nation Water Declaration. Retrieved March 10, 2022, from https://www.syilx.org/wp/wp-content/uploads/2016/11/Okanagan-Nation-WaterDeclaration_Final_CEC_Adopted_July_31_2014.pdf
- Syilx Okanagan Nation. (2022). Environmental Flow Needs. Retrieved March 18, 2022, from <https://www.syilx.org/projects/environmental-flow-needs-efn/>.
- Taylor, A, Wilson, S and Sauer, G (2013). The Natural Capital of Mission Creek in Kelowna: The Value of Ecosystem Services. Retrieved March 22, 2022, from <https://www.missioncreek.ca/wp-content/uploads/2013/04/The-Natural-Capital-of-Mission-Creek-in-Kelowna.pdf>
- Taylor, A., & Sauer, G. (2013). The Natural Capital of Mission Creek In Kelowna: The Value of Ecosystem Services. Kelowna: Mission Creek Restoration Initiative.

- Taylor, A., Wilson, S., & Sauer, G. (2012). *The Natural Capital of Mission Creek in Kelowna: The Value of Ecosystem Services*. Retrieved March 26, 2022, from <https://www.missioncreek.ca/wp-content/uploads/2013/04/The-Natural-Capital-of-Mission-Creek-in-Kelowna.pdf>
- Taylor, P. D., Fahrig, L., Henein, K., & Merriam, G. (1993). Connectivity is a vital element of landscape structure. *Oikos*, 68(3), 571–573. <https://doi.org/10.2307/3544927>
- Tengö, M., Brondizio, E. S., Elmqvist, T., Malmer, P., & Spierenburg, M. (2014). Connecting diverse knowledge systems for enhanced ecosystem governance: The multiple evidence base approach. *Ambio*, 43(5), 579–591. Kluwer Academic Publishers. <https://doi.org/10.1007/s13280-014-0501-3>
- The United Nations. (2007). United Nations Declaration on the Rights of Indigenous Peoples. Retrieved March 10, 2022, from https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf
- The Water Sustainability Act, (2016). Retrieved March 10, 2022, from <https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/14015#section1>.
- Tourism Kelowna. (2017). Year-round Family Fun at Mission Creek Greenway. Retrieved March 18, 2022, from <https://www.tourismkelowna.com/blog/post/year-round-family-fun-at-mission-creek-greenway/>
- Tourism Kelowna (2022a). Explore Kelowna Sustainably. Retrieved March 26, 2022, from <https://www.tourismkelowna.com/plan/explore-kelowna-sustainably/>
- Tourism Kelowna (2022b). Mission Creek Greenway. Retrieved March 25, 2022, from <https://www.tourismkelowna.com/listing/mission-creek-greenway/1599/>
- UCLA Sustainability (2022). What is Sustainability? Retrieved March 22, 2022, from <https://www.sustain.ucla.edu/what-is-sustainability/>
- UNFCCC. 1992. United Nations Framework Convention on Climate Change. Retrieved March 22, 2022, from <https://unfccc.int/resource/docs/convkp/conveng.pdf>.
- University of Alberta Office of Sustainability (2010). What is Sustainability? Retrieved from <https://www.mcgill.ca/sustainability/files/sustainability/what-is-sustainability.pdf>. Accessed March 22, 2022.
- Vargas, L., Willems, L., & Hein, L. (2018). Assessing the capacity of ecosystems to supply ecosystem services using remote sensing and an ecosystem accounting approach. *Environmental Management*, 63(1), 1–15. <https://doi.org/10.1007/s00267-018-1110-x>
- Warman, L. D., Forsyth, D. M., Sinclair, A., Freemark, K., Moore, H. D., Barrett, T. W., . . . White, D. (2004). Species distributions, surrogacy, and important conservation regions in Canada. *Ecology Letters*, 7(5), 374-379.
- Westbank First Nation. (2022). History. Retrieved March 9, 2022, from <https://www.wfn.ca/our-community/community-profile/history.htm>

- Westbank First Nation. (2022). Land Registry. Retrieved March 10, 2022, from <https://www.wfn.ca/docs/lands-registry-brochure.pdf>
- Westcott, M. (2016). Transforming communities through tourism: a handbook for community tourism champions. Retrieved March 21, 2022, from <https://indigenoustourism.ca/wp-content/uploads/2016/12/Transforming-Communities-through-Tourism.pdf>
- Westrek Geotechnical Services. (2000). Upper Mission Creek terrain study for Riversie Forest Products Ltd., Kelowna Division. Prepared by: Westrek Geotechnical services in conjunction with: VanDine Geological Engineering Limited and Dobson Engineering Ltd. Retrieved March 21, 2022, from [Mission Stability Study 1229989438572_b8491e6308c5c7e1e9fa4aa2fa99b2e2d699262b242a65fd52db43fe2cc3359.pdf](https://www.wfn.ca/docs/lands-registry-brochure.pdf)
- WFN (2019). Kelowna and the Okanagan: Thriving on a National Level. Retrieved March 22, 2022, from https://www.wfn.ca/docs/coedc_003_infographic_2019_web.pdf
- Wilson, N. J. (2019). “Seeing Water Like a State?”: Indigenous Water Governance through Yukon First Nation Self-Government Agreements. *Geoforum*, 104, 101-113. <https://doi.org/10.1016/j.geoforum.2019.05.003>.
- Wilson, N. J., Mutter, E., Inkster, J., & Satterfield, T. (2018). Community-Based Monitoring as the Practice of Indigenous Governance: A Case Study of Indigenous-led Water Quality Monitoring in the Yukon River Basin. *Journal of Environmental Management*, 210, 290-298. <https://doi.org/10.1016/j.jenvman.2018.01.020>.
- Wilson, N., Harris, L., Joseph-Rear, A., Beaumont, J., & Satterfield, T. (2019). Water is Medicine: Reimagining Water Security through Tr’ondëk Hwëch’in Relationships to Treated and Traditional Water Sources in Yukon, Canada. *Water (Basel)*, 11(3), 624. <https://doi.org/10.3390/w11030624>.
- Winter, G.; Fried, J.S. 2000. Homeowner perspectives on fire hazard, responsibility, and management strategies at the wildland-urban interface. *Society & Natural Resources*, 13(1), 33-49.
- Wiseman, R. (2022). Email Correspondence. In R. Kroschinsky (Ed.).
- Wu, J. (2013). Landscape sustainability science: Ecosystem services and human well-being in changing landscapes. *Landscape Ecology*, 28(6), 999–1023. <https://doi.org/10.1007/S10980-013-9894-9/FIGURES/7>
- Wu, J. (2014). Urban ecology and sustainability: The state-of-the-science and future directions. *Landscape and Urban Planning*, 125, 209–221. <https://doi.org/10.1016/J.LANDURBPLAN.2014.01.018>
- Yuan, B., N. Lukey, J. Squakin, and K. Alex. (2020). Mission Creek Restoration Initiative Effectiveness Monitoring, 2016-2019. Retrieved March 9, 2022, from https://www.syilx.org/wp/wp-content/uploads/2020/07/ONA_MCRI-Effectiveness-Monitoring-2019-FINAL_no-appendix-1.pdf.

