St George Rainway Proposal for Public Engagement

Elise Carelse, Hannah Deppiesse, Jesse Kemp, Zoey Schutz & Laurie Solkoski

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Simon Fraser University
Dr. Tara Holland
Julie McManus, City of Vancouver Green Infrastructure Implementation
Kelly Gardner, CityStudio

We respectfully acknowledge that the St George Rainway lies on the unceded Traditional Coast Salish Lands including the Squamish (Sḵwx̱wú7mesh Úxwumixw), Tsleil-Waututh (səlilwətaʔɬ) and Musqueam (xʷməθkʷəy̓əm) Nations.

Executive Summary

St George Street will soon see a transition from grey to green. The City of Vancouver is planning to introduce green rainwater infrastructure (GRI) such as bioswales and rainwater tree trenches along St George Street in Mount Pleasant, designating it as a Rainway (Figure ES1). Through the implementation of GRI in this community, the City of Vancouver aims to provide a multitude of co-benefits to its citizens. The primary focus of the Rainway is to manage rainwater in a way that aligns with the City of Vancouver's Rain City Strategy (2019). Ideally, the GRI will also enhance biodiversity, mitigate climate change effects, and contribute to place-making among other contributions to the physical, social, and economic wellbeing of the community.

Figure ES1. Map showing the location of the proposed St George Rainway GRI project and the location of the historic stream tə Statləw, which inspired the project. The red star on the inset map indicates the location of the proposed St George Rainway. Map created by Laurie Solkoski using QGIS.

The Problem

While the intentions of GRI implementation are well placed, citizens may have differing views on certain aspects of the project, resulting in a spectrum of attitudes towards the Rainway. On one end of the spectrum, citizens may be skeptical towards a GRI project in their neighbourhood. In the St George Rainway Vision and Values survey (2021), concerns such as safety, loss of parking and road space, and issues related to costs and maintenance were cited. On the other end of the spectrum are passionate advocates for the project. These citizens want to see the stream daylighted, car space eliminated, and have little to no cost or operational objections (City of Vancouver, 2021). Our goal is to educate and engage the public about the implementation of GRI along the St George Rainway in ways that will both alleviate the skeptics' concerns and instill a more realistic idea of the project in the advocates. To do this, we will be focusing on emphasizing the benefits for rainwater management and co-benefits for the environment and the community that the St George Rainway will provide. This will be a beneficial approach in regards to reaching citizens from across the spectrum of support. Through education and engagement, skeptics will be made aware of the benefits of the project and advocates will realize that it is not necessary to daylight the stream in order to achieve environmental benefits.

What Will We Do About It?

Community engagement is essential in any GRI project to ensure success (Hostetler et al., 2011). However, communicating science to the public can be a challenge due to varying levels of scientific literacy (Martin, 2017). Methods such as citizen science and social media campaigns can be used to overcome this while also reaching a broad, diverse set of demographics, thereby increasing community engagement. These approaches are both ones that we suggest the City of Vancouver employ to engage and educate citizens with respect to the St George Rainway.

We propose public education and engagement resources with the objective of encouraging dialogue and participation among all members of the community, from the skeptics to the advocates. In response to the City of Vancouver's Request for Proposals, we have developed an engagement plan featuring various components, including a workshop designed for students at Mount Pleasant Elementary School, targeted social media posts, educational signage, and materials for homeowners to make their own properties more rainwater- and biodiversity-friendly. The components will involve engagement and education opportunities before, during, and after the installation of the Rainway. Through our resources, we aim to reach multiple demographics and foster broad understanding and support for the St George Rainway by showcasing the co-benefits it will provide to both the community and environment.

In this report, we first provide a background of the history of and context for the proposed St George Rainway. Then, to situate our proposal, we undertook a literature review in which we

researched the importance of and some of the methods of community engagement with a focus on GRI and its co-benefit of biodiversity. Finally, we outline the details and materials that make up our proposed plan for public engagement.

Our proposal will focus on the present, while looking to the future and honouring the past. It can also be expanded to other parts of Vancouver, with the potential to contribute to achieving a city filled with residents who are knowledgeable and optimistic about the usage of GRI. It will aid the City of Vancouver in achieving the goals of the Rain City Strategy (2019) in a way that is inclusive and equitable. By educating and engaging the citizens of Mount Pleasant, we can help increase public support for a project that will ultimately result in a range of environmental, social, and economic benefits.

Our Goal

To create resources to educate and engage the public about the implementation of GRI along the St George Rainway, emphasizing the benefits for rainwater management and co-benefits for the community and the environment.

Our Objectives

- To reach members of the public from across the spectrum of support and include their input in an equitable way
- To engage the local public in actively contributing to the project via citizen science and/or environmentally friendly initiatives at the personal scale (e.g. rain barrels)
- To engage with elementary school-aged children at Mount Pleasant Elementary School in order to foster a sense of personal involvement in the project and to raise the next generation of environmental champions
- To remember and pay homage to the historic stream that underlies St George Street

Overview of Engagement Plan

We believe that employing a multivariate approach in our engagement plan will best reach the diverse demographics that exist within the community. Our engagement plan includes two distinct but complementary components (Figure ES2): a workshop for students attending Mount Pleasant Elementary School and broader outreach tactics for those that do not have a connection to the school.
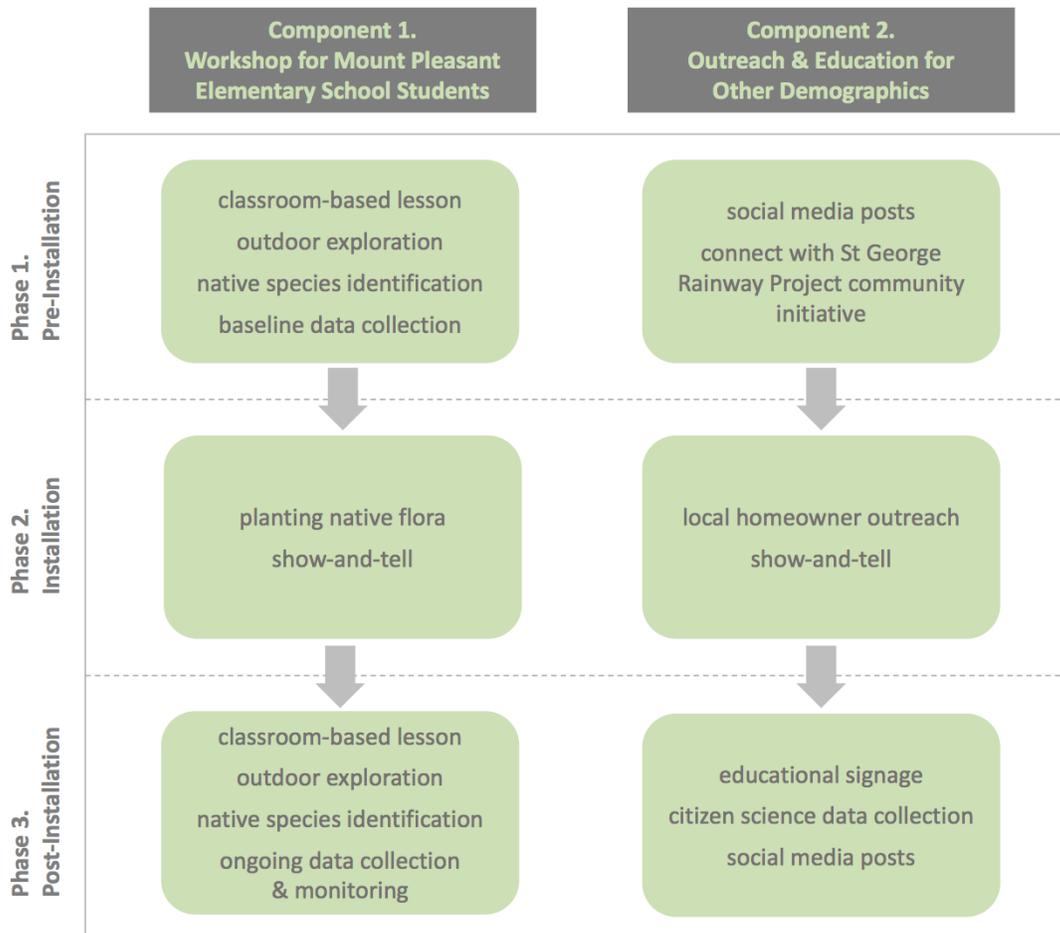
Figure ES2. Flow chart outlining the phases of our engagement plan components

Component 1 will consist of a workshop for school children attending Mount Pleasant Elementary School, which is adjacent to the St George Rainway. This workshop is designed for older elementary school students in grades 4 – 7, but has the potential to be adapted to include younger grades as well.

Before installation of the Rainway occurs, we propose a classroom lesson led by an ecologist and a Coast Salish representative. This lesson could be performed in front of all of the classes in an assembly-style lesson, or on a classroom-by-classroom basis over the course of the school day. After the children receive this lesson, they will go outside with their classroom teachers and guest speakers to collect preliminary biodiversity data in the vicinity of the proposed Rainway. The children and teachers will be using the citizen science app iNaturalist to collect this data for the St George Rainway iNaturalist project. This data can be used by the City of Vancouver to assess pre-Rainway biodiversity metrics.

During installation of the Rainway, we propose that the City of Vancouver provide classroom teachers with seeds of the plants that are planned for the rain garden portion of the Rainway so that the children can grow these plants throughout the school year. This will potentially instill a

sense of pride in the children as well as a sense of responsibility for the natural environment. At the end of the year the children can take their plants home and plant them in their own gardens, thus contributing to biodiversity in the neighbourhoods surrounding the Rainway.

After the Rainway is installed, we propose that the first phase is mirrored, with a lesson from the ecologist and Coast Salish representative, followed by outdoor exploration and iNaturalist data collection. The City of Vancouver can use the data collected in this phase to compare to pre-installation data to measure biodiversity increases. Grades 4 – 7 students will participate in this workshop year after year, resulting in their greater understanding of GRI and specifically the co-benefit of biodiversity that it provides.

Component 2 focuses on the education and engagement of the broader community. It aims to include a variety of methods to engage the public in order to reach as many people as possible. Pre-installation outreach will begin with GRI social media posts across the City's Instagram, Facebook, and Twitter accounts. These social media posts can also be used to promote the St George Rainway iNaturalist project within the community, so that the baseline dataset can be expanded further.

While the Rainway is being installed, we suggest that homeowners be provided with educational materials on how to make their own properties more rainwater- and biodiversity-friendly. Seed packets for native plants will be provided to homeowners in the community surrounding the Rainway. Temporary educational signage will also be placed along the Rainway during construction.

After the Rainway is installed, permanent educational signage will be installed along it to outline the history of the area and how the Rainway is contributing to the wellbeing of the community. Social media posts will continue in this phase and into the future, especially as the City of Vancouver expands its green rainwater infrastructure program and introduces new projects.

