

Exploring the restoration of the Chrystal Creek Watershed through virtual  
media: *A guide to observing and tracking historical, present and future  
ecological changes at the Chrystal Creek Watershed*

Lisa Angstadt (V00880443) and

Kelsey Day (V00901448)

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ES 471- Prof. Eric Higgs

University of Victoria

Abstract:

Virtual media such as 360° tours allow for an inclusive, accessible means of engagement for a broad and far-reaching audience. With the restoration taking place on Galiano Island, a remote location, 360° tours and photography of the Chrystal Creek watershed provide a platform for participation, learning and engagement. Tracking historical, present and future changes from restoration can be difficult to visualize due to the perceived slow speed in which one witnesses a landscape change, however, visual media can help remedy this challenge. For this project, we used repeat photography combined with a multi-photosphere tour to assist in observing change. Repeat photography allows for a visual aid to monitor and track changes that occur on the landscape as a direct result of restoration practices and the innovation and hard work of Galiano Conservancy Association staff and volunteers. Photospheres and 360° tours also allow one to see changes that are occurring on the landscape in an interactive medium. Together, these two methods are exemplary at demonstrating the changes over time in a vast landscape in a relatively easy manner.

Introduction and Background:

Our project focused on restoration work undertaken at the Galiano Conservancy Association's (GCA) Millard Learning Centre (MLC), which is located on Galiano Island British Columbia. The restoration efforts of the Cedars for the Next Century are recovering damage to the Chrystal Creek watershed, entirely located with this 76-hectare property (Galiano Learning Centre Management Committee, 2013). The watershed has seen a century of damage due to historical small-scale agriculture and logging operations (Eco-Action Proposal, n.d.). The restoration of the watershed is now one of many such projects on the property, although none are

so far as ambitious as the whole-watershed initiative. The GCA's goal is to restore the hydrology and ecological integrity of this degraded watershed. This area is subject to compacted soils, introduced agronomic species, impacts from past grazing from cattle, sheep, and significant herbivory by deer (Eco-Action Proposal, n.d.). Despite the end of logging and agricultural activities with the purchase of what is now the Millard Learning Centre in 2012, the need for human intervention to aid the restoration process of this area is recommended as per the goals of the GCA to preserve, protect and enhance the quality of natural environments (Eco-Action Proposal, n.d.).

The restoration of the watershed is an important project for the GCA as they are devoted to stewardship, environmental education, conservation and public awareness as per their mission statement (Galiano Conservancy Association, n.d.). With the MLC being a remote location, challenges can arise with promoting awareness and providing nature-based learning experiences specific to Galiano Island, however, this project can help provide a learning and engaging experience for those who cannot make it to the island. Not only can virtual media help promote environmental education and bring awareness to the MLC's restoration projects, it also provides an engaging way to experience and observe environmental change. Aligning with the GCA's mission of protecting and restoring the integrity and resilience of Galiano's ecosystems for the benefit of this and future generations through ecological awareness (Galiano Conservancy Association, n.d.), virtual 360° tours and repeat photography can aid this goal by providing a means to educate and observe ecological change.