Zaksek, M., & Arvai, J. L. (2004). Toward improved communication about wildland fire: Mental models research to identify information needs for natural resource management. *Risk Analysis*, 24(6), 1503–1514. <https://doi.org/10.1111/j.0272-4332.2004.00545.x>

Tables

Table 1. Challenges, goals, and recommendations facing the management of Mission Creek

Challenges	Goal	Recommendations
Maintain quality kokanee spawning habitat in Mission Creek	<ul style="list-style-type: none"> · Reduce visitor impact on kokanee habitat 	<ul style="list-style-type: none"> · Explore the provision of viewing areas and platforms that prevent human entry into spawning habitat · Utilize small sections of fencing and prickly vegetative barriers that will not impact wildlife movement for stream sections where people persist in entering · Advise dog owners at entry to the off-leash area that it is on-leash during kokanee spawning season
Respond to the impacts of climate change including pests, drought, flooding and wildfire	<ul style="list-style-type: none"> · Maintain trails and infrastructure that are climate change resilient · Undertake flood and drought mitigation projects that improves the park's natural resilience 	<ul style="list-style-type: none"> · Landscape with native plant species. Non-native trees may be used in the Outdoor Recreation management zone.
Potential for wildfires to be started within the park due to high fuel load	<ul style="list-style-type: none"> · Decrease the risk of a wildfire 	<ul style="list-style-type: none"> · Explore options to incorporate traditional knowledge and practices into wildfire mitigation and fuel management work and implement recommendations within the Regional Parks Community Wildfire Protection Plan, including forest thinning and fuel management by priority and when UBCM Grant's are available
Unsanctioned activities like camping, smoking, littering, vandalism, and walking off-leash dogs occur inside the park	<ul style="list-style-type: none"> · Reduce inappropriate and potentially damaging activities within the park 	<ul style="list-style-type: none"> · Facilitate sanctioned activities where appropriate in the park · Increase proper park etiquette education in the park. · Design and develop the park in a manner that minimizes or deters inappropriate activities and is in keeping with current

Challenges	Goal	Recommendations
		Crime Prevention through Environmental Design (CEPTED) principles
Maintain a healthy Ponderosa Pine forest ecosystem free of invasive plant species	<ul style="list-style-type: none"> · Prevent the introduction of invasive species in the park · Control the spread of existing invasive plants in the park 	<ul style="list-style-type: none"> · Minimize bare soil conditions and re-vegetate disturbed park areas with site-appropriate native species (Volunteer Program). · Minimize ground disturbance from tree removal and other maintenance activities. · Map invasive plant species in the park to characterize the number of species present and the extent of their spread (Includes Volunteer Support). · Create an Ecological Restoration Plan for the park that includes exploring options to incorporate traditional knowledge and practices and a detailed weed management strategy. · Implement an Ecological Restoration Plan (Volunteer Supported)

Table 2. Capital Cost Summary

Capital Costs Summary	
Budget	\$3,060,000.00
Full-time equivalents (FTE Annual)	0.20
FTE One-time	0.47

Table 3. Environment and Conservation (Capital)

Action	Budget Allocation
Plan and implement enhanced trail connection to meet public desire lines	\$400,000.00
Create an ecological restoration plan for the park to incorporate traditional knowledge	\$25,000.00
Explore the provision of viewing areas and platforms that prevent human entry into the spawning habitat	\$150,000.00
Wildlife viewing platforms and trails to minimize human impact on ecologically sensitive sites	\$50,000.00
Install underpasses at strategic locations on nature trails to allow movement of water, amphibians, and reptiles	\$40,000.00
Restore and enhance riparian habitat and introduce a boardwalk and viewing platforms at Evelyn Island	\$100,000.00
Subtotal	\$765,000.00

Table 4. Recreation and Access (Capital)

Action	Budget Allocation
Install a new Mission Creek bridge crossing at Gerstmar Road	\$325,000.00
Encourage low impact, passive recreational activities in the southern part of the park	\$350,000.00
Consider inclusive access for all new park infrastructure for people of all abilities	\$50,000.00

Action	Budget Allocation
Develop inclusive access to natural areas and wildlife viewing platforms for people	\$100,000.00
Provide picnic shelters near the EECO	\$400,000.00
Expand parking at the Leckie Road entrance	\$600,000.00
Provide more park amenities	\$200,000.00