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Report Authors

Elise Carelse

Elise Carelse is finishing her 4th year studying Environmental Science at Simon Fraser University with a concentration in Applied Biology. Throughout her university career, Elise has pursued her interests in ecology, conservation biology and field research. During the summer months Elise has had various environmental related jobs; working in the non-for-profit sector for Fraser Valley Conservancy and Watershed Watch Salmon Society as well as in the private sector as an environmental monitor. In her spare time Elise enjoys birdwatching and photography.

Hannah Deppiesse

Hannah Deppiesse is majoring in Environmental Science with a concentration in Environmental Earth Systems at Simon Fraser University. During her summers, Hannah has worked for the City of Port Coquitlam doing education/outreach for the City's solid waste, wildlife awareness, and water conservation programs. During her time at the City she worked extensively on the City's waste sorting app and played a prominent role in implementing and organizing Repair Cafés and river clean-up events. In her spare time, Hannah coaches softball in her local community.

Jesse Kemp

Jesse Kemp is graduating with a double major in Biological Sciences and Environmental Science. She is passionate about avian ecology and conservation. She has conducted undergraduate research, worked in the non-profit sector, and volunteered with diverse avian species.

Zoey Schutz

Zoey is a 4th year Environmental Science Honours student with a concentration in Environmental Earth Systems. She is particularly interested in environmental policy and law, and plans to pursue environmental law after completing her undergraduate degree. Zoey currently works for a not-for-profit, The Loon Foundation, doing a variety of research and writing projects, particularly those related to grant proposals. When she's not working or studying, Zoey enjoys getting out in nature by hiking, mountain biking, or walking her puppy.

Laurie Solkoski

Laurie Solkoski is in her last year as an undergraduate student in the Environmental Science Earth Systems concentration at Simon Fraser University. Laurie is passionate about environmental policy and plans to pursue a career in environmental law and policy analysis.
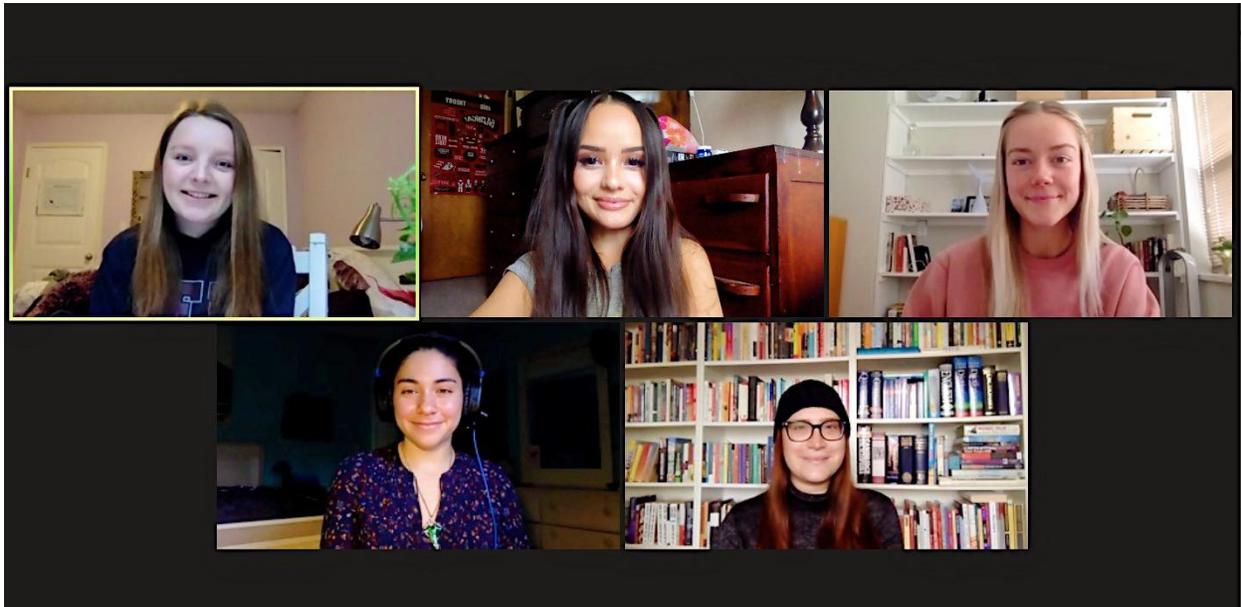
Team Photo

Figure 1. Our team during a weekly Zoom meeting (top left to bottom right: Hannah Deppiesse, Laurie Solkoski, Zoey Schutz, Elise Carelse, & Jesse Kemp).

Introduction

Green rainwater infrastructure (GRI) integrates nature and traditional grey infrastructure to provide ecosystem services and facilitate climate change mitigation. GRI has numerous benefits, including improved stormwater management, increased biodiversity, and improved public spaces. GRI is increasingly being adopted in unique and sustainable ways across the globe and in Vancouver specifically, such as the forthcoming St George Rainway.

Figure 2. Map showing the location of the proposed St George Rainway GRI project and the location of the historic stream tə Statləw, which inspired the project. The red star on the inset map indicates the location of the proposed St George Rainway. Map created by Laurie Solkoski using QGIS.

The St George Rainway will be located along St George Street from East Broadway to East 5th Avenue in Vancouver, British Columbia, where the historic creek tə Statləw once flowed (Figures 2 & 3). The creek was buried underground in the early 1900s to accommodate roads and housing developments (City of Vancouver, 2019), and the Rainway intends to honour tə Statləw by bringing more greenspace and biodiversity back into the neighbourhood. As part of the City of Vancouver's Rain City Strategy (2019), an initiative to transition from grey rainwater infrastructure to green rainwater infrastructure (GRI), the St George Rainway project will feature GRI elements such as bioswales and rainwater tree trenches. The Rainway GRI will help to restore the local hydrological cycle, which has been limited by grey infrastructure, by allowing increased infiltration and evapotranspiration of water. Benefits of GRI also include reduced urban runoff, improved water quality, increased water management sustainability, resilience to climate change effects, and enhanced livability and wellness within the community. This will be particularly beneficial to St George Street as it experiences localized flooding during rainfall events (Figure 4).

Figure 3. Photos showing the current state of St George Street in January 2021, prior to the construction of the St George Rainway green infrastructure project. Photos by Laurie Solkoski.
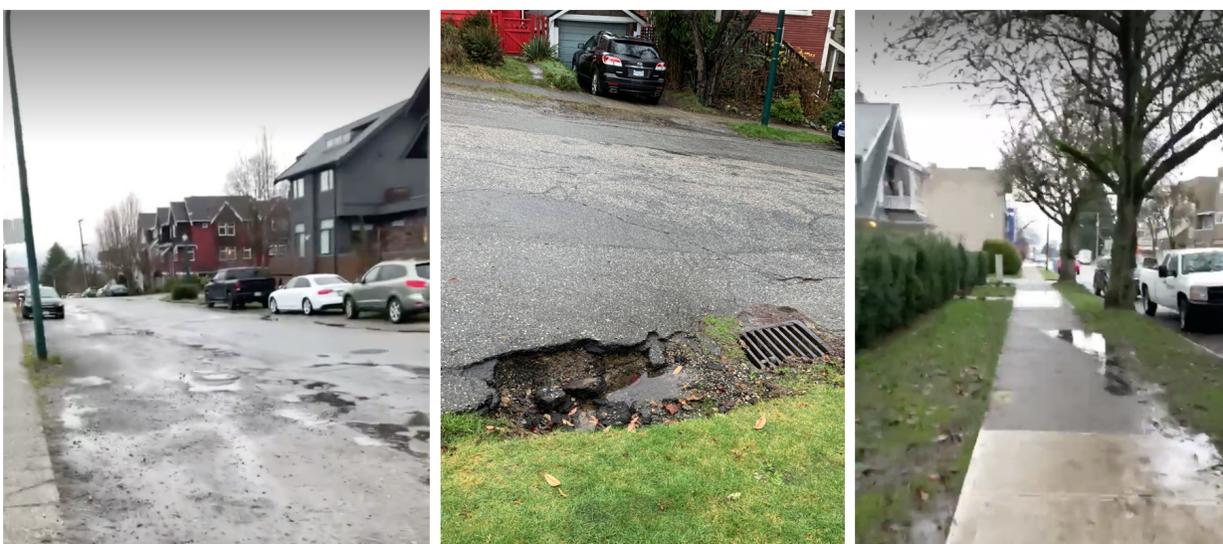

Figure 4. Photos showing localized flooding and erosion along St George Street during a rainfall event in January 2021. Photos by Laurie Solkoski.

Place-making is a key goal of the St George Rainway and the Rain City Strategy (City of Vancouver, 2019). Through projects such as the Rainway, the City of Vancouver aims to create public spaces that engage the local people and reflect the needs, assets, and values of the community as a whole. This must include connecting with local Indigenous Peoples to respect their interests, support Vancouver's commitment to Reconciliation, and, in the case of the St George Rainway, properly honour tə Statləw. Communication through public engagement and education is therefore vital to the progress and success of this project. As part of early engagement in 2020, the City of Vancouver conducted the St George Rainway Vision and

Values survey (City of Vancouver, 2021). The survey results provided preliminary information on the local demographics and general preferences of residents. The wide variety of feedback highlighted a need for an ongoing resource to engage and educate the public on the features and co-benefits of the St George Rainway in order to foster broad understanding and support of the project.

Objectives

The overall goal of this project is to create resources to educate and engage the public about the implementation of GRI along the St George Rainway, emphasizing the benefits for rainwater management and co-benefits for the community and the environment. More specifically, our individual objectives are:

- To reach members of the public from across the spectrum of support (skeptics, believers, participants, advocates) and include their input in an equitable way
- To engage the local public in actively contributing to the project via citizen science and/or environmentally friendly initiatives at the personal scale (e.g. rain barrels)
- To engage with elementary school-aged children at the adjacent school (Mount Pleasant Elementary School) in order to foster a sense of personal involvement in the project and to raise the next generation of environmental champions
- To align the resource with the goals of the City of Vancouver's Rain City Strategy
- To remember and pay homage to the historic stream that underlies St George Street
- To consider COVID-19 restrictions in developing the resource (i.e. something that citizens can use/participate in without having to worry about restrictions), while also creating something that will reach those who are not tech savvy (i.e. having an offline component)
- To use outside-the-box thinking to develop a unique and creative resource

Literature Review

Introduction

Green rainwater infrastructure (GRI) is a form of infrastructure that integrates natural elements in order to provide ecosystem services that traditional grey infrastructure cannot (Filazzola et al., 2019). In addition to improving water management in urban environments, GRI has the potential to provide diverse co-benefits for the environment, biodiversity, and public health (Alves et al., 2017). However, GRI can fail to reach its full potential due to misguided actions by the general public if they do not understand the nature and purpose of the GRI (Hostetler et al., 2011). It is thus vital to engage and educate the public on any GRI project in order to facilitate its success (Hostetler et al., 2011). GRI is inherently linked to science and communicating science to the public can be challenging due to varying levels of scientific literacy (Martin, 2017). To effectively engage a large cross-section of a community, diverse approaches to communicating the nature and goals of a project should be employed. Citizen science is amongst the most effective approaches because it actively engages the public in participating in the project, thereby increasing public interest and support while also collecting valuable data (Dickinson et al., 2012). The use of social media and its various platforms can further reach a broad, diverse audience with varying scientific backgrounds (Pavelle & Wilkinson, 2020). If the local community is engaged with a GRI project, the result is more likely to be a successful GRI project that bestows a sense of place-making on satisfied citizens (Donaldson & João, 2020). Here we review approaches to citizen engagement in science and GRI, with a particular focus on the co-benefit of biodiversity, in order to support the development of a robust and informed approach to public engagement for the proposed St George Rainway GRI project.