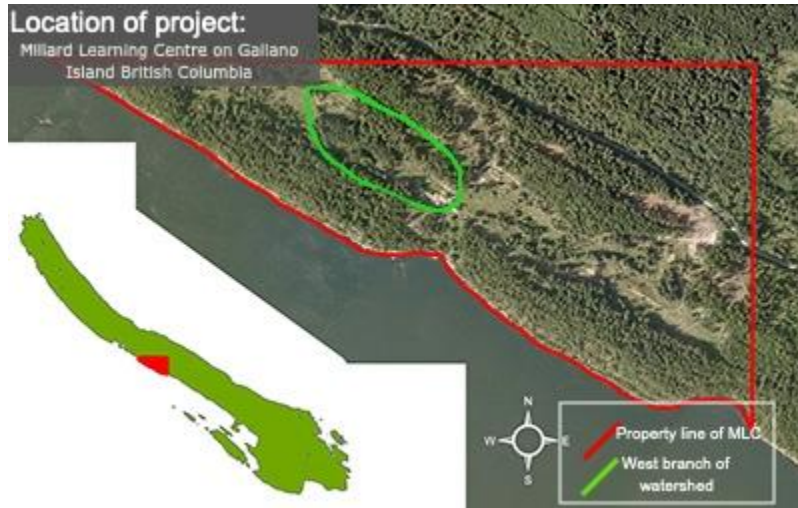
Through the online engagement created by the virtual tour, people from many places can interact with the current projects that are happening at the MLC. This project involves a 360° virtual Kuula tour which uses the smartphone App *Google Street view* to capture 360° panoramic photos that users can interact with and move through, creating a virtual experience of any location. Kuula is the platform used to ‘stitch’ together all photospheres and embed media such as audio, historical facts and species identification that results in an final product of a visual, auditory and educational experience of the Chrystal Creek watershed. This type of media is increasing in popularity with Kuula being used by over 200,000 professionals of various industries (Kuula, n.d.). Very user friendly, virtual tours can provide an interactive experience where users can immerse themselves in an environment without leaving their home. Providing online environment education pertaining to restoration happening at the MLC is helpful for the GCA as it promotes awareness, creates engagement and eases the challenges caused by the remoteness of the property. By providing virtual media in an accessible format, the GCA can introduce many to the innovation, successes and change that is continually happening on Galiano Island. Additionally, the photospheres taken for the tour can act as a form of repeat photography in that future photospheres can be taken to compare ecological change over time.

The second part of this project uses repeat photography which is defined as the comparison of historical and recent landscape photos that are taken from the same camera point (Kull, 2005). This type of media is of value to the GCA and useful for observing outcomes of restoration practices within the Chrystal Creek watershed as repeat collection of the same photographic point will allow for change to be identified and measured (Hammond et al., 2020). Using compass bearings for camera directions and field notes and rebar stakes to allow for relocation of photo locations (figure 1), this method of observing change provides an alternative

to expensive and technologically advanced forms of spatial representation such as airplane and satellite-based remote sensing (Kull, 2005). As the Cedars for the Next Century project moves forward with the restoration goal of restoring ecological integrity to the watershed, repeat photography can capture outcomes that are detailed, small-scale and specific to the site (Turner et al. 2003). This type of media, along with photospheres, can provide the GCA and the wider community with visual material to showcase historical, present and future changes that occur on the property as a result of restoration.

#### Site description:

The Chrystal Creek Watershed is located on Galiano Island in British Columbia, Canada. Galiano Island is long and narrow and situated within the southern Gulf Islands in the Strait of Georgia. Off the coast of Vancouver, the island is located in the traditional territories of the Hul'qumi'num Treaty Group, Stz'uminus, Á,LENENEÇ ŁTE (WSÁNEĆ), Quw'utsun, s̓cəwaθenaʔł təməxʷ (Tsawwassen) and the Coast Salish peoples (Native Land, n.d). The Chrystal Creek Watershed is situated on 28 hectares of land within the MLC and is entirely owned by the GCA (Galiano Learning Centre Management Committee, 2013). Restoration of this site is suggested by the GCA due to historical anthropogenic damage such as drainage ditches, introduced agronomic species, altered topography, compacted soils and grazing impacts from cattle (Eco-Action Proposal, n.d).



*Figure 1: Map showing the location of the Millard Learning Centre and the west branch of the watershed on Galiano Island British Columbia.*

For this project, our goal is to provide a resource in which the GCA, volunteers and/or future students can track, observe and promote restoration activities, achievements and outcomes that occur on-site at the MLC. Furthermore, we wish to provide a virtual experience for those that are not able to be on-site or who wish to check back on the progress of the restoration of the Chrystal Creek watershed.