Figures

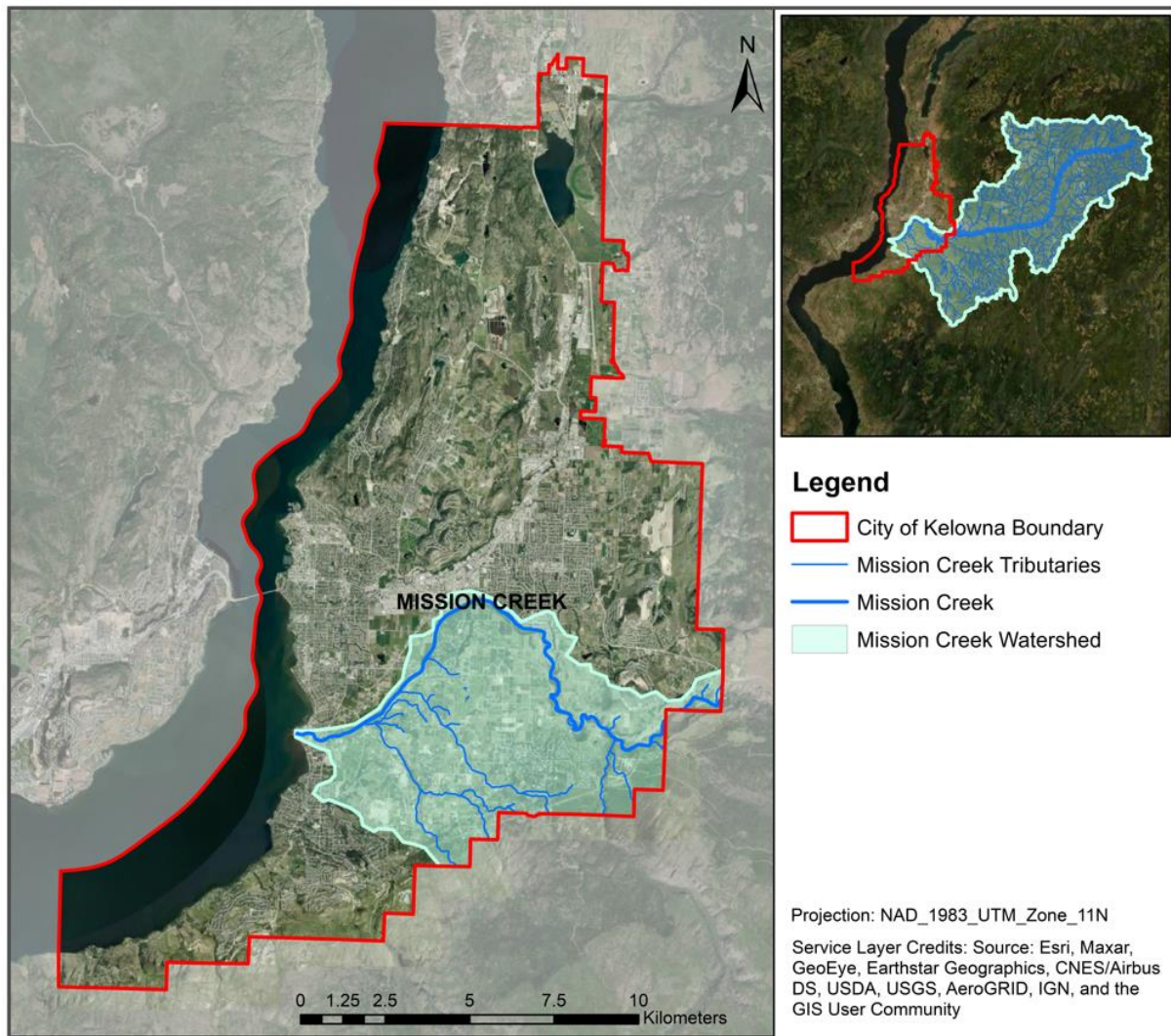


Figure 1. Mission Creek and its watershed in Kelowna, British Columbia. Left: the proportion of Mission Creek overlapping the municipality of Kelowna. Inset: Mission Creek watershed, inclusive of the headwaters outside of the City of Kelowna boundary. The Mission Creek Watershed was digitized from the RDCO sub-basin layer (RDCO, 2022). Cartography by: C. Allen. Data obtained from: City of Kelowna and the Regional District of Central Okanagan.