Biodiversity within an Urban Setting

Of the many co-benefits provided by green rainwater infrastructure (GRI), our proposal centres on biodiversity. Biodiversity is a complex ecological concept related to the number of different kinds of organisms and species that are present in a given area (Purvis and Hector, 2000). In cities like Vancouver, rapid urbanization has impacted natural habitats and threatened native species (City of Vancouver, 2019), and there is a need for development decisions that benefit both humans and the environment. (Filazzola et al., 2019). GRI supports significantly higher biodiversity than conventional grey rainwater infrastructure, while maintaining the same rainwater management effects and providing additional ecosystem services to society (Filazzola et al., 2019). Urban biodiversity is beneficial in that it provides habitat connectivity for pollinators and other wildlife, increases resilience to climate change, and improves aesthetic value (City of Vancouver, 2019). Engagement with local residential and commercial communities have been found to improve the success of GRI projects with respect to urban biodiversity (Hostetler et al., 2011). Ongoing public engagement through educational materials when implementing GRI is

important to ensure that negative human influence on biodiversity is minimized (Hostetler et al., 2011). Biodiversity conservation and the benefits provided to humans by ecosystem services are not mutually exclusive, but rather can both be achieved through thoughtful GRI design, implementation, and education (Filazzola et al., 2019; Hostetler et al., 2011).

Overcoming Challenges of Engaging the Public with GRI

Differences of opinions and lack of scientific knowledge can be pitfalls in GRI implementation, but inclusion of public stakeholders throughout the entire process of a GRI project can help to diminish these hurdles (Alves et al., 2017; Tayouga and Gagné, 2016). In particular, it is important that engagement be maintained on an ongoing basis after the installation of the GRI project is complete (Hostetler et al., 2011). Engaging the public on projects that are based in scientific principles, such as GRI, can be difficult due the complexity of science as a topic (Martin, 2017). One way to overcome this is to incorporate traditional ecological knowledge (TEK) because it is holistic in nature and can make a project less intimidating and more inclusive (Kimmerer, 2002). Additionally, when it comes to GRI projects, the public often has different priorities on which co-benefits are most important compared to the government employees who facilitate the project (Alves et al., 2017). A survey showed that the public often cares more about recreation benefits than government workers, who tend to favour amenities and water treatment reduction (Alves et al., 2017). Despite its challenges, public engagement is vital to the success of a GRI project: without proper understanding of the project, the public can unknowingly undermine the goals of a GRI project through seemingly benign actions such as planting exotic plants in their gardens, overusing fertilizers, and allowing pets to roam free (Hostetler et al., 2011). In an extensive literature review, Tayouga and Gagné (2016) note that educating the local public on GRI can reduce counterproductive public actions and increase the overall efficiency of implementation. For example, TRANSGREEN, a GRI project that was implemented in multiple European countries, has demonstrated how increasing public education and collaboration increased the public's level of interaction with GRI and the success of the project (Finka et al., 2017).

Engagement through Citizen Science

Citizen science initiatives present an effective way to engage the public on GRI projects and create a sense of community and ownership over the GRI (Finka et al., 2017; Saunders et al., 2018). Citizen science can influence peoples' perceptions, increase people's understanding of science and encourage them to participate in projects (Bonney et al., 2016), such as the proposed St George Rainway. When the public is a part of citizen science, it facilitates connections that allow them to become more involved in the project's process (Tayouga and Gagné, 2016). Citizen science initiatives have also been found to encourage the public to better manage their own yards to support biodiversity (Kobori et al., 2016), which will help ensure the success of nearby GRI projects. Most citizen science projects attract members of the public who already have a high level of scientific knowledge; engaging people with lower scientific literacy requires more effort and communication, but has been successful (Mark, 2017). While not

without challenge, citizen science can be very rewarding for the public and researchers alike; for example, Worthington et al. (2012) found nearly 3,000 new snail polymorphisms through a citizen science project. Citizen science has further been successfully employed to track migration, track the spread of disease in wild populations, monitor invasive species, and has even identified species believed to be extinct (Dickinson et al., 2012). These examples underscore an additional benefit of citizen science: the generation of reliable, usable ecological data (Dickinson et al., 2012; Kobori et al., 2016). Citizen science enables the collection of far more data than researchers could collect without mobilizing the public, all while increasing public interest and engagement in a project (Kobori et al., 2016). Citizen science has also been integral in achieving conservation goals (Dickinson et al., 2012; Kobori et al., 2016), which is a further benefit that aligns well with the St George Rainway's goals of enhancing biodiversity.

To reach the largest audience possible, engaging and educating schoolchildren using citizen science significantly increases the local public's knowledge on a given topic (Saunders et al., 2018). Providing environmental education to schoolchildren has been shown to indirectly increase overall public knowledge of a project through knowledge transfer from children to their families and community members (Vaughan et al., 2003). Hands-on, research-based learning has proven to engage students in topics better than conventional annual curricula, improve scientific literacy, and foster long-term scientific interest (Saunders et al., 2018). Children's learning can be supported further by integrating TEK into science education, which has been found to make science less intimidating (Kimmerer, 2002). The most conducive environment for including TEK in science education is in the field, which allows learners to gain hands-on experience and build a personal relationship with their local ecology; an immersion with TEK has been found to be transformative for students, broadening their horizons and encouraging a mindset directed towards sustainability (Kimmerer, 2012). It is essential to engage with TEK in a respectful and appropriate manner that allows Indigenous peoples to retain control of TEK and avoids cultural appropriation (Kimmerer, 2002). iNaturalist has been identified as an invaluable tool in exploring citizen science with schoolchildren (Echeverria et al., 2012). In schoolchildren's self-reported feedback on an iNaturalist project, the app's learning-by-doing approach was found to increase schoolchildren's motivation, confidence, community awareness, and knowledge of science (Echeverria et al., 2012). Additionally, students reported a high likelihood of using the app again outside of the classroom (Echeverria et al., 2012), which highlights how projects that begin in the classroom can percolate into the community at large. TEK and iNaturalist should integrate well as both necessitate field-based learning-by-doing.

Social Media as a Tool for Public Education and Engagement

Social media has become a modern educational tool that has the ability to educate and influence the younger generation, the general public, and stakeholders on a wide array of topics related to science and conservation (Pavelle & Wilkinson, 2020), including the importance of GRI in an urban setting. At the dawn of the social media era, the ways in which the public and the scientific community communicate was revolutionized as there was a rise in an emphasis on sharing, participation, and collaboration (Battrawi & Muhtaseb, 2013). A key value gained from social media is influence: information can instantly reach millions with just the tap of a finger. Science education through social media creates a bridge of knowledge between the scientific

community and general public, thereby enabling scientists to reach a larger audience with media posts (Pavelle & Wilkinson, 2020). The prevalence of smartphones and social media applications such as Instagram, Facebook, and Twitter have paved a path for new and emerging ways to engage citizens and stakeholders on the importance of projects such as GRI. For example, scientific organizations like the American Geoscience Union are actively adopting social media presences and employing hashtags to reach large and diverse audiences through their social media accounts, especially Twitter and Instagram (AGU, 2020). Hashtags make social media posts more discoverable and thus increase citizen engagement with the topic (Swift et al., 2020). Platforms such as Facebook and Twitter have been found to be effective for science communication, with citizens self-reporting that engaging with scientific content on these apps provided them with both interesting scientific information and an appreciation for nature in a format that was personal and approachable (Pavelle & Wilkinson, 2020). Photos with educational captions were one of the most popular forms of social media amongst respondents (Pavelle & Wilkinson, 2020). A recent study demonstrated how a researcher's use of a hashtag led to a viral tweet that inspired a local high school to initiate their own mycology research project (Swift et al., 2020). In this case, the high school's project was so successful that it was presented at a local science fair and received national media coverage (Swift et al., 2020). This case study is an example of how social media can serve as a conduit between the science community, youth, and the media, which has the potential to further educate and engage broader audiences.

Although the tools that social media provides can be harnessed to engage individuals within a community, there are still limitations to this method. With the abundance of social media accounts and information, it can oftentimes be challenging to distinguish a credible source from other accounts that release inaccurate information (Huber et al., 2019). Online users might be skeptical of viewing information released through social media platforms, and a lack of quality control online could lead to a spread of misinformation, thus instilling public mistrust in scientific information on these platforms (Huber et al., 2019). A recent study found that users' perceptions of credibility are platform-dependent, with Twitter being less reliable than other platforms (Boothby et al., 2020). However, the information shared online by individuals in the scientific community has been found to be trustworthy overall (Huber et al., 2019). Further, there are features available to the scientific community to increase their credibility online, such as an indication of which profiles are "Verified", which informs users that the account belongs to the original researcher or organization (Boothby et al., 2020). To enhance the quality of public opinion regarding GRI, social media posts are typically aimed at increasing the public's awareness, interest, and scientific literacy (Pavelle & Wilkinson, 2020). A single post with the right description, hashtags, and image can create a ripple effect within a community. Investing in the public's interest to identify how and where gaps in public understanding and education have not yet been met is a useful tool in the GRI development process.

Conclusion

By employing a number of various education and engagement approaches in the context of GRI, more citizens will understand the goals of GRI, increasing the likelihood that a given GRI project will reach its full potential. Public education regarding GRI ultimately results in greater

acceptance of GRI implementation within communities. There can be challenges in implementing GRI such as: low scientific literacy in the public, counterproductive actions by the public including the introduction of exotic garden plants or off-leash pets, and different priorities regarding co-benefits. Challenges such as these relate to a lack of understanding, and it is therefore essential to engage and educate the public in order to minimize the effects of these challenges and create a successful GRI project. Through involving children in science education efforts, opportunities for knowledge transfer are facilitated. Additionally, hands-on education approaches like citizen science and the incorporation of TEK in childrens' education enhances their learning. For citizens who cannot be reached through the education of schoolchildren, the utilization of social media platforms is a potentially powerful method of conveying scientific knowledge to the public. Citizen science is also an effective tool in terms of engaging adults as it creates a sense of involvement through the feeling that they are contributing to science. While each of these tactics has its limitations, they all contribute to greater public education and subsequently greater public acceptance of GRI. When the local community is engaged and educated, GRI projects, like the St George Rainway, will be able to achieve their intended goals for rainwater management and co-benefits such as place-making, biodiversity support, and additional ecosystem services.