#### Goals and Objectives:

Goal #1: Promote accessibility to Chrystal Creek Watershed for all demographics and interests by introducing restoration practices through various virtual engaging activities that demonstrate how restoration can be applied elsewhere.

Objective: to develop multiple photospheres to create a 360° tour that helps off-site visitors immerse themselves in an ongoing restoration project.

The shift to an online presence is more prevalent these days, and because of this, people have been getting outside into nature to change the scenery. Access to nature is not always available or an option for some people, so this virtual component is a way to bring nature to people through visuals, sounds, and educational components. This virtual experience also goes hand-in-hand with a monitoring element as over time we will see progress in the Chrystal Creek watershed restoration project.

The Chrystal Creek Watershed restoration project is a small-scale example of immersing a broad audience while educating and introducing people to a unique place-based restoration practice that can be applied further. Through the Kuula 360° virtual tours, people from all backgrounds can be introduced to a basic understanding of the importance of ecological restoration and its long-lasting benefits. When people engage with these virtual tours, we hope to inspire and see GCA restoration practices introduced to other parts of British Columbia or even the world.

Goal #2: Provide accessible and repeatable media that allows for tracking and observation of ecological changes over time caused by restoration practices within the west branch of the Chrystal Creek watershed.

Objective:

1. Develop a resource that details why virtual 360° tours and repeat photography are valuable to restoration projects at the MLC, specifically the Chrystal Creek watershed
2. Provide a method that is repeatable to capture future ecological changes that have resulted from restoration activities

This project not only provides an opportunity to experience and learn about restoration through virtual and visual media, it also provides a tool for the GCA and a broad and far-reaching audience to observe changes occurring to the area. With the virtual 360° tour being published on the GCA's website at <https://galianoconservancy.ca/360tours/>, the public has an accessible method to experience the MLC, actively learn about site-specific restoration practices and observe changes on the landscape over time.

Not only is the virtual 360° tour an engaging experience for the public, the photospheres and repeat photos can provide the GCA with reference photos to see how their restoration work will progress. The 360° photospheres and the repeat photography were taken from specific photo points that will not be disrupted by restoration work, therefore, providing a reference baseline of sorts to view the evolution and ecological successional stages of the site. The location specifics and particulars of the photo setup were carefully documented in order for the staff and/or volunteers of the GCA to precisely duplicate the photos in the future to observe changes on site. The photospheres have a similar function, although the location specifics and particulars were not as rigorously documented, they provide an effective tool to monitor the progress of the restoration project.

As virtual tours are a newer media, there is the possibility that their popularity will decline and/or the technology will improve making past photospheres more difficult to duplicate. Fortunately, repeat photography provides a repeatable easy method to capture future changes on the landscape, making this media a valuable durable tool that stands the test of time. Combined, virtual 360° tours and repeat photography provide an effective way of observing change due to restoration. Both media are capable of providing the opportunity to observe the project's



progression, see how the watershed has changed since various restoration techniques have been implemented and educate and promote awareness on restoration efforts.