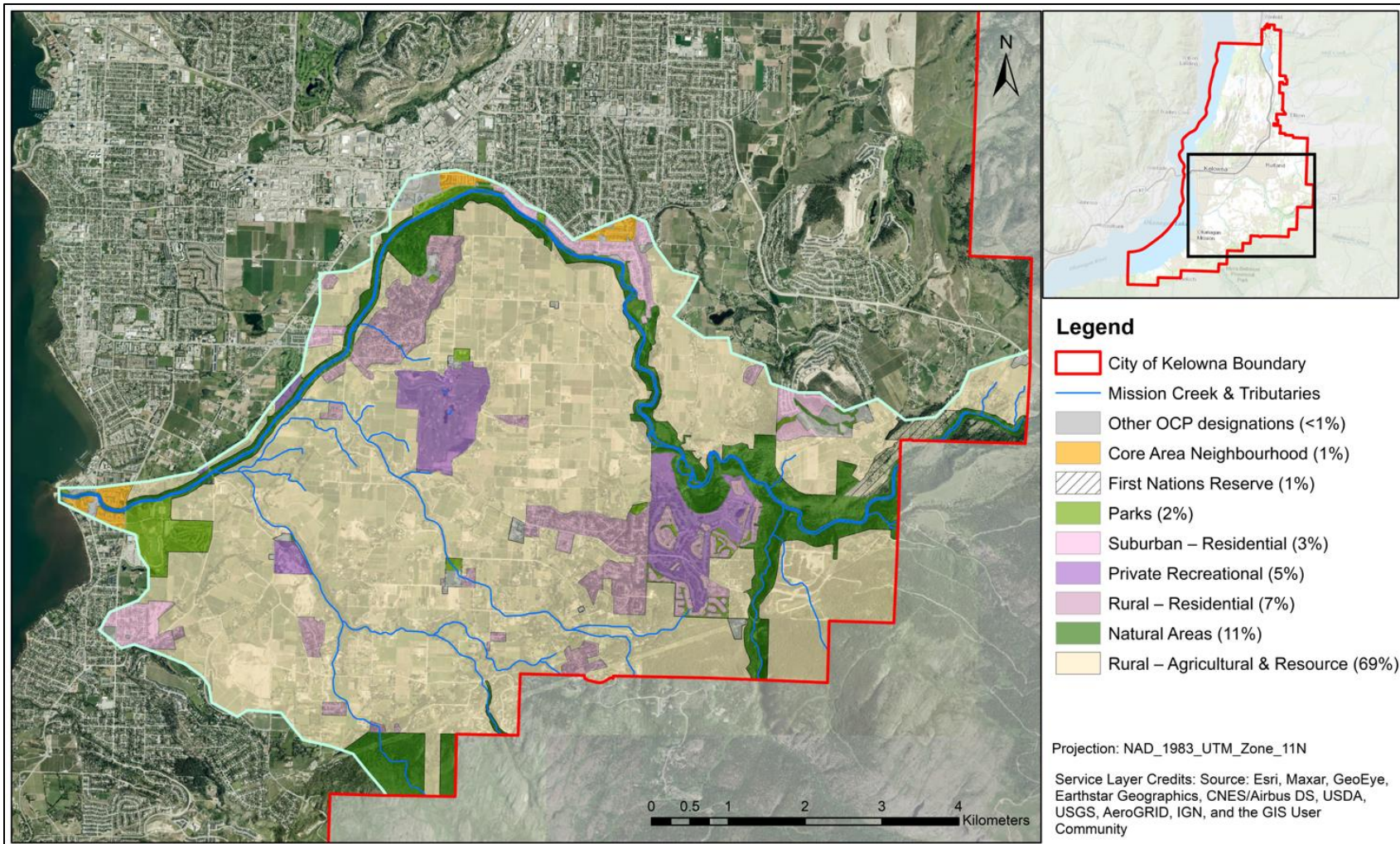


Figure 2. Official Community Plan (2040) land use designations overlapping the Mission Creek Watershed. Percentages indicate the proportion of the watershed occupied by each land use designation. Cartography by C. Allen. Data obtained from the City of Kelowna (2022).

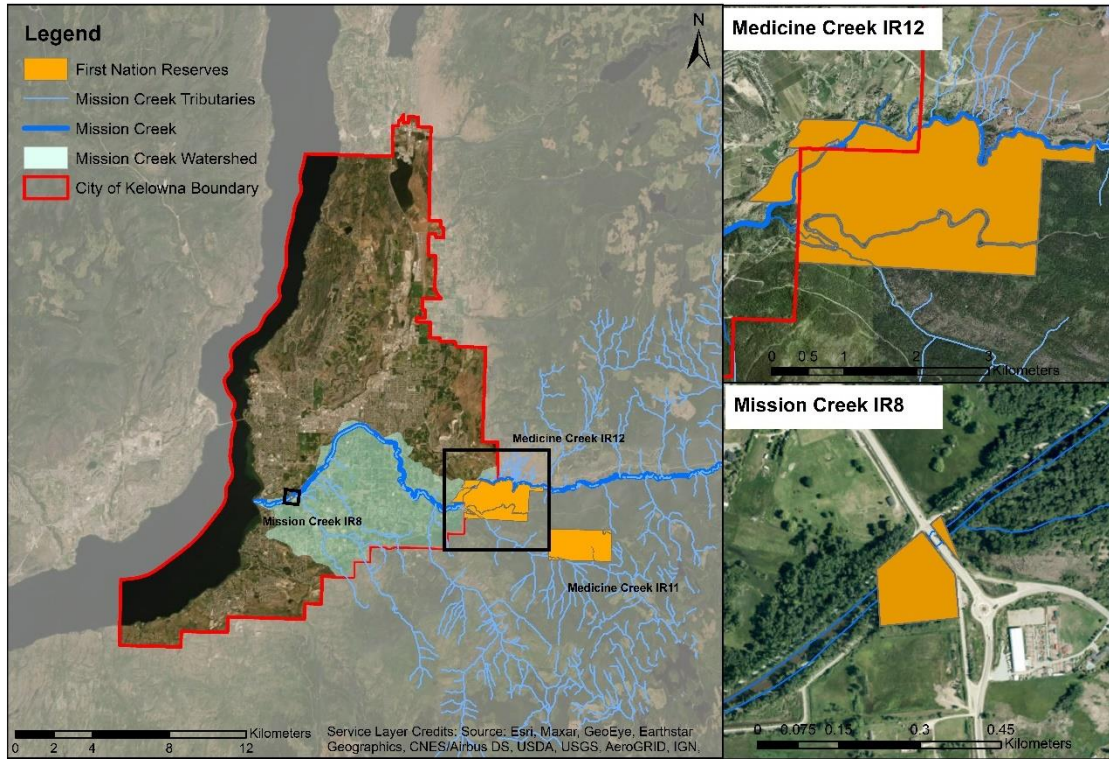



Figure 3. Westbank First Nation IR 8, 11, and 12. Cartography by C. Allen. Data obtained from: City of Kelowna, the Regional District of Central Okanagan, the Provincial Geographical Warehouse.



Component	Employment		Wages (\$ Millions)	Value-Added GDP (\$ Millions)	Economic Output (\$ Millions)
	Jobs	FTEs			
Accommodations	2,360	1,680	\$92	\$166	\$280
Other Tourism Related*	4,120	2,510	\$193	\$364	\$886
Visitor Spending**	2,730	1,760	\$84	\$112	\$212
Total Direct	9,210	5,950	\$369	\$642	\$1,378
Indirect***	2,300	1,810	\$132	\$223	\$416
Induced***	1,470	1,160	\$72	\$179	\$277
Grand Total	12,970	8,910	\$573	\$1,044	\$2,071

Notes:

* Other tourism industries impact reflects employment in attractions, and other supporting businesses and organizations of the tourism sector in the region.

** An estimated 2,730 jobs are associated with visitor spending that takes place in the Kelowna area. The level of visitor spending is based on the 2018 Visitor Intercept Survey conducted by InterVISTAS, and includes expenditure on retail, food & beverage, and local transportation.

*** Does not include indirect and induced impacts for visitor spending (only for Accommodations and Other Tourism Industries) to mitigate the possibility of double-counting of impacts.

— Figures may not sum to totals due to rounding.

Figure 4. Total impact of Tourism in Kelowna, 2018 (Adapted from InterVISTAS, 2020)