Proposed Methodology

In order to engage a large cross-section of the community, our engagement plan includes two distinct but complementary components (Figure 5). We feel that this multivariate approach will best reach the diverse demographics within the community in order to foster strong support for the St George Rainway. By focusing on active community involvement, we aim to create in the community an understanding of the goals and the co-benefits of the project as well as a sense of community ownership for the Rainway.
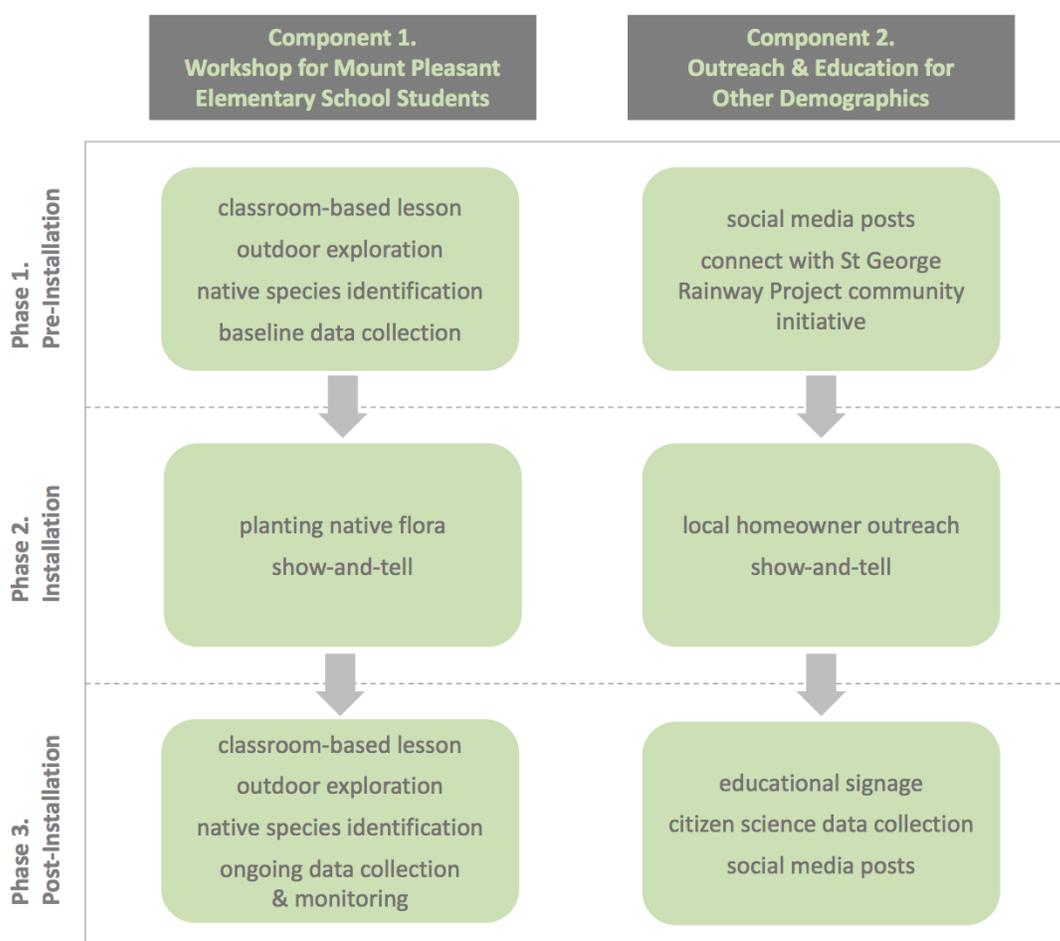
Figure 5. Flow chart outlining the phases of our engagement plan components.

Component 1. Workshop for Students at Mount Pleasant Elementary School

We propose the implementation of a workshop aimed at the children who attend Mount Pleasant Elementary School, which is adjacent to the proposed St George Rainway. There is

evidence that focusing education efforts on school children has a broad reach, leading to information being shared widely within the community as children involve their parents who then go on to discuss with their friends and neighbours (Vaughan et al., 2003). Primarily, the workshop will be focused on learning about the past and present biodiversity of the area and how the St George Rainway can increase biodiversity, amongst its other co-benefits.

We recommend an approach that allows children to be actively involved in the St George Rainway through engaging in citizen science. Having novel research questions and encouraging active participation increases student engagement and can help foster a life-long interest in the sciences (Saunders et al., 2018). This should also create in students a sense of ownership for the project and encourage a positive opinion of the project by both students and their families. Further, involving school children in ecological field work can lead to reasonably high quality datasets (Saunders et al., 2018), suggesting that data collected by students will be useful to the long-term data monitoring goals of this project. We recommend that this work be conducted with an ecologist and a representative from a Coast Salish nation so that the children obtain a broad education from both the perspectives of western science and traditional ecological knowledge (TEK). The holistic nature of TEK can help make science less intimidating for younger children (Kimmerer, 2002) and TEK can be used to explain the significance of the historical stream tə Statləw that inspired the St George Rainway.

We propose that students in grades 4 – 7 be included in this workshop, as the methods and learning outcomes of the workshop will be in line with a number of the science curricular competencies as outlined by the Government of British Columbia for these grade levels (Province of British Columbia, 2019). The particular curricular competencies our workshop will address are outlined in our Lesson Plan (Appendix 1). Specifically, we believe that the workshop exemplifies the following curricular competencies (Province of British Columbia, 2019):
- Experience and interpret the local environment;
- Identify First Peoples perspectives and knowledge as sources of information;
- Identify some of the social, ethical, and environmental implications of the findings from their own and others' investigations.

We propose that this workshop be conducted over three phases that align with the progress of the installation of the St George Rainway. Each phase is designed as a stand-alone workshop and can be conducted once per school year.

Phase 1. Pre-Rainway installation

This phase can begin immediately and be modified to adhere to all COVID-19 restrictions for as long as they remain relevant and necessary.

The workshop will begin with a classroom-based lesson in which the ecologist and Coast Salish representative can both present background information on the ecology and history of

the area and the goals of the St George Rainway. Depending on COVID-19 restrictions at the time, this lesson could be conducted over Zoom or a similar platform, or delivered assembly-style in the morning with all participating classes. Children will learn about native species and how many are largely absent in urban environments. They can also learn about stormwater management through relatable ideas, such as how St George Street experiences localized flooding during rainfall events.

Outside activities are fun and engaging for children, while remaining safe during the pandemic. After the classroom lesson, children will go outside on their school grounds with their teacher and, if possible, the ecologist and Coast Salish representative. The grounds of Mount Pleasant Elementary School are dominated by a lawn, but also contain a small grove of conifers and cultivated gardens (Figure 6). Within the scope of this workshop, the diversity of habitat contained within the school grounds likely supports sufficient diversity of plants, birds, and invertebrates for children to identify. Ideally the workshop can remain on school property to minimize risk, but it would also be possible for children and workshop leaders to venture beyond the school grounds to increase the diversity of species located, as long as permission is obtained from the children's guardians. Children will be tasked with locating and identifying biota in and around the school grounds and determining whether they are native or introduced species. This will allow children to see first-hand how local biodiversity has largely decreased from what it was historically. The ecologist and Coast Salish representative will help students identify species and explain their roles in the ecosystem.

Figure 6. Photos showing the diversity of habitat types on the grounds of Mount Pleasant Elementary School in March 2021. Photos by Laurie Solkoski.

We have started an iNaturalist project for the St George Rainway, which already shows hundreds of species that have been observed in the St George area by citizen scientists (Figures 7 – 9). Out of several available citizen science apps, iNaturalist has been found to be one of the most valuable for engaging students with biodiversity because it is easy to use, available on many platforms (Figures 7 & 8), and provides interaction with a large community of citizen scientists (Echeverria et al., 2021). Taking photographs of the organisms found and sharing them to iNaturalist helps refine identification and contributes to an ever-growing citizen science dataset. Furthermore, observations on iNaturalist are validated by community experts based on the photographs and location information provided, which limits the possibility of misidentifications (Echeverria et al., 2021). Our iNaturalist project can be viewed and joined at www.inaturalist.org/projects/st-george-rainway in a web browser. On the iNaturalist app, our project can be viewed and joined by clicking More > Projects and searching for "St George Rainway."

We therefore propose that the classroom workshop contribute to this iNaturalist project. The use of tablets provided by either Mount Pleasant Elementary School or the City of Vancouver with iNaturalist can help students and educators identify species. The students will build on this dataset by adding data specifically along the route of the St George Rainway, which is currently less represented than surrounding areas (Figure 9). This dataset collected with the students and by other citizen scientists will serve as baseline data on biodiversity prior to the installation of the St George Rainway and can be compared with the dataset collected in future to assess the success of the Rainway in achieving its biodiversity goals.
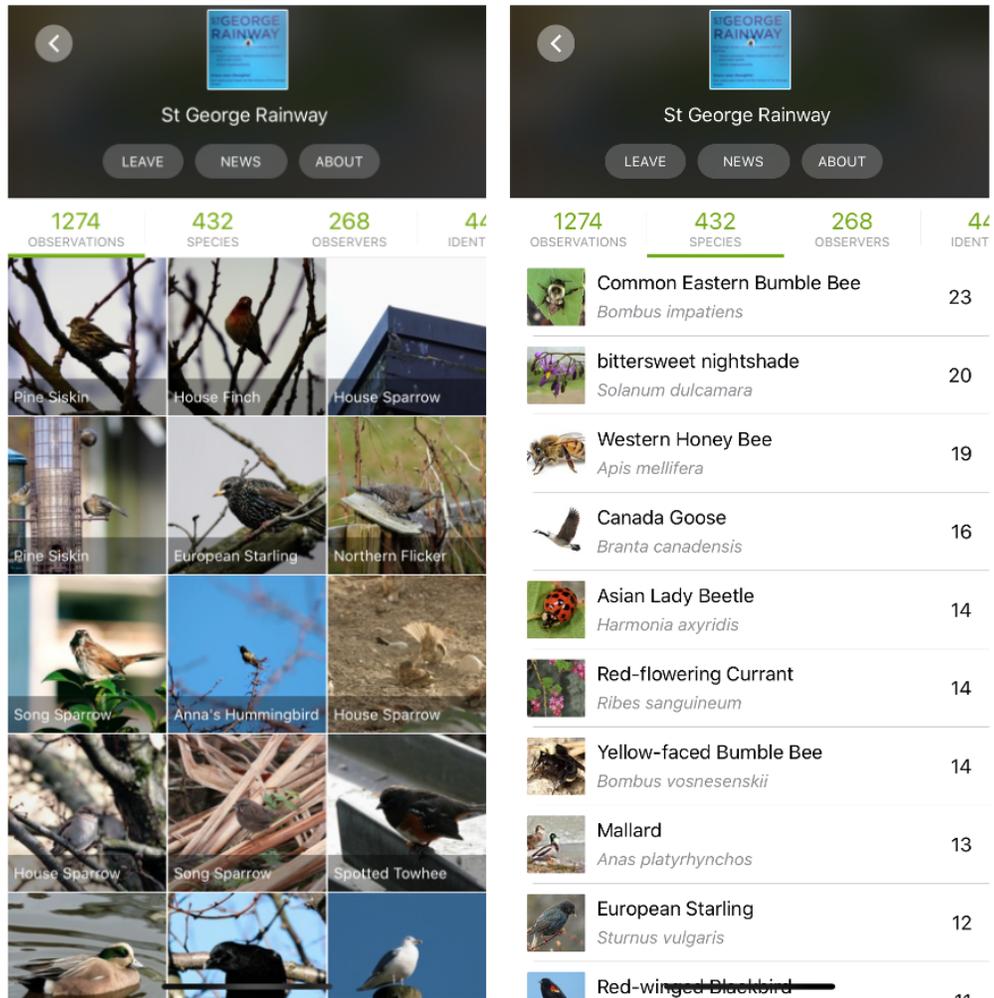
Figure 7. Screenshots of the St George Rainway iNaturalist project on the iOS version of iNaturalist showing the most recent observations (left) and the most commonly observed species (right).