#### Approach:

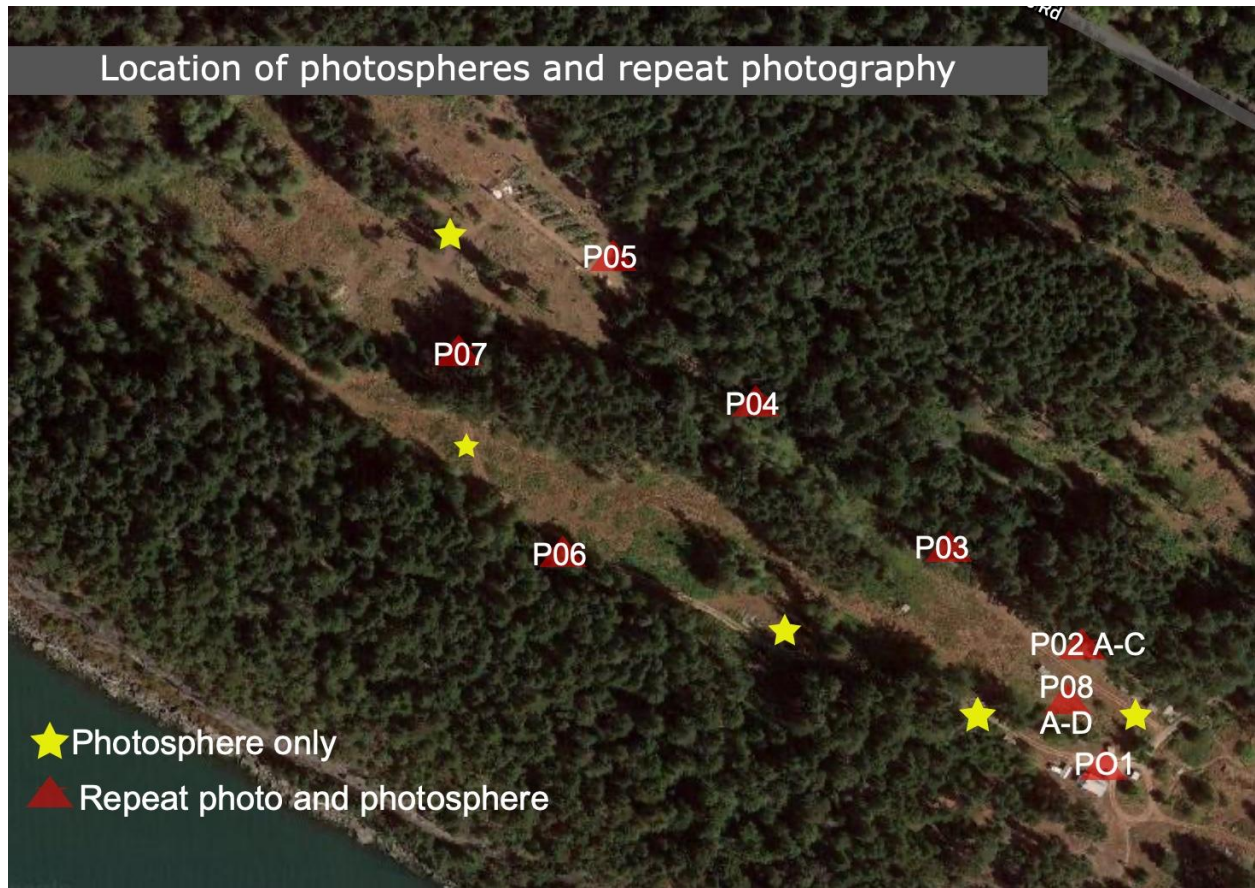
This project is composed of two components. The first is the reference photos and the second is the 360° virtual tours developed using Kuula software. The reference photos were captured at specific locations according to predetermined criteria (Appendix A). The lens height, distance from the lens to board (meter stick), and bearing are a few of the several notations that we adopted in conversation with GCA staff member, Adam Huggins. These exact locations were also marked with rebar and red flagging tape that will hopefully allow for easy identification in the future. This enables repeat photographs to be taken in the future and compared directly to the original reference image. These reference and repeat photos will enable GCA staff and/or volunteers to record any differences observed between two or multiple time frames as ecological restoration progresses.

Materials we needed were: a camera (Canon Powershot X520 IS), camera tripod, Trimble (GPS), compass, clipboard and paper for notes, vertical meter stick for scale, rebar, flagging tape, and a measuring tape for documenting precise details for ease of future reference photography.

The second component we incorporated in the project was the Kuula 360° virtual tours. These were created by taking “photospheres” on a smartphone using the Google Street View application. This user-friendly application made it easy for us to capture a 360° view using iPhone 11 smartphones. We chose the locations of the photospheres based on where we took the reference photos, as well as realizing the need for further context. From here, these photospheres

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from Google Street View were first saved to our smartphones, then uploaded to the website “Kuula” to allow one to virtually move through the area in a full 360° view to experience the landscape. Along with these photospheres, for the Kuula 360° virtual tours, we have also included soundscapes of the observed areas, which included various songbirds and insects. These soundscapes, photos, and other virtual components further enhance the ability for people to experience nature on an online platform.