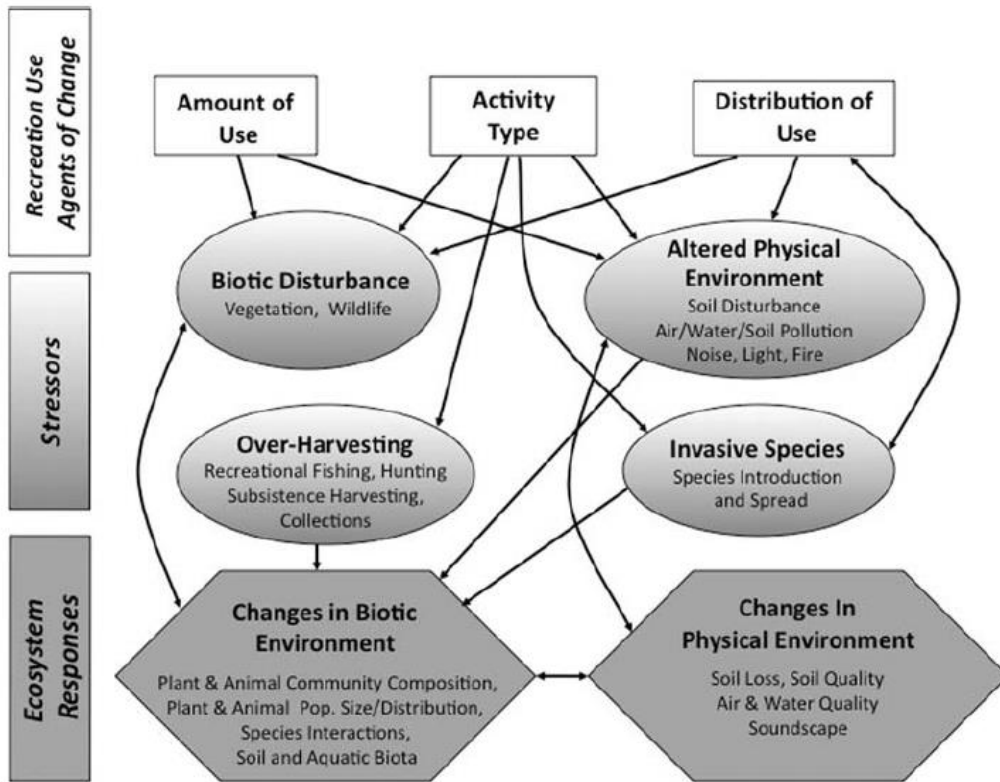


Figure 5. Impacts of outdoor recreation (from Monz et al., 2013).

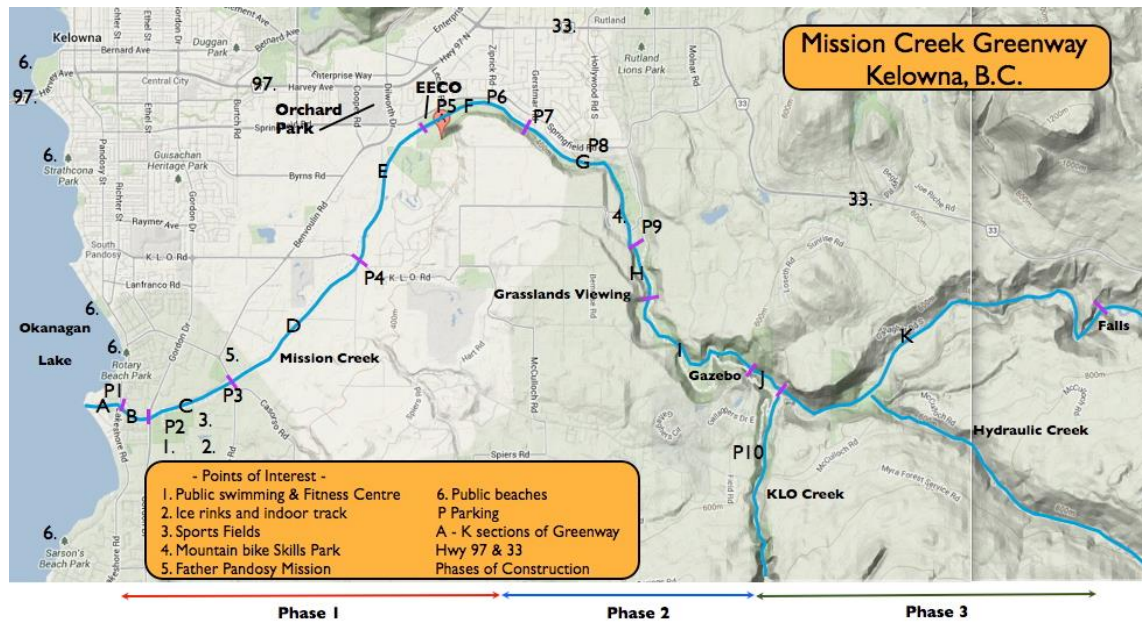


Figure 6. Mission Creek greenway map (Friends of Mission Creek Society, 2013)

Appendix A City of Kelowna 2040 Official Community Plan Verbiage

Objective 9.2 Strengthen the relationship with the syilx/Okanagan people through initiatives and processes to advance and support reconciliation in Kelowna

Policy 9.2.1 Truth and Reconciliation

Where possible, apply an Indigenous lens when undertaking 2040 OCP implementation actions with knowledge of syilx/Okanagan history and with consideration of documents such as the Calls to Action from the Truth and Reconciliation Commission and the United Nations Declaration on the Rights of Indigenous Peoples.

Policy 9.2.2 syilx/Okanagan Approach to Social Challenges

Collaborate with syilx/Okanagan people to support initiatives that address social issues rooted in the impacts of the residential school system, such as housing, transportation, and food security, in a way that recognizes the traditions, wisdom and governance of syilx people.

Objective 10.3 Ensure Parks Reflect their Unique Natural and Cultural Context

Policy 10.3.5 Reconciliation and Celebration of Indigenous Culture

Include spaces in parks that provide opportunities for reconciliation with Indigenous peoples of Canada, and celebrate Indigenous culture, particularly syilx/Okanagan culture. Work collaboratively with the syilx/Okanagan people to pursue opportunities for sharing the Nsyilxcen traditional language in parks and public spaces.

Objective 12.2.2 Prioritize Climate Resiliency in City Operations

Policy 12.2.5 Indigenous Knowledge

Collaborate with syilx/Okanagan people to incorporate Indigenous knowledge into climate change action.

Objective 13.4 *Provide a Secure Supply of Water*

Policy 13.4.6 *syilx/Okanagan Water Declaration*

Collaboration with the syilx/Okanagan communities to incorporate elements of their Water Declaration into City management policies and practices.

Objective 14.4 *Preserve and Enhance Biodiversity and Landscape Diversity, Integrating and Connecting Ecological Networks Through the City*

Policy 14.4.6 *Culturally Significant Vegetation*

Look for opportunities to preserve areas with culturally significant syilx/Okanagan plants and ecology such as bitterroot, siya, and birch.