Figure 8. Screenshot of the St George Rainway iNaturalist project on the desktop version of iNaturalist, showing recent observations. This project can be explored in detail at https://www.inaturalist.org/projects/st-george-rainway
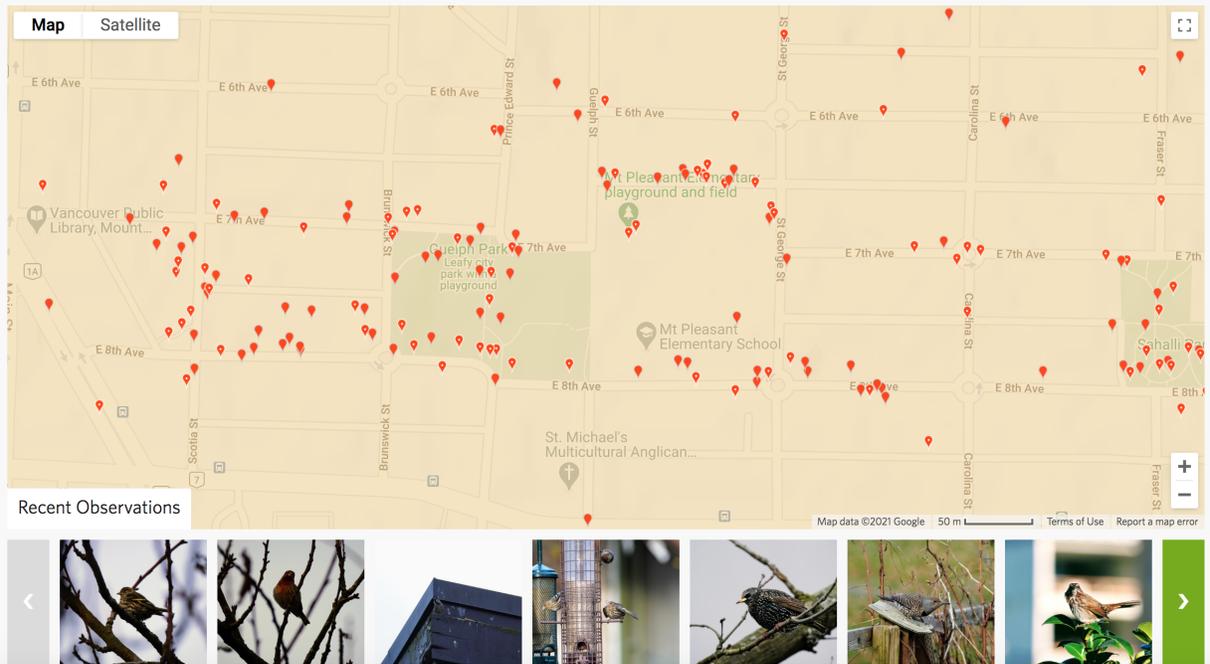
Figure 9. Screenshot of the Map of Observations for the St George Rainway iNaturalist project on the desktop version of iNaturalist. Note that while there are many observations in the area, observations along St George Street itself are lacking.

If the COVID-19 regulations at the time of implementation of this workshop prevent guests from entering school property and participating in the outdoor component of the workshop, the initial Zoom lesson can be adapted to be more informative about the species that the students are likely to encounter. The classroom teacher will also be provided with additional resources such as a field guide to use when outside.

The classroom teacher will also be encouraged to incorporate this project into regular lesson plans (*sensu* Saunders et al., 2018). This could involve having students do science reports on one native species that they identified or that they hope to see return to the area after the installation of the St George Rainway. This could also involve art projects, such as having students paint their chosen species or their vision for the St George Rainway. While this will not be directly related to the Rainway and can be done at the teacher's discretion, it would further the students' learning outcomes related to the project and help keep the project front of mind in the community.

Prior to this workshop, literature will be sent home with students to give their parents an overview of the St George Rainway project and how their children will be contributing to it. This literature should emphasize that children will be actively involved in citizen science and propose that parents can also participate by downloading the iNaturalist app and collecting data. This literature would contain similar information as is provided to teachers in our lesson

plan (Appendix 1). If the children enjoy data collection during school time, they will likely want to continue exploring local biodiversity with their parents outside of school hours. Encouraging family participation outside of school will increase the amount of preliminary data collected. This will be particularly useful because it expands the area surveyed by citizen science to well beyond the school property and into other areas neighbouring the proposed St George Rainway.

Phase 2. Rainway installation

When the St George Rainway is being physically installed, there will be disruption to the area and it will not be ideal timing to collect biodiversity data. Students will therefore be involved in a different way.

First, the students will have a similar classroom-based lesson to Phase 1. This will occur once during the school year in which the Rainway is installed. The lesson can be conducted over Zoom or a similar platform or in person, depending on the regulations at this time. Students will learn from the ecologist and Coast Salish representative about the specific plants that have been chosen to be planted in the St George Rainway and why these plants will be beneficial to this area.

Children will then go outside to plant. So as not to affect the integrity of the Rainway itself, children can plant the same species that will be in the Rainway, but in contained planter boxes on school property and in small pots. They can raise individual plants in their own pots during the school year and ultimately take the plants home to plant in their gardens or grow on their balconies. This will expand the habitat of the Rainway onto school grounds and private homes. Having children actively involved in planting adjacent to the St George Rainway will foster a sense of pride and ownership over the project, which should contribute to a positive community outlook for the project.

After planting is completed, there will be a show-and-tell event when parents and guests will be led by students on a walk of the new St George Rainway. Students can show their families their planter boxes and the Rainway itself and explain why these species were planted. Depending on COVID-19 restrictions at this time, this event can be held at one time with all guests or staggered over several hours with a small number of guests at each time. If restrictions make it impossible for such an event to be hosted by Mount Pleasant Elementary School, then literature can go home with students encouraging parents to privately tour the St George Rainway with their children on their own time. This event could optionally be repeated in subsequent years after the installation of the Rainway. Although the students in subsequent years will not have done planting that they can show to guests, they can tour the guests around the Rainway and tell them what they learned about GRI and biodiversity in their workshop.

Phase 3. Long-term monitoring

After the St George Rainway is established, ongoing community engagement will be fostered by long-term monitoring involving students. Phase 3 will largely parallel Phase 1 with the initial classroom-based lesson followed by active collection of ecological data on the school grounds and submission of species sightings to the St George Rainway iNaturalist project. This dataset can be compared to the initial data collected in Phase 1. This data can be analyzed over time to determine if and how biodiversity has been affected by the St George Rainway. Because long-term monitoring of the St George Rainway is crucial to determine if the project has met its goals under the Rain City Strategy, Phase 3 can effectively extend indefinitely, engaging students in learning about local biodiversity and collecting data for years to come.

Success metrics for Component 1

In order to measure the success of our workshops for Mount Pleasant Elementary School, we recommend low-stakes exercises that allow students to demonstrate their learning. In our lesson plan outline (Appendix 1), we suggest some questions that the children could be asked before and after the workshop. The expectation is that before the workshop, students will not be knowledgeable about local biodiversity or GRI and that by the time they have finished the workshop, they will have detailed and robust answers to the same questions. The difference in the quality and detail of the answers should demonstrate how well the children understood the workshop.

Another recommendation is to have the classroom teacher facilitate a trivia game such as classroom *Jeopardy!* Classroom *Jeopardy!* would be fun and engaging for the children and could include similar questions to a formal quiz without adding the stress of worrying about grades. Instead of grades, the students could receive small prizes. For example, the winning team could be given small native plants to take home and plant. The opportunity to win prizes should motivate the children to participate. Furthermore, planting their prize plant at home will help increase the local vegetation surrounding the Rainway. How the children answer these questions and how many questions are answered correctly could provide both qualitative and quantitative data on the success of the workshop.

Component 2. Outreach and Engagement for Other Demographics

Because not all community members in the St George Rainway area have a connection to Mount Pleasant Elementary School, we propose a second engagement component that will reach other demographics.

Phase 1. Pre-Rainway installation

To engage a range of different demographics in the pre-installation phase, we have decided on a variety of approaches that we believe will engage the general public. It is important for the overall success of this GRI project that stakeholders are involved and feel connected to the proposed project (Alves et al. 2017; Donaldson and João 2020).

We first propose a suite of social media posts to reach a large audience with a range of demographics. Instagram, Facebook, and Twitter are the three main platforms that we suggest the City of Vancouver uses to promote the St George Rainway. To provide an idea of what the social media posts may look like, we have mocked up potential posts for Instagram, Facebook, and Twitter (Figures 10 – 12). We have endeavoured to make the content specific to each social media platform based on the most likely audience on each platform. For Instagram, we have focussed on aesthetic and social values with simpler images and little text that can be fully appreciated on a smartphone screen (Figure 10). For Facebook, we have chosen images with more detail and have linked to City resources for users to find more information (Figure 11). We anticipate that many users will use the desktop version of Facebook and will be able to view and understand greater complexity and easily visit external links. For Twitter, we have chosen posts such as infographics and promotion of the iNaturalist project as we felt these would align well with the type of content often shared in Twitter's substantial scientific community (Figure 12).

In Phase 1, we recommend posting background information on the St George Rainway; this could include historical context as well as current information. We propose that these posts also provide general information on what the proposed project will entail and the overall goals of this project to give the public an idea of what to expect from the St George Rainway. These posts will also encourage local community members to join the St George Rainway iNaturalist project to expand the reach of the project beyond the school grounds. This can tie into data monitoring plans and help the City of Vancouver to collect baseline data for the St George Rainway GRI project.