*Figure 2: A map of the west branch of the Chrystal Creek watershed showing points where a photosphere was taken either with or without a repeat photo*

Recommendations and Actions:

We recommend that repeat photography and 360° photospheres be taken from the specific photopoints (Figure 2, Appendix A) by GCA staff, volunteers or future students when major activities within the Chrystal Creek Watershed have occurred or an appropriate amount of time has passed. Using the appendix within this report, specific parameters to produce a repeatable photograph are noted to aid in the creation of a new photo at the same location. As per consultation with the GCA restoration team, all repeat photos and photosphere locations were taken from areas that will continue to be accessible by foot. The 360° photospheres were not documented as rigorously as the repeat photography, however, the majority were taken near or directly at documented photopoints making their collection simple once the photopoint is located. We found that the nature of a 360° photosphere is able to adequately capture the landscape, therefore, the precise location using GPS coordinates was not warranted as this media is less formal and intended more for educational purposes.

Actions warranting repeat photography and/or photospheres within the west branch of the Chrystal Creek watershed could include:

- Completion of thinning the Fuelwood forest
- The proposed relocation and reconstruction of a portion of Chrystal Creek
- After the rough and loose technique has commenced in areas with historical agriculture use
- Completion and/or ongoing activity of restoring the diverse seasonal and permanent freshwater wetland
- Removal of logging roads, dilapidated human infrastructure and refuse from site

- After planting and staking of native species combined with fencing and removal of invasive species

The capture of ecological change due to restoration work can also be conducted on a timescale that is deemed appropriate by those actively involved in the restoration of the site. We suggest that repeat photography could be conducted after completion of the project in three, five and ten years if appropriate and depending on the resources available to the GCA. Recommendations for photosphere are similar in that they could be collected after major restoration events, the completion of the project and in five and/or ten years if appropriate. We find that these recommendations could effectively tell the story of the restoration work within the watershed and promote innovative ideas for restoration work elsewhere. Ultimately, we believe that the quantity and frequency of collection for photos and/or photospheres in the future will be determined by resources available to the GCA and the story the GCA wishes to tell about their restoration work on site at the MLC.

#### Acknowledgements:

Our project was completed on the traditional territories of the Hul'qumi'num Treaty Group, Stz'uminus, Á,LENENEÇ ŁTE (WŚÁNEĆ), Quw'utsun, scəwaθenaʔl təməx<sup>w</sup> (Tsawwassen) and the Coast Salish peoples. We wish to express our thanks and gratitude to those whose land we are guests upon.

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bird photography; and, finally our ES 471/ER 412 classmates for an engaging, exciting and fun learning environment.

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Appendix A:

Table 1: Repeat Photography Data

SITE DESCRIPTION	PHOTO POINT (P0__)	LENS HEIGHT (m)	DISTANCE FROM LENS TO BOARD (m)	BEARING (°)	COMMENTS
At intersection of field house, pear tree, apple tree, outdoor shack, in front of horse chestnut tree	P01	1.4	13	35°	Taken on June 25, 2021; full sun; photo taken in shade; took photosphere here as well
Near Douglas fir and Arbutus trees; on top of ridge; north of road	P02A	1.14	30.7	150°	Taken on June 25, 2021; full sun; photos taken in full sun; took photosphere here as well at beginning of road
	P02B	1.14	12.5	211°	
	P02C	1.14	N/A (no board placed in photo)	280°	
Near Douglas fir tree and a nursery log	P03	0.98	5.05	191°	Taken on June 25, 2021; full sun; photo taken in shade; took photosphere here as well
Near rocky outcropping and decaying tree, across the forest	P04	0.94	5.16	170°	Taken on June 25, 2021; full sun; photo taken in partial shade; took photosphere here as well at rebar location
Located east of Food Forest, on top of hill in grass	P05	1.09	12.73	191°	Taken on June 25, 2021; full sun; photo taken in full sun; took photosphere here as well
Located roughly 20m East from tree stumps	P06	1.13	8.39	11°	Taken on June 26, 2021; full sun; photo taken in partial shade; took photosphere here as well
Located inside Fuel Wood Forest, east of trails	P07A	1.1	3.6	110°	Taken on June 26, 2021; full sun; photos taken in shade; took photosphere here as well
	P07B	1.3	9.28	169°	
Located directly on top of mound in middle of wetland; small Western redcedar tree growing; uneven groundcover	P08A	1.02	6	312°	Taken on June 26, 2021; full sun; photos taken in full sun; took photosphere here as well
	P08B	1.02	6.6	199°	
	P08C	1.02	5.57	122°	
	P08D	1.02	5	30°	