Policy 14.4.9 *Natural Viewscape*

Collaborate with the Regional District of the Central Okanagan, neighboring communities, First Nations, and senior levels of government to protect the natural viewscape of the Central Okanagan. (City of Kelowna, 2022)

Objective 14.4 *Preserve and enhance biodiversity and landscape diversity, integrating and connecting ecological networks through the City*

Policy 14.4.1 *Ecosystem Level Planning*

Use an ecosystem level approach to ecological planning and management to ensure the ongoing function of environmentally sensitive areas (ESA), establishment and/ or retention of ecosystem connectivity corridors and the preservation of species at risk.

Policy 14.4.3 Natural Riparian Areas and Watercourses

Preserve riparian areas and watercourses in their natural state and link them with upland natural areas to develop a connected network of natural areas throughout Kelowna.

Policy 14.4.7 Stewardship of Environmentally Sensitive Areas

Encourage landowners to protect, preserve, and enhance environmentally sensitive areas on private property through conservation tools such as conservation covenants, land trusts, and eco-gifting.

Objective 14.5 *Protect and restore environmentally sensitive areas from development impacts.*

Policy 14.5.1. Development design in environmentally sensitive areas

Design new development to prioritize protection of environmentally sensitive areas as identified in Map 21.1 Natural Environment Development Permit area. Design the development to not disturb natural ecosystems, preserve environmentally sensitive features, adapt to natural topography and to avoid overall environmental impact.

Policy 14.5.2 Native Vegetation Retention

Maximize the retention of existing native vegetation and restore native vegetation wherever possible during site development in environmentally sensitive areas to enhance ecosystem services, maintain biodiversity, and minimize erosion and runoff.

Policy 14.5.3 Environmentally Sensitive Area Protection Tools

Protect and preserve environmentally sensitive areas using one or more of the following measures at the time of development:

- *Dedicating land as a City park or natural area and managed to prioritize their sensitive features in balance with public use;*
- *Returning to crown land;*
- *Placing a covenant for conservation purposes with the City, the Province, and/or a non governmental organization (e.g., Central Okanagan Land Trust) eligible to hold Conservation Covenants;*
- *Incentivizing development within the permanent growth boundary +(e.g., density transfer, cluster housing, etc.) that will facilitate the protection of all or significant portions of ESAs*

Policy 14.5.6 Riparian Area Restoration

Restore negatively impacted riparian areas prior to subdivision or rezoning approval.

Policy 14.5.7 No net loss of terrestrial habitat

Requires land use and development projects to have “no net loss” Of natural ecosystems and their functions as determined through environmental assessments for those properties identified in Figure XX. In the long term the City will strive for a net gain in overall productivity of terrestrial habitats.

Policy 14.5.8 No net loss of aquatic habitat productivity

Requires land use and development projects to have “no net loss” of aquatic habitat productivity, based on the principle of the Department of Fisheries and Oceans “no net loss” policy. In the long term the City will strive for a net gain in overall productivity of aquatic habitats.

Policy 14.5.11 Environmentally Sensitivity Areas Linkages

Ensure that development and activity does not compromise the ecological function of ESAs and maintains the integrity of plan and wildlife corridors.

Appendix B Reflections (Attached Document)

Please note that this report was created as part of academic training exercise and information may not be complete and fully validated due to time and other constraints attached to the assignment.

Appendix B Reflections – Group 1

Rheanne

Gaining a greater understanding of the complex and multi-faceted sustainability and resiliency considerations surrounding the Mission Creek watershed has been an enlightening and highly useful process. I am grateful for the opportunity, as these learnings are certainly applicable and contributive towards my personal watershed governance research. Pursuing this sort of collaborative learning has been a growth experience for me in a multitude of ways. Primarily, I have had the opportunity to gain valuable insight from the extensive diversity of my colleague's research backgrounds, and exposure to ideas and concepts outside of my scope of study. The design of the report, assigning each individual contributor a distinct area of examination within the Mission Creek watershed, allowed for the confluence of a series of interconnected spheres of interest and activity – making for the weaving of a rich and comprehensive socio-ecological tapestry to be referenced as a model for future decision-making structures.

I have come to understand Mission Creek as a microcosm of watershed health, vitality and functionality throughout the Okanagan region. Consideration of the many interconnected socio-ecological challenges and opportunities has allowed me to augment my framework of understanding through which to conceptualize other watershed case studies. Though each watershed is unique and the hydrosocial landscape reflects this individualism, overarching lessons can be gleaned from analysis of Mission Creek through the lens of complex adaptive systems. It is my hope that the intentionality of this report shines through its text, and that the opportunities presented within will motivate the four jurisdictional bodies, in particular, the City of Kelowna, to commit to a more robust, inclusive, and effective framework of governance.

Luis

Learning about the Mission Creek watershed has been a fascinating experience. I got to know a place that I have yet to visit in detail while getting familiarized with the local environment and part of its culture. The entire experience of doing a group paper was eye-opening and much more straightforward than I initially thought. It was rewarding as I got to work with people with entirely different backgrounds from my own, which, in turn, allowed me to gain a broader scope of understanding of Mission Creek and, overall, a view for my projects in the future. The various perspectives we all had on the matter allowed us to create a more solid project.

This project reminded me of what I did with www.lacasaproject.org, where we got very familiar with one single feature or micro-area. This experience with Mission Creek has taught me things in great detail, understanding flora and fauna, politics of the area, tourism, and other aspects we touched upon. The interconnection between this seemingly unrelated aspect was something that surprised me. Our paper and presentation flowed beautifully because one depended on the other. Without flora and fauna, there would be no recreational spaces, tourism, or culturally appropriate food. In the same way that tourism promotes the preservation of the local ecosystem as tourists indirectly give it an economic value.

I hope that the report shines a different perspective that perhaps the local government had not thought of before, making this more than just a class project but an actual tool that can create some change and do some good in the City of Kelowna.

Daniela

This course has been really enlightening for me in several ways. First, because before I came here from Mexico, I had the misconception that in order to achieve sustainability, the economic sectors,

including businesses and consumers, had to be responsible for improving their practices to reduce the environmental impacts of producing and consuming goods. However, throughout this course I have come to realize that, not only sustainability has different meanings and dimensions, but also that there are numerous aspects and actors that come into place, in this case the government plays an essential role to achieve sustainability. I now realize that government policies and regulatory systems are key to achieve a sustainable municipality, and I have learned that sustainability and resilience not only refers to a healthy environment, but also the quality of life of the population is highly important to meet those goals and standards.