Figure 10. Mock-up Instagram posts the City of Vancouver can use to promote the St George Rainway prior to installation. Left image was taken from St George Rainway City of Vancouver website. Right photo by Laurie Solkoski.
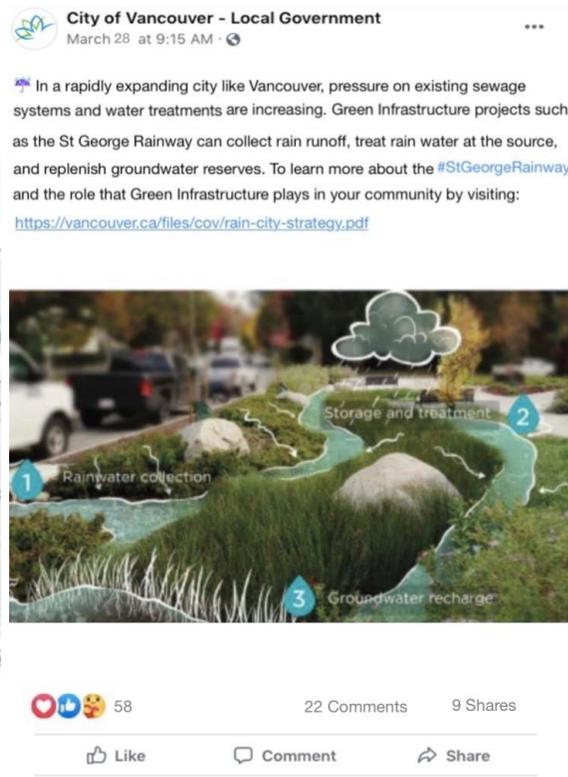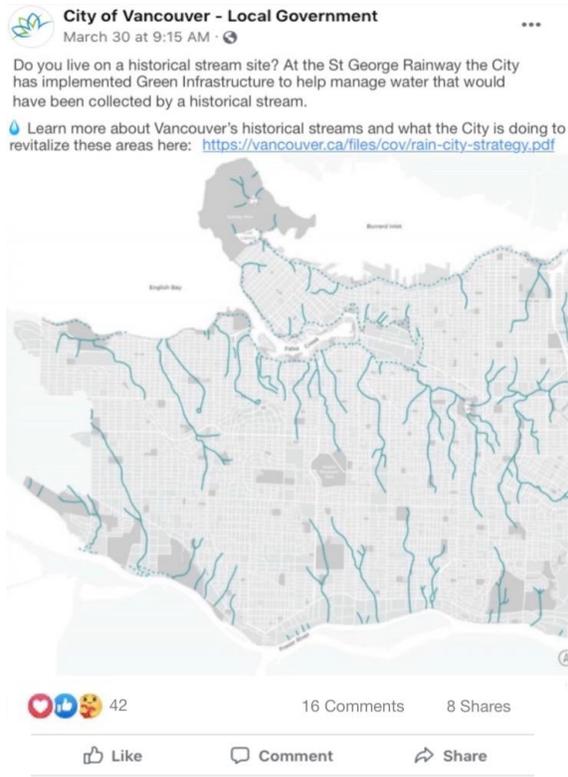
Figure 11. Sample Facebook posts that the City of Vancouver can use to promote the St George Rainway prior to installation. Images were taken from the City of Vancouver Rain City Strategy (City of Vancouver, 2019).

Figure 12. Sample Twitter posts that the City of Vancouver can use to promote the St George Rainway prior to installation. Left image from the City of Vancouver Rain City Strategy (City of Vancouver, 2021). Right photo of Red Flowering Currant by Jesse Kemp.

We propose encouraging local community members to take part in data collection through joining the St George Rainway iNaturalist project (Figures 7 – 9). To recruit more citizen scientists from the community, we suggest advertising the iNaturalist project in our social media plan, such as in Figure 12. Education about the citizen science initiatives could also be in the form of information on temporary signage along the St George Rainway or a deliverable given to residents of the area that encourages and teaches them how to use the app. Broader community participation in the iNaturalist project will increase data collection and usable observational data beyond the restrictions of working with the school children during school hours and on school property.

We propose that the City of Vancouver forms a working connection with the St George Rainway Project community initiative. We recommend this because the St George Rainway Project has already been involved in community outreach and engagement and we believe aligning goals with this group will greatly increase the success of the St George Rainway. This connection would involve some preliminary education on why the city will not be daylighting the stream so that all parties have a shared understanding of the scope of the project. Since daylighting the stream is a main goal of the St George Rainway Project community initiative, we suggest sharing with them detailed information on the co-benefits of this proposed project and other possible ways in which they can support local populations of salmon and other fishes. Connecting with this group will allow the City of Vancouver to engage more people since the St George Rainway Project community initiative is already established in the community.

Phase 2. Rainway installation

By this stage of the project, the community will be educated on the proposed GRI project and construction will begin. While it may be difficult to directly involve the community in the construction process, we propose ways in which the community can contribute to the project and ways in which the project itself can engage the community.

During Phase 2 we suggest that the City of Vancouver encourages local homeowners to make their gardens and lawns more rainwater- and biodiversity-friendly. This would involve educating and encouraging local homeowners to incorporate native plants into their properties and to use rain barrels on their own properties. This would help the community to become a part of the St George Rainway in that their own properties expand the benefits of the GRI onto private land. This will increase biodiversity in the local area and help maintain the native plants being used in the green infrastructure (Hostetler et al. 2011). We suggest providing local homeowners with packs of native seeds that they can plant in their gardens as this will make it fun and easy for them to be a part of the St George Rainway. These seed packets will be accompanied by a business card-sized document that provides homeowners with a brief explanation of the St George Rainway and how planting on their own property can help it achieve its biodiversity goals (Figure 13).

Wait, what is a rain garden?

A rain garden uses plants to manage rainwater in a natural way. Rainwater is collected in rain gardens when it rains. Rain gardens reduce flooding, increase water quality, and contribute to biodiversity. To top it all off, they also look great!

Rain gardens will be a part of the upcoming St George Street Rainway. In the meantime, you can help make the neighbourhood a more biodiverse place by planting these seeds in your garden!

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Questions? Contact raincity@vancouver.ca

Figure 13: Mock-up business card-sized educational material to be sent out to homeowners with seed packets

We also recommend specifically targeting strata managers of the apartment buildings in the area and encouraging the strata to plant native plants and install rain barrels on communal property. This would further extend the reach of the Rainway and provide a connection to the Rainway for apartment-dwellers who do not have yards of their own in which to plant. Seed packets or small plants of the same species being installed in the Rainway itself could be provided to strata managers in order to facilitate the planting on strata property at lower cost. To increase incentive for strata managers, the City could look into recommending that strata managers apply for subsidies or small grants such as the already extant Greenest City Neighbourhood Small Grants.

After the Rainway is created, our plans for our two demographics will have an opportunity to come together. By this point, students from Mount Pleasant Elementary School will have a deeper understanding of GRI and it is important to encourage these students to share their learned information with their friends and families. This sharing of knowledge from children to their family has been shown to be an effective way of educating a community (Vaughan et al. 2003). Students from the local elementary school will also be encouraged to take their families to the St George Rainway once its construction is finished. Again, this will promote the Rainway, increase its usage by the community, and further educate the public about the co-benefits of the completed project.

We also suggest the installation of both temporary and permanent engaging signage along the St George Rainway. The temporary signage will go up during Phase 2 to educate and build excitement for the GRI project. Our group has created a mock up of temporary signage to help showcase our vision (Figure 14). This signage contains a QR code that links to the Rain City Strategy and lists our proposed social media hashtag so that interested citizens can learn more about the project. The permanent signage would be put into place during Phase 2 as it is aimed at long-term engagement and therefore will be discussed further in the following section.

Figure 14. Mock-up for temporary signage that could be placed along St George Street during installation of the Rainway. The main goal of this signage is to make people aware of the project and build the community's knowledge on the co-benefits of the GRI project.

Phase 3. Monitoring and continued engagement

Once the project is completed, it is important to continue engaging with the local stakeholders (Hostetler et al. 2011). The City of Vancouver would also like to monitor and collect data on the impacts of the GRI, which can be facilitated by community involvement in citizen science.

Based on the public engagement survey results, we propose including permanent educational signage along the St George Rainway to add a historical and educational perspective (City of Vancouver, 2021). We recommend that the signage along the Rainway highlights the historical stream and what its significance was and would have been to the local Coast Salish peoples. This would also be an opportunity to educate the public on the numerous other underground streams that are across Vancouver. The signage would also have information on the native plants incorporated into the GRI and how they help increase biodiversity and collect stormwater runoff. Our group has also created mock ups for the permanent signage (Figures 15-17).

To encourage use of the Rainway by people outside of the immediate St George community, we propose another round of social media posts. These posts could be similar in spirit to the draft social media posts we developed for Phase 1 (Figures 10 – 12). We have not developed drafts of Phase 3 social media posts because we recommend sharing photos and information about the completed St George Rainway, which is not available at this time. These posts should highlight the co-benefits produced by St George Rainway GRI and to promote community usage (assuming COVID-19 restrictions are lifted by the time the St George Rainway is complete). Promoting a broader community to use the St George Rainway will educate a large range of people and potentially help the general public to be more supportive of future GRI projects in the city. We also suggest that the City further promote continued community engagement in citizen science data collection for the St George Rainway iNaturalist project in social media posts. These posts could mirror the draft Twitter post promoting the project we recommended for Phase 1 (Figure 12) and expand the diversity of species shared, highlighting native plants when they are in bloom and migratory species when they return to the area.

Figure 15. Proposed permanent signage that will be along the St George Rainway. This signage provides general information on the Rainway.

Figure 16. Proposed permanent signage that will be along the St George Rainway. This signage provides a sample of the native biodiversity that could be observed on or around the Rainway.
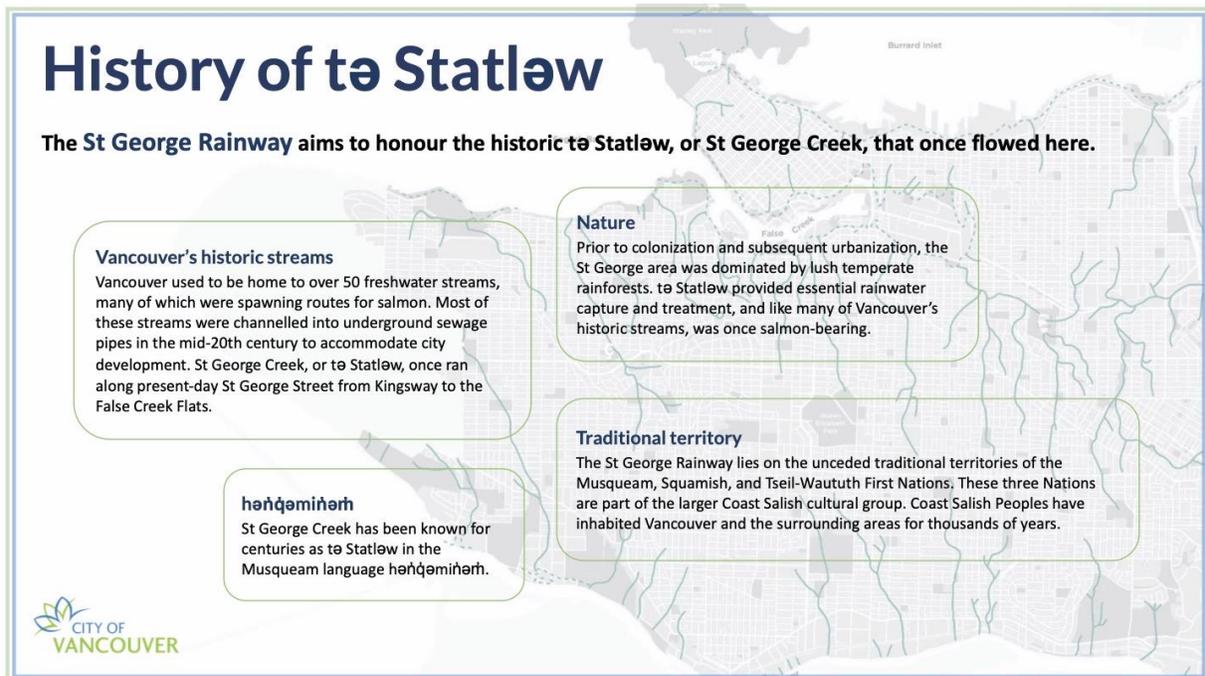
History of tə Statləw

The **St George Rainway** aims to honour the historic tə Statləw, or St George Creek, that once flowed here.