Appendix B: Repeat Photos and Data

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SITE ID: MLC\_CC

Figure 3: Example of Repeat Photography Data sheet to record photo particulars

**PHOTO MONITORING DATA**

SITE ID: MLC\_CC      DATE: June 25, 2021

SITE DESCRIPTION:

REFERENCE POINT DESCRIPTION:

DIST - REF. PT. TO PP1:      AZI - REF. PT. TO PP1:

DIST - REF. PT. TO PP2:      AZI - REF. PT. TO PP2:

DIST - REF. PT. TO SITE/SETUP SHOT:      AZI - REF. PT. TO SITE/SETUP SHOT:

CAMERA AND LENS TYPE:

**PHOTO POINT 1**      **PHOTO POINT 2**

LENS HEIGHT: 1.4m      LENS HEIGHT:

DIST - LENS TO BOARD: 10m 13m      DIST - LENS TO BOARD: 10m

BEARING - LENS TO BOARD: 351°      BEARING - LENS TO BOARD:

COMMENTS:      COMMENTS:

**SITE / SETUP SHOT:**

LENS HEIGHT:

DIST - LENS TO BOARD: 10m

BEARING - LENS TO BOARD:

COMMENTS:

**SITE MAP**

The site map is a hand-drawn diagram of the study area. It features a central creek flowing from the top left towards the bottom right. To the left of the creek is a 'field house'. To the right of the creek are two trees: a 'pear tree' and an 'apple tree'. Below the creek, there is a 'brush point' marked with an asterisk and an 'X horse chestnut' tree. A 'barrier stack' is also indicated near the brush point. A north arrow is drawn on the left side of the map.

P01 data sheet

Repeat photography of the west branch of the Chrystal Creek watershed



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Photo 1: P01 taken 25/6/21 on *CANON POWERSHOT X520 IS*



Photo 2: P02A taken 25/6/21 on *CANON POWERSHOT X520 IS*

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Photo 3: P02B taken 25/6/21 on *CANON POWERSHOT X520 IS*



Photo 4: P02C taken 25/6/21 on *CANON POWERSHOT X520 IS*

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Photo 5: P03 taken 25/6/21 on *CANON POWERSHOT X520 IS*



Photo 6: P04 taken 25/6/21 on *CANON POWERSHOT X520 IS*

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Photo 7: P05 taken 25/6/21 on *CANON POWERSHOT X520 IS*



Photo 8: P06 taken 25/6/21 on *CANON POWERSHOT X520 IS*

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Photo 9: P07A taken 25/6/21 on *CANON POWERSHOT X520 IS*



Photo 10: P07B taken 25/6/21 on *CANON POWERSHOT X520 IS*

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Photo 11: P08A taken 25/6/21 on *CANON POWERSHOT X520 IS*



Photo 12: P08B taken 25/6/21 on *CANON POWERSHOT X520 IS*

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Photo 13: P08C taken 25/6/21 on *CANON POWERSHOT X520 IS*



Photo 14: P08D taken 25/6/21 on *CANON POWERSHOT X520 IS*