Secondly, it was very interesting to see how the human and ecological systems are so interconnected and dependant of each other, and how each of them are composed of so many different structures, elements, and networks. I am very grateful for the opportunity to learn about one of Kelowna's more important ecological landscapes, which is the Mission Creek watershed. I had the opportunity to visit the Mission Creek Regional Park during my first month living in Kelowna, which was actually salmon spawning season, so I was able to enjoy the touristic and recreational side of the area. However now, I really appreciate having had the chance to learn in more depth and from a different perspective, about the entire area and the importance and value of the watershed from a cultural, social, economic, and ecological perspective. Additionally, learning about the multijurisdictional and multi-structural nature of this type of ecological asset, gave me a very clear idea about the complexity of designing a solid, unified and collaborative strategy that not only meets the sustainability requirements of the landscape, but also the interests of every entity and stakeholder involved.

Lastly, one of my most valuable takeaways from this project is the experience of working in collaboration with such an interesting group of people, everyone with a different background

and area of expertise. This is my first time working as part of an interdisciplinary group, and I am extremely grateful for being able to learn something different from every one of the team members. I am sure that this experience will serve me in the future as a reference on how to work collaboratively on a project with a diverse and interdisciplinary group of experts.

Corrie

For this project, our group engaged with the three pillars of sustainability and explored operationalizing each in the Mission Creek watershed. Societally, we explored the importance of positioning syilx Nation members in leadership roles and working collaboratively across worldviews to co-develop solutions, as well as identified opportunities to support a sustainable tourism and recreational sector juxtaposed in ecologically significant areas. Environmentally, we grappled with the importance of restoring and protecting important populations of fish, wildlife, plants, and ecosystems despite a legacy of extensive change. And lastly, from an economic lens, we asked how a restored (or maintained) ecosystem can provide monetary value to the City of Kelowna. Finally, we reflected on how the City mobilizes knowledge related to these three pillars of sustainability, and where there are opportunities to improve on this. I am appreciative to the breadth of experience, worldviews, and disciplinary perspectives that collided in our group; this interdisciplinarity was instrumental for engaging with so many facets of sustainability and knowledge mobilization.

After this project though, I find I'm still struggling to reconcile what sustainability means as more than a perfunctory ideology. I don't think that participating in this group project or course has provided me with any clarity on how we may transition towards a more sustainable future. Indeed, many of the challenges our group identified are so deeply entrenched in socio-political

norms, overcoming them feels insurmountable. It's also hard to shake the feeling that there is simply too much momentum behind the status quo to make meaningful steps towards creating a more sustainable and just future. Even where our group was able to identify opportunities to advance sustainability directives, we found they were often incommensurable with other objectives. It seems that every potential decision will yield a cascading storm of unintended consequences. While our group reflected on some of these unintended consequences and attempted to resolve them, I'm sure there are many we overlooked.

Bringing this to my own research and career, this project highlighted to me the importance of crossing sectoral and disciplinary lines – many of the solutions our group naturally evolved towards I would not have identified working on my own. Second to this, I have a better appreciation of the breadth of challenges the City of Kelowna faces in decision-making processes. I expect I will view new policies, decisions, or planning directives with greater empathy for the challenges the City overcame to bring it forward. I'm also left with a sense of grief – I'm increasingly appreciating that the kind of transformative change needed to transition to a sustainable future is likely not possible.

Ghazal

The project has been a great source of inspiration and learning for me. Besides the group-based and interdisciplinary nature of the project which pushed me out of my comfort zone and helped me build stronger collaboration skills. The process of researching Mission Creek has made me realize how entangled things are with regard to sustainability. For instance, changing the path of a river can impact the flora and fauna whereas wildfire can impact the quality of water. In my opinion, one of the most important concerns is the extent to which sustainability scholarship has been mostly human-centered. Despite the efforts to conserve ecology and species, it seems to me

that the ultimate endpoint for sustainability is more – or sustained – extraction of so-called natural resources. In other words, we tend to consider nature and other species as objects of consumption. I would like to highlight this issue in relation to the scholarship which focuses on how the channeling and diking in Mission Creek adversely affected spawning and, as a result, fishery. We tend to live in a world that is used to thinking animals such as fish exist for our use rather than in relation to us. If we consider the original cause of the crisis, we can easily see that the mentality or worldview which underlies it is simply based on the assumption that humans come first and it is the same worldview that then causes problems not only for humans but also for the environment. We have destroyed so much of our environment in such a short time that now we must work hard to conserve areas that we can then use for recreation, which is not harmless to species and nature.

Emmanuel

A journey of a thousand miles indeed begins with a step. As I write this today, I am filled with joy and excitement over accomplishing such a task with a wonderful and super supportive team. The sum of the whole is greater and better than the individual parts, and together as a group we were able to finish this report. My reflection on the report recalls some key lessons I have learned throughout the process of the report from its inception to completion. Prior to this project my knowledge on sustainability and resilience was limited to mainstream media and a few talks on the subjects. However, the project allowed me to not only learn more about sustainability and resilience but also enabled me to apply its principles to identify challenges and provide viable solutions to the city of Kelowna.

After countless meetings on tackling the sustainability and resilience challenges in the city of Kelowna, our group resolved to looking at a very important part of the city which has a myriad

of ecological, social, and economic importance to the residents and surrounding communities and tourists that visit the city. We settled on the Mission Creek watershed as the study area for our project. With its importance, our project area was well situated within the three pillars of sustainability. This allowed us to assess the watershed using the pillars of economic, environmental, and social challenges and providing solutions for the described challenges in the watershed. The breath and depth of sustainability was covered in this process.

How about resilience? What did that mean for our group and in particular our study area? On resilience, our group acknowledge the need for the emphasis on adaptation in its definition. The ability of the system to bounce back after a disruption or disturbance is desirable but we also acknowledge that it may not be the case always. Situating the Mission Creek watershed in this lens shows us the impact of dyking and channelization of the Creek that has happened in the watershed beginning in the 1950s. This has greatly impacted the watershed and its flood plains in ways where I personally see adaptation as a viable and most useful way of achieving resiliency for the watershed. While other resilience issues exist in this watershed (explained in the report), the concept of cascading effect is seen in this watershed, particularly linked to the dyking and channelization of the Creek.