Vancouver's historic streams
Vancouver used to be home to over 50 freshwater streams, many of which were spawning routes for salmon. Most of these streams were channelled into underground sewage pipes in the mid-20th century to accommodate city development. St George Creek, or tə Statləw, once ran along present-day St George Street from Kingsway to the False Creek Flats.

həṅḋəmiṅəṁ
St George Creek has been known for centuries as tə Statləw in the Musqueam language həṅḋəmiṅəṁ.

Nature
Prior to colonization and subsequent urbanization, the St George area was dominated by lush temperate rainforests. tə Statləw provided essential rainwater capture and treatment, and like many of Vancouver's historic streams, was once salmon-bearing.

Traditional territory
The St George Rainway lies on the unceded traditional territories of the Musqueam, Squamish, and Tseil-Waututh First Nations. These three Nations are part of the larger Coast Salish cultural group. Coast Salish Peoples have inhabited Vancouver and the surrounding areas for thousands of years.

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Figure 17. Proposed permanent signage that will be along the St George Rainway. This signage aims to educate on the history of tə Statləw.

Success metrics for Component 2

Many of the platforms we have recommended have in-built abilities to track public engagement. For example, when monitoring the St George Rainway iNaturalist project, an increase in the frequency of posts and in the number of users who have joined the project would demonstrate that the public has become involved with the project. This would suggest that the public were interested in the project after hearing about it through the children who went through the workshop at Mount Pleasant Elementary School or through our social media posts.

On social media platforms such as Facebook and Instagram, there are in-built analytics that can be used to track success. For example, Instagram tracks analytics such as how people interact with specific posts or how many people have clicked on website links (Instagram, 2021), as do most other social media platforms. Hashtags can also be utilized across social media platforms as a way to assess how people are interacting with the St George Rainway itself. Our group suggests a unique hashtag such as #StGeorgeRainway to ensure that content using these hashtags are specifically related to the St George Rainway in order to facilitate data collection on success metrics. Monitoring the frequency of use of this hashtag and the types of posts the public is sharing with the hashtag will provide both quantitative and qualitative data about the community's interest in the project.

Limitations

First and foremost, it is important to note that the community members in the area surrounding the future St George Rainway already have diverse and contradictory opinions about the proposed Rainway (City of Vancouver, 2021). Because of this, we must acknowledge that although we have made great effort to educate and engage as many demographics as possible, there will always remain a small number of citizens who are not in favour of this project.

Another fundamental limitation is that all the resources we have proposed are in the English language. Some platforms we have recommended have translation abilities: Facebook for example can translate posts in situ. However, many of our resources will not be accessible to citizens who have little or no fluency in English. We discuss a potential remedy for this in the Next Steps section below.

A major component of our proposal aims to engage local students, which is reliant on the principal and teachers of Mount Pleasant Elementary School being willing to participate in the workshop and incorporate new information and activities into their grade 4 – 7 curricula. The inclusion of an ecologist and Coast Salish representative in the classroom will require coordination with multiple additional parties on top of the educators from Mount Pleasant Elementary School. While scheduling may be difficult, our team strongly feels that in-person interactions between educators and students will foster the most long-term engagement and education for the students and is most likely to lead to successful knowledge transfer from students to the broader community.

We acknowledge that the most robust and interactive parts of our proposal rely on technology: the iNaturalist project and posts on Instagram, Facebook, and Twitter. Participation in the iNaturalist project outside of the classroom and with our social media posts does require personal access to a smartphone, tablet, or computer as well as a connection to the internet or cellular data. It is possible that there are community members who do not have access to or are not knowledgeable of how to use such a device. Our analogue signage and seed packets are designed to reach this demographic, but we must recognize that the most interactive parts of our plan will not be accessible for community members who are unable to use a smartphone, tablet, or computer. However, because of the general approachability and potential for large-scale engagement that these platforms provide, we feel that this level of technology use will be worthwhile for community engagement overall.

It is also worth noting that the potential exists for misidentification of plants and wildlife when using iNaturalist. Because photos and geographic coordinates are supplied with each observation, experts in the iNaturalist community can verify the observations for accuracy (Echeverria et al., 2021); this means that any misidentifications are highly likely to be corrected and should not hinder the quality of the dataset for the St George Rainway iNaturalist project. However, because expert validation is not immediate, there could be potential misidentifications

during the proposed school workshop. We do not feel that the small potential for misidentification will hinder the success of the workshop because even if every species is not correctly identified in the moment, students will still be exploring and learning about biodiversity in their neighbourhood.

Next Steps

Our hope for this proposal is that it generates robust community support for the St George Rainway and that it can also serve as a pilot project to model citizen engagement with future GRI initiatives. In order to ensure the long-term success of this goal, we have several recommendations for next steps the City could take to expand the scope of this engagement proposal.

As a solution for any existing language barriers that prevent community engagement, resources could be translated into languages other than English. Temporary and permanent signage for example could be displayed in multiple languages. If it is cost- or space-prohibitive to include multiple versions of each sign, a QR code that links to a digital version of the translated signs could be added to each sign so that community members will all be able to understand the content.

Should our classroom workshops for students in grades 4 – 7 be successful, we suggest that these workshops be adapted for the younger grades. The workshops would of course have to be modified to be appropriate for younger children. We feel that because this workshop takes place largely outside and involves locating and discussing unique and interesting organisms, it would excite young children's natural curiosity and should therefore be appropriate for younger children if approached correctly.

Should our proposal be successful in engaging the community at large, we believe that it could serve as a template for community engagement with similar GRI projects in Vancouver in the future. We recognize that inviting an ecologist and a Coast Salish representative requires rigorous scheduling and potential financial constraints, which could be prohibitive for any upscaling of the classroom workshop. We therefore recommend that to expand the scope of this type of school workshop, a recorded video lesson could take the place of the in-person classroom lesson with the ecologist and Coast Salish representative. This video lesson could be more generalized about the ecology of the region so that it would be appropriate to play at schools in different areas prior to a teacher-led iNaturalist outing. Should our social media campaign be successfully embraced by the online community, we recommend that the City of Vancouver adopt a unique hashtag to use for all future GRI projects and employ a similar series of cross-platform posts to educate and engage the public.

Following the Rainway installation, St George Street could be a possible host for community events like World Water Day, Earth Day, or World Health Day. Events such as these would add

to the Rainway's place-making potential by attracting citizens from outside the area, instilling pride in residents for their community, and increasing the overall appeal of the St George area. It would showcase the completed Rainway project and provide an opportunity to further engage and educate people on the co-benefits of GRI in general.

Acknowledgements

References

Alves, A., Gómez, J.P., Vojinovic, Z., Sánchez, A. & Weesakul, S. (2017). Combining co-benefits and stakeholders perceptions into green infrastructure selection for flood risk reduction. *Environments, 5*(2), 29. https://doi.org/10.3390/environments5020029.

American Geophysical Union [AGU]. (2020). How to use Instagram for science communication. Retrieved March 18, 2021, from https://www.agu.org/Share-and-Advocate/Share/Social-multimedia/Howto-use-instagram

Battrawi, B., & Muhtaseb, R. (2013, March). *The Use of Social Networks as a Tool to Increase Interest in Science and Science Literacy: A Case Study of "Creative Minds" Facebook Page*. The Second Edition of the International Conference New Perspectives in Science Education, Florence, Italy.

Bonney, R., Phillips, T.B., Ballard, H.L. & Enck, J.W. (2016). Can citizen science enhance public understanding of science? *Public Understanding of Science, 25*(1), 2-16. https://doi.org/10.1177/0963662515607406

Boothby, C., Murray, D., Waggy, A. P., Tsou, A., & Sugimoto, C. (2020). Credibility of Scientific Information on Social Media: Variation by Platform and Presence of Formal Credibility Cues. *SocArXiv.* https://doi.org/10.31235/osf.io/4dhcz

City of Vancouver. (n.d.). *St George Rainway.* Shape Your City. Retrieved February 9, 2021, from https://shapeyourcity.ca/st-george-rainway

City of Vancouver. (2019). *Rain City Strategy: A green rainwater infrastructure and rainwater management initiative.* Retrieved from: https://vancouver.ca/files/cov/rain-city-strategy.pdf

City of Vancouver. (2021). *St George Rainway phase 1 engagement – Vision and values analysis, draft 1.*

Dickinson, J.L., Shirk, J., Bonter, D., Bonney, R., Crain, R.L., Martin, J., Phillips, T., & Purcell, K. (2012). The current state of citizen science as a tool for ecological research and public engagement. *Frontiers in Ecology and the Environment, 10*(6), 291–297. https://doi.org/10.1890/110236

Donaldson, G.H., & João, E.M. (2020). Using green infrastructure to add value and assist place-making in public realm developments. *Impact Assessment and Project Appraisal*, *38*(6), 464–478. https://doi.org/10.1080/14615517.2019.1648731

Echeverria, A., Ariz, I., Moreno, J., Peralta, J., & Gonzalez, E.M. (2021). Learning plant biodiversity in nature: The use of the citizen–science platform iNaturalist as a collaborative tool in secondary education. *Sustainability, 13*, 735. https://doi.org/10.3390/su13020735

Filazzola, A., Shrestha, N., & MacIvor, J. S. (2019). The contribution of constructed green infrastructure to urban biodiversity: A synthesis and meta-analysis. *Journal of Applied Ecology, 56*, 2131–2143. https://doi.org/10.1111/1365-2664.13475

Finka, M., Ondrejička, V., Jamečný, Ľ., & Husár, M. (2017). Public participation procedure in integrated transport and green infrastructure planning. *IOP Conference Series: Materials Science and Engineering, 245,* 052054. https://doi.org/10.1088/1757-899X/245/5/052054

Hostetler, M., Allen, W., & Meurk, C. (2011). Conserving urban biodiversity? Creating green infrastructure is only the first step. *Landscape and Urban Planning 100*, 369–371. https://doi.org/10.1016/j.landurbplan.2011.01.011

Huber, B., Barnidge, M., de Zúñiga, H.G., & Liu, J. (2019). Fostering public trust in science: The role of social media. *Public Understanding of Science*, *28*(7), 759–777. https://doi.org/10.1177/0963662519869097

Instagram. (2021). *About Instagram Analytics.* Retrieved 28 March 2021, from https://www.facebook.com/help/instagram/788388387972460

Kimmerer, R.W. (2002). Weaving traditional ecological knowledge into biological education: A call to action. *BioScience, 52*(5), 432–438. https://doi.org/10.1641/0006-3568(2002)052[0432:WTEKIB]2.0.CO;2

Kimmerer, R.W. (2012). Searching for synergy: integrating traditional and scientific ecological knowledge in environmental science education. *Journal of Environmental Studies and Sciences, 2,* 317–323. https://doi.org/10.1007/s13412-012-0091-y

Kobori, H., Dickinson, J.L., Washitani, I., Sakurai, R., Amano, T., Komatsu, N., Kitamura, W., Takagawa, S., Koyama, K., Ogawara, T., & Miller-Rushing, A.J. (2016). Citizen science: a new approach to advance ecology, education, and conservation. *Ecological Research, 31,* 1–19. https://doi.org/10.1007/s11284-015-1314-y

Martin, V.Y. (2017). Citizen science as a means for increasing public engagement in science: Presumption or possibility? *Science Communications, 39*(2), 142-168. https://doi.org/10.1177/1075547017696165

Pavelle, S., & Wilkinson, C. (2020). Into the Digital Wild: Utilizing Twitter, Instagram, You Tube, and Facebook for Effective Science and Environmental Communication. *Frontiers in Communication, 5,* 575122. https://doi.org/10.3389/fcomm.2020.575122

Province of British Columbia (2019). Science K-10 – Curricular Competencies https://curriculum.gov.bc.ca/sites/curriculum.gov.bc.ca/files/curriculum/continuous-views/en_science_k-10_curricular-competencies.pdf

Purvis, A., & Hector, A. (2000). Getting the measure of biodiversity. *Nature, 405*, 212–219. https://doi.org/10.1038/35012221

Saunders, M.E., Roger, E., Geary, W.L., Meredith, F., Welbourne, D.J., Bako, A., Canavan, E., Herro, F., Herron, C., Hung, O., Kunstler, M., Lin, J., Ludlow, N., Paton, M., Salt, S., Simpson, T., Wang, A., Zimmerman, N., Drews, K.B., Dawson, H.F., Martin, L.W.J., Sutton, J.B., Webber, C.C., Ritchie, A.L., Berns, L.D., Winch, B.A., Reeves, H.R., McLennan, E.C., Gardner, J.M., Butler, C.G., Sutton, E.I., Couttie, M.M., Hildebrand, J.B., Blackney, I.A., Forsyth, J.A., Keating, D.M., & Moles, A.T. (2018). Citizen science in schools: Engaging students in research on urban habitat for pollinators. *Austral Ecology, 43*, 635–642. https://doi.org/10.1111/aec.12608

Swift, J. E., Lovett, B., Koltermann, C. E., Beck, C. L., & Kasson, M. T. (2020). From hashtag to high school: How viral tweets are inspiring young scientists to embrace STEM. *Journal of Microbiology & Biology Education*, *21*(3). https://doi.org/10.1128/jmbe.v21i3.2133

Tayouga, S.J., & Gagné, S.A. (2016). The socio-ecological factors that influence the adoption of green infrastructure. *Sustainability, 8*, 1277, https://doi.org/10.3390/su8121277

Venkataramanan, V., Packman, A.I., Peters, D.R., Lopez, D., McCuskey, D.J., McDonald, R.I., Miller, W.M., & Young, S.L. (2019). A systematic review of the human health and social well-being outcomes of green infrastructure for stormwater and flood management. *Journal of Environmental Management*, *246*, 868–880. https://doi.org/10.1016/j.jenvman.2019.05.028

Vaughan, C., Gack, J., Solorazano, H., & Ray, R. (2003). The effect of environmental education on schoolchildren, their parents, and community members: A study of intergenerational and intercommunity learning. *Journal of Environmental Education*, *34*(3), 12–21. https://doi.org/10.1080/00958960309603489

Worthington, J.P., Silvertown, J., Cook, L., Cameron, R., Doss, M., Greenwood, R.M., McConway, K., & Skelton, P. (2012). Evolution MegaLab: A case study in citizen science methods. *Methods in Ecology and Evolution, 3*, 303–309. https://doi.org/10.1111/j.2041-210X.2011.00164.x

Appendix 1. Lesson Plan for Teachers for School Workshop

St George Rainway Educational Green Rainwater Infrastructure Workshop

What is Green Rainwater Infrastructure (GRI)?

Green Rainwater Infrastructure is a natural and sustainable alternative to traditional grey infrastructure. It manages rainwater by increasing vegetative area and allowing more water to be taken up by plants. This decreases flooding, increases water quality, and helps to restore the natural water cycle. The St George Rainway GRI project provides additional benefits to the area such as more suitable habitat for species previously driven out of the area by urbanization.

Why this workshop?

It is our goal through this workshop to introduce students in grades 4-7 to their surrounding natural environment, and give them a sense of involvement in a project that is happening close to home. Students will participate in hands-on learning experiences such as data collection and raising plants in the classroom. By doing this, we aim to raise a new generation of environmental champions in the Mount Pleasant community.

How does it fit in the curriculum?

The workshop fits into a number of Curricular Competencies as outlined on the Government of British Columbia's website for grades 4 – 7 science classes. Outlined below are examples of the specific Curricular Competencies that the workshop fits into by grade level as they are stated in the BC curriculum.

 For more info, visit this link: https://curriculum.gov.bc.ca/curriculum

BC's Curricular Competency - Grade 4: Science
- · Demonstrate curiosity about the natural world
- · Observe objects and events in familiar contexts
- · Make observations about living and nonliving things in the local environment
- · Collect simple data
- · Experience and interpret the local environment
- · Identify First Peoples perspectives and knowledge as sources of information
- · Identify some simple environmental implications of their and others' actions
- · Contribute to care for self, others, school, and neighbourhood through individual or collaborative approaches
- · Transfer and apply learning to new situations

BC's Curricular Competency – Grade 5: Science
- · Make observations in familiar or unfamiliar contexts
- · Experience and interpret the local environment
- · Identify First Peoples perspectives and knowledge as sources of information
- · Identify some of the social, ethical, and environmental implications of the findings from their own and others' investigations
- · Contribute to care for self, others, and community through personal or collaborative approaches
- · Transfer and apply learning to new situations

BC's Curricular Competency – Grade 6: Science
- · Make observations in familiar or unfamiliar contexts
- · Experience and interpret the local environment
- · Identify First Peoples perspectives and knowledge as sources of information
- · Identify patterns and connections in data
- · Identify some of the social, ethical, and environmental implications of the findings from their own and others' investigations
- · Contribute to care for self, others, and community through personal or collaborative approaches
- · Transfer and apply learning to new situations

BC's Curricular Competency – Grade 7: Science
- · Make observations aimed at identifying their own questions about the natural world
- · Experience and interpret the local environment
- · Apply First Peoples perspectives and knowledge, other ways of knowing, and local knowledge as sources of information
- · Seek patterns and connections in data from their own investigations and secondary sources
- · Demonstrate an understanding and appreciation of evidence (qualitative and quantitative)
- · Consider social, ethical, and environmental implications of the findings from their own and others' investigations
- · Contribute to care for self, others, community, and world through personal or collaborative approaches
- · Transfer and apply learning to new situations

LESSON PLAN

To begin the workshop, students will be asked 3 questions about the St George Rainway. It is expected that they will not know much or anything at all – that is okay. This is so we can measure learning before and after the workshop.

Questions:

1. What is biodiversity?

2. What is a raingarden? How does it work?

3. What are some of the local animals and birds that you know? List as many as you can.

Guest Speaker Presentation:

The workshop will begin with a classroom-based lesson from an ecologist and Coast Salish representative so that the children obtain a broad education from both the perspectives of western science and traditional ecological knowledge (TEK). They will teach the students background information on the ecology and history of the area and the goals of the St George Rainway. They will also give information on identifying native species so that students and teachers can learn this before going out in the field. The guest speakers will come prepared with their own presentation. It is suggested that classroom teachers encourage students to start thinking of any questions they may have about the local environment beforehand.

While Greenbricks is not specifically focused on ecology, this non-for-profit focuses on sustainable development education in schoolchildren and could be a potential partner.
For more information visit their website: https://greenbricks.ca/about/
There is also a more general resource put out by the City of Vancouver that suggests resources for environmental science to be brought into the classroom:
https://vancouver.ca/people-programs/tools-for-teachers.aspx

Outside Data Collection:

In the afternoon after the workshop, the ecologist and Coast Salish representative will go outside and collect biodiversity data using the app iNaturalist.

Here is a link explaining how to get set up using iNaturalist:
https://www.inaturalist.org/pages/getting+started

Here is a link showing how to add observations in iNaturalist:
https://www.inaturalist.org/pages/video+tutorials

Here is a link for teachers using iNaturalist in the classroom:
https://www.inaturalist.org/pages/teacher's+guide

Raising native plants:

The City of Vancouver will provide classroom teachers with native seeds that will also be planted in the St George Rainway rain gardens. The students will be tasked with taking care of these plants by watering them and giving them enough sunlight throughout the school year. At the end of the year they can take them home with them.

Rainway show-and-tell:
Near the end of the year, students will take their parents and guardians on a show-and-tell adventure through the St George Rainway. They will explain to their parents what they did throughout the course of the workshop, and teach them some of the things they have learned. They can also show off the planter boxes they planted on school property to explain their own role in the project. Parents and guardians will be given a sheet with a question to answer so that we can measure their learning as well.

Question for parents/guardians:
What are two things your child has taught you about the St George Rainway today?

Optional learning opportunities:
The classroom teacher upon their discretion can assign the students art or science projects sticking with the St George Rainway theme. These projects can include topics such as the pathways of rainwater in the city, and native plants/animals to the Mount Pleasant area.

If the classroom teacher is willing, they could facilitate outside data collection multiple times throughout the school year. This would further the students' workshop learning outcomes by teaching them concepts like how biodiversity can look different with the changing seasons, for example.

After workshop:
Administer the same question set to students as was assigned before the workshop.

1. What is biodiversity?

2. What is a rain garden? How does it work?

3. What are some of the local animals and birds that you know? List as many as you can.

Alternatively, the classroom teacher can administer a game of *Jeopardy!* using questions related to the St George Rainway. Classroom *Jeopardy!* would be fun and engaging for the children and could include similar questions to a formal quiz without adding the stress of worrying about grades. Instead of grades, the students could receive small prizes. For example, the winning team could be given small native plants to take home and plant.