Our report amidst other solutions to solving the sustainability and resilience challenges described for the watershed highlights to a great extent and in depth the importance of Indigenous people and the roles they play in this watershed. Through this I had the opportunity to learn about the sylix people who have been custodians of the watershed. The role of Indigenous people is highlighted such as in the Mission Creek Restoration Initiative. Our report also allowed me to learn about the ownership and jurisdictional purview for the watershed which shows that there are

collaborations ongoing with regards to management of the watershed with several actors at play. Collaboration remains one of the ways to achieving sustainability and resilience in the watershed. These principles highly relate to my research work where I believe collaboration is instrumental as my study area crosses several jurisdictions and legal boundaries. I am therefore thankful for all I had learned from undertaking this project. I want to use this opportunity to say a big thank you to my group members as well. It was a great learning experience with you all.

Reflections on Reflections

Corrie

Reading my colleagues reflections, there are two common sentiments reverberated across our thoughts - the value we each felt working with such an interdisciplinary team, and the importance we all placed on working fluidly across these disciplinary boundaries to tackle sustainability challenges. I echo many of the reflections of my peers; this group experience provided such a unique opportunity to engage in ways we are normally not able to. A graduate project can be a highly individual endeavor; I so appreciate being afforded the opportunity to collaboratively produce a deep-dive into sustainability challenges in Mission Creek. I expect that the integrated solutions we were able to evolve towards, as well as the challenges we overcame, will serve as important learning experiences for me as I continue down my academic career.

Ghazal

I agree with Corrie's truly realistic view that sustainability, as it is, is nothing more than a "perfunctory ideology". As long as we continue to look at the world instrumentally, a future in which we stop damaging the environment seems unimaginable – because basically what nature

means to us is only comprehensible in financial terms. To make this even clearer, we just need to consider how sustainability scholarship is predicated on the quantification of ecosystems and how it resorts to ‘technical’ or ‘scientific’ solutions in the face of ecological disasters. Such solutions cannot ever take us back to the 19th century when so many species had not yet gone extinct. In the end, I am left with the impression that the neoliberal ecological project is itself the problem: As long as the extraction of natural resources translates to financial profit, there will always be an incentive for indiscriminate and unjustified extraction. Although I recognize that human needs are real and should be adequately addressed, I believe that we should begin to formulate alternative ideologies that are less extractivist and more nature-oriented.

Emmanuel

Reflecting on the reflections of the group I highly resonate with and equally acknowledge the multifaceted and complex nature of our study area which served as a perfect example of a human-dominated socio-ecological system. Our study area was well positioned in helping us understand the coupled interactions and connectivity issues that exist in many landscapes. It is true to state that although with our divergent world views, discipline and expertise used in identifying sustainability and resilience challenges for the watershed and providing solutions for them, that often a time we may have overlooked or oversimplified the unintended consequences that may arise from them. The landscape is dynamic and ever changing as such sustainability and resilience goals and objectives should be flexible in addressing challenges.

Aside the obvious learnings of the impact of unsustainable management on the survival of a landscape for posterity that run core to each member of the group and equally highlighted in depth in our report, partaking in this report taught me one important lesson that is my takeaway

and is reflected in everyone's reflections. One of my key lessons from this report is the importance of collaboration for achieving a common goal. First off, each of the group members were unique. We had different disciplines, expertise or educational background and experiences, but a common goal. Working through the report as a group, each member drew on their wealth of knowledge and experience which contributed to the success of the report. Issues were viewed through different lenses which enriched our discussions by leaving almost no stone unturned. This came with its own challenges in some cases where we had multiple viable solutions or paths and had to decide on which one to choose. *I recall our decision process to define our study area as the Mission Creek watershed.* From that I realized another important lesson that challenges most collaborative works during this exercise, which is accepting compromises for the greater good. Compromises had to be made, inconveniences had to be accommodated and the common goal and objective had to triumph any personal interests throughout the duration of the exercise. One thing always remained constant and that was our common goal to write a sustainability and resiliency report for the city of Kelowna. I believe this kept everyone on board about decisions made and enhanced our collaborative efforts.

Daniela

I appreciate my colleagues' thoughts and words about our work together. I agree with them and appreciate how collaboratively approached this project, specially because it was based on a very complex human-ecological landscape. Working with this group has been such a rewarding experience, and even though this project is not applicable my research focus, it was interesting to get a deeper understanding on how to identify sustainability challenges and possible solutions in a specific context.

Nonetheless, I also share some the *not-so-positive* sustainability challenges that the humankind- are facing. First, I understand and feel what Corrie described about having some sort of grief—since I think have come to the realization that the damage we have done to the environment, so many ecosystems and wildlife, is practically irreversible. And even if we work hard on finding new solutions, there are so many social and political barriers that prevent us from implementing effective mitigation strategies. In addition, I share Ghazal’s concerns on how we tend to look at sustainability merely from a human-centric perspective, and we appropriate the ecosphere as if it belongs.

Rheanne

I very much appreciate all of my colleague’s reflections upon this process, and the themes explored. I share in the frustration voiced in regard to the complexity of these challenges, and our lack of response to them. I am inspired, however, by multi-disciplinary projects such as this one, as the diverse knowledge base we utilized to better understand these themes within the Mission Creek watershed allowed for a more comprehensive grasp of both the challenges and the opportunities. I am grateful for this experience, and can assert that it has certainly cultivated a greater awareness within me as a researcher, and as a citizen, of the multi-dimensional facets of watersheds in the Okanagan.

Luis

Corrie mentioned something I had not realized; we did our project around the pillars three pillars of sustainability. I guess in my personal case a bit over a year into this journey that what I learned last year is already part of what I do. Part of what we all do in our group, we had no debate on it, we just went at it naturally.

Another thing that echoed with me was Daniela's "meanings and dimensions" though we rarely think about it, the course did point to it through the different talks, not everyone is on the same page. Often this is a good first step to agree on basic definitions to treat the same issue equally.

The reality is that as a civilization we extract resources from nature and that civilization has an economy that fuels it. That will not change, what can change is our demands on that system and our consumption. Yes, our companies must be responsible, so must our cities as we learned from the class, but so must we. If anything, the collaboration and reflections, give me hope that we can attain sustainability. How? That is not yet clear, but the will seems to be